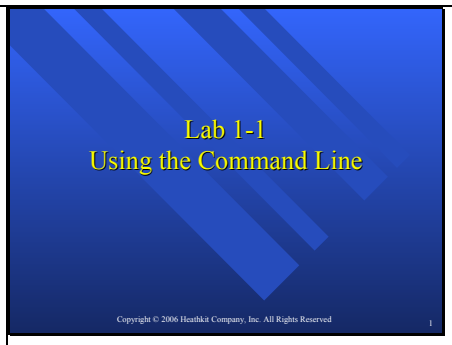
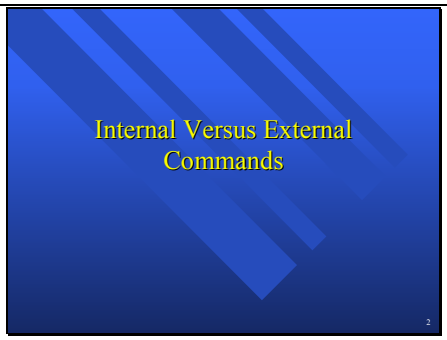
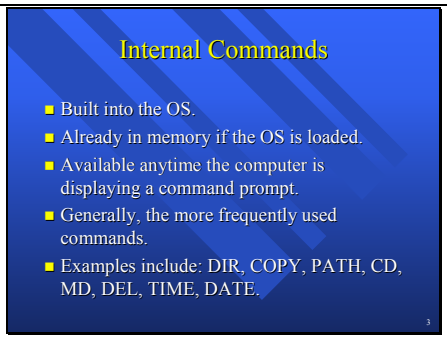
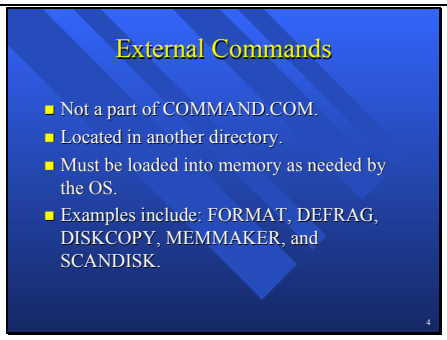
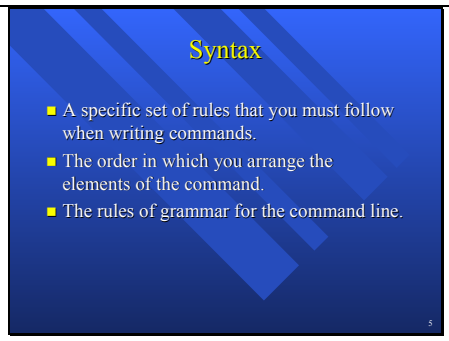
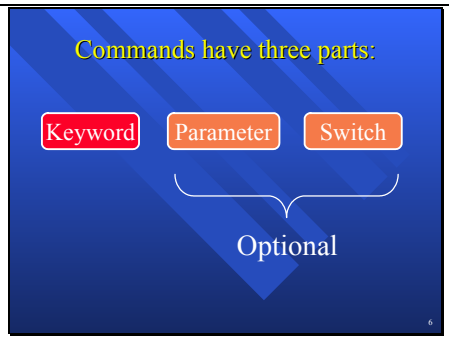
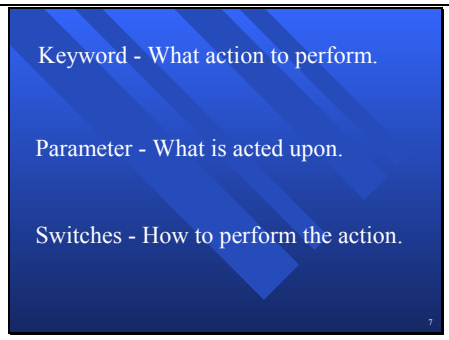
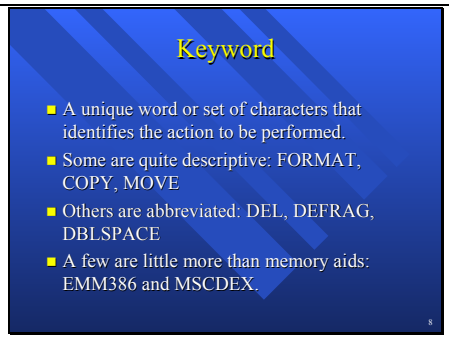
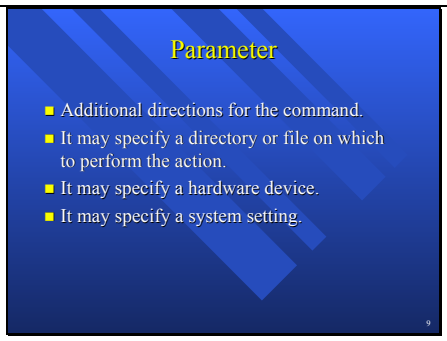
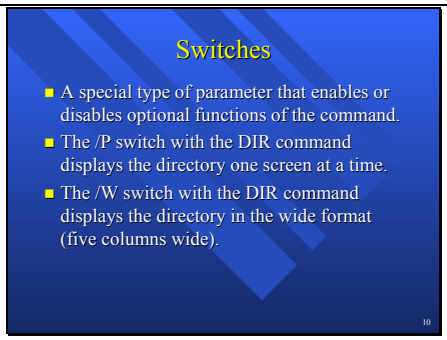
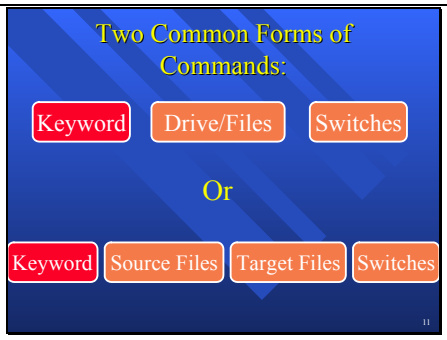
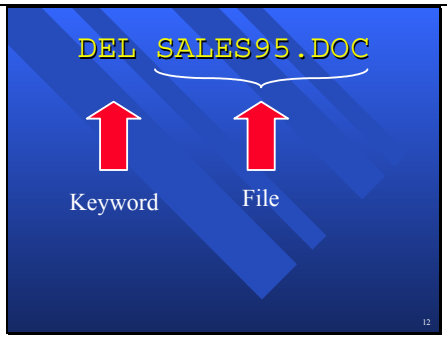
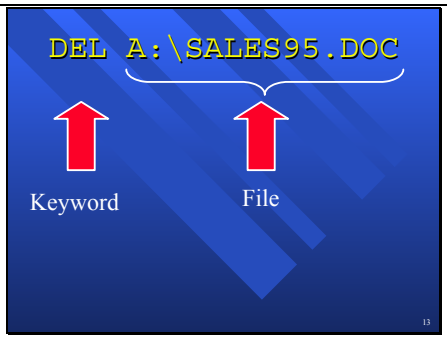
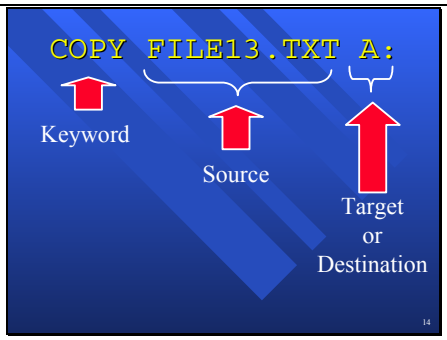
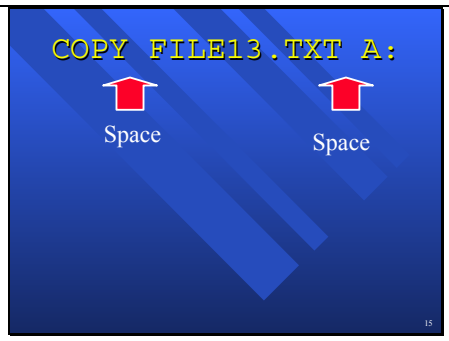
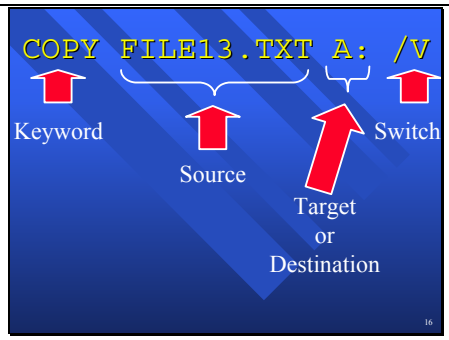
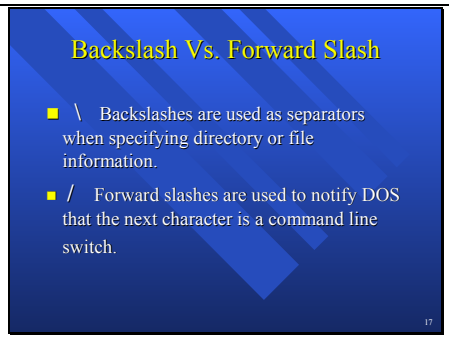
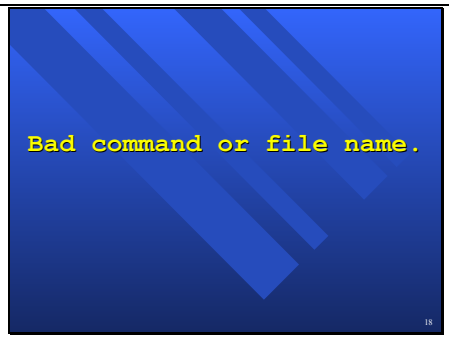
Slide 1		In this lab, you will study the command line, concentrating on its command structure and its syntax. In the hands-on part of the lab you will begin using some of the commands, with special emphasis on wild card features.
Slide 2		There are two types of commands, called internal and external. It is important that you understand their differences.
Slide 3		The internal commands are an integral part of the operating system. Because the internal commands are part of the OS they are already in memory anytime that OS is loaded. Originally, the idea was that these are the most frequently used commands and time could be saved by making them part of COMMAND.COM. A few examples of internal commands are listed here. Altogether, there are about two dozen of these internal commands.
Slide 4		External commands are not part of COMMAND.COM, or the OS. Instead, they are separate programs that are not normally in memory. In fact, they generally reside in a directory on the boot drive. A few examples of external commands are listed here. But this list is by no means complete. Most commands are external commands. Because they are not normally in memory, they must be loaded into memory before they can be executed.

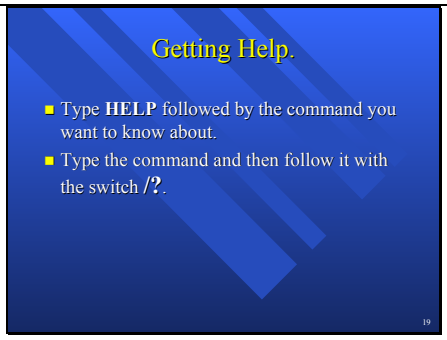
Slide 5		One of the things that we will be discussing in this and future labs is the syntax of the command. Syntax is simply a fancy word for a set of rules that we must follow when writing commands. It has to do with the order of the different elements that make up the command. You can think of syntax as the rules of grammar the command line.
Slide 6		Commands are made up of one, two, or three parts as shown here. The three basic parts are called the Keyword, the Parameter, and the Switches. The last two parts are optional. One or both may not be needed with some commands.
Slide 7		A good way to think of these three elements is like this. The Keyword tells what kind of action is to be performed. The Parameter tells what the action will be performed upon. And the Switches tell how the action will be performed. Let's take a closer look at each of these.
Slide 8		The Keyword is a unique set of characters (usually two to eight characters) that tells what action is to be performed. Some are English words that mean more or less what they say such as Format, Copy, and Move. Others are abbreviations such as DEL for delete, DEFRAG for defragment, and DBLSPACE for double-space. Still others are simply memory aids that convey as much meaning as possible in a few characters such as EMM386 and MSCDEX.

Slide 9		The Parameter provides additional information. It specifies what will be acted upon. This may be a file, a directory, a hardware device, or a system setting. Most often it indicates a specific file that is to be acted upon.
Slide 10		Most commands have several different ways of carrying out their action. The switches tell the command how it will perform its action. Switches enable or disable certain optional functions of the command. For example, when you ask for a directory listing, you can specify the form the listing will take. The slash-P switch displays the directory one screen at a time. The slash-W switch displays the directory in a wide format.
Slide 11		Most commands will take one of these two basic forms. Notice that both use a keyword. In fact, every command requires a keyword. In the first example, the parameter indicates the drive and the file that is to be acted upon. In the second example, both a source file and a target file are indicated. The difference between these two can be better understood by considering some examples.

Slide 12		Let's suppose you find a file called SALES95.DOC. Let's assume that this is an old sales report that is no longer needed and you want to erase it to free up disk space. The command shown here will do that. The keyword is DEL, which is short for DELETE. What action is to be performed? Delete. What is to be deleted? The file called SALES95.DOC. Because you gave no details about where the file is located, the OS assumes that it is in the current directory. That is, if you are currently in the C:\BUSINESS directory, the OS assumes that it will find the file called SALES95.DOC in that same directory. If SALES95.DOC is located somewhere else, you must tell the OS exactly where it is.
Slide 13		For example, let's suppose the file is on a floppy disk instead of the hard drive. In this case you place the floppy disk in drive A and then inform the OS as shown here. It will look for and delete the file called SALES95.DOC on the disk in drive A.
Slide 14		With many commands you must be concerned with both a source file and a target or destination file. Here is an example. Suppose you wish to share a file called FILE13.TXT with a friend. An easy way to do this is to copy it to a floppy disk using the command shown here. The keyword is COPY. That is the action to be performed. The file that is to be acted upon or copied is FILE13.TXT. This is called the source file. You must also tell MS-DOS the destination or target to which you wish to copy the file. In this case, it is drive A, which is indicated by the "A:" at the end of the command.

Slide 15		Notice that blank spaces are used to separate the parts of the command. There must be a space between the keyword and the source and again between the source and the target.
Slide 16		Here we see the same command but with a switch added. The slash V at the end of the command tells the OS to verify that the copy has been recorded correctly.
Slide 17		When you first begin working with the command line it is easy to confuse the backslash with the slash. It is important to realize that these are entirely different characters that are used for entirely different purposes. The backslash is used as a separator in the file path. The forward slash is used to identify switches.
Slide 18		The command line is intolerant of errors in syntax. If you so much as leave out a space or use a slash where you should use a backslash, the OS will probably give you a simple error message like this one. When you see this message, and you will see it frequently when you are first starting out, go back and look at your command syntax.

Slide 19



Sometimes, in spite of your best efforts, you will need help with a command, especially when first starting out. Fortunately, the OS provides you with an on-screen alternative. Its built-in, on-line Help system provides a wealth of information about the various commands.

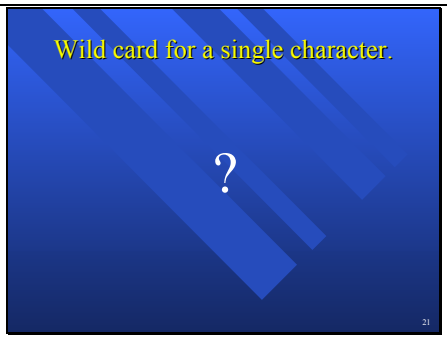
There are two ways to access this information. One way is to type the word HELP followed by the command keyword. Another way is to use the switch "slash-question mark" at the end of the command line. You will experiment with both these techniques in the hands-on portion of the exercise.

Slide 20

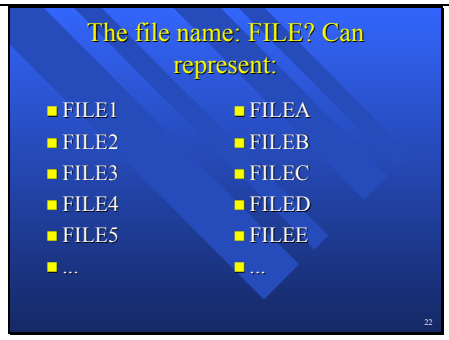
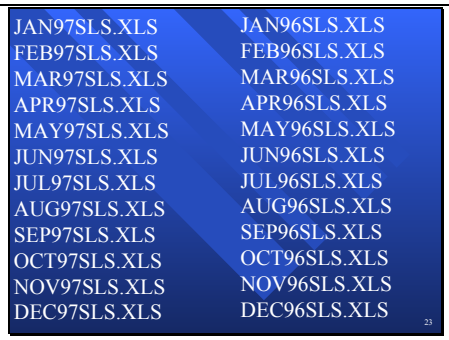
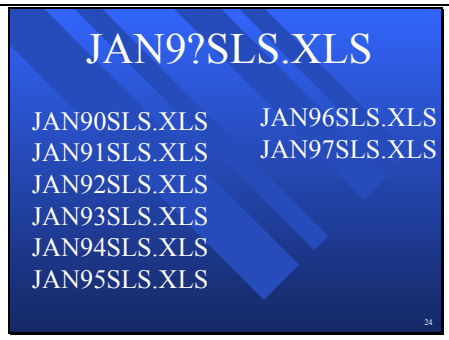
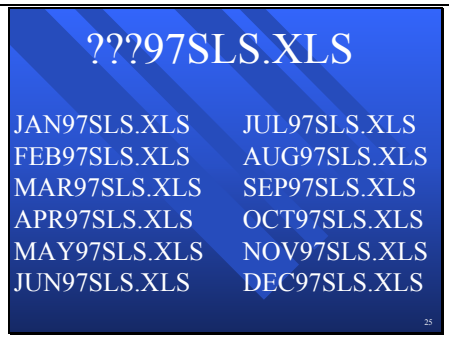
Another subject you will explore in some detail is the use of "wild cards." Most of you are probably familiar with this concept from card games. A wild card is a card that can substitute for any other card.

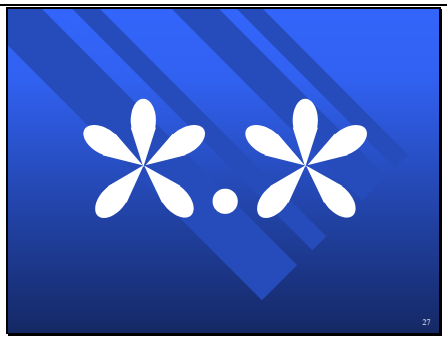
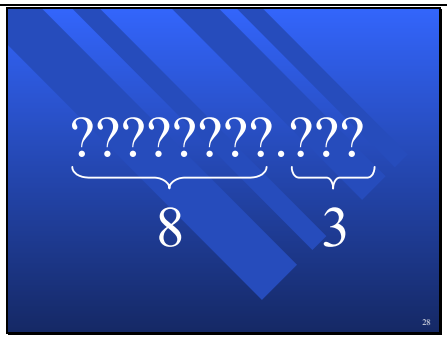
A wild card is a character that can be used in a file name and can substitute for any other character. There are two types of wild cards, the question mark and the asterisk.

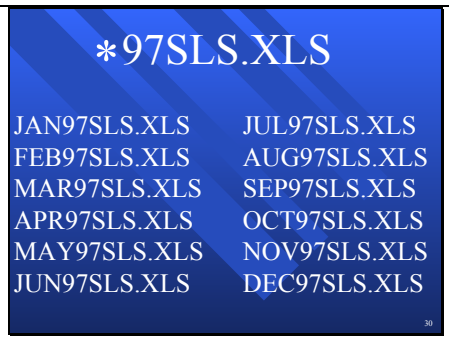
Slide 21

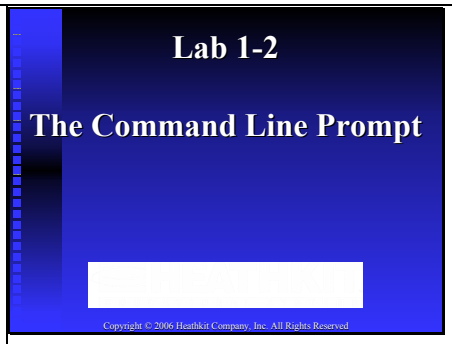
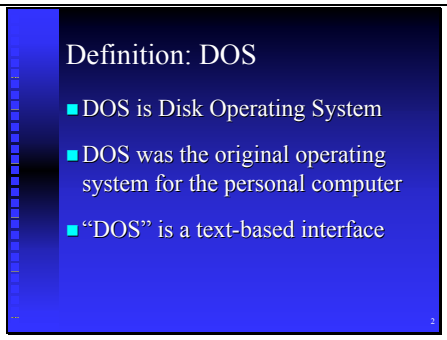
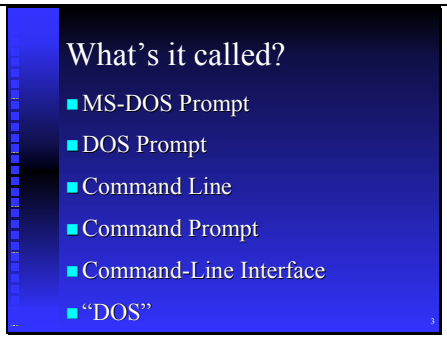


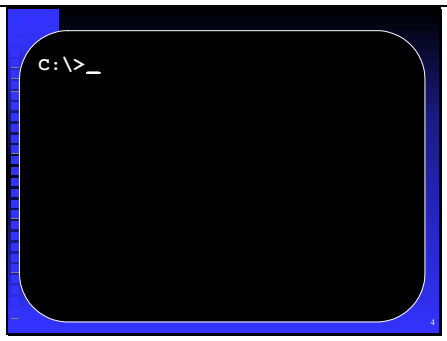
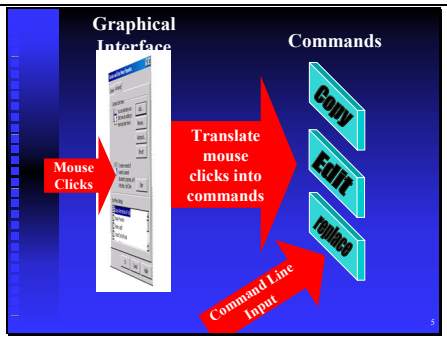
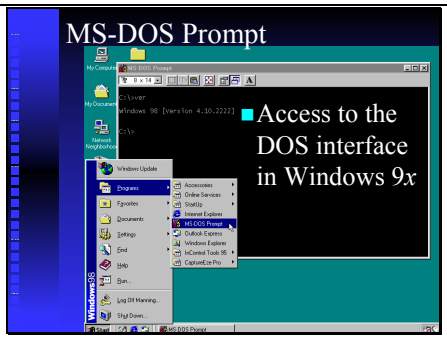
The question mark is the wild card for a single letter. That is, it can represent any character.

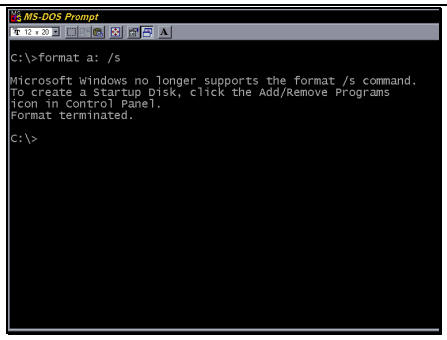
Slide 22		While it might not be immediately obvious, this can be a powerful tool. For example when used in a file name, one name can represent several files. For example, "FILE?" Can represent FILE1, FILE2, FILE3 or FILEA, FILEB, FILEC, etc.
Slide 23		What does that buy you? Well for one thing, it allows you to do things like copying a dozen files with one command. For example, let's assume that you have several years of spreadsheet files recording monthly sales figures. Let's further assume that someone had the foresight to give them names that reflect their content: JAN97SLS.XLS, FEB97SLS.XLS, etc.
Slide 24		Now out of these hundreds of files, let's suppose you want to copy only the January files of the 1990's. Since all the January files have the same name except for the last digit of the year, you could write the COPY command using a wildcard in the file name like this: JAN9?SLS.XLS. As you can see, this would yield all the January files for the 1990's.
Slide 25		Or, suppose you wanted every month of 1997. Then you would use the question mark wildcard in each of the first three characters as shown here. This would yield each of the months in '97.

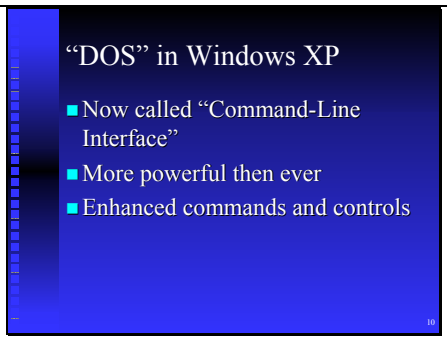
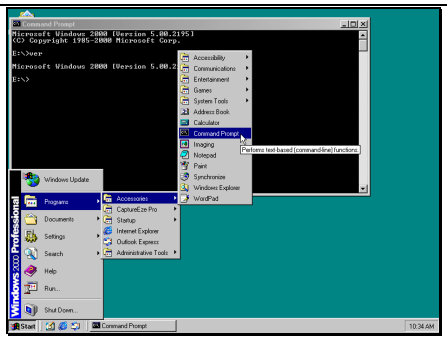
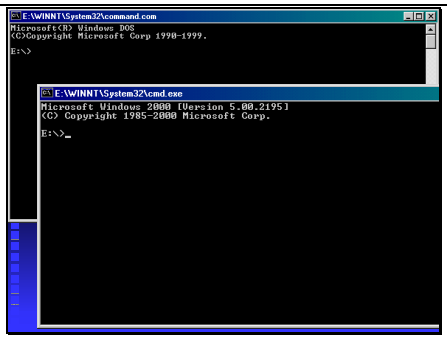
Slide 26		The asterisk wildcard has a slightly different meaning. The asterisk can represent one or several digits.
Slide 27		For example, this combination will represent any file. The first asterisk represents the one- to eight-character file name. The second represents from one- to three-character extension. It is often used to copy all files in a directory, to delete all files on a floppy, etc. Incidentally, this combination is often referred to as “star dot star”.
Slide 28		Now, you could accomplish the same thing using the question mark wild card, but a separate wild card would be required for each character.
Slide 29		Applying the asterisk to the examples given earlier, it can replace a single letter as shown here. It has no advantage over the question mark in this example.

Slide 30		But in the second example, the asterisk does provide an advantage in that a single asterisk may be used rather than three question mark wildcards.
Slide 31		Now it's your turn. The best way to learn the command line is to use it. You will get the opportunity to do this in the hands-on lab.

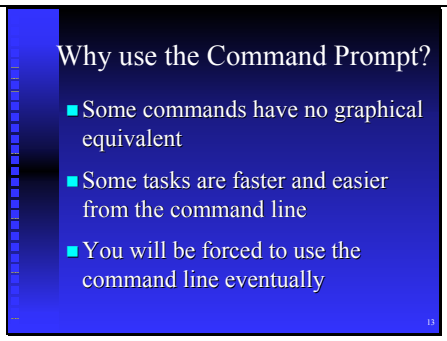
Slide 1		So, you thought you didn't need to know anything about DOS or a command line? Think again, because your ability to type a command is more important than it has been for a long time. This lab will demonstrate the importance of being able to perform operations and run applications from the command line.
Slide 2		Before we proceed, we need to define a term. Although we might think of "DOS" as the operating system before Windows, it is actually a generic term that refers to a system for managing disks in a computer, or a Disk Operating System. One of the forerunners was a DOS called CP/M. Then, Microsoft developed MS-DOS. Later, IBM and Microsoft developed a similar operating system called PC-DOS. And there were others that never really caught on with the computing public. Just remember that DOS was a system that required you to type commands character-by-character. If you didn't grow up using this interface, you will probably hate it at first. But, it is a very important part of every Windows operating system.
Slide 3		When you hear someone make a reference to one of these phrases, they all mean the same thing: typing commands from the keyboard. Even Microsoft isn't always consistent with its terms, so don't get confused by them

Slide 4		Regardless of what it's called, this is the "command prompt." And of course, you remember the C: represents the active disk drive, the forward slash represents the root directory, the side ways arrow serves to separate the prompt from the command text, and the underline represents the blinking cursor waiting for you to type something.
Slide 5		What's so good about the command prompt? The Windows GUI only shows what it wants you to see. You have to click around to different places to makes things happen. Select an item, change it, click OK, click Next, and so on. This is simple, because you only have certain buttons to click, and sometimes instructions are provided. But sometimes it's tedious and time consuming. The command line skips a step, taking you directly into the commands. In many cases the command line offers more options for a given command. If you type fairly well, it can also be much faster than the GUI.
Slide 6		In all the flavors of Windows 9x, you can access the DOS prompt on the Start menu. Here you can see the interface running in a window; if you press the Alt-Enter key combination you will get the interface in full screen mode, which looks like a real DOS environment.

Slide 7		One more thing you can do in Windows 9x is restart the system into MS-DOS mode. This is a true real-mode DOS restart, not just a virtual DOS-world within Windows. Many people came to call this "DOS 7." Although Microsoft officially denies the existence of a DOS 7, there has been much evidence that "DOS 7" was in fact used internally at Microsoft to describe this system. Many high-end games automatically restart the system this way to take advantage of the performance improvements that accompany the lack of a graphical user interface.
Slide 8		Windows Me is different from Windows 9x in many ways. One important change is that all the simple tools you might use to access a DOS prompt are gone. There is only one easy way to get at DOS in Me, and that's to open COMMAND.COM in the Run dialog. And once you get there, many of the familiar DOS commands have been removed.
Slide 9		As an example, this is what has happened to the venerable FORMAT command…there's no easy way to make simple bootable floppies in Windows Me. The SYS command is gone, and you can't boot to DOS from the Start Menu, either.

Slide 10		In some of the Windows XP documentation, the MS-DOS Command Prompt is called the "Command-Line Interface." Even though Microsoft has removed a great deal of DOS support from Windows Me, Windows XP has many advanced tools that can only be used from the Command Line.
Slide 11		Although Microsoft refers to this as the Command-Line Interface, it's called Command Prompt within both Windows 2000 and Windows XP. Both terms are referring to the same thing, just by different names.
Slide 12		There are actually two different command line interfaces in Windows 2000. The first is opened by typing command.com in the Run dialog. This environment is similar to what you'll find in previous operating systems. Whether you run Command Prompt from the Start menu or type cmd in the Run dialog makes no difference. However, the cmd.exe environment is much more powerful than COMMAND.COM.

Slide 13

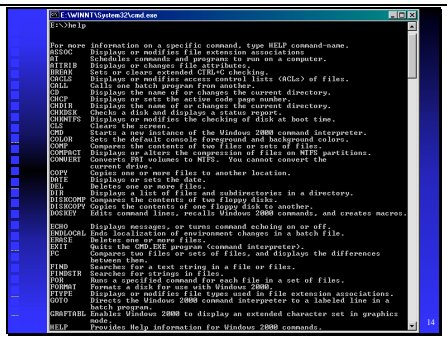


Why would you want to use the command prompt for anything? Isn't everything available in a dialog box somewhere?

Actually, there are several commands that cannot be completed anywhere else but at the command prompt. For instance, the IPCONFIG, PING, TRACERT, and NSLOOKUP have no graphical equivalents.

But there's one very good reason to learn about the command-line interface: at some point a problem will arise that can be fixed easily and simply, but only if you know how to use the commands.

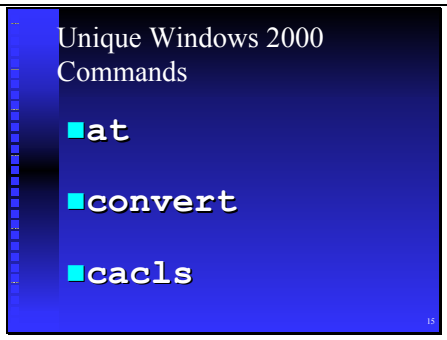
Slide 14



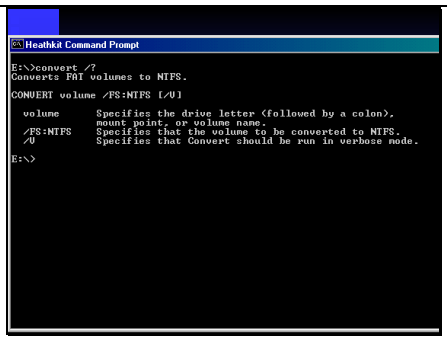
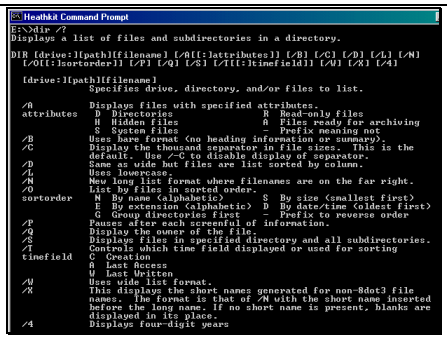
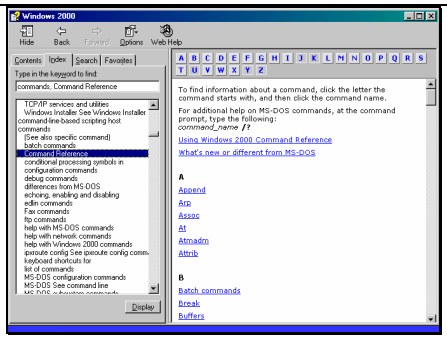
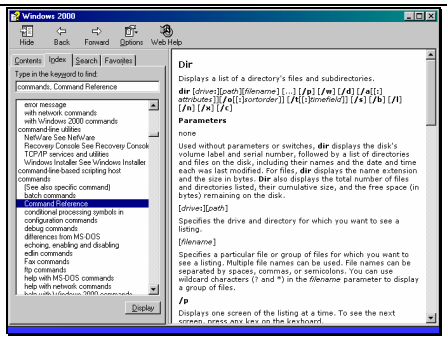
So you thought DOS was dead and gone? Hardly. Here's a partial list of the commands available in the Windows 2000 command-line interface, along with a brief description of what each command does. You'll recognize most of these as standard commands that have been around since MS-DOS was king. But if you look closely, there are some new commands available.

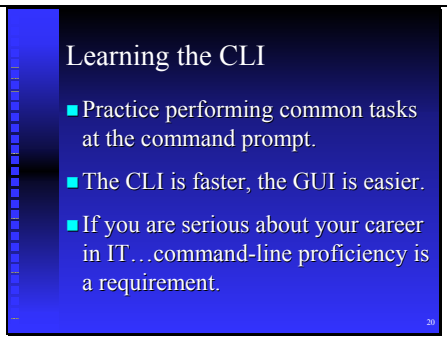
Notice that the "help" command generated this list.

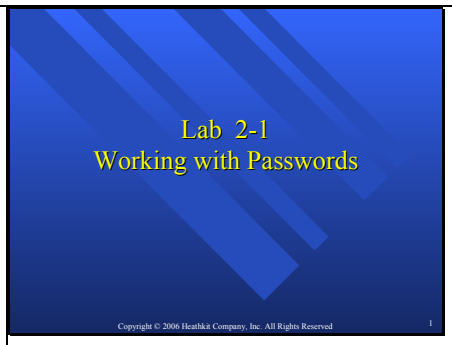
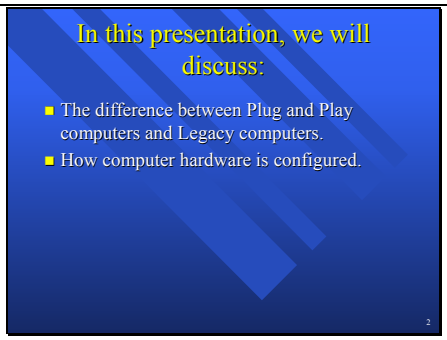
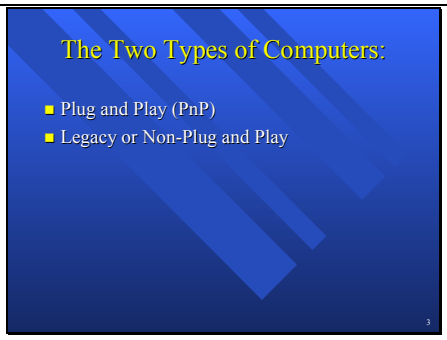
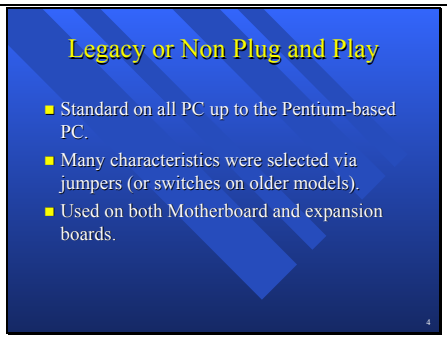
Slide 15

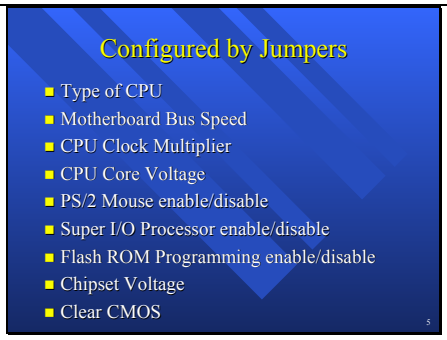
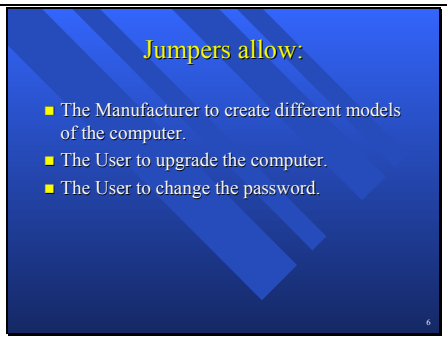
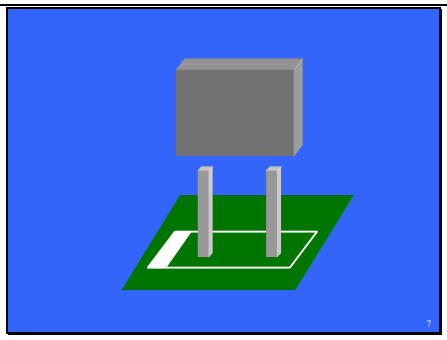
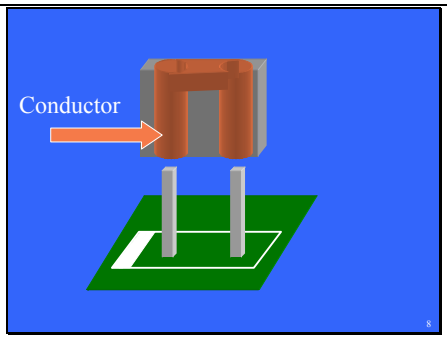


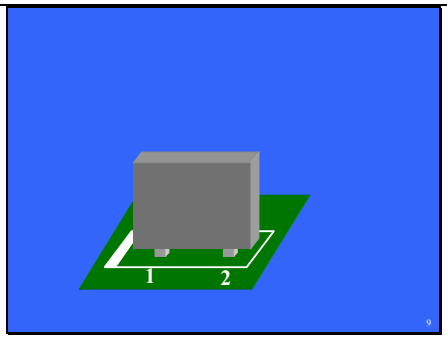
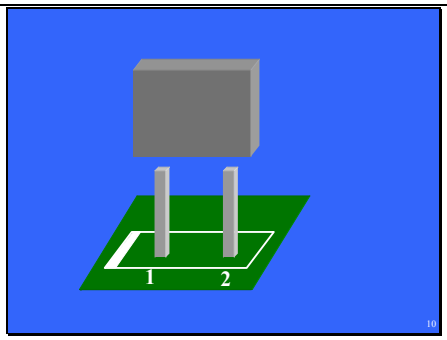
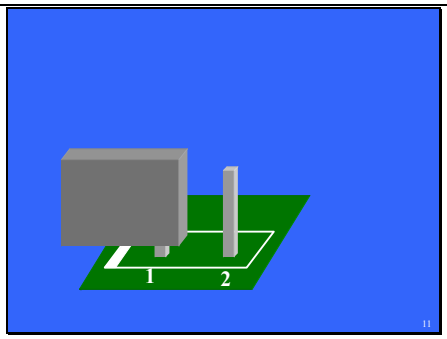
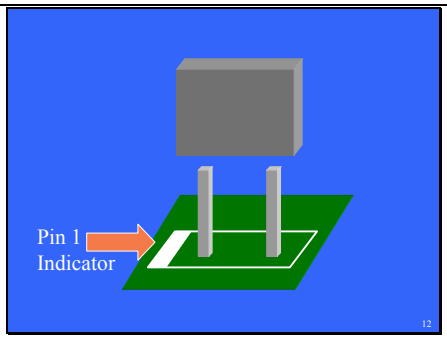
As proof that Microsoft expects many professionals to use the command prompt, there are several commands that don't exist in DOS or Win 9x. The "at" command allows you to schedule programs and commands, convert makes NTFS partitions from FAT partitions, and cacls allows you to change file permissions. These are just a few examples of many new commands.

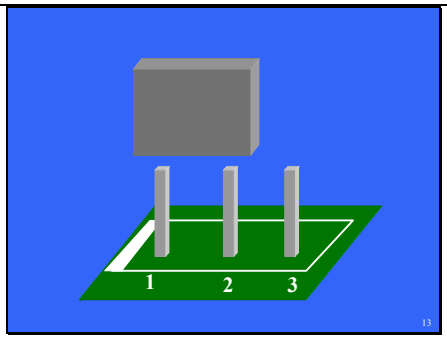
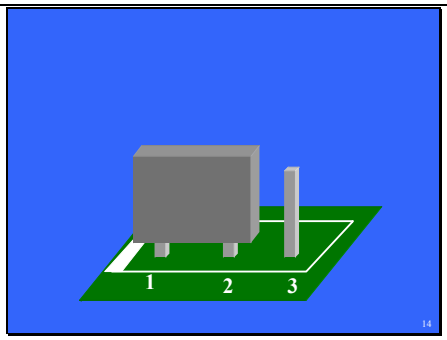
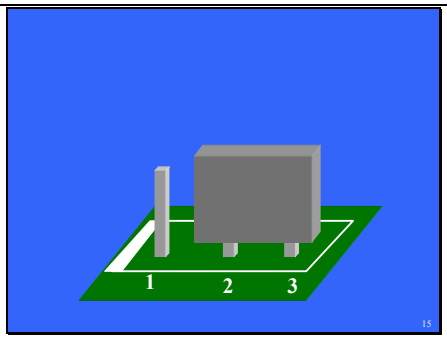
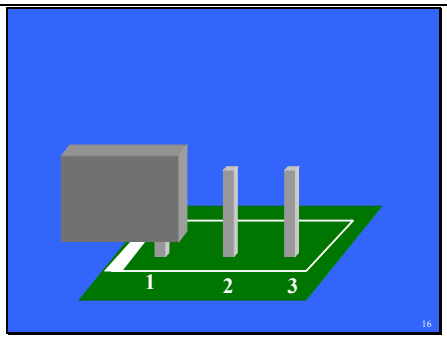
Slide 16		Earlier we used the help command to generate a partial list of the Windows 2000/XP DOS commands. But that list doesn't tell you anything about the individual commands. To find out how to use a command, you type the command followed by a backslash and a question mark. This will produce a short description of what the command does and how to structure the command. Here, we typed "convert /?" to illustrate what you can expect in the way of a description and command structure.
Slide 17		This is the DIR command, one of the most important commands you'll use at the command prompt. As compared to DOS, or even Windows 98, this version of the DIR command has many new features including /Q, /T, and /X.
Slide 18		The only source of comprehensive information on Windows commands is in Windows Help. You should be able to judge the depth of the material presented in Help by the size of the scroll bars. There are thousands of topics, well organized and hyperlinked to related topics.
Slide 19		Our earlier look at the DIR command provided a brief summary of the command. Here, you get a richly detailed description of Dir, and at the end a link to other related commands.

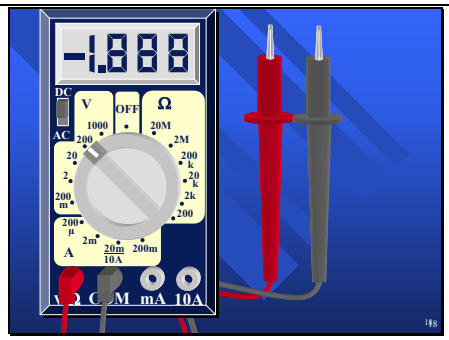
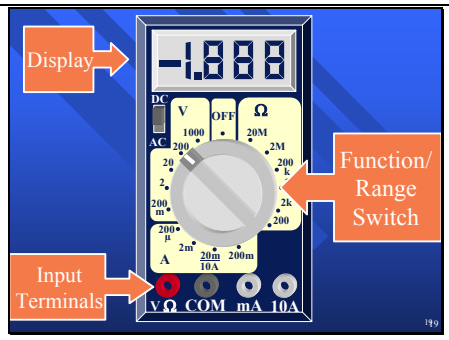
Slide 20		Unless you are forced, learning to use the command prompt will be a chore. But the first time you can save the day for your boss, your friends, or your most important customer by typing madly at the keyboard, you'll be convinced. Keep in mind that working at the keyboard has been shown to be much faster than working through a GUI. Even when you can click adeptly, you still waste time moving your hands between the mouse and keyboard. If you practice, there is little that cannot be done by using the keyboard exclusively. Finally, as your career horizons expand the need to have a variety of skills increases. Everybody can run the Windows GUI, but how many technicians can fix a problem in MSDOS.SYS without ever touching a mouse? That's the type of skill that gets you hired before the others.
Slide 21		Now it's time to try your hand at command line in the lab.

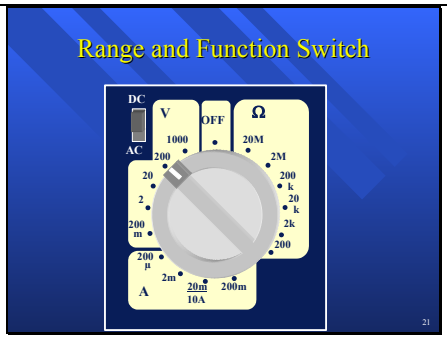
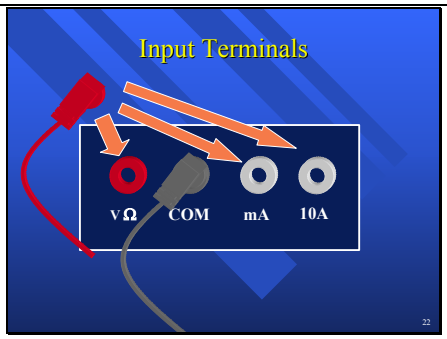
Slide 1		Today's hands-on exercise is concerned with working with passwords. As you know, a password is a handy way to prevent unauthorized use of a computer.
Slide 2		This presentation will be concerned with larger issues. In particular, we will be discussing the difference between Plug and Play computers and the older "Non Plug and Play" or "legacy" computers. We will discuss how both types of computers are configured.
Slide 3		The PCs in use today can be divided into two broad categories: Plug and Play and Legacy. Legacy is simply a fancy term for non plug and play.
Slide 4		Legacy is often defined as something handed down from an ancestor. In the PC world, the word is used to describe any PC that is not Plug and Play. This includes virtually all computers made before 1997 and many made afterwards. A PC can usually be identified as a Legacy unit by a number of jumpers or even switches on the motherboard and the expansion boards. These jumpers or switches allow the manufacturer or the user to change many of the characteristics of the motherboard or expansion card.

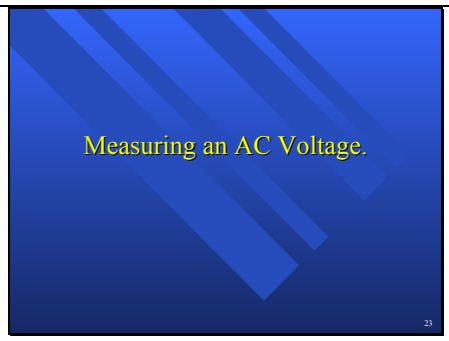
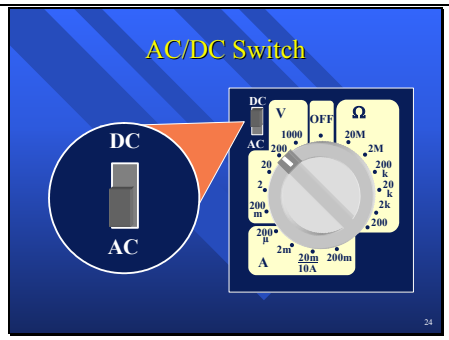
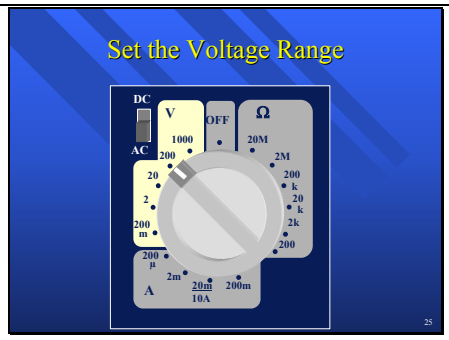
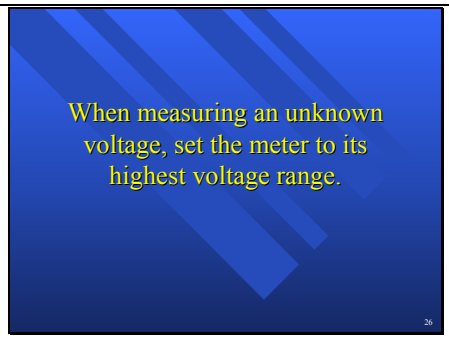
Slide 5		In Legacy-type PCs, you can configure a whole list of items by moving jumpers on the motherboard. Jumpers are provided which allow you to select different processor types, motherboard bus speeds, CPU speeds, and CPU core voltages. Other jumpers allow you to enable or disable the PS/2 mouse, the Super I/O Processor, and flash ROM programming. Another sets the chipset voltage. And finally, another allows you to clear the CMOS, and so on.
Slide 6		The jumpers allow the manufacturer to create different models of the computer using a common motherboard. They also allow the user to upgrade the computer as faster processors, new versions of BIOS, etc., became available. One jumper allows you to change your password should it become compromised or simply because you forgot the old password.
Slide 7		On Legacy-type motherboards, you can change all these things by moving small jumpers like the one shown here.
Slide 8		This cutaway drawing shows how the jumper works. Inside the movable plastic jumper block, there is a conductor.

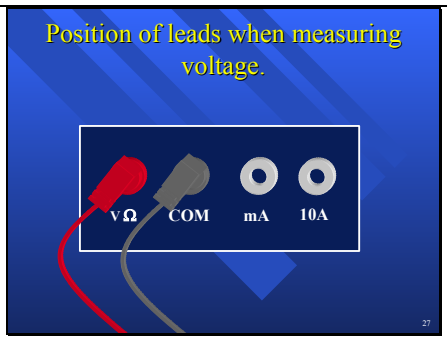
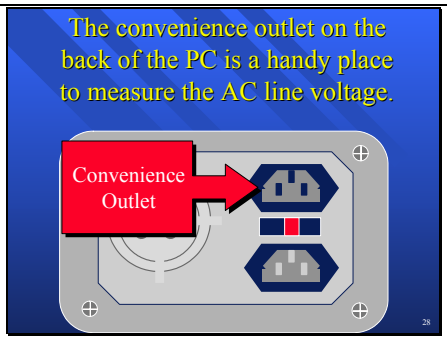
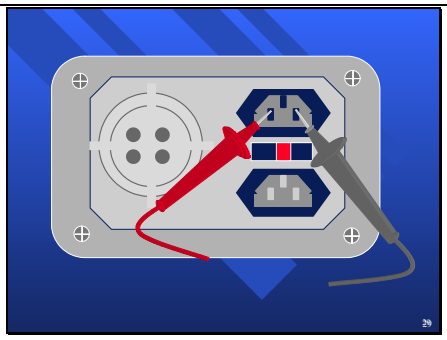
Slide 9		When the block is pushed down on the pins, the two pins are shorted together.
Slide 10		When the block is removed, the pins are left open. However, when a jumper block is removed as shown here, it is still a good idea to leave the jumper block behind in case it is needed in the future. How do you leave it behind without shorting out the pins?
Slide 11		Like this. By connecting the block to only one pin, it will not short the pins and it will be handy when you need it in the future.
Slide 12		Sometimes, it is important to know which pin on the jumper is pin 1. The bold line indicates pin 1 of the jumper.

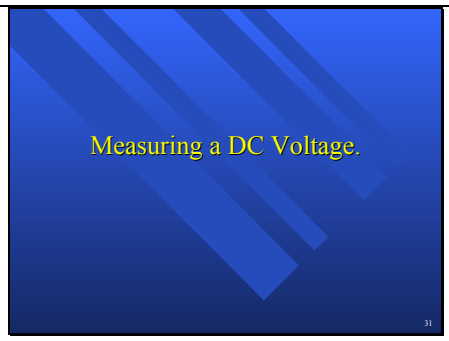
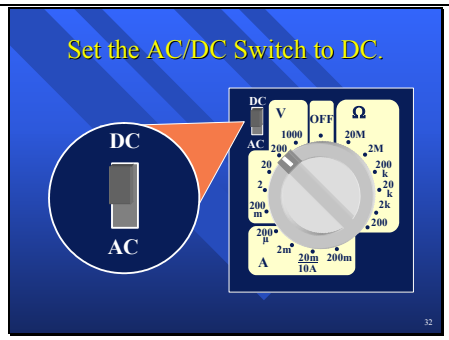
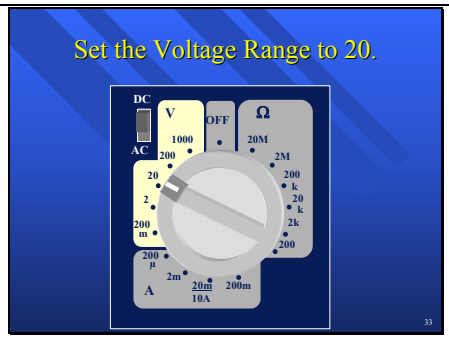
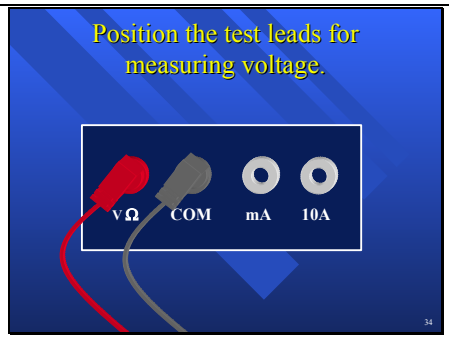
Slide 13		Sometimes the pins are numbered as well. The numbers become more important when you have three pins as shown here. With this type jumper there are three possibilities. First, all pins may be open.
Slide 14		Or, pins 1 and 2 can be shorted.
Slide 15		Or finally, pins 2 and 3 can be shorted.
Slide 16		As before, if all pins are open, it is still a good idea to leave the jumper block behind in this harmless position so that it will be handy when you need it.

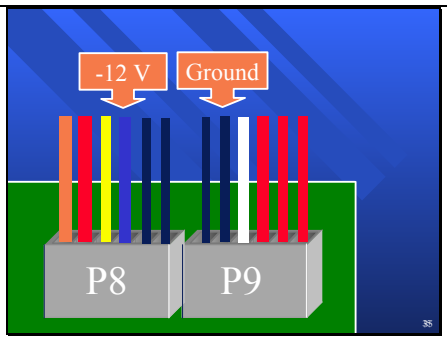
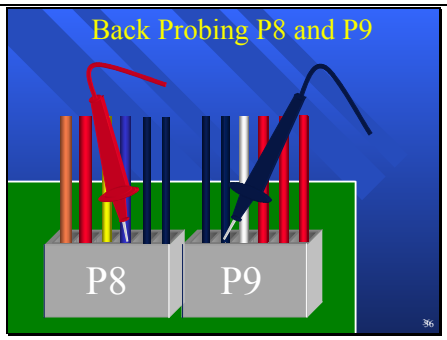
Slide 17		The most common test instrument used in PC servicing work is the Digital Multimeter. It is called a *multi* meter because it combines a voltmeter, a current meter, and an ohmmeter in a single package.
Slide 18		Here we see a typical digital multimeter. Yours will not look exactly like this one, but it will have several things in common. If you understand this most basic model, you should not have problems with other units you encounter.
Slide 19		Here you see the three main parts of the multimeter. The digital display is usually at the top. It gives a visual indication of the voltage, current or resistance being measured. The Function/Range Switch is in the middle on most meters. It allows you to set the function of the meter… Voltmeter, Ammeter, or Ohmmeter. And it gives you a choice of ranges so that you can pick the range that gives you the best reading. Finally, at the bottom are the input terminals. This is where the test leads connect to the meter. As you can see, on this meter, several different lead placements are possible. Let's take a closer look at each of these three parts.

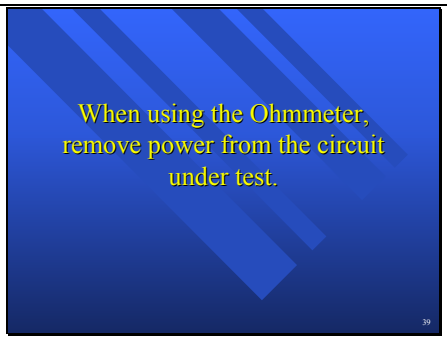
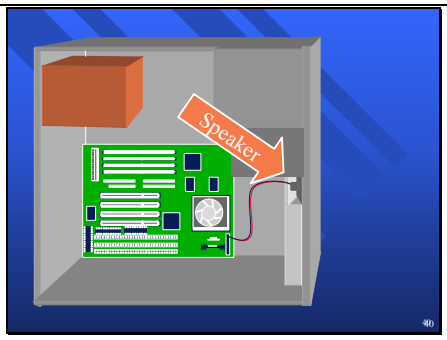
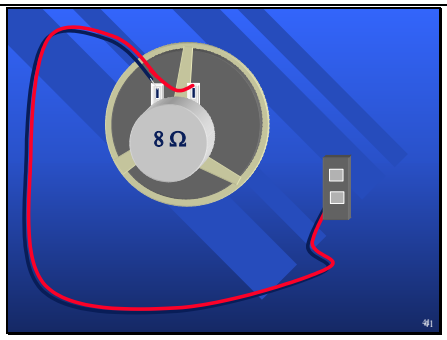
Slide 20		Liquid crystal displays are common because of their very low power consumption and because they are easy to read even in brightly lighted areas. The display shown here is typical. It consists of three 7-segment numerals (on the right) that can display any digit from 0 to 9. In addition it has a fourth digit (on the left), but it can display only "1", a minus sign, or both. Because this fourth digit does not display 2 through 9, it is often called a half-digit. Therefore, the overall display is referred to as a three-and-a-half digit display.
Slide 21		The Function/Range Switch sets the overall function of the meter. Here a rotary switch is used. Some meters will use push button switches, but all multimeters will have some method of selecting the function you wish to perform. The three most common functions found on most multimeters are Voltage, Current, and Resistance. Some have many additional functions such as Capacitance, Inductance, etc. But in reality, these additional functions are rarely used. On this meter, the same rotary switch is used to set the range. Some meters use a switch dedicated solely to this purpose. Others are *auto-ranging*, meaning that they automatically set the best range for a particular measurement.
Slide 22		The input terminals at the bottom are where the two test leads are connected. The black lead is almost always connected to the common or ground terminal as shown here. On this particular meter, the red lead is connected to the red terminal on the right when measuring voltage or resistance. On the other hand when measuring low values of current, the red lead is plugged into the terminal labeled "mA" for milliamps. For higher levels of current, an additional terminal is provided labeled "10 A" for 10 amps.

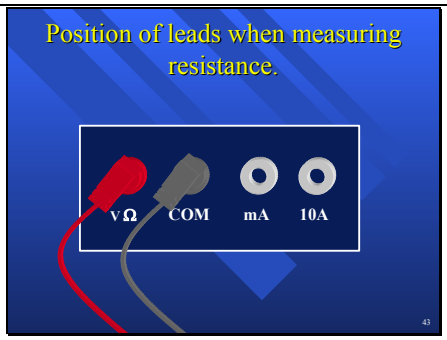
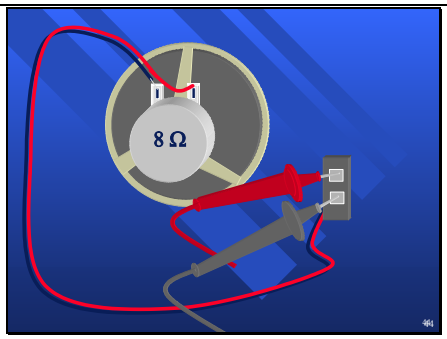
Slide 23		Let's begin by measuring an AC voltage. Let's say that you suspect that the AC line voltage is low and you decide to measure it. Here's a quick and easy way to do it.
Slide 24		First, set the meter to the AC Function. On our typical meter, you set the AC-DC switch shown here to the AC position. This sets up the internal circuitry of the meter to measure AC… either AC current or AC voltage.
Slide 25		Next, select the function and range with the large rotary switch. Let's say we expect the line voltage to be 115 Volts AC. Rotate the Function Switch over to the voltage ranges and select the range that is closest to, but higher than, the expected voltage. In this case, that is the 200-Volt range.
Slide 26		Incidentally, if you do not know what voltage to expect, you should start at the highest range and work your way down to the appropriate range.

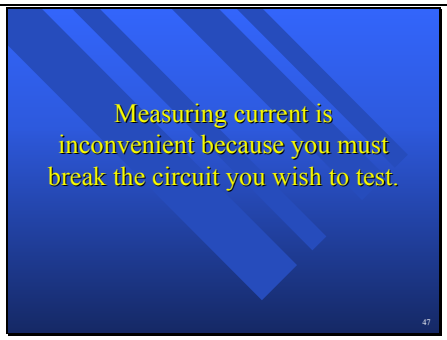
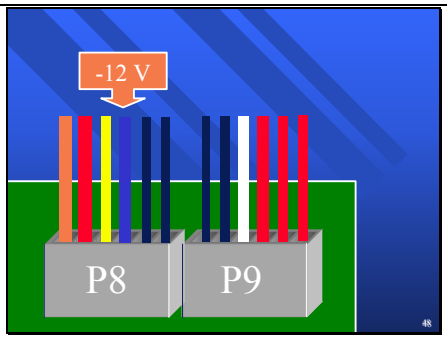
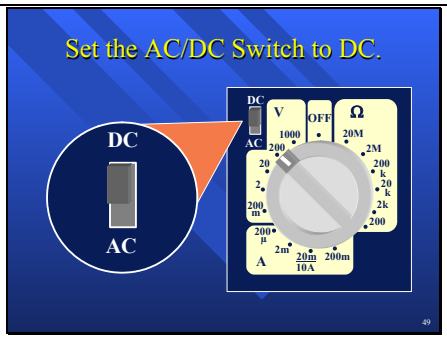
Slide 27		Next, connect the leads to the meter. The black lead goes to the Common or Ground terminal; the red lead to the terminal labeled "V" for voltage.
Slide 28		Find a convenient place to make the measurement such as the wall outlet. Or, on some computers there is a convenience outlet on the back of the power supply. The convenience outlet is provided for a monitor or other device that you want to "come on" when the computer is turned on. Of course the AC line voltage is present at the convenience outlet only when the computer is plugged in and turned on.
Slide 29		However, before connecting the test leads to the convenience outlet make sure that the computer is turned off. Then connect the red lead to one side of the line and the black lead to the other.
Slide 30		Finally, apply power to the outlet by turning the computer on and take your voltage reading... in this case, 112.8 volts AC.

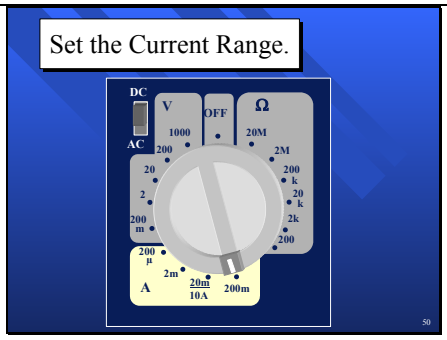
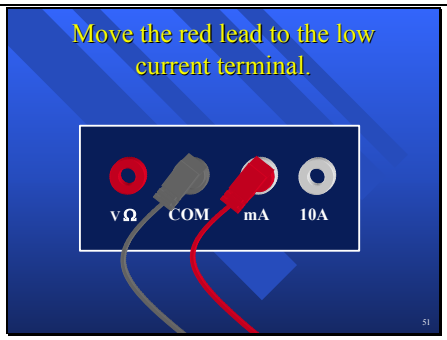
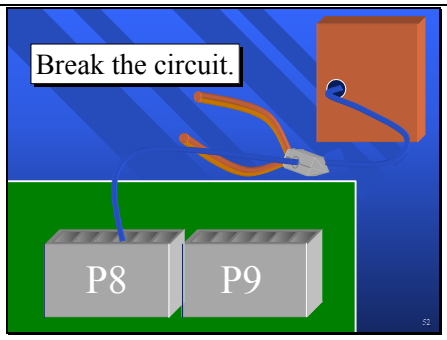
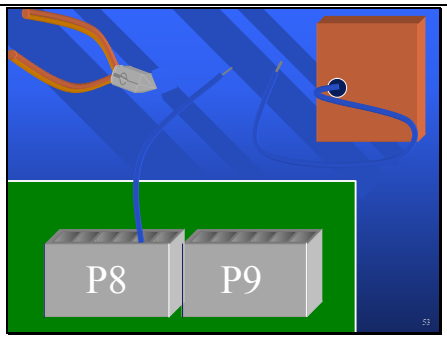
Slide 31		Measuring a DC Voltage is much the same. For example, let's say we wish to measure the minus 12 volts produced by the power supply in a computer.
Slide 32		First, set the meter to DC by setting the AC-DC switch to the appropriate position.
Slide 33		Next, select the function and range. This time we expect to measure –12 volts. Rotate the Function Switch to the voltage ranges and select the range that is closest to, but higher than, the expected voltage. In this case, that is the 20-Volt range.
Slide 34		Next, connect the leads to the meter. As before, the black lead goes to the Common or Ground terminal; the red lead to the terminal labeled "V" for voltage.

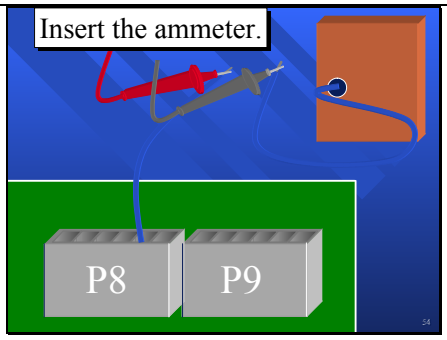
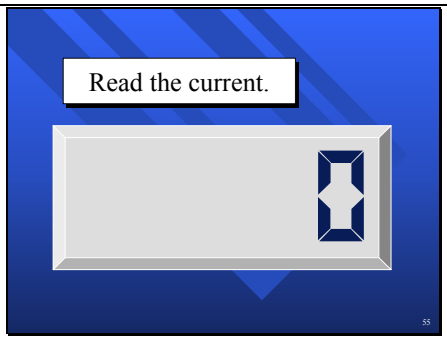
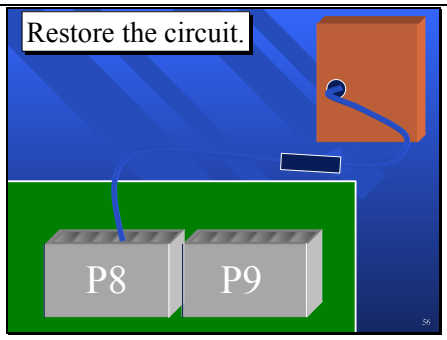
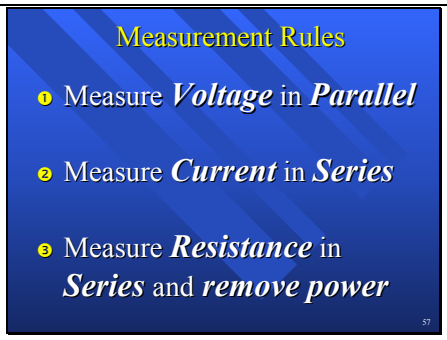
Slide 35		Find a convenient place to make the measurement. In this case, let's say we have an AT-type motherboard and we decide to measure the voltage at the power connections to the motherboard. The blue wire in P8 should carry the –12 volts. That is, you should be able to measure the –12 volts between the blue wire and ground.
Slide 36		Once again, before connecting the test leads make sure that the computer is turned off. Then connect the red lead to the blue wire using a technique called "back probing." The power leads in the computer are constructed so that you can probe them from the back while they are still connected. As for the black lead, it can be connected to ground by back probing one of the black wires. If several voltage readings are required, the black test lead is usually connected to the chassis ground and left there until all measurements are complete.
Slide 37		Finally, apply power to the computer and take your voltage reading. In this case, –11.93 volts DC.

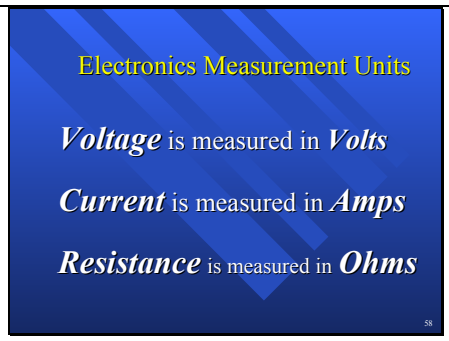
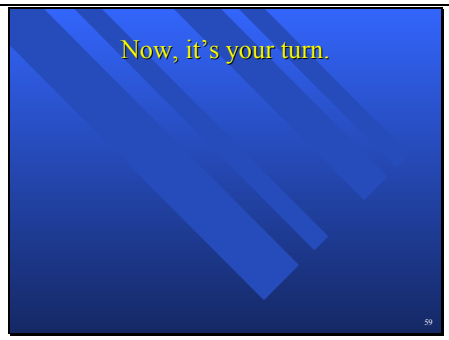
Slide 38		Measuring resistance is just as easy, if you remember a few important rules.
Slide 39		The first and perhaps the most important rule is: When using an Ohmmeter, remove power from the circuit under test. Failure to do so will give you incorrect readings and in extreme cases may damage the Ohmmeter or the circuit being tested.
Slide 40		There is a small speaker inside the front of the computer as shown here. Let's assume that the speaker no longer beeps, but everything else seems to work fine. A quick way to check the speaker is to measure its resistance.
Slide 41		Let's assume that the speaker has 8 ohms written right on it. This is its impedance, not its DC resistance, which is what the Ohmmeter measures. The DC resistance should be slightly lower than the impedance. Let's measure the resistance. The first step is to remove power from the circuit under test. With the speaker, you simply unplug it.

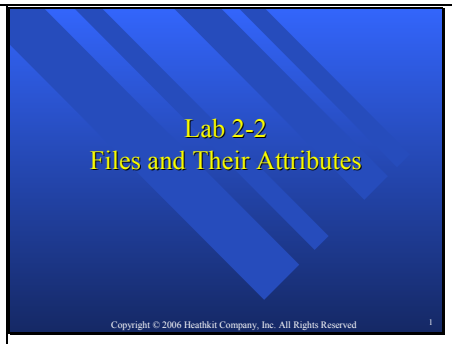
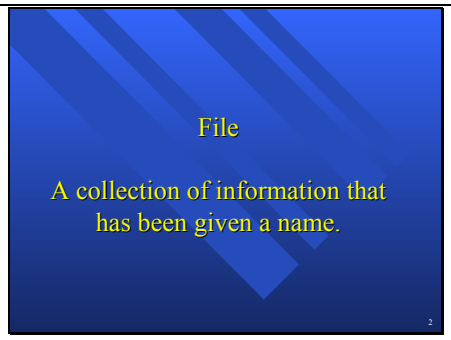
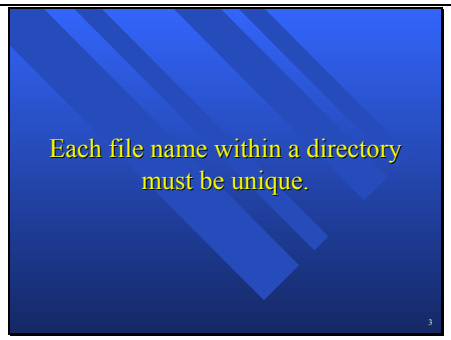
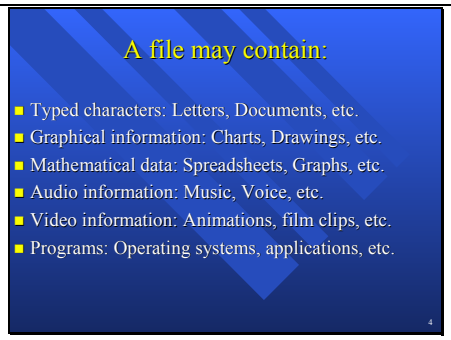
Slide 42		Next, set the meter to the proper function and range. We expect the resistance to be something less than 8 ohms. The lowest range available on this meter is 200 ohms, so we will have to settle for that.
Slide 43		The test leads are connected to the meter just as they were earlier: the red lead to the Ohms terminal, the black lead to the Common.
Slide 44		Next, you connect the test leads across the speaker. This is easiest at the now unplugged connector.
Slide 45		Finally, read the resistance. In this case it is just below 8 Ohms, so the speaker is probably good. As you can see, measuring resistance is straightforward and easy. Just remember to remove power from the circuit before you attach the Ohmmeter.

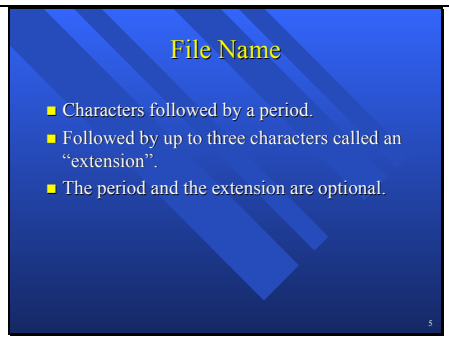
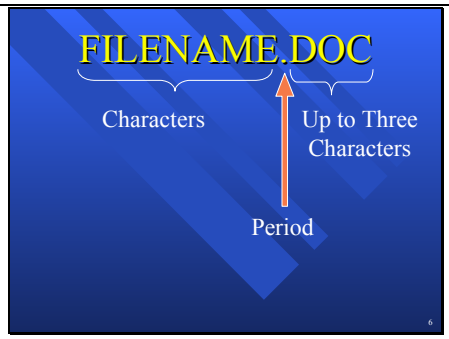
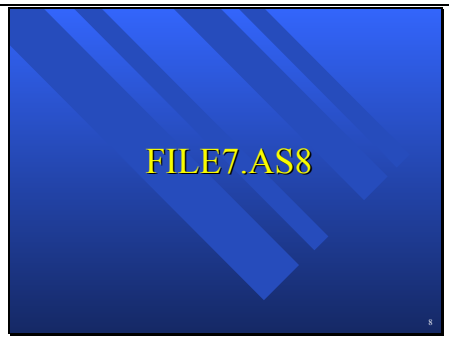
Slide 46		Finally, let's talk about measuring current. This is not something you do very often when working with computers. Actually, it is pretty much of a hassle to measure current in most electronics equipment.
Slide 47		The reason for this is that you must break the circuit you want to test in order to measure current. Why? Because the current being measured must flow through the meter. You actually connect the meter in series with the circuit you are testing.
Slide 48		This is best illustrated by an example. Earlier, you saw where and how to measure the voltage produced by the –12-Volt power supply. Now let's suppose we want to measure the current flowing through that same blue wire, shown here. In other words, how much current does the motherboard draw from the –12 volt supply? Here is the procedure for making that measurement.
Slide 49		Let's begin by setting up the meter. Since we will be measuring direct current, the AC/DC switch is set to DC.

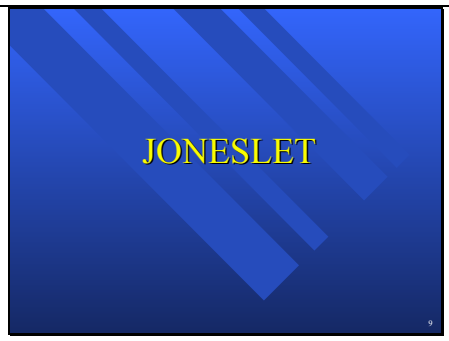
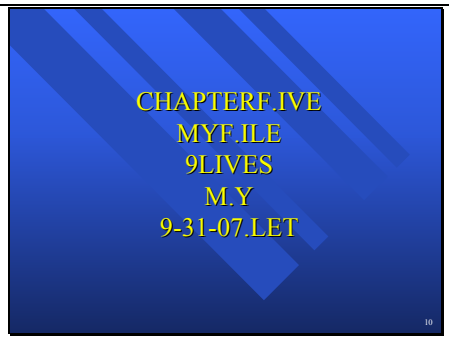
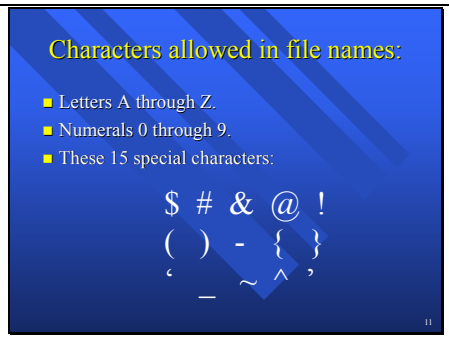
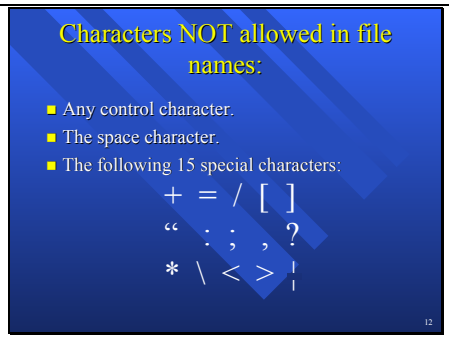
Slide 50		Rotate the Function Switch to the Current ranges. Let's also assume that we know from experience that the current will be less than 100 milliamps. Choose the range that is closest to, but higher than, the expected current; in this case, 200 milliamps.
Slide 51		Rotate the Function Switch to the Current ranges. Let's also assume that we know from experience that the current will be less than 100 milliamps. Choose the range that is closest to, but higher than, the expected current; in this case, 200 milliamps.
Slide 52		The meter is set up properly for measuring the current in the blue wire. Now, how do you connect the ammeter to the circuit to make the measurement? Here is why we are not going to be making current measurements here in the classroom. First, you turn off power to the computer. Then you cut the blue wire.
Slide 53		Somewhere between the motherboard and the power supply, you cut the wire in two and strip off the ends so as to expose the bare wire. Let me say again: "This is a demonstration only. You will not be cutting any wires in the computer here in the classroom."

Slide 54		Anyway, after the wire is cut, you insert the ammeter by connecting the leads to the bare wires. On some meters you must do this in such a way that the electron flow is from the black lead to the red lead. This is known as "observing polarity." Our meter is not so particular. It will simply register a negative value of current if connected backwards.
Slide 55		Finally, you take the current reading. In this case, the current will probably be minimal because the –12 volts is rarely used in modern PCs. Rather it is a holdover from earlier days. It is not used on the motherboard other than being routed to the ISA and PCI buses. But even when the current reading is useful, is it worth all the trouble required to get it?
Slide 56		And incidentally, you are not through yet. You still have to restore the original circuit. This probably means using a soldering iron and some heat-shrink tubing to repair the blue wire. Because of the hassle, you seldom make current measurements such as this one. Bench technicians that must make dozens of current measurements each day build or buy special fixtures that eliminate the need for cutting wires.
Slide 57		In summary, here are the rules for measuring electrical properties.

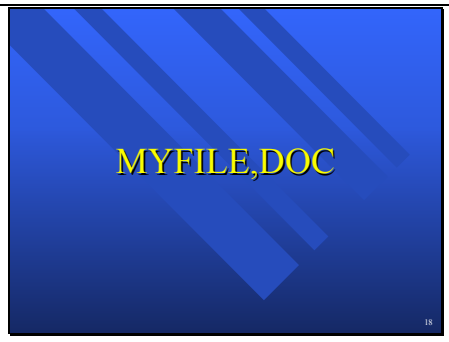
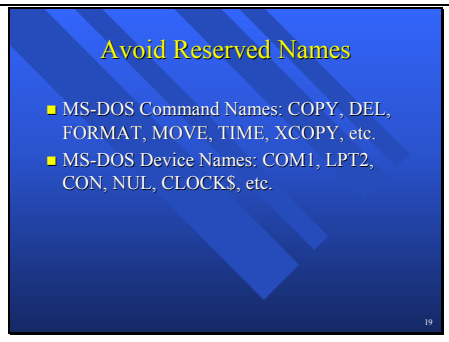
Slide 58		And finally, you should become familiar with the electrical terms are what they represent.
Slide 59		So now, it is your turn.

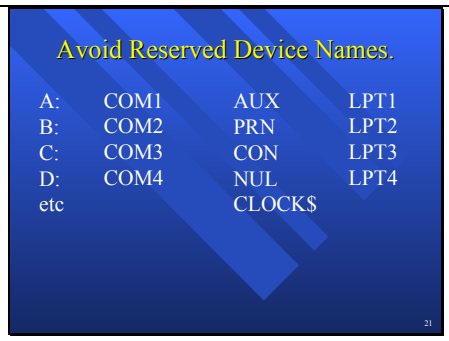
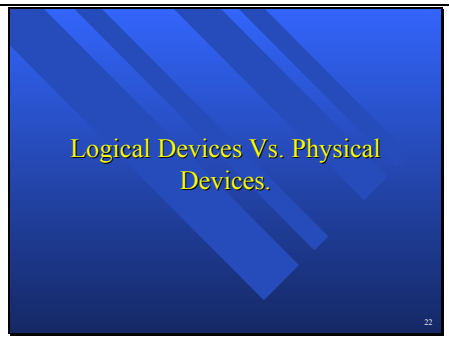
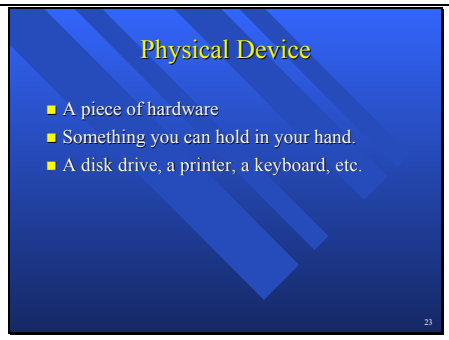
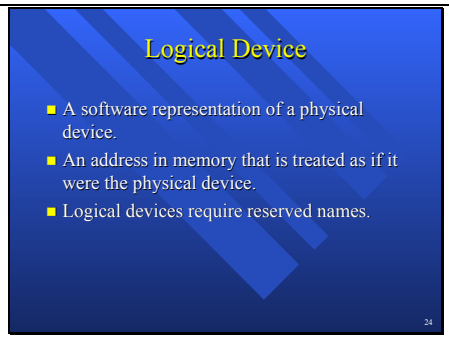
Slide 1		Welcome to Lab 2-2. In this lab you will continue your study of the command line by learning all about files. In particular, you will study the rules for naming files and the special characteristics or properties of files called *attributes*. You will also begin to grasp the many different types of files a computer can handle.
Slide 2		A file is simply a collection of information that has been given a name.
Slide 3		Because the operating identifies the file by its name, each file name must be unique within a directory. That is, you should not have two files that use the same name in a given directory.
Slide 4		There are hundreds of different types of files, just as there are many different types of information. A file may contain typed information, graphical information, mathematical data, audio, video, and, of course, programs.

Slide 5		As you work with the computer, you will create many files of your own, most of which you will have to name. There are certain rules to which you must conform when naming files. They begin with these. First, the name can have from one to a couple hundred characters, depending upon the location of the file. This is generally followed by a period which is followed by up to three more characters called an extension. However, the period and the three-character extension are optional.
Slide 6		Here is an example. Here the file name consists of eight characters, namely FILENAME. Then, the optional period is used, followed by the optional extension. Here the extension contains three characters, but it could just as easily have one or two. Incidentally, when reading file names the word "dot" is often used instead of the word "period." Thus, this example would be read: FILENAME dot DOC.
Slide 7		Let's look at some other examples of file names that conform to these rules. Here only six characters are used before the period.
Slide 8		Here we see that the characters can be numerals as well as letters of the alphabet.

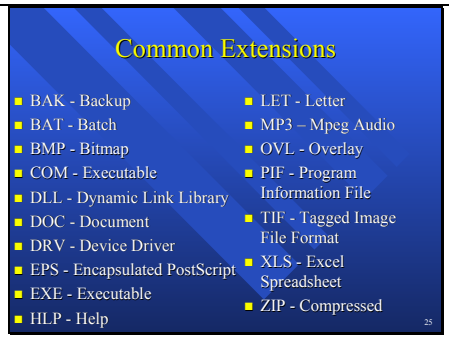
Slide 9		In this example, the optional period and extension are omitted… still perfectly legal.
Slide 10		Here are some additional examples. Some may look strange, but all are legal.
Slide 11		Certain characters may be used in file names, but others must be avoided. In particular, a file name can contain the letters A through Z, the numerals 0 through 9, and certain other symbols as shown here.
Slide 12		There are certain characters that you must not use in a file name. They include all the various control characters, the space, and the special symbols shown here.

Slide 13		To be certain that you have the idea, here are some examples of bad file names. What is wrong with this example? It has nine characters before the period. A maximum of eight is allowed.
Slide 14		What is wrong with this one? It has four characters in the extension. A maximum of three is allowed.
Slide 15		How about this one? It uses a space. Spaces are not allowed in MS-DOS file names.
Slide 16		What is wrong with this one? It uses an illegal character, the slash. Recall that MS-DOS uses the slash to indicate a switch, therefore you cannot use it in a file name.

Slide 17		How about this one? The "and" sign and "dollar" sign are fine. But recall that the question mark is a wild card. You must not use it in an assigned file name.
Slide 18		Here is a final example. What is wrong? If you look very closely you will see that a comma has been used instead of a period. This won't do.
Slide 19		Also, there is a long list of words that MS-DOS reserves for its own use. Generally, these fall into two categories: command words and logical device names.
Slide 20		Command words such as MOVE, DEL, DIR, and FORMAT have precise meaning to MS-DOS. These are the various commands that DOS performs. There are well over 100 of them. They are listed in your *Using MS-DOS* Textbook. You must avoid using these reserved command words for file names.

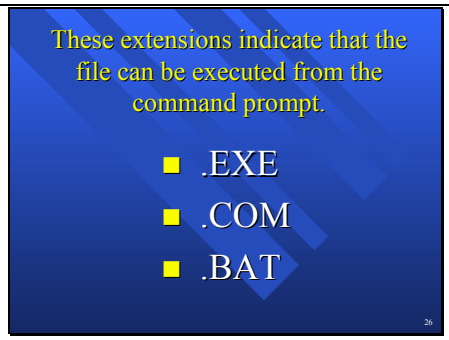
Slide 21		In the same way, MS-DOS reserves the names it applies to logical devices. These include MS-DOS's names for the various disk drives, the various communications ports, the keyboard and display, etc.
Slide 22		From MS-DOS's standpoint, these are referred to as logical devices. So let's spend just a moment comparing logical devices with physical devices.
Slide 23		A physical device is a piece of hardware, something that you can hold in your hand.
Slide 24		A logical device can be thought of as a software representation of a hardware device. Your computer trainer has a single physical hard drive. And yet the operating system "sees" it as two different hard drives that it calls C: and D:. It could be configured so that it is seen as three or four logical drives.

Slide 25



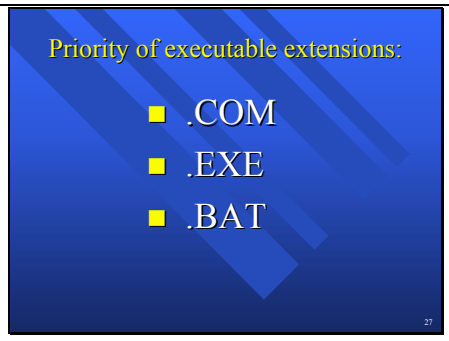
The guidelines described above are hard, fast rules. If you violate them, the OS will probably send you an error message or worse. Other guidelines are called conventions and are not quite so strict. Often, you can violate a convention without encountering serious problems. Some of the most common conventions involve the use of extensions. As mentioned earlier, there are hundreds of ways that you can classify files. It is common practice to use extensions that help to categorize files. A few of the more common extensions are shown here. A much more extensive list is in your Textbook.

Slide 26

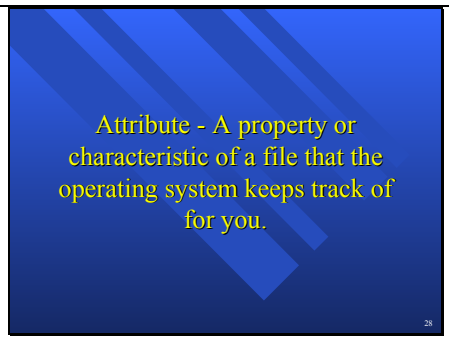
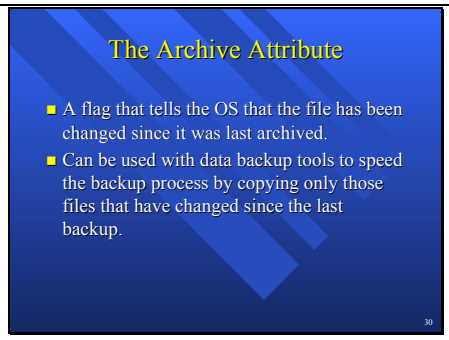
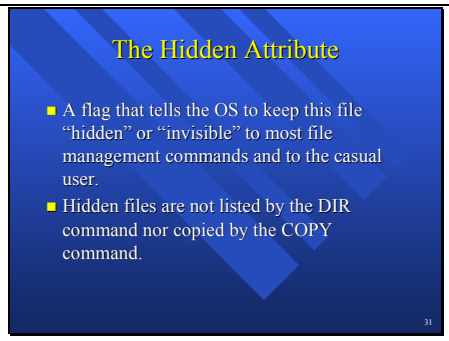


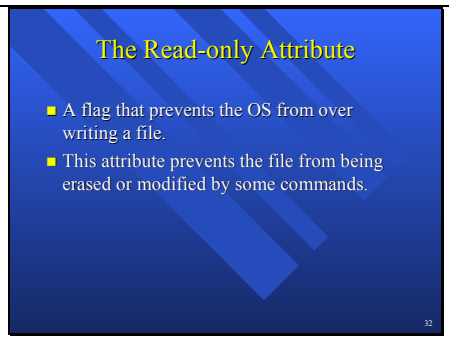
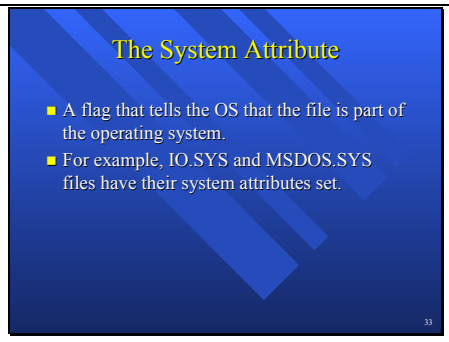
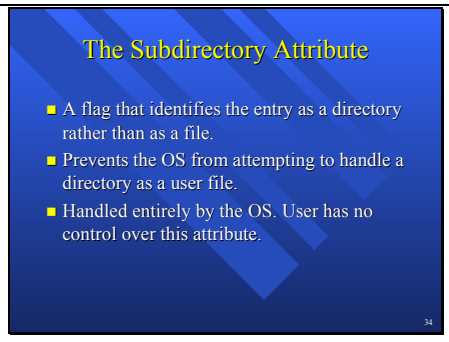
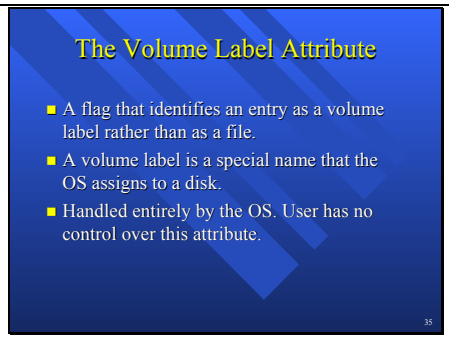
These three extensions are particularly important because they indicate files that perform a function… files that do something. These are files that can be executed from the command line. Consider a game called DOOM. This game has an executable file called DOOM.EXE. When this file is executed the game begins. Files with the extension .COM are also executable in the same way. Finally, files with the .BAT extension are batch files. As the name implies, a batch file is not a single file, but rather a list of files that are to be executed one after another. Your AUTOEXEC.BAT file is a good example of a batch file.

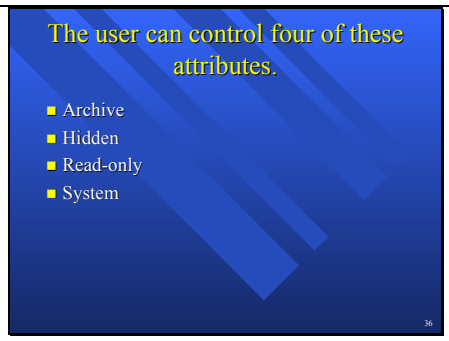
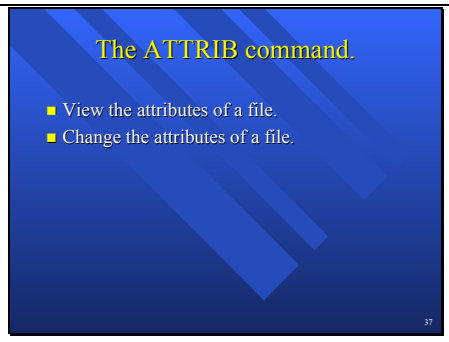
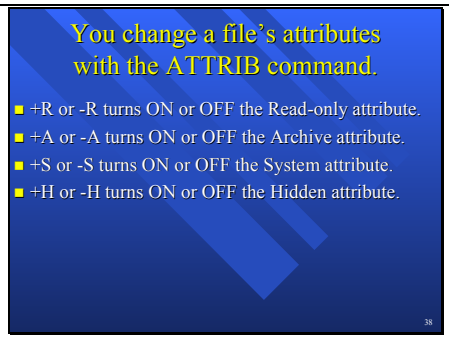
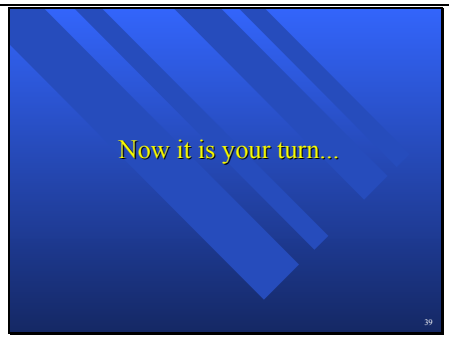
Slide 27

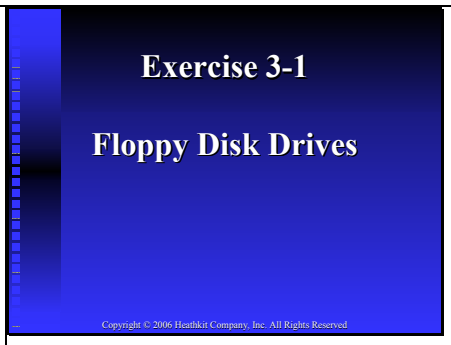
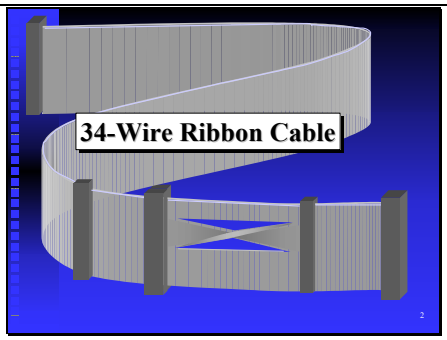
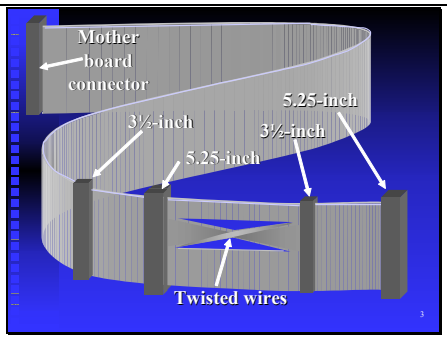
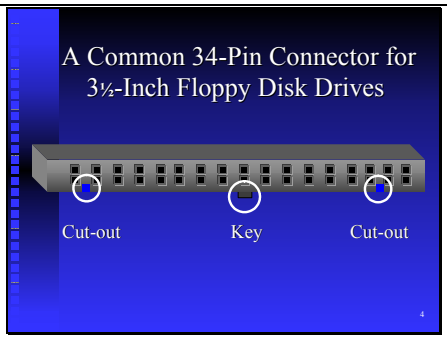


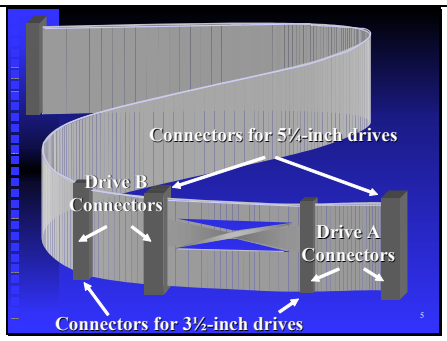
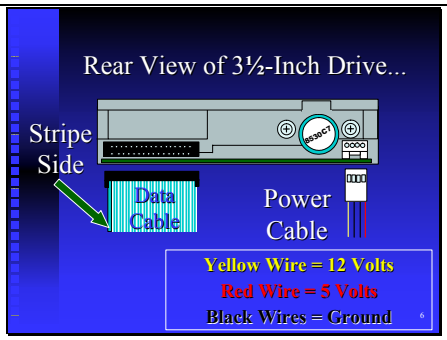
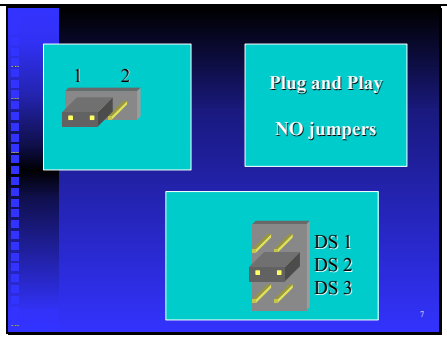
Because there are three different extensions that indicate executable files or a batch file, the OS has a priority of looking for these executable files. For example, let's say you have a game called Ghost Robot and that you launch it by typing ROBOT at the command line. The OS will first look for a file called ROBOT.COM. If it finds it, it will execute the file. If there is no such file, it will look for ROBOT.EXE. If ROBOT.EXE does not exist, it will look for ROBOT.BAT.

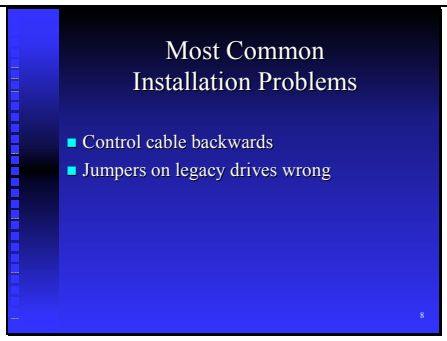
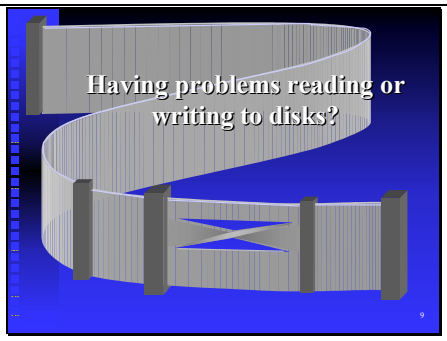
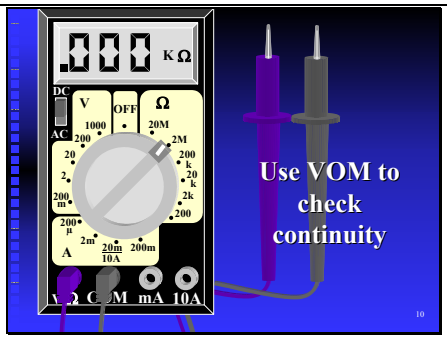
Slide 28		Finally, let's briefly discuss file attributes. An attribute is a special property or characteristic of a file that the OS keeps track of for you.
Slide 29		There are six different file attributes. As shown here they are called archive, hidden, read-only, subdirectory, system, and volume label. Let's look at each one in a little more detail.
Slide 30		The archive attribute helps to simplify the backup process. It can be thought of as a flag that tells the OS that the file has changed since it was last archived. To archive means to back up. You should develop the habit of backing up files on a regular basis. Most operating systems provide a special command that makes the backup process fast and easy. One way that the backup process is speeded up is to check for the archive flag and backup only those files that have changed since the last backup.
Slide 31		The hidden attribute gives you a way to hide a file. Setting this attribute makes the file invisible to most file management commands. Recall that IO.SYS and MSDOS.SYS are hidden files. Apparently, the theory is: You won't mess up what you can't find.

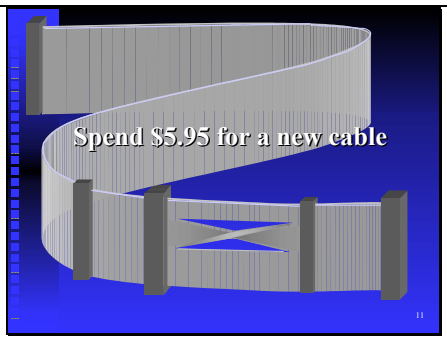
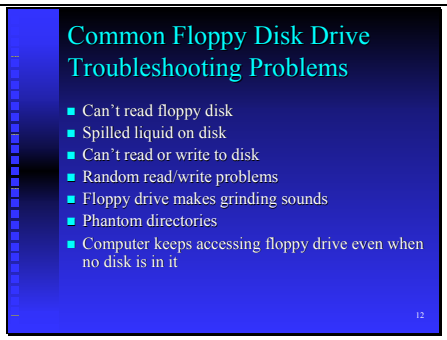
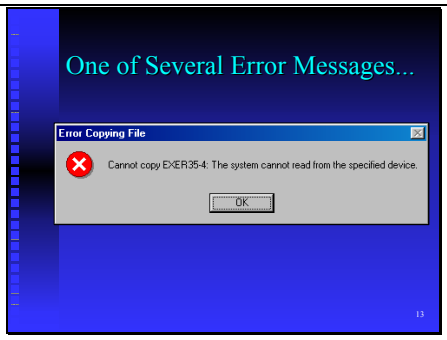
Slide 32		The read-only attribute gives a way to protect a file from accidental erasure or modification. When it is set, many commands cannot overwrite the file, and the ones that can overwrite it will ask for conformation before doing so.
Slide 33		The system attribute is a flag that tells the OS that a file is part of the operating system. For example, the hidden files called IO.SYS and MSDOS.SYS are flagged as system files.
Slide 34		The rules for naming a directory are the same as those for naming a file. To help the OS avoid the confusion, the Subdirectory attribute is used. The OS flags directories with this attribute as they are created. From that point on, the OS knows that the entry is a subdirectory, not a file name, because the subdirectory attribute is set.
Slide 35		The OS identifies a disk with an 11-digit Volume Label that looks just like a file name. It automatically flags this name with the volume label attribute so that it will not confuse it with a file name.

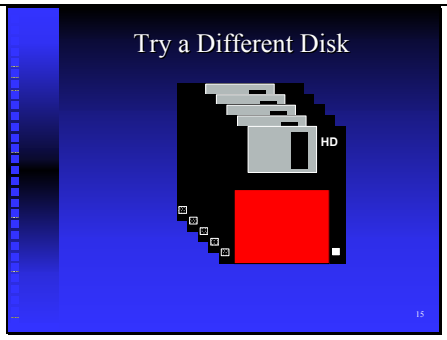
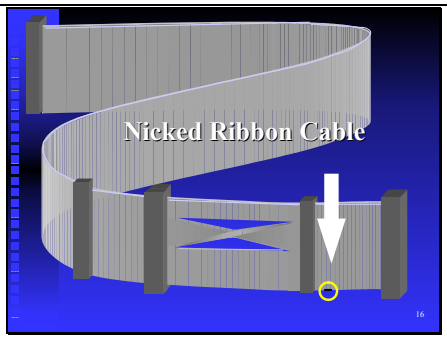
Slide 36		Computer users have some control over four of these attributes in that they can turn them on and off. The ones that can be controlled by the user are the archive, the hidden, the read-only and the system attributes. The user has no control over the Subdirectory and the Volume Label attributes.
Slide 37		MS-DOS has a special command called the attribute or ATTRIB command that allows the user to view and change file attributes.
Slide 38		You change the attribute by using the first letter of the attribute along with a plus or minus sign. For example, +A turns on the archive attribute; -A turns it off.
Slide 39		Well, now it is your turn. As you work through the lab in your workbook, you will experience first hand many of the subjects that we just talked about.

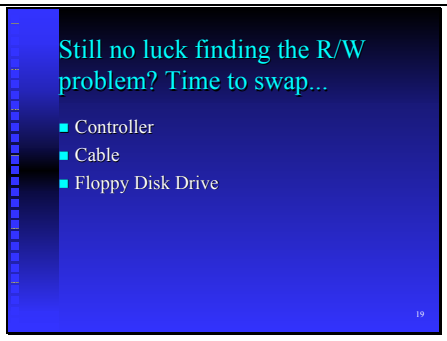
Slide 1		In the lab exercise today you work with floppy disks. This slide presentation will give you additional insight into troubleshooting floppy drive problems.
Slide 2		The floppy disk drive is connected to the motherboard by a 34-pin connector and cable. Notice the twist in the ribbon cable.
Slide 3		At one end of the ribbon cable, by itself, is a connector for the motherboard. Down the cable from the motherboard connector are a pair of connectors. Then there is a place where some of the wires in the ribbon cable are twisted. Finally, there are two more connectors near the end of the cable.
Slide 4		Here's what the connector for a three-and-a-half-inch floppy disk drive looks like. It's keyed with cut-outs near each end and a plastic ridge near the middle. A connector is keyed to make it more difficult for someone to plug it on wrong. Not all floppy drive connectors are keyed. Before you remove the connector, be sure to note where the striped side of the cable is positioned so you can re-install the connector properly.

Slide 5		There is a three-and-a-half-inch drive connector and a five-and-a-quarter-inch drive connector on either side of the cable twist. Drive A connects to one of the end connectors and Drive B, if the computer has one, connects to one of the middle connectors. Question: If the ribbon cable has 34 wires, how many of those wires carry data? **(Instructor**: Only one wire carries data. The disk drive uses a serial interface.)
Slide 6		It is important to connect the 34-pin control connector correctly. With the floppy disk drive in your lab computer, Pin 1, which is marked with the colored stripe on the ribbon cable, goes toward the outside of the drive like in this slide. This connector is keyed but even keyed connectors can sometimes be plugged-in wrong. The power connector is always keyed to make it difficult to plug the power cable in wrong. A good rule of thumb is that if you are having trouble plugging the power cable in, it is probably upside down. Turn it over and try again.
Slide 7		You may find a jumper block on some legacy floppy drives. This block may have only one jumper or it may have several. Although some drives have a few other functions selected by jumpers, most use jumpers only for drive select. Remember the twist in the cable? To use a twisted cable with two floppy drives, the drives should be jumpered for the same drive assignment. The twist in the cable causes the drives to be selected as drive A and drive B. Normally, there is no need to change the default jumper settings. Some floppy disk drives have no jumpers at all. These are Plug and Play drives. Oh, that brings up a good question. What about the BIOS settings for a floppy drive? Do we have to make changes to it when we install a second drive? Normally, that would be the case. You'll learn about that in today's lab Exercise. You will also be reminded that the lab computer does not support a second floppy disk drive. That seems to be a common trend in computers.

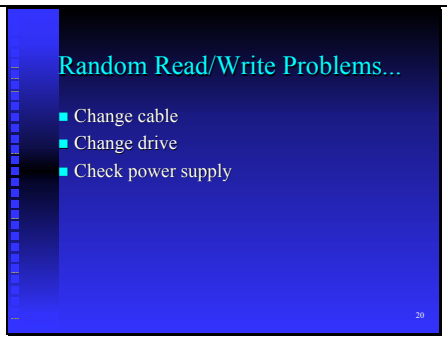
Slide 8		The most common problem when installing a floppy disk drive is that the data ribbon cable is plugged in upside down. When this happens, the drive comes on when power is applied and does not go off until the computer is turned off. The second most common problem happens when two drives are installed and the drive select jumpers are not set the same. Both drives then respond to the same drive selection. In other words, they both think they are drive A. When this happens, the drive does not go active until selected. But then both drives go active and neither can be read.
Slide 9		When there is a problem reading or writing floppy disks, the data ribbon cable is one of the prime suspects. This cable is made up of 34 tiny wires. The connectors make contact with the wires by pressing sharp teeth through the cable insulation. Now when you open the computer and do almost any troubleshooting task, you know that this cable is always in the way! As a result, it tends to get pushed to the side and shoved out of the way without much thought. This moving and bending can cause a wire that is already stressed by the connector teeth to break. Of course, you can't see the break, and quite often the pressure of the wire insulation is enough to hold the ends of the wire together. So that you wind up with an intermittent connection—a most fun problem to troubleshoot.
Slide 10		You can use a DMM to check the continuity of each of those 34 wires making up the cable. In other words, use the meter to make sure the connectors are working and that there are no breaks in the wire. Hmmm…definitely sounds like a boring job. Doing boring tasks is probably not the reason you wanted to learn how to troubleshoot computers.

Slide 11		Well there's an easier solution. Put your DMM back on the shelf and spend six bucks for a new cable to replace the suspect one. This is the type of decision you will have to make constantly when you are troubleshooting floppy drives. Do I fix a component or do I replace it?
Slide 12		Let's look at some common floppy drive troubleshooting problems. These are just some of the basic ones. I'm sure that after you become experienced troubleshooters you can add more to the list. We'll look at each of these problems in the remainder of this slide presentation.
Slide 13		Let's look at the first common troubleshooting problem—the floppy drive cannot read a floppy disk. This could be a hardware problem like a defective floppy controller, the data cable, the power cable, or the disk drive. Or it could be something simple like a bad disk. Most of the time, it's the disk. No matter what Windows operating system you are working with—Windows 3.1, Windows 98 or Windows 2000—you will see an error message letting you know you have a problem. The more desperately you need to get at the data on the floppy disk, the more serious sounding the error message will be!

Slide 14		Sometimes the problem is simple, maybe you forgot to put the floppy disk you want to work with in the drive. In that case the solution is easy. You simply put the floppy disk in the drive and click Retry. At other times the problem is more severe and no matter how many times you click Retry, the disk is not readable. Sometimes just simply removing the floppy disk from the drive and then putting it back in again will solve the problem. Maybe the computer can read it then.
Slide 15		Maybe it's the floppy disk that's the problem. Try another disk. Try one that you know is good and that you can read and write to in another computer. Format a floppy disk in the suspect drive and then see if a drive in another computer can read and write to it. Or, take the disk you are trying to access and bring that to another machine to see if it's readable and writeable. Again, maybe the disk is at fault, and not the computer hardware. This makes a good case for backing up important data on a media other than floppy disks. With their relatively short shelf life of three to four years, it's probably better to back up important data on tape, CD-R disks, a network drive, etc.
Slide 16		Possibly the reason you can't read or write to a floppy disk is that the floppy disk drive's ribbon cable has been damaged or the connector to the motherboard or to the drive has worked loose. Push the connectors in. Check for nicks. Even a small nick could do it. The 34 wires that make up the cable are very small. One nick could eliminate a signal path. Visually check for nicks, use a VOM to check continuity in all 34 wires, or replace the cable with a new one. I know what my choice would be!

Slide 17		You have to ask yourself, is it really worth spending much time on a disk drive when you can buy them in quantity six-pricing for $30? Your time as a troubleshooter and the user's time are worth much more than that. You have to consider the user's time, too. They may be inconvenienced by your troubleshooting efforts. At times it makes more sense to toss the floppy drive and replace it with a new one.
Slide 18		The computer's power supply could be at fault. If you replace the floppy disk drive with a new one and it still does not work, the power supply might be the problem. Pull out the VOM again. Unplug the power cable from the floppy drive. Check the voltages at the Berg or Molex connector pins where the yellow and red power harness wires connect. The yellow wire pin should read around 12 volts DC. The red wire pin should read approximately 5 volts DC. If you don't get these results I would suspect either the power supply has a problem or possibly the power cable itself running to the drive has a problem.
Slide 19		Not having much luck finding the problem? After you do the preliminary testing, it's time to swap components. Start with the cable. Finally, swap the floppy drive for a new one. Remember, when you use the "swap" method of troubleshooting you should swap one item and then check to see if that solves the problem. If swapping a component doesn't fix the problem, put the old component back in and swap the next one. Don't swap all the components at once. If you do that you won't know what really caused the problem.

Slide 20

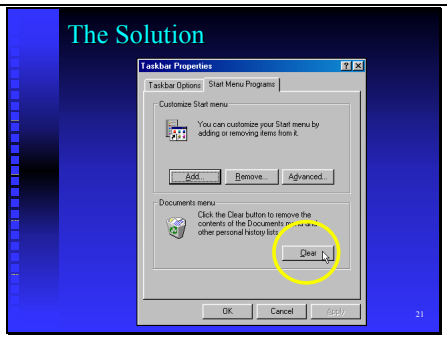


Another type of floppy disk drive problem is the random read/write problem. This can be a tough one to solve. Sometimes the problem is there. Sometimes it's not.

Your best plan of attack is to use the swap method of troubleshooting. Swap the cable, the drive, and test the power supply voltages. After each swap, you may have to wait to see if the problem shows up again.

A random problem may be a good time to deviate from the "substitute and check performance rule." Since the problem is intermittent, you don't have time to replace one component at a time and wait around to see if it worked. Replace everything that is replaceable, check the power supply voltages, and be done with it. It may be cheaper when you consider you labor costs versus the cost of replacement parts.

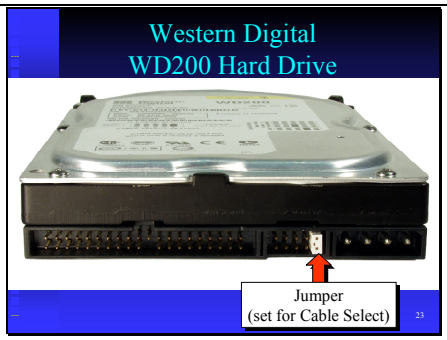
Slide 21



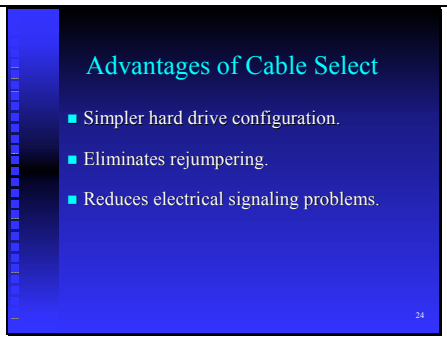
Sometime in your troubleshooting career you will more than likely be called by a user who tells you that the computer keeps trying to access the floppy disk drive even when they have no floppy disk in it. When they call they will probably sound "on edge" since this is a problem that drives users crazy.

Here's the problem. The Windows 98 Documents Menu lists a floppy drive file that was worked on earlier. The floppy has since been removed. However, every time you open a document in Windows, it goes out and attempts to restore the Documents Menu address references. That's why the drive keeps running, Windows is trying to find the floppy file listed in its Document Menu. How do you solve the problem? Simple, delete the file from the list. But, you just can't click on the file name and press the Delete key. No, you have to:

Select Start, Settings, Taskbar & Start Menu… then, select the Start Menu Programs tab and click on the Clear button. Problem solved!

Slide 22		Next, we are going to learn more about hard drive partitions and IDE cables. Let's begin by looking at the objectives of this exercise.
Slide 23		You already know how to use the jumpers on hard disk drives to set them as either Master or Slave. Today you will learn about a third way to program hard drives. That is Cable Select. To configure a hard drive for Cable Select, you just set the jumper to Cable Select, CS, or something similar. Refer to the documentation that came with the drive for more information. This slide shows a Western Digital WD200 drive configured for the Cable Select mode.

Slide 24



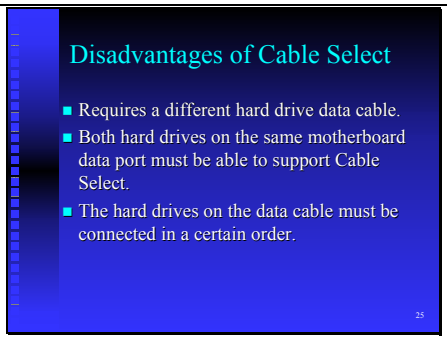
Some of the advantages of using Cable Select are:

Simpler hard drive configuration. You set the hard drive jumpers to Cable Select and forget about them. You no longer have to worry about Master/Slave jumpering.

Eliminates rejumpering when you remove one of the hard drives. You should recall that Master drives require you to set its jumper to Master Only or Master With Slave, depending upon whether or not a Slave drive is installed. When you remove the Slave drive, you need to move the jumper on the Master drive to reflect the change. With Cable Select, no jumper changes are required when you add or remove the Slave drive.

Reduces electrical signaling problems. The Master drive must be connected to the far end of the data cable. When the hard drive jumpers are configured in a Master/Slave arrangement, a single, Master drive can be connected to the connector near the middle of the cable, with nothing connected to the end connector. When the end of the data cable is left unterminated, reflections in the cable can cause data read/write problems.

Slide 25



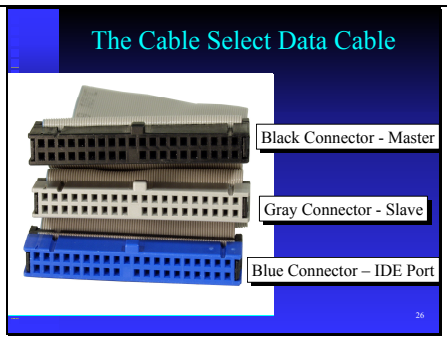
Some disadvantages of using Cable Select are:

Cable Select requires an 80-conductor cable. A 40-connector cable can be modified to work with Cable Select, but it is not recommended. We'll talk more about the cables shortly.

Both hard drives on the same motherboard data port must be able to support Cable Select. Older hard disk drives may not have a jumper setting for Cable Select, so they cannot be used in a Cable Select configuation.

The hard drives on the data cable must be connected in a certain order. Because the drives themselves are not jumpered for Master and Slave, the drive's position on the data cable determines whether it is the Master or the Slave.

Slide 26



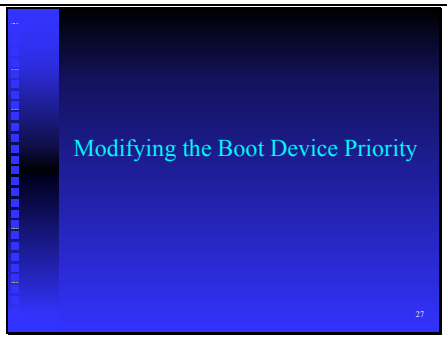
As stated before, a Cable Select data cable has 80-conductors instead of the usual 40. Even so, the connectors used on a Cable Select cable still have 40 pins. The extra conductors are connected to ground and are interspersed between the conductors which normally carry data. This helps reduce the possibility of signaling problems and crosstalk which can occur at higher data transfer speeds.

As mentioned earlier, a hard drive's position on the cable determines whether it is the Master or Slave drive. Instead of a twist in some of the conductors, which was common with floppy disk cables, the logic level on pin 28 (referred to as CSEL) determines how the hard drive is used. When pin 28 is grounded, the drive is configured as the Master, and when the pin in ungrounded, the drive is considered as the Slave.

In the Cable Select configuration, the hard drive connected to the black connector is the Master, and the hard drive connected to the gray connector is the Slave. The blue connector is always connected to the IDE port on the motherboard.

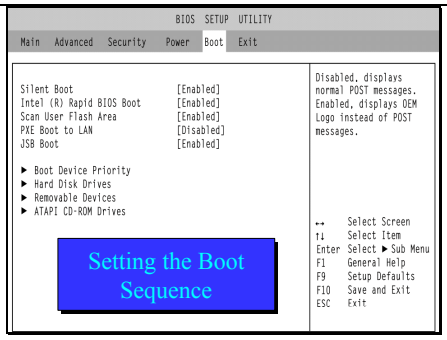
An ordinary 40-conductor cable can generally be replaced with an 80-conductor cable, even if you still want to set the Master and Slave jumpers on the drives manually. When the drives themselves have their jumpers set, the logic level on pin 28 is ignored, so they work just like they would with a 40-conductor cable.

Slide 27



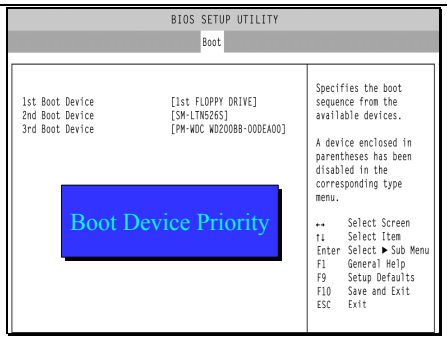
Now let's learn about some different ways you can modify the boot device priority.

Slide 28



You already know that you can go into the BIOS Utility's Boot menu, choose Boot Device Priority, and change the 1st, 2nd, and 3rd Boot Device to suit your needs.

Slide 29

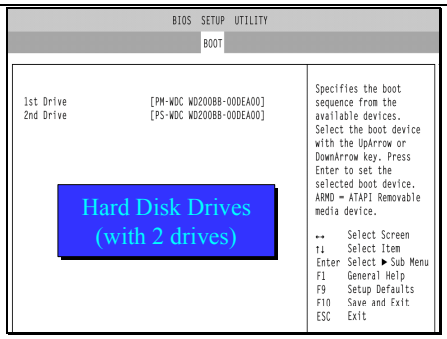


The only three choices you have are the hard disk drive, the CD-ROM drive, and the removable (or floppy) disk drive, so you can't go too far wrong. But what if you have more than one hard disk drive?

Your answer might be that the hard drive configured as the primary master is the one listed under the Boot Device Priority. But this isn't necessarily the case.

Let's take a look at the Hard Disk Drives item in the Boot menu.

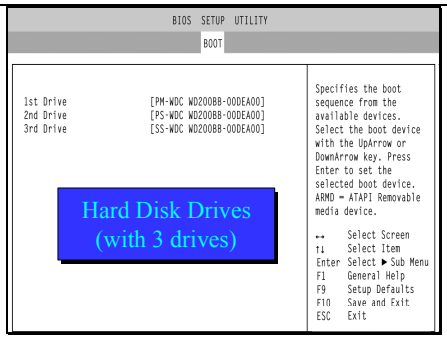
Slide 30



If there is second hard disk drive installed in the computer (like you did in the previous exercise), there will be two hard drives listed. If they are the same type as shown in this slide, how do you know which is which? In this example the drive designations start with either PM or PS. Depending upon the version of BIOS, and the way BIOS is configured, the drive designations may instead start with 3M or 3S, respectively. In one case, the BIOS uses the letter P to indicate the primary IDE port. In the other case, the BIOS uses the number 3 to indicate port 3 on the motherboard. Either way, it refers to the same thing. Following the letter P or number 3 will be either the letter M or S to indicate that the drive is configured as Master or Slave.

From this example, you could logically deduce that PM (3M) indicates the Primary Master drive, while PS (3S) indicates the Primary Slave drive. Now let's see what happens if there is third hard disk drive in the computer.

Slide 31



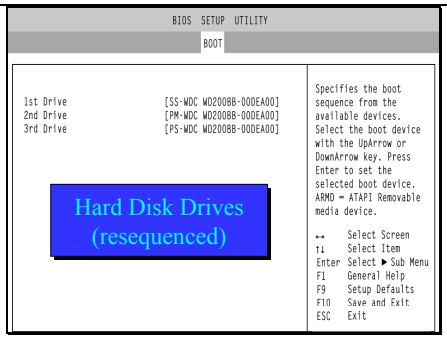
When a third hard disk drive is present in the computer, it will also be listed in Hard Disk Drives of BIOS Setup's Boot menu.

But there are no more connectors available for hard drives on the primary IDE cable, so this third hard drive is connected to the secondary IDE cable which goes to the CD-ROM drive. In this configuration, the CD-ROM drive is generally configured as the Master, and the hard drive is configured as the Slave.

Note that in this slide the third hard drive's designation begins with the letters SS. The first letter indicates this drive is connected to the secondary IDE port, and the second letter indicates that this drive is configured as the Slave. As before, depending upon the version of BIOS and how it is configured, the drive designation may appear as 4S instead of SS. The 4 simply indicates port 4 of the motherboard, which is the secondary IDE port.

You can easily change the order in which these three drives are listed any way you want. For example, let's assume you change the 1st Drive to Secondary IDE Slave SS (or 4S).

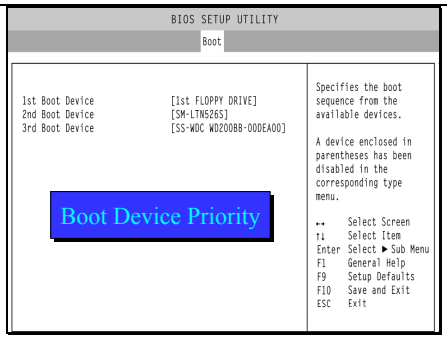
Slide 32



As you can see from this slide, the secondary slave hard drive is now listed as the 1st drive. The other two drives are still listed, but have moved down one position. If you wanted to, you could also switch the 2nd and 3rd hard drives around.

Now let's return to the Disk Drive Priority screen and see what may have changed.

Slide 33



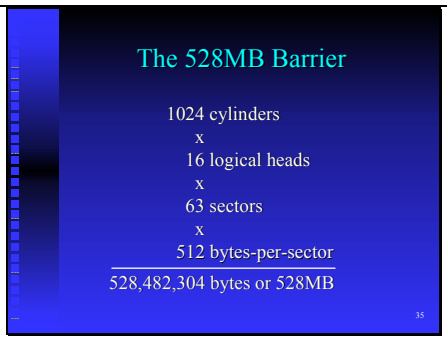
In this slide, the secondary slave drive is listed as the 3rd boot device. It should now be obvious that whichever drive is listed as the 1st Drive in the Hard Disk Drives menu item appears in the Boot Device Priority. The point is that it is possible to boot from any hard disk drive, as long as the drive contains an operating system. Although you probably wouldn't normally want to do this, you could have Windows 98 on one hard drive, Windows 2000 on the second hard drive, and Windows XP on the third hard drive. Then, by adjusting the sequence of the drives in the Hard Disk Drives menu item, you could cause the computer to boot any one of the three operating systems.

Because the drive designations can be quite confusing, especially if the drives are all the same model as they were in this presentation, they are very easy to get mixed up. For this reason, any time you do something drastic to a hard drive in a multiple-hard-drive computer, such as run Format, we strongly recommend that you unplug the other drive(s) to make sure you don't accidentally get the wrong one. You certainly wouldn't want to destroy important data on a client's computer. Remember that you may have to reconfigure the remaining drive as a single master while you have the other drive(s) unplugged.

Slide 34

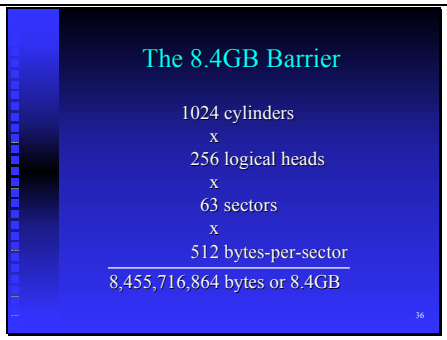
The next subject we should talk about concerning hard disk drives is Drive Capacity Limitations. These are commonly called "barriers."

Slide 35



Hard disk drives prior to 1994 were limited to 528 megabytes. The reason for this is that the software interrupt 13 (INT13) Application Programming Interface (API) required a sector to be addressed by its CHS (cylinder/head/sector) location. But these were limited to a maximum of 1024 cylinders, 16 logical heads, and 63 sectors due to limits in the ATA-1 through ATA-5 interface specification. When you multiply the maximum number of cylinders, heads and sectors together, you obtain a total of 1032,192 sectors. There are always 512 bytes-per-sector, so if you multiply the total sectors by 512, you obtain 528,482,304 bytes or simply 528MB.

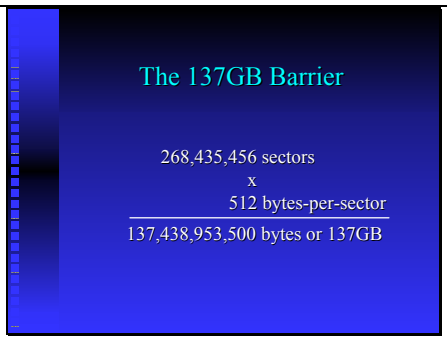
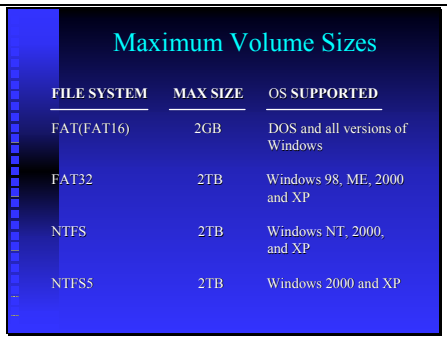
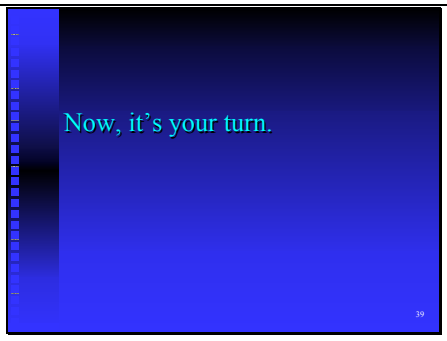
Slide 36



In early 1994 much larger hard disk drives were beginning to be produced, but the BIOS and ATA limits mentioned in the previous slide still prevented more than 528MB from being addressed. To fix this problem, BIOSes began to appear which used parameter translation. This allowed the maximum number of heads which could be addessed to increase to 256. Now, if you multiply the maximum number of cylinders (1024), heads (256), and sectors (63) together, and them multiply the result by 512 bytes-per-sector, you obtain 8,455,716,864 bytes or simply 8.4 GB.

Actually, there were a couple of other barriers between 528MB and 8.4GB which appeared for a short while. These were referred to as the 2.1GB and 4.2GB barriers. The 2.1GB barrier occurred because a BIOS defect allowed for only 4096 cylinders, 16 heads, and 63 sectors. When you multiply this numbers together and then multiply the result by 512 bytes-per-sector, you obtain 2,113,929,216 bytes or 2.1GB. There is also a 2.0GB barrier that was caused by a problem between the operating system and the file allocation table (FAT).

The 4.2GB barrier occurred because early versions of Windows 98 and Windows ME could not properly address a hard disk with 256 heads. These versions of Windows used only an 8-bit number to store the sector information, but the number 256 requires at least a 9-bit number.

Slide 37		In 1998 BIOS manufacturers began to adhere to the BIOS Enhanced Disk-Drive Specification (EDD). This resulted in a theoretical maximum of 9.4 trillion GB. The problem here was that ATA drives still used 28-bit addressing, which limited the drive to 268,435,456 sectors. When you multiply this number by 512 bytes-per-sector, you obtain 137,438,953,500 bytes or 137GB. A couple of years later a new standard, ATA-6, began to used 64-bit addressing. This provided for larger hard drives up to 144 quadrillion bytes. As you probably know, 160GB and larger drives are available today.
Slide 38		This slide shows the maximum volume sizes for the various File Allocation Table (FAT) systems and the operating systems which support them. The abbreviation TB refers to terabytes which equals 1,000,000,000,000 bytes or 1000GB. Note that all but FAT(FAT16) support volumes up to 2TB. However, the type of file system available is limited by the operating system.
Slide 39		That's the end of the slide presentation. Hopefully, this will arm you with some basic disk drive troubleshooting information. Now, do the lab in your student workbooks and learn some drive troubleshooting tips firsthand.

Slide 1

In your lab Exercise today you will install a third hard disk drive in in the computer trainer.

Slide 2

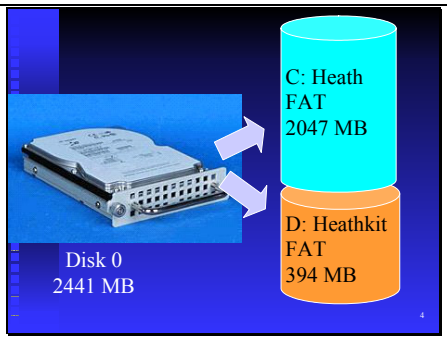
In this presentation we are going to look at the the disk drive interface called *Integrated Drive Electronics*, better known by its initials IDE.

You should be familiar with everything in this presentation, from previous reading assignments. But today we are going to pull it all together so you can see the relationships between all of the different IDE interfaces.

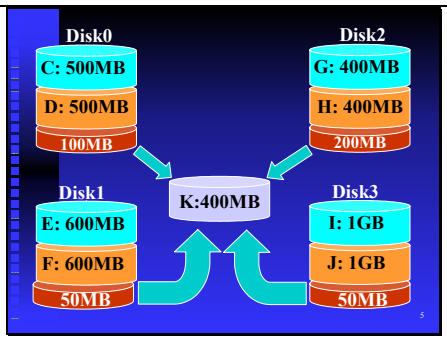
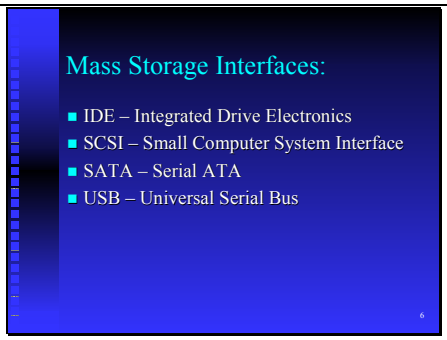
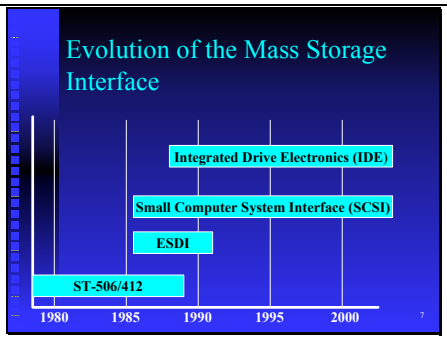
Slide 3

To begin with, recall that there are two types of drives: physical drives and logical drives. The physical drive shown on the left came out of a server rack. A physical drive is something that you can hold in your hand. By contrast, the logical drive is a software construct. On the right we see two logical drives, one called Heath (C), and the other, Heathkit (D). These two logical drives may reside on a single physical drive or they may each reside on separate physical drives.

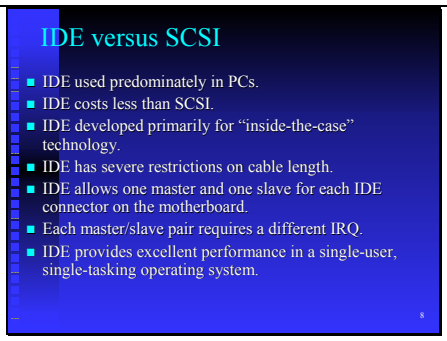
Slide 4



Perhaps this diagram will help you visualize the relationship between the physical and logical drives. Here you see that a single *physical* hard drive, called Disk 0, is partitioned into two *logical* drives called C: Heath and D: Heathkit.

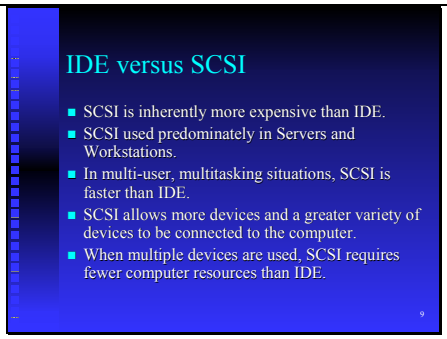
Slide 5		A logical drive can even reside on several different disks. Here Disks 0 through 3 are four separate physical drives. Each physical drive is partitioned into two logical drives. Thus, drives C through J are logical drives. However, notice that there is also a drive K, in the middle of the drawing. Drive K is a logical drive that is made up of pieces of the four physical drives. This type of logical drive is called a volume set. We'll get into that subject in a later presentation. The point is that the logical drive is a software construct that allows us to arrange physical drive space in a more convenient way.
Slide 6		Today there are four different mass storage interfaces commonly used with personal computers. They are called IDE for *Integrated Drive Electronics*, SCSI for *Small Computer System Interface*. In sheer volume, IDE is historically more popular because it is used in most desktop and portable PCs. SCSI, on the other hand, is used primarily in high-performance applications such as servers and workstations. Serial ATA is being used in most new computers today, and USB is primarily used for portable and backup storage situations.
Slide 7		This chart shows how several mass storage interfaces have evolved over the years. One of the earliest was from Seagate Technologies called ST-506. Dating back to the late 1970s, it was originally introduce for a 5 MB hard drive. A little later it evolved into the ST-412, which was a 10 MB hard drive. While the Seagate design was adapted as a standard by the industry for several years, its limited performance and capacity eventually caught up with it and it was discontinued in the late 1980s. Next was the Extended Small Device Interface (ESDI). It allowed much faster and larger hard drives. However, it too became obsolete in the early 1990s. This leaves only two surviving mass storage interfaces, SCSI and IDE. SCSI evolved first with IDE following close behind. SCSI will be discussed in future presentations. This presentation concentrates primarily on IDE.

Slide 8

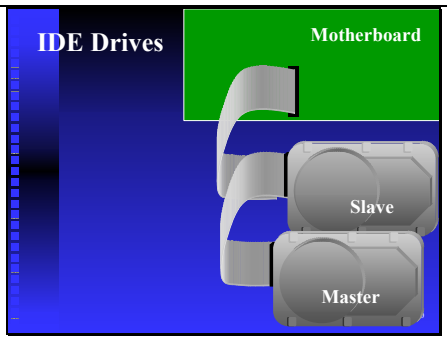
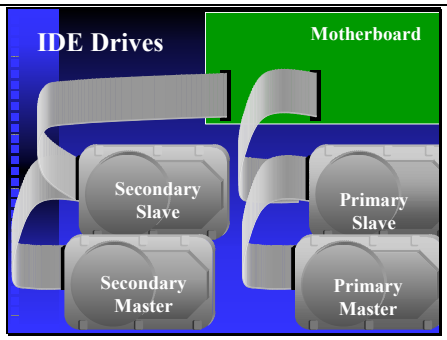
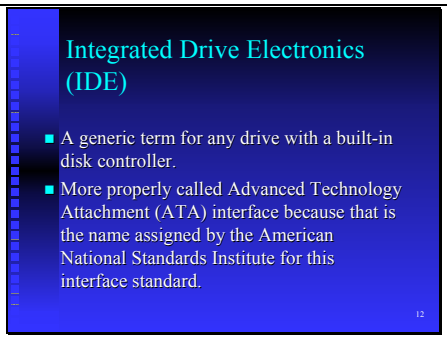


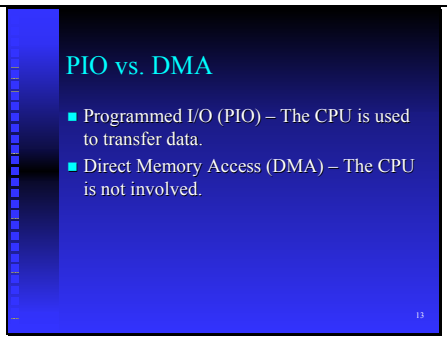
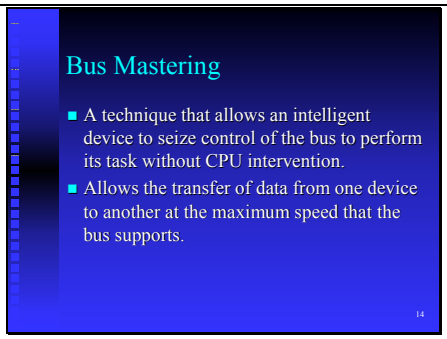
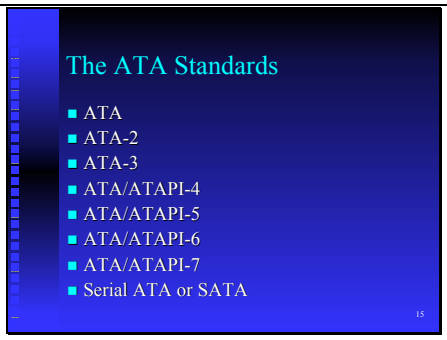
IDE is the predominant mass storage interface in desktop and portable PCs. The reason is cost. IDE costs less than SCSI. The hard drives themselves cost less because many more IDE drives are used than SCSI drives. Moreover, the IDE interface is built right into the chipset itself, and thus is free for all practical purposes. However, IDE is primarily an "inside-the-case" technology. Its severe restrictions on cable lengths make external IDE problematical. IDE allows one master and one slave device for each IDE connector on the motherboard. And, while a desktop PC may have two IDE connectors, each master/slave pair requires its own IRQ, a resource that is in short supply in most PCs. In spite of these limitations, IDE provides excellent performance in a single-user, single-tasking situation like that found in most desktop computers.

Slide 9

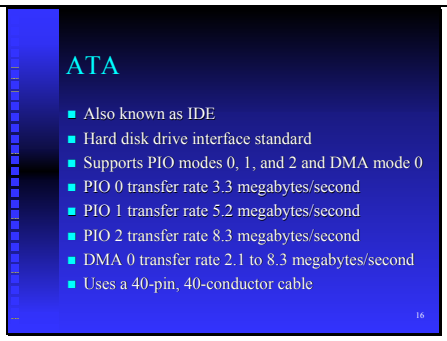


SCSI is inherently more expensive than IDE. Because of these higher costs, SCSI is usually reserved for servers and high performance applications like workstations. These high-end applications can more readily use SCSI to advantage. In multi-user, multitasking situations, SCSI is faster. SCSI also allows more devices and a wider variety of devices to be added to the computer than does IDE. SCSI requires a separate SCSI host adapter that is not included in the chipset. The SCSI host adapter may be integrated into the motherboard or it may require a PCI plug-in card. Either way, it is an additional expense. However, when multiple drives are required, SCSI requires fewer computer resources than does IDE. While the SCSI host adapter requires an IRQ line, the single host adapter can handle either 7 or 15 SCSI devices, depending on whether narrow or wide SCSI is used.

Slide 10		A major difference between IDE drives and SCSI drives is the way they connect to the Motherboard. Recall that IDE drives are connected in a master-slave relationship with each drive jumpered accordingly. The cable can accommodate only two drives.
Slide 11		Additional drives can be added by plugging a second cable into the secondary controller connector on the motherboard. The result is a primary master-slave pair and a secondary master-slave pair. Each pair requires its own IRQ. Some PCs have provisions for additional pairs, but here again, each pair requires a separate IRQ. This can quickly eat up available IRQs.
Slide 12		Over the years, Integrated Drive Electronics has become a generic term for any drive with a built-in disk controller. That's because the Western Digital marketing department did such an outstanding job telling everyone the name for their the disk controller. And, of course, the name stuck. Actually, the correct name for this interface is ATA, for *Advanced Technology Attachment*, a name first used by IBM and the name given to this interface standard by the *American National Standards Institute*, or *ANSI*.

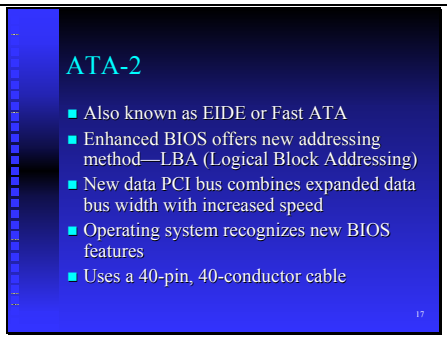
Slide 13		Recall that there are two fundamentally different ways for a computer to handle data transfers to and from hard drives. The first is called Programmed I/O or PIO. Using this technique, the CPU is used to transfer data between the hard drive and memory. This tends to tie up the CPU and it also results in slow data transfers. The second approach is called Direct Memory Access or DMA. Using this approach, the CPU does not get involved in the data movement. The disk controller transfers data directly between memory and the drive under the control of the system DMA controller or the drive interface, depending on the mode of operation for the operating standard.
Slide 14		An important extension of the DMA idea is called bus mastering. This technique allows an intelligent device such as an NIC or sound card to seize control of the bus to perform its task without CPU intervention. It allows the transfer of data from one device to another at the maximum speed that the bus supports. In a server, for example, it might allow a high-speed NIC to transfer data to a hard drive at the maximum speed of the bus. Here, the process is controlled by circuits on the devices themselves rather than by a separate controller.
Slide 15		ATA standards have gone through several revision in the past. Each revision has resulted in higher speeds and more features. We could ignore the earlier ATA standards, since they are no longer supported. However, they do create a foundation for the later standards, and give us something to hang our hats on.

Slide 16



As I explained earlier, the ATA standard is commonly known as the IDE standard. It is a hard disk drive standard that supports three PIO and one DMA mode of data transfer. It is necessary for the system BIOS match the PIO mode data rate with the system ISA bus data rate. Hence the three different PIO modes support by this early standard. The DMA data rate was regulated by the system DMA controller to 2.1, 4.2, and 8.3 megabytes-per-second single-word transfers or 2.1 megabytes-per-second multi-word transfers. Again, these rates are related to the ISA bus architecture. The ATA standard uses a 40-pin, 40-conductor cable.

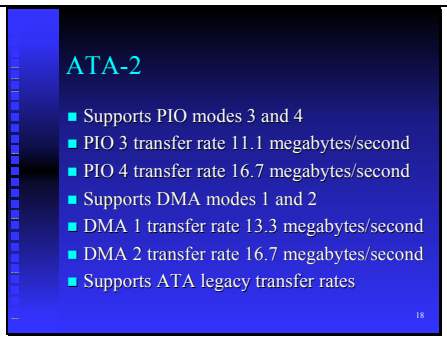
Slide 17



The ATA-2 standard evolved slowly. In fact, the evolution was too slow for the drive manufacturers, who began manufacturing drives to what they thought the standard would become, months in advance to the standard. Western Digital called their drives EIDE for Enhanced IDE, while Seagate called theirs Fast ATA. Can you guess whose marketing department did the better job of selling the name?

Three major system improvements combine to make ATA-2 a dramatic standard update. First, a new, enhanced BIOS offers a new data addressing method called LBA, or Logical Block Addressing, something we talked about in an earlier presentation. Second, motherboard manufacturers began using the latest PCI data bus. Switching from ISA to PCI doubles the width of the bus to 32 bits, and quadruples the speed to 33 megahertz. Third, Microsoft adapted its Windows operating system to work with the new hard disk drive addressing scheme and the new data bus. The one thing that does not change is the continued use of a 40-pin, 40-conductor cable.

Slide 18

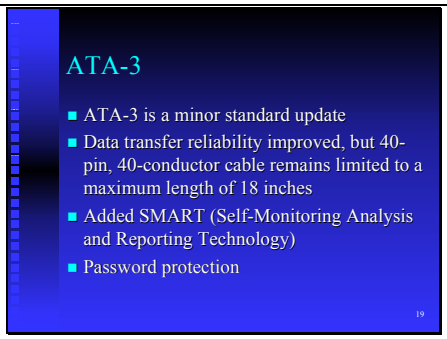


The ATA-2 standard uses the enhanced support to add two new PIO modes and two DMA modes. PIO mode 3 allows data transfer rates of 11.1 megabytes per second. PIO mode 4 allows data transfer rates of 16.7 megabytes per second.

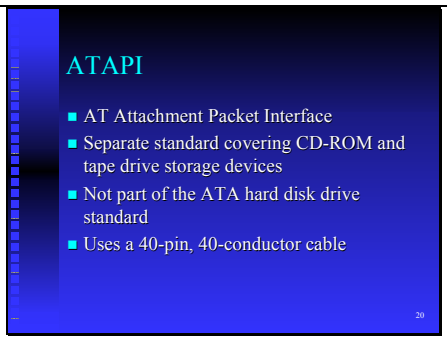
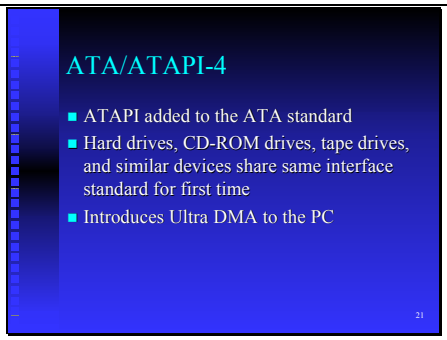
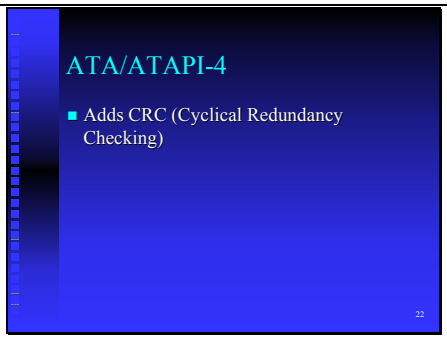
DMA mode 1 allows data transfer rates of 13.3 megabytes per second. DMA mode 2 allows data transfer rates of 16.7 megabytes per second.

Although ATA-2 continues to support the legacy ATA data transfer modes, there is one exception. Single-word transfers in DMA mode 0 are no longer supported. From here on, all DMA transfers are multiword transfers.

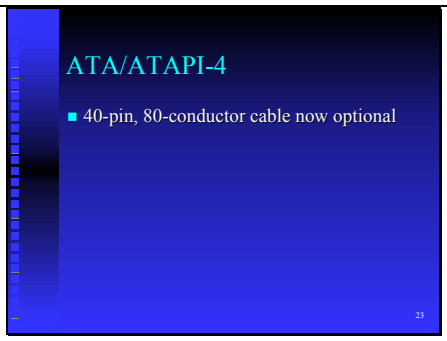
Slide 19



ATA-3 is considered a minor standard update. There are several interface circuit changes to improve the reliability of the data transfer, but the 40-pin, 40-conductor cable remains limited to a maximum of 18 inches. You will find computer builders who use longer cables, but data reliability is dramatically affected. Another internal change that goes a long way toward improving data reliability is called SMART. That stands for *Self-Monitoring Analysis and Reporting Technology*. When enabled, the control circuits on the drive continually monitor internal drive functions. These include, the space between the flying read/write head above platter, the number or remapped data sectors, read/write errors, temperature, etc. If any of these, and other, characteristics exceed preset boundaries, the drive issues a SMART warning. At this point, nothing has failed, but the potential is real, and the timing is soon. A drive manufacturer will replace a drive that generates a SMART warning, if the drive is within its warranty period. Password protection is provided through the System BIOS, rather than on the drive itself.

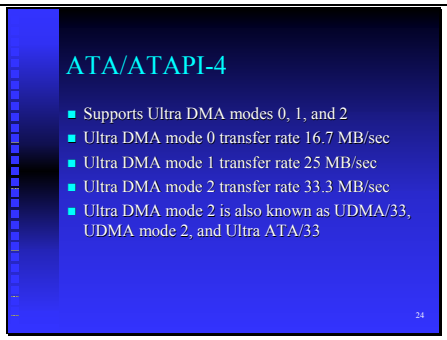
Slide 20		The AT Attachment Packet Interface, better known as ATAPI is an ANSI standard. The standard covers how CD-ROM and tape drive storage devices interface to the computer. The ATAPI standard, as it was conceived and written, was completely separate from the ATA hard disk drive standard. However, like the hard disk drive standard, it generally uses a 40-pin, 40-conductor cable.
Slide 21		Beginning with the fourth ATA standard revision, ATAPI is made part of the standard. That means that hard drives, CD-ROM drives, tape drives, and similar devices share the same interface standard for the first time. The new transfer scheme, Ultra DMA, is similar to DMA in function, except the DMA controller that performs the data transfer is now part of the drive interface. As a result, DMA and PIO are now considered legacy data transfer modes.
Slide 22		A part of the Ultra DMA data exchange is a process called Cyclical Redundancy Checking, or CRC. Each time a block of data is moved, the source calculates a value that represents the contents of the data, and adds that value to the data. When the data is received, a similar calculation is made and compared to the attached CRC value. If the values match, the data is accepted. If the values don't match, the source is asked to retransmit the data.

Slide 23



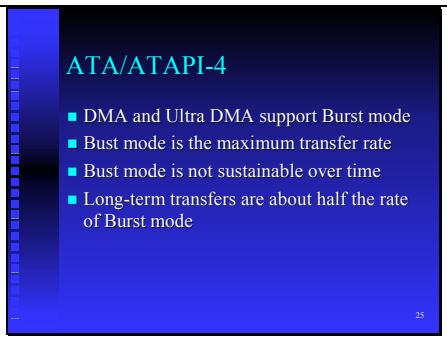
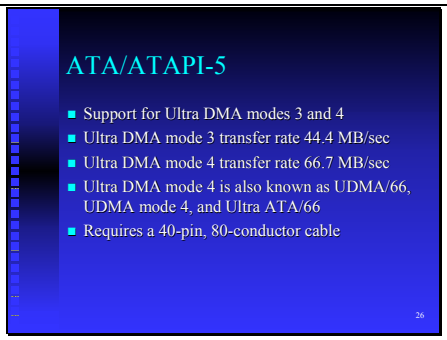
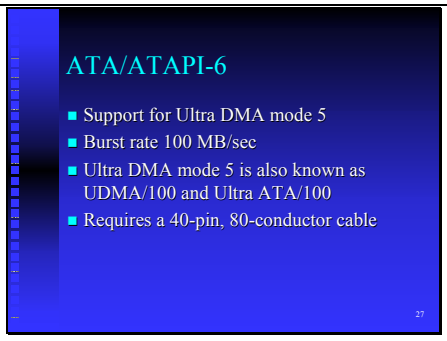
During development of the standard, the 40-pin, 40-conductor cable was converted to a 40-pin, 80-conductor cable. You may be curious as to how a 40-pin cable can have 80 conductors. Each of the 40 conductors that are connected to pins are separated by grounded conductors. The grounded conductors connected to the common ground pins. This helps cable noise immunity, and still allows backward compatibility with a 40-conductor cable. As part of the ATA/ATAPI-4 standard, the 80-conductor cable is an option that may only be needed in those systems that suffer from excessive electrical noise.

Slide 24

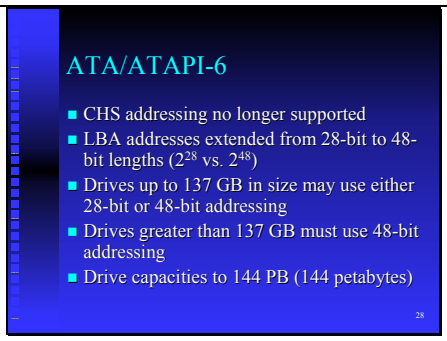


The ATA/ATAPI standard actually supports three different Ultra DMA modes. Mode 0 allows transfer rates up to 16.7 megabytes per second. Mode 1 allows transfer rates up to 25 megabytes per second. And, mode 2 allows transfer rates up to 33.3 megabytes per second. Of the three, mode 2 was the most popular because everyone loves speed. And that's also why mode 2 is the only mode to have acquired so many other names to describe the mode. The most popular appear to be UDMA/33, UDMA mode 2, and Ultra ATA/33.

Both DMA and Ultra DMA are able to support high transfer rates because they are able to move large blocks of data over very short periods of time. We call this process "burst mode." The burst mode transfer rate is the maximum rate a DMA mode can sustain. For example, Ultra DMA 2 has a burst mode rating of 33.3 megabytes per second. Measured over time, each DMA and Ultra DMA mode is able move data at about one-half its burst rate. The actual transfer rate is affected by how the data is presented to the DMA controller and how the data is stored.

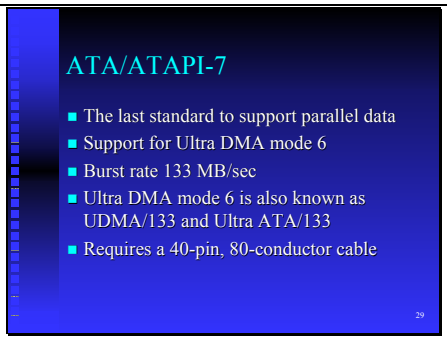
Slide 25		One final point, before we move on. Both DMA and Ultra DMA are able to support high transfer rates because they are able to move large blocks of data over very short periods of time. We call this process "burst mode." The burst mode transfer rate is the maximum rate a DMA mode can sustain. For example, Ultra DMA 2 has a burst mode rating of 33.3 megabytes per second. Measured over time, each DMA and Ultra DMA mode is able move data at about one-half its burst rate. The actual transfer rate is affected by how the data is presented to the DMA controller and how the data is stored.
Slide 26		Picking up where the previous standard ended, ATA/ATAPI-5 adds two more Ultra DMA modes. Ultra DMA mode 3 has a burst rate of 44.4 megabytes per second. Ultra DMA mode 4 has a burst rate of 66.7 megabytes per second. The more popular Ultra DMA mode 4 is also known as UDMA/66, UDMA mode 4, and Ultra ATA/66. That 40-pin, 80-conductor cable that was optional before is now required to maintain an acceptable data error rate. If a 40-conductor cable is used instead of the 80-conductor, the drive interface will recognize the substitution and limit the data burst rate to 33.3 megabytes per second.
Slide 27		The ATA/ATAPI-6 standard adds one more data transfer mode, Ultra DMA mode 5. That mode has a data burst rate of 100 megabytes per second. Generally, the mode is known as UDMA/100 or Ultra ATA/100. As before, the 40-pin, 80-conductor cable must be used. If it is not, the drive is only allowed a data burst rate of 33.3 megabytes per second.

Slide 28



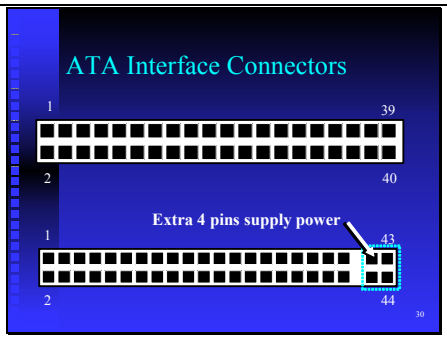
The ATA/ATAPI-6 standard no longer supports the legacy addressing mode CHS. In addition, it extends the maximum drive capacity that can be addressed by adding 20 more bits to the LBA address. With a 28-bit address you may address up to 137 gigabytes of data. With a 48-bit address, it is possible to address up to 144 petabytes of data. That's 144 times 10 to the fifteenth power. By comparison, 137 gigabytes is 137 times 10 to the ninth power. Naturally, the BIOS and operating system must also support 48-bit addressing, or you will never get past 137 gigabytes, regardless of drive capacity.

Slide 29

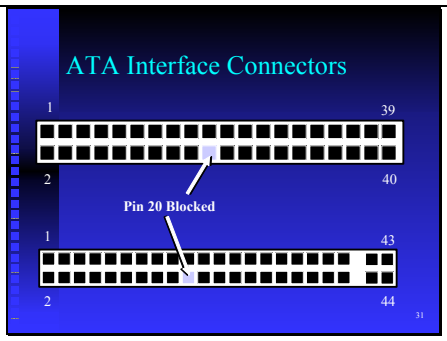
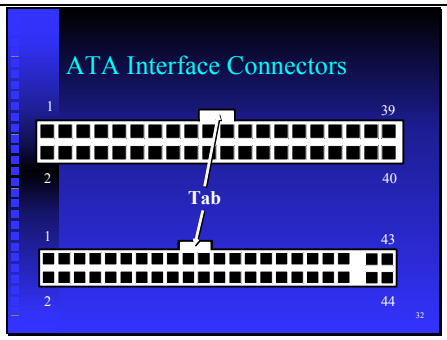
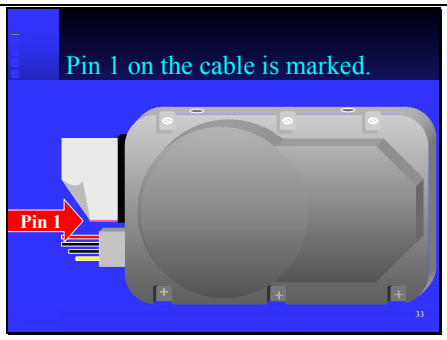
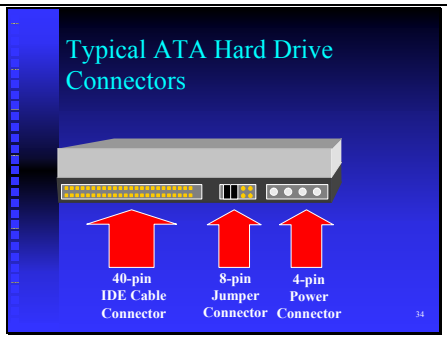


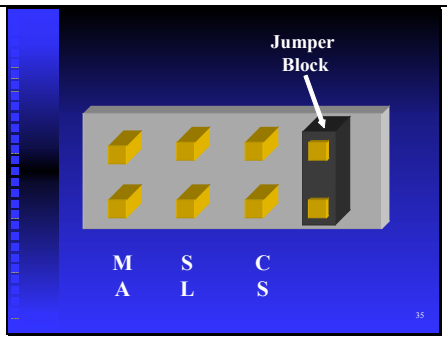
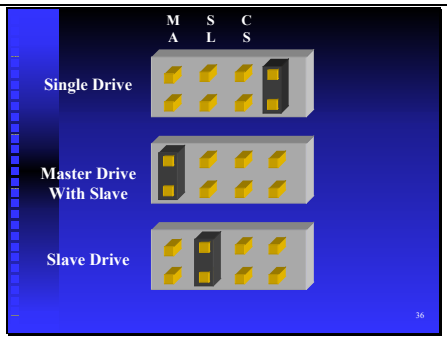
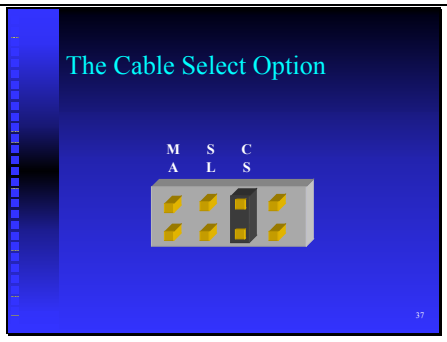
ATA/ATAPI-7 is the last ANSI standard to support parallel data transfers. It's only claim to fame is the adoption of Ultra DMA mode 6. This allows for data burst rates of up to 133 megabytes per second. As with earlier Ultra DMA modes, mode 6 long-term data rates fall off to around half the burst rate. Generally, mode 6 is known as UDMA/133 or Ultra ATA/133. And as before, the 40-pin, 80-conductor cable must be used. If it is not, the drive is only allowed a data burst rate of 33.3 megabytes per second.

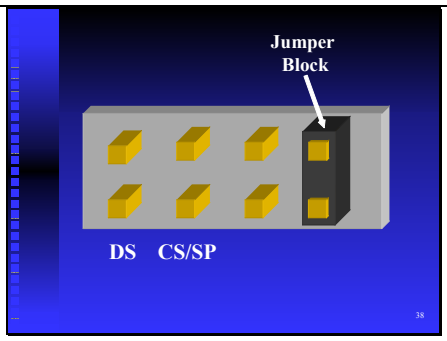
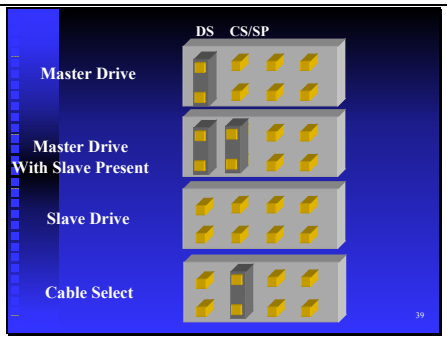
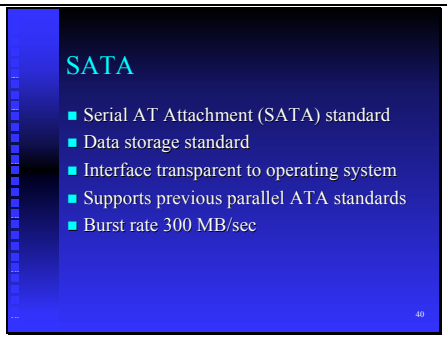
Slide 30

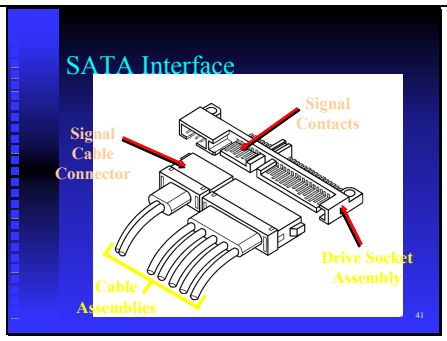
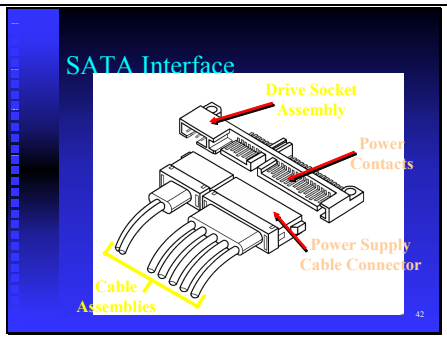
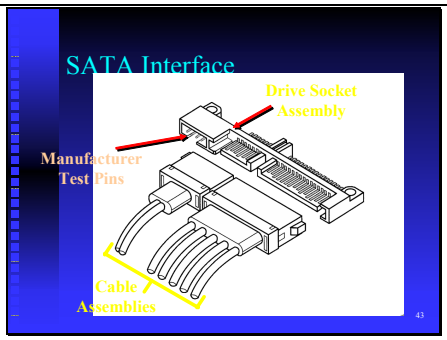


There are two versions of the ATA connector. The most common is shown at the top. It is the 40-pin ribbon cable connector used in most desktop PCs. The less familiar 44-pin version is shown at the bottom. While this connector is about 14% smaller than the 40-pin connector, it is pin-for-pin identical to the 40-pin, except for the extra 4-pins numbered 41 through 44 on its end. The purpose of those extra pins is to supply power to the disk drive. That is, these pins replace the separate power connector that is normally used with the 40-pin version. As you might imagine, the 44-pin connector is used in situations where space is at a premium, such as in portable and laptop devices.

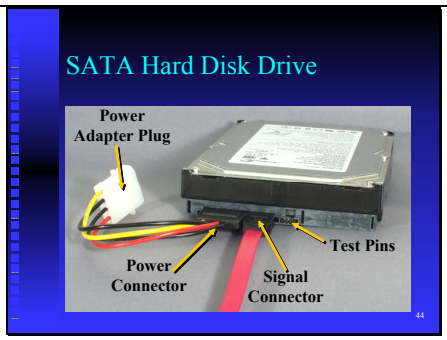
Slide 31		Whichever type is used, some method is often provided to prevent the possibility of reversing the connector. Frequently, pin 20 is used as a key, as shown here. On the cable connector, hole 20 is blocked so that it cannot receive a pin. The drive connector has pin 20 missing so that it does not interfere with the blocked hole. This allows the cable to be plugged into the drive in only one direction.
Slide 32		Another common method of keying the cable is shown here. The tab at the top of the connector matches up with a hole in the drive connector shell in such a way that the cable cannot be plugged in backward.
Slide 33		As one final precaution, pin1 on the cable is identified with a red or blue stripe as shown here.
Slide 34		On the ATA hard drive itself, you are likely to see the following connectors and jumpers. The 40-pin IDE cable connects to one side; the 4-pin power cable connects to the other. In between is an 8-pin jumper connector that is used to tell the controller whether the drive is a master or a slave. This jumper configuration varies from one drive type to another, so you should consult the documentation provided with the drive to determine the proper jumper settings. Often a jumper setting diagram is included right on the hard drive label. Let's take a look at a couple of typical jumper settings.

Slide 35		A typical situation is shown here. Three of the four pairs of pins are labeled. MA stands for master; SL stands for slave; and CS stands for cable select. The final pair of pins may be unlabelled and is often used simply as a holding place for an unused jumper block.
Slide 36		Here are some typical jumper settings. If this is the only drive on the cable, you will leave the jumper block parked in the unused position, as shown at the top. If this drive is to be a master and there is a slave also attached to the cable, the jumper block is placed on the MA pair, as shown in the middle. Finally, if this drive is to be a slave, the jumper block is placed on the SL pair, as shown at the bottom. Since these are the only three situations you are likely to encounter, you may be wondering what the CS pair of pins is for. Let's take a look.
Slide 37		It turns out that some systems use a different method of selecting whether the drive is to be a master or a slave. On these systems, pin 28 carries a Cable Select (CSEL) signal which can automatically control which drive is the master and which is the slave. Placing the jumper on the CS pins allows the signal on pin 28 to control the designation. This system is by no means universal, so (if possible) you should refer to the jumper diagram on the drive or in the documentation. Also, the labeling of the jumpers is not always so straightforward. Let's take a look at another fairly common convention.

Slide 38		Here, one pair of pins is labeled DS, probably for *Drive Select*. The other is labeled CS/SP, for *Cable Select/Slave Present*. The unlabeled pairs are not used or are used simply as holders for the unused jumper blocks. With only two active jumper pairs, the various configurations can be confusing. Let's take a look.
Slide 39		Here are the typical jumper settings. If this is the only drive on the cable, it is by default a master, and the jumper block is placed on the DS pair, as shown at the top. If this drive is a master and there is a slave also attached to the cable, two jumper blocks are used. If this drive is a slave, the jumper block is left off entirely (or placed on one of the unused pairs). Finally for the cable select (CSEL) situation described earlier, placing the jumper block on the CS/SP pins allows the signal on pin 28 to control the designation of master or slave. While this is typical, it is by no means universal, so refer to the documentation when setting drive jumpers.
Slide 40		The Serial AT Attachment, or SATA, is the latest ANSI hard disk drive interface standard. The standard covers how data storage devices interface to the computer. SATA is a hardware standard. For that reason, the interface is transparent to the operating system. That is, the operating system communicates with a Serial ATA device just like it would with any parallel ATA storage device. At this time the SATA standard supports a maximum burst rate of 300 megabytes per second. Prior to the introduction of the 865 and 875 Intel chipsets the only way to interface with an SATA device was through a controller on an external PCI card. That imposed a bus-limited data transfer rate of 66 megabytes per second. Now that the SATA interface is part of the motherboard controller, the full burst rate may be achieved.

Slide 41		The SATA interface connectors are very different from the typical ATA connectors. There are two cables, the signal cable and the power supply cable. The signal cable uses a twisted pair of conductors for the transmit signal and a second twisted-pair for the receive signal. Each wire pair use low-voltage differential amplifiers for improved noise rejection and longer cable lengths. I'll give you a detailed explanation of differential and single-ended signaling in a late presentation. All together there are seven contacts within the signal connector—two each for the receive and transmit differential signals and three for the various cable shield grounds. These are shown on the "drive socket assembly."
Slide 42		The power supply cable has 15 connectors. There are three for 3.3-volt power, three for 5-volt power, and three for 12-volt power. Five of the remaining connectors supply ground. The 15th connector, pin 11, is reserved for future use, and grounded at this time. You may be able to see in the socket assembly that the signal and power contacts are different lengths. These allow you to "hot-swap" a drive without causing irreparable damage. That is, they make it possible to remove a defective drive and install a replacement without switching-off power to the drive or the computer.
Slide 43		Finally, note that there are no jumper blocks to configure on an SATA drive. Those "manufacturer test pins" shown on the left side of the socket assembly, are simply that—a way to test a drive during manufacture. They are not used to program the operation of the drive, and you may not find them on every SATA drive.

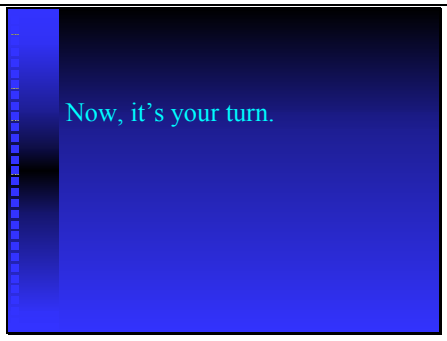
Slide 44



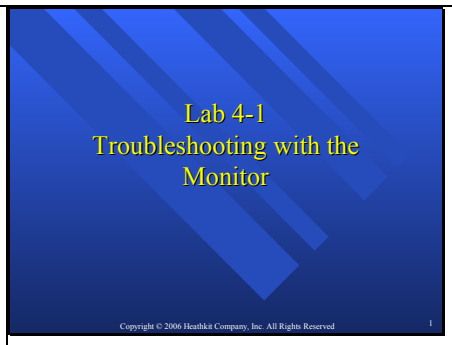
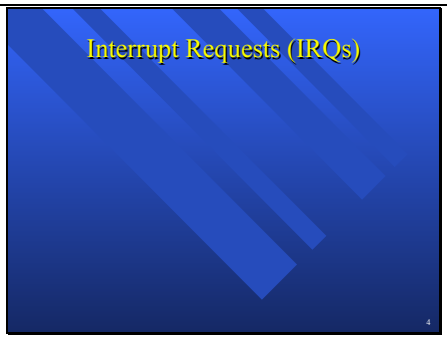
Here is an example of an SATA drive with its cables connected. The power supply cable on this drive has an adapter that allows you to plug the drive into a common power supply drive connector. Did you notice that like every other ATA drive, this drive does not use 3.3-volt power? The SATA power connector was designed to accommodate 3.3-volt power, but it is not being used at this time.

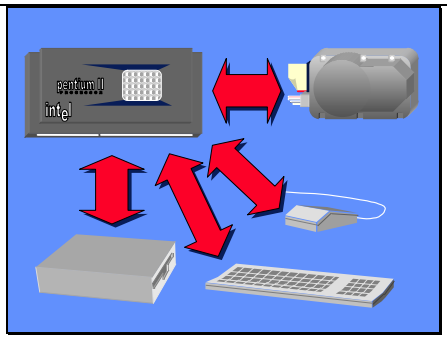
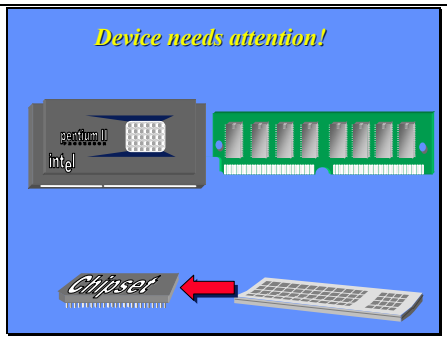
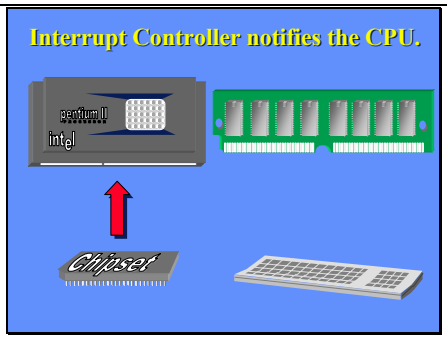
The signal cable on an SATA drive is one of its best features. The cable a whole lot narrower than the usual 40- or 80-conductor ATA signal cable. That makes it much easier to route inside the computer case; and because it is so narrow, it allows better air circulation for improved cooling. Recall that in addition to being very wide, the ATA parallel cable is also very short—no more than 18 inches. The SATA cable, on the other hand, can be up to one meter in length. And finally, you don't have to be concerned about properly connecting and programming an SATA drive. There are only two connectors on the signal cable, and they are identical. One plugs into the drive, the other into the motherboard host connector, and there are no configuration jumpers to ponder over.

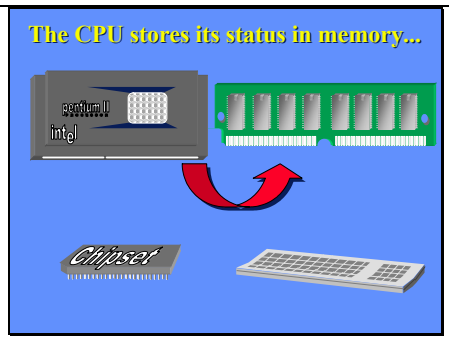
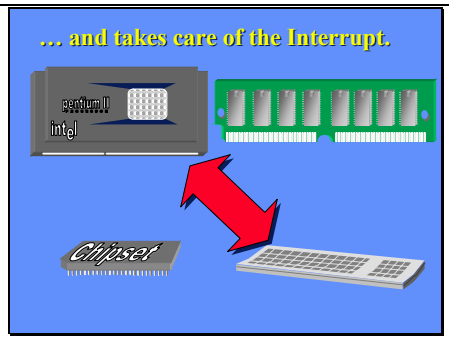
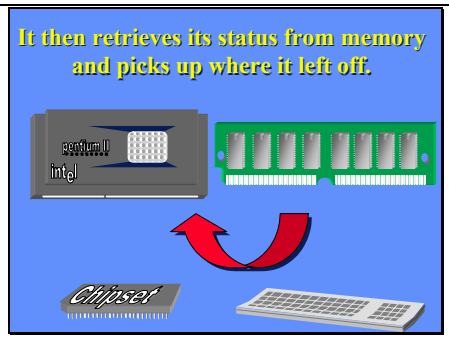
Slide 45



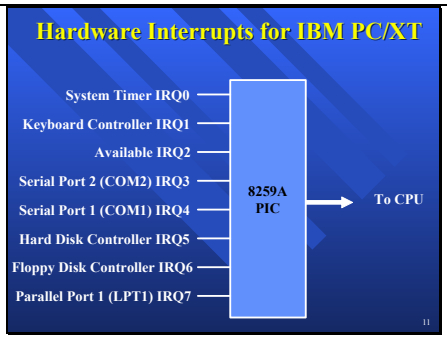
While you won't be installing an SATA drive in this lab, you can look forward to seeing a lot of them in the future, they are fast becoming the next PC standard.

Slide 1		Today's presentation is about system resources and the Plug and Play capability of the modern PC. You will see that it has made the configuration of the PC a nearly hands-off operation. But, you will also learn that "PnP" has added another level of complexity to PC servicing and troubleshooting.
Slide 2		*Systems Resources* refer to several areas of the computer that are used by internal and external devices attached to the computer. If these resources are not allocated properly they can become a serious source of problems.
Slide 3		The system resources that can have finite size and capabilities include those listed here. Let's take a look at each type of resource.
Slide 4		The resource conflict that you will hear most about involves hardware interrupt requests or IRQs. An interrupt request is the way that a hardware device signals the motherboard that it, the device, needs attention. It's roughly the computer equivalent of a student raising his hand in class.

Slide 5		In the personal computer there are a great many devices that require the CPU's attention from time to time. Some of the more obvious ones are shown here. These include the keyboard, the mouse, the floppy drive, and the hard drive. But, there are less obvious ones as well, including the serial and parallel ports, the real time clock, and even the math coprocessor inside the CPU core.
Slide 6		To see how an interrupt request works, let's consider an example. One of the things that makes the personal computer "personal" is its trait of dropping whatever it is doing and turning its attention to the keyboard the instant we depress a key. The sequence of events works something like this. When we depress a key, the keyboard controller on the motherboard alerts a device called the interrupt controller in the Chipset. The interrupt controller monitors up to 15 different hardware devices and assigns each a level of priority. The keyboard is given a very high priority, second only to the system timer on the motherboard.
Slide 7		The interrupt controller alerts the CPU that one of the devices needs attention.

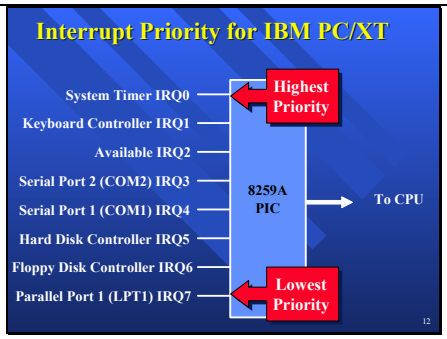
Slide 8		The CPU now realizes that it must stop whatever it is presently doing and attend to the device that generated the interrupt. In order to resume its current task when finished with the interrupt, the CPU stores its status in memory. Its "status" includes the contents of all its registers, including the address of the next instruction to be executed.
Slide 9		Next, the CPU determines which device issued the interrupt. Finally, it attends to that device.
Slide 10		Once the CPU has finished servicing the device that generated the interrupt, it retrieves its status information from memory and picks up exactly were it left off with its original task.

Slide 11



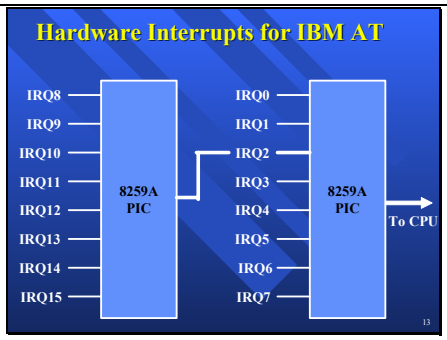
The interrupt structure used in the modern personal computer has its roots in the distant past. Its evolution makes its current structure somewhat easier to understand. Like most things in the personal computer, it all started with the early IBM models that we talked about in a prior presentation. The earliest models of the IBM PC had only eight interrupts. An off-the-shelf IC called an 8259A Programmable Interrupt Controller handled them. Seven of the interrupts were taken up by devices common to most PCs in those days: the system timer, the keyboard controller, the two serial ports, the hard disk controller, the floppy disk controller, and the parallel port. This left only one interrupt, number 2, available for all other purposes.

Slide 12

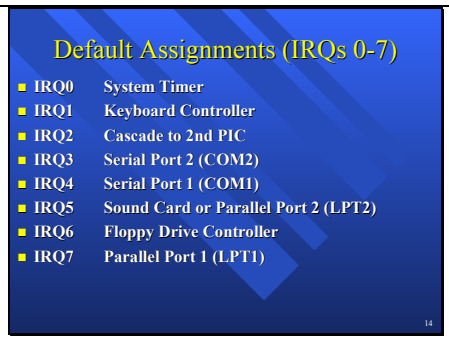
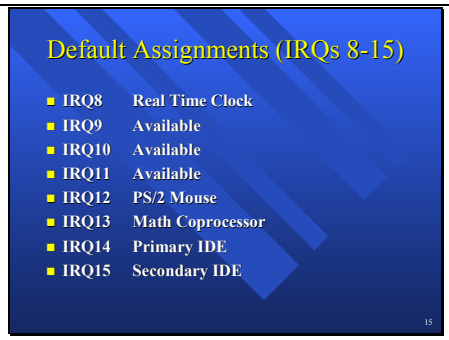
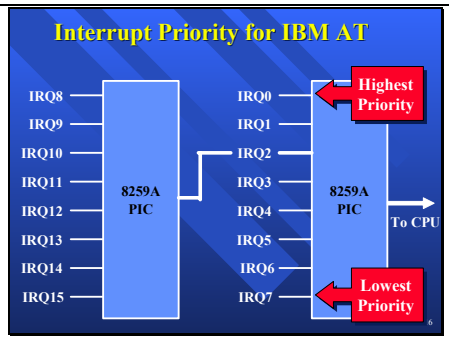


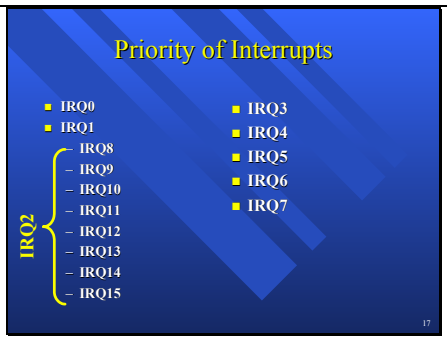
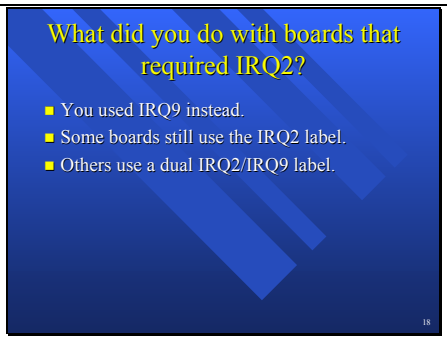
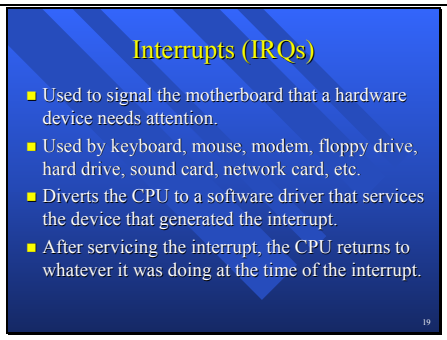
The interrupts were prioritized according to their number, with IRQ 0 having the highest priority and IRQ 7 having the lowest. Thus, the keyboard controller had priority over everything except the system timer. COM2 had priority over COM1, and so forth.

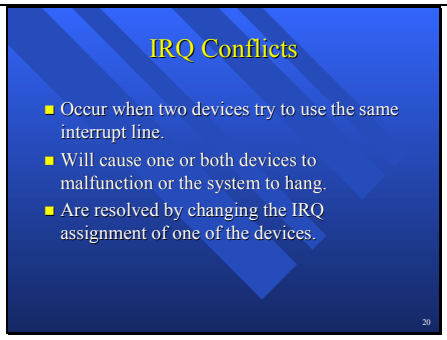
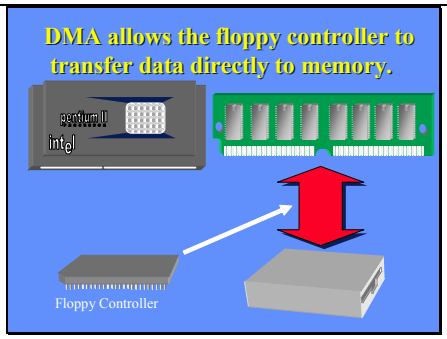
Slide 13

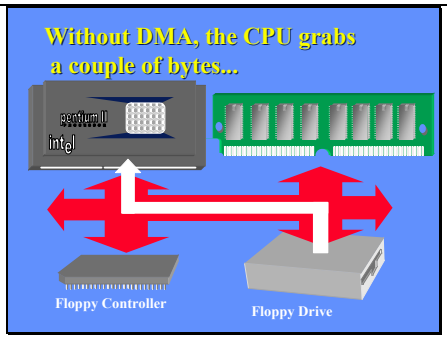
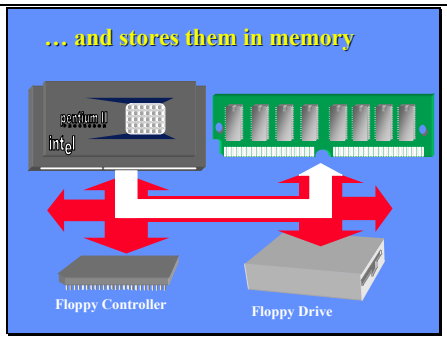
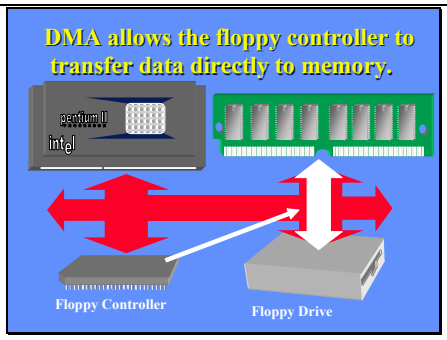
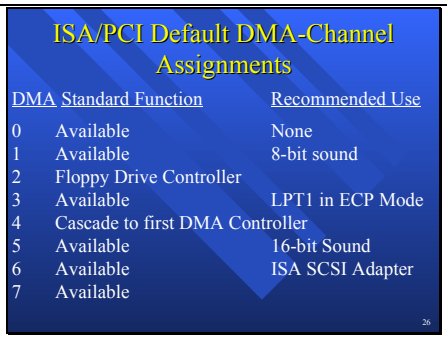


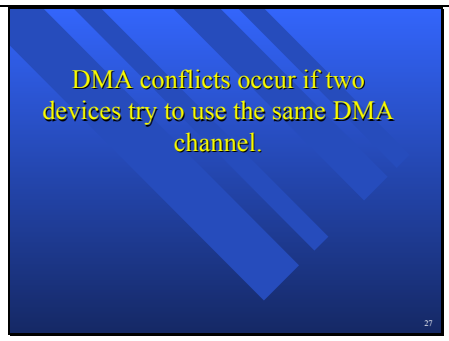
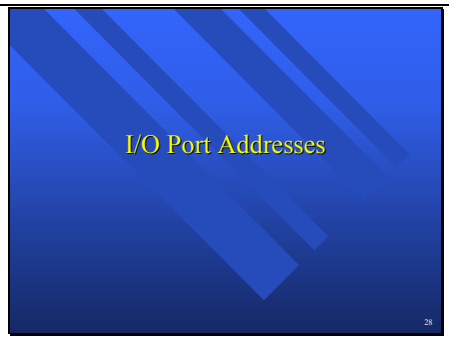
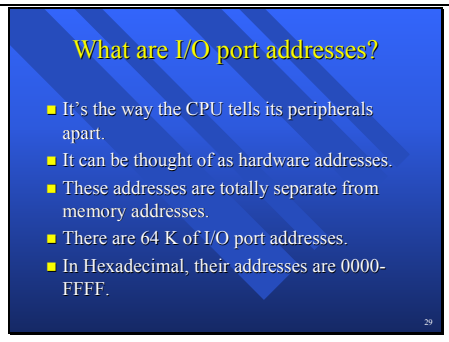
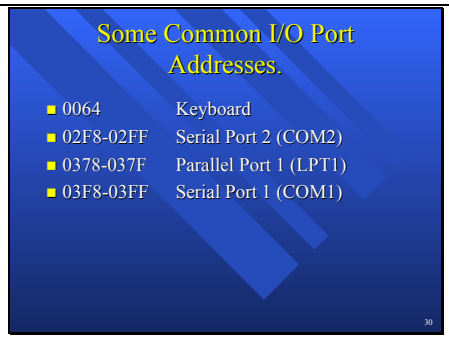
When IBM introduced the AT-model personal computer, the interrupt structure was expanded. A second 8259A was added. However, it had to somehow connect to the same CPU interrupt line as the existing Interrupt Controller. The way this problem was solved still haunts us today. The output of the second Interrupt Controller was connected to the available input of the first Interrupt Controller, as shown here. This eliminated IRQ 2 but added IRQs 8 through 15. That is, the number of usable IRQs increased from 8 to 15. This structure still exists today in PCs, although the two controllers have long since ceased to exist as separate ICs. Today they are buried deep inside the chipset.

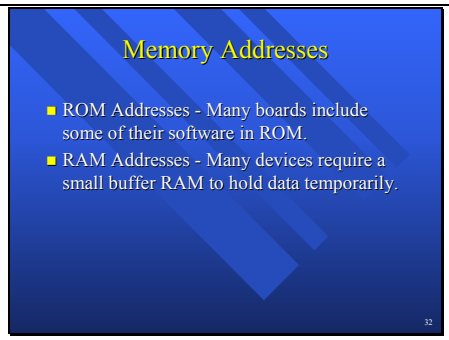
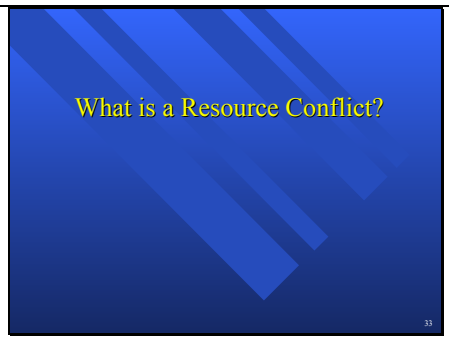
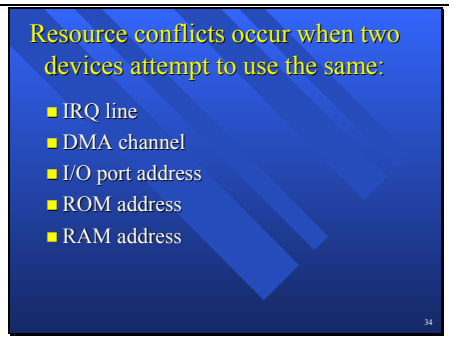
Slide 14		The default assignments of IRQs 0 through 7 are much as they were in the original IBM Models, with two exceptions. IRQ 2 is not available because it is cascaded to the output of the second Interrupt Controller. The interrupt for the hard drive controller was moved to the second Interrupt Controller, freeing IRQ 5 to be used by a sound card, a second parallel port, or some other function.
Slide 15		The default assignments for IRQs 8 through 15 are shown here. The real time clock uses IRQ 8. The PS/2 mouse uses IRQ 12. Even though it is inside the Pentium core, the math coprocessor uses IRQ 13, just as it did when it was a separate IC on the motherboard. The primary IDE controller uses IRQ 14. This controller can handle two hard drives, or a hard drive and a CD-ROM drive. The secondary IDE Controller uses IRQ 15. Like the primary IDE controller, it can handle two hard drives, or a hard drive and a CD-ROM drive. This leaves IRQs 9, 10, and 11 available for other purposes, such as network cards, SCSI controllers, Universal Serial Bus Devices, etc.
Slide 16		By cascading the second Interrupt Controller into IRQ 2, an interesting thing happened to the priority. Notice that IRQ 0 still has the highest priority and IRQ 7 still has the lowest. However, IRQs 8 through 15 now take over the priority formerly enjoyed by the no-longer available IRQ 2.

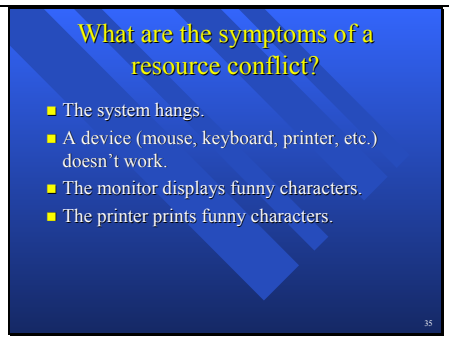
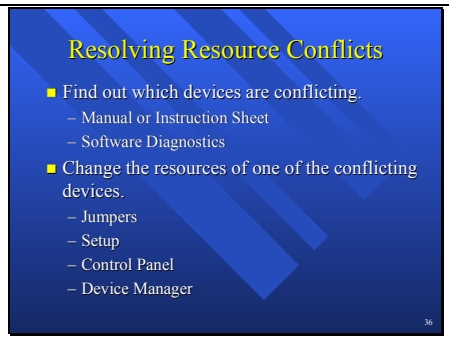
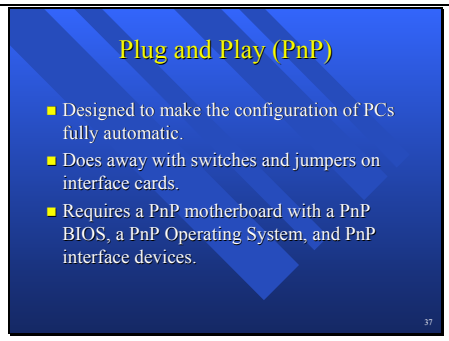
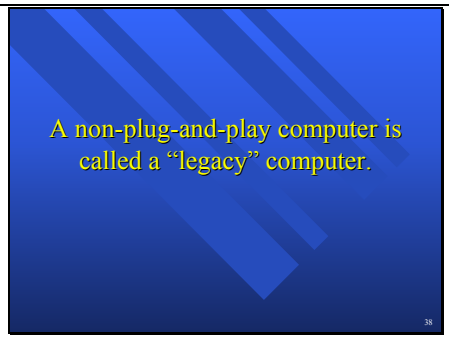
Slide 17		So the overall priority scheme looks like this. Notice that there is a break in the rule that states that lower numbers have higher priority. The rule is still true for IRQs 0 through 7 and for IRQs 8 through 15. However, IRQs 8 through 15 all have a higher priority than IRQ 3, but lower than IRQ 1. While this arrangement seems strange, it did allow AT-class computers to be "backward compatible" with the earlier and more primitive XT-class computers.
Slide 18		This new arrangement raised one other complication. With IRQ 2 no longer available, what happened to all those cards that had used IRQ 2 in the older design. There were millions of these cards because IRQ 2 was the only interrupt available for expansion purposes in the older design. To accommodate these older cards, the AT-class computers are designed so that IRQ 9 can be substituted for IRQ 2. So if you ever see a card that "requires" IRQ 2, use IRQ 9 instead.
Slide 19		Okay, let's quickly review. Interrupts are used to signal the motherboard that a device needs attention. By "device," we mean such things as the keyboard, mouse, modem, floppy drive, hard drive, sound card, network card, etc. The interrupt diverts the CPU from whatever it is doing to a special service routine or software driver that takes care of the device that generated the interrupt. Once the interrupt has been serviced, the CPU picks up where it left off before the interrupt occurred.

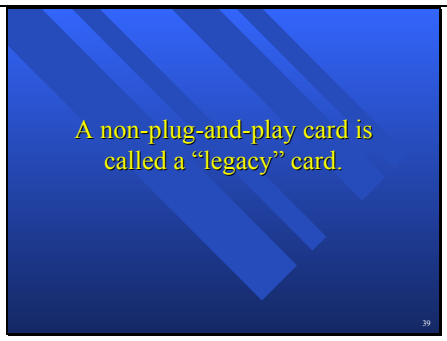
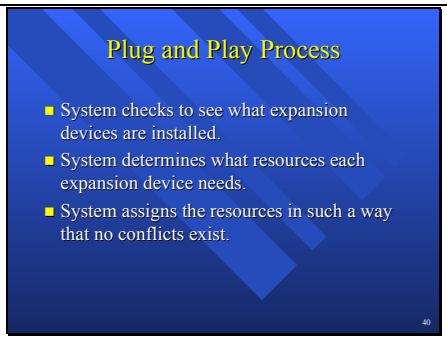
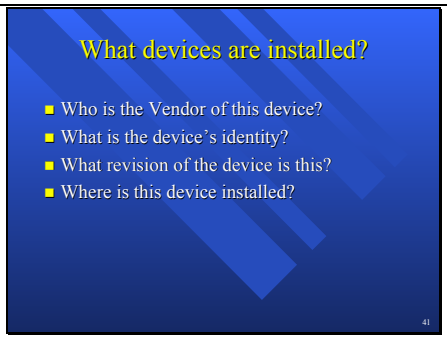
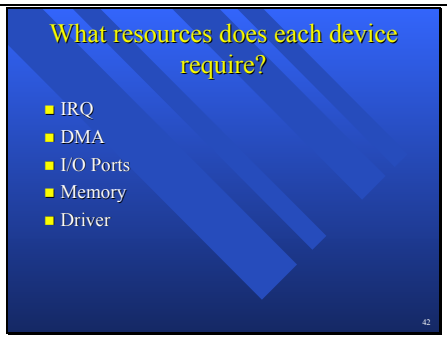
Slide 20		A common problem with computers is an IRQ conflict. A conflict occurs when two devices attempt to use the same IRQ line. Let's suppose that we inadvertently assign IRQ 5 to both the sound card and the printer. The interrupt service routine for the sound card is entirely different from the service routine for the printer. When an interrupt occurs on IRQ 5, the computer may not know which service routine to use or it may use the wrong service routine. This may cause one or both of the devices to fail or it may cause the system to hang up. This problem is resolved by reassigning one of the devices a different and unused IRQ. On the sound card, this may be done by a jumper, or by a SETUP routine provided with the sound card. Or, as you will see later, operating systems such as Windows give us an easy method of changing the printer's IRQ.
Slide 21		Interrupts are not the only resource that can cause conflicts. Direct Memory Access (DMA) channels may cause similar problems. Let's take a brief look at how Direct Memory Access works.
Slide 22		DMA is a technique that allows a controller in the chipset to transfer data from certain devices to memory and back again. Only a few devices, such as the floppy drive and the sound card, require DMA. Here, for example, we see a floppy drive controller transferring data back and forth between memory and the floppy drive. To see why DMA is important, consider what would have to happen without it.

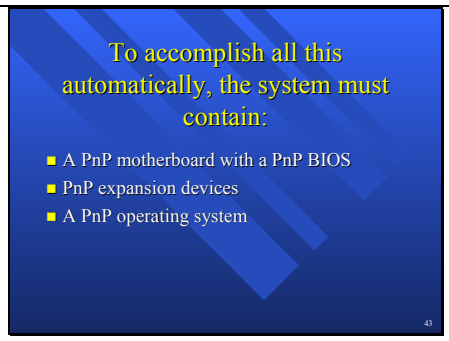
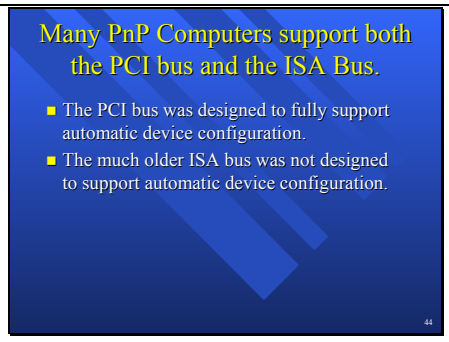
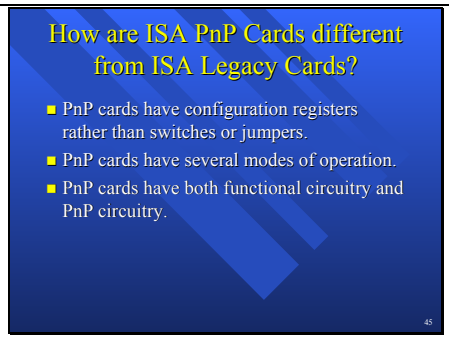
Slide 23		Without DMA, the CPU itself would grab a few bytes at a time from the floppy…
Slide 24		…and then store them in memory. Obviously, this would take up valuable CPU time and slow down the overall system.
Slide 25		A much better arrangement is to allow the floppy controller to handle such mundane data transfers, leaving the CPU free to handle more important tasks. Of course, the floppy drive is not the only device that can take advantage of DMA. The sound card, the parallel port, and SCSI adapters may also use this technique.
Slide 26		The problem is there are a limited number of DMA channels and, as with interrupts, they must be uniquely assigned. The DMA channels are labeled 0 through 7 as shown here. Channel 2 is reserved for the floppy drive controller. Channel 4 is not available because it is cascaded to a second DMA controller in much the same way that IRQ2 was cascaded to a second Interrupt Controller. Although not cast in stone, sound cards often uses both channels 1 and 5. Other "recommended" uses are shown.

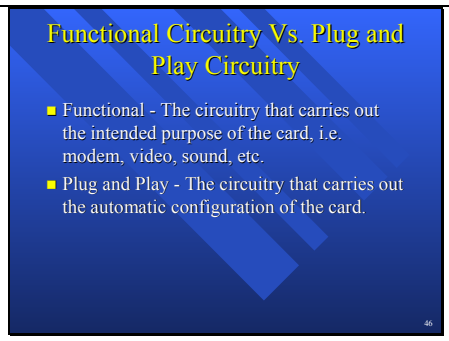
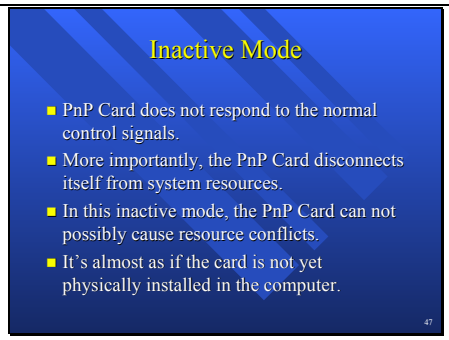
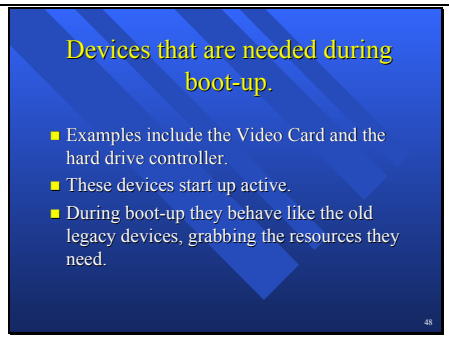
Slide 27		Generally, there are more than enough DMA channels to go around. However, conflicts will arise if two devices are assigned the same DMA channel. Once again, the solution is to sort things out and assign a unique DMA channel to each device that requires one.
Slide 28		Another area of possible resource conflict is with I/O port addresses.
Slide 29		An I/O port address is the way a CPU tells its peripherals apart. It can be thought of as a hardware address for each device attached to the CPU. It is important to realize that I/O port addresses are totally separate from memory addresses. There are 64 K of I/O port addresses ranging from hexadecimal address 0000 to FFFF.
Slide 30		For example, some common I/O port addresses are shown here. Notice that most devices have a small band of I/O port addresses. Even so, with so many addresses available, one would think that conflict would be rare. However, they do happen. And when they do, they must be resolved by assigning each device a unique address or a unique range of addresses.

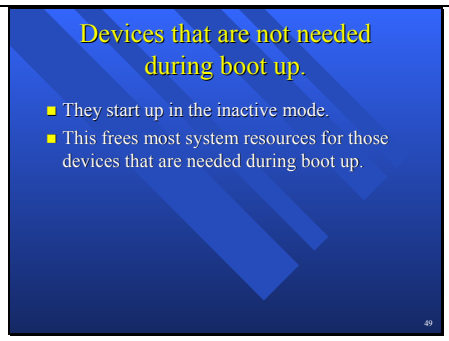
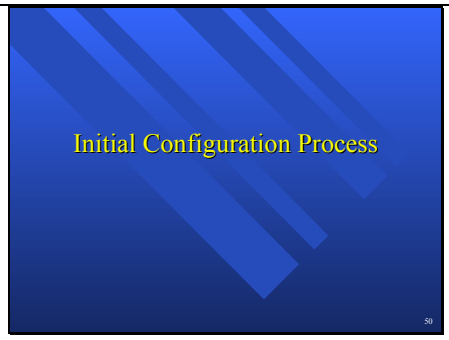
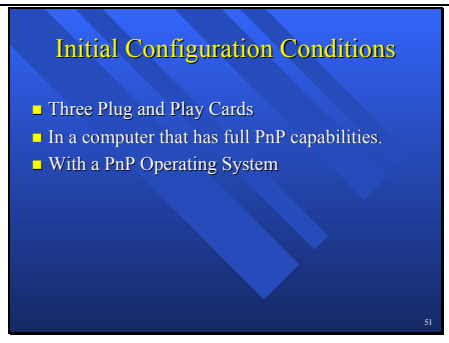
Slide 31		The final resource that can cause conflicts is the memory address.
Slide 32		These fall into two broad categories: ROM and RAM. Many boards include some of their software in a ROM on the board itself. This small additional ROM must be given a unique memory address to integrate seamlessly with the system. Also, many cards require a small block of RAM to serve as a buffer. Here too, unique addresses are required. If a card or other device is given a ROM or RAM address that is already in use, a resource conflict will arise. You will learn more about this in future exercises.
Slide 33		Let's briefly recap today's presentation. It has been all about resource conflicts. What is a resource conflict?
Slide 34		A resource conflict occurs when two devices attempt to share the same IRQ line, DMA channel, I/O port address, or memory address.

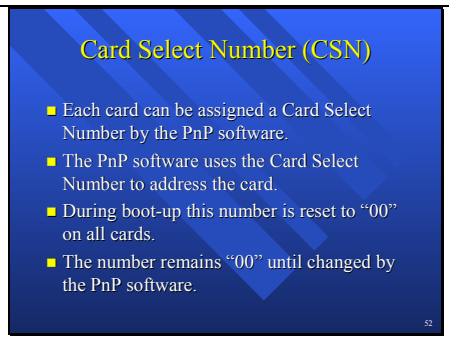
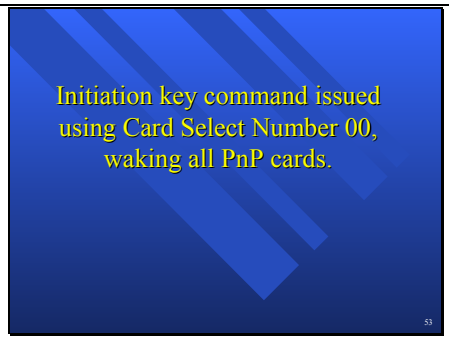
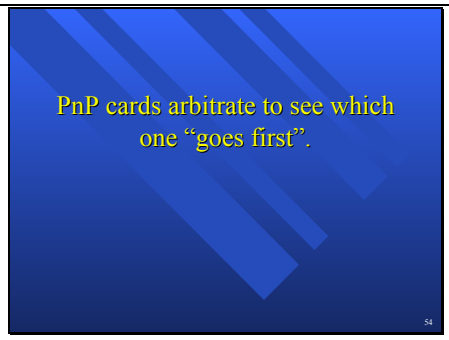
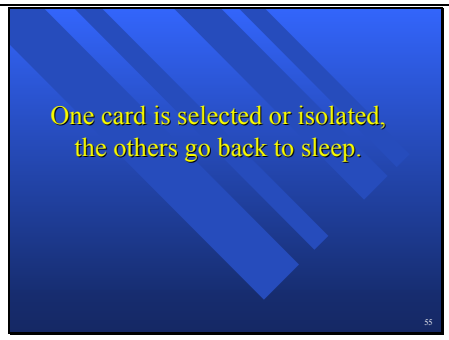
Slide 35		The symptoms of a resource conflict are these: The system hangs up. A device just doesn't work properly. The monitor displays funny characters. Or, the printer prints strange or garbled characters. Unfortunately, these are also symptoms of a virus. So it is a good idea to run a virus checker before you start playing around with resource assignments.
Slide 36		Once you have determined that the problem is indeed a resource conflict, you must identify which resources are being shared. You may be able to do this by checking the manuals that came with the various cards and the motherboard. Also, there is diagnostic software available that may help. You will study some examples of diagnostic software later in this course. Once you have identified the conflicting resources, you must change them. Depending on the situation, this may be done with jumpers, or by a SETUP routine provided with the board, in the Control Panel or in the Device Manager.
Slide 37		Plug and play, which is often abbreviated PnP, was designed to make the configuration of PCs fully automatic. And even today, it does this to a large degree provided that the PC has a PnP motherboard with a PnP BIOS; that it uses a PnP operating system like Windows 95 or Windows 98; and that it uses only PnP devices. Therein lies the problem. Until the world completes the transition to plug and play, there will be both *plug and play* and *non plug and play* computers, operating systems, and interface cards.
Slide 38		Incidentally, a non plug and play computer is called a *legacy* computer.

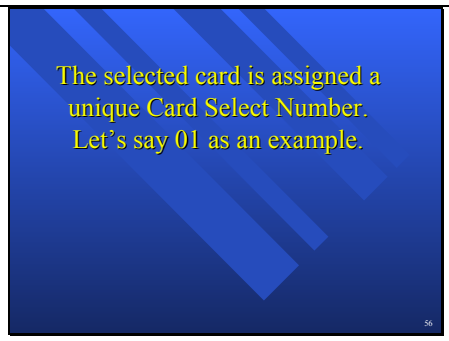
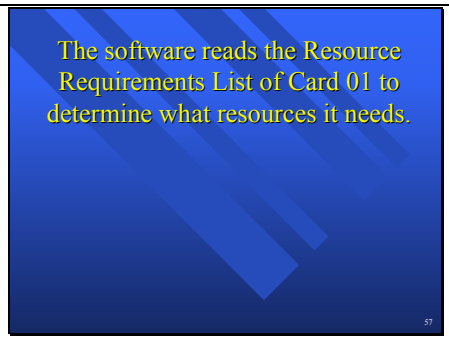
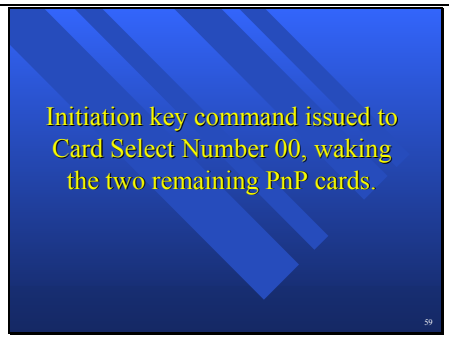
Slide 39		And non plug and play boards are called *legacy* boards. The mixture of plug and play and legacy equipment that is presently in use has complicated the situation, not simplified it. But for the moment let's ignore the complication of mixing plug and play and legacy equipment and discuss how a true plug and play system works.
Slide 40		Reduced to its most basic form, the plug and play process looks like this. Each time the computer is turned on, the system checks to see what expansion devices are installed and what resources each expansion device needs. Once this is determined, the system assigns the resources in such a way that no conflicts exist.
Slide 41		To do this automatically and accurately, the system must know a great deal about each of the installed devices. It must get this information from the devices themselves. Here are some of the things it needs to know. The first three pieces of information are read from information coded in the PnP devices. The system figures out the final piece of information using a process that will be discussed later in this presentation.
Slide 42		The system not only figures out the normal resources (Interrupts, DMAs, I/O Ports, and memory assignments); but it also automatically loads the right driver for each device.

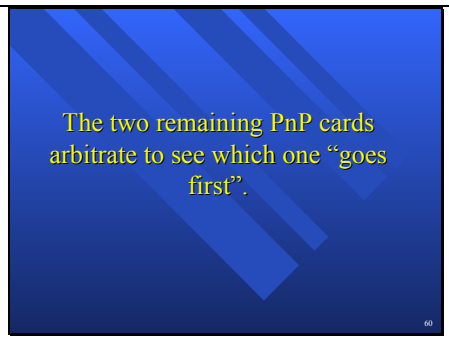
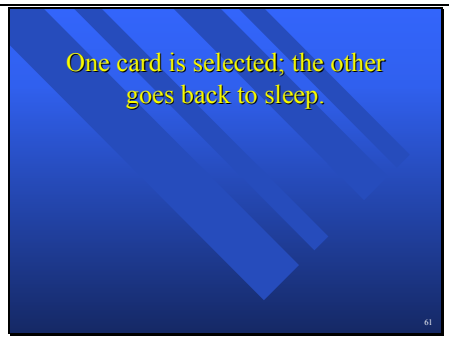
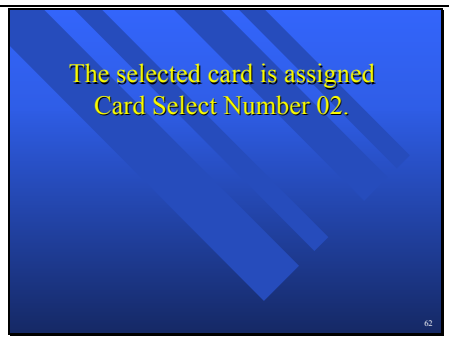
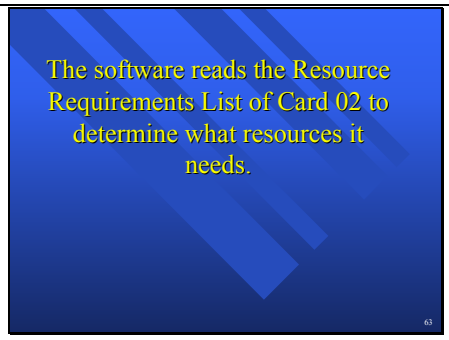
Slide 43		Clearly, to accomplish all this, PnP computers must be fundamentally different from legacy computers in terms of Motherboard and BIOS, interface devices, and operating system.
Slide 44		Plug and play is further complicated by the fact that many PnP computers support two different types of expansion buses: PCI and ISA. Now the PCI bus was designed with the idea of automatic device configuration in mind. The much older ISA bus was not. Thus, the PCI bus is much easier for PnP software to handle. Even so, the designers of the plug and play standard did not leave out the ISA bus. Instead they figured out a way to get around some of the ISA bus's shortcomings in this regard. The rest of this presentation will concentrate on the ISA bus PnP cards since they are the hardest for the PnP software to handle.
Slide 45		ISA PnP cards are fundamentally different from ISA legacy cards. Configuration registers that are loaded by the PnP operating system or BIOS replace the switches and jumpers of the earlier legacy cards. Also, because these cards must undergo a rigorous selection, isolation, and configuration process, they have multiple modes of operation. Finally, every PnP card has two types of circuits on-board: *functional* and *PnP*.

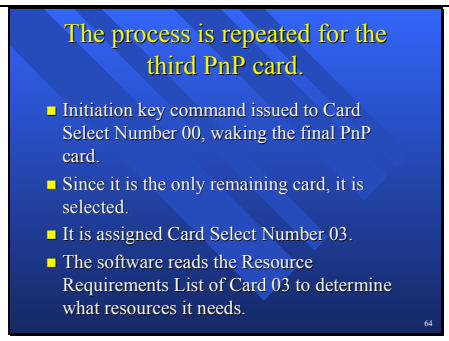
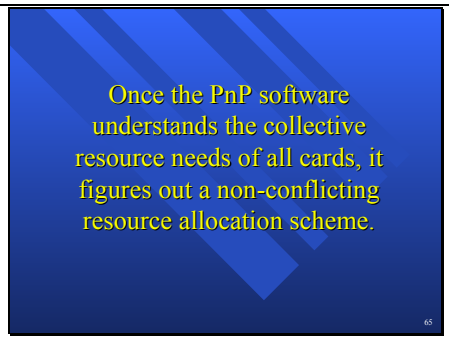
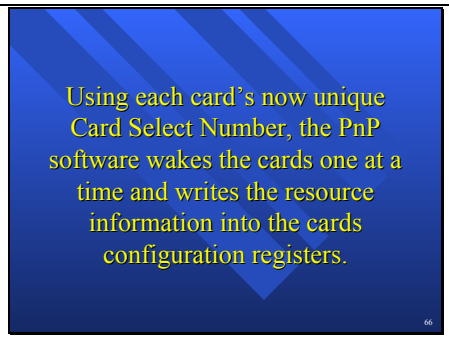
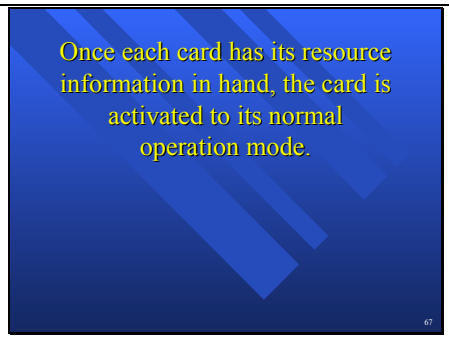
Slide 46		Functional circuits perform the basic operation of the card such as modem, sound card, etc. The PnP circuits perform the automatic configuration function of the card.
Slide 47		The ISA PnP card has several modes of operation not found on ISA legacy cards. One of the most important is the *inactive* mode. In this mode, the card does not respond to most control signals from the bus. More importantly, in the inactive mode, the card effectively disconnects itself from all computer resources. Therefore, when the card is inactive, it can not possibly interfere with the computer's resources. As far as the computer's resources are concerned, it is as if the card is not there.
Slide 48		Most cards and other PnP devices are not needed during boot-up, but some are. For example, the video card is needed so that the operator can see the various POST and boot-up milestones. The hard drive controller is needed to load the operating system, etc. The devices that are needed during boot-up start up in the active mode. During this active start-up phase, these devices grab system resources just as the old legacy devices did.

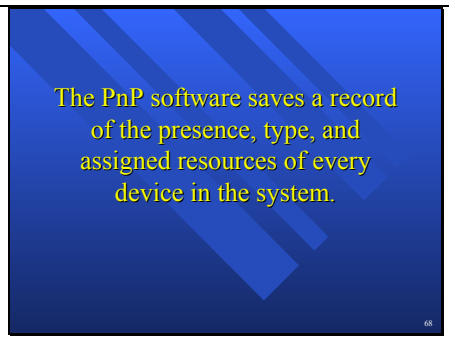
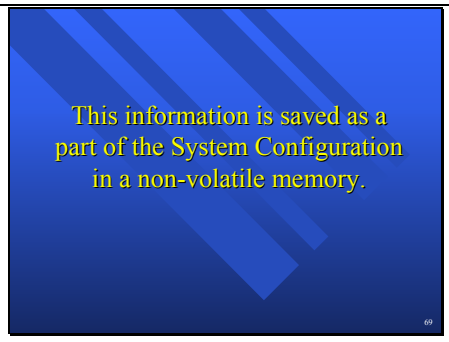
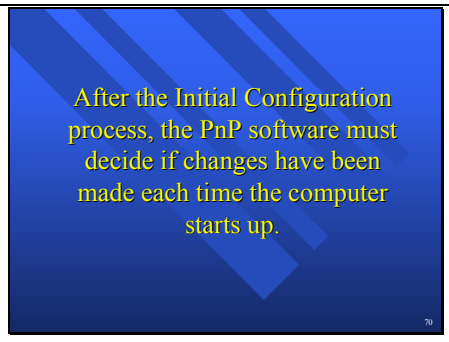
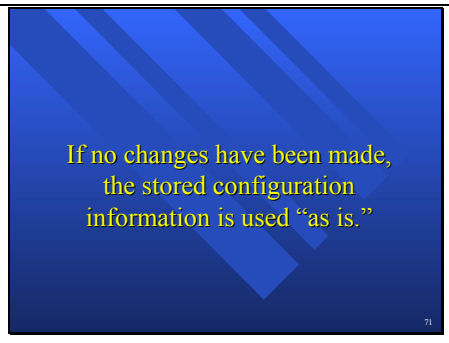
Slide 49		Those devices that are not needed during boot-up start up in the inactive mode. Recall that in the inactive mode, the device is effectively disconnected from computer resources. This leaves most system resources available for those few devices that are needed during boot-up. While it is theoretically possible to have a resource conflict during boot-up, it is highly unlikely because of the limited number of devices involved and because of the agreed upon standards involved. For plug and play, this grabbing of resources is unnatural. After all, one of the reasons plug and play was developed in the first place was to avoid this. However, this unnatural situation exists only until the Configuration Process can distribute the computer resources more judiciously.
Slide 50		Let's start by assuming that the computer has never been configured. That is, let's assume that the configuration in CMOS has no record of the devices installed nor of the resources assigned to those devices. In this case, the computer must go through an Initial Configuration Process that is more involved than would be necessary if this information were available. Let's first go through this Initial Configuration Process. Then we will see how subsequent Configuration Processes are simplified.
Slide 51		Let's further assume that we have three ISA PnP cards in a PnP computer with a PnP operating system.

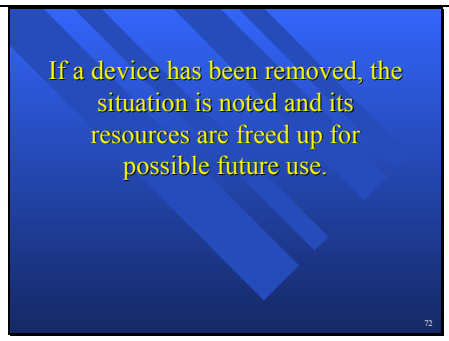
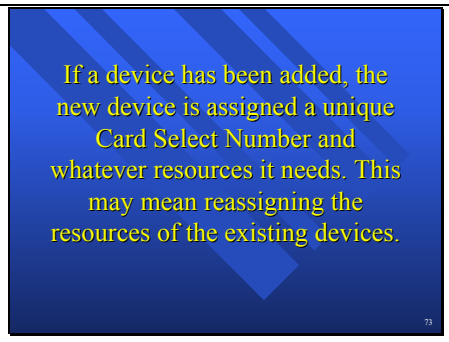
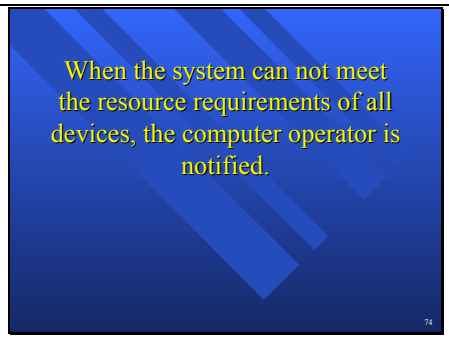
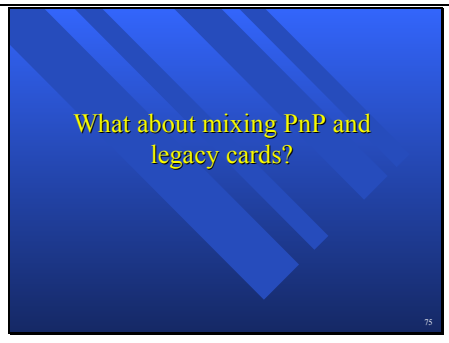
Slide 52		Each card has a card select number, or CSN. This is a number that can be set by the PnP software. The software uses this number to address the card. During boot-up, the card select number of all three cards is reset to "00." And the card select number will remain 00 until changed by the PnP software.
Slide 53		The Initial Configuration Process begins with the PnP software issuing an "initiation key command" to Card Select Number 00. Because all cards have this Card Select Number, they all wake up and snap to attention.
Slide 54		Now that the PnP software has everyone's attention, it leads the cards through an arbitration process, to see which card gets to "go first".
Slide 55		Through this process, one of the cards is chosen, and the other two go back to sleep. The chosen card is said to be isolated because the PnP software can now work on this card independent of the other two.

Slide 56		The PnP software assigns the selected card a unique Card Select Number. For the sake of simplicity, let's assume the number 01 is assigned. From this point on, the software can now uniquely identify this card by using the 01 Card Select Number.
Slide 57		Next, the PnP software reads Card 01's Resource Requirement List. As the name implies, this is a list of all the Resources required by this card.
Slide 58		For example, if Card 01 is a sound card, the list might contain the following types of information. The PnP software collects this information and files it away. Once the information is collected, Card 01 is instructed to go back to sleep.
Slide 59		At this point only one card has been given a unique Card Select Number. The other two still have their original 00 number as a result of the reset mentioned earlier. The process repeats the previous steps. First, the software issues an initiation key command to Card Select Number 00. Thus, the remaining two cards (which still have this number) snap to attention.

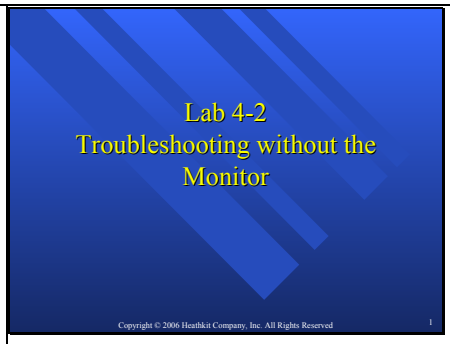
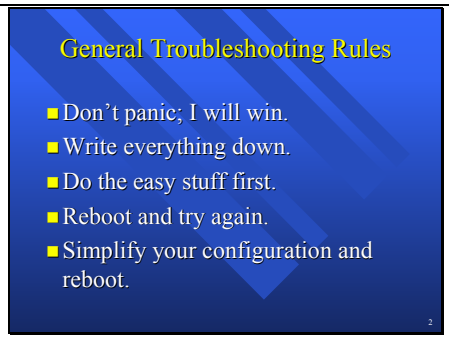
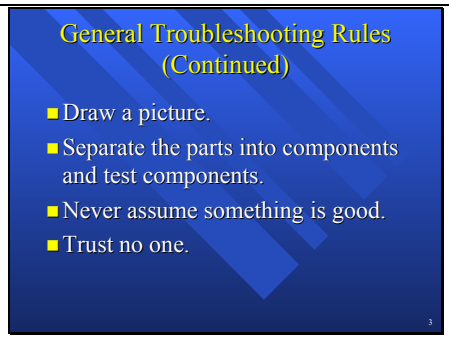
Slide 60		The arbitration process is repeated to see which of these two cards goes first.
Slide 61		One card is chosen; the other goes back to sleep.
Slide 62		Now the selected card is given its own unique Card Select Number. For simplicity's sake, let's assume it is given the number 02.
Slide 63		Next, the PnP software reads Card 02's resource requirements list to see which of the computer's resources this card needs. This information is filed away along with the resource requirements of Card 01.

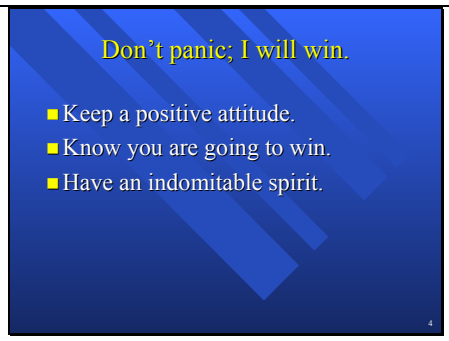
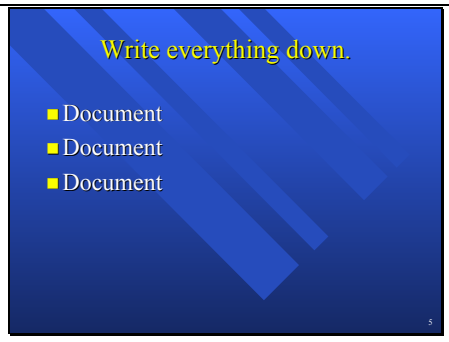
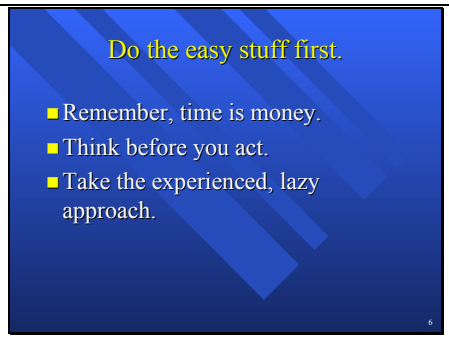
Slide 64		The process is repeated for a third time. This time only one card is left with the number 00. The card is awakened, assigned Card Select Number 03, and its resource requirements are gathered.
Slide 65		Once the PnP software has gathered the resource requirements of all the cards, it figures out a non-conflicting resource allocation scheme, assuming one is possible.
Slide 66		Using each card's now-unique Card Select Number, the PnP software wakes the cards one at a time and writes the resource information into that card's configuration registers.
Slide 67		When every card has its non-conflicting resources assigned, the cards are enabled and allowed to operate normally.

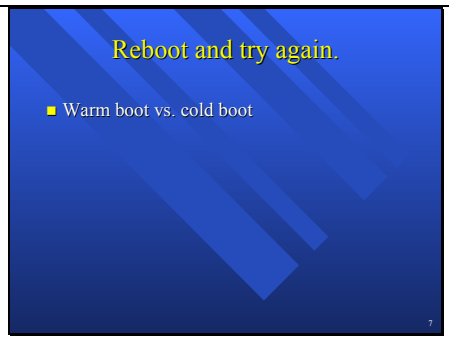
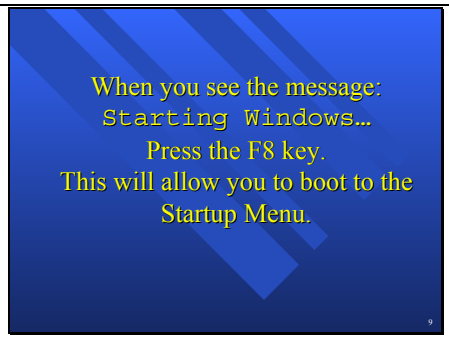
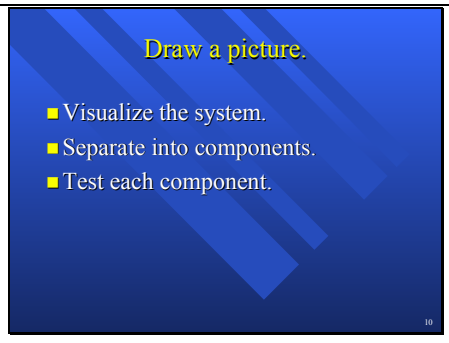
Slide 68		At the same time, the PnP software saves a record of the presence, type, and assigned resources for every device in the system.
Slide 69		This record becomes part of the configuration and is saved in CMOS along with other SETUP information.
Slide 70		The Initial Configuration Process is quite involed because the system is starting from scratch. Once the configuration has been established and saved in CMOS, subsequent configuration processes are somewhat simpler. Even so, each time the system boots up, it must decide if anything has changed.
Slide 71		If nothing has changed, the stored configuration information is used “as is.”

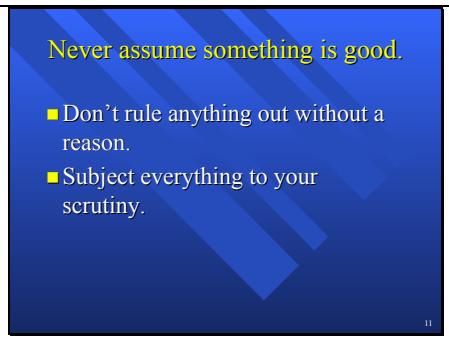
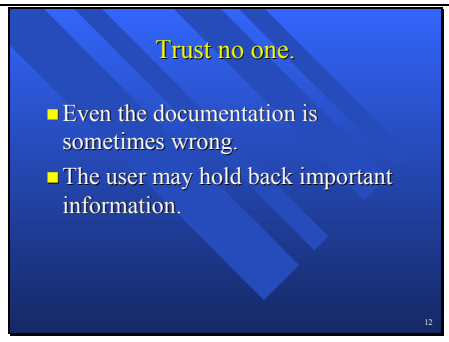
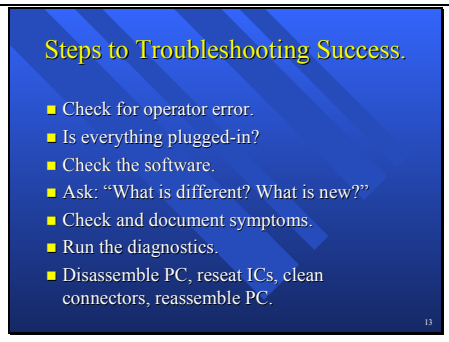
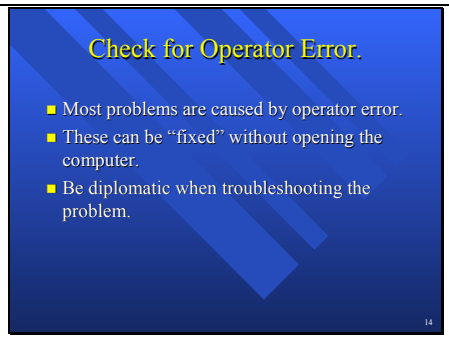
Slide 72		If a device has been removed, the situation is noted and its resources are freed up for possible future use.
Slide 73		On the other hand, if a new card has been added, it is isolated using the process described earlier. It is assigned its own unique Card Select Number. Then its resource requirements are read from its Resource Requirements List. These requirements are compared with those already in use. If necessary, the resources are reallocated so that the new card gets the resources it needs.
Slide 74		Even with this system, there are still situations in which the resource requirements of all the devices can not be met with the limited resources of the machine. When this occurs, the software sends you an error message. Then it is up to you to take appropriate action.
Slide 75		The situation is complicated when you have a mixture of legacy and PnP cards. In this case, you may have to specify certain resources as *fixed* and others as *PnP* in order to make everything work.

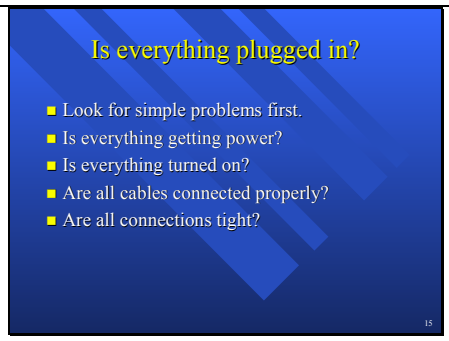
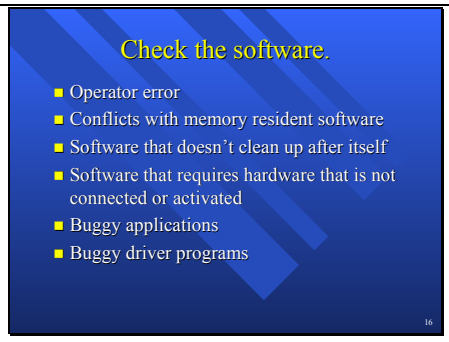
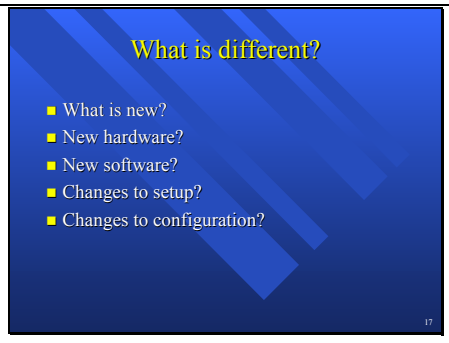
Slide 76		Now it's your turn…

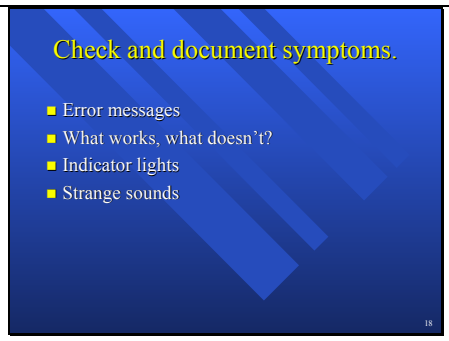
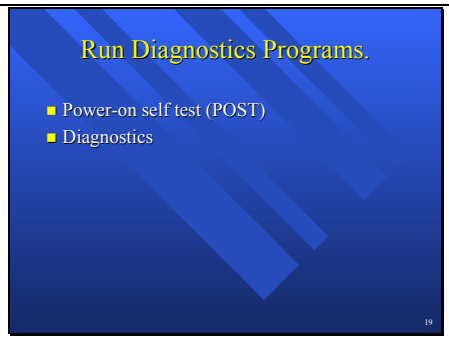
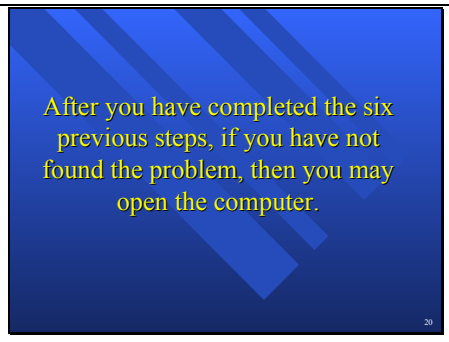
Slide 1		Welcome to Lab 4-2. In this exercise you will continue your study of common troubleshooting methods.
Slide 2		Troubleshooting is a skill that can be learned like any other skill. Some skills are best learned from books, others from practice. Troubleshooting probably falls into the latter category. So in the next few exercises, we will give you some hands-on experience. But first, let's talk about some general troubleshooting rules that will serve you well as you begin your troubleshooting experience. The troubleshooting philosophy espoused by your textbook makes a good starting point. First, don't panic and keep an "I will win" attitude. Second, write down everything. Third, do the easy stuff first. Then after doing a few things, reboot and try again. If that doesn't work, simplify your configuration and try again.
Slide 3		Draw a sketch of the situation to help you visualize what is going on. Divide and conquer by separating the system into its component parts. Then test the parts. Never assume that anything is good. And then, somewhat humorously, trust no one. Let's look at each of these in a little more detail.

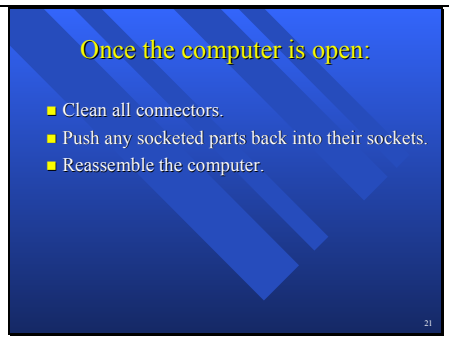
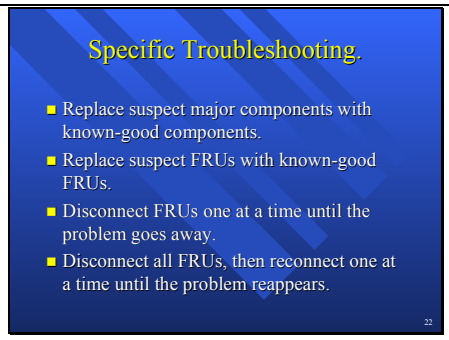
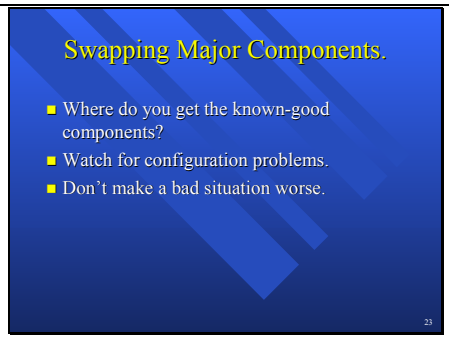
Slide 4		In troubleshooting, as with most things in life, attitude is everything. You must enter every troubleshooting episode with the attitude that you are going to win.
Slide 5		Second, as we stressed in earlier exercises, you must get in the habit of documenting everything. There are many advantages to doing this. It crystallizes exactly what the problem is. If you can't write it down then you don't yet understand the problem. Also, it gives you a permanent record that you can refer to in the future. Most computer problems fall into distinct categories. Careful documentation will allow you to sort out these categories early in your career. Also, detailed documentation will save you the embarrassment of forgetting how to put the computer system back together again.
Slide 6		It may surprise you to discover that with many computer repairs, the repair technician never knows exactly what the problem was other than some vague awareness such as "a cable was loose." The reason for this is that most have learned to do the simple things first. This means checking things like making sure the power cables are plugged in, that power is turned on, that control cables are tightened down properly, etc. Often, something as simple as adding paper to the printer, or cycling the power off and back on will get things going again. While this may not seem terribly satisfying, the important thing is to get the computer running again. In this business, time really is money. And while this may seem like a lazy approach, good technicians have learned to use it because it works.

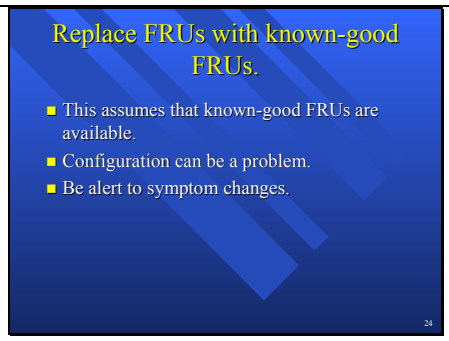
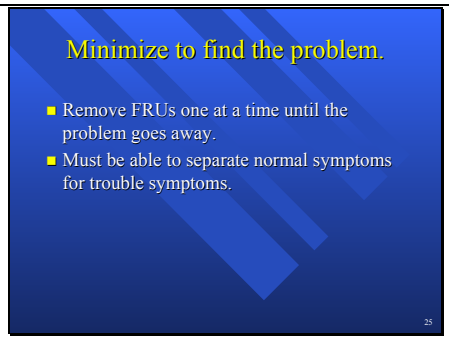
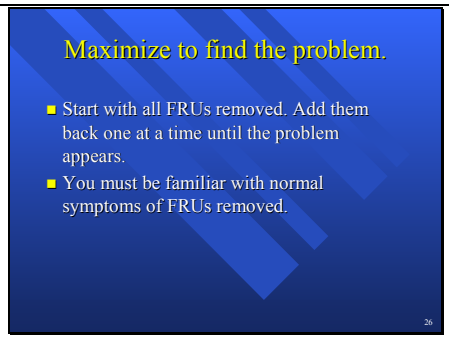
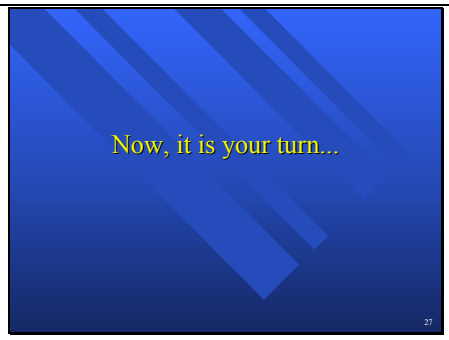
Slide 7		After making a few changes like tightening the cables, reboot the computer and try again. You will be surprised how often the computer performs normally after such trivial handling. Also, keep in mind the difference between the warm boot and the cold boot. During the cold boot, everything starts from scratch. The power-on self-test does its tests and everything begins anew, fresh and clean.
Slide 8		If you still have no luck, simplify your configuration and try again. Disconnecting from the network, if you happen to be attached to one, may help. Also, get rid of your screen savers and other TSRs that may be complicating things.
Slide 9		An easy way to do this is to press the F8 key immediately after "Starting Windows" appears. This will cause the system to launch to the Startup Menu, where you can make additional boot choices.
Slide 10		Most people can visualize a system better if they draw a sketch. For one thing, it helps break the system into its components parts. The drawing, in effect, tells you what to check and in what order.

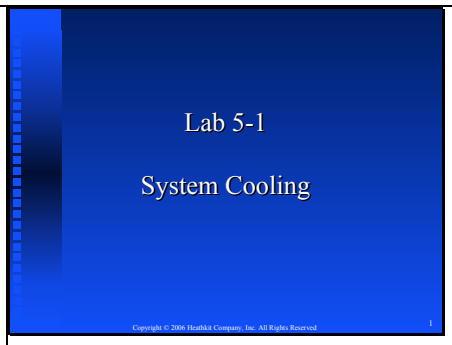
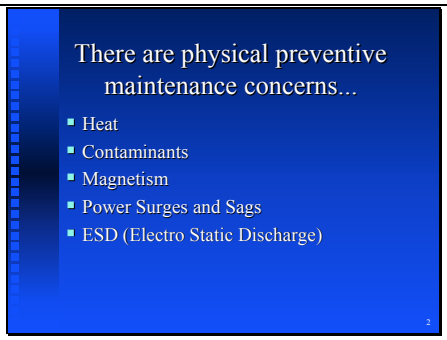
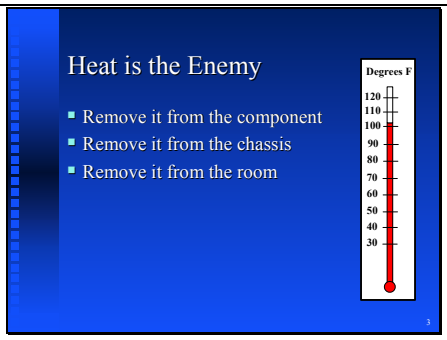
Slide 11		Never assume that something is good. A cable that "could not possibly fail" will fail. Also, attitudes like "It must be good because it is brand new" are misplaced. Subject everything to your critical scrutiny.
Slide 12		This final tip is slightly cynical, but contains wisdom, nonetheless. And it is a matter of accuracy more than honesty. Computer operators and even computer manuals are sometimes wrong. In fact, they are wrong often enough that you should not blindly accept what they say without some scrutiny. Obviously, this must be done diplomatically.
Slide 13		With these steps, we address your general attitude and demeanor. But then, we can still offer seven concrete steps to achieving troubleshooting success. They are shown here. Read them over quickly and then we will look at each of these in more detail.
Slide 14		The first and perhaps most important tip is "Check for operator error." Operator error accounts for more problems than any other. Until you are able to verify for yourself that there is a real software or hardware problem, you should assume that the operator is unknowingly at fault. Great diplomacy is required in these cases. It is sometimes helpful to think back to the times that you were in the shoes of the hapless operator. Be gentle. Practice your people skills with the same diligence that you practice your troubleshooting skills.

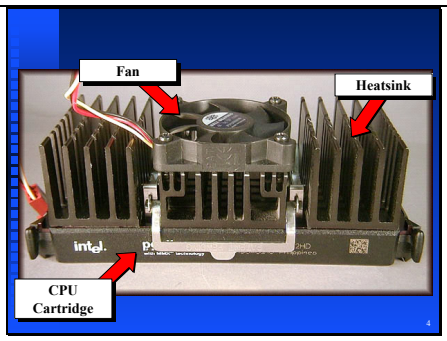
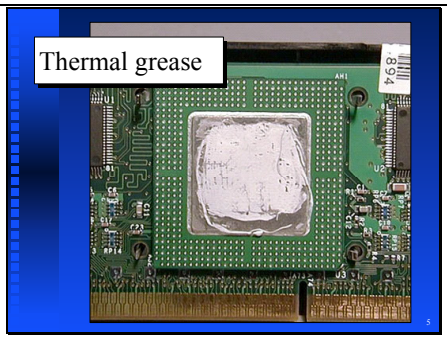
Slide 15		"Is everything plugged in?" is another way of saying: "Look for simple problems first." Is everything getting power? Is everything turned on? Are all cables connected properly? Are all connections tight? Don't make the problem bigger than it is. If you can fix the problem without opening the computer you are time and money ahead.
Slide 16		The next step up the ladder is to check the software. Here again "operator error" is to be considered until eliminated as a suspect. But there are a lot of other possibilities as well. Some software does not work well with some TSRs. Sometimes one piece of software will leave a mess behind that causes difficulty for other programs. Some software has strict hardware limitations, particularly with regard to memory. Some software just has bugs, period. It was not rigorously tested on your particular combination of hardware. Another common problem is the wrong version of the driver. Often software vendors are aware of the problems and have free software patches or new drivers available. Often you can download these from their Web Sites.
Slide 17		In many ways, this is the best question you can ask. Upgrades, fixes, and additions often do not go well, especially when done by the uninitiated. And the problem may not show up immediately. Recent hardware upgrades or software revisions should raise a red flag, as should changes to the setup program and the configuration.

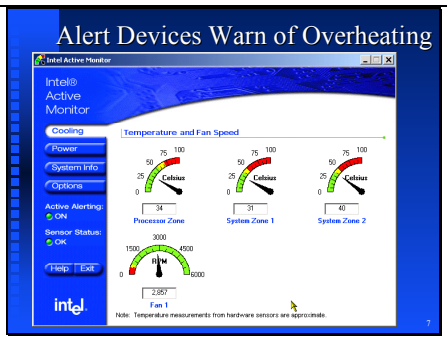
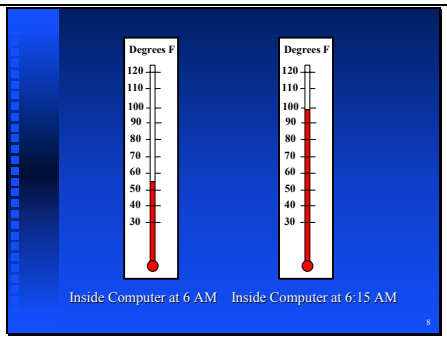
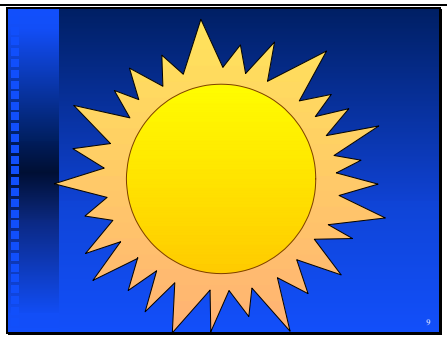
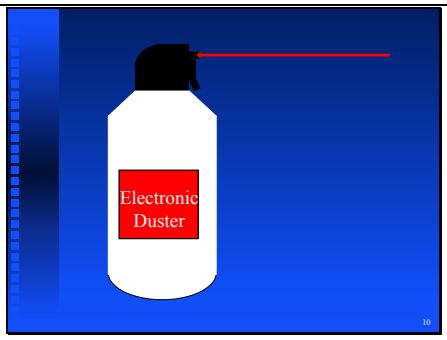
Slide 18		Carefully checking and documenting the symptoms can be a very valuable exercise. Not only does it force you to define the symptoms clearly enough to record them, but it also gives you a permanent record of the symptoms and their cure, the next time you encounter the same problem.
Slide 19		Virtually all PCs have the power-on self-test as part of the boot-up procedure. It carries out dozens of tests and if a problem is found it reports its findings as a series of audio beeps or as a written error message on the monitor. Also, diagnostics can be an invaluable troubleshooting aid if you know how to use them.
Slide 20		Finally, if all the preceding steps do not work, then you can open the computer.

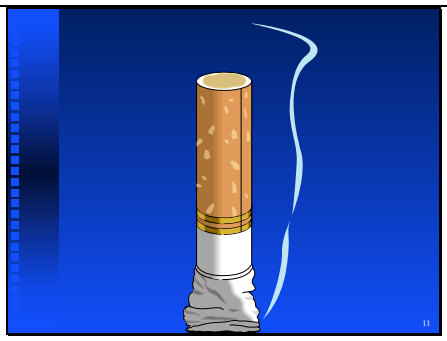
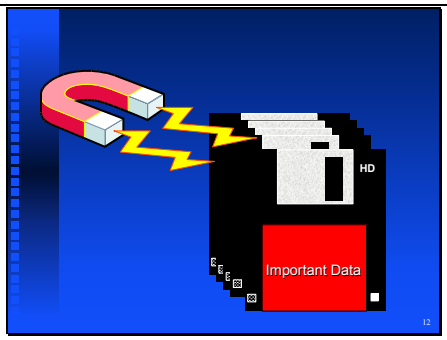
Slide 21		But even at this late stage it is still too soon to start probing around with an oscilloscope or warming up a soldering iron. In fact, you will rarely use either an oscilloscope or a soldering iron. Instead, you will first try the following: 1. Clean the various connectors, and 2. Push any socketed parts down into their sockets. Then you will reassemble everything and see if that fixes the problem. Very often it will.
Slide 22		If the PC still does not respond, then the real troubleshooting begins. Usually you will employ one or more of these techniques. If possible you can narrow down the problem to a specific major component of a system by swapping known-good components for suspect components. Then carried a step further you can often isolate the problem to a specific field replaceable unit (FRU) by swapping known-good FRUs for the suspect FRU. Another good technique is to disconnect the FRUs one at a time until the problem goes away. A variation of this theme is to disconnect all FRUs, then reconnect them one at a time until the problem reoccurs. Let's discuss each of these in greater detail.
Slide 23		Swapping major components is one of the quickest ways to isolate the problem. For example, suppose the PC boots up but there is no display on the monitor. Swapping a known good monitor will tell you if the problem is with the monitor or with the PC. Obviously this assumes that another monitor is available.

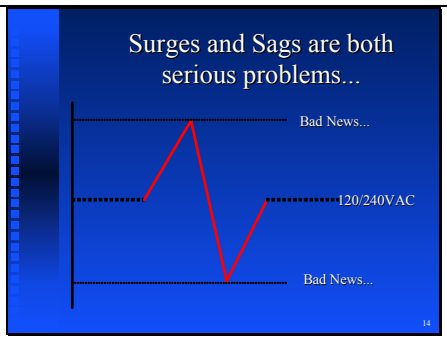
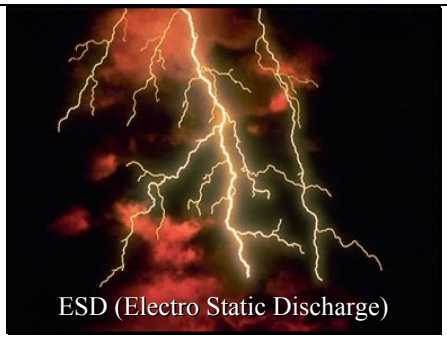
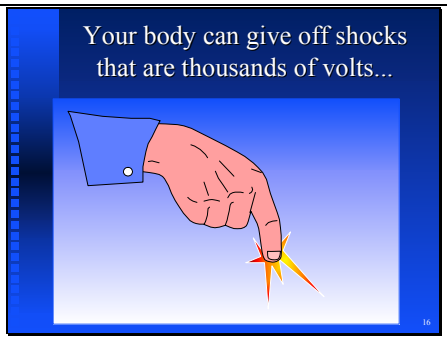
Slide 24		Taking this a step further, we can swap individual FRUs, if a known-good replacement is available. Many times, two or more computers of the same type will be available and you may be able to swap parts temporarily to isolate the problem. However, you should be aware that even seemingly identical FRUs could be configured differently with on-board jumpers or switches. If so, you may easily misinterpret the results.
Slide 25		This method is best illustrated by an example. Let's suppose the PC will not boot properly and you suspect a misbehaving FRU. In this case, you would shut off the power, remove the suspect FRU and then see if the computer will boot up. If so, you have found your problem. If not, replace the first FRU and remove another. Repeat the process until the offending FRU is found.
Slide 26		A variation of this theme is to remove all FRUs and then replace them one at a time until the computer fails. Unfortunately, the computer can give some pretty strange symptoms with all the FRUs removed. So this technique requires a good bit of experience to be successful.
Slide 27		As you will see, identifying the symptoms can be critical to understanding the health of the computer when things are so bad that your monitor is not working. So now, it is your turn…

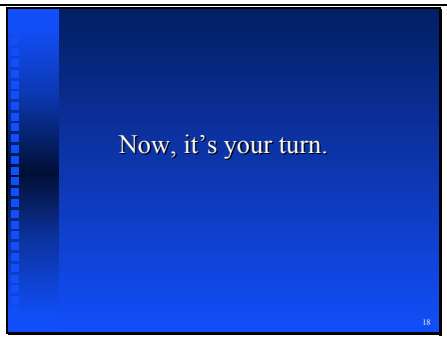
Slide 1		Today you will learn about system maintenance. As a troubleshooter, the best way to fix problems is to prevent them from happening.
Slide 2		As a good troubleshooter, you have to be concerned with these preventive maintenance issues... • Heat • Contaminants • Magnetism • Power Surges and Sags • ESD (Electro Static Discharge).
Slide 3		Our first and most frequent concern is heat. Most electronic components will last forever if they are kept at a low operating temperature. But if you get them too hot, they fail quickly. Today's multi-gigahertz processors, hard drives, and gigantic memory ICs generate plenty of heat, and the trick is to get that extra heat away from these components. This is a three-step process: remove the heat from the component, then remove it from the computer chassis, then remove it from the room.

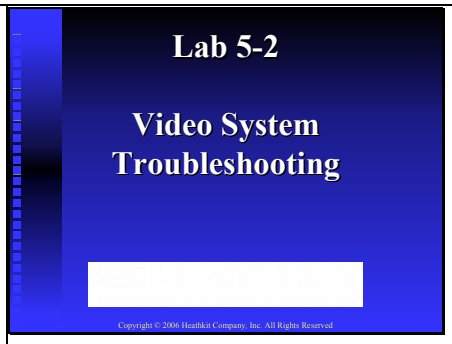
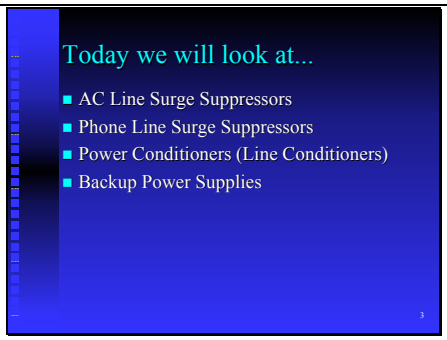
Slide 4		The first step is to remove the heat from the component. This is done with a hunk of metal called a *heatsink*. The heatsink is usually made of aluminum, or some other metal with good heat conduction properties. A heatsink has lots of protrusions, or fins, which are designed to increase the surface area, which in turn allows more air to circulate to reduce the temperature. In the case of this CPU, there is so much heat that a fan is used to circulate as much air as possible. The heatsink works without a fan, but the fan adds considerably to the ability of the heatsink to remove heat, via convection. Notice that the heatsink is colored black. There's a reason for this too, which is to help the heatsink radiate heat better.
Slide 5		When you take the Pentium II/III cartridge apart, you'll see a layer of grease between the CPU and the heatsink. This is called a thermal grease, and it helps transfer heat, via conduction, from the CPU itself to the heatsink. This grease is an important part of the cooling process.
Slide 6		Fans serve two purposes…they remove heat from heatsinks, and they remove heat from the computer chassis. Most of the noise you'll hear from a computer is its fans, and you can usually hear them when they start making unusual noises. The problem with fans is that they fail more often than most other computer parts. And when they fail, some components get hot and then you have two problems.

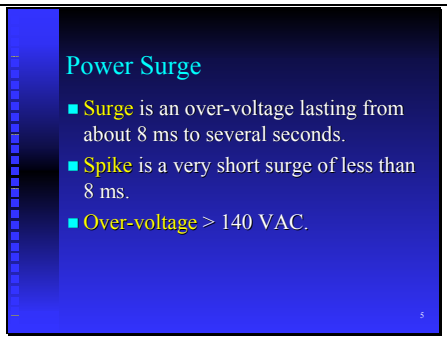
Slide 7		Most current Intel motherboards have some handy tools to keep track of your system. This one is typical, and it shows the approximate temperature of the processor as well as two other locations on the motherboard. It also shows the rotational speed of the primary chassis fan. If this fan stops, then the monitor will alert you before any heat-related damage can occur.
Slide 8		Another heat-related problem can occur when a computer or other electronic device is rapidly warmed or cooled. For instance, let's say you left a laptop computer in your car on a freezing night. Freezing a laptop shouldn't cause any trouble, as long as you let it warm up slowly. If you open up the laptop indoors and turn it on right away, it's possible that something will break. The stress on the parts warming up quickly can damage your drives, display, or even the heatsink on the processor.
Slide 9		The sun can generate a tremendous amount of heat, especially through clear windows. Make sure computers are not in a location where the sun can raise their temperatures substantially. Beware of offices with banks of windows that allow the hot, afternoon sun to beam down on computer equipment. The added heat can raise the temperature inside the computer enough to cause problems.
Slide 10		No matter where a computer is located or how clean the environment appears to be, there will always be airborne particles that will accumulate and eventually cause performance problems. Whenever you have reason to open a piece of computer equipment, give it a blast of compressed air to eliminate accumulation of dust. Eliminating dust around fans, filters, drives, etc. can prevent future problems. It's also a good idea to clean the keyboard while you are at it too. An air filter in the room can't hurt, either.

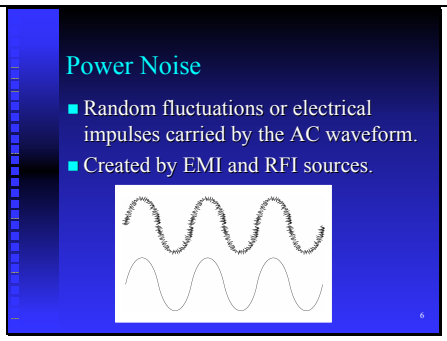
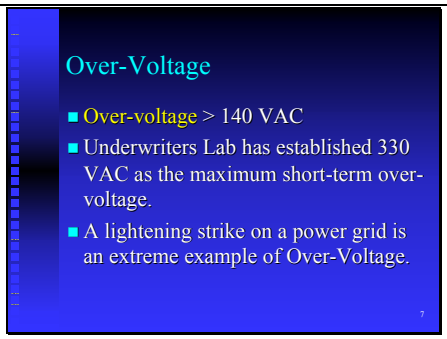
Slide 11		No matter where a computer is located or how clean the environment appears to be, there will always be airborne particles that will accumulate and eventually cause performance problems. Be sure to make areas where computer equipment is located no smoking areas. Cigarette smoke contains contaminants that can speed the death of computer components.
Slide 12		Prevent anything containing magnets from being used near computer systems. Magnets can especially harm data storage media such as floppy disks, tape media, etc. Keep anything magnetic out of the computing area.
Slide 13		Here are some objects that can present problems in the computer area…things such as paper clip holders, magnetic screwdrivers, anything with a motor in it, computer monitors (they contain a big magnetic coil), some telephones-usually older ones with a bell ringer, printers-again, they have a motor, and fluorescent lights.

Slide 14		You can't control the quality of the power your power company delivers to your facility or what mother nature does to it. But there are steps you can take to prevent power surges and sags. Most computing equipment generally likes its AC around 120 or 240 volts. It will tolerate some variation but wide variances are common and can do considerable damage. A surge occurs when the AC line voltage is much higher than 120VAC. It may be just for a fraction of a second but that is long enough to harm computer equipment. A sag occurs when the AC power drops below 120VAC. This happens when a heavy load comes on line (like during hot weather when air conditioners near your facility are turning on and off). Power conditioning equipment can prevent these problems and is a good investment.
Slide 15		Electrostatic discharge can create havoc with sensitive electronic equipment, especially when you are poking around inside a computer looking for a problem. ESD will damage integrated circuits, and there's no way around it. If you do not practice good ESD protection techniques, you will pay for it eventually.
Slide 16		Our bodies can generate incredibly powerful shocks. Fortunately, even though they can be thousands of volts, the current is very low so we don't end up electrocuting everyone around us. But these shocks are still powerful enough to damage computer equipment. There are steps you can take to fight ESD...

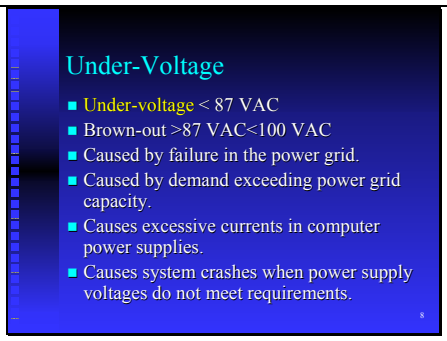
Slide 17		Low humidity is definitely the enemy of computer equipment. Install humidifiers or bring in plants or aquariums to raise the humidity level in the computer area to an acceptable level. You could install anti-static carpet in computing areas. Sometimes you cannot control the humidity or carpet choices, but you can make sure you always use an anti-static wrist strap, and to use anti-static pads in work areas.
Slide 18		That's a quick view of some preventive maintenance issues to watch for.

Slide 1		Today's presentation you will learn about AC power quality and protection.
Slide 2		Power protection is a lot like virus protection. You take it for granted until you need it. Taking power protection for granted is fine as long as you have power protection in place. Not having power protection can be a disaster waiting to happen.
Slide 3		In this presentation we will look at: AC line surge suppressors protect equipment connected to the AC line from voltage spikes, surges, and noise. Phone line surge suppressors protect those electronic devices that use phone lines from voltage spikes, surges, and noise. Power conditioners, also known as line conditioners, are AC line surge suppressors that also isolate the computer AC connection from over voltage and under voltage conditions. Backup power supplies provide the capabilities of power conditioners, as well as, an uninterruptible source of AC power for those times when there is an AC line failure.

Slide 4		Before we look at the protection devices themselves, let's review what it is they are protecting a computer from.
Slide 5		A power surge is also an over-voltage condition. It can last from as little as 8 milliseconds to several seconds. A surge may be caused by a power company switching between power grids, or a large electrical motor starting-up or shutting-down, or even the office next door blowing a fuse. The momentary release of energy can be substantial. At the other end of the spectrum is the lightening strike that gives over-voltage a whole new meaning. Related to the power surge is the power spike. Actually, surges and spikes are the same thing. It's just that some people are uncomfortable calling something that lasts a few milliseconds a surge. Spike works for me. You might be wondering what an over-voltage is. Actually, it is any voltage that exceeds the local power grid specification. In America, the residential voltage has an approximate range between 87 and 140 volts AC. So you could say that 141 volts on a power line that is nominally 120 volts is an over-voltage.

Slide 6		The term refers to the random fluctuations or electrical impulses carried by the AC waveform. The upper waveform in this slide represents noise on the AC waveform. The lower waveform represents a clean AC waveform. Noise is usually created by Electromagnetic Interference—EMI—or Radio Frequency Interference—RFI. Recall that RFI is noise caused by high-frequency sources like radio and TV transmitters. EMI is noise generated by sources like electric motors and florescent light ballasts. Noise can cause bit values to change, causing program or data errors.
Slide 7		Under-voltage and over-voltage conditions can also damage a PC power supply. Over-voltage does it by frying components. By definition, an over-voltage condition begins at 140 volts AC. Underwriters has established that a short-term surge of no more than 330 volts AC will probably not damage electrical equipment. Exceed that voltage, or the duration of the voltage and the chances of frying something increase dramatically. Over the long term, however, components will fail from voltages that barely exceed the standard upper-limit of 140 volts AC. While low over-voltage conditions can cause component failures, it's those lightening strikes on the power lines that cause the real, immediate damage.

Slide 8

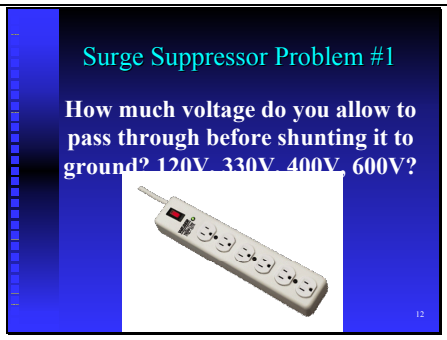
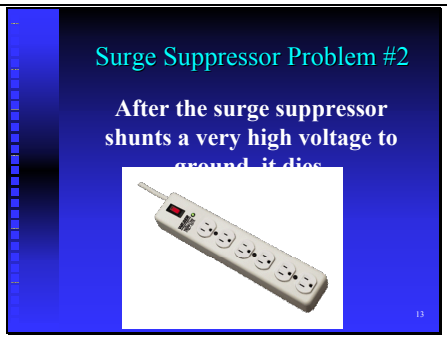


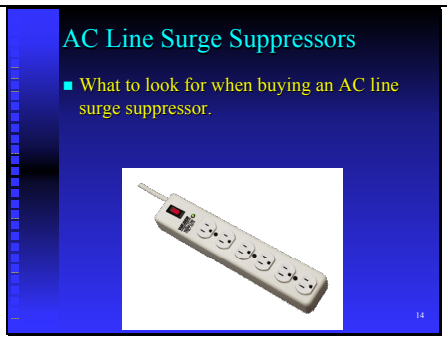
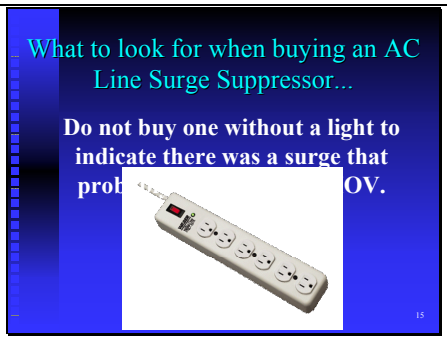
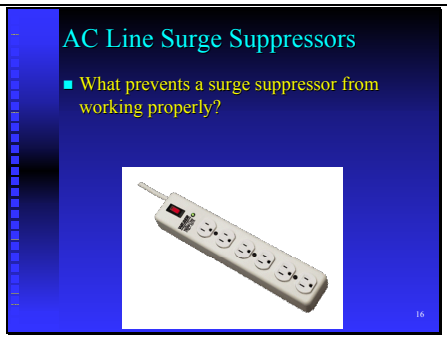
By definition, an under-voltage condition begins at 87 volts AC. Before that happens though you are in what we call a Brown-Out or voltage sag. That occurs somewhere around 87 to 100 volts AC. Brown-outs, and ultimately, under-voltage conditions are caused by a failure in the power grid or by demand exceeding power grid capacity. In fact, 87% of all power disturbances are caused by these conditions. Unless you have exceptional wiring in your kitchen at home. You experience a brown-out there every day. Watch the lights the next time you toast a piece of bread. Better yet, run the microwave, then run the toaster. You should hear a noticeable drop in noise from the microwave as your kitchen experiences a brown-out.

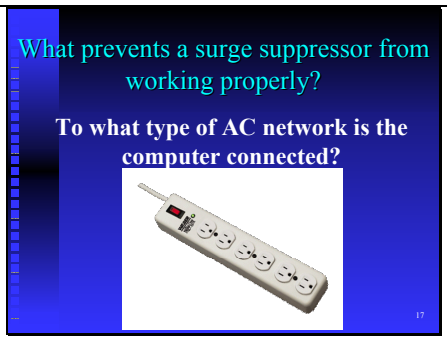
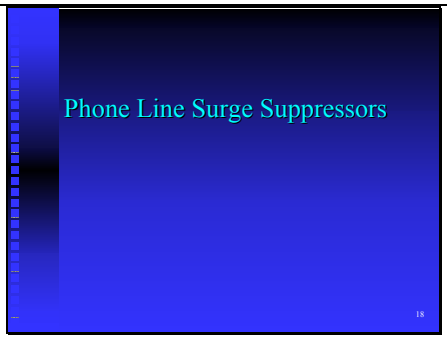
What about the computer? When there is a brown-out or under-voltage condition, the power supply winds-up drawing more current to make up for the reduced voltage. The result is excessive HEAT! In the long term, that too can damage the power supply. In the short term, it can mean system crashes because the power supply voltages do not meet motherboard or peripheral requirements.

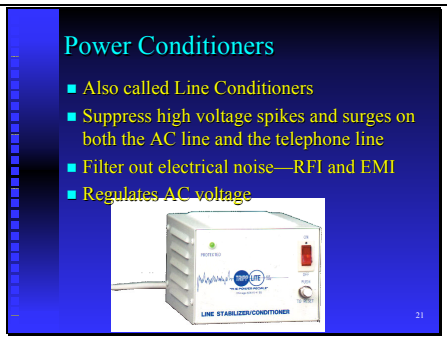
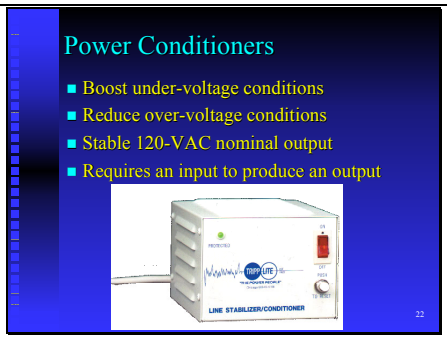
Slide 9

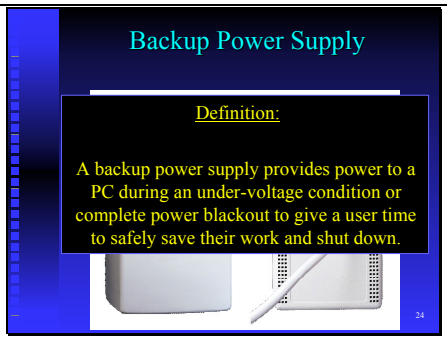
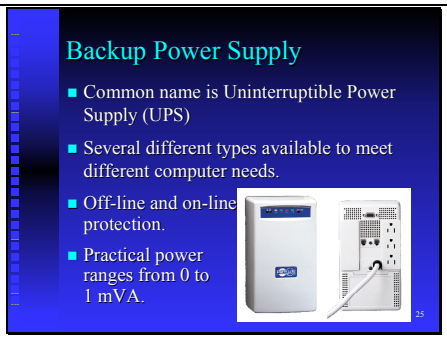
Okay, we've established that there are times when the AC power line can be most harmful to a computer. Let's see what we can do to protect that delicate piece of hardware.

Slide 10		Let's look at AC line surge suppressors first.
Slide 11		AC line surge suppressors are also called spike isolators. They use a component called an MOV (Metal Oxide Varistor) to send spikes and surges to ground. Some also use gas discharge tubes, pellet arrestors, or coaxial arrestors to block the spikes and surges. As valuable as AC line suppressors are, they are far from being the ideal device.
Slide 12		Here's the first problem with surge suppressors. It's a problem AC line suppressor designers have to deal with. How much voltage do you allow to pass through before shunting it to ground? Do you let 120v, 330V, 400V, or 600V pass through? Ideally, the answer is 120 volts. But that gets to be very expensive. So, you must determine how much pass through you can live with, versus the cost of protection.
Slide 13		Problem number two: After a simple surge suppressor does its job and shunts a large spike or surge to ground, it usually dies. That's right. It is destroyed. But you might not even realize that a surge came through and was shunted to ground. The MOV did its job and is now dead, leaving you unprotected. And, there is no way to test the MOV to see if it still works. It's like the joke that goes; if I tell you the secret I have to kill you. With a MOV, the only practical way to test it is to destroy it. But you won't know it's destroyed because nothing appears to have changed.

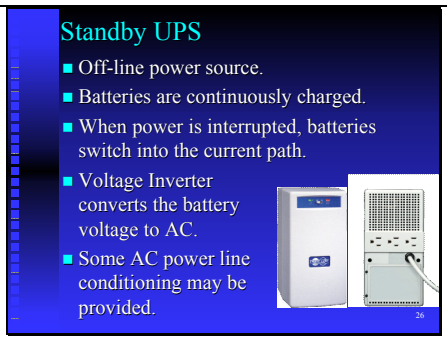
Slide 14		Knowing what we now know, what do we look for when buying an AC line surge suppressor?
Slide 15		**Don't buy one without a light** that indicates there was a voltage surge that probably destroyed the MOV. An investment of a few more dollars could mean the difference between thinking you are protected and knowing you are protected. Otherwise, all you are really buying is a power distribution box, not a surge suppressor.
Slide 16		What prevents an AC line surge suppressor from working properly?

Slide 17		You will encounter two different types of power distribution networks in a house—two-prong and three-prong. All businesses and all new houses, by law, must use three-prong wiring. That is, the two flat-blade prongs are connected to the hot and neutral power lines. The third, round prong, is connected to earth ground. The surge suppressor uses the third prong to shunt over-voltages and noise to earth ground. If that prong is missing, even though the neutral prong is also connected to earth ground, the surge suppressor will not work.
Slide 18		The next level of surge protection includes the phone line surge suppressor.
Slide 19		Like the power line surge suppressor, the phone line surge suppressor protects against over-voltage conditions on the phone line. Normally, that means protection from lightening strike surges traveling down the telephone line and damaging the modem, fax board, or whatever else may be attached to the line. Phone line surge suppressors are usually found on AC surge suppressors. They provide an input jack and an output jack. Cable from the telephone wall outlet is connected to the input jack of the surge suppressor. A cable is then connected from the suppressor output jack to a modem or fax card in the computer. You can also use one of these things to protect your telephone or an external fax machine.

Slide 20		The next type of protection we want to look at is the power conditioner.
Slide 21		A power conditioner, also known as line conditioner, operates like a sophisticated surge suppressor. It operates like a surge suppressor because it too suppresses high voltage spikes and surges on the AC telephone lines. It also filters electrical noise to ground. However, where the power conditioner shines is how it regulates the incoming AC voltage.
Slide 22		Using transformer-based circuitry, power conditioners boost under-voltages and reduce over-voltages to a nominal 120 volts AC. The actual range for most power conditioners and like the one shown here is between 87 and 140 volts AC. They are designed for those areas where the AC power grid voltage drifts from one extreme to the other. While the input to the conditioner is unstable, the output remains very stable, insuring the greatest protection for the computer's power supply components. What it cannot do is make something from nothing. It needs an input before it can produce an out, and that input must fall within its limited range of input voltages to be useful.

Slide 23		When the power grid cannot support the operation of the power conditioner, you need a device that is self-powered. That's the job of the backup power supply.
Slide 24		A backup power supply provides power to a PC whenever the power grid no longer meets the minimum voltage standards, or during those times when there is a complete power failure—also known as a blackout. This backup power is designed to give a user time to safely save their work and shut down their computer.
Slide 25		The common name for a backup power supply is the Uninterruptible Power Supply, or UPS. There are many different types of UPS available to meet virtually any computer installation requirement imaginable. They range from the most basic standby UPS supplying 300 to 600 volt-amps of power to a Delta Conversion on-line system supplying in the range of 5000 kilovolt-amps to one million-volt-amps of power. The terms off-line and on-line refer to how primary power and back-up power are handled within the UPS. Today, we'll look at an example of each.

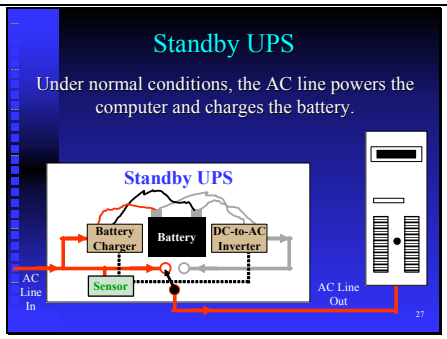
Slide 26



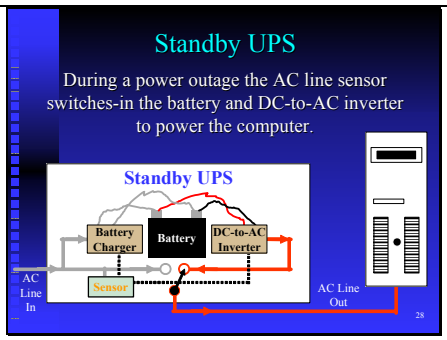
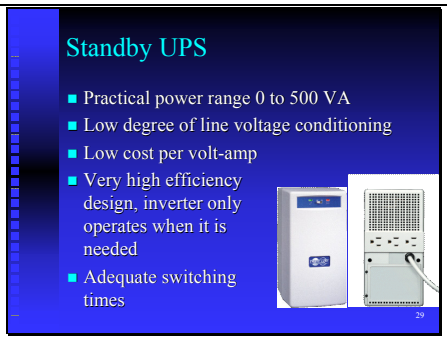
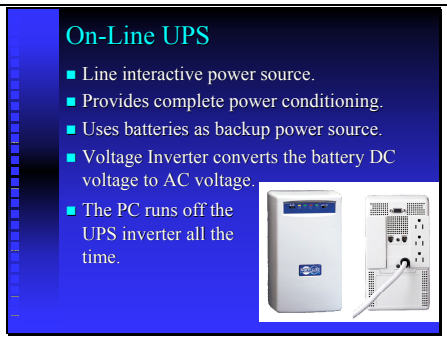
A standby power supply is an off-line power source. That is, the primary power path completely bypasses the internal control circuitry until backup power is actually needed. What that means is, the PC the UPS is connected to runs off the AC line until there is a problem. A standby power supply uses a smart charging circuit to make sure the backup battery is always in a fully charged condition.

When a power outage does occur, an internal sensor opens the primary power line and reconnects the computer's power cord to the backup battery through a voltage inverter. The inverter converts the battery voltage to AC to power the computer. Normally, the size of the UPS power source is great enough to keep the computer and any necessary peripherals running for 6 to 10 minutes. That should be more than enough time to safely shut down the system. Depending on the model UPS being used, some power conditioning may be provided in the form of noise filtering or AC power surge suppression.

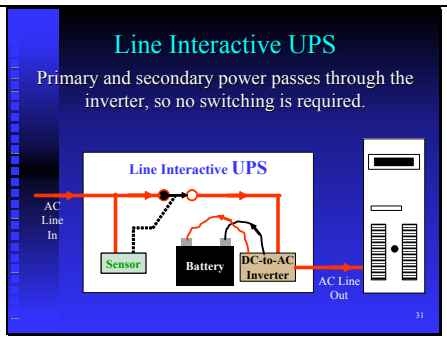
Slide 27



This is what the basic Standby UPS looks like inside. Under normal conditions the computer is getting its power directly from the AC line input, through a switch inside the UPS. Notice that while the computer is receiving power from the AC input, that same AC power is also routed through a battery charger to keep the battery fully charged. The AC line sensor directs the operation of the battery charger, the DC-to-AC inverter, and the AC line switch.

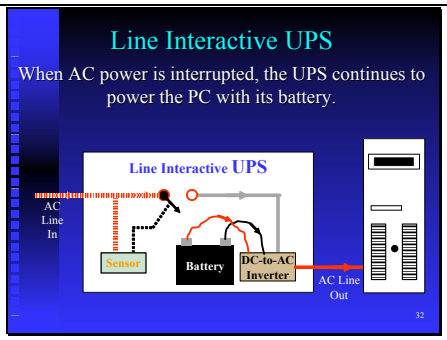
Slide 28		If the AC line voltage sensor detects a serious problem on the input it immediately disconnects the input from the circuit. At the same time, it connects the AC output line to the DC-to-AC inverter to run off of battery power. It will stay in this mode of operation until AC input power is restored or the battery runs down.
Slide 29		These are the characteristics of a typical standby UPS design. They have a limited practical power range. For that reason, they are used primarily to backup home computers and workstations. To keep things in perspective, a standby UPS with a 350-volt-amp rating can keep a computer system that draws 200 watts of power running for approximately six minutes during a power blackout. To keep costs down, they offer a low degree of line voltage conditioning. Depending on the installation, conditioning may not be adequate—something to keep in mind when specifying a backup system. As might be expected, the standby UPS has the lowest cost per volt-amp. It is also a very efficient design because the inverter only operates when it is needed. Switching between primary and backup power is not the fastest or most surge-free process but it is adequate for the installation.
Slide 30		The Line Interactive is the second-most popular type of UPS—the standby UPS is number one. As a rule, the on-line UPS provides power conditioning, along with surge and noise suppression. Like all UPS devices, it uses batteries and a voltage inverter to convert DC to AC power to power the PC. In this particular UPS design both primary and secondary power passes through the inverter, so switching time is not a factor.

Slide 31



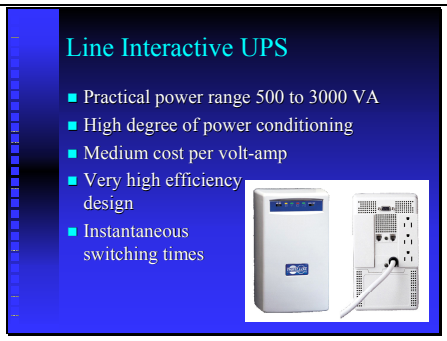
Here's what a line interactive UPS looks like. The primary AC passes through a line interrupter switch to the voltage inverter. From there, a portion of the AC is inverted and passed to the battery to maintain its charge. The rest of the primary AC goes to the AC output and on to the computer.

Slide 32



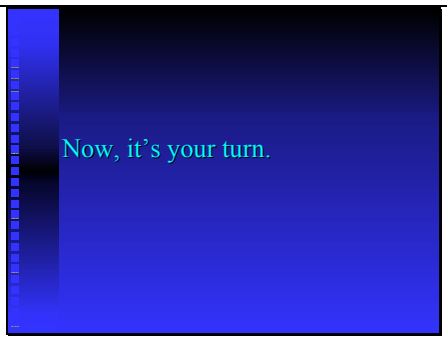
When the AC power is interrupted, battery current reverses and flows out the voltage inverter as AC power. This happens instantaneously—no switching is required. At nearly the same time, the AC line voltage sensor determines there is a serious problem with the input, and it immediately disconnects the input from the rest of the circuit. The sensor won't allow the switch to close until primary power is restored and it is stable. Opening the switch will not generate a voltage surge at the output of the UPS because the UPS is already operating on backup power.

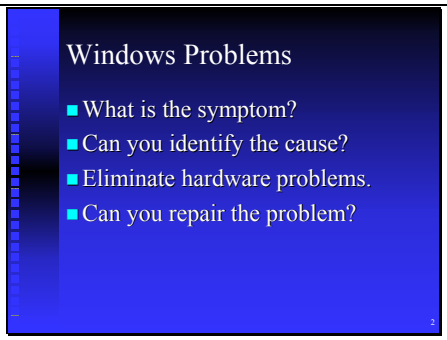
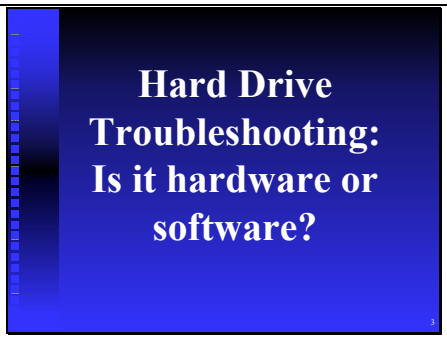
Slide 33

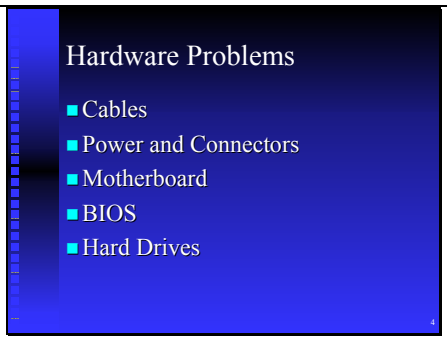
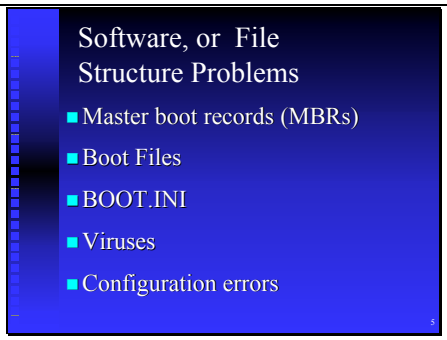


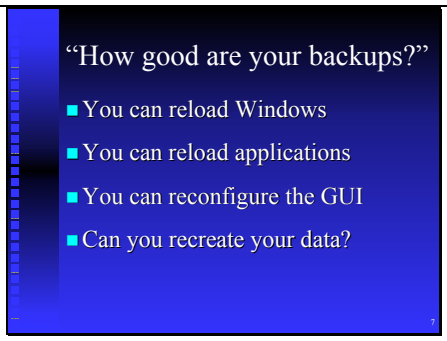
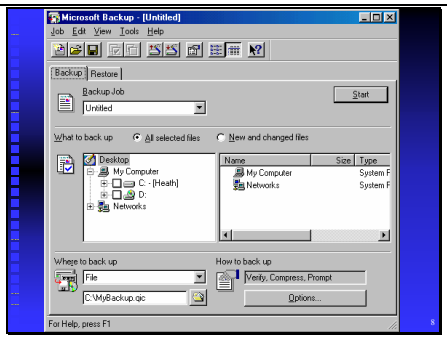
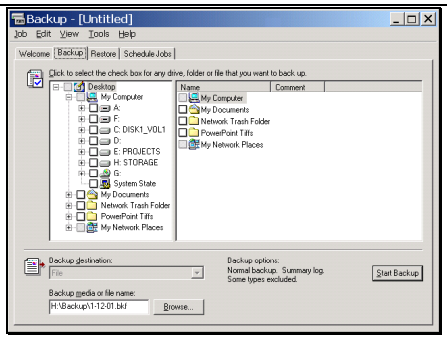
These are the characteristics of a typical line interactive UPS design. They have a practical power range that is high compared to a standby UPS. But at 3 to 5 thousand volt-amps, is no where near the capacity of the larger on-line UPS designs. For that reason, they are used primarily to backup large workstations and small distributed server racks. Their highly efficient power conditioning make them ideal for harsh power environments. As might be expected, the line interactive UPS has a higher cost per volt-amp than the standby UPS, but it is still very low compared to the larger on-line UPS designs. Switching between primary and backup power is virtually instantaneous for surge-free operation.

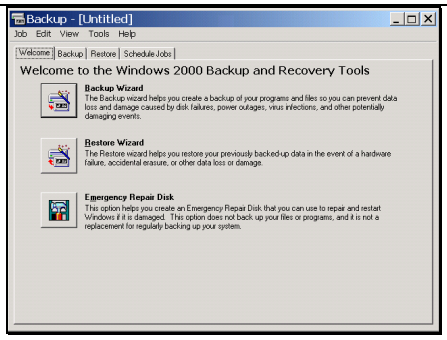
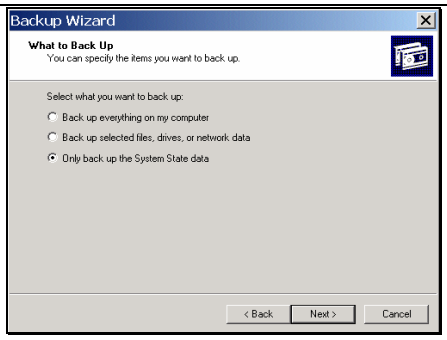
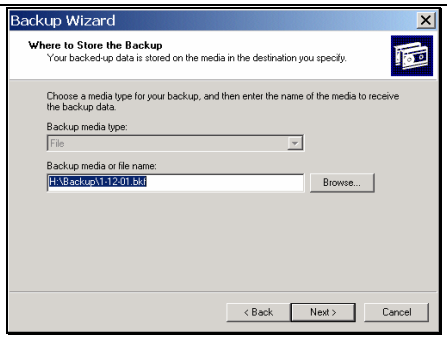
Different USP designs are appropriate for different applications. You've just had a quick review of what is available. While you are not yet an expert on the subject, you should now know enough to ask the right questions.

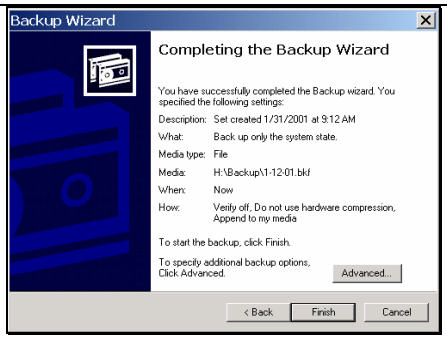
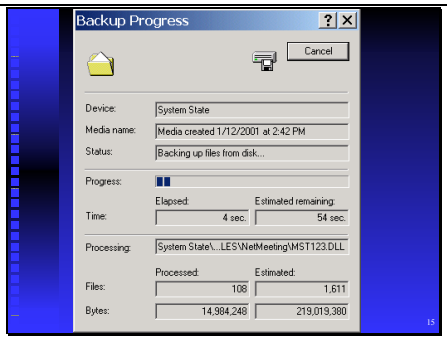
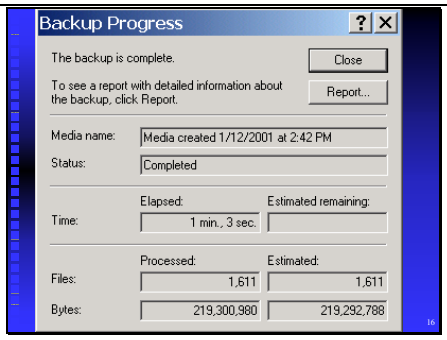
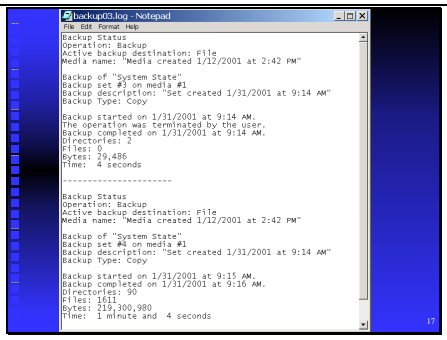
Slide 34		Now turn to the lab in your workbook.

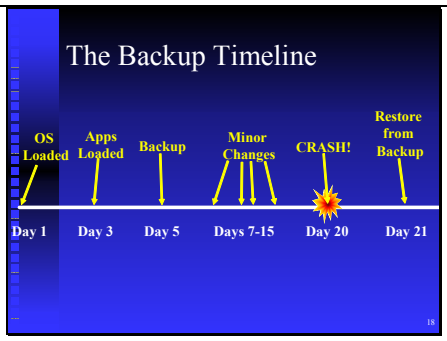
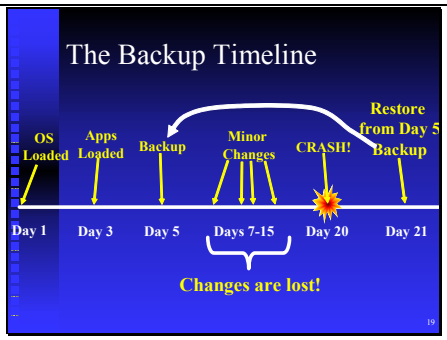
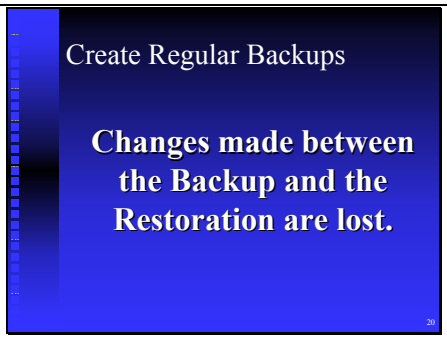
Slide 1		Things don't always go according to the plan. Count on it. And, you should be prepared to fix whatever problems crop up along the way. This exercise and presentation demonstrate one of the most common troubleshooting scenarios, a failed hard drive.
Slide 2		Windows problems have a wide variety of causes. Solving these problems involves four basic tasks. First, you need to identify the symptom. Hopefully the symptom is repeatable, because random problems are the most difficult to resolve. Once you have a clear look at the symptom, you can begin to determine the cause of the problem. Sometimes, this is the most time consuming step. Always eliminate hardware problems before attempting to troubleshoot Windows. Finally, you have to repair the problem. Occasionally the problem is too complex to identify, and the re-installation of some component or software is the solution.
Slide 3		One of the first questions you must answer when attempting to fix a problem on a Windows-based computer is this: Is there a problem with the hardware malfunctioning, or is there a problem with the operating system or file structure?

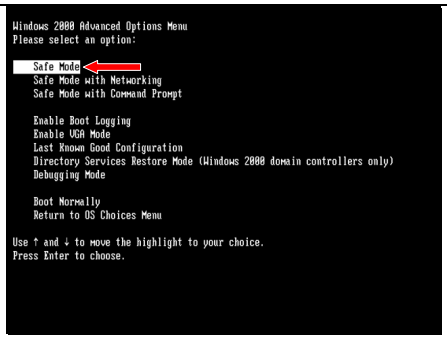
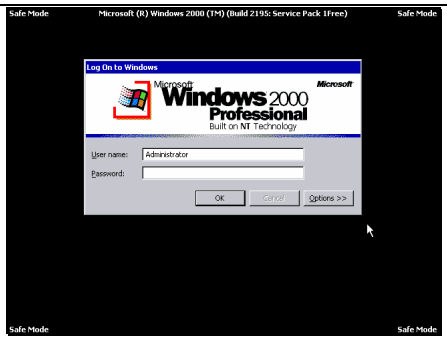
Slide 4		Hardware problems tend to be a bit more severe. That is, in most cases the drive fails completely and there is no mistaking that a serious problem has occurred. You'll hear the computer generate beep codes, grind, or do nothing at all when it should be making normal startup noises. The BIOS may even fail to locate the drive. Drives fail, but their supporting circuitry is often to blame.
Slide 5		Problems that are not caused by physical or electrical malfunctions are often harder to diagnose. These problems are often caused by corruption of the boot records or the boot files. Many times a virus is the culprit, but just as often these problems are the result of a major configuration error.
Slide 6		In this presentation we are going to focus on the big problems, those where something fairly serious is wrong with Windows. You have three tools available to repair the big problems. For smaller problems Safe Mode may help you identify the cause and allow you to solve them. When that doesn't work, you can try to fix a problem from a Windows command prompt. And if that fails to get the system up and running, you'll have to boot the system from a different disk entirely, such as a Startup Disk. But none of these tools can help you restore data that has been destroyed, so let's discuss Backups first.

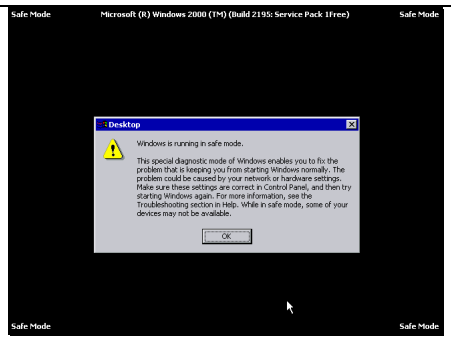
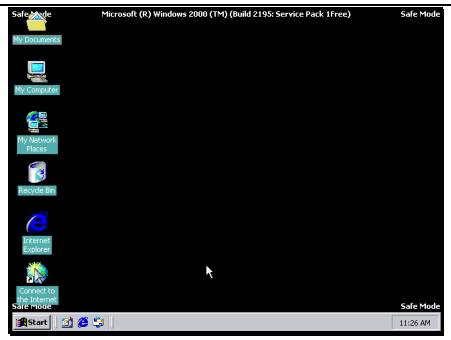
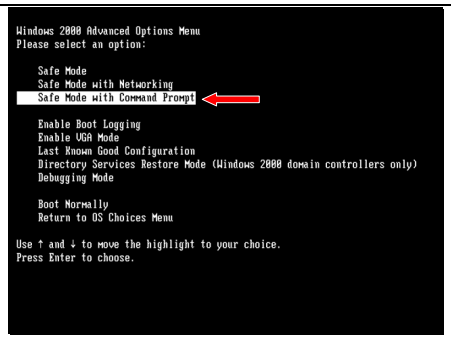
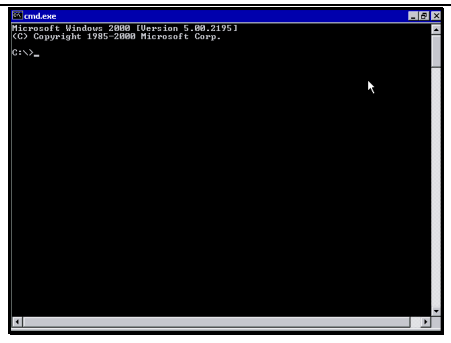
Slide 7		Ultimately your troubleshooting success depends upon how well you are prepared. Do you have the tools you'll need? Do you know how to use them? And, do you have a backup in case the error is unrecoverable? In the PC support industry, time is everything. You can reload an entire computer without too much trouble from the CDs, but it takes time. On the other hand, the creative or analytical work of a business is often not possible to recreate. Some of that data may have taken years to build, and may represent the value of the business itself. What's that backup worth now?
Slide 8		Backing up a PC can be a complex job, which is probably why there are so few backups being made. But once you have a handle on the concepts, it's actually simple and boring. This slide shows the Windows 98 Backup program. It's not too hard to follow, and the Help files make it even easier.
Slide 9		The Backup program in Windows 2000 is more powerful than any previous Microsoft backup tool. It's just as complicated, but there are some Wizards that take us through the basic tasks. Let's take a look at making a backup of the important system files in Windows 2000.

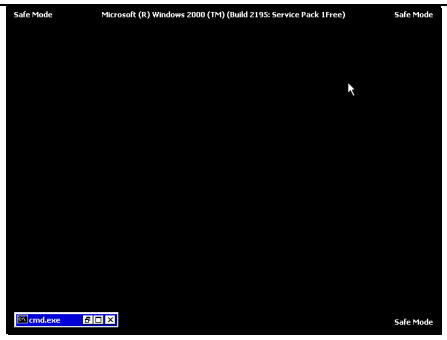
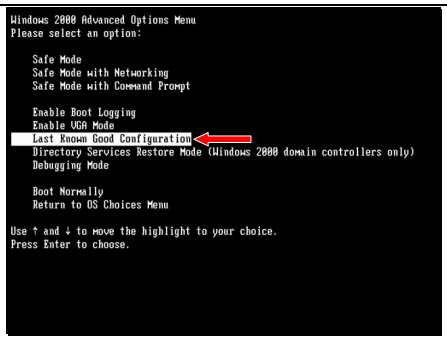
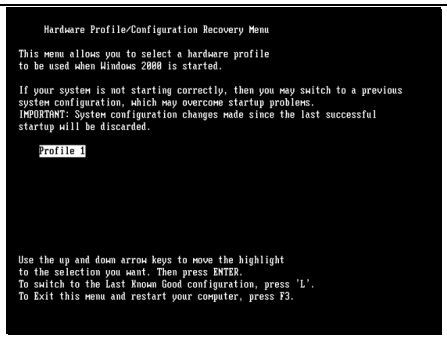
Slide 10		The previous slide showed you the complex side of Windows 2000 backup. Before you get to the complicated interface there are three Wizards that help you perform the most common tasks. Let's use the Wizard to back up the most important system data.
Slide 11		Not much going on here, just click Next…
Slide 12		The default is to back up everything on the computer, but there's really no reason to do that now. Let's back up the System State data.
Slide 13		After you decide "what' to backup, you have to decide "where" to put the backup. In most cases we're talking about a tape drive or some other network drive that is backed up automatically. For now, let's put the backup on the hard drive somewhere. Then later we can put it on a CD or somewhere just as safe.

Slide 14		One of the nicer features of Windows 2000's wizards is a summary screen. All the choices that you selected are shown one last time before the backup actually begins. If you want to change settings you can use the Back button.
Slide 15		Once you click OK, the actual backup starts. The amount of time this requires depends upon how many files you are saving. This one took about a minute.
Slide 16		Finally, the backup is complete. Let's take a look at the report.
Slide 17		This report is a record of how much data was backed up, when it was done, and the elapsed time. You probably don't need this log for a backup of your home computer, but a large company might require that these logs be kept in a safe place.

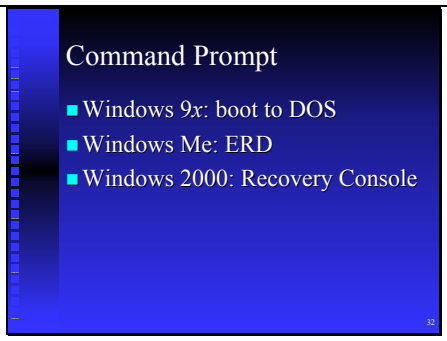
Slide 18		Let's look at a timeline of the events leading up to a typical restore scenario. You install the operating system on the first day, and the applications a couple days later. Everything is working fine on the fifth day, so you make a backup of the system files. Over the next week or so you make minor changes to the system, things like shortcuts and you load some small utility software. On the 20th day, the system crashes. But that's OK, because you made a backup. You restore from the backup and everything is back to normal, right?
Slide 19		Almost back to normal. The backup was created on Day 5, but that backup didn't include the minor changes made during Days 7-15. What does this mean to the system you have just restored?
Slide 20		What it means is that any changes you made between the day you made the backup and the day you restored the crashed system are lost forever. In our example that doesn't amount to much. But imagine you are building a website for a big customer, your backup was made three months ago, and the new websites aren't backed up…what does that crash mean to you then?

Slide 21		Now that you have a backup, you can aggressively work on fixing the system. You have covered Safe Mode before, but it's worth a quick review. Safe mode is a way to launch Windows without using a huge list of drivers and services. The idea is to isolate problems by process of elimination. If the problem is solved when running the Windows in Safe Mode, you have narrowed the possibilities substantially. Problems that disappear when Windows is launched in Safe Mode are usually caused by device drivers and Registry problems.
Slide 22		You've seen the method for launching Windows 9x in Safe mode. In Windows 2000 you need to press the F8 key when you see this screen.
Slide 23		This should look familiar, although many of the options are different and it's now called the Advanced Options Menu. You have lots of choices here, so let's take a look at a few of them. First we'll take a peek at the Windows 2000 Safe Mode option.
Slide 24		The first thing you see, naturally, is the logon dialog.

Slide 25		As if you had no idea what this was, a warning pops up to let you know that you are running Windows in Safe Mode.
Slide 26		This is what you get! Most of your applications should run in Safe mode, but a few may have trouble. If you are experiencing odd video-related problems, and they disappear in Safe Mode, you can bet your video drivers aren't working properly.
Slide 27		Another option is Safe Mode with Command Prompt. Before you start thinking that you can get at a real command prompt in Windows 2000, let's see what this startup option actually provides…
Slide 28		…this is what you get, a virtual DOS window. Maybe there's something behind all of this, so you'll minimize the window…

Slide 29		…and this is all you get. You're not really at a DOS prompt, you're at the Command Line Interface without the Windows GUI in the background. From the command prompt, you may be able to resolve some problems, or tweak a setting in a configuration file to kick-start Windows. But that's about all.
Slide 30		The last important choice we're going to cover is the Last Known Good Configuration.
Slide 31		If you choose the Last Known Good Configuration you will see this screen. Why Last Known Good? The idea here is to step back in time and use a configuration that appeared to be working properly. This isn't like Windows 98's Scanreg that allowed you a choice of five previous configurations, here you get just one point in time to choose from. However, if you install something and it crashes your system, or you make a major configuration mistake in Windows 2000, the Last Known Good Configuration might save your day. This option also exists in Windows NT4, but it is presented a little differently.

Slide 32

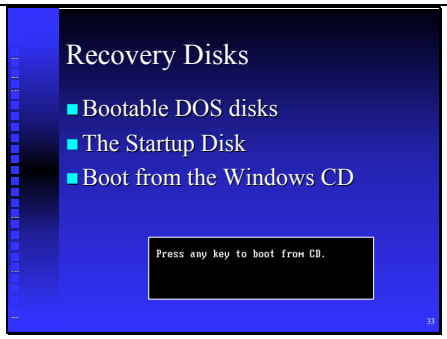


If the problem is more serious, say a critical system file is missing or corrupt, You may not be able to get Windows to launch Safe Mode. In this case you can get to a "real" command line to attempt a fix. In windows 9x, you can boot to a DOS prompt through the Startup Menu, or your Startup Disk. This is very much like real MS-DOS, and you can use all your DOS skills to copy, delete, edit and replace configuration files and drivers.

Windows Me eliminated the DOS prompt option. You must build and boot a Startup Disk to see a real DOS prompt in Windows Me. From there, you need to know your DOS because many of the old trusted tools have been changed.

With Windows 2000, you need to use the Recovery Console to get to a command prompt. This is a whole new tool, so we'll be taking a closer look in a moment.

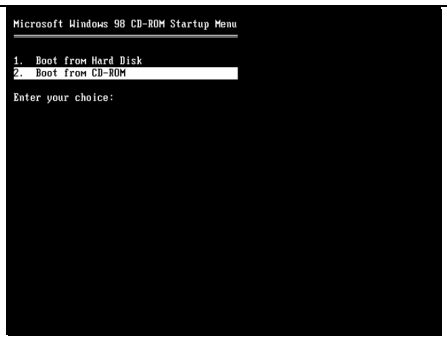
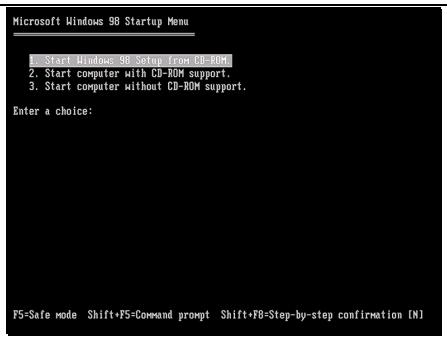
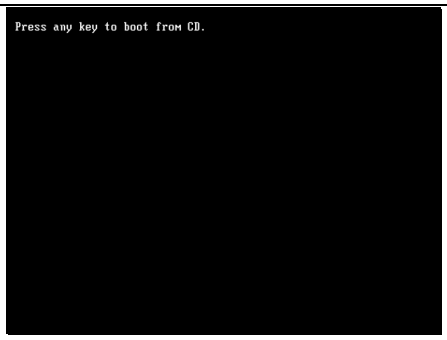
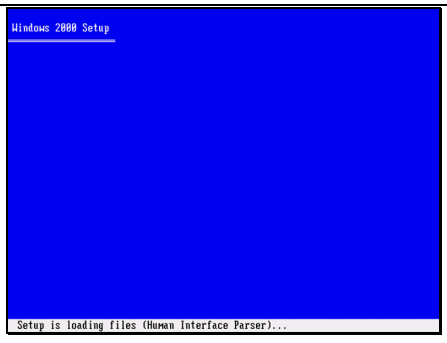
Slide 33

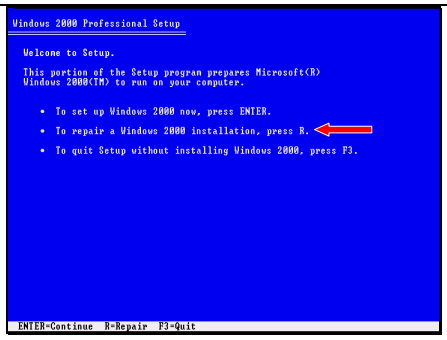
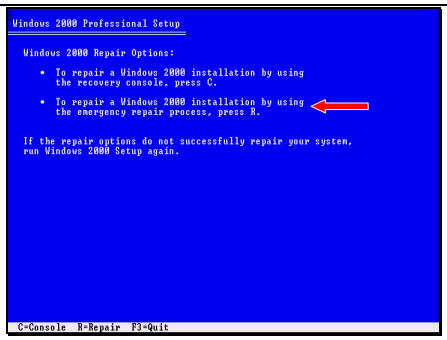
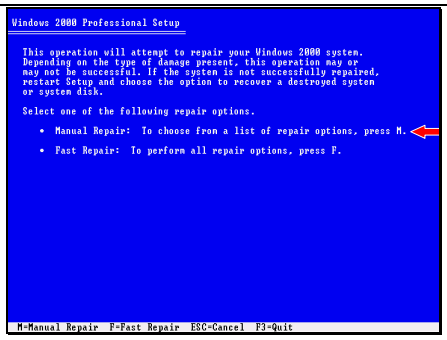
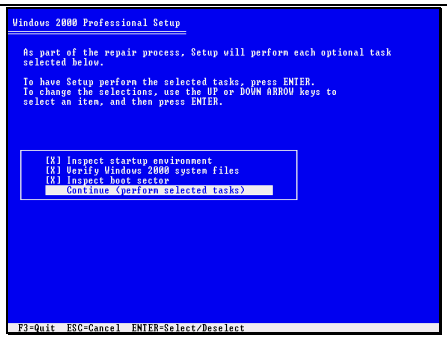


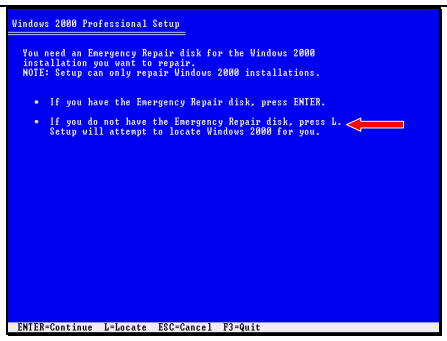
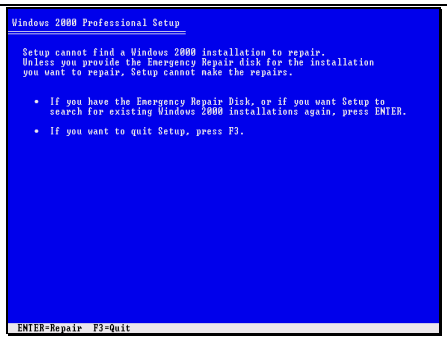
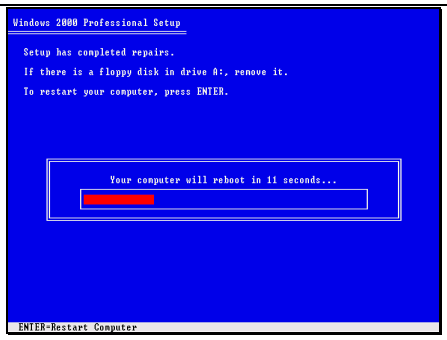
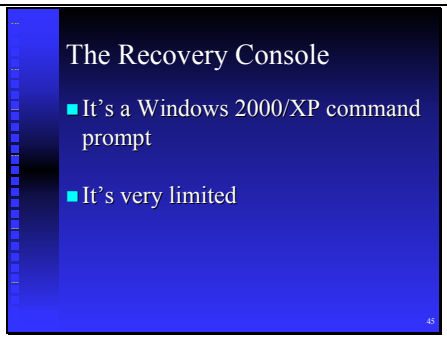
When the system won't even boot, you have to boot from another disk. In Windows 9x this can be essentially any bootable disk. You want to use a bootable Startup Disk created by the OS you are troubleshooting, but it isn't completely necessary in an emergency.

Most Windows 98 CDs, and all Windows ME and 2000 CDs are bootable. Configure the BIOS boot sequence to look for the CD first, and insert the Windows CD. The exact method depends upon the BIOS in your computer, with some systems you'll briefly see the message shown here.

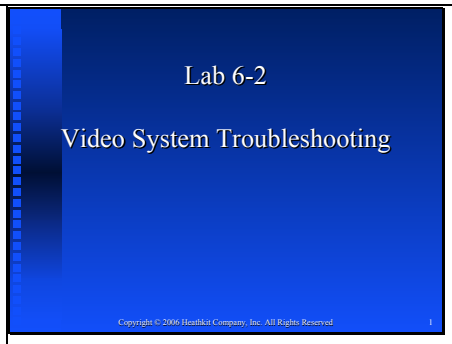
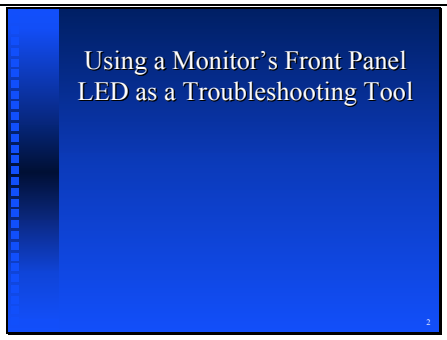
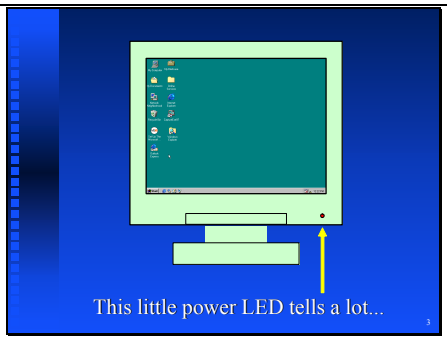
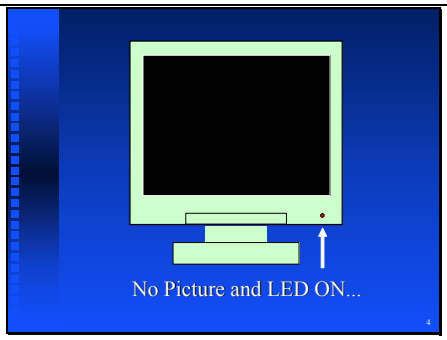
The Windows CD will give you the option of booting from the hard drive or booting from the CD. You will also have the option of installing the OS, but you don't want to do that. If you boot from the CD you will be taken to a DOS prompt where you can repair the trouble.

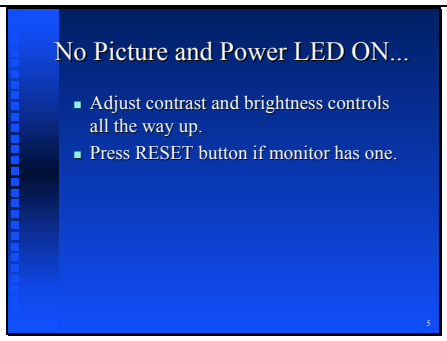
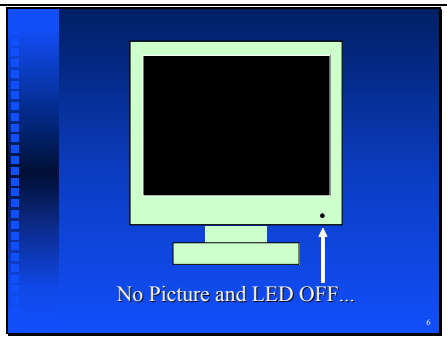
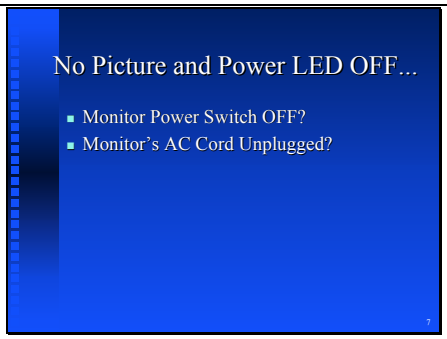
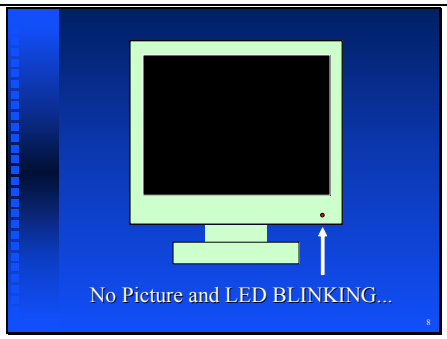
Slide 34		When you attempt to boot from the Windows 98 Installation CD, the process is straightforward. Choose the boot drive here.
Slide 35		And choose how you want to boot here. You can begin Setup directly, or start the computer by booting from the CD ROM. Most computers are going to make the CD drive look like A:, so be careful.
Slide 36		Again, in Windows 2000 you get this message. This one isn't up on the screen for long, it's there so you don't get stuck booting from the CD if you accidentally leave the CD in the drive.
Slide 37		Next, you see this Setup screen. No, we aren't installing Windows 2000 yet…

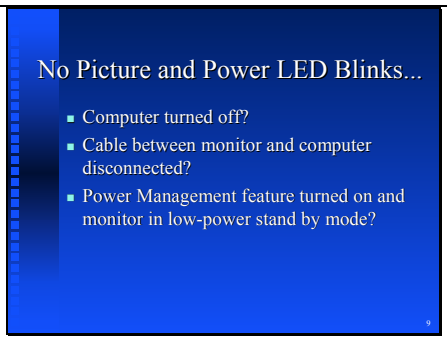
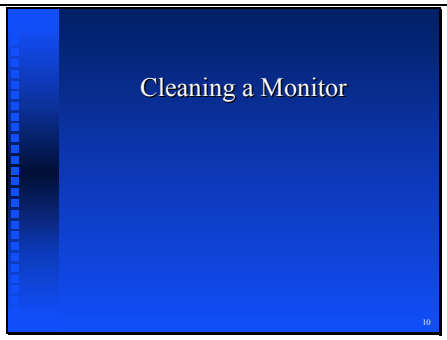
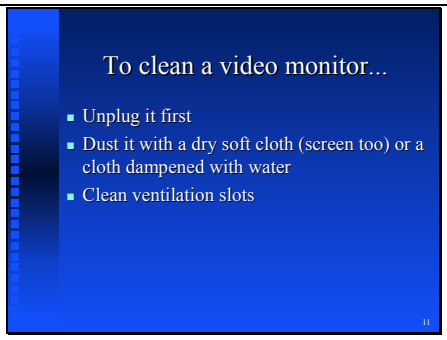
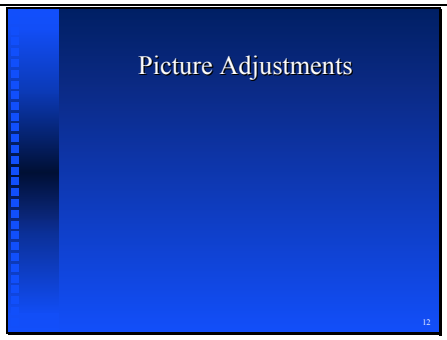
Slide 38		Windows 2000 is just preparing itself for these options. You can begin Setup, Quit, or repair Windows 2000. Let's follow the repair option.
Slide 39		Here you have two more choices: run the Recovery Console or attempt an emergency repair. We will discuss the Recovery Console in a moment, so let's take the emergency repair option.
Slide 40		Two more options…Fast Repair doesn't sound like any fun, so let's see out options under the Manual Repair menu.
Slide 41		By default all three repair tasks are selected. Let's leave it this way, and see what happens.

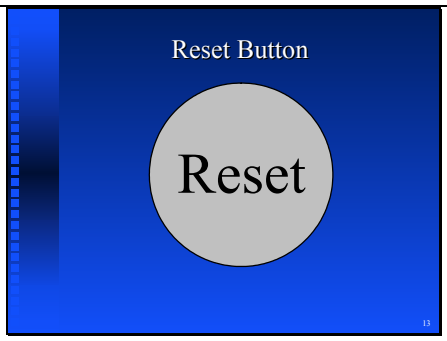
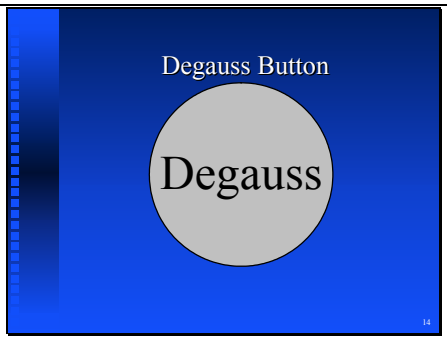
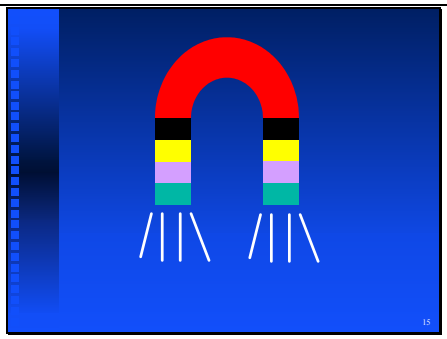
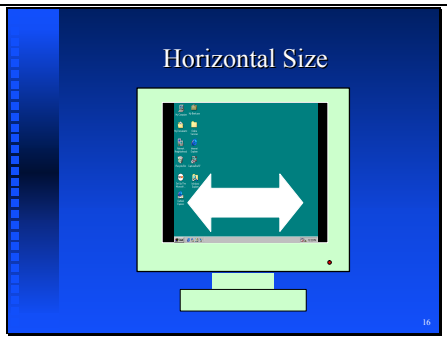
Slide 42		Here's one more reason to make that ERD…Setup can't fix Windows very well without it. If you have the disk then the process continues. But, let's see what happens if we don't have our ERD.
Slide 43		Your chances of repairing Windows 2000 without that ERD are slim. As shown here, Setup can't find an installation to repair. What makes this so much more interesting is that the existing Windows 2000 installation is default all the way. From here you can circle through the last few screens, but you won't make any progress. Which leads us to…
Slide 44		…this. Actually, there were no repairs completed. So what's next? The final option is the Recovery Console. Let's take a peek at how it works.
Slide 45		Windows 2000 presents a special problem because there are no Startup Disks and you cannot make bootable floppies. The Recovery Console is the answer. The console is a command-line interface that can read an NTFS disk, with limited functions.

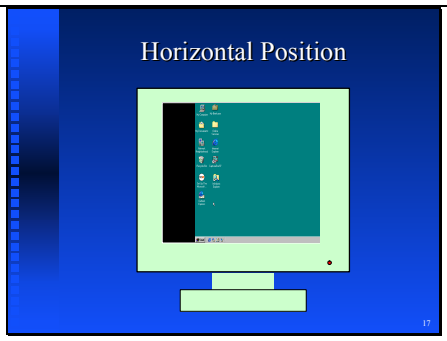
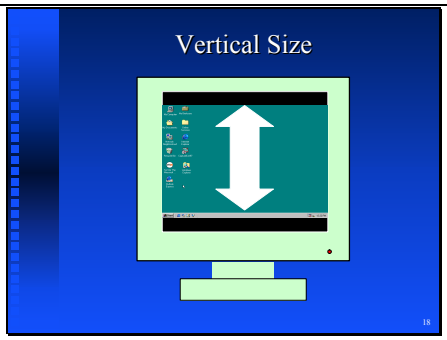
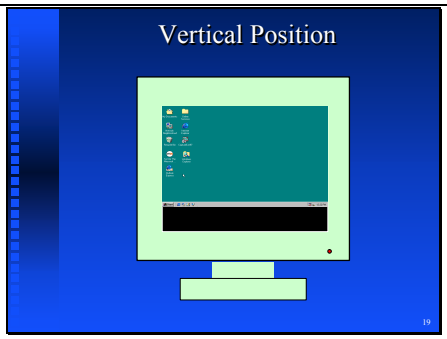
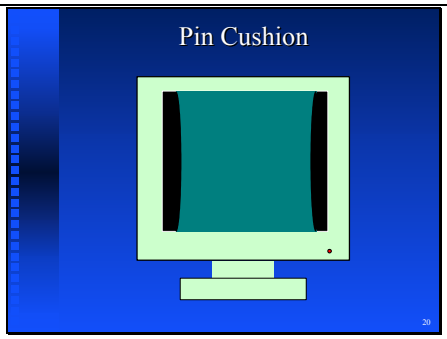
Slide 46		As you can tell, recovering from serious problems often requires all of your talent and skills. Let's put them to use in the lab.

Slide 1		Today you will learn some basic video troubleshooting techniques.
Slide 2		A very simple, yet important video troubleshooting tool is the monitor's power indicator on its front panel.
Slide 3		This little light tells you a lot about the operation of the video system. It not only tells you the video monitor is on, but it also provides other valuable troubleshooting information.
Slide 4		Let's say a user calls you, the #1 troubleshooter working at ABC Manufacturing Company. He tells you that the monitor is displaying nothing. The screen is dark and the power LED on its front panel is continuously lit. What is the first thing you would do when you arrive at his office?

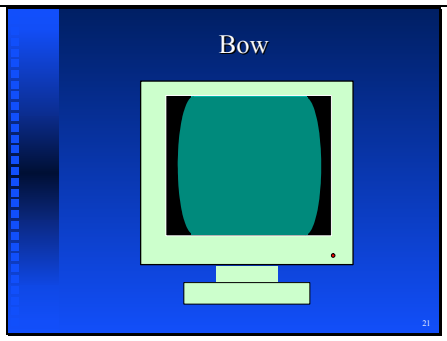
Slide 5		First check the contrast and brightness controls. Make sure someone has not turned them all the way down. If the monitor has a RESET button, push it. This sets the monitor's adjustment controls back to the factory default values. Could you be lucky enough to have the display work now?
Slide 6		Maybe you notice that there is no picture and the LED power light is OFF.
Slide 7		Check the monitor's power switch. Is it turned OFF? Is the monitor's AC cord unplugged? After crawling under the desk and damaging your elbow for life reaching behind a file cabinet, you may discover that the maintenance person caught the monitor's cord in the floor buffer and pulled it out. Again, could the solution be this simple?
Slide 8		Maybe there is no picture and the power LED is blinking.

Slide 9		Is the computer turned OFF? Is the video cable between the computer and the monitor disconnected? Did the power management feature kick in and put the monitor in the low-power stand by mode? Check the power management setting at the Control Panel's Display Properties Screen Saver screen. Also check the Power Management Properties extension in the Control Panel. You'll study this more in your lab.
Slide 10		The best way to keep a computer system up and running is to practice good preventive maintenance. That way you can put off the inevitable troubleshooting a little longer. Keeping the monitor clean helps keep the video system running.
Slide 11		Here's how you clean a video monitor. First unplug it. You are probably getting the message by now that this is an important rule in computer troubleshooting. Don't take risks with your life. Be safe. Unplug the monitor before you clean it. Dust it with a dry, soft cloth or a cloth dampened with water. Don't use any cleaners or waxes. Just use plain old water. Clean the screen this way too. Be sure to remove any dust and dirt buildup in the air slots. Monitors run at a high temperature and need all the air they can get to keep going.
Slide 12		A common video troubleshooting call involves minor picture adjustments. Over time the user's video monitor doesn't display like it used to. This is normal and you can do several things to improve the display.

Slide 13		Sometimes a user adjusts the video monitor's controls and makes the display quality worse. If the monitor has a Reset button, push it to return the monitor's settings to the factory defaults. The factory default settings are fine for most users. At least they are a good starting point for you to make other changes from.
Slide 14		What's a Degauss button?
Slide 15		Maybe in a physics class or an electronics class you learned about magnetism? A gauss is a unit of magnetic flux density. When you see a Degauss button, just think of magnetism. Over time, a monitor's color purity is negatively affected by magnetism developed inside the monitor. The monitor's picture tube uses magnetism in its basic design. Eventually, some stray magnetism affects the picture. The Degauss button removes these color impurities.
Slide 16		Let's discuss some of the common picture adjustment controls found on a monitor. These controls are usually located behind a small door on the front panel. The Horizontal Size control adjusts the size of the picture, horizontally. Adjust the picture so it fills the screen. We don't want to waste any of the available screen space.

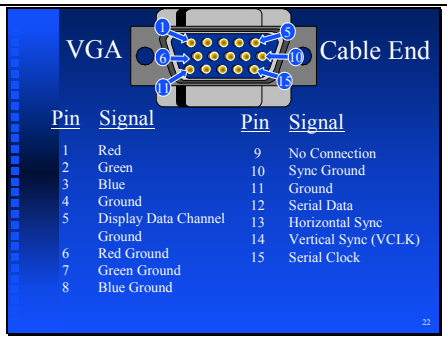
Slide 17		The Horizontal Position control adjusts the horizontal position of the display. Adjust the display so it is centered.
Slide 18		The Vertical Size control works like the Horizontal Size control except it adjusts the size of the picture vertically. Again, adjust the picture to fill the screen.
Slide 19		Any idea what the Vertical Position control does? That's an easy one isn't it. Like the Horizontal Position control, it adjusts the vertical position of the display. Adjust the Vertical Position control to center the picture vertically.
Slide 20		Have you ever sat down at someone's computer and the screen looked like it was warped? This is the pin cushion effect. You can adjust the Pin Cushion control to make the sides of the display straight.

Slide 21



Another effect is called bow. Use the Bow control to make the sides of the display straight.

Slide 22

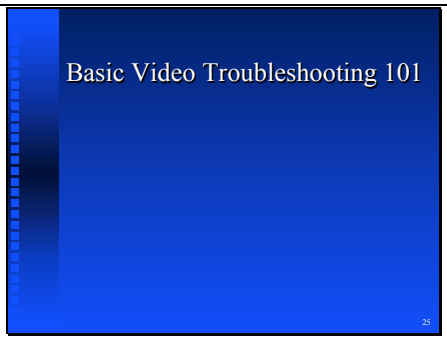
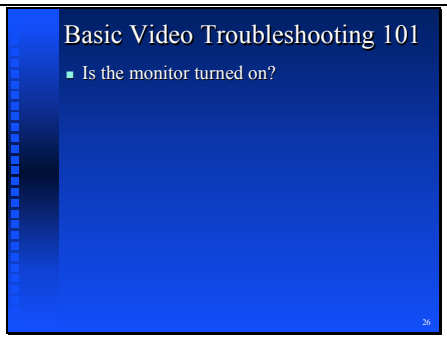
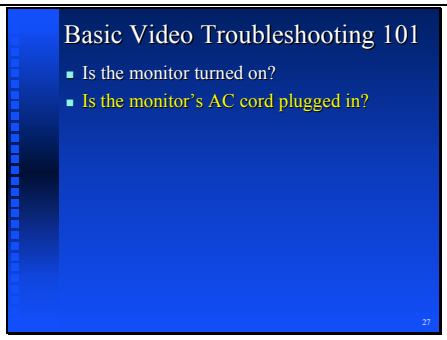


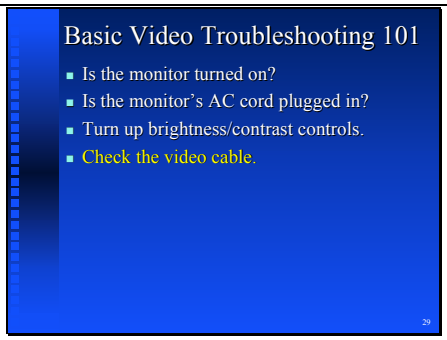
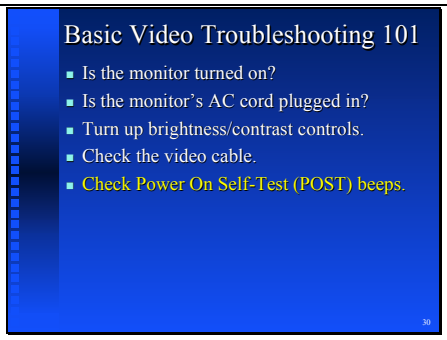
While not something you are going to be asked to recite from memory every day, it's helpful to know what signals are traveling through the video cable connecting the computer to the video monitor. The connector on the end of the cable is called a 15-pin D-sub connector.

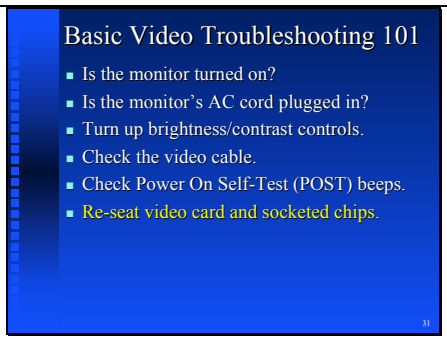
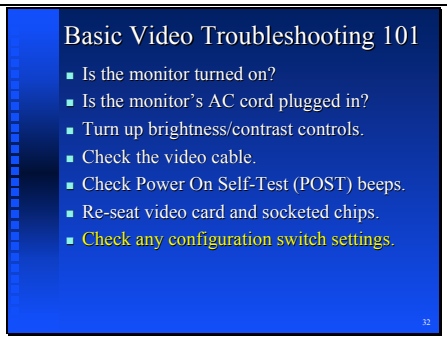
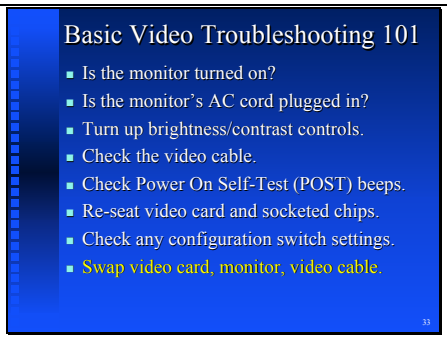
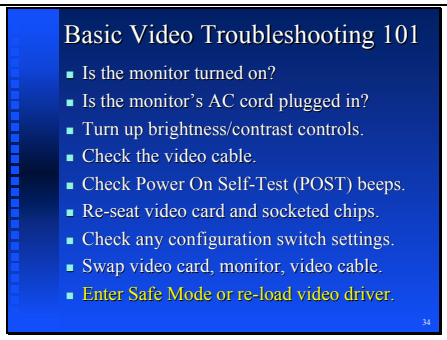
Here's what the video cable's connector looks like. Each side of the connector has a thumbscrew that holds the connector to the computer. People often don't take the time to tighten these thumbscrews so the cable can come off from the video card. When investigating a video problem, make sure the cable is properly connected to the computer's video connector and that the thumbscrews are tight. The primary signals in a VGA cable are the Red, Green and Blue signals. The display colors are made from these three colors. The other signals are grounds, sync, and clock signals.

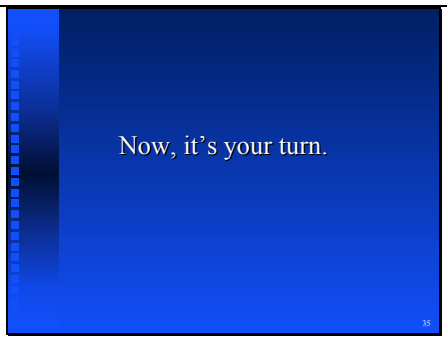
Slide 23

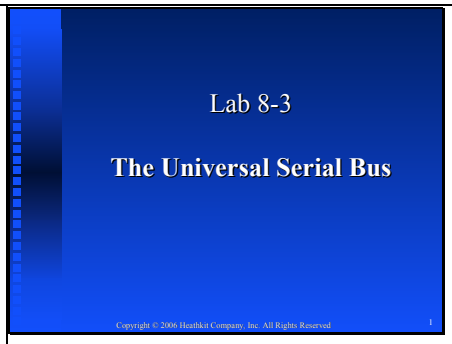
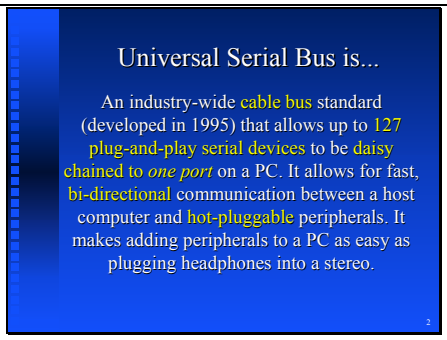
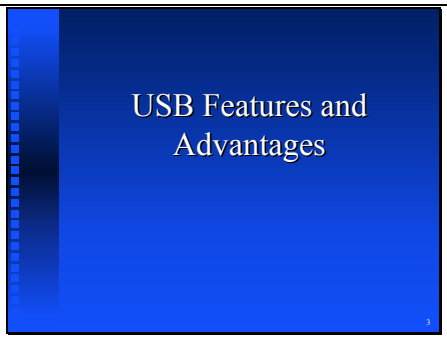
Assume that we did a monitor swap to fix a user's video problem. The new monitor works fine and the user is all smiles. You decide that you can save your company money if you fix the monitor yourself. How do you open the monitor and repair it?

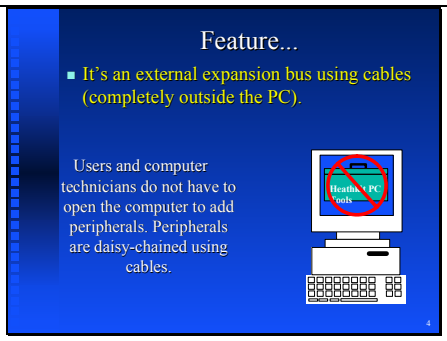
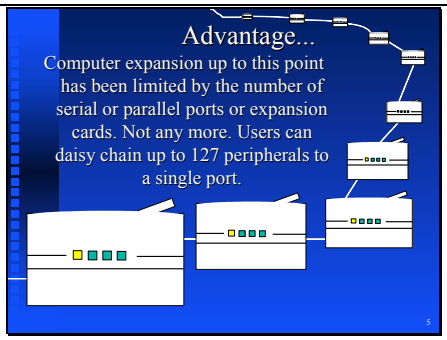
Slide 24		You don't! Save this task for someone who has special training in video monitors. Besides containing complex circuitry and circuitry that just isn't repairable, there are extremely high voltages present. These high voltages can kill. *Never*, and I'll repeat it again, *never* open a monitor and attempt to repair it. Save that job for an expert.
Slide 25		Let's take a look at some basic video troubleshooting techniques. Assume a user calls and says her monitor doesn't work. You pay her a visit and follow these steps…
Slide 26		Make sure the monitor is turned ON. Do this first. Nothing is worse than to have a user point out to you 60 minutes later that the monitor is turned OFF. Avoid embarrassment at all cost! Check the obvious first!
Slide 27		Along the same lines…make sure the monitor's AC cord is plugged in. Not only make sure it is plugged in, but also make sure the AC outlet it is plugged into works.

Slide 28		Turn up the monitor's brightness and contrast controls. Again, this is a simple problem with a simple solution. But you would be surprised at how often this happens. The user decides she is going to dust off her computer and monitor. While doing so she accidentally changes the contrast and brightness settings and can no longer see the display.
Slide 29		After checking the monitor over, check the video cable. Like I mentioned earlier, make sure the cable didn't come unplugged from the computer. Make sure it is plugged all the way in and that the thumbscrews are tight.
Slide 30		Reboot the computer. And that means a *cold boot*. Turn the computer OFF. Wait a short period of time and turn it back ON. Listen for the Power On Self-Test (POST) beep. You will hear one beep during a normal boot. If you hear one long beep followed by two short beeps, chances are the video card is bad. Today's modern computers, like your lab test computer, shut down automatically if the video card is defective. You'll hear one beep and will never hear the long and two short ones. If you have time you can try this during your lab. Just remove the video card and reboot. Does anyone know why you need to do a cold boot and not a warm boot? (Instructor: a warm boot bypasses the POST tests).

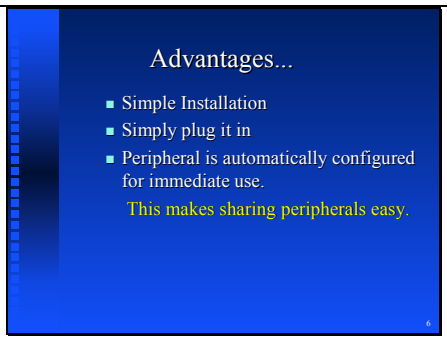
Slide 31		Check the video card to be sure it is seated all the way in its socket. If the video card has any chips in sockets, make sure those chips are properly seated. Chances are today you won't run into many video cards with socketed integrated circuits. But you will more than likely work on some older machines now and then.
Slide 32		If the video card has any configuration switches, check to make sure they are set right. It's very unlikely users will open the computer and try to fix a problem themselves, but then again, who knows.
Slide 33		Still not having much luck in solving the video problem? Swap out the video card, monitor, and video cable with replacements that you know work. Swap one at a time and reboot the computer to see if that item is the problem. Sometimes a monitor has a video cable permanently connected to it so you may not always be able to swap the cable.
Slide 34		And finally, enter Safe Mode or re-load the video driver. We studied Safe Mode some time back. Safe Mode loads a simple, basic, no frills VGA driver. If this solves the problem, you know the video driver is the problem. Re-load the driver and see if that helps. Software drivers are far from perfect. Applications and fatal system problems can corrupt them. Sometimes just re-loading the driver will fix a video problem.

Slide 35		Now it's time to do the lab workbook and to learn more about video troubleshooting.

Slide 1		Welcome to Lab 8-3. Today you will learn how to install a USB device and take a look at a few of today's common USB devices.
Slide 2		You will attach a Universal Serial Bus device to your computer in your lab today. Since we will be working with a USB device, it's probably a good idea to discuss what exactly USB is. USB is an industry-wide cable bus standard developed in 1995 that allows up to 127 Plug-and-Play serial devices to be daisy chained to one port on a PC. It allows for fast, bi-directional communication between a host computer and hot-pluggable peripherals. It makes adding peripherals to a PC as easy as plugging headphones into a stereo. In this presentation we'll touch on each of these features and explain their advantages.
Slide 3		Let's talk about some of USB's features and the advantages these features offer.

Slide 4		USB is an external expansion bus using cables. All USB cables and peripherals are outside the computer. What's the advantage of an external expansion bus? The big advantage is that users and yourself, as a troubleshooter, do not have to open the computer to add peripherals or to troubleshoot a USB problem. All USB peripherals are daisy-chained to each other using cables. Daisy chained means that they are attached with cables serially, one right after the other.
Slide 5		Another USB feature is that you can daisy-chain up to 127 USB peripherals to one port. Most computers today have two USB ports, so you can connect 254 USB devices to one PC. That sounds like a lot. But then again, ten years ago nobody thought you would demand 128 megabytes of memory in your computer! Being able to daisy-chain a lot of peripherals to the PC using cables is definitely a big USB advantage. Up to this point, computer expansion has been limited by the number of serial and parallel ports on the computer and by the number of free expansion slots inside the computer. But USB changes all that, since you can connect so many USB peripherals to a single USB port.

Slide 6

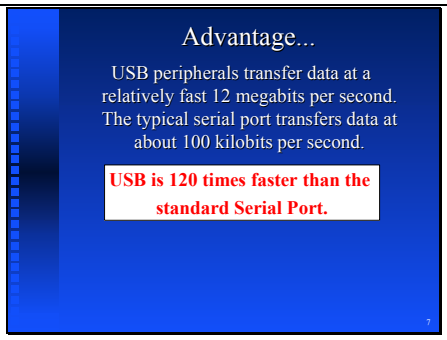


The Universal Serial Bus...has Plug-and-Play capability, is hot-pluggable, and configures peripherals automatically.

This advantage is great when you add a new peripheral to the system. All you have to do is plug the USB peripheral into the USB with a cable while the computer is running. The computer automatically detects the new peripheral and configures it so you can use it immediately. You no longer have to worry about interrupts, I/O addresses, memory addresses, and so on. You don't even have to reboot. And removing a USB peripheral works the same way—the Universal Serial Bus does all the work.

What a great advantage for people who need to share peripherals. For example, when someone brings their laptop computer to your office and wants to print a report from it, they can just plug into the printer's USB port and print the report. They don't need a driver and don't have to worry about configuration. USB does all the work for them.

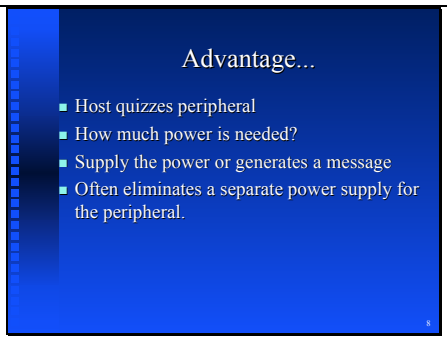
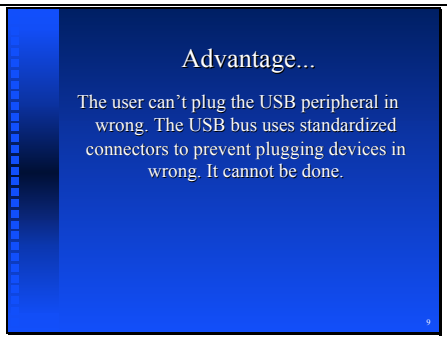
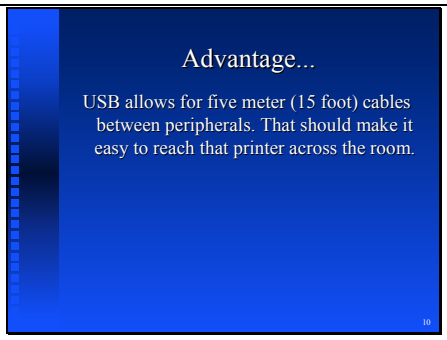
Slide 7

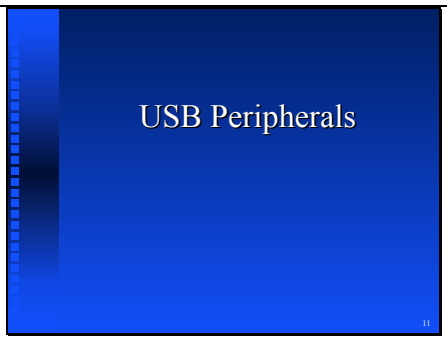
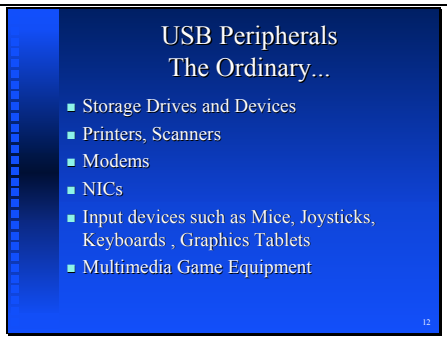


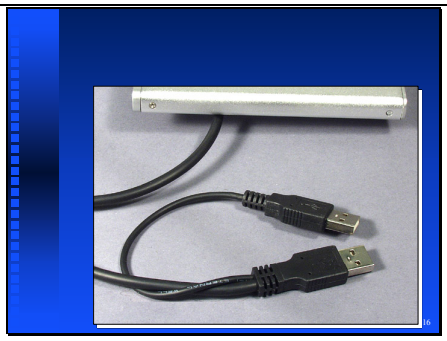
USB transfers data at 12 megabits per second. For slow devices that don't require that kind of speed, it transfers data at 1.5 megabits per second.

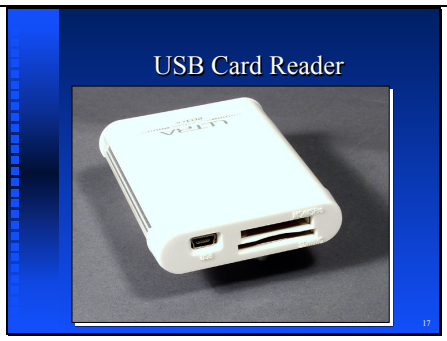
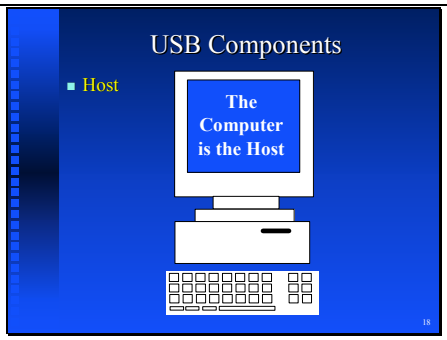
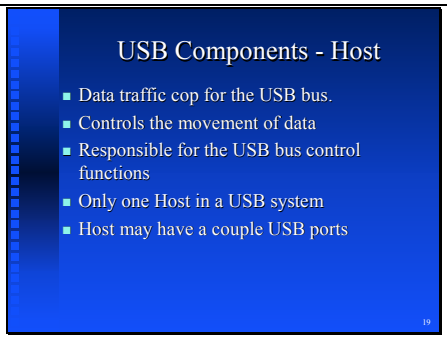
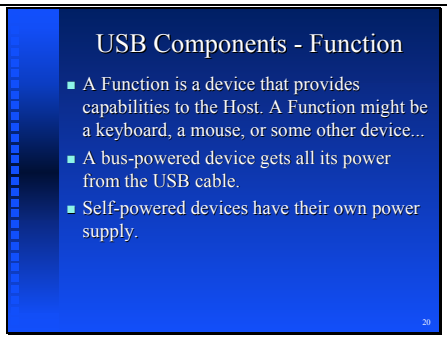
USB's 12 megabits per second rate is pretty fast when you stop and consider that a PC's standard serial port transfers data at 100 kilobits per second.

So USB is 120 times faster than the standard PC serial port.

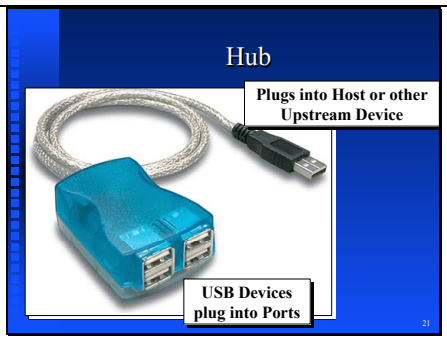
Slide 8		A very nice USB feature is that USB peripherals can often be powered by the USB bus. The USB bus supplies plus 5 volts DC to peripherals that need it. When you plug a USB peripheral into the USB bus, the host, the computer that is, quizzes the USB peripheral to find out how much power it needs. The USB bus then supplies power directly to the USB peripheral or it generates a message telling the user that the USB peripheral needs more power than the USB bus can supply. This is a nice advantage because being able to supply power to a peripheral means that a separate power supply or power cube can often be eliminated. That saves not only money but also "cord clutter." Having fewer power supplies cuts down on the mess of cords in the computer area.
Slide 9		USB uses standardized connectors. It has only two types of connectors, Type A and Type B. We'll look at these in a few minutes. Having standardized connectors means a user can't plug a USB peripheral in wrong. It can't be done. If the peripheral is plugged in at all, you know it's plugged in right.
Slide 10		You can use five meter-long cables between peripherals. Five meters is about 15 feet. That should make it easy to reach that printer across the room.

Slide 11		Let's take a quick look at the different types of USB peripherals.
Slide 12		First of all, there are many USB peripherals that fall into the "ordinary" category. You can buy USB peripherals that are... • Cartridge, tape, and floppy drives • Modems • Printers and scanners • network interfaces • Input devices like mice, joysticks, keyboards, and graphics tablets • Multimedia game peripherals
Slide 13		Here are "unordinary" USB peripherals... • Digital Cameras, Biometric security devices, Multi-user games, Digital audio devices Hubs allow you to connect more peripherals to a USB system. We'll talk more about hubs in a minute. CTI devices are Computer Telephony Integration devices. They allow you to control telephone equipment with your computer. For example, in a small office you might use a computer to manage voice mail, faxes, calls that come into the office, and so on. Biometric security devices are used to read a person's fingerprint and to decide if they are allowed access to something such as a bank account program. Multi-user games allow a user to join in a game already in progress and to leave the game without interfering with other players.

Slide 14		The most common USB device being used today is the flash storage plug. These are often called a thumb drive, pen drive, or jump drive. They come in hundreds of shapes and sizes, as well as memory capacities. 128 MB models can be had for under $10, and prices for these smaller units are still falling.
Slide 15		One step up from flash drives are USB hard drives. These units have recently become inexpensive, often going for less than $30 for a 6 GB drive. While the capacity and cost-per-megabyte is lower than flash drives, hard drives remain fragile and potentially easy to damage with rough handling. Flash drives, having no moving parts, can be tossed around continuously. This drive is actually a standard 40-pin 2½-inch IDE drive, with the addition of an IDE-to-USB adapter board. Very simple.
Slide 16		Another problem with some USB hard drives is the need for power. Drives may require more power than a single USB port can provide. Look at this drive cable for an example. The drive requires the combined power provided by a pair of USB ports before it can operate properly.

Slide 17		Another common USB device is the memory card reader. These come in all shapes and sizes, and some readers can read many different types of cards. The one shown here has four different slots, two in front and two in back. This device shows up in Windows Explorer as four different drives.
Slide 18		Up to this point we've just touched on USB. We've looked at what it is, what its features and advantages are, and different types of USB applications. Now let's dig a little deeper and take a look at the technical side of USB. Let's first look at the different components USB is made of. First there's the host.The host is actually the computer itself.
Slide 19		The host is the traffic cop for the USB bus. It controls all data transmissions over the bus. The host is also responsible for the USB control functions. The control functions are the tasks that are performed when a USB device attaches or detaches from the USB bus. There is only one host in a USB system although that host might have a couple of USB ports like many computers today do.
Slide 20		Another USB component is the function. A function is a device that provides capabilities to the host. In other words, it does something for the host. A function might be a printer, a keyboard, a mouse, or any other device. You might hear the terms "bus-powered device" and "self-powered device." A bus-powered device gets all its power from the USB bus. Modems and joysticks are examples. A self-powered device has its own power supply. Printers and scanners are examples.

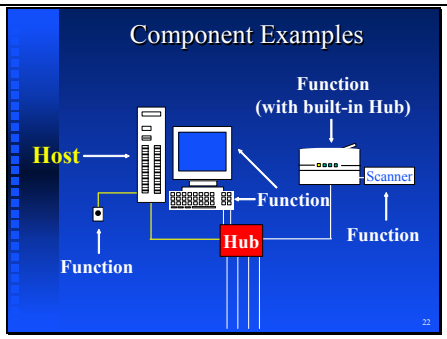
Slide 21



Earlier we mentioned hub. A hub is another USB component. A hub is an expansion device for connecting other devices to the USB bus. Hubs can be stand-alone devices or can be built into keyboards, monitors, printers, and so on. A hub provides power functions and attach/detach functions for the USB devices that connect to it. Only one USB device has to plug into a PC's USB port. If this one device is a hub, then other devices can plug into the hub.

A hub is nothing more than a box with a number of port connectors and a cord with a USB connector on the end to plug into the PC's USB port. It could also be plugged into a port on another hub.

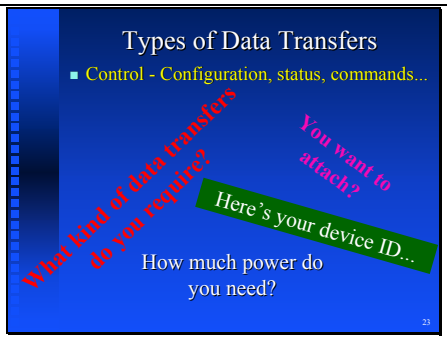
Slide 22



Okay, let's look at an example USB system showing all three USB components—host, function, and hub.

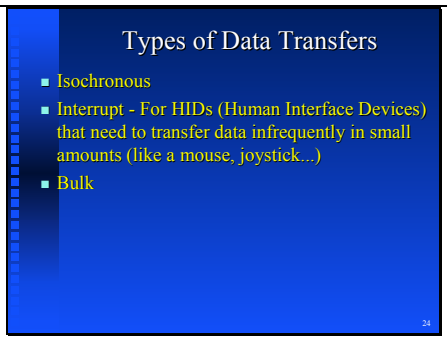
In this picture, the computer is the host. It's the only host in the system. The trackball is a function and is plugged into one of the PC's two USB ports. The hub plugs into the other PC USB port. The keyboard and monitor, also functions, plug into the hub. The printer is a function with a built-in hub and plugs into our stand-alone hub. The scanner, also a function, plugs into the printer's built-in hub.

Slide 23



The primary function of the USB system is to transfer data on its bus. Let's look at USB data transfers. The first type of data transfer is the *Control* transfer. It is simply the questions the host asks peripherals and the answers they send back to the host. Control transfers are used for USB bus configuration, Status information sent between host and function, and commands from host to function.

Slide 24



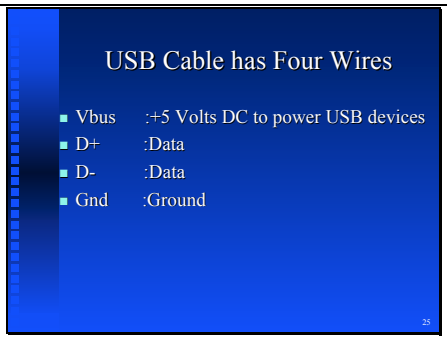
Another type of data transfer is the *Isochronous* transfer (eye-*sock*-runus). This type of transfer has bus priority—in other words, if a USB peripheral that uses Isochronous transfers needs to use the bus, it gets the bus.

Peripherals that use Isochronous transfers are telephone applications, digital audio applications, and other applications that are time critical. Take audio as an example. What would the CD you are playing sound like if the USB CD-ROM drive it is being played on isn't allowed to use the bus when it needs it? Words might be skipped, the tone could be off, and so on.

The third type of USB data transfer is the *Interrupt* transfer. This is used by HID (Human Interface Device) peripherals that need to use the bus once in a while and for small amounts of data. Examples of peripherals using Interrupt transfers are the mouse, joystick, and so on.

The fourth, and last, type of USB data transfer is the *Bulk* transfer. It's used by peripherals that need to transfer large amounts of data on the USB bus. These devices might be printers, scanners, and so on.

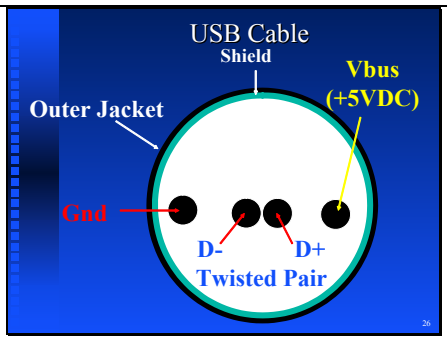
Slide 25



One of the nice things about USB is that it uses simple cables. The USB cable has four wires. Here's what they carry...

- Vbus wire: The +5 volts DC used to power bus-powered peripherals.
- D+ wire: A data signal
- D- wire: Another data signal
- Gnd wire: The ground wire

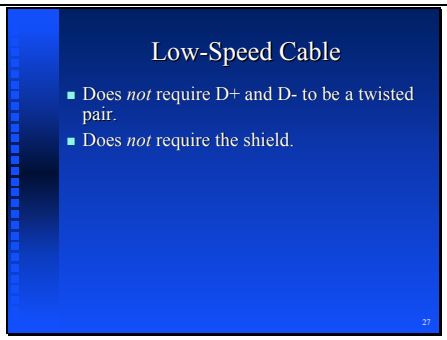
Slide 26



Here's what a cross-section of a USB cable looks like.

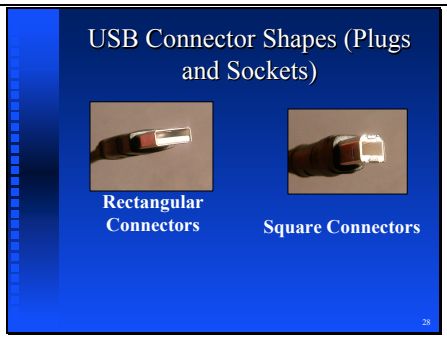
The two data wires, D+ and D-, are twisted together like a twisted pair cable. The ground and 5 volt DC wires are near the cable's outside. A shield surrounds the cable for noise protection and the outer jacket protects the wires inside from physical damage.

Slide 27



You will sometimes see a low-speed cable instead of the cable we just looked at. The low-speed cable is used by some devices where noise is not a problem. The low-speed cable does not require the D+ and D- wires to be a twisted-pair, and it does not require the shield around the outside of the cable.

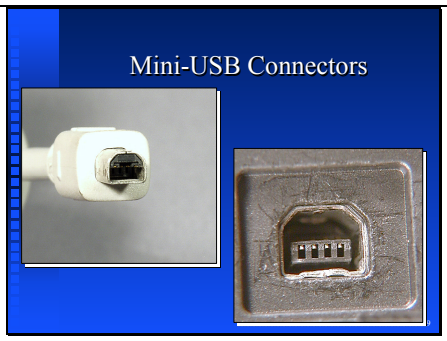
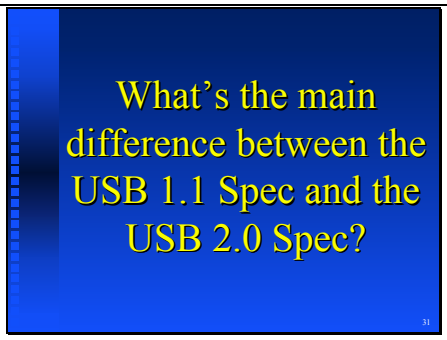
Slide 28



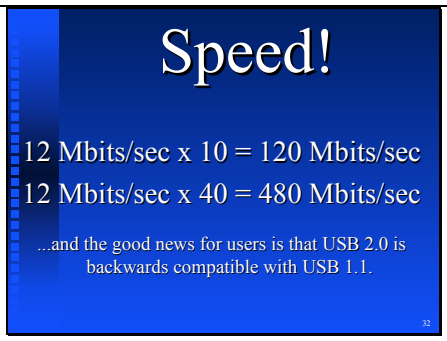
Earlier we touched on the USB connectors by saying that they are standard connectors and the user cannot plug them together wrong. There are two basic types of USB connectors—Type A and Type B. You can easily tell them apart by their shapes. These shapes are the same whether the connector is the plug or the socket.

- Type A connectors are shaped like rectangles; wide but not very high.
- Type B connectors are shaped like squares.

These are the only two types of USB connectors.

Slide 29		These are the second-generation of USB connectors, used for devices such as digital cameras and inexpensive data devices.
Slide 30		These connectors are used for newer USB cameras, and those devices that utilize USB 2 data transfer speeds.
Slide 31		USB has been around since 1995. The second generation USB specification is USB 2.0. How does USB 2.0 compare with USB 1.1? There's one main difference between USB 1.1 and USB 2.0. What's that difference?

Slide 32

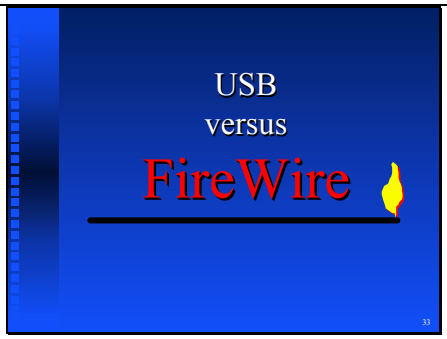


It's just a little thing called *speed*. USB 2.0 increases data throughput by a factor of 10 or 40 times.

The current USB 1.1 specification speed is 12 megabits per second. At 10 times faster, USB 2.0 will offer a data throughput of 120 megabits per second. At 20 times faster, USB 2.0 will offer a data throughput of 240 megabits per second.

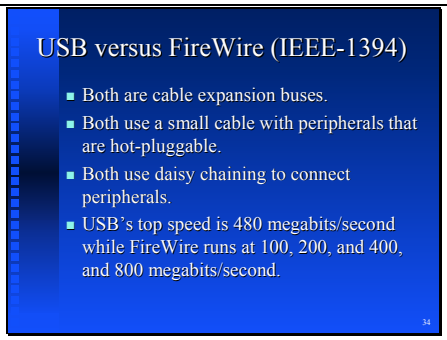
The good news for USB users is that USB 2.0 is backward compatible with USB 1.1. That means USB 1.1 cards will work in USB 2.0 systems. Of course, they won't offer the high speed.

Slide 33



FireWire is a special name given the the IEEE-1394 serial data transmission specification. FireWire is similar to USB, but let's look at a closer comparison.

Slide 34



Here's how they compare.

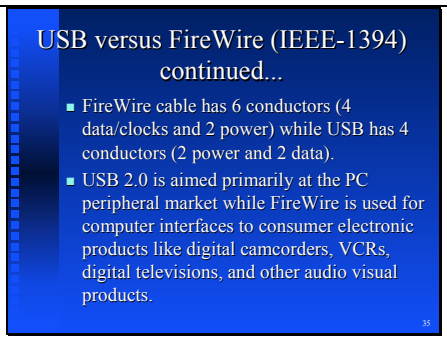
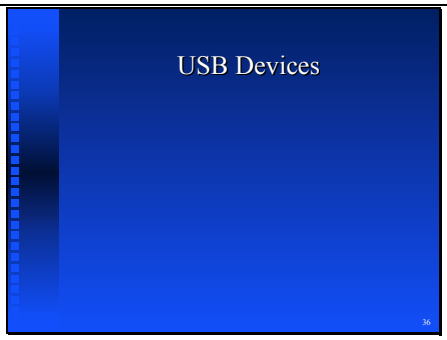
• Both FireWire and USB are cable expansion buses.

• Both use a small cable with hot-pluggable peripherals.

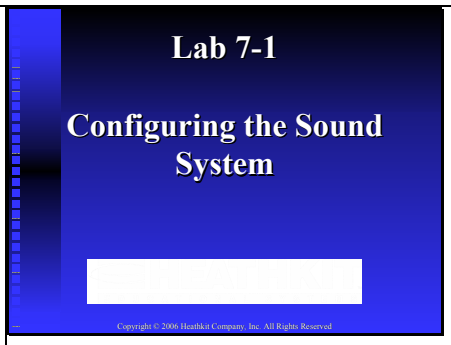
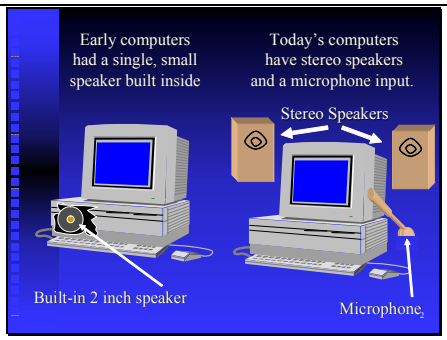
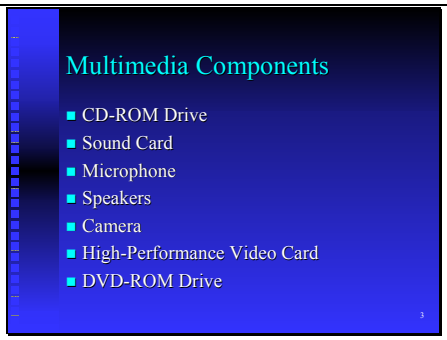
• Both use daisy-chaining to connect the peripherals.

• USB's top speed is 12 megabits per second while FireWire runs at 100, 200, or 400 megabits per second.

And there's more...

Slide 35		FireWire's cable has 6 conductors (4 data and clock wires and 2 power wires) while USB's cable uses 4 conductors (2 power wires and 2 data wires). Finally, their target markets are different. USB (especially USB 2.0) is aimed primarily at the PC peripheral market, while FireWire is used for computer interfaces to consumer electronic products like digital camcorders, VCRs, digital televisions, and other audio visual products.
Slide 36		
Slide 37		USB is an interesting subject and one you should become familiar with. Here's a source of more information.
Slide 38		On the internet, check out **www.usb.org**. That's the web address of the USB organization responsible for writing and approving the USB specification. You will find a wealth of USB information there such as the specification itself, technical information, and so on.

Slide 39		That's it for today's lecture. Now onto the Exercise in your Student Workbook.

Slide 1		Today you will examine the multimedia support provided by a computer. First, you will study what makes up a multimedia system in this presentation. Then, you will install a sound system in the lab computer.
Slide 2		Sound cards are relative newcomers in the world of personal computers. For many years, programmers did amazing things with the computer's built-in speaker, which had poor fidelity and was designed to produce simple beeps and other sounds to indicate computer operations. A good sound card allows the computer to produce and store high-fidelity stereo sound to go with the programs in the computer. You can also connect a microphone to the computer for input and stereo, or even multi-channel, speakers or headphones for sound output.
Slide 3		Sound cards used to come packaged with other components and were known as *multimedia*. A multimedia PC contained a CD-ROM drive and a sound card connected to a microphone and speakers. Today these items are standard with most computers, and the term multimedia isn't used as much as it used to be. The latest multimedia gadgets include digital cameras, high-performance video cards used for watching Internet video clips, and DVD-ROM for games and digital movies.

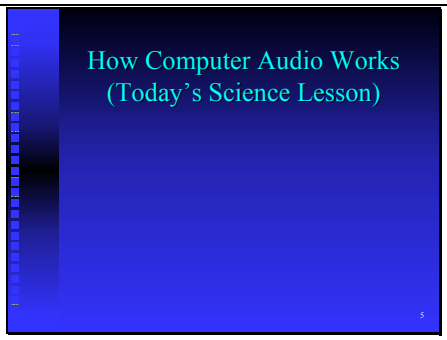
Slide 4

Some computer audio applications are:

- Foreign language training
- Music composition
- Background music as you work
- Telephone through your computer
- Voice recognition
- Sound effects for presentations and games.

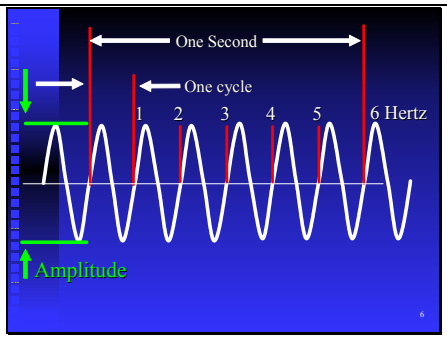
These are just a few of the possible applications. Let's see how sound cards add to these applications.

Slide 5

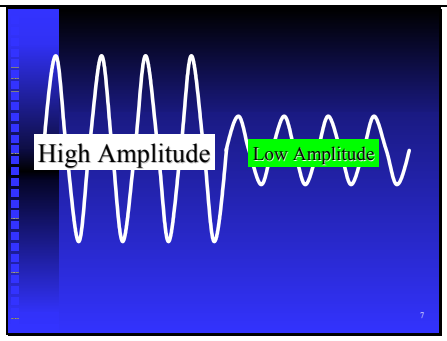
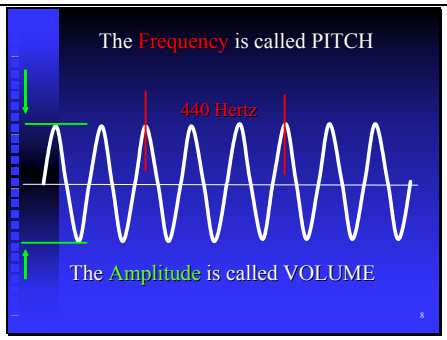
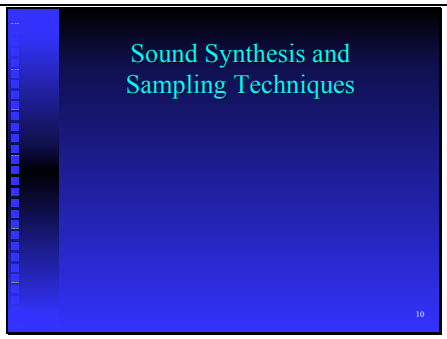


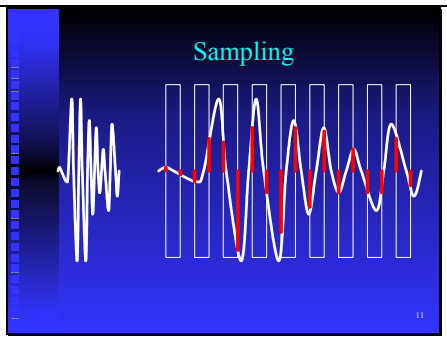
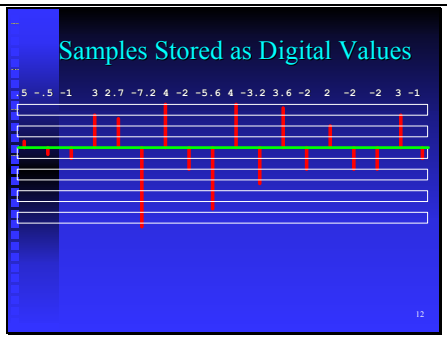
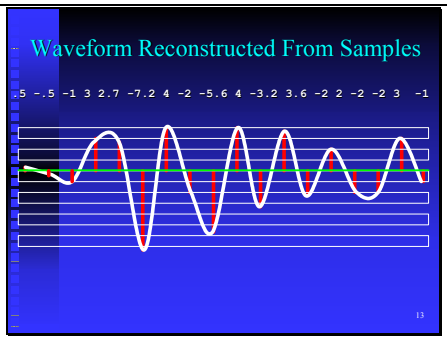
Without getting too deep into physics, let's look at some basic audio principles.

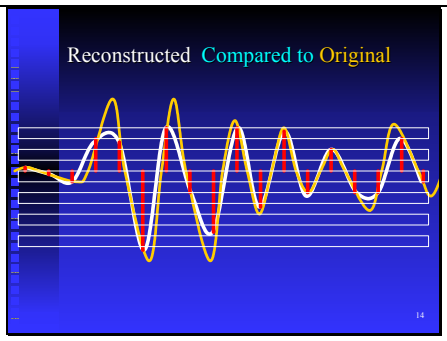
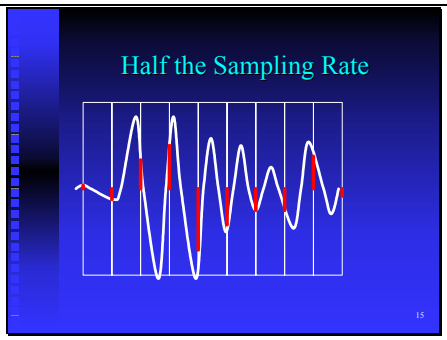
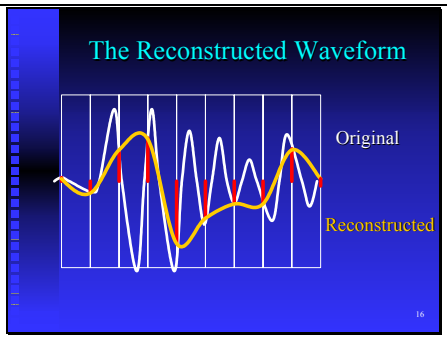
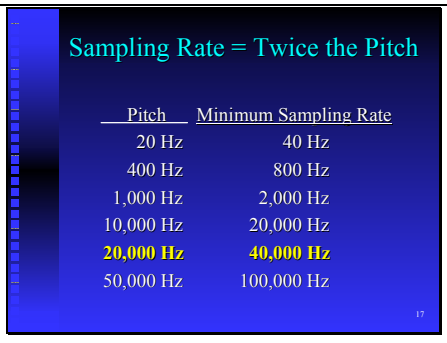
Slide 6



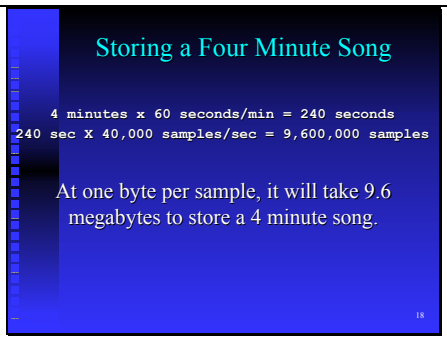
The sound picked up by a microphone is changed into an electrical wave. A continuous tone, like when you hold an organ key down, produces a sine wave like this one. The sine wave has two characteristics: frequency, which is measured by how many times a second the wave starts a new cycle; and amplitude, which is a measure of how loud the tone is. The sine wave here has a frequency of six cycles a second, or six Hertz. The human ear can generally hear sounds between 20 Hertz and 20,000 Hertz. Not everyone can hear this wide of a range, though. It depends on the genes your parents passed on to you and the amount of loud noise your ears have been exposed to.

Slide 7		Loud sounds produce high amplitudes, and quiet or soft sounds are low amplitude.
Slide 8		In audio terms, frequency is called pitch and amplitude is called volume.
Slide 9		Speech is made up of high and low amplitudes and changing frequencies. A picture of a sound is called a sonogram.
Slide 10		Sampling is a very important method of computer sound reproduction.

Slide 11		Sampling is often used for speech encoding. On the left is a portion of a speech sonogram. On the right is the same pattern stretched out to show how sampling works. It is not practical to store each point on the waveform, so samples are taken at regular intervals, as indicated by the red lines. For absolute accuracy in sound reproduction you would store every point on the waveform. But this isn't really practical and it's not necessary. Sampling, that is selecting and storing only some of the points, produces good sound reproduction. Sampling technology is so good today that most of us can't tell the difference between the original sound and the copy.
Slide 12		These samples are then stored in digital form. The number values at the top match the sample levels in red. The green horizontal line is the zero volt reference level. Remember that the intervals between the samples are equally spaced. That's because the samples are taken with the same amount of time between all of them. We might take one sample every second or every 100 microseconds.
Slide 13		When the computer wants to play back the sound, it reconstructs the waveform from the digitized sample points. The waveform, shown here in white, is the best fit to the values stored. The more samples taken for a given time period, the more accurate the reconstructed sound wave. Of course this makes the CPU work all that much harder, but more importantly, it takes up a lot of memory to store all those points!

Slide 14		Here's what I mean by reconstructing the sound wave. If the samples are taken often enough, the reconstructed waveform, shown here in white, will sound similar to the original waveform shown in orange.
Slide 15		But what happens if the sampling rate is changed? Here the sampling rate is half of what it was before. Now what will the reconstructed waveform look like?
Slide 16		The reconstructed waveform in orange looks nothing like the original in white. The samples were so far apart that they failed to capture the waveform. This sound would sound nothing like the original. So what sampling rate should be used?
Slide 17		Experience has shown that if the sampling rate is at least twice the pitch, the reconstructed waveform will be close to the original. For most humans, the highest pitch they can hear is less than 20,000 hertz. So to sample music and reproduce high fidelity sound that sounds correct, we must sample no less than 40,000 times per second.

Slide 18



What does this mean in digital terms? Let's assume that we wish to record a song that is four minutes long. Four minutes times 60 seconds per minute is 240 seconds. Multiply that by 40,000 samples per second, and the result is 9,600,000 samples. Assume one byte per sample and your song takes up 9.6 megabytes of disk space.

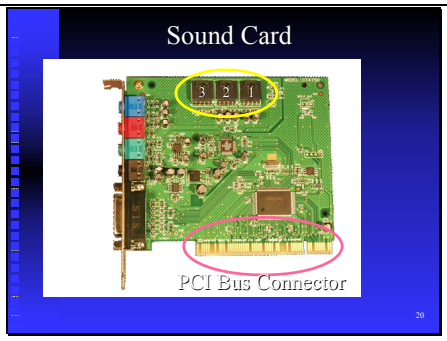
Wow! If you do much digital recording at all, you'll fill the hard disk drive up quickly. Working with music on a computer definitely requires a lot of storage space.

Slide 19

Now let's take a look at the hardware needed for working with sound or for listening to CD-ROM disks while you work.

We will look at a typical sound card.

Slide 20



Many computers use a sound card similar to this example. It's a PCI card, so it's Plug and Play—no resources to configure.

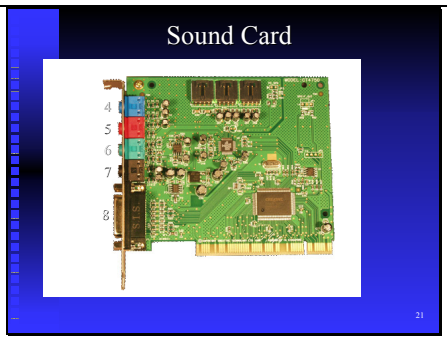
There are three connectors across the top.

Connector 1 connects a video card or a IDE CD-ROM for audio input—it's the Auxiliary sound input.

Connector 2 is the connector we use to connect audio from the CD-ROM drive.

Connector 3 connects to a telephone answering device (TAD) or a modem for voice amplification.

Slide 21



There are five connectors on the back edge of the card. Four are used for sound I/O, the other is for data I/O.

Connector 4 is a Line In jack to connect external devices such as cassette or MiniDisc player for playback and recording.

Connector 5 is the Microphone In jack to connect an external microphone for voice input.

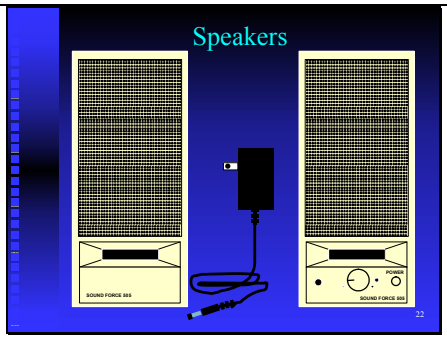
Connector 6 is the Line Out jack to connect headphones, powered stereo speakers, front channel powered Surround speakers, or an external amplifier.

Connector 7 is the Rear Out jack to connect rear channel powered Surround speakers.

Connector 8 is used to connect a joystick input device or an I/O MIDI device.

I have just described a typical sound card. Your computer trainer doesn't use a sound card. Rather, it has an on-board sound processor chip that works with the CPU to perform the same functions as those of a typical sound card.

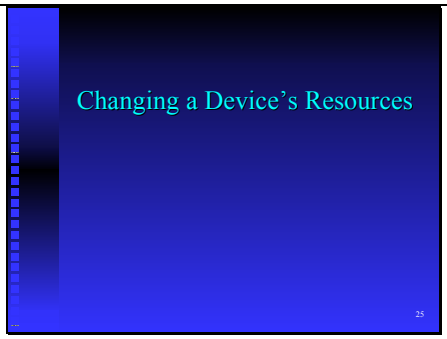
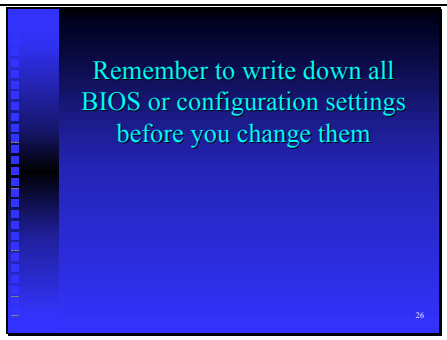
Slide 22

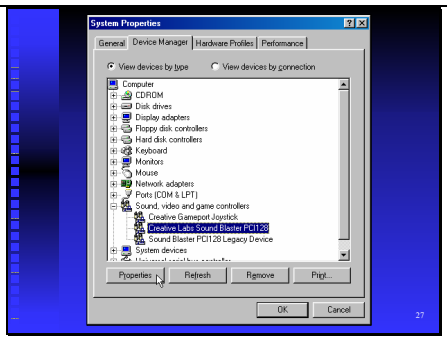
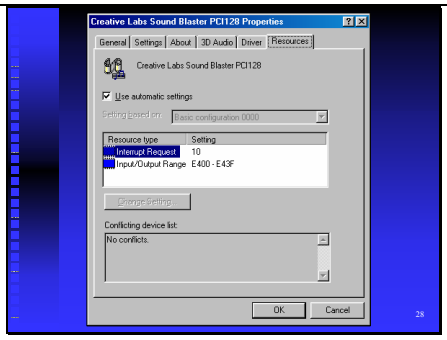
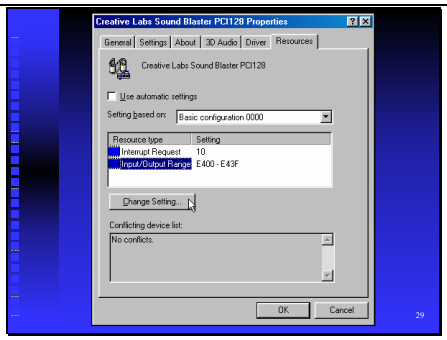


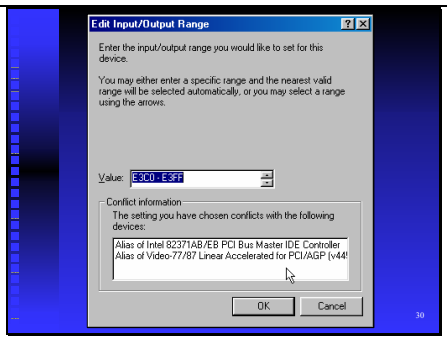
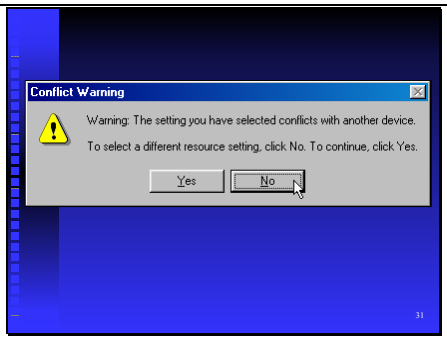
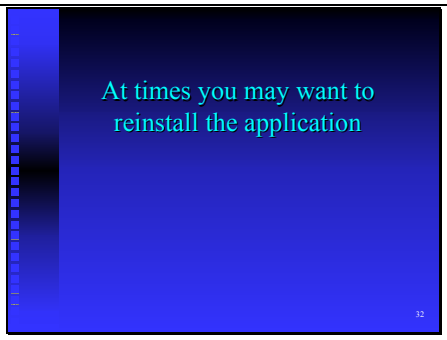
What would multimedia be without speakers with a built-in amplifier?

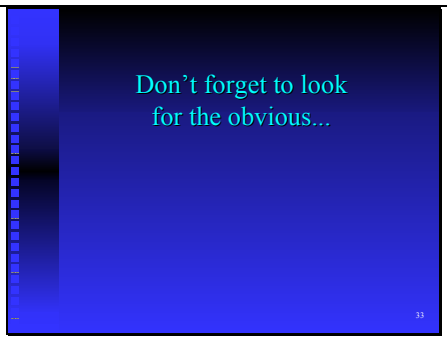
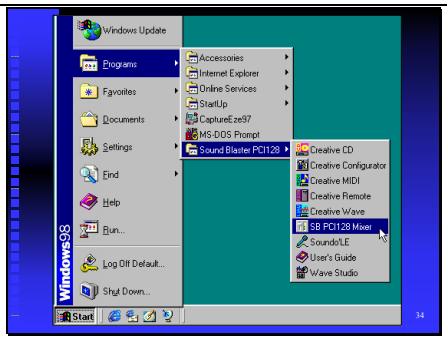
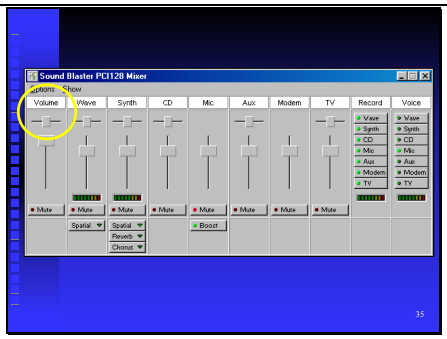
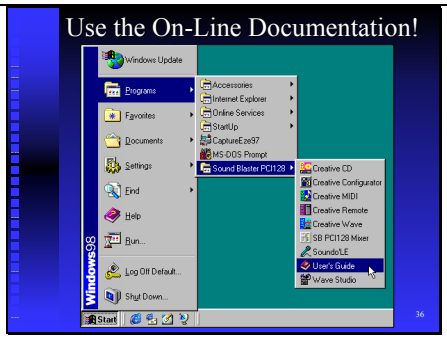
There is a minor drawback. Most people these days are not happy with stero sound from a pair of speakers. For realistic sound, they want, at a minimum, 4-channel audio. That's why our typical sound card has two audio output jacks. One for each pair of speakers.

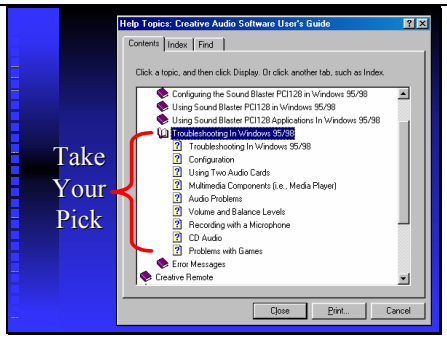
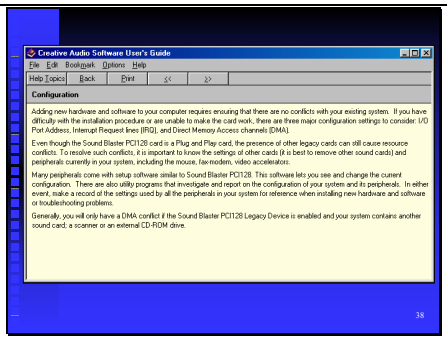
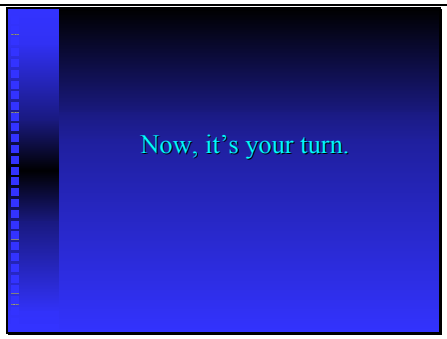
Something to keep in mind. Remember that 4-minute song we talked about earlier? That was only good for one channel of sound. To have stereo, we need two waveforms to drive the two channels of audio. So our four-minute song now takes up twice as much space on our disk drive. Make that 4-channel sound and we're talking four times as much disk space—about 38.4 Megabytes.

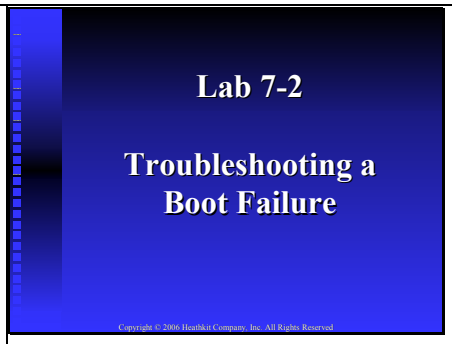
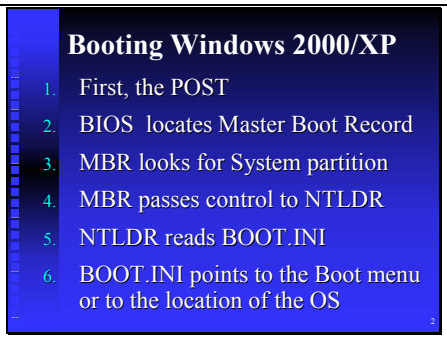
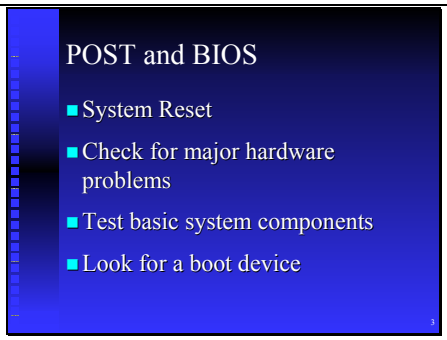
Slide 23		The last part of the multimedia picture is the software drivers and applications to control the operation of the hardware. Fortunately, today's multimedia systems use software that virtually installs itself. There's not much to talk about. Run the Installer routine and answer the obvious questions. Often, the most difficult part is reading the user's manual that is usually supplied on the driver CD. Yes, it's inconvenient, but it does reduce the cost printing the book and it helps to save a few trees.
Slide 24		Now that you are familiar with the pieces that make up the multimedia pie, let's look at a few areas that may cause problems. Consider, with Plug and Play BIOS and operating systems, resource conflicts are a thing of the past. However, there are a lot of legacy computers still around that don't use Plug and Play hardware. For that reason you should never ignore the possibility that a multimedia problem is not related to how a resource is configured.
Slide 25		Need to change a device's resources because the user of the PC you are troubleshooting thought they had to? Here's how you can examine a device's resources and, if necessary, change them back to what they should be.
Slide 26		Oh, yes...that cardinal rule of troubleshooting. Even though we troubleshooters are faultless and have great memories, be sure to *write down system settings before you change them*. Making a change that doesn't help or that makes the problem even worse may require you to change back to the original settings. Let's make sure the values you restore are the ones you changed.

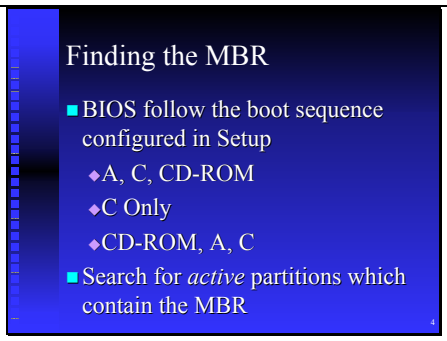
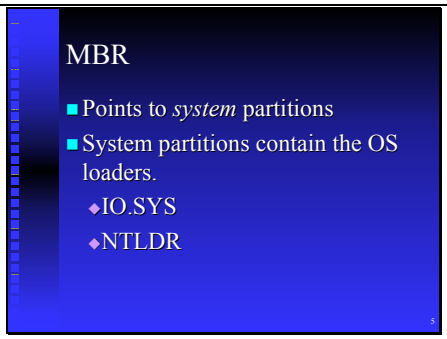
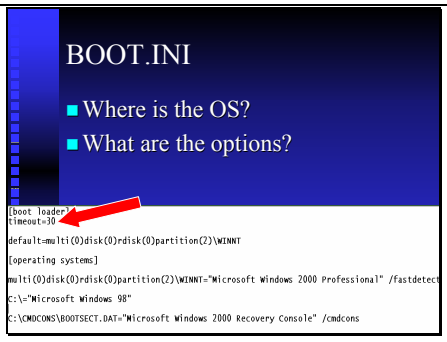
Slide 27		To find those resources, open the Control Panel's System Properties screen and click the Device Manager tab. Select the hardware device, in our case the sound card, and click the Properties button. Note that even though your computer trainer doesn't have a Creative Labs Sound Blaster, that's what I have been describing, so let's continue with that thought. What you will find in the exercise will not be the same, but it does give you an idea of where you are heading.
Slide 28		Click the Resources tab so we can see what IRQ and I/O address the sound card is using.
Slide 29		Uncheck the "Use automatic settings" check box and select the resource type you want to change. Then click the Change Setting button. Some settings cannot be changed using Windows 98. You have to change them using the system BIOS. For example, the sound card here will not let you change the IRQ using this screen. You can, however, change the I/O address with this screen. Before you do so… *write down the current address range.*

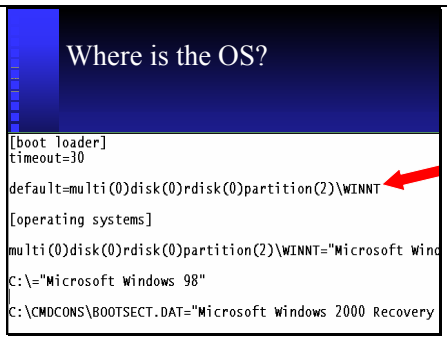
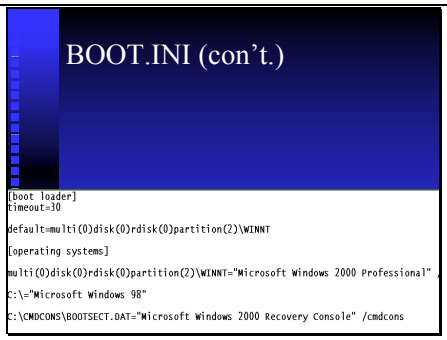
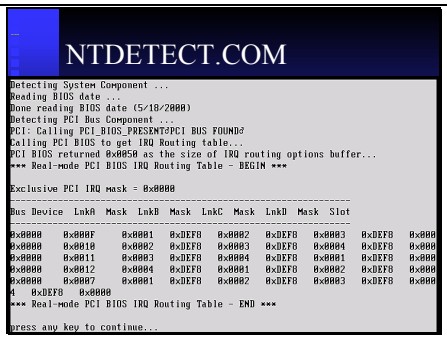
Slide 30		Select a new value for that resource while watching the Conflict information area at the bottom of the screen. You want to select an address range that does not conflict with any other hardware within the computer. Click OK when finished.
Slide 31		It's hard to imagine a user accidentally changing a resource setting with Windows 98 and its tight control over resources. If the user does change a resource, there are plenty of warning messages like this one to scare them off, hopefully.
Slide 32		One of the things you may do to troubleshoot a software problem is to just throw your hands up in the air and do a software re-install. Since most software today comes on CD-ROM disks, it's not too time-consuming to re-install it. Imagine what it was like in the past to have to re-install an application that had 15 floppy disks. However, before you reinstall that software, read the user's manual and any README text files on the CD. Often, you are told to uninstall the software before you can reinstall it. Make a mistake here and can wind-up with Registery and DLL file problems.

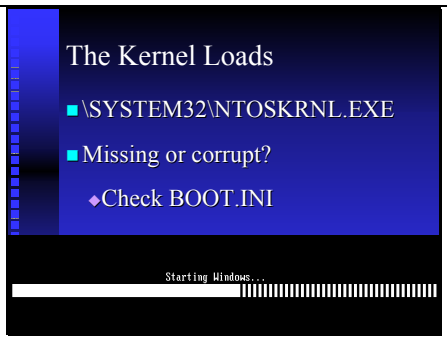
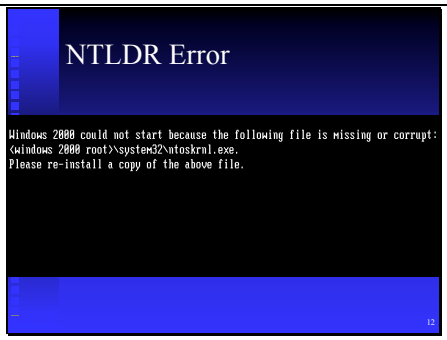
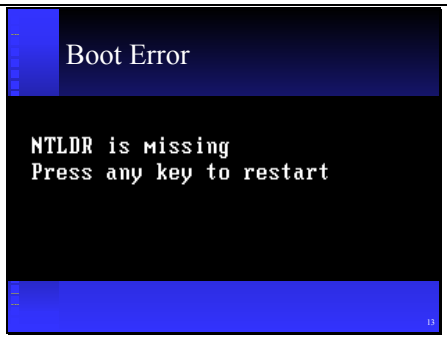
Slide 33		As (soon to be) well-trained troubleshooters, we sometimes look right past a solution for a problem. Sometimes the solution is right in front of us and we don't see it.
Slide 34		Here's a good example. A user might complain that one of the channels of their CD-ROM drive doesn't work when they are playing music. You could dive right in and begin troubleshooting the speakers, cables, and sound card. But before doing a lot of hard and unnecessary work, check the sound card's software settings. In this case, let's look at the sound mixer.
Slide 35		The circled area on this slide is the right and left channel balance control. If the user had set the slider all the way to one side, you wouldn't be able to hear the other channel. This time the user didn't make that mistake, so you may have to check out the hardware after all. But my point is, that sometimes the solution is simple, and by taking some time to look for a simple solution, you just might be rewarded.
Slide 36		Another thing troubleshooters tend to do is to ignore the manufacturer's documentation. I guess it's a matter of pride. We hate to pull out the manual and search for a solution. Or, the manual is inconveniently located on the drive CD. Maybe we think the user will think we aren't a good troubleshooter. Well nowadays the documentation is often on-line. In this case, that means it's loaded on the computer hard disk drive and listed in the Start | Programs application list, as shown here. Take a look at the documentation and you just might...

Slide 37		...find some useful information, such as troubleshooting help. Most manufacturers know from experience what the trouble spots for their product are, and often will discuss those trouble areas and offer solutions. Here's an example for the sound card. At least it gives you a starting point. Just select a troubleshooting topic and...
Slide 38		...there's some help. There will be times when you find just what you need. Other times it may be no help at all.
Slide 39		Now that we've wet your appetite, it's time to configure the sound system in your lab computer.

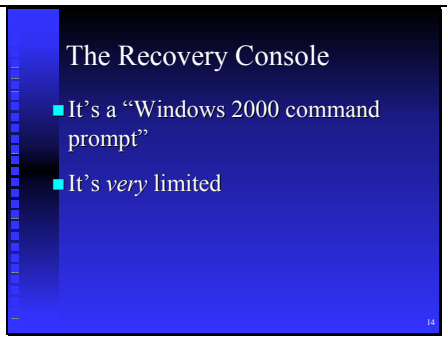
Slide 1		In this presentation, you will see how to solve basic boot failures.
Slide 2		In most cases, it troubleshooting a boot problem is easier if you have a good understanding of the boot process. You don't need to know the intimate details, just the basic facts. Before Windows wakes up on your hard drive, many things happen behind the scenes. Let's take a look at some of these steps.
Slide 3		As you recall, the Power On Self Test provides system checks for the major components. It compares the BIOS settings to the hardware currently installed, and tests many other items such as keyboards and memory. If something fails here, you're going to hear about it…literally. Beep codes are the rule, but newer systems use a series of lights on the rear of the motherboard. If all is well, then the BIOS searches for a boot device, using the drive sequence saved in the BIOS Setup. Obviously, failures at this stage can only be hardware.

Slide 4		The BIOS then looks for the master boot record by searching each drive in the order configured in Setup. Once an active partition is located, which has a master boot record, the BIOS knows where to locate the system partition, where the operating system is located. A typical error at this stage is "non-system disk or disk error." Problems at this stage are often hardware, but may also be partition configuration problems.
Slide 5		Once the BIOS locates an active partition, which contains the MBR, the MBR then points to a system partition. The system partition contains information that points to the location of the operating system itself. In DOS and Windows 95/98 that file was IO.SYS. In Windows NT/2000/XP that file is NTLDR.
Slide 6		BOOT.INI tells NTLDR where to find the operating system itself, and a few other things as well. We'll look at BOOT.INI in a moment. It is important to note that from this point many different operating systems can be launched. Windows 2000/XP are built to deal with multiple operating systems on the same system.
Slide 7		A copy of a typical BOOT.INI is shown here. Spaces have been added to make it easier to see. There are two sections, called [boot loader] and [operating systems]. The first entry tells NTLDR how long to wait before launching the default OS. Following this timeout, is the location of the default operating system.

Slide 8		The next line contains very important information. All of the parameters are 0, except for "partition," which is 2. The 2 tells NTLDR to go to the second partition on the disk to look for the operating system. This is an odd partition naming scheme, but it's used for compatibility with older devices.
Slide 9		The last few lines of BOOT.INI describe the options available at the Startup menu. In this case the default Windows 2000 launch is followed by the option to launch Windows 98. Finally, there is the ability to launch the Recovery Console.
Slide 10		To keep things simple, let's go with the default choice and launch Windows 2000. The next step once the OS loader files are located is hardware detection. NTDETECT is looking for hardware, performing an inventory to make sure that everything is in place and still responding. This screen is cryptic, but provides a clue what NTDETECT is doing. This can be compared to the Plug-n-Play mechanisms in Windows 9x. Problems at this stage are difficult to diagnose because of the tight interaction between the hardware, BIOS, and operating system, any one of which could have a problem. By the way, you won't see this screen in normal operation.

Slide 11		Thing get complicated very quickly from here. But if you see the "Starting Windows" progress bar you've made it to this point. The kernel load/initialization is phase includes loading the Hardware Abstraction Layer and various portions of the Registry. Anything that goes wrong at this point is unlikely to be hardware. The difficulty though, is getting at the problem so you can fix it.
Slide 12		This looks like a very serious error, but it really isn't. In fact, this error results from a simple typo in BOOT.INI. (The first bracket in the file was deleted) The problem here is that Windows 2000 is loaded on the second partition, and NTLDR can't find it. If Windows 2000 was loaded onto the C: drive, this error would then be serious.
Slide 13		This also looks serious, but isn't. This error occurs if you leave a non-bootable floppy in the drive on a Windows 2000 machine. It's the same as "Non-System disk or Disk Error" that you see with earlier operating systems. These two errors were simple and easy to fix. But what do you do if the solution isn't quite as easy? That's when you need the serious troubleshooting tools…

Slide 14



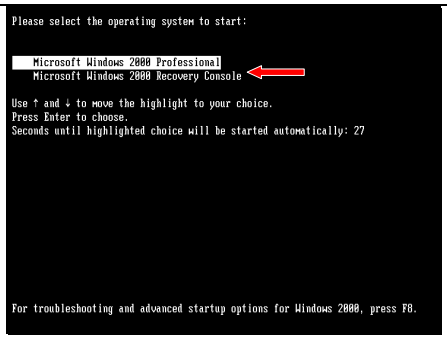
Windows 2000 and XP present a special troubleshooting problem, especially if you are familiar with basic troubleshooting on earlier operating systems. There are no Startup Disks, and you cannot make useful bootable floppies. When Windows 2000/XP is loaded on a FAT16 or FAT32 disk you should be able to use any Startup disk to fix the drive. But if you have an NTFS partition a regular bootable floppy is worthless. That's because a regular bootable floppy can't see an NTFS partition.

The Recovery Console is the answer. The console is a command-line interface that can read an NTFS disk, with limited functions. The console's ability is so limited that it may be useful only to Windows experts and programmers. And for those people, there are tools from other companies that don't have the limitations of Recovery Console.

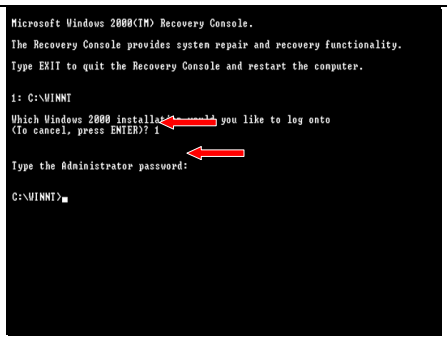
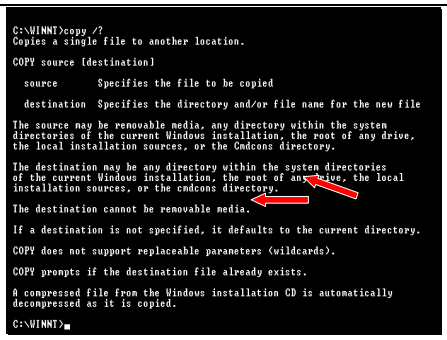
Slide 15

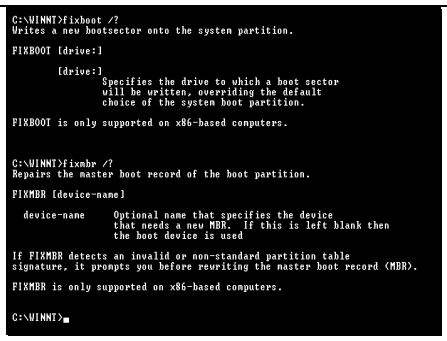
The Recovery Console isn't installed by default. If you want to be prepared for a disaster, and you have some extra hard drive space, then you might consider loading the console before you really need it. You can load the Recovery Console from the installation CD using the command line shown here. But as you saw previously, if you boot from the Installation CD you can get to the console from there rather than installing the whole thing.

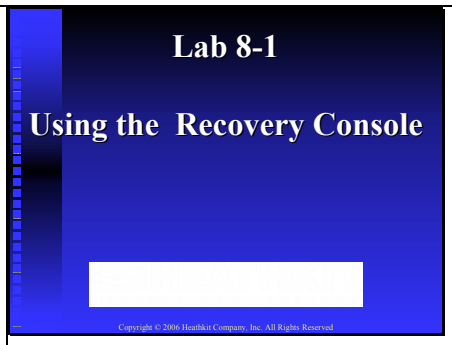
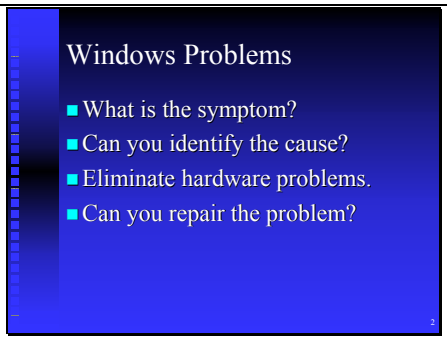
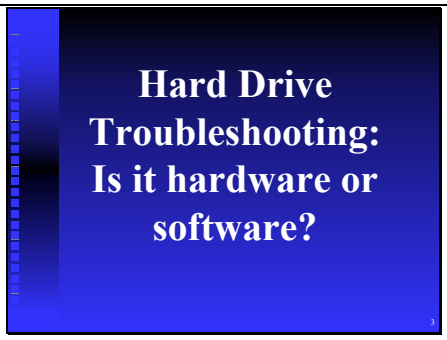
Slide 16

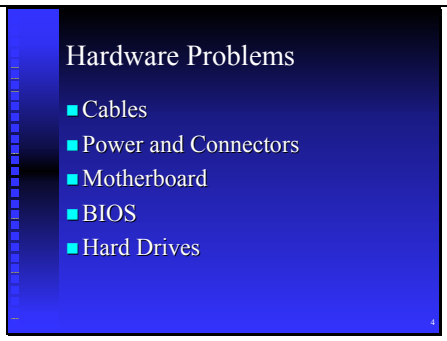
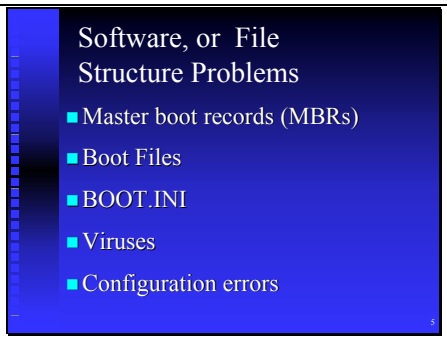


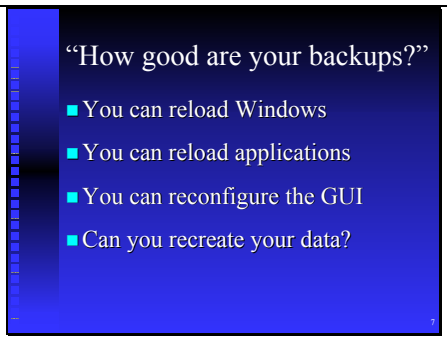
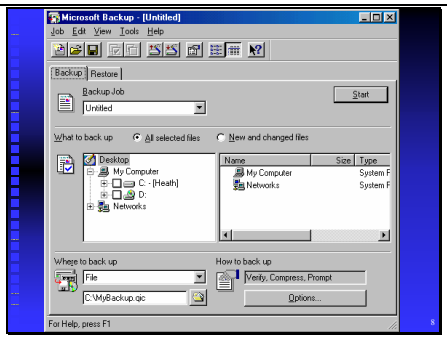
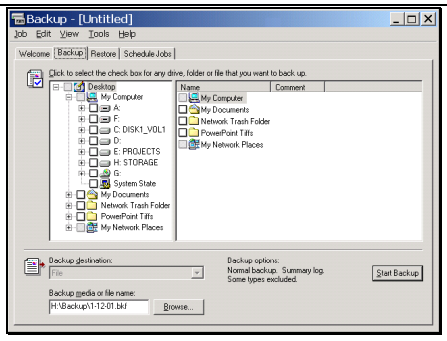
When you install the Recovery Console it becomes a part of your boot menu.

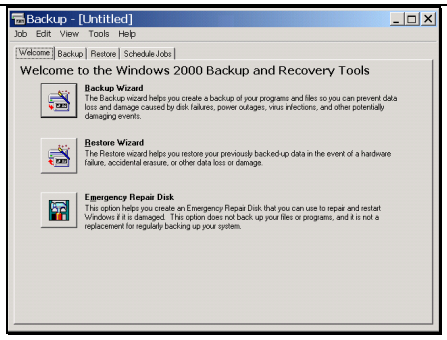
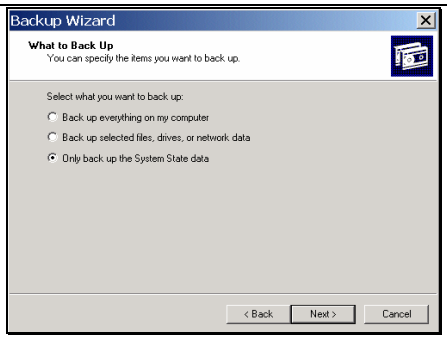
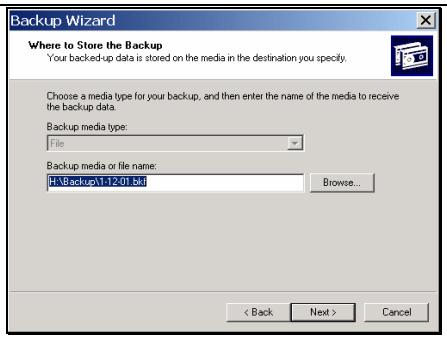
Slide 17		If you select the Recovery Console from the menu, you'll see this screen. As with the Setup emergency repair tool, you have to select which installation you want repaired. Here we entered "1" to select the only installation present, then entered the administrator's password. That gets us to the only true command line available in Windows 2000. But what can you do from here?
Slide 18		If you type "HELP" at the command line you will see a complete list of commands available. This screen shows the bottom of the list, a few have scrolled off the top. As we look closer, we're going to find that the console is limited more than one might expect…
Slide 19		You know how to use the copy command, and you also know that it is a vital and powerful tool. But look closely here, and notice that you can copy from a floppy to the hard drive, but you cannot copy from the hard drive to any removable drive. You also cannot use wildcards.
Slide 20		Here's another basic tool, the delete command. Again, the function of the tool has been curtailed to a bare minimum. Why has Microsoft done this? Primarily to keep the security of the system intact.

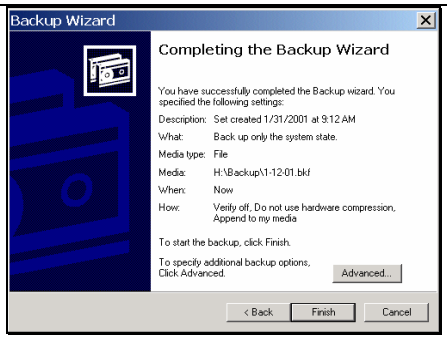
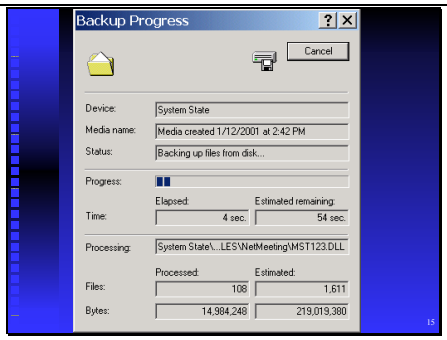
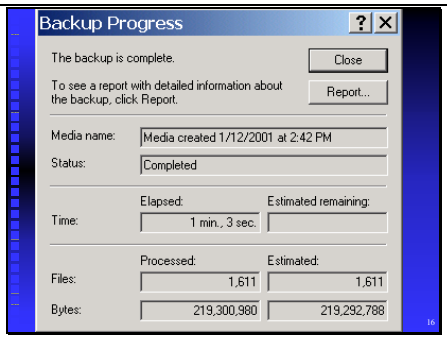
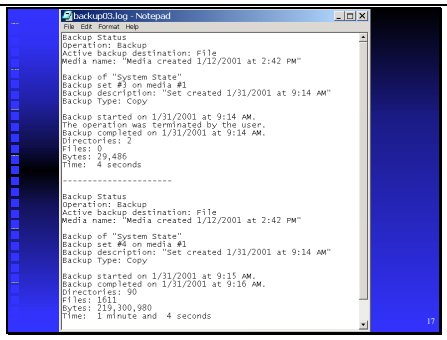
Slide 21		There are a few new tools available, too. Here we show two of them, the FIXBOOT command and the FIXMBR command. These might be very useful if the boot sector or master boot record were corrupted or damaged somehow. It was discussed before, some experience with the command-line interface could be valuable if you encounter major problems.
Slide 22		That was quite a bit of information, now let's see how it applies in the lab.

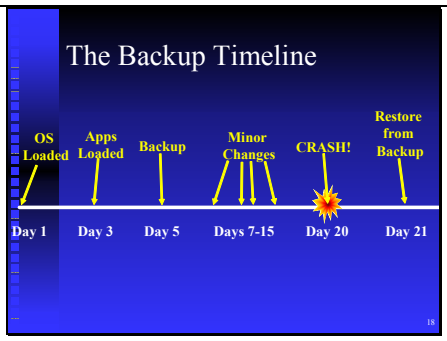
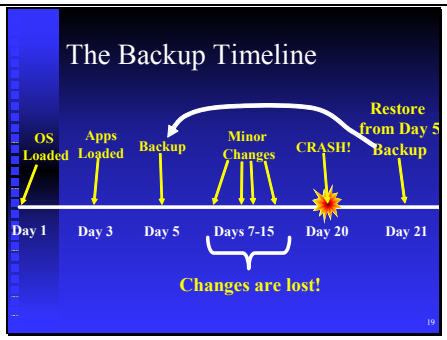
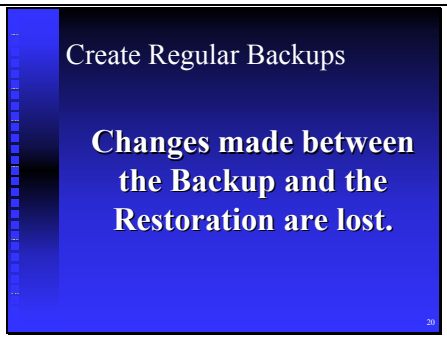
Slide 1		Things don't always go according to the plan. Count on it. And, you should be prepared to fix whatever problems crop up along the way. This exercise and presentation demonstrate one of the most common troubleshooting scenarios, a failed hard drive.
Slide 2		Windows problems have a wide variety of causes. Solving these problems involves four basic tasks. First, you need to identify the symptom. Hopefully the symptom is repeatable, because random problems are the most difficult to resolve. Once you have a clear look at the symptom, you can begin to determine the cause of the problem. Sometimes, this is the most time consuming step. Always eliminate hardware problems before attempting to troubleshoot Windows. Finally, you have to repair the problem. Occasionally the problem is too complex to identify, and the re-installation of some component or software is the solution.
Slide 3		One of the first questions you must answer when attempting to fix a problem on a Windows-based computer is this: Is there a problem with the hardware malfunctioning, or is there a problem with the operating system or file structure?

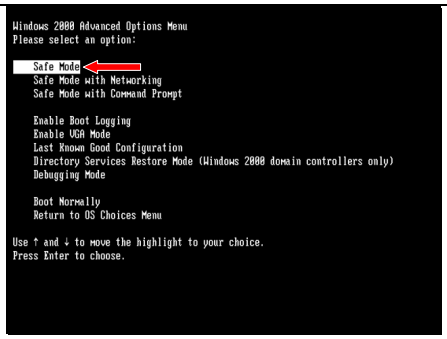
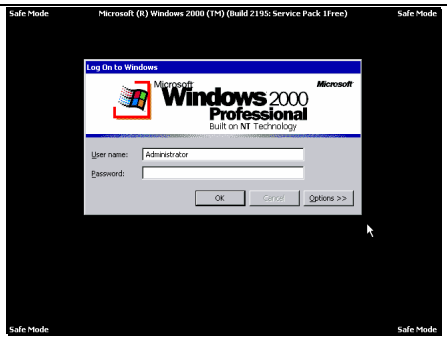
Slide 4		Hardware problems tend to be a bit more severe. That is, in most cases the drive fails completely and there is no mistaking that a serious problem has occurred. You'll hear the computer generate beep codes, grind, or do nothing at all when it should be making normal startup noises. The BIOS may even fail to locate the drive. Drives fail, but their supporting circuitry is often to blame.
Slide 5		Problems that are not caused by physical or electrical malfunctions are often harder to diagnose. These problems are often caused by corruption of the boot records or the boot files. Many times a virus is the culprit, but just as often these problems are the result of a major configuration error.
Slide 6		In this presentation we are going to focus on the big problems, those where something fairly serious is wrong with Windows. You have three tools available to repair the big problems. For smaller problems Safe Mode may help you identify the cause and allow you to solve them. When that doesn't work, you can try to fix a problem from a Windows command prompt. And if that fails to get the system up and running, you'll have to boot the system from a different disk entirely, such as a Startup Disk. But none of these tools can help you restore data that has been destroyed, so let's discuss Backups first.

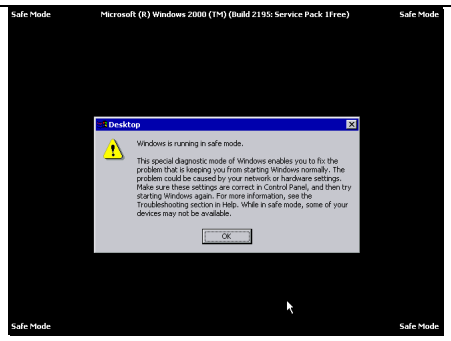
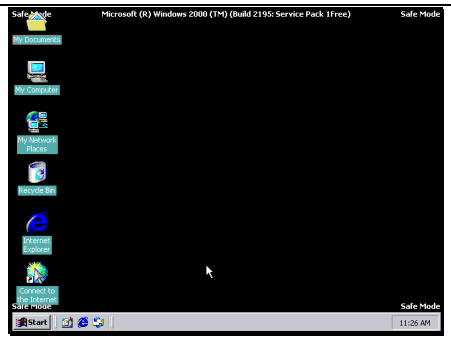
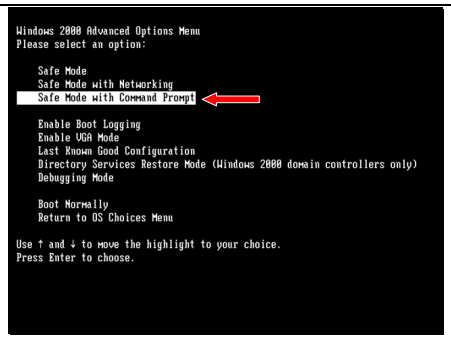
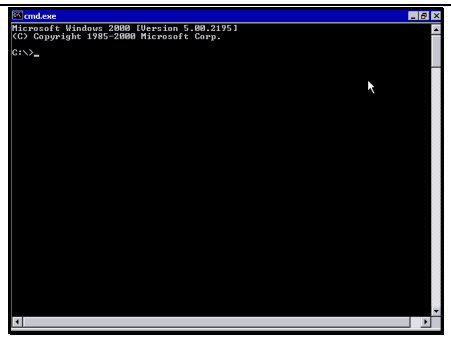
Slide 7		Ultimately your troubleshooting success depends upon how well you are prepared. Do you have the tools you'll need? Do you know how to use them? And, do you have a backup in case the error is unrecoverable? In the PC support industry, time is everything. You can reload an entire computer without too much trouble from the CDs, but it takes time. On the other hand, the creative or analytical work of a business is often not possible to recreate. Some of that data may have taken years to build, and may represent the value of the business itself. What's that backup worth now?
Slide 8		Backing up a PC can be a complex job, which is probably why there are so few backups being made. But once you have a handle on the concepts, it's actually simple and boring. This slide shows the Windows 98 Backup program. It's not too hard to follow, and the Help files make it even easier.
Slide 9		The Backup program in Windows 2000 is more powerful than any previous Microsoft backup tool. It's just as complicated, but there are some Wizards that take us through the basic tasks. In Windows XP, the wizards drive the entire process. Let's take a look at making a backup of the important system files in Windows 2000.

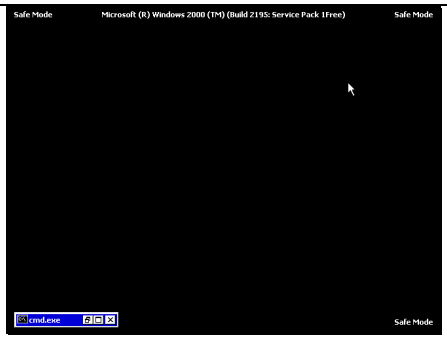
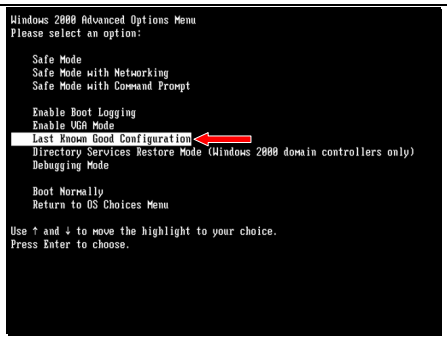
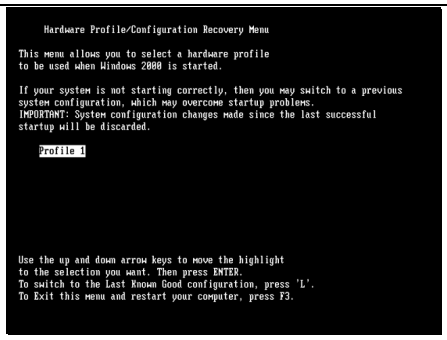
Slide 10		The previous slide showed you the complex side of Windows 2000 backup. Before you get to the complicated interface there are three Wizards that help you perform the most common tasks. Let's use the Wizard to back up the most important system data.
Slide 11		Not much going on here, just click Next…
Slide 12		The default is to back up everything on the computer, but there's really no reason to do that now. Let's back up the System State data.
Slide 13		After you decide "what' to backup, you have to decide "where" to put the backup. In most cases we're talking about a tape drive or some other network drive that is backed up automatically. For now, let's put the backup on the hard drive somewhere. Then later we can put it on a CD or somewhere just as safe.

Slide 14		One of the nicer features of Windows 2000's wizards is a summary screen. All the choices that you selected are shown one last time before the backup actually begins. If you want to change settings you can use the Back button.
Slide 15		Once you click OK, the actual backup starts. The amount of time this requires depends upon how many files you are saving. This one took about a minute.
Slide 16		Finally, the backup is complete. Let's take a look at the report.
Slide 17		This report is a record of how much data was backed up, when it was done, and the elapsed time. You probably don't need this log for a backup of your home computer, but a large company might require that these logs be kept in a safe place.

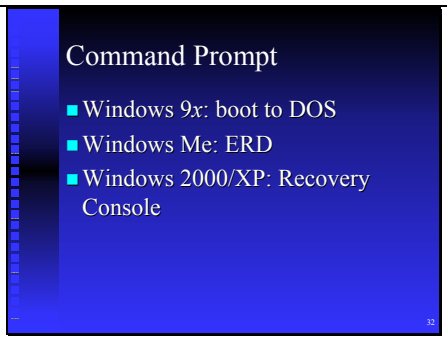
Slide 18		Let's look at a timeline of the events leading up to a typical restore scenario. You install the operating system on the first day, and the applications a couple days later. Everything is working fine on the fifth day, so you make a backup of the system files. Over the next week or so you make minor changes to the system, things like shortcuts and you load some small utility software. On the 20th day, the system crashes. But that's OK, because you made a backup. You restore from the backup and everything is back to normal, right?
Slide 19		Almost back to normal. The backup was created on Day 5, but that backup didn't include the minor changes made during Days 7-15. What does this mean to the system you have just restored?
Slide 20		What it means is that any changes you made between the day you made the backup and the day you restored the crashed system are lost forever. In our example that doesn't amount to much. But imagine you are building a website for a big customer, your backup was made three months ago, and the new websites aren't backed up…what does that crash mean to you then?

Slide 21		Now that you have a backup, you can aggressively work on fixing the system. You have covered Safe Mode before, but it's worth a quick review. Safe mode is a way to launch Windows without using a huge list of drivers and services. The idea is to isolate problems by process of elimination. If the problem is solved when running the Windows in Safe Mode, you have narrowed the possibilities substantially. Problems that disappear when Windows is launched in Safe Mode are usually caused by device drivers and Registry problems.
Slide 22		You've seen the method for launching Windows 9x in Safe mode. In Windows 2000 you need to press the F8 key when you see this screen.
Slide 23		This should look familiar, although many of the options are different and it's now called the Advanced Options Menu. You have lots of choices here, so let's take a look at a few of them. First we'll take a peek at the Windows 2000 Safe Mode option.
Slide 24		The first thing you see, naturally, is the logon dialog.

Slide 25		As if you had no idea what this was, a warning pops up to let you know that you are running Windows in Safe Mode.
Slide 26		This is what you get! Most of your applications should run in Safe mode, but a few may have trouble. If you are experiencing odd video-related problems, and they disappear in Safe Mode, you can bet your video drivers aren't working properly.
Slide 27		Another option is Safe Mode with Command Prompt. Before you start thinking that you can get at a real command prompt in Windows 2000, let's see what this startup option actually provides…
Slide 28		…this is what you get, a virtual DOS window. Maybe there's something behind all of this, so you'll minimize the window…

Slide 29		…and this is all you get. You're not really at a DOS prompt, you're at the Command Line Interface without the Windows GUI in the background. From the command prompt, you may be able to resolve some problems, or tweak a setting in a configuration file to kick-start Windows. But that's about all.
Slide 30		The last important choice we're going to cover is the Last Known Good Configuration.
Slide 31		If you choose the Last Known Good Configuration you will see this screen. Why Last Known Good? The idea here is to step back in time and use a configuration that appeared to be working properly. This isn't like Windows 98's Scanreg that allowed you a choice of five previous configurations, here you get just one point in time to choose from. However, if you install something and it crashes your system, or you make a major configuration mistake in Windows 2000, the Last Known Good Configuration might save your day. This option also exists in Windows NT4, but it is presented a little differently.

Slide 32

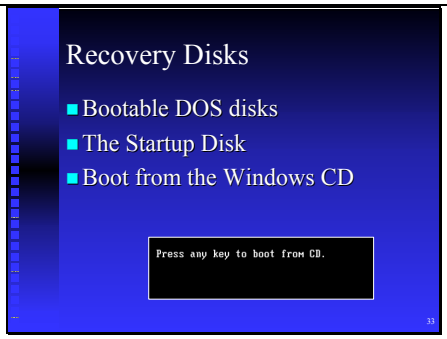


If the problem is more serious, say a critical system file is missing or corrupt, You may not be able to get Windows to launch Safe Mode. In this case you can get to a "real" command line to attempt a fix. In windows 9x, you can boot to a DOS prompt through the Startup Menu, or your Startup Disk. This is very much like real MS-DOS, and you can use all your DOS skills to copy, delete, edit and replace configuration files and drivers.

Windows Me eliminated the DOS prompt option. You must build and boot a Startup Disk to see a real DOS prompt in Windows Me. From there, you need to know your DOS because many of the old trusted tools have been changed.

With Windows 2000 and XP, you need to use the Recovery Console to get to a command prompt. This is a whole new tool, so we'll be taking a closer look in a moment.

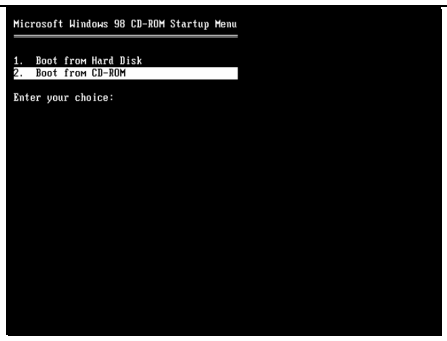
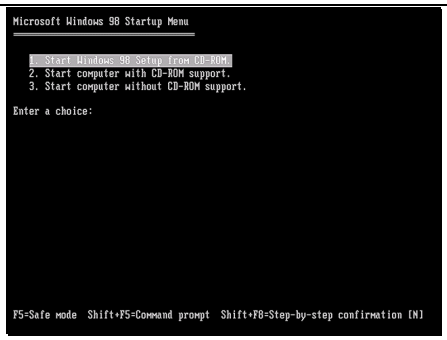
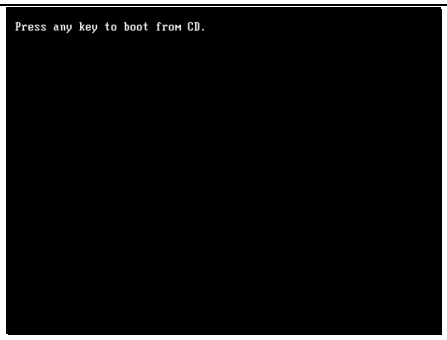
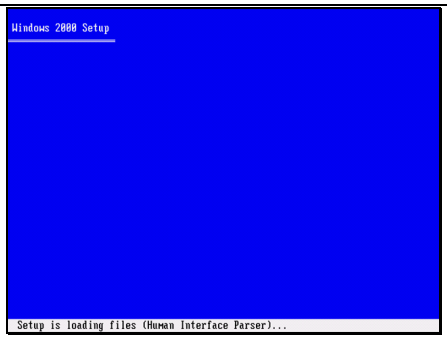
Slide 33

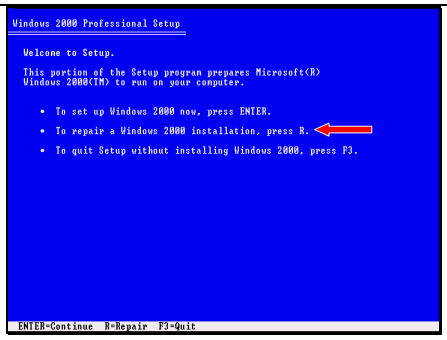
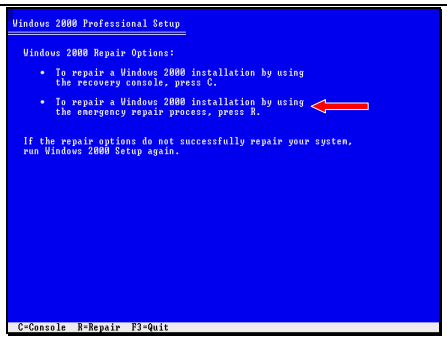
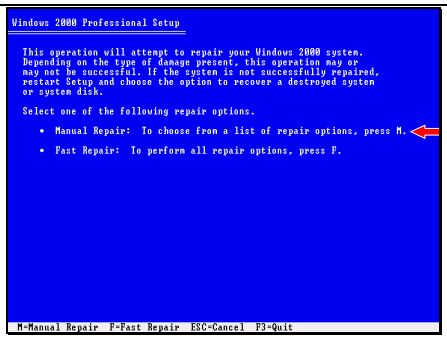
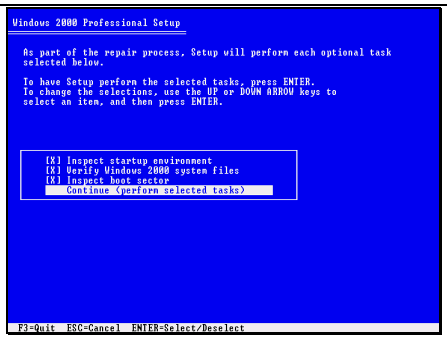


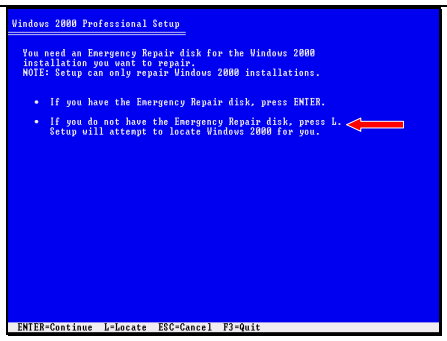
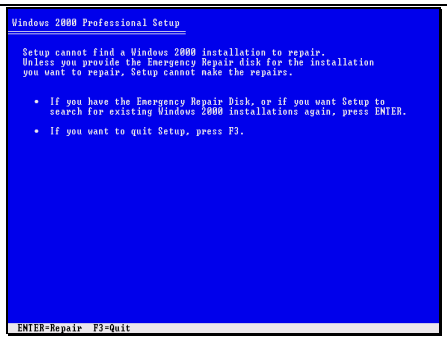
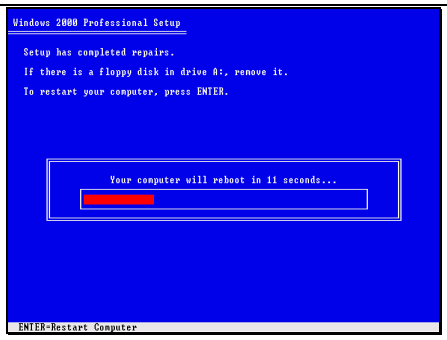
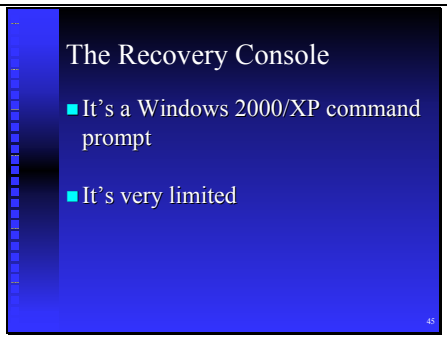
When the system won't even boot, you have to boot from another disk. In Windows 9x this can be essentially any bootable disk. You want to use a bootable Startup Disk created by the OS you are troubleshooting, but it isn't completely necessary in an emergency.

Most Windows 98 CDs, and all Windows ME and 2000 CDs are bootable. Configure the BIOS boot sequence to look for the CD first, and insert the Windows CD. The exact method depends upon the BIOS in your computer, with some systems you'll briefly see the message shown here.

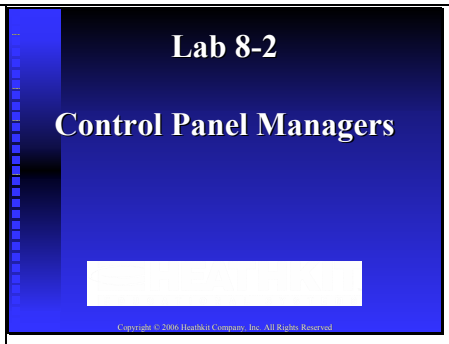
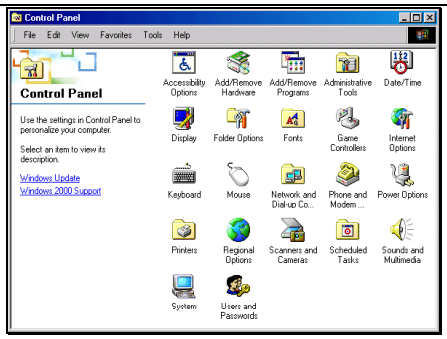
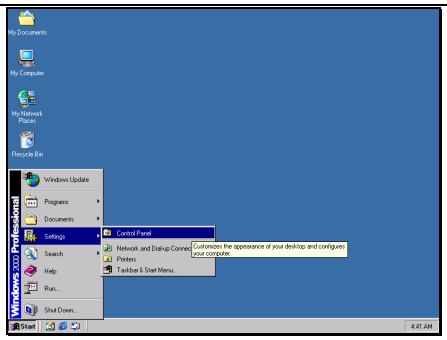
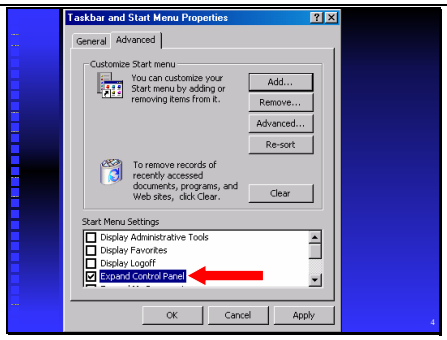
The Windows CD will give you the option of booting from the hard drive or booting from the CD. You will also have the option of installing the OS, but you don't want to do that. If you boot from the CD you will be taken to a DOS prompt where you can repair the trouble.

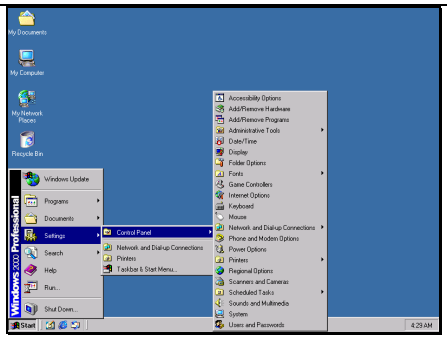
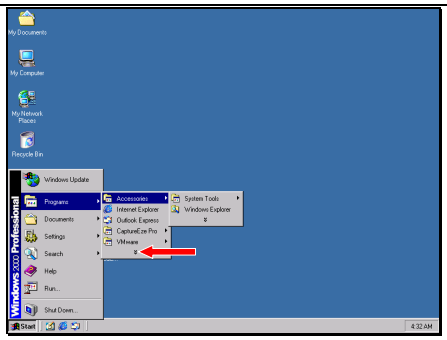
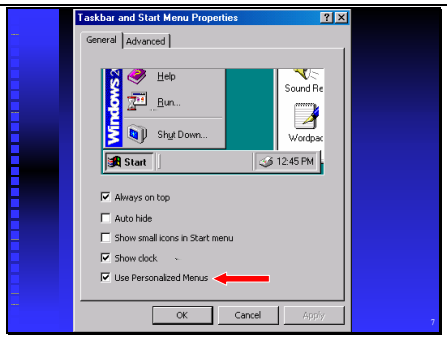
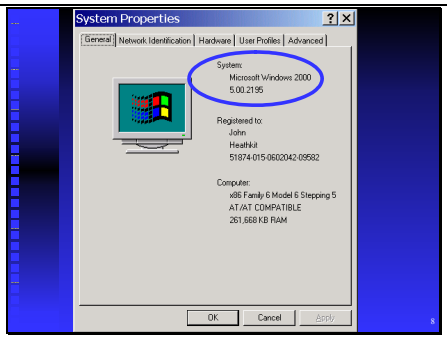
Slide 34		When you attempt to boot from the Windows 98 Installation CD, the process is straightforward. Choose the boot drive here.
Slide 35		And choose how you want to boot here. You can begin Setup directly, or start the computer by booting from the CD ROM. Most computers are going to make the CD drive look like A:, so be careful.
Slide 36		Again, in Windows 2000 you get this message. This one isn't up on the screen for long, it's there so you don't get stuck booting from the CD if you accidentally leave the CD in the drive.
Slide 37		Next, you see this Setup screen. No, we aren't installing Windows 2000 yet…

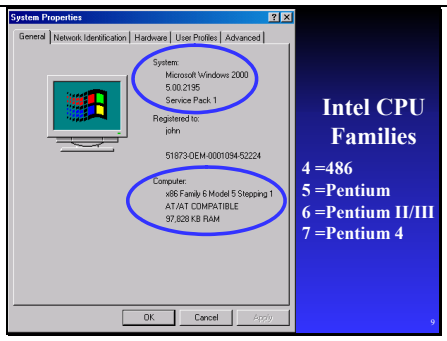
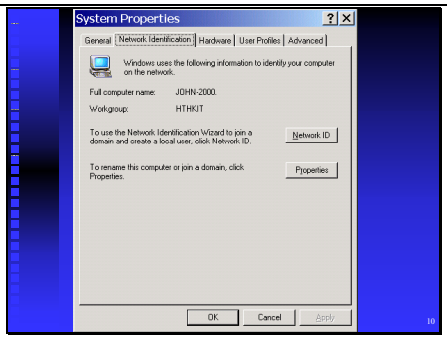
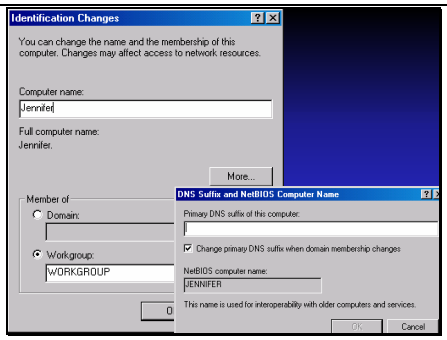
Slide 38		Windows 2000 is just preparing itself for these options. You can begin Setup, Quit, or repair Windows 2000. Let's follow the repair option.
Slide 39		Here you have two more choices: run the Recovery Console or attempt an emergency repair. We will discuss the Recovery Console in a moment, so let's take the emergency repair option.
Slide 40		Two more options…Fast Repair doesn't sound like any fun, so let's see out options under the Manual Repair menu.
Slide 41		By default all three repair tasks are selected. Let's leave it this way, and see what happens.

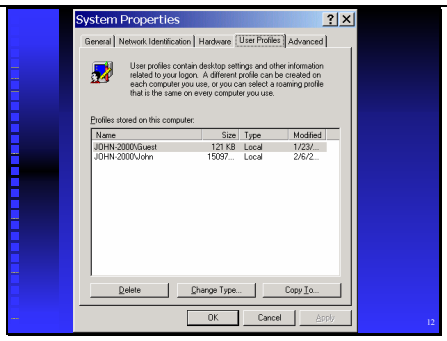
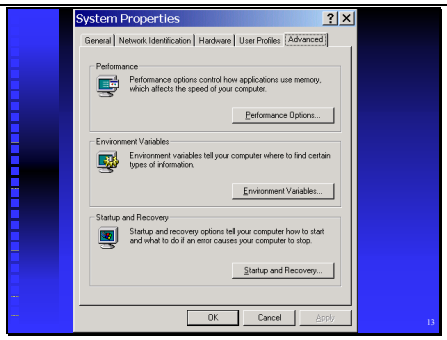
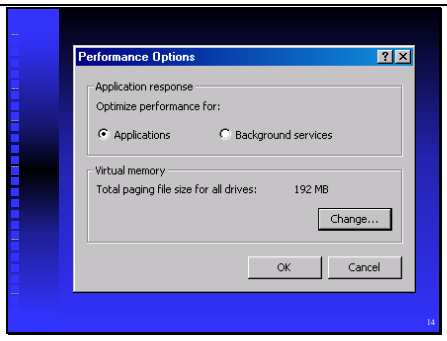
Slide 42		Here's one more reason to make that ERD…Setup can't fix Windows very well without it. If you have the disk then the process continues. But, let's see what happens if we don't have our ERD.
Slide 43		Your chances of repairing Windows 2000 without that ERD are slim. As shown here, Setup can't find an installation to repair. What makes this so much more interesting is that the existing Windows 2000 installation is default all the way. From here you can circle through the last few screens, but you won't make any progress. Which leads us to…
Slide 44		…this. Actually, there were no repairs completed. So what's next? The final option is the Recovery Console. Let's take a peek at how it works.
Slide 45		Windows 2000/XP presents a special problem because there are no Startup Disks and you cannot make bootable floppies. The Recovery Console is the answer. The console is a command-line interface that can read an NTFS disk, with limited functions.

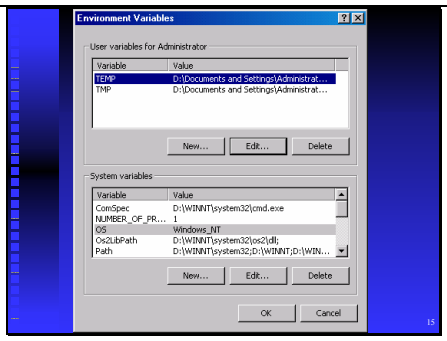
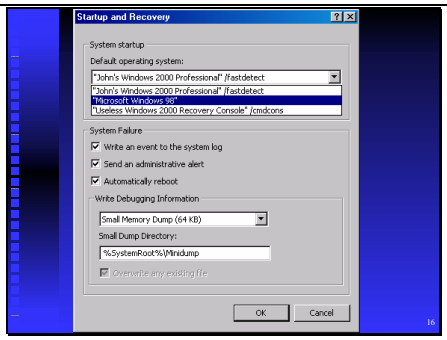
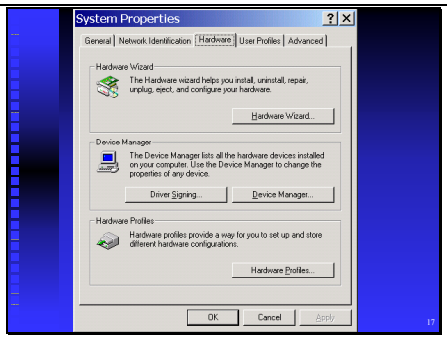
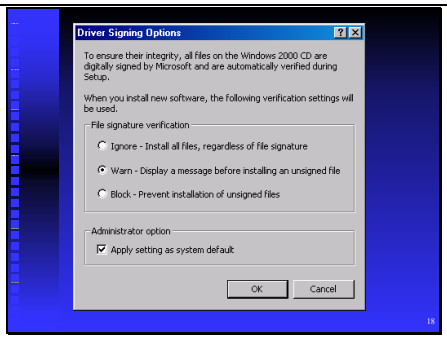
Slide 46		As you can tell, recovering from serious problems often requires all of your talent and skills. Let's put them to use in the lab.

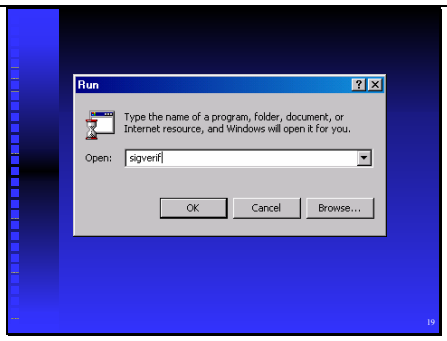
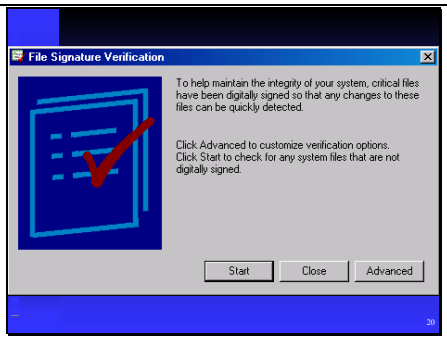
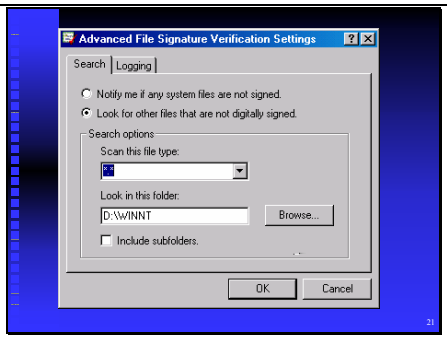
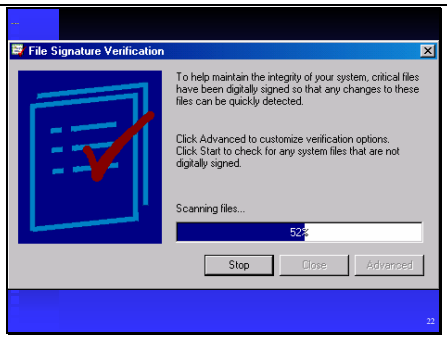
Slide 1		Windows 2000 offers some new tools in Control Panel. You will explore these new tools in the exercise, and they will be discussed in this presentation. Additionally, the presentation will discuss the System Properties dialog.
Slide 2		The Windows 2000 Control Panel is similar what you've seen in previous versions of Windows. There are a couple new applets here, and some of the old ones are gone. In the next few slides we're going to focus on the System applet, but first let's explore a few of the Control Panel Options.
Slide 3		Traditionally, you access the Control Panel through the Start Menu by clicking the link as shown here. You can also get there from My Computer or Windows Explorer, where Control Panel is a special object. Windows 2000 makes it easy to get at yet another option.
Slide 4		Right-click any open spot on the taskbar, and select Properties from the context menu. That opens the Taskbar and Start Menu Properties sheet, which you see here. Then select the Advanced tab to see this display. The red arrow points to a new option titled "Expand Control Panel." Check the box and click OK.

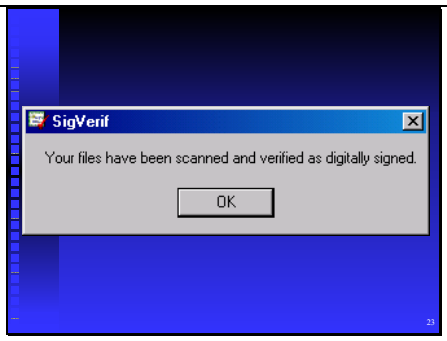
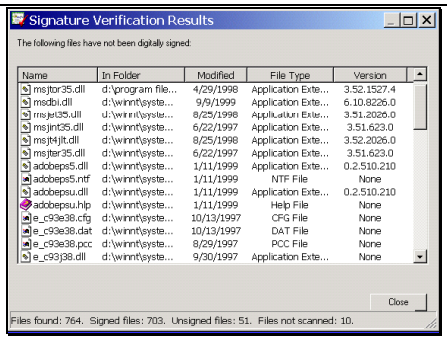
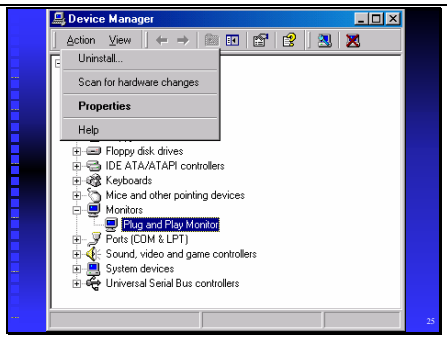
Slide 5		Now when you navigate the Start Menu, you don't have to open a new window just to access a single Control Panel applet. In fact, if you look closely you can drill down even deeper into a few of the applets from here. You might find this a useful customization if you use Control Panel often. Speaking of useful customizations, let's look at another.
Slide 6		You may have seen these small chevrons on the Start Menu. They are there to tell you "more is available on this menu if you hover the mouse over me." These are part of a Microsoft feature called Personalized Menus, and people either love them, hate them, or don't know they exist. If you have a couple dozen applications loaded, but use just one or two most of the time, then Personalized Menus will actually save you some time.
Slide 7		If you right-click the taskbar again, and select Properties you'll see this dialog. At the bottom is the switch for the Personalized Menus. Check it or don't based on your preferences.
Slide 8		Back to our Control Panel applets, if you open the System applet in Control Panel, you'll see this dialog. If you look closely, there is actually a fair amount of system information provided here. For instance, you can quickly see the version of Windows, the amount of installed RAM, and the type of processor. Notice the Windows version. Now let's look at the System Properties from a different computer.

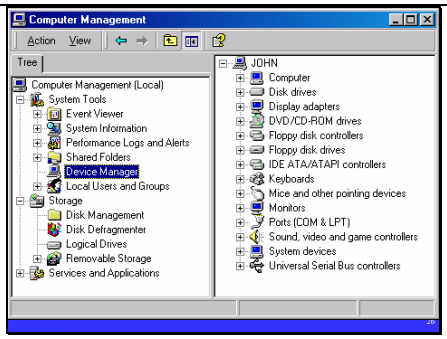
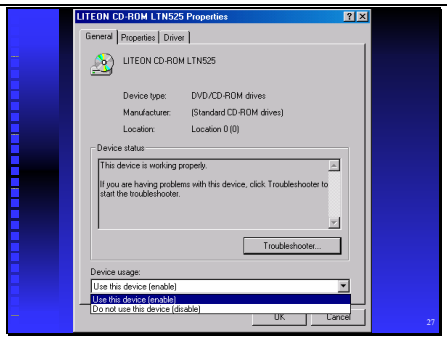
Slide 9		On this system a line is added to indicate that this is a newer version of Windows, which includes Service Pack 1. The Service Pack is an update provided by Microsoft to remove the bugs and problems that slipped through the original release. You can also identify the CPU family here. If you learn the models within each family, you can easily identify which processor is installed. Unfortunately a good list is hard to find, and Intel doesn't offer a simple chart. This one happens to an a Pentium II-350. (The previous screen shows a Celeron 433.) Windows 98 doesn't show the family and model unless you download and use a CPU ID tool from Intel.
Slide 10		The next tab is Network Identification. Here you'll find a wizard to create new users, and a dialog to rename the computer. Let's see what happens when we click the Properties button.
Slide 11		This is a fairly powerful dialog, one you don't want to mess with if you belong to a domain. Creating a new computer name will give you trouble if you are sharing files…you'll have to reconfigure all your shares. The dialog in the bottom corner is shown when you click the More… button.

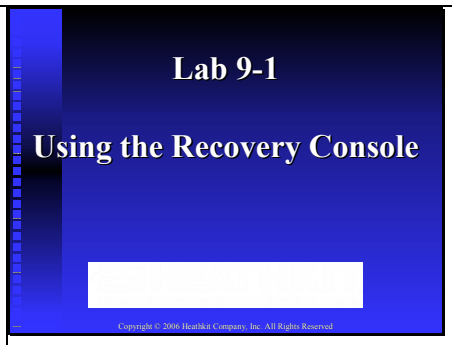
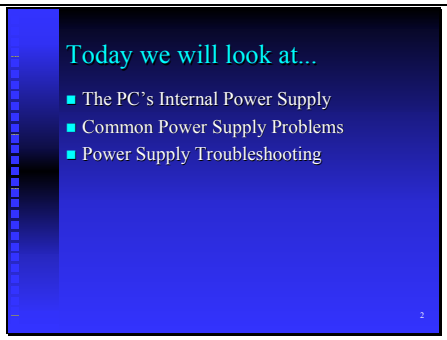
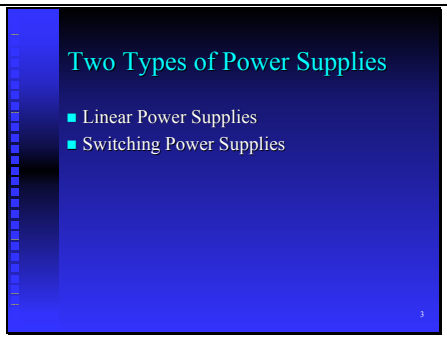
Slide 12		We'll come back to the Hardware tab in a moment. The User Profile tab is useful to determine how many different profiles are available on the machine. There is one very useful tool here, the Copy To… button. This button allows you to copy an entire profile to another location. Why would you want to do this? Recall that a profile contains all your unique user settings, including My Documents and your desktop settings. If you get a new computer, or need to reinstall Windows 2000 for some reason, you can copy your profile into the new system, saving you hours of configuration time.
Slide 13		The Advanced tab contains three important tools. First, let's take a peek at the Performance tool.
Slide 14		In the Performance Options dialog you can adjust the system to perform background services at a higher priority than applications you are running. Why would you do this? You might use this setting if you are running Windows 2000 as a small workgroup server, and you want the server users to get fast service. You can also adjust the Virtual memory paging file sizes and locations, as well as put a limit on the size of the Registry.

Slide 15		The Environment Variables button is truly for advanced users. You can adjust settings here, but be aware that you will probably cause all types of problems unless you are experienced with these parameters.
Slide 16		The Startup and Recovery dialog is an important one for the technician. You might recall a previous discussion of the MSDOS.SYS file, and its settings. Here, you can adjust which OS is loaded by default, and how long before that default will be selected, without actually editing the MSDOS.SYS file. You can also control what happens after a system failure, although the results of these logs are difficult to interpret.
Slide 17		Now let's skip back to the big one, the Hardware tab. The Hardware Wizard is the same wizard you'll find in the Control Panel. Hardware Profiles is useful if you use a portable computer with a docking station, or you tend to remove major hardware devices frequently. Otherwise, this tool is of limited value. Driver Signing is a new tool designed to protect you from bad drivers and malicious programs. Let's take a look at the Driver Signing Dialog.
Slide 18		Here you can decide to accept only drivers that are digitally signed by Microsoft. Any other drivers will not be installed, depending upon the options you choose. Digital signing is a method to prevent untested and untrusted drivers from being installed. You may have seen this before; you install a new device, say a scanner. After you run the installer and load the drivers, the system crashes, or other devices start to act badly. This is a classic case of a badly written driver, and Windows 2000 contains tools to prevent this problem. Let's take a quick detour and look at this function.

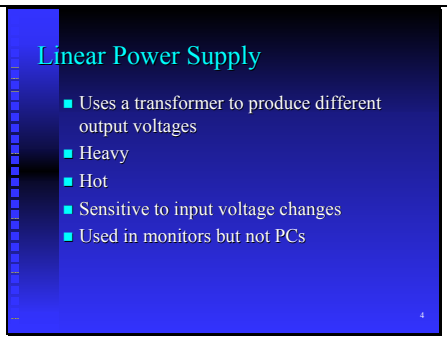
Slide 19		The companion tool for the Driver Signing Options sheet is the Signature Verification tool. This tool isn't on any menus, so you need to launch it from the Run dialog.
Slide 20		The File Signature Verification tool opens, and you can start the check. But first, naturally, we need to poke around in the advanced section…
Slide 21		The default search looks for system files only. Optionally you can choose to look for all sorts of unsigned files, in any folder on the system.
Slide 22		Going with the defaults, we begin the verification. This test takes about a minute, or even less on a faster machine.

Slide 23		If no unsigned files are found, you are rewarded with this brief message.
Slide 24		On the other hand, you may have some unsigned files. This system contains 51 unsigned files. That doesn't mean this system isn't running properly, in fact this system is being used to create this very slide, and it works perfectly well. What it simply means is that there are driver and system files here that Microsoft won't vouch for. They may be perfectly safe and properly written, but not signed. Note that any device or application developed before Windows 2000 cannot have signed drivers, which is demonstrated by the dates shown here. Keep this in mind when you adjust the signed driver options in System Properties.
Slide 25		Finally, the Device Manager. This operates just like older versions of Windows. The only real difference is the location of the buttons. In Windows 2000 you have to open the Action menu. This looks just like another Windows 2000 tool, do you recall which one?

Slide 26		Device Manager is also found in Computer Management. On the last slide we mentioned that there wasn't much difference between this Device Manager and earlier Device Managers. There is one tool that may prove useful for troubleshooting, so let's expand a device and check it out.
Slide 27		If you expand the CD-ROM, and double-click the device you'll see the properties sheet for that device. Near the bottom is a new pull-down menu that will allow you to disable the device. This options is available for most devices, but Windows is sharp enough not to let you disable things like the primary IDE channel, the keyboard, and other essential devices. Floppies, sound cards, NICs, SCSI adapters, and ports can all be disabled.
Slide 28		Now it's time to see how these tools really work in the lab.

Slide 1		Let's spend some time discussing how to troubleshoot power supplies.
Slide 2		Today we'll look at the PC's internal power supply, common power supply problems, and techniques to troubleshoot those problems.
Slide 3		There are two types of common power supplies used in electronic equipment today. • Linear power supplies - these are not used in PCs. • Switching power supplies - these are used in PCs. Let's look at both types…

Slide 4



Let's look at the linear power supply first.

• It uses a transformer to produce different output voltages. The transformer converts AC voltages like 120 volts down to 12 volts, 5 volts, or whatever voltages are needed to run a piece of electronic equipment.

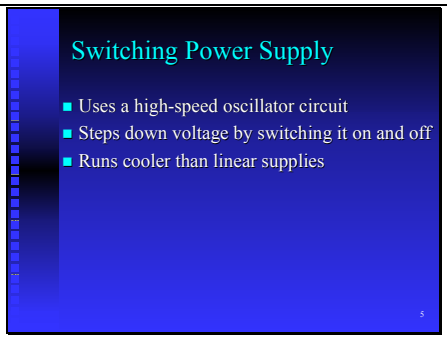
• It usually weights a lot. Those transformers can be heavy devices.

• A linear power supply runs hot. It generates a lot of heat even during normal operation.

• They are sensitive to input voltage changes. In other words, when the AC line voltage varies like it might on a hot day when air conditioners in the area are turning on and off, the linear power supply's output voltage can vary, too.

• And yes, you will find linear power supplies in video monitors, but never in a personal computer.

Slide 5

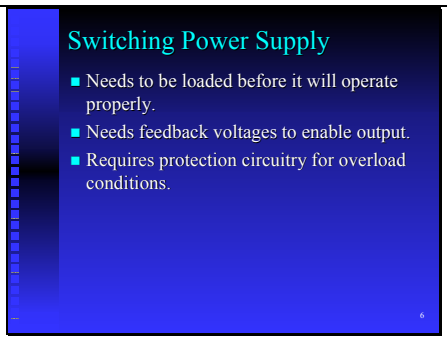
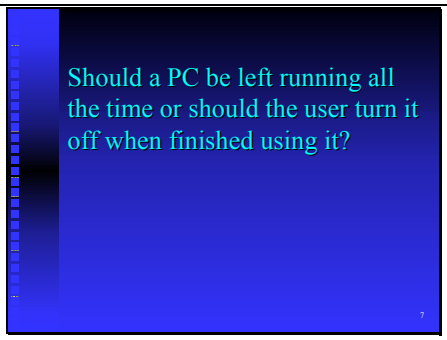
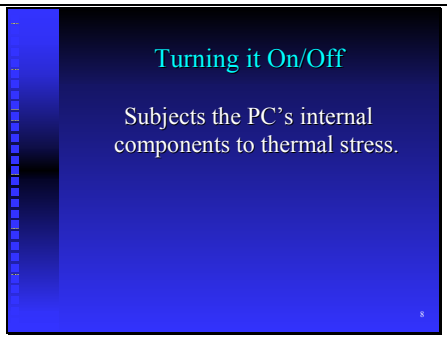


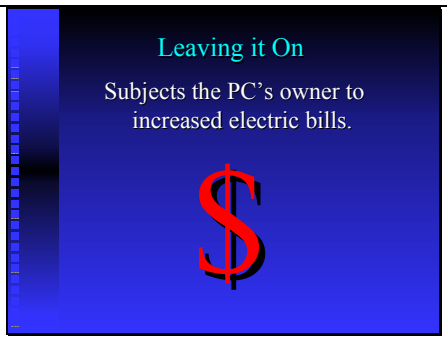
Switching power supplies are the only type of power supply used in PCs.

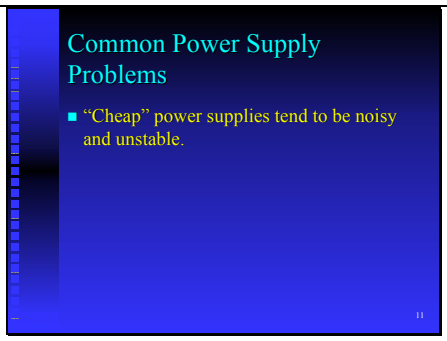
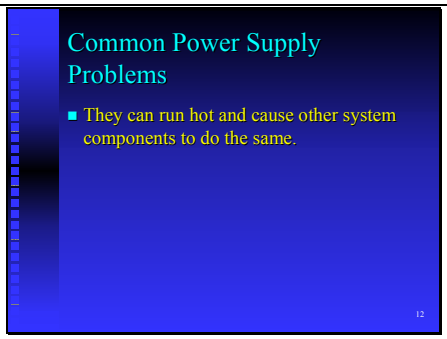
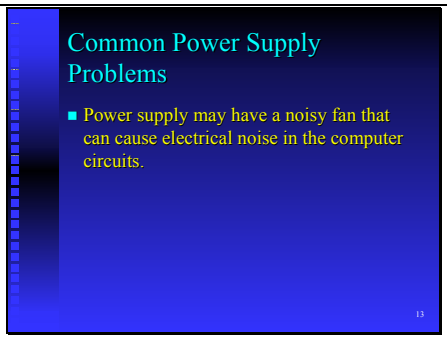
• Instead of a transformer, they use a high-speed oscillator circuit.

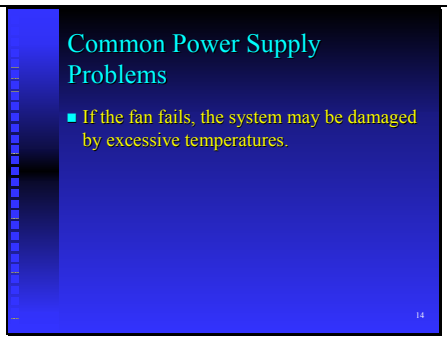
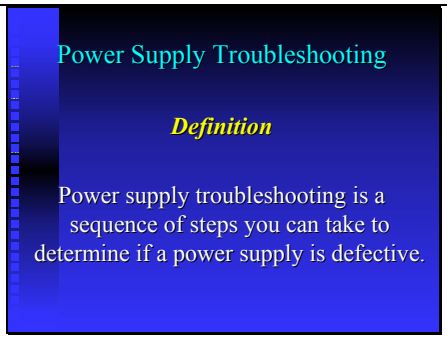
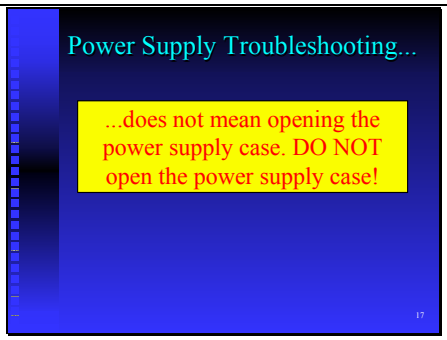
• The oscillator steps down the voltage by switching it on and off quickly.

• A switching power supply runs cooler than a linear supply. That's not to say a switching supply runs cool. It still generates heat, just not as much as a linear supply.

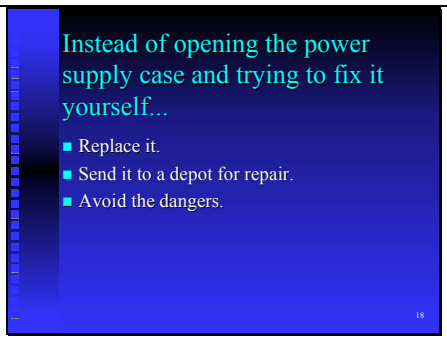
Slide 6		A switching power supply needs a load attached to its output in order to operate properly. You can't remove a switching power supply from the PC, put it on your workbench, plug it in, and expect to read the output voltages with your voltmeter. A switching supply needs a load attached like that provided by a computer motherboard. Not only is a load required, but feedback voltages are needed to sustain the output. Further protection is required to prevent overload problems. If the current requirements exceed the capacity of the power supply, the supply must be shutdown. That's because excessive current draws will lower the output voltages or possibly destabilize the voltage regulators and damage the motherboard and possibly the daughter board circuits as well.
Slide 7		Here's something to think about. Should a PC be left running all the time or should the user turn it off when finished using it? In other words, should it be left on 24 hours per day? Or should the user turn it on when she arrives at work and turn it off during break, lunch, and when she goes home? What do you think?
Slide 8		Whenever you turn a computer on or off, its internal components such as semiconductor chips, circuit boards, disk drive motors and platters, and so on, are subjected to thermal stress. When you turn the PC on these devices heat up from room temperature to very hot temperatures. The same thing happens when you shut the PC off. The components go from being very hot back to room temperature. This constant change in temperature causes components to expand and contract. It eventually can shorten their life.

Slide 9		On the other hand, leaving a computer on 24 hours per day subjects the PC owner's wallet to stress. The higher electric bills will help empty their wallet quickly. The answer lies somewhere in between. A user could turn it on when she arrives at work in the morning. She would leave it on during the day including when she goes to breaks and lunch. Then turn it off when she leaves for home at the end of the workday. That's a good compromise. Any way you do it, there is going to be thermal stress. That's why good computer troubleshooters are in demand today. Components are going to wear out and will have to be replaced no matter how often the computer is turned on and off.
Slide 10		Let's look now at some common power supply problems. Knowing what to look for will make it easier to troubleshoot power supply problems.

Slide 11		Some computer manufacturers use "cheap" power supplies in their designs to help their bottom line; their profits, that is. These cheap supplies can cause noise, both audible and electrical, and they can be unstable, both thermally and electrically. Audio noise is a growing problem as more and more cooling fans are added to these new high-speed computers cool. Proper fan design can help reduce noise. Poorly regulated power supplies are, by their nature, electrically noisy. By cutting corners with filter and regulator components the output voltages may drift out of spec and be subjected to ripple that can affect the operation of the computer circuits. Thermal and electrical instability is also reflected in the quality of the power supply components. Bad design will cause overheating conditions. Bigger, noisier fans are often employed to reduce the heat. When that doesn't work, voltages will drift—often out of spec—and components will fail sooner than they should.
Slide 12		A computer's power supply can run hot and cause other system components to run hot, too. A poorly designed power supply can give off a lot more heat than a properly designed supply. Larger fans may help, but there are tradeoffs between too much heat versus too much fan noise. Often noise wins out to make that sale. Later, the customer suffers when the computer fails because of the excessive heat not removed by the "quiet" fan.
Slide 13		Not only can a poorly designed power supply generate electrical noise, but a poorly designed fan motor can too. This electrical noise can be radiated by the fan motor or it can appear as ripple or voltage spikes that travel down the 12-volt supply line to the motherboard.

Slide 14		If the power supply's fan fails, temperatures inside the PC will rise. Again, components don't like heat and will eventually fail if the defective power supply fan isn't discovered soon. This is a very common problem. The air is full of dust an the fan acts as a small vacuum cleaner. Over time the build-up of dust will slow-down and finally stop the fan. When that happens, the only thing between your computer failing or surviving is the thermal shutdown circuits in the power supply or on the motherboard.
Slide 15		We now know some of the problems a defective or poorly designed power supply or power supply fan can cause. How can we troubleshoot these problems?
Slide 16		First let's define what we mean by power supply troubleshooting. Power supply troubleshooting is a sequence of steps you can take to determine if a power supply is defective.
Slide 17		*It does not mean opening the power supply case* to find out what is wrong inside the supply, or to see if there is anything you can fix inside the supply. *Do not open the power supply case.*

Slide 18



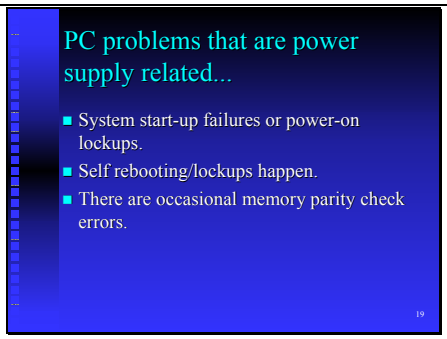
There are three reasons why you shouldn't open the power supply case…

First, PC power supplies are not very expensive. You can replace one for anywhere from fifty to one hundred dollars. You can't afford to spend time trying to fix it yourself. Your time is valuable and by the time you bill the customer for trying to fix it, you might as well have replaced it.

Second, your company may have an arrangement to send components like PC power supplies to a repair depot. The depot personnel are experts and can fix a power supply for a reasonable charge, and they have the equipment to do the job right. Let the experts do their work. Don't try to do it for them.

Finally, there are dangers inside a PC power supply that you must avoid. Capacitors can hold a high-voltage charge for a very long time. Coming in contact with this charge could be dangerous or even fatal. Again, don't take risks by opening the PC power supply case.

Slide 19



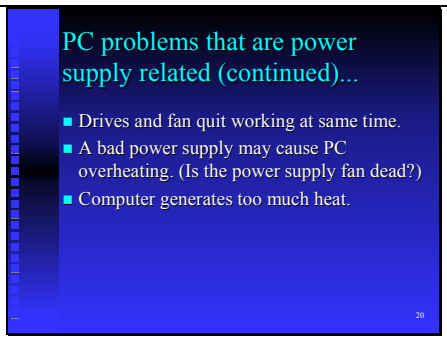
Here are some PC problems that could be power supply related:

The user may be experiencing start-up failures or power-on lockups. When the computer is turned on, it might lock up or may give a start-up error message. A power supply problem might be at fault.

Even if the computer gets past the start-up, it might experience lock-ups during operation. Also, the computer might re-boot for no apparent reason. These may be power supply related.

If a user complains of occasional memory parity check errors, the power supply could be at fault. We aren't talking about memory parity errors all the time, we are talking once in a while. Errors all the time would point to a memory chip problem.

Slide 20

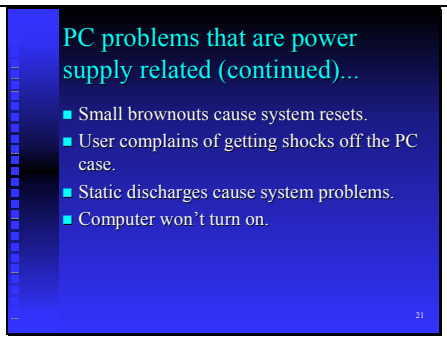


If a computer's disk drives and fan both quit working at the same time, it's probably a power supply problem. We're talking about the computer's fan, not the power supply fan. Both the computer's fan and the disk drives run off the power supply's 12-volt output, so if both quit at the same time, chances are the power supply's 12-volt output has failed.

A bad power supply could cause computer overheating. Maybe the power supply's fan quit working?

If the computer seems to "run hotter" than it used to, the power supply is may be the cause. More often than not, to much dust has accumulated on the internal heat sinks or fan, preventing the heat from escaping.

Slide 21

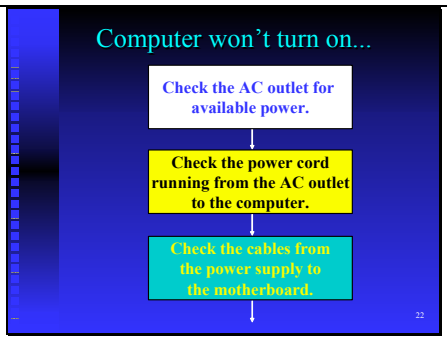
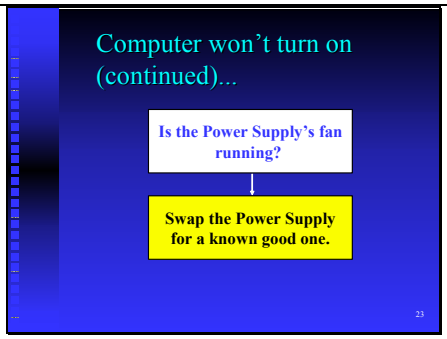


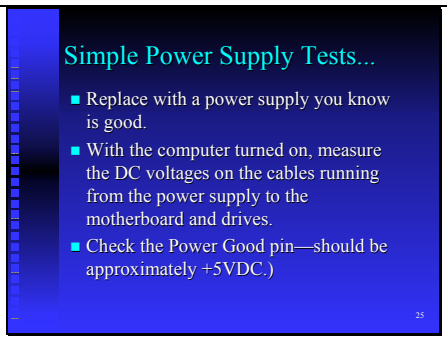
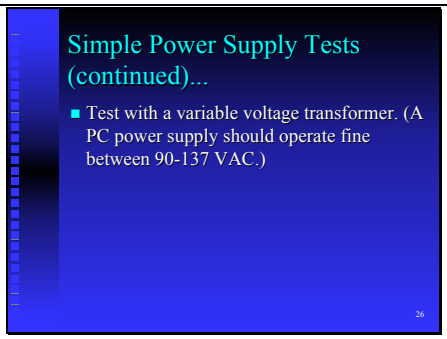
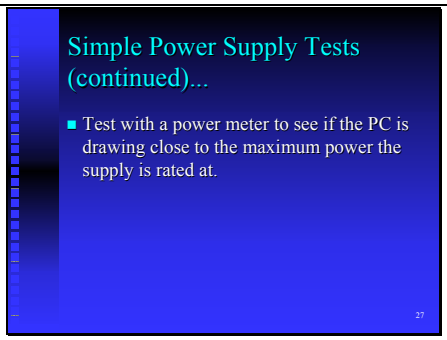
Small brownouts can cause system resets. A brownout is when the AC voltage from the power company drops drops below the allowable limits set by the Federal Government. If the voltage drops too far, it is normal for the power supply to reset the system. As a rule, a properly designed power supply should be able to handle small brownouts. But even the best power supplies fail when the AC voltage drops too far. If you find small brownouts causing too many power resets check out the power supply.

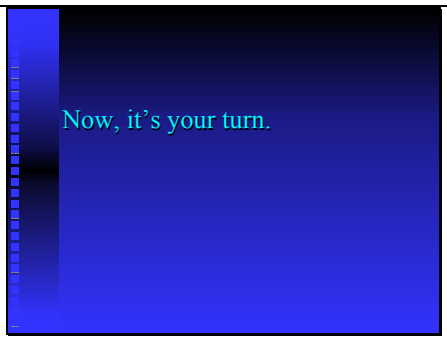
A user may complain that he gets "shocks" when touching the PC. Definitely look into this immediately. It could be a power supply problem or an AC outlet wiring problem. Either way, it could be a deadly condition.

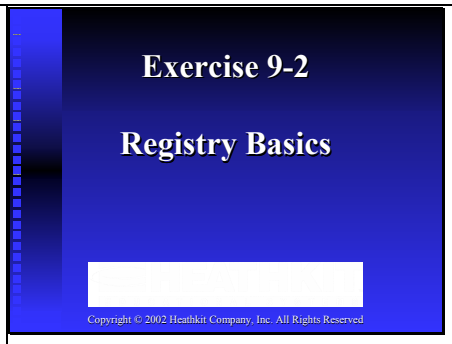
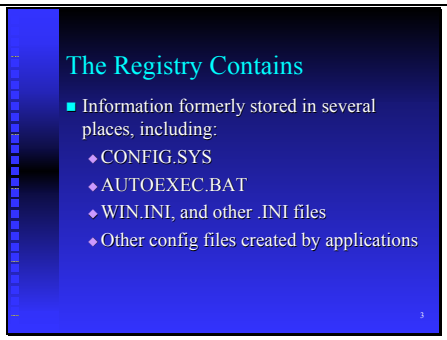
If slight static discharges create system problems, it could be a power supply problem. Normally, that is a grounding issue within the power supply or between the power supply and the rest of the computer.

If the computer won't turn on at all, this is a good indication that there is something wrong with the power supply or its peripherals. By peripherals, I mean things like a defective power-on switch, power-good feedback from the motherboard missing, or a loose AC power cord. Where do you start troubleshooting a problem like this?

Slide 22		Here's a series of steps you can follow if the computer doesn't turn on at all. First, make sure the AC outlet the computer is plugged into has power. Use a DMM, a desk lamp, or radio to verify power is available. A blown fuse or circuit breaker could be at fault instead of the computer's power supply. Next, check the power cord running from the AC outlet to the computer. Is the power cord firmly attached to the AC outlet and the AC connector on the back of the computer? Open the computer and check the cables running from the power supply to the motherboard and the power switch. Make sure they are plugged in and that the cables themselves are in good condition. Sometimes a cable is damaged or pulled out of its connector during an upgrade. A damaged wire may cause an open current path or a short circuit to another wire or to ground.
Slide 23		Is the power supply's fan running? If it is, this could indicate that the AC power to the power supply is OK but the power supply's output is dead. Something is wrong inside the power supply. Use the troubleshooter's best tool. Swap the suspect power supply with a power supply you know works.
Slide 24		Now that we have solved the problem of the computer that won't turn on, here are some simple tests you CAN perform to check out a power supply whether the computer turns on or not.

Slide 25		Of course, the old swap the suspect power supply with a known good one trick is number one. Didn't I say this was the troubleshooter's best tool? With the computer plugged in and turned on, measure the DC voltages on the cables running from the power supply to the motherboard and drives. Of course, the cables must be plugged in, or the power supply will shut down. You shouldn't have much trouble touching each of the metal pins through the back of the connectors with the voltmeter probe. Use your voltmeter to measure the DC voltage at the Power Good pin. It should be around plus 5 volts DC.
Slide 26		There are two handy pieces of equipment to help you troubleshoot power supply problems. The first is the variable voltage transformer. It's basically a box with a transformer inside. It plugs into the AC outlet and the computer plugs into the box. You can adjust the AC voltage being fed to the computer to see how much tolerance the power supply has high and low voltage levels. A properly operating PC power supply should operate fine between 90 and 137 volts AC when the input power selector switch is set to 115/120 VAC. If it fails to operate within that voltage range the power supply most likely has a problem or it was badly designed.
Slide 27		You can also use a power meter to see if a PC's power supply is drawing close to the maximum power it is rated at. The power meter is installed in the AC line between the computer and the AC outlet. It tells you how much current the computer is drawing so you can calculate how many watts the computer is using. If it's close to the maximum watts the computer's power supply can supply, you may want to look into upgrading the power supply with a higher capacity one.

Slide 28		Okay, that's enough on power supplies. Now, onto the lab exercise!

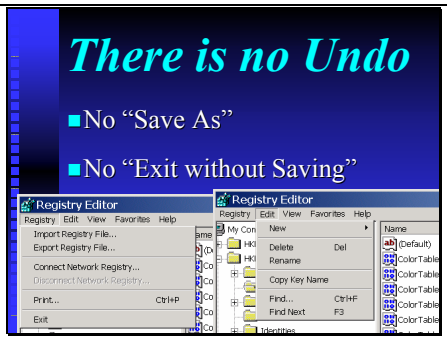
Slide 1		In this presentation we'll review a topic covered last quarter, and also provide information on troubleshooting power problems.
Slide 2		The registry is one of the more important parts of a Windows system. Windows has had a registry since Windows 3.1, but it became a critical component with the release of Windows 95. You can describe the registry as a centralized location where Windows can saves configuration information.
Slide 3		The registry is the place where virtually all configuration and startup information is stored. Everything from the color of the buttons, to the fonts used on the screen, a list of drivers and the hardware they control, to the number of processors and the name of the system's users is stored in the registry. If you are familiar with MS-DOS, you might recall that the CONFIG.SYS and AUTOEXEC.BAT files contained much of the system setup information. Windows 2000 is immensely more complicated, and as a result the registry is equally complicated when compared to these older system files.

Slide 4

In MS-DOS, you used Edit to make changes. In Windows 3 you used Sysedit. But since Windows 95, A tool called the registry Editor was created.

You can edit the registry directly with the registry Editor, by running the program as shown here. But before we go any further we need to cover some issues first.

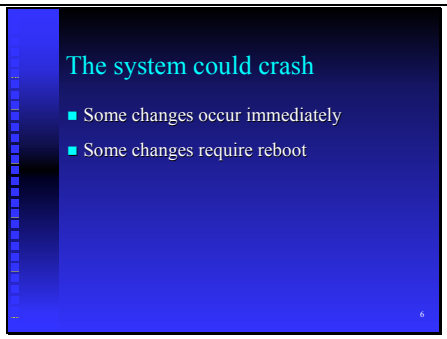
Slide 5



The registry Editor, called Regedit, does not work like the typical text editor. For instance, you can't make a bunch of changes, then exit without saving if you make a mistake. The registry is *live* as you edit it. When you make a change, the change is immediately written to the registry. So if you make a mistake and forget where you made that mistake, there may be no way to repair the damage.

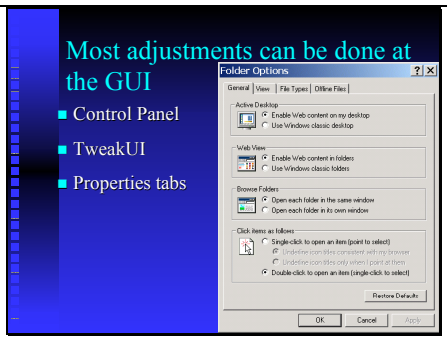
This slide shows two of the Regedit menus, and right away you should notice that there are no Undo or Save items. This is another powerful Windows tool, and you must be careful as you use it.

Slide 6



Parts of the registry are live all the time, while other parts are only implemented during the boot cycle. If you edit something that is being used, you could lockup the system in its tracks, with no way to recover. If this happens you need to do two things: First, restore a known-good registry from one of your backups. Second, either find a way within the GUI to make your changes or give up on the change. Keeping a backup is critical, and we'll discuss that in a moment.

Slide 7



Every time you make a change to your desktop, such as a screen color or a folder view preference, you are indirectly editing the registry. You typically do this with the tools in Control Panel, special purpose tools like TweakUI, and the various places where you can adjust object properties. In the dialog box shown here, the registry is edited when you make a change and click Apply or OK. This happens in the background, and it works perfectly.

As simple as this is, why would you ever want to fool with the registry? Well, there are some good reasons to get into the registry, but we're not going to cover them here.

Slide 8

So let's say you decide to get in there anyway to fix something that's "broken" in the registry. Before you even consider it, there are three things you should do.

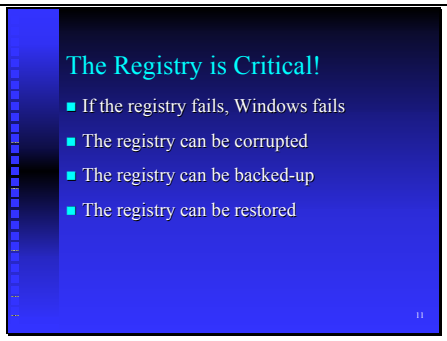
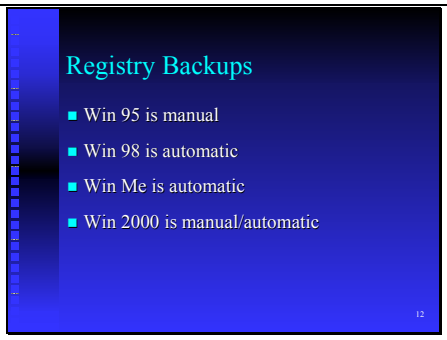
First, make a backup copy of the registry. We'll show you how shortly.

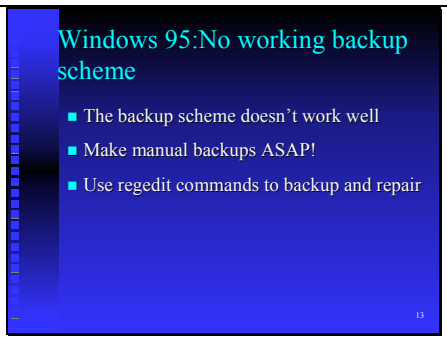
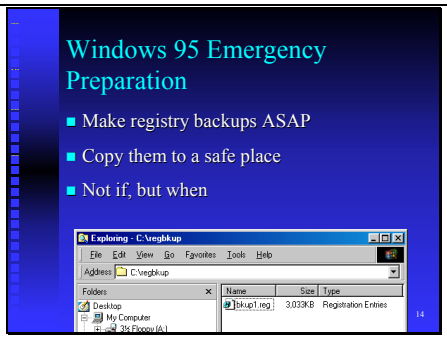
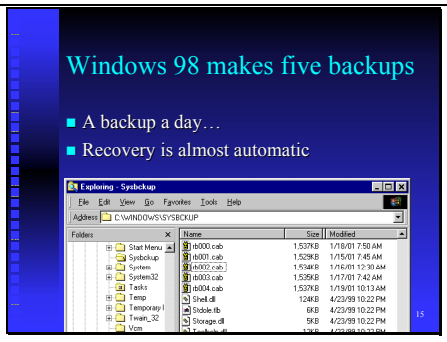
Second, you must know how to restore the registry from that backup copy. After all, what good is a backup that you can't use?

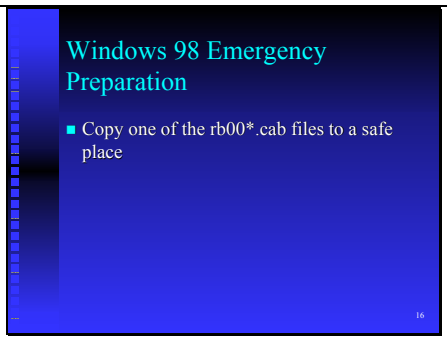
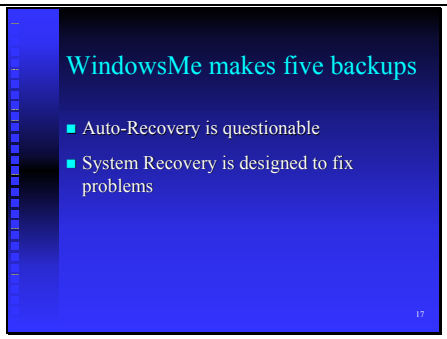
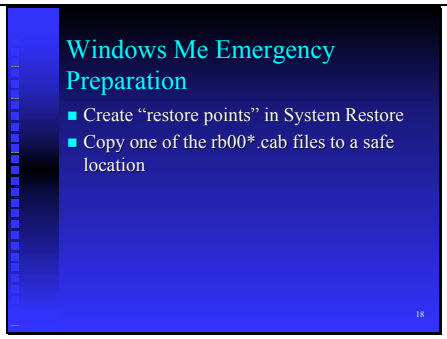
Third, test your backup plan. Many backup schemes look good on paper, only to find out that they don't work in the real world. Don't make this mistake!

Slide 9

The second rule is that you should not make changes in the registry when you can make them from a dialog box in the Windows GUI. Why? Because the dialog boxes in the GUI won't let you make choices that conflict with each other, which may lead to crashes or worse. But in the registry, you can do anything you want, whether Windows allows it or not. And, it won't tell you this either.

Slide 10		The last rule is may be the most important. You should never experiment with the registry in a computer that contains important information. For instance you might be tempted to play with a couple settings that are supposed to improve the performance of the system. Fine, but don't do it on your family's computer. Don't do it on your main work computer, either. Until you become expert on the workings of the registry, limit your exploration to a system devoted to learning, such as the one used in this class, or a spare you use for this purpose.
Slide 11		The registry contains critical system information. This information, if lost, could wreck your entire day if you can't recover quickly. Registries are typically corrupted by application software that is poorly written, by viruses, and by people digging around and making mistakes. Fortunately, recovering from a corrupted registry is fairly simple if you have a proper backup.
Slide 12		The four major flavors of Windows each have their own unique registry backup scheme. Let's look at each of these in a bit more detail.

Slide 13		This isn't completely true, Windows 95 has a registry backup scheme, but it's built upon the premise that the registry isn't going to become corrupted. And of course, the Windows 95 registry is often corrupted during software installations and driver additions. Windows 95 makes its own backup, but that backup is quickly overwritten during the routine "reboot and try again" we all use when a problem occurs. Which leaves us with a single backup copy that is broken, just like the registry you might want to replace. When Windows 95 begins working properly and you have everything loaded, you need to make the backup. You make these manual backups of the Win 95 registry with the regedit/e command.
Slide 14		When running a Windows 95 system, make your registry backup as soon as the system is running and stable. You are likely to end up reinstalling Windows 95 from scratch if you wait for a problem to occur first. Copy these backups to a safe location on the hard drive, someplace where Windows won't look, such as C:\RegistryBackup\. Be prepared for a Windows 95 crash. As the old adage goes, don't plan for the time when a problem MIGHT occur, plan for the time when that problem WILL occur. The image shows one of these backups that might be used if the registry were to become corrupted.
Slide 15		Windows 98 solved the registry backup issue with a process that saves five backup copies of the registry, automatically. A new backup is created every day, replacing the oldest one in the group. This image shows the five backups, and their location in a Windows 98 machine. Built-in tools handle the recovery from a severely corrupted registry. With these tools, you can choose which of the five backups should be restored.

Slide 16		Windows 98 keeps five copies of the registry in files named rb001.cab, through rb005.cab. Each day you start up your system the oldest "rb" file is replaced with a new one. Periodically, it's not a bad idea to copy one of these files to a safe place. This way you can step-back to a point longer than five days ago, such as when a problem doesn't become apparent for a couple weeks. Then you can put the file back, and run scanreg to restore to the older file.
Slide 17		WindowsMe uses the same general scheme as Windows 98, with a couple new tools. First, the ability of the system to recover automatically is questionable. Sometimes it works, and sometimes it doesn't, but it is different than Windows 98. The new tool, called System Recovery, allows you to make much larger recoveries, including application setups and much more. This new tool isn't perfect however, especially when viruses are involved.
Slide 18		System Restore uses a series of "Restore Points." These are points in time where complete restoration information is saved. After a couple restore points are saved, the system can be restored to any one of the points. For instance, if something that you installed yesterday ate your system today, you could restore to a point just before you installed the problem. Ideally, anyway. This tool will get better, but its first version needs some adjustments. In addition, you should also consider saving one of the registry backup files, just like you did in Windows 98.

Slide 19

Windows 2000 makes a single automatic backup copy of the registry as part of its Last Known Good boot options. When something really bad happens in Windows 2000, you can always boot to the Last Known Good settings, which were saved after a successful launch and logon. That's all you get for automatic backups though.

Windows 2000 has several excellent recovery tools, the best of which is its prevention of problems in the first place. We will be discussing the others later.

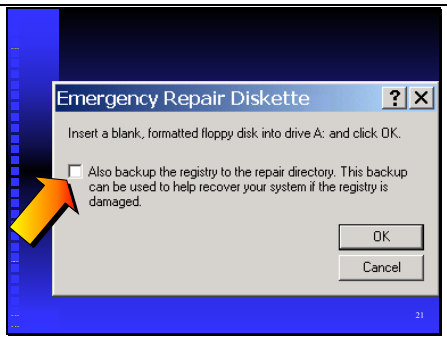
Most importantly, destroying the registry is a lot harder in Windows 2000 than is is in any other Windows OS. That is, as long as you stay out of the registry Editor.

Slide 20

One of the first things you should do with a Windows 2000 system is make an Emergency Recovery Diskette. In Windows 9x this was done from the Add/Remove Programs applet in Control Panel. In Windows 2000, use the Backup program, found under System Tools on the Start Menu.

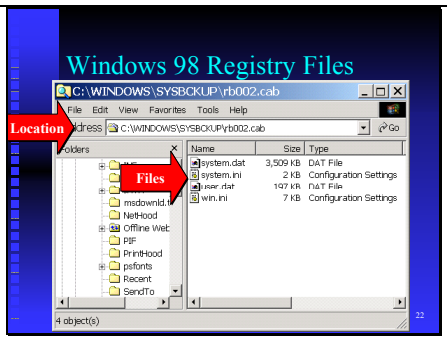
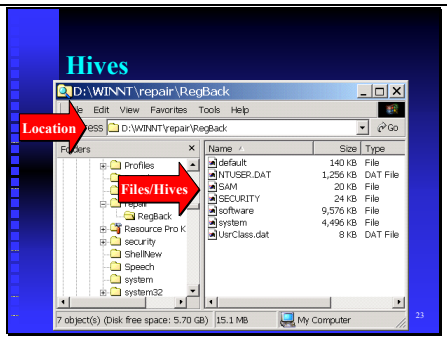
The message accompanying the ERD button tells us that this process won't back up files or programs…

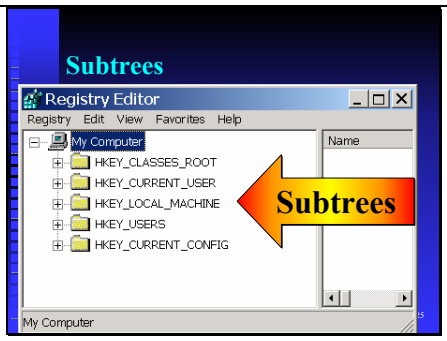
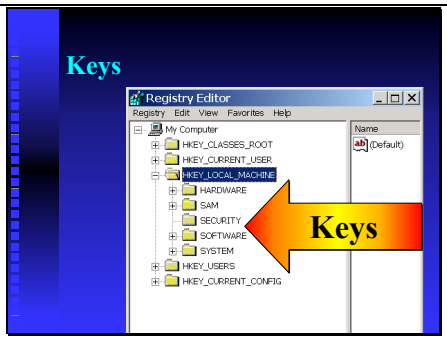
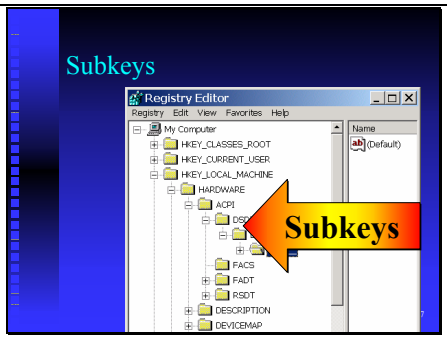
Slide 21

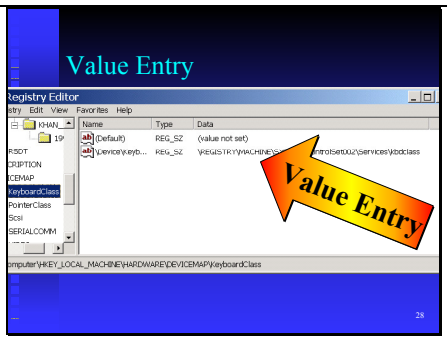
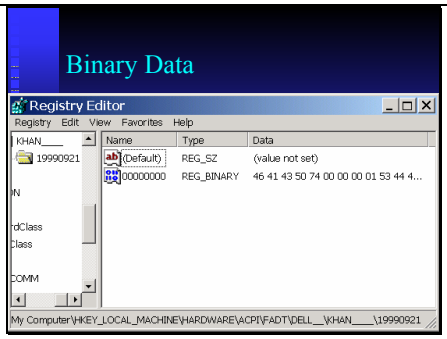
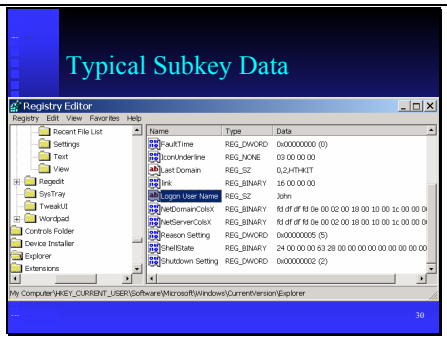


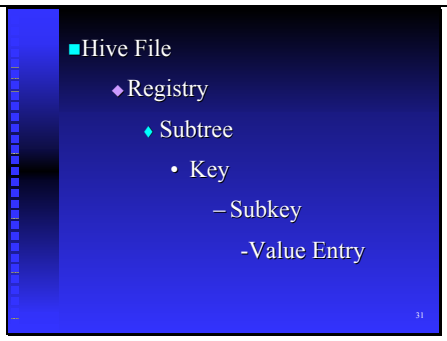
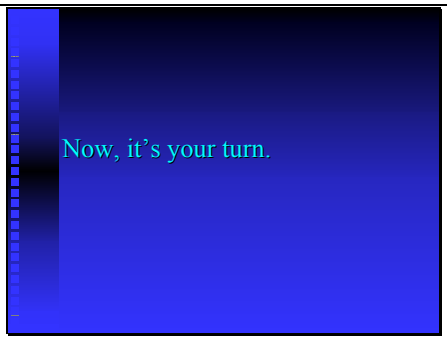
But after you click the ERD button you will see this dialog. Check the box, and a backup of the registry will be saved.

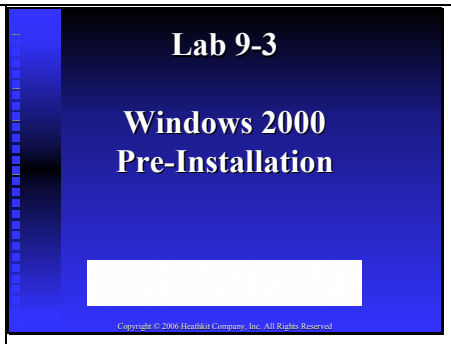
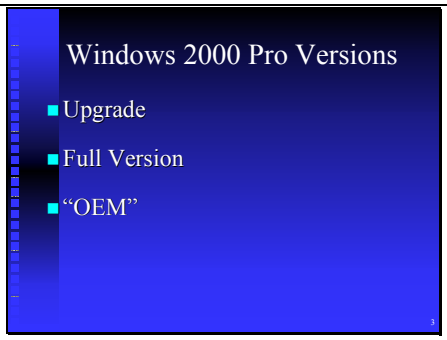
After you make the disk, label it and date it. Then put it in a safe place where you will be able to find it later. If you attempt to fix a broken installation later, this disk will greatly increase the chances of your success.

Slide 22		Now that we have made our backups, let's look a little more closely. In Windows 98, remember that the registry is made up of different files, all of which are usually found in the C:\Windows\ folder. In order to show you a simple list of the files, it's best to show you the backup. Here, they are shown in the standard backup location, as a file called rb002.cab. If you double-click the .cab file, Windows Explorer will open the file and show us the contents. (Win 95 can't do this…) The .INI files are not part of the actual registry, but they are important and backed up along with the registry.
Slide 23		Here we're looking at the result of our registry backup made with the Windows 2000 Backup tool. There are several more files involved, simply because the Windows 2000 registry is a bit more complicated than the Windows 98 registry. These files that make up the registry are called "hives." The hives are normally scattered in several places throughout your Windows 2000 system, but performing a registry backup places them together in a location where the ERD can find them.
Slide 24		When you launch the operating system, the Hive files are combined into the structure we know as the registry. Parts of the registry are actually created as the system is loading, and other parts are pre-assembled from the hive files.

Slide 25		Now that you know a bit more about the registry, let's go back and open the registry Editor. The registry is organized like your hard drive, more than anything else. The first level of organization is the subtree. There are five subtrees in the registry, as shown here.
Slide 26		Just like a folder in Windows Explorer, you can open the subtrees. Each subtree is split into sections called Registry Keys.
Slide 27		And within the keys are subkeys. This arrangement can go on and on, as the registry is a very complicated affair.

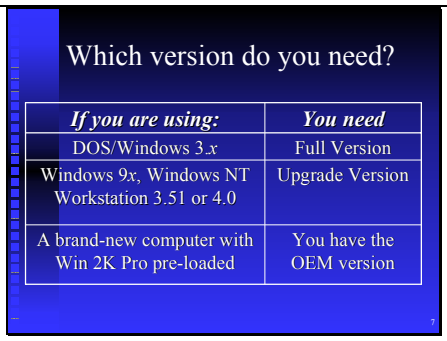
Slide 28		In some keys you have to drill down deep to find the real data, in others you don't. When you get to the end of the line, you reach a value entry. This, finally, is the data stored in the registry. Notice that there are three columns in the right side of the editor. The Name of the entry is on the left, followed by the data type. There are two primary types of data, strings of ASCII text and binary. The entry in the Type column tells the registry what data format will follow. ASCII strings can be anything, including simple words and sentences.
Slide 29		The second value entry shown here is a binary entry. It's not ones and zeros like you might expect, rather the data is viewed in a hexadecimal format.
Slide 30		This is a typical group of value entries at the end of a subkey. There is a mix of binary, data strings, and regular text at the end of many keys like this one. In the end, these all come together to make your system work properly. Occasionally you will need to modify a data string in the registry. With this information, you'll be able to better understand how to do it.

Slide 31		And there you have it, the structure of the registry. Keep in mind that this entire structure is simply a way to organize the data stored as value entries.
Slide 32		Now, turn to your workbook and the next lab.

Slide 1		Throughout the labs in this course, we have largely skipped past Windows 2000. In this presentation, we need to take a look at the installation issues and processes involved in installing Windows 2000. Most of what is presented here is applicable to Windows XP as well. "Win 2k Pro," as it is usually called by technicians, is more complex, more stable, and more powerful than any previous Microsoft operating system. The latest Microsoft operating system, XP, is Windows 2000 with a few bells and whistles added. So what you learn in this and the remaining exercises will serve you well when you study XP sometime in the future. This exercise and presentation will show you what you need to do before you even think about loading an operating system on a computer.
Slide 2		Windows 2000 comes in several different "flavors." Professional, the program you'll be using, is the default OS for the desktop and workstation. It will support PCs running one or two CPUs. Windows 2000 Server is the replacement for Windows NT Server. It can support computers using up to four CPUs at a time. The Advanced Server has several additional features, and it can support servers using up to eight CPUs. The Datacenter Server is designed for large critical applications. In addition, it can support up to 32 CPUs in the same machine. These are the computers that might be found running credit-card authorizations and massive websites.
Slide 3		Complicating matters even further, Windows 2000 Pro is available in three versions. The OS is the same no matter which version you have, only the price and installation options vary. The OEM version is more likely to be the most recently released code from Microsoft, but that's really the only difference…until you try the installation. We'll discuss that in a few moments. These are worth more discussion, so let's look at each of them.

Slide 4		Unless you buy a new computer with Windows 2000 Professional pre-installed, most of you will purchase the Upgrade version. Microsoft wants you to upgrade, and they make this version less expensive so you are more likely to buy it. There are two catches with the Upgrade version: First, you must have a valid license for the supported previous-version OS. Second, expect to prove that you have that older version when you upgrade. Notice the statement on the CD about searching for eligibility. That means this disk won't install the OS if you don't have a previous Windows already installed, or you can load the previous version Windows disk into the computer for examination.
Slide 5		The Full version does not require that you have anything, except more money. This version is available today for about $260, as compared to the Upgrade version at $110 after a rebate. (There always seem to be rebates…) Here's the deal: if you build your own machine and plan to install Windows 2000 Pro, you need to buy the Full version of the operating system.
Slide 6		OEM stands for "Original Equipment Manufacturer." That means it's a version of Windows used by the companies that build and sell computers. When you buy a Dell or Gateway PC, or any other brand for that matter, the Windows 2000 Pro on that machine is the OEM version. Technically, this is the cheapest version you can get, if you could buy it. Why so cheap? First, you don't get a proper box or manuals. Second, Microsoft doesn't provide technical support. Look closely at the text on the CD; it says: "For product support, contact the manufacturer of your PC." If you need help or tech support with the OS on a Dell or Gateway, only Dell or Gateway will help you. If you call Microsoft, they won't provide help unless you pay for it first.

Slide 7

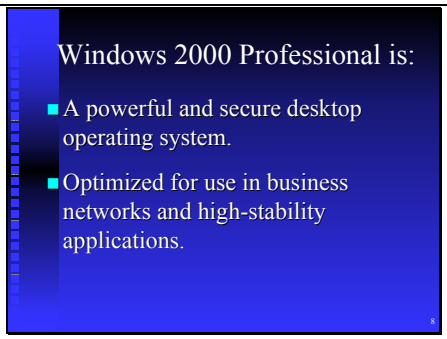


The Upgrade version is generally the least expensive route, but you have to make sure you qualify. You can't upgrade from Windows 3.x, but when you think about this, would Windows 2000 run on a machine still laboring behind Windows 3? Probably not.

The upgrade version can only be used if you have a version of Windows 9x—95, 98, or ME—or Windows NT Workstation 3.51 or 4.0. There are price differences between the two upgrades, but the software is exactly the same.

New computers almost always come with the OEM version pre-loaded on the hard drive. These computers may come with a CD built by Microsoft, or they may come with a "Recovery CD" built by the manufacturer of the computer. If the CD was built by the manufacturer, in most cases it won't work on any other brand of computer.

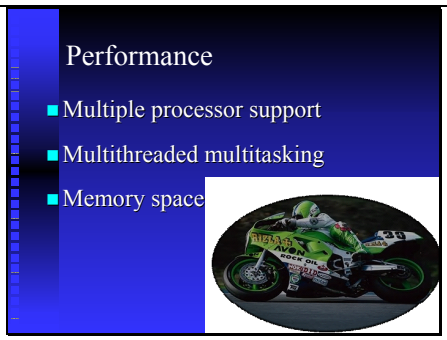
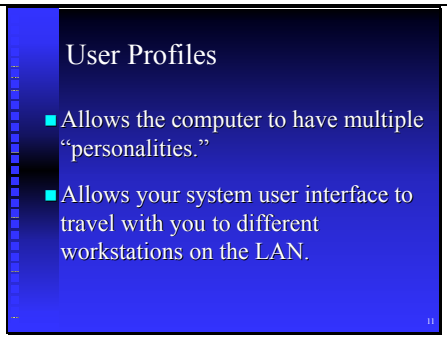
Slide 8

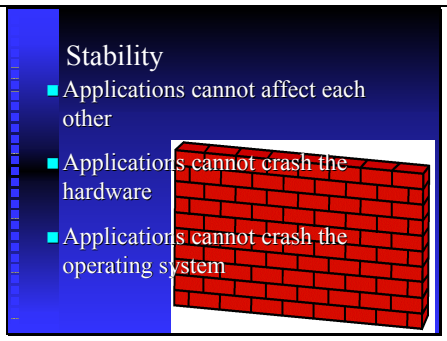
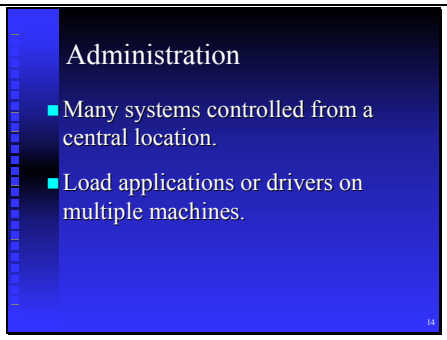


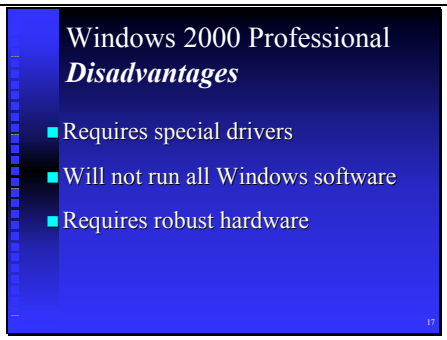
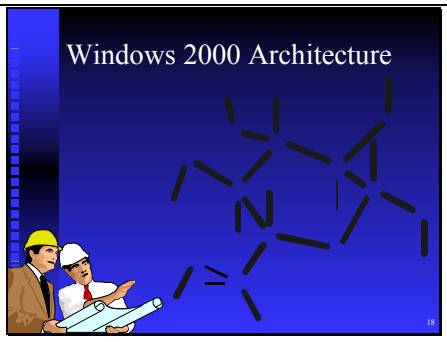
Windows 2000 Professional can be thought of as a companion to Windows 2000 Server. It shares many security features and compliments the administrative tools provided in Server. Professional is well suited to the business environment, where centralized administration and support of desktop computers is implemented. What this means is that as the support technician, you can service many problems without actually touching the computer that has the trouble. It also means that you can set up all the systems the same way, and make changes to this setup very easily. Windows 2000 Professional is optimized for desktop use.

Slide 9

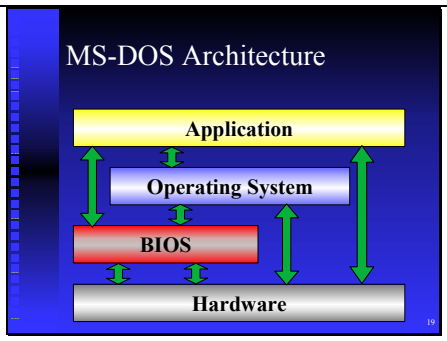
Windows 2000 Professional also boasts a long list of features. Let's look at some of these in more detail.

Slide 10		Just like 2000 Server, 2000 Professional can take advantage of systems that contain more than one CPU. This is especially helpful when you are running several applications simultaneously. Multithreaded multitasking is what a system does with multiple processors; it does several things all at the same time, often within the same application. Windows NT Workstation can handle up to 4GB of RAM. That sounds like a ridiculously large amount of RAM, but so did 1MB at one time.
Slide 11		User profiles are another nod to the system administrator. Profiles allow two users to share the same hardware, but with completely different GUI and network settings. In the same manner, you can use your logon at any workstation and it will look and operate just like your "home" workstation.
Slide 12		In a stand-alone computer, any of the versions of Windows 9x have little real security. Sure, it can be setup to require a password before you can logon. But the way to break past the password is easy to find and use. *Real* easy. At startup, simply hit the escape button to skip the logon entirely. Windows 2000, both Professional and Server, implement strong security measures. While no security scheme is 100 percent secure, Windows 2000 is very difficult to penetrate. This feature alone is often a good reason to use 2000 instead of other Windows versions.

Slide 13		Stability is another reason to consider Windows 2000 instead of a version of Windows 9x. In 2000 Pro, applications are run in totally separate address spaces. This greatly reduces the chance of one program causing another to crash. There is also an additional layer of isolation between the application and the hardware. Where DOS programs and even many Windows 9x programs can access hardware directly, Windows 2000 does not allow direct hardware access by applications. This feature ensures that properly written programs will run without crashing. At the same time, it prevents older or poorly-written programs from crashing the entire system. Device drivers are most affected by this layer of protection. Some hardware is supplied with specific drivers written just for 2000. Some programs simply won't run under 2000, and often this is why. Yet another layer of protection exists between the application and the operating system. Special techniques are used to reduce the chance of an errant application making the OS crash.
Slide 14		Central administration allows the system administrator to present the same desktop and setup to a group of users. For instance, this allows the administrator to add a new icon to several users' desktops without having to do it at every computer. The administrator can add a new application to several workstations; or, update a common hardware driver at every workstation, without ever leaving his or her office.
Slide 15		With so many advantages to Windows 2000 Professional, you may wonder why anyone would still use Windows 9x as a workstation operating system. And yet there are still more Windows 9x machines attached to networks than there are Windows 2000 Professional or Windows NT Workstation machines. Let's compare the two and see if we can figure out why.

Slide 16		There are many reasons to choose Windows 2000 Professional for a desktop operating system. As mentioned previously, performance, security, administration, and stability are key issues.
Slide 17		Although 2000 Professional offers many strong features, it has some disadvantages as well. First, it can be difficult to use with many peripherals commonly used in small offices and at home. The problem is, 2000 requires special drivers and peripheral manufacturers cater to the masses. Since there are many more 9x users than 2000 users, few peripheral manufacturers dare to make hardware without Win 9x drivers. 2000 drivers are often never made. Another issue is not all Windows programs will run on 2000; most will, but a few will not. Finally, 2000 Professional requires a faster CPU, more memory, and overall a more powerful machine than Windows 9x.
Slide 18		Before we get into the installation of Windows 2000 Professional, we should take a look at the reasons behind these advantages and disadvantages. A look at the construction of the Windows 2000 OS core will show us why the system is so much more stable and secure than the Windows 9x family. But don't worry, we won't get too technical…

Slide 19

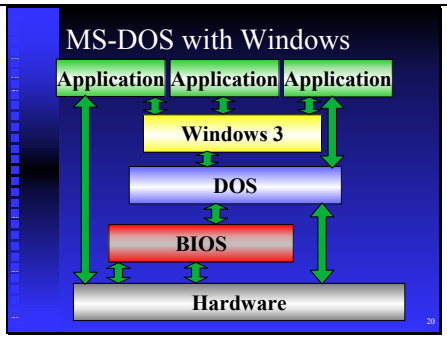


We discussed the architecture of MS-DOS before, but let's do a quick review. In its most basic form, a DOS system is built of the four components shown. There are more pieces to this diagram, but these are the important ones.

The arrows show the communications paths between the system components. This looks fine, except for a couple things: Allowing the applications to talk to the BIOS and hardware directly can be a problem. Why? Let's say one application decides to talk to the hardware, but there's a mistake in the program, and something goes wrong. If the application leaves the hardware in a condition where it can't respond to the next command, say a command from the BIOS or OS, the system is probably going to lock up.

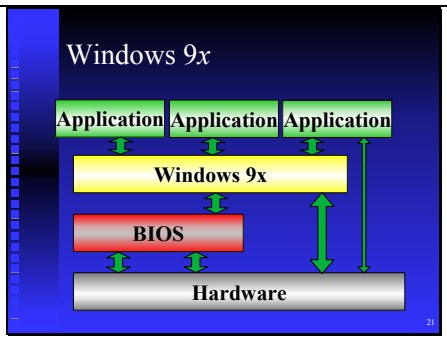
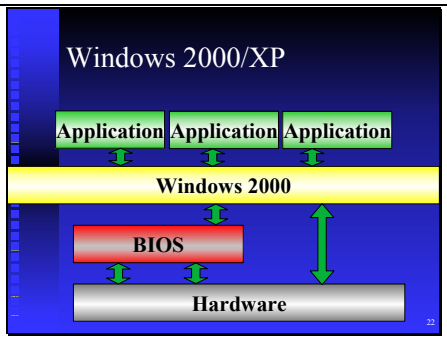
This was a common problem when DOS was king, but it wasn't too bad because we could only run one application at a time.

Slide 20

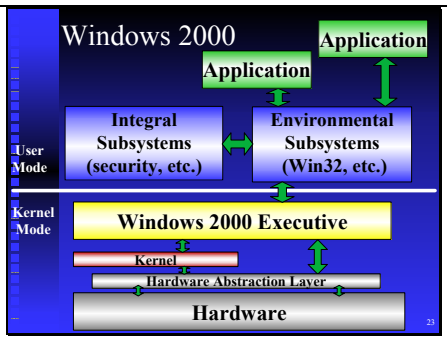


Now let's add Windows 3 into the mix. It allowed us to run many applications simultaneously, called multitasking. But in reality, all Windows 3 did was build a taller house of cards. Running several applications at the same time multiplies the risk of a crash. So if a Windows 3 application does something it isn't supposed to do, which seemed to happen all the time, not only does the suspect app lock up, but usually the entire computer still locks up. This happens because the applications aren't protected from each other, and the OS isn't protected from the apps. (and vice-versa)

Even worse, Windows 3 itself often caused problems. It wasn't supposed to be this way.

Slide 21		Windows 95 fixed a few of the problems. Most importantly, an entire layer was removed. A Windows 95 compliant application is supposed to follow the rules, which required that apps NOT go directly at the hardware or BIOS. After the first generation, most of these apps followed the rules. Once in a while though, the app talked directly to the hardware anyway. Additionally, apps crash all on their own more than they should. Windows 9x is fair at resolving these issues, but the system usually becomes unstable until the system is completely rebooted.
Slide 22		Windows 2000 and XP (and NT, for that matter) do not allow interaction between the application and the hardware. ALL communication is intercepted by the OS and handled by trusted and stable subsystems. Furthermore, apps are completely separated from each other, running within separate address spaces. With this model, if one application crashes, the rest of the system can continue on as if nothing had happened. This ability requires a bunch of memory, which we'll discuss a bit later.

Slide 23

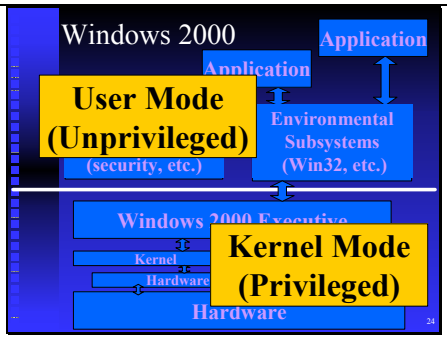


This diagram of the Windows 2000 architecture shows more detail. The important point is the distinction between the User Mode side of the system and the Kernel Mode side. Applications are never allowed on the Kernel Mode side. If they make the attempt, Windows will generate an error and/or shut the application down.

An application that needs to interface with the hardware, say get data from the hard drive, must make the request and the Windows subsystems will retrieve the data. Because all the subsystems are built by Microsoft and naturally trusted not to stray into the wrong area or do something wrong, the chance for a crash is greatly reduced.

You'll also notice that the applications must be written to abide by the rules of the OS. Windows 2000 does not tolerate applications that break the rules. This is significant because Windows 9x complained, but usually allowed a rogue application to do as it pleased, usually resulting in a system reboot at some point. Most applications have no trouble with the Windows 2000 rules, but some utilities such as diagnostics and repair tools that worked under Win 9x, may not work under Windows 2000.

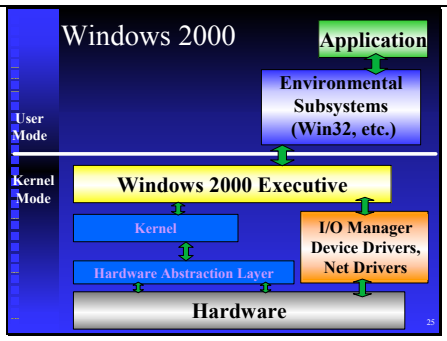
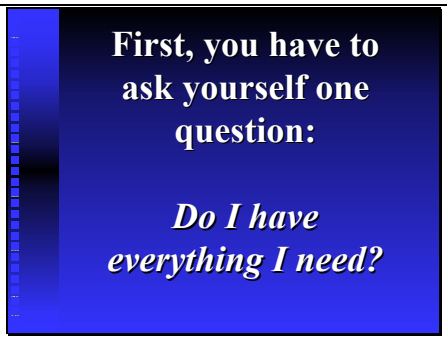
Slide 24



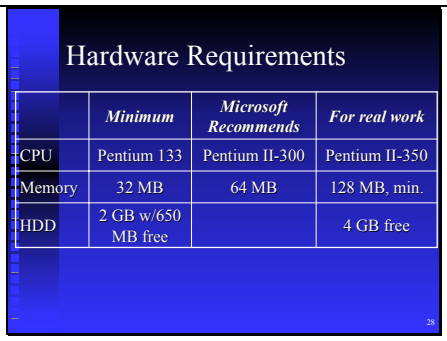
Microsoft makes a big deal out of the line between the two modes, so let's look at it one more time. No applications are allowed on the Kernel Mode side. If they try to perform a task that should be handled by Windows in Kernel Mode, Windows will generate an error and/or shut the application down.

This is the reason Windows 2000 is so hard to crash, and why it is so stable. If you only use applications with the official Windows 2000 endorsement, you may never see the system crash because the application plays by the rules.

Hardware drivers sit in the kernel mode side, and must be written to very strict rules. Because of these strict rules, many hardware manufacturers won't write new drivers.

Slide 25		Speaking of hardware drivers, just where do they fit? This diagram adds one more detail. An application that needs data from the hard drive must make a request for that data, and Windows will retrieve the data. Of course, there must be hardware drivers just like in all operating systems. The drivers must communicate through the Windows Executive, which is why many hardware vendors won't bother with new drivers for older hardware. It's a lot of work to build such a driver. The end result is better drivers that don't cause crashes, and an OS that keeps running.
Slide 26		Now that you've seen what Windows 2000 Professional is all about, are you ready to install this new operating system?
Slide 27		But first, there's just one question you have to ask yourself: Do you have everything you will need in order to properly and successfully install Windows 2000 Professional? Just what do you need to have? First, you need an appropriate computer.

Slide 28



Windows 2000 will run with the Minimum allowable hardware, but just barely, and it won't be any fun. Foremost, Windows 2000 requires a LOT of memory. 64 MB is an absolute minimum, and at 128 MB the system can run well. As you know, the amount of memory you need depends on the applications you run and the size of your files.

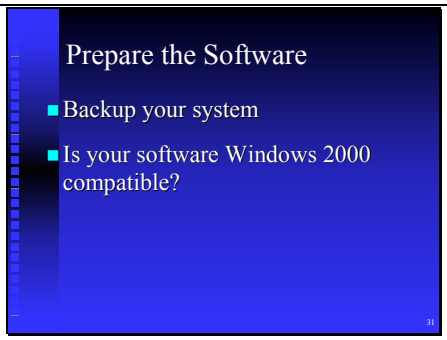
Windows 2000 Pro runs well on a 350 MHz Pentium II. Recall that the 350 is the first CPU to use a 100 MHz motherboard bus. You can get by with a slower processor, but you'll need a ton of memory. As with memory, you'll need a big hard drive. Windows 2000 can chew up a lot of disk space.

Naturally, these requirements and recommendations look like last year's news compared to the many systems available today that are well past 2 GHz and 120 GB.

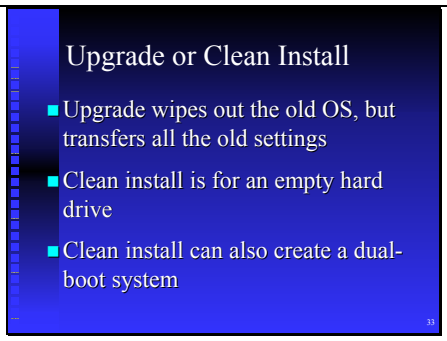
Slide 29

Microsoft has been approving various hardware components for quite some time. Under Windows NT, choosing hardware that was on the approved list was vital. With Windows 2000, most computer equipment is much better, and a listing by Microsoft isn't quite as valuable. There's a lot of excellent hardware that isn't on the list because it's expensive to get there.

But if you are buying servers, you only use hardware that's on the list. Why? Because Microsoft is unlikely to provide tech support for Windows 2000 if you use hardware that isn't on the HCL. The HCL is on the web, and an older list is on the Windows 2000 installation CD. If you aren't sure of something, always go to the Microsoft web site and review the current HCL.

Slide 30		HCL or not, the bottom line is this: if you attempt to load Windows 2000 on a computer that has any type of hardware problem, plan on a lot of troubleshooting. Also, plan on doing it without any help. If you start with good-quality hardware, and apply any updates to the firmware that are needed, you should have a pleasant installation.
Slide 31		Preparing your software isn't quite the same as hardware. First, you have to make a special backup of the important data files and any other program or configurations you need to keep. Most applications will work just fine without an upgrade, but two classes of programs might cause you to upgrade. First, diagnostic utilities will need to be upgraded. If the utility was written for DOS, then forget about even trying to use it. Many Windows 95 utilities may work, it just depends how they access the system hardware. Second, games that reboot Windows 9x into DOS mode won't work either, since Windows 2000 cannot be rebooted in this manner. And don't forget that backup.
Slide 32		The wrong time to make decisions is during the install process. Many of the setup options are difficult or impossible to change once they are selected, and in most cases the choices must be fully understood before you make them. Let's look at each of these choices.

Slide 33

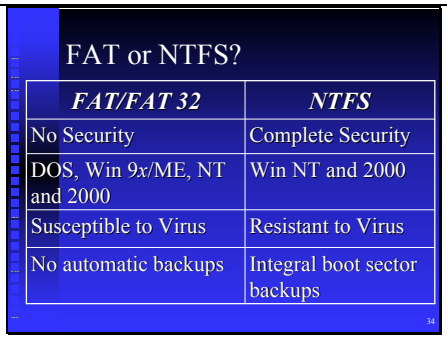


A Windows 2000 upgrade is like any other upgrade, Windows 2000 reads the old OS and attempts to implement all the original configuration settings. This seems the easiest way, but most experts strongly recommend that you do not upgrade. We'll discuss this topic in detail later.

A clean install is typical of loading Windows 2000 on a new or re-partitioned hard drive. You install from scratch, and then perform a complete configuration. You also need to load all your applications. This is regarded as the best and most reliable installation method. Again, more later.

A clean install can also be placed alongside your existing Windows 95/98/NT Workstation installation. That is, you can choose which operating system you want to run, every time you reboot the computer. This has some trade-offs too, but seems to work very well.

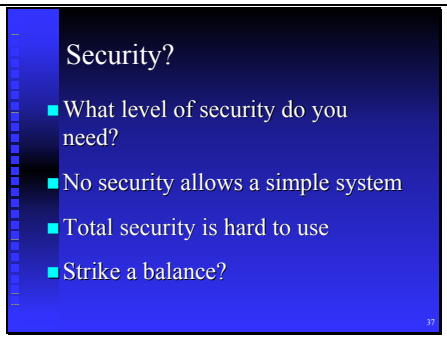
Slide 34



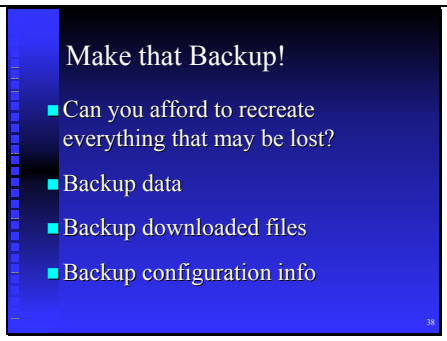
As you studied back in Windows 98, the only choices for partition structures were FAT and FAT32. Windows NT has used the NT File System since its inception. NTFS adds many capabilities as compared to FAT:

FAT has four main attributes for files; Read-only, archive, system, and hidden. NTFS offers several more attributes, including one that deals with the security of each individual file and folder.

NTFS is less susceptible to viruses because of its complex structure, and also because of the security features. And the last big issue is that NTFS makes automatic back-ups of the boot sector.

Slide 35		If making a choice is difficult, consider this: Converting a drive from FAT or FAT 32 to NTFS is a simple operation.
Slide 36		On the other hand, converting from NTFS to anything else is very difficult, and impossible with tools supplied by Microsoft. There are utilities available for this, but they can't guarantee you won't lose any data in the process.
Slide 37		Before you begin the installation, you probably already know what you will be doing with the new Windows 2000 Professional system. Maybe it's just being used for standard office applications in a small-business setting, where there is little need for security. Or maybe it will be used by a financial analyst or stock broker, where absolute security is required. Keep in mind that the tighter the security, the harder the system is to use. Between the extremes is a balance between ease-of-use and security.

Slide 38



Should you make a backup first? Another question helps to determine the answer: Do you have the time or ability to recreate everything that could be lost, if the hard drive fails completely?

Obviously, you should make backups of your data files. This includes all your documents and spreadsheets. But it also includes your email folders, Favorites folders, and anything that you have downloaded and can't afford to lose.

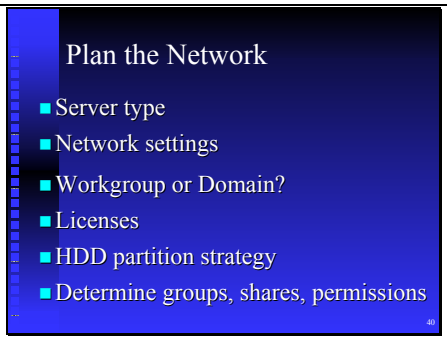
Write down your existing network settings and any other settings your computer may use, or make print screens and keep them handy.

Slide 39

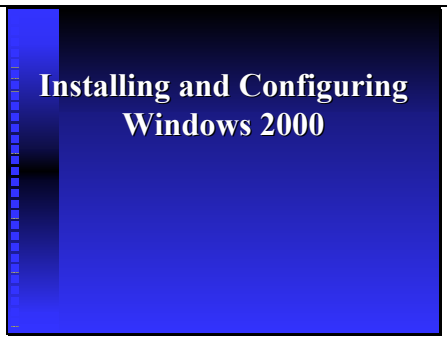
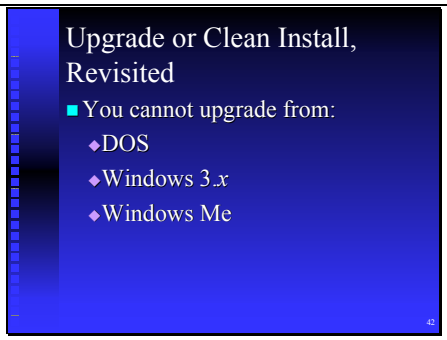
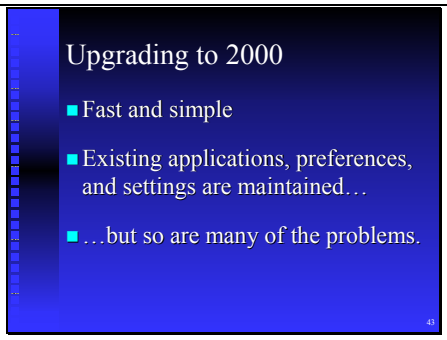
The features that make Windows 2000 so stable are the same features that eliminate the use of all but the most sophisticated hardware diagnostics. Troubleshooting hardware problems in a Windows 2000 system can be difficult. The best strategy is to prove to yourself that all the hardware is working properly *before* you install that new OS. Load an old version of DOS, and run your favorite diagnostics through every available test. Once you are convinced everything is fine, then load Windows 2000.

Windows 2000 requires specific drivers for most devices. Many Windows 98 drivers are useless in Windows 2000. Get the latest Windows 2000 version. The same is true for SCSI adapters, NICs, modems, sound cards, CD burners, and everything else.

Slide 40



Before you begin loading any software, determine if the server you will be connecting to is a domain controller or configured for some other function. Remember that switching from a workgroup to a domain is easier than going the other way. Determine the protocols you will use, and obtain the necessary TCP/IP settings and network names. Of course, obtaining the appropriate licenses is a necessity. Deciding on the configuration of the hard drive is easy now, after installation your options are more limited. The concepts of groups, shares, and permissions will become clearer as you go through the next several lessons.

Slide 41		Next, let's take you through the actual installation of Windows 2000 Professional. As with all software, there are many options and many installation strategies.
Slide 42		Let's start by discussing the upgrade and clean install issue in some detail. First, upgrades from DOS, Windows 3, and Windows Me are not supported. That's not to say these upgrades cannot be done, but don't expect any help from Microsoft, and don't expect that everything will work properly. Windows Me is a special case. Windows 2000 Professional was released *before* Windows Me, so there's little chance that Microsoft developers could make this upgrade work properly. Don't expect Windows 2000 to operate properly on top of Windows Me.
Slide 43		Upgrading is the easiest way to get to Windows 2000. At least, as far as the installation is concerned. With an upgrade there's no need to be concerned with your old network and application settings, everything stays right where it is, for the most part. But that's also true of problems and configuration bugs…they stay right where they are, too.

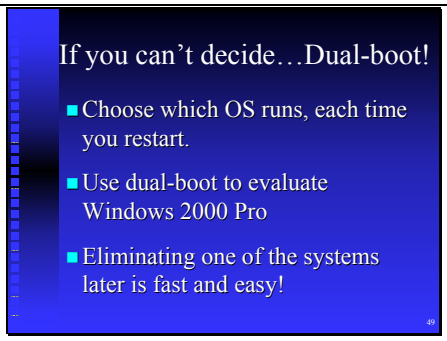
Slide 44	**Upgrading cannot repair bad configuration settings or hardware problems.**	Many people think that an upgrade will solve all of there operating system woes. The reality is quite different. When upgrading, the new OS simply reads the old settings and emulates them. So, if your Windows 98 dial-up Networking configuration is messed up, Windows 2000 is likely to implement the same bad settings. If you have problems in the registry, then Windows 2000 is likely to pick those up and the problems follow you into the upgrade.
Slide 45	**"…employ everything in your power *not* to upgrade an existing installation."** *Source: Windows Magazine, The Essential Guide to Installing Windows 2000*	Here's one expert's view:
Slide 46	**"Unless you have to, don't do this. [Upgrading] can cause any problems … to migrate to the new system."** *Source: Windows 2000 Unleashed, Sams Publishing*	And another.
Slide 47	Only upgrade if: ■ You are using several applications that cannot be easily reinstalled ■ You have too many users to reconfigure and reinstall every application on all machines. 47	There will be cases where an upgrade is necessary. For instance, you'll have to upgrade when you cannot easily reinstall the applications on the target system. You should also consider an upgrade when you have many systems to support. If you are forced to upgrade, keep in mind that many applications may not operate properly under a Windows 2000 upgrade, but these same applications work just fine under a clean install.

Slide 48

If you have fooled around with Windows 9x long enough, you know that giving your hard drive a good scrub every year or so fixes lots of little problems. Every application that you install adds a bit more to the pile of data, and no amount of uninstalling removes it all. After 18 or 24 months, a system can end up running very slowly. A fresh start can give that system a new lease on computing.

This is just as true for a new operating system as it is for an older operating system. You start from the first day with an optimized and clean registry, a new set of drivers, and a clutter-free hard drive.

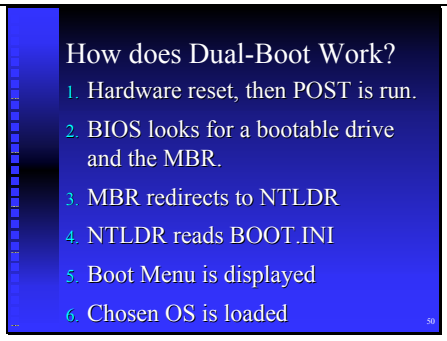
Slide 49



Windows 2000 makes your installation choice easier by offering to leave your old OS right where it is, then installing Windows 2000 Pro alongside. By doing this, you can choose which OS you want to use every time you start the computer.

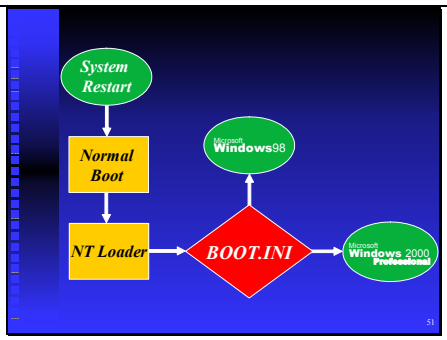
Dual-boot is a great choice if you are just evaluating Windows 2000, or you just aren't ready to make a complete conversion. When you are finally ready to make that decision, cleaning up the computer is simple and fast.

Slide 50



Dual-booting is fairly simple, if we stay out of the actual code that makes it happen. This list is the same as the boot sequence for DOS or Windows 9x, until step 3. NTLDR, or NT Loader, looks at a configuration file called BOOT.INI. When you build a dual-boot system a couple new lines are added to this file. These lines tell the NT Loader where to go for boot files, based upon the choice you make at the Boot Menu.

Slide 51



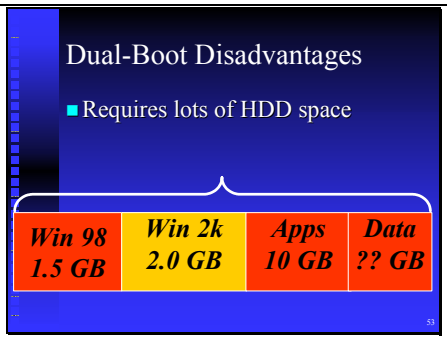
Again, the process is straightforward, At the point where the MBR would normally just point to operating system boot files, the Windows 2000 partition boot sector points to the NT Loader instead. The NT Loader then checks out BOOT.INI. If the system is set up normally Windows 2000 loads itself directly. However, if you have installed Windows 2000 in a dual-boot configuration, the Boot Menu is displayed. At this menu you choose which OS to load, and the NT Loader follows your instruction. In fact, the OS is loaded in such as way that it knows nothing about any other OS on the computer.

Slide 52

Dual-booting provides several advantages, the most important of which is that you don't have to make a commitment to either operating system. Use Windows 2000 in the morning, reboot and switch to Windows 98 in the afternoon. Or switch every hour, if that's what you prefer.

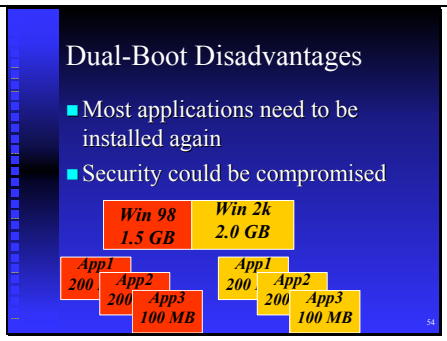
If you have older hardware that isn't supported under Windows 2000, you get all the benefits of the new OS, and you can still easily switch over to Windows 98 when you need access to unsupported devices or software.

Slide 53



As great as a dual-boot computer sounds, it's not a perfect solution. First, you're going to need a big hard drive, and you'll want it separated into distinct partitions. You should load each OS onto its own partition. The numbers shown here are large, but typical.

Slide 54

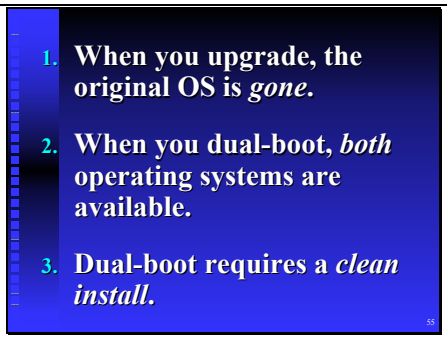


Another reason for extra disk space is a second installation of your applications. That's right, if you expect to use any applications in both operating systems, you need to load that application again. Many applications refer to registry settings, or .DLL files stashed away in the system folders. But if you are running Windows 2000, Windows 2000 will *never* look in the Windows 98 system folders.

That means you'll have to have you applications loaded twice, into separate folders preferably on separate partitions.

If you need a secure system, then having an another OS on the hard drive could become a security hole.

Slide 55



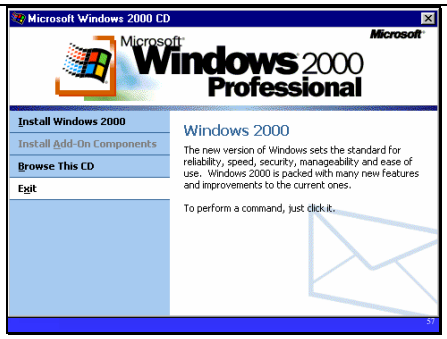
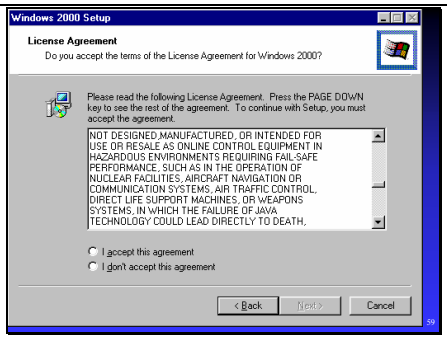
Here's the bottom line: when you perform an operating system upgrade, the original operating system will be replaced, and it is gone.

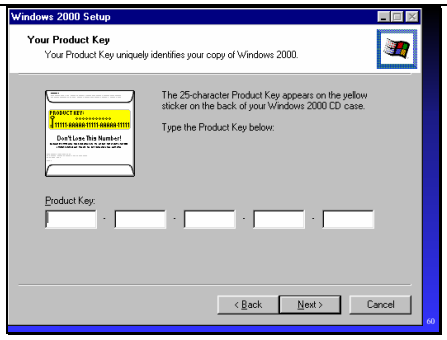
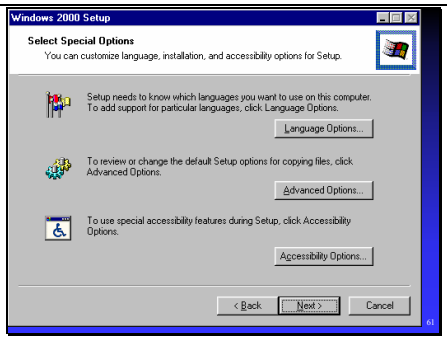
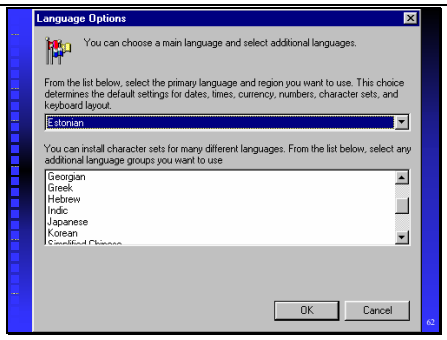
When you install as a dual-boot arrangement, you can use both the original operating system, and Windows 2000, which means you don't have to make a commitment to Windows 2000 yet.

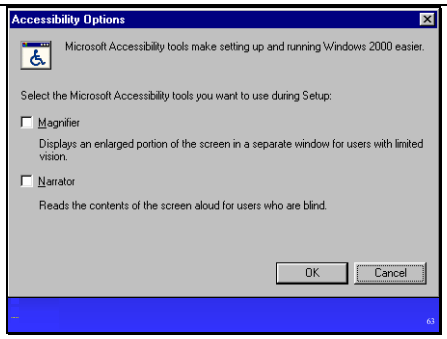
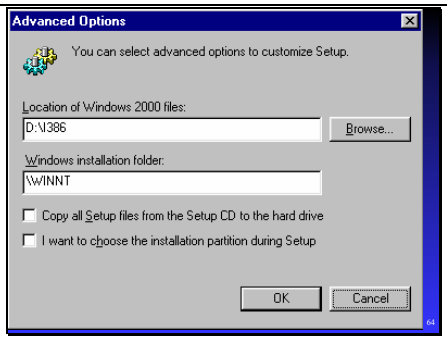
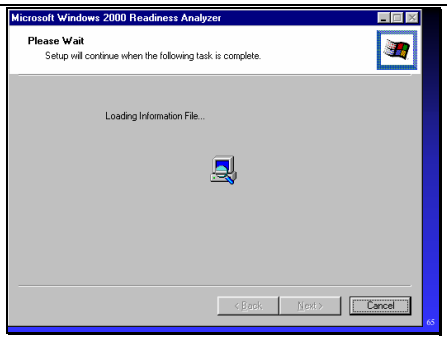
Because dual-boot allows either operating system to launch, and the old OS is gone when you perform an upgrade, a clean install is required for the dual-boot configuration.

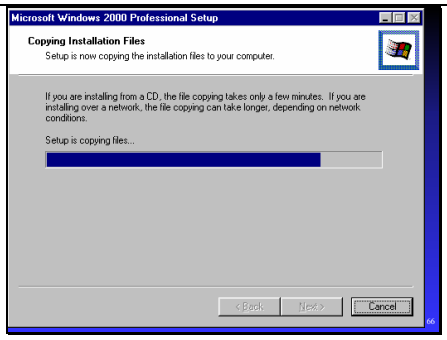
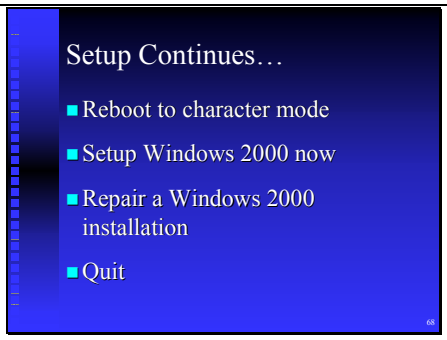
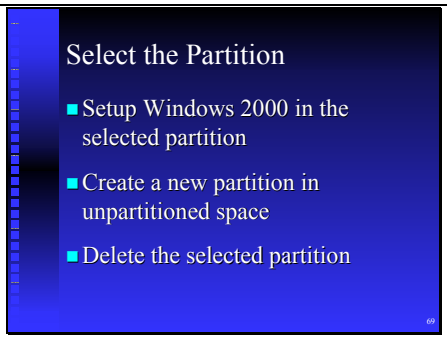
Slide 56

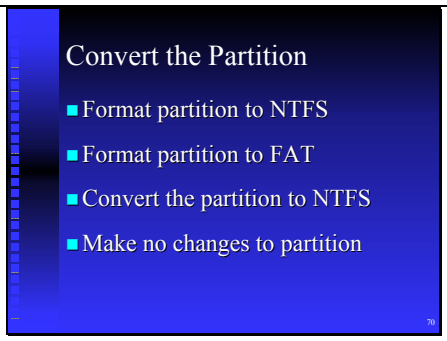
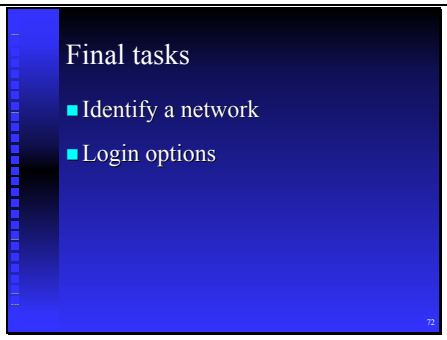
When the Windows 2000 Professional Upgrade CD in inserted in a system running Windows 98SE, this is the message you'll receive. Unless you have made the decision to perform an upgrade, click No.

Slide 57		That leaves you with this Windows 2000 CD command window. From here you can begin the installation procedure or explore the CD. Naturally, if you want to install Windows 2000 you should click that command.
Slide 58		The Setup Wizard begins, and the installation begins. The choice here looks simple, but as you have seen so far the difference between these two installation options is substantial. You should know exactly which option you desire before you see this screen. We're discussing a Clean Install in this presentation, so let's say we've selected that option and clicked Next.
Slide 59		The infamous End-User License Agreement. You really don't have any choices here; you must either accept the agreement or quit the installation. You cannot continue until you accept, and if you don't accept, the installation process ends. Parts of the agreement are interesting, so be sure to read it sometime. After installation, the license can be found in a file called eula.txt. By most accounts, this is a document that protects only Microsoft, and gives them the edge in any potential legal proceedings you might wish to pursue.

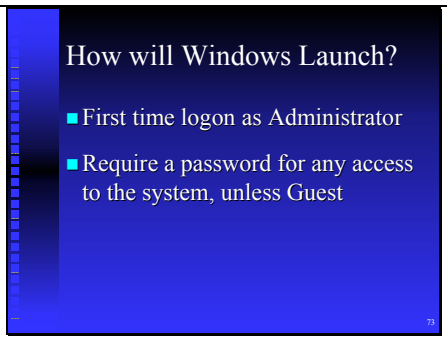
Slide 60		Next, you must provide the product key, or serial number. On new computers this number is usually attached to the computer case. With the upgrade version of Windows 2000 Professional the number is attached to the CD package—usually on the outside of the plastic wrap. The back of the CD case reads: Don't lose this number! Believe that message, because if you don't have a proper Product Key you won't be installing Windows 2000 Pro. Note that the label also instructs you to attach the label permanently to the computer where it will be used.
Slide 61		Next, you have a handful of Setup options to choose from.
Slide 62		The Language option should be easy. Pick the language you are most comfortable using. You can also install character sets. These sets allow special characters, that may be unique to various languages, to be displayed properly.

Slide 63		These accessibility options are designed for people who have difficulty seeing the screen.
Slide 64		There are two important choices here. First, you can select where Setup finds the install files. Possibly you have copied them from the CD to the hard drive, making the installation faster. Regardless, this field should point to the current location of the files; in the case of this image, the CD drive. The second important choice is the Windows 2000 installation folder. You don't want to install to the same folder as the current operating system, which is probably at C:\Windows. The two checkboxes will be superceded by options later on in the install process, so their settings really don't matter now. After you make any Special Options changes, you will click Next.
Slide 65		The Setup Wizard then runs the Windows 2000 Readiness Analyzer. This tool checks for specific hardware and software that is known to cause problems with Windows 2000. You can also download the Readiness Analyzer directly from the Microsoft website.

Slide 66		If your computer passes the Readiness test, then files are copied to the hard drive. This process isn't copying all the Windows 2000 files just yet, it's only copying the files necessary to support the rest of the Windows 2000 installation.
Slide 67		In past Windows versions, you had to sit around and watch progress bars. When they reached 100%, you had to press enter a couple times to keep the installation process moving forward. You were forced to sit there and watch progress bars grow. Fortunately, Windows 2000 can run on its own when there aren't any decisions to be made.
Slide 68		After the reboot, setup continues in DOS-like character mode. Right away you have three choices: you can quit, continue the installation, or repair a damaged Windows 2000 installation.
Slide 69		This is where your advance installation planning will be needed. This isn't the time to be making installation partition decisions; you should already know what you want to do before you are faced with these choices.

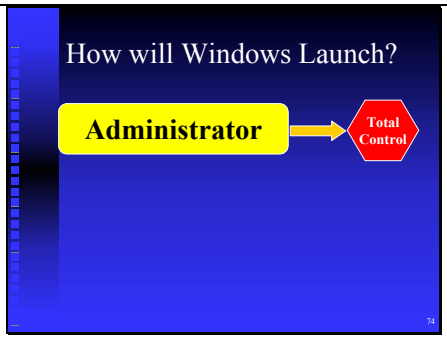
Slide 70		Formatting the partition is appropriate when there is no data on the partition already. If you are using a partition that has files and folders you want to keep, then you can convert the partition of leave it as it is. Be aware that formatting will destroy any existing data on the partition. Once you make a choice and verify your selection, the partition is ready to receive more files. That completed, it's time to reboot again.
Slide 71		Setup now resumes in GUI mode. First, an inventory of devices is taken. You then begin to customize the installation for who you are, and where you work and live. Setup copies even more files, then begins a lengthy internal process of preparing Windows and cleaning up after itself. Finally you are asked to remove the Windows 2000 CD, and click Finish to restart.
Slide 72		Finally, Windows 2000 Professional is running. Before Setup is complete, it checks for existing networks. The final task is configuring the launch of Windows 2000.

Slide 73



Earlier we discussed the strong security built-into Windows 2000. The final Setup task will determine just how secure your new workstation will be. If you don't really need the security, why did you install Windows 2000, Windows 98 is probably a better choice. On the other hand, this is Windows 2000 so you must configure the system to require a password for any access to the system. In fact, the first time you login, you will do so as the Administrator. Thereafter, you will have to create one or more Users who have access to the operating system. Each user will have his or her own password. Whether you are the Administrator or a user, be sure you don't forget your password. Because if you do, you may never get back into this copy of Windows 2000.

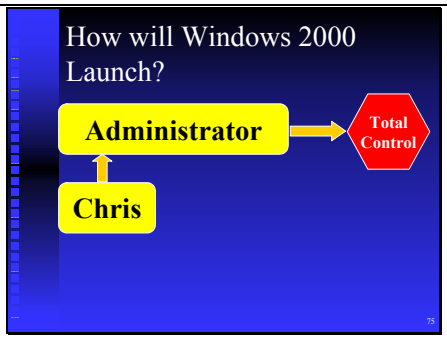
Slide 74



Let's look at this password business a little more closely. All Windows 2000 installations must have an administrator. The administrator is the person responsible for maintaining the computer, and has total control and access to everything on the computer. More correctly, Administrator is the "user account" that has those rights.

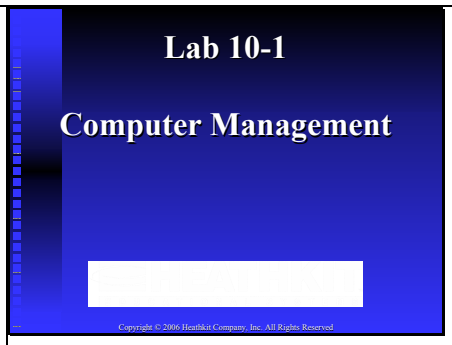
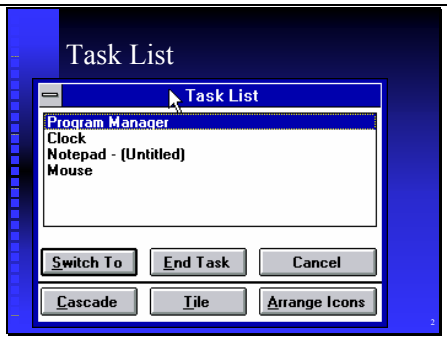
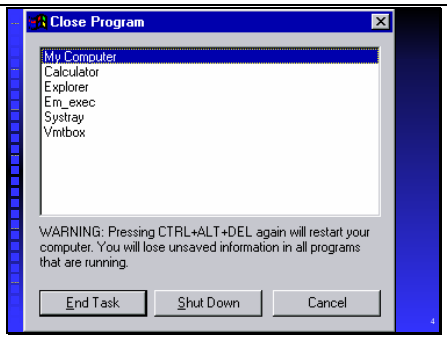
You probably won't want to login as "Administrator," for security purposes, so you will have to choose another login name and password.

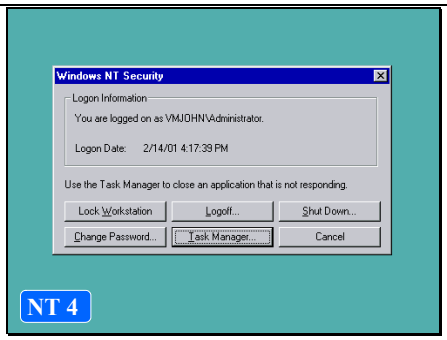
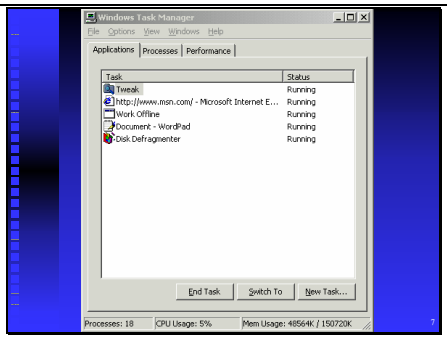
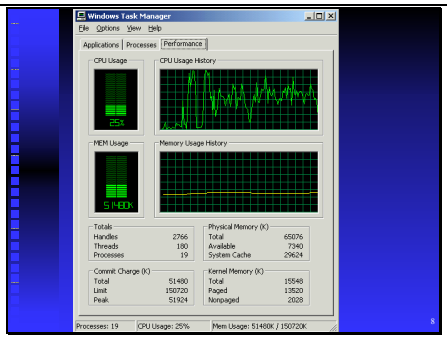
Slide 75

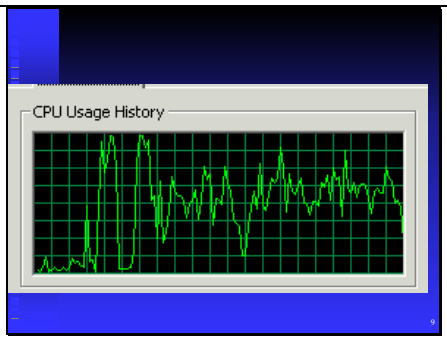
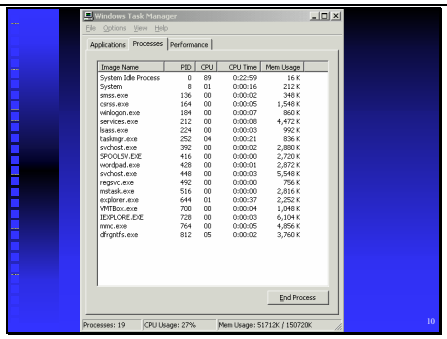
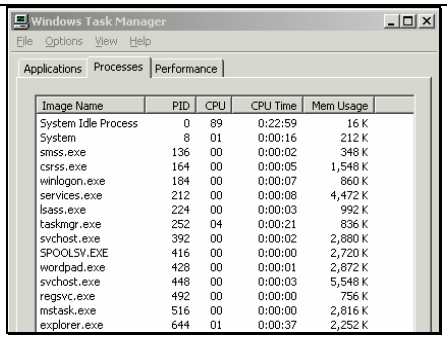
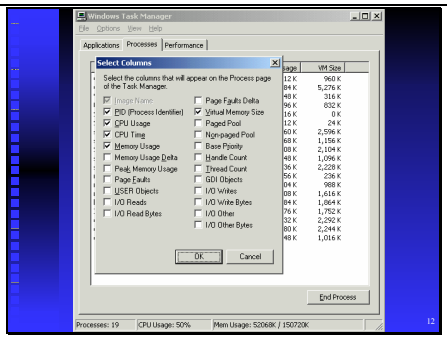


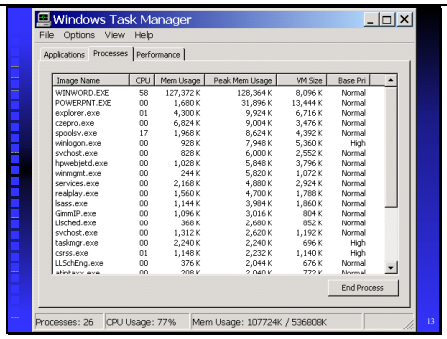
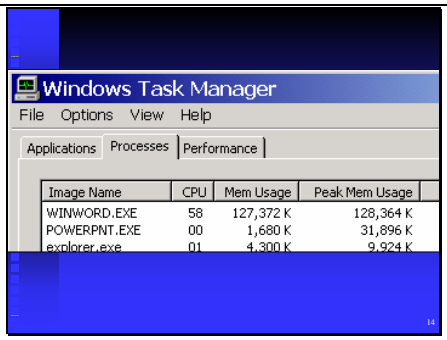
Let's say you will login as Chris. As the only user of this computer, Chris will expect complete control of the system. By making Chris the Administrator, Chris will be able to do anything and everything within this computer. Chris and the Administrator are not the same user, they are different users with the same permissions. You could easily configure a password for Chris that allows Chris to act as the administrator, and at the same time configure a different password for the account named "Administrator." Unless you expect to have different permissions for Chris and the administrator, you probably wouldn't do this, but you could. We'll get into these concepts in a lot more depth later on.

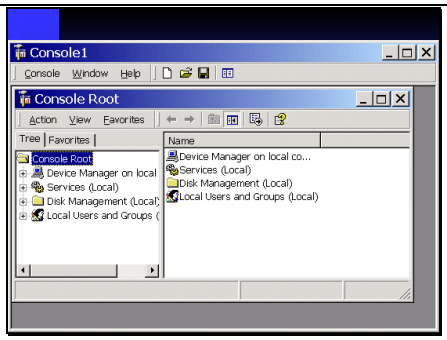
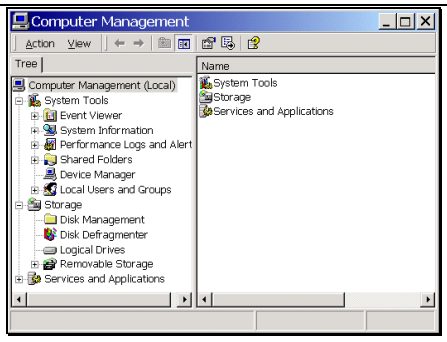
Slide 76		This concludes the presentation but not your study of Windows 2000. Let's go to the lab and practice some of the techniques you learned for preinstalling Windows 2000.

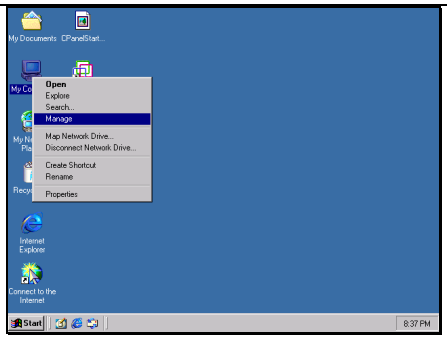
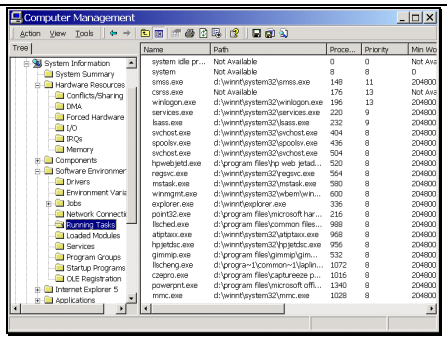
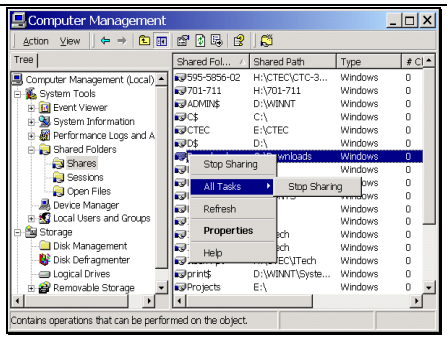
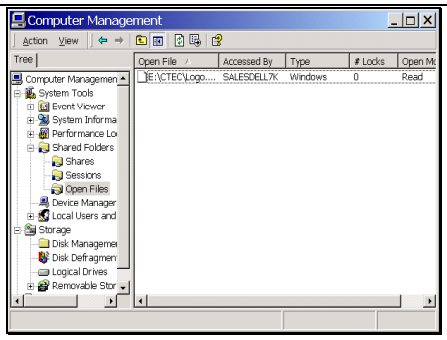
Slide 1		This exercise begins a short journey through the Windows management tools. The lab will delve into Computer Management and you will explore it in detail. This topic makes for a dull presentation, so we will take this opportunity to briefly discuss many of the basic Windows tools.
Slide 2		The original Windows 3 Task Manager was an important new tool. This was the first time most computer users had the ability to run more than one application at the same time. The Task List was a way you could easily see what was running, and provided a way to shut down applications that weren't responding. The problem was that you couldn't get to this dialog because the entire system usually crashed.
Slide 3		With the creation of the Windows 95 Taskbar, there was little need for a Task List. Instead of using Alt-Tab to switch between apps, we were encouraged to click the application on the taskbar. However, the Task Manager still worked, and Alt-Tab is by far the fastest way to switch between open applications.
Slide 4		Switching between apps was easier than ever, but closing wayward apps was still, unfortunately, a necessity. Control-Alt-Delete would completely restart a DOS/Win3 machine, making a simple keystroke all too powerful. In Windows 95, Control-Alt-Delete is a powerful and very useful tool. Press these keys once, just once, and you see a list of all open programs. If a program has crashed, you'll see it right here. And, you can close the program and continue working. (Although a reboot is a good idea anyway.)

Slide 5		Windows 2000 and Windows XP offer a couple of new tools more powerful than any before. When you hit Ctrl-Alt-Del, you see this dialog or one very much like it, and several options. The two you'll use most often are *Cancel* and *Task Manager*.
Slide 6		And we shouldn't forget that Windows NT4 has the same feature, but without the fancy graphics.
Slide 7		When you click on Task Manager in either Windows 2000 or XP, by default you'll see this dialog. As with previous versions of Windows, you can close any active application. The difference with Windows 2000/XP is that you are unlikely to crash the system due to the strength of the OS architecture. When Applications fail to respond you should hit Ctrl-Alt-Del and shut them down.
Slide 8		We'll come back to the Processes tab in a moment. The Performance tab provides you with a look at the resources available on your system. This window shows how much work your computer is doing, and how much CPU usage and memory are available. This screen is useful for diagnosing application complaints. For instance, some apps are wasting time looking or waiting for something, where other apps are working very hard before responding to you. Here, you can tell the difference.

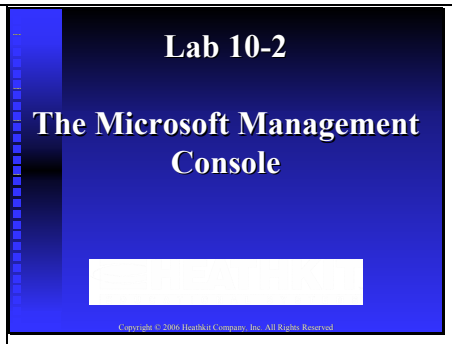
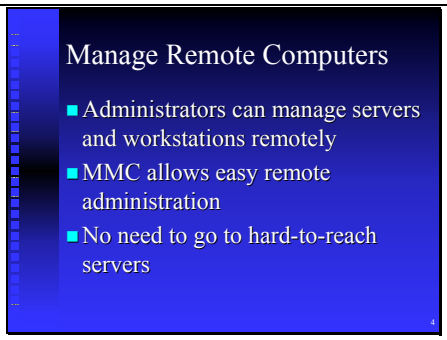
Slide 9		What you're looking for here is 100% CPU usage. If your computer is constantly running at 100% one of a couple situations may be occurring. First, you may be running an application that requires more power than your current CPU can provide. This happens with multimedia apps, or some high-powered games. Or, some application or utility may be performing a task that requires the CPUs full attention, such as a system restore tool. In any event, here you can quickly determine if the CPU is working or waiting.
Slide 10		The Processes tab breaks down resource usage, showing how much memory each process and application is using. By default there are four columns, three of which are useful. Let's look at these in more detail.
Slide 11		The first column lists the process. The second column is the Process Identifier, which isn't very useful to us. The third column, CPU, tells us what percentage of the CPUs time each process is utilizing. With this number you can tell if a single application, such as a virus scanner or system recovery tool, is using up a big chunk of CPU power. CPU time should be self-explanatory, but Mem Usage is worth a look. This column shows how much memory each application is using.
Slide 12		If you open the View menu and choose Select Columns, you can pick what processes are important to you. Let's add Peak Memory Usage, Virtual Memory Size, and Base Priority to the list. Windows 2000/XP offers a few more columns than Windows NT4.

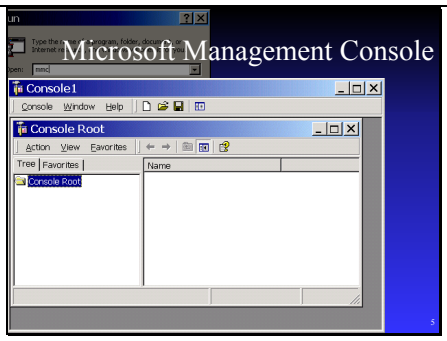
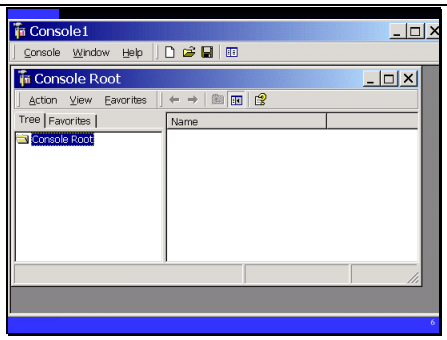
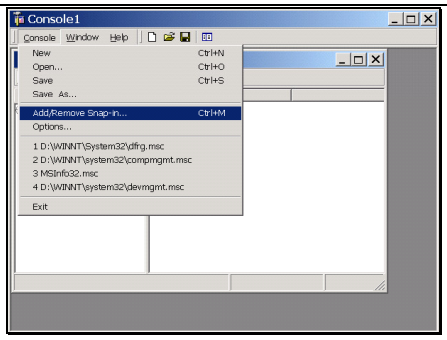
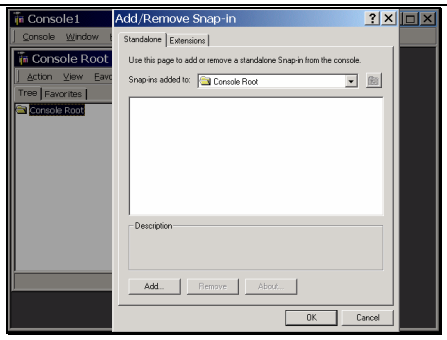
Slide 13		A little rearranging, and we see this display. The Peak column tells us the highest amount of memory the application used. This number is useful to determine if your computer really needs additional memory. If you look closely at this window, you'll see the WINWORD is using 127 MB of memory, and that POWERPNT has used up to 31 MB! We were working with some large files to create this display…
Slide 14		Let's look at this a bit more closely. In this case we are working with a *huge* Word file. If you add up the amount of memory usage and the virtual memory size, and the total is higher than the amount of physical RAM in your system, you might consider adding more RAM. Remember that virtual memory means hard disk swapping, which is slow. On the other hand if your memory usage is well below the totals, then any performance problems probably won't be helped with a memory upgrade. From here you can also close any applications. That's about all for the Task Manager, an important but almost hidden tool. Next, let's look at ways to manage a Windows NT4 workstation.
Slide 15		Windows NT4 and Windows 2000/XP both require the same type of training and management, with a few exceptions. The management tasks for these systems are similar, but the tools have been revamped. These are NT4 management tools. You access them independently from the Start Menu, or from Control Panel. If you have a large system you have probably loaded additional management tools, and those may be located anywhere within the system. Once you learn where the tools are located you should have no trouble using them.

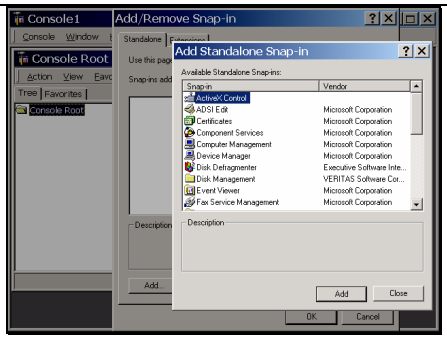
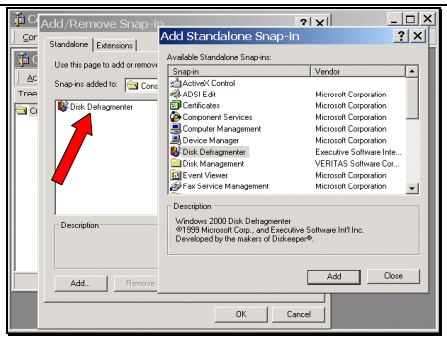
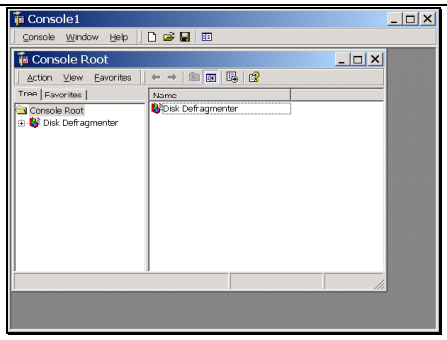
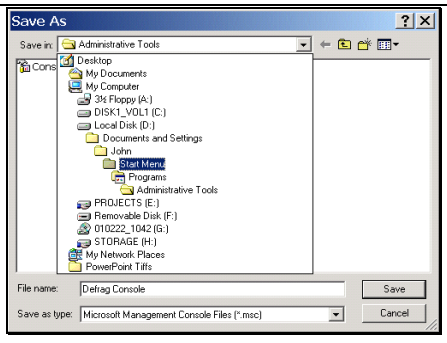
Slide 16		Chasing down these tools is routine for the experienced administrator, but for someone learning the trade this can be confusing. Microsoft created a new host for all of its management tools for Windows 2000. They call the tool the Microsoft Management Console. Its main feature is "extensibility," which simply means it can be extended. By the way, you launch the MMC from the Run dialog.
Slide 17		Extending a console means adding tools. Actually, it's called "snapping-in" tools. And the tools, naturally, are called Snap-ins. Here we have added four snap-ins. You might notice that three of them are the same tools shown in NT4 at the beginning of this discussion. They are now all in one place, and we even added Device Manager for good measure. You use MMC to build consoles, which you can access from many places. We'll discuss how to build and use your own console a bit later. For now, let's focus on a pre-assembled console, called Computer Management.
Slide 18		You have seen Computer Management before. Recall that this is where you can add new users, adjust hard drives, and check all sorts of things. This is a pre-assembled management console containing the most commonly used tools. If you are the administrator of a system or LAN, you will spend some time here.

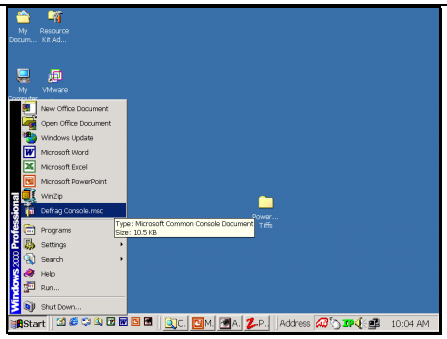
Slide 19		Do you remember how to launch Computer Management? Right-click My Computer and select Manage from the context menu.
Slide 20		If you open up the first node, System Information, you'll find more information that you could possibly digest. There are hundreds, possibly thousands of entries in this branch. A list of Running Tasks is shown here, which is similar to the Task Manager display.
Slide 21		If you open Shared Folders, you can see how to do some real work. From here you can manage all your shared folders without digging through Windows Explorer.
Slide 22		Clicking the Sessions and Open Files nodes offers a view of who is using your shared resources and what files are being used, just like the old Netwatcher program. You can also close sessions and open files from these nodes.

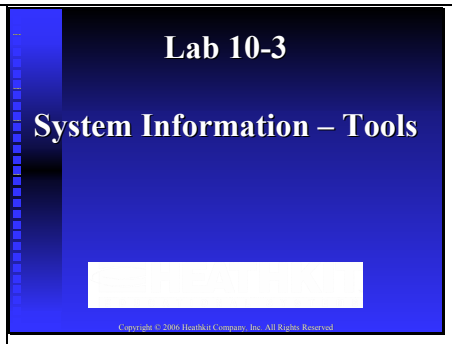
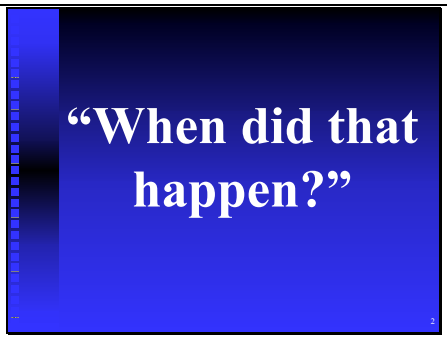
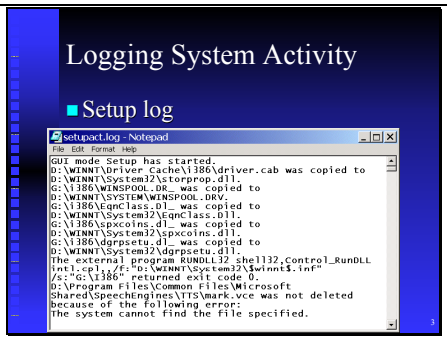
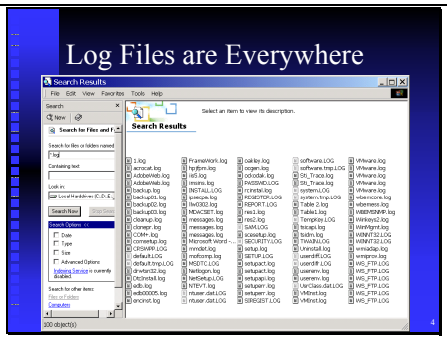
Slide 23		That's just the basics, now's your chance to try it out in the lab.

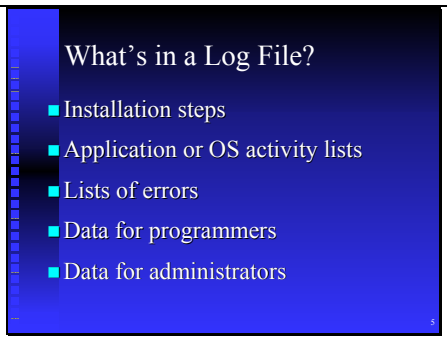
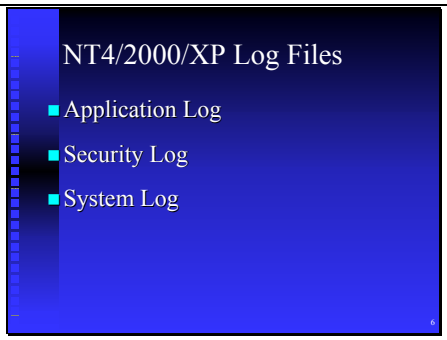
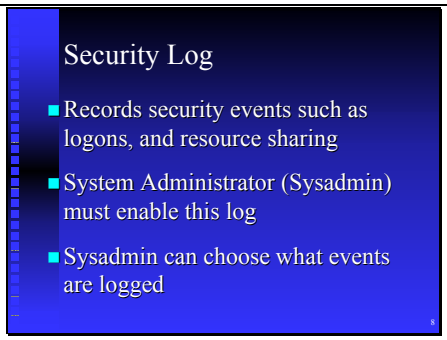
Slide 1		Microsoft is always striving to make a system easier to manage. With that goal in mind, they created the Microsoft Management Console. This presentation will briefly discuss the MMC, and you'll explore this new tool in the exercise.
Slide 2		Managing a computer or network means becoming familiar not only with the necessary tasks, but becoming efficient with the tools as well. When you think of tools in this sense, think of the the tool you use to add or remove users, or the tools that control security. Windows has become so complex that you need to locate and use dozens of tools. Unfortunately these tools tended to be scattered all over the system.
Slide 3		Another management problem is controlling access to management tools. In larger networks you might be assigned to manage and maintain the hardware on a LAN, but you may not be allowed to adjust any Users or Groups settings. In earlier versions of Windows, an administrator was "all-or-nothing" proposition, but now many of these tasks can be easily separated.
Slide 4		Remote administration is another feature of Windows NT/2000/XP. Under NT 4, administering a remote server or workstation was workable but often difficult. With the MMC in 2000 and XP, administering many computers from a single workstation is much easier. For instance, servers are often placed in out-of-the-way locations, while an administrator's office is out with the rest of the staff. The ability to manage the servers reliably and remotely saves administrators time and trouble.

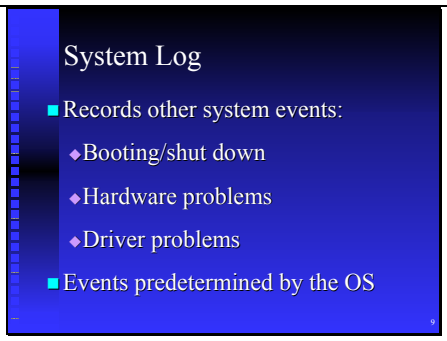
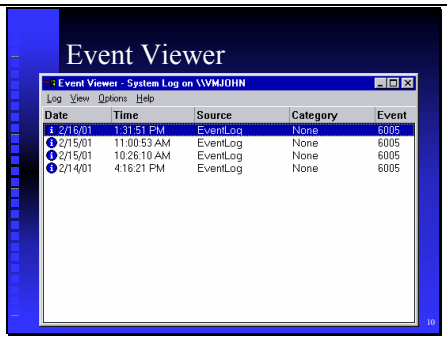
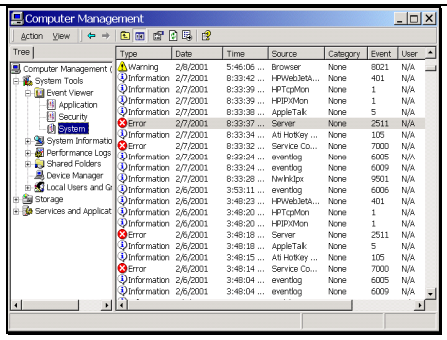
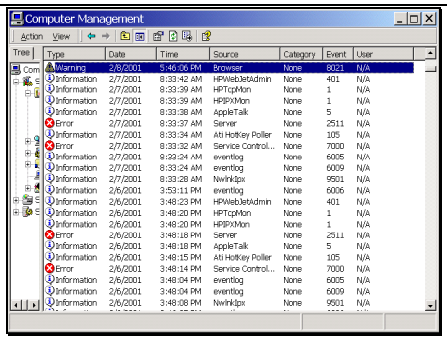
Slide 5		The management console is really a tool for constructing more tools. To be a little more specific, it's a tool used to build collections of separate tools. When you run the MMC, you get an empty console. Let's explore the process for creating a small tool collection and then making it useful and accessible.
Slide 6		Getting a handle on the MMC can take a bit of time and exploration because it isn't an intuitive system. The main window, titled Console 1 here, is the tool you use to build new tools. The window labeled Console Root is the new tool. Let's add something useful to the tool.
Slide 7		The first step is to add a tool. The tools, by the way, are called snap-ins. The idea here is that you snap them into place. Open the console menu, and you'll find an item there called Add/Remove Snap-in.
Slide 8		That opens this window, where you'll click the Add button.

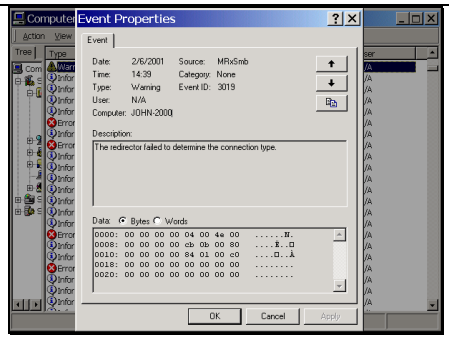
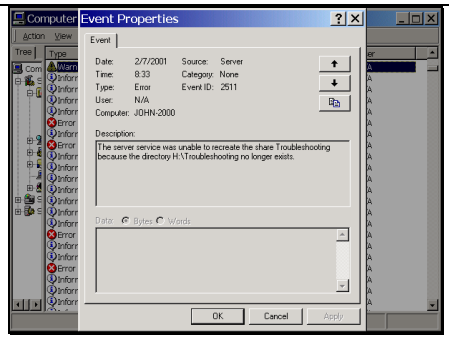
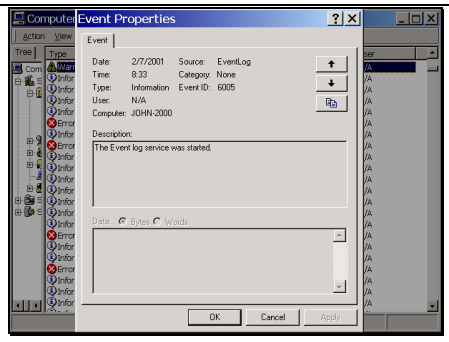
Slide 9		Finally you reach the list of available standalone snap-ins. From here you simply select which tools you want included in your customized console. Let's see what happens when we add the Disk Defragmenter snap-in.
Slide 10		Immediately after you click the Add button, the new snap-in appears in the Add/Remove window. You can continue to add as many snap-ins as you want, and you could add some of them twice.
Slide 11		Now we have the new console built, it's time to save it someplace useful. Open the Console menu again, and click Save As…
Slide 12		Placing the new console directly on the Start menu seems like a great idea, but let's put it right up front. Also, we're going to name the new console "Defrag Console."

Slide 13		And there it is. Now realistically, you wouldn't create such a tool to access Disk Defragmenter on your own computer. You might put some management tools there, or a special collection of built-in tools along with some tools supplied along with another product. Or, you might create some tools that allow you access to the management functions or a remote server or workstation. By the way, the MMC in Windows XP is version 2, in Windows 2000 it is version 1.2, while version 1 has been available for Windows NT4, and Windows 9x for some time, mainly as a tool for managing personal web server (FrontPage) and IIS (Internet Information Services) functions.
Slide 14		Now it's time to try it for yourself in the lab.

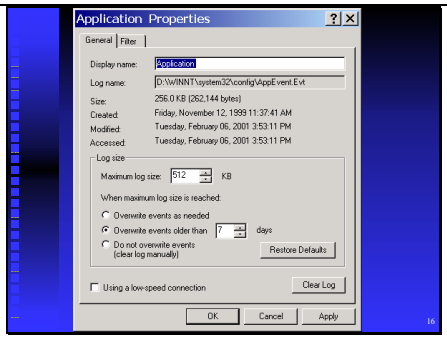
Slide 1		Like other Windows operating systems, Windows XP is loaded with tools of all kinds. There are too many to discuss in a course such as this. In this exercise and presentation we will take a look at the most common Windows XP/2000/NT4 tools.
Slide 2		When you begin to troubleshoot a difficult problem, one of the questions you'll need to answer is: When did this problem happen?" The answer might tell you where to begin troubleshooting, and it might also tell you where you don't need to troubleshoot. Knowing that System Administrators and technicians will spend a lot of their time troubleshooting the operating system, Microsoft built a system for keeping track of what happens within Windows XP, 2000, and NT4.
Slide 3		The events that Microsoft thought most important are recorded in text files. Certain actions are logged, and written to text files called .LOG files. These logs contain a record of some of the most important activities in your system, as well as some rather mundane stuff. The log shown has a record of the Windows Setup after the GUI was launched, complete with a few errors.
Slide 4		A new Windows NT4 machine should have six or seven log files. A new Windows XP or Windows 2000 installation will have around 60 files. The search shown here resulted in 100 hits. This machine, however, has been in continuous use for about a year and has many applications installed. And we shouldn't forget that some log files don't have .LOG extensions, so there are even more log files!

Slide 5		Some log files track the successful steps in an installation; when the entries suddenly end you'll know right where the installation failed. Others keep track of the various errors that occur behind the GUI. Some logs are extremely difficult to interpret, except by the programmer that wrote the application. Another type of log file contains information for network administrators, and that's the type we're going to focus on here.
Slide 6		The most useful log files for the Windows administrator are the Application Log, the Security Log, and the System Log. Within these three logs are records of all significant events that occur within the OS. If an application crashes, that's in the log. If a login fails, it's in the log. If a hardware device or driver fails, that's in the log too.
Slide 7		The Application log is a place where apps can dump information regarding errors and other events. For instance, the successful completion of an installation may be recorded. Or, some sort of program error might be recorded. Few applications actually use this log, mostly Microsoft applications, and very few of those even record events. The Application Log's usefulness is determined by the programmer of the application, and that programmer may or may not provide useful information in the log.
Slide 8		The Security log doesn't do much for a simple single-user system. But in a larger network, this may be one of the most important tools an administrator will use. This log can record successful logons, attempts to logon that failed, and attempts to gain access to any secure resource in the system. You should recall that Windows NT, 2000, and XP are built with security in front of every internal action. What that means is that virtually everything can be recorded, if you choose.

Slide 9		The system log is a powerful tool for the hardware troubleshooter. You can examine the log and learn when the machine was booted, when it was shut down, and when hardware or drivers were installed. The System Log also records network communication errors. The downside with this log is that you can't control what events are logged, and which are ignored.
Slide 10		So how do we take a look at these logs? The answer is with the Event Viewer. Experienced Sysadmins regularly use Event Viewer to solve problems, as a system planning tool, and as a security analysis tool. In windows NT4, the Event Viewer is on the Start Menu under Administrative Tools. Shown here is the System Log. This NT installation is just a few days old, so the event log is nearly empty. In NT4 you can choose to view the other logs by selecting them under the Log menu.
Slide 11		In both Windows 2000, and in Windows XP, the Event Viewer is found in Computer Management, or you can build your own Microsoft Management Console and add the Event Viewer snap-in. However you get there, this is typical of what you will see. This Windows 2000 Professional system has been running for just over a year, and the event logs are loaded with information. Let's look at this log in a bit more detail.
Slide 12		Four of the columns shown here contain important and useful information. First, the event Type, which we'll explore in just a moment. Second and third, the date and time columns tell us when the event occurred. And fourth, the Source tells us where the event came from, be it a device or service.

Slide 13		If you double-click the event you'll see some details about that event. Most of the events are difficult to interpret unless you are a programmer, networking, or security expert, but some are plain-language. This Warning event is telling us that there was a network redirector problem. If you were the user on this system when this event occurred, you might have a good idea what this means…since you saw the error or noticed that something didn't work properly. Or, you may have been totally unaware that a problem ever existed.
Slide 14		This is an Error event. However, if you read the Description is seems fairly obvious what happened. The user attempted to create a share for a folder that no longer exists.
Slide 15		And this one, an Information event, is just wasting space although possibly this message reassures you that the event log is in fact working.

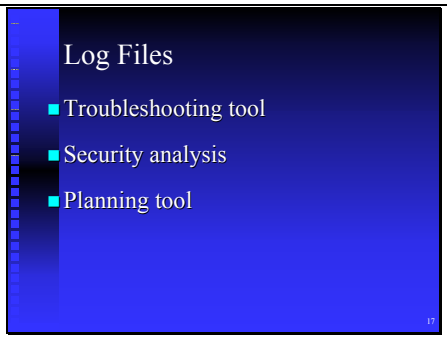
Slide 16



There are potentially hundreds and hundreds of events that can be logged. Should an administrator decide to log a broad selection of security events, the log file could overwhelm a hard drive eventually.

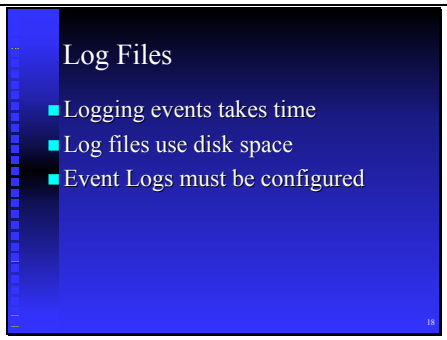
With that possibility in mind, there are definite limits placed on the size of log files. This dialog shows the properties for the Application log, obtained in the usual manner (right-click the log and select properties…). Here you can make several choices about how your log files are handled and how big they can become. Many administrators must save these logs, so overwriting isn't an option. Those poor sysadmins must keep a close eye on the size of the log file, and reset it manually as needed.

Slide 17



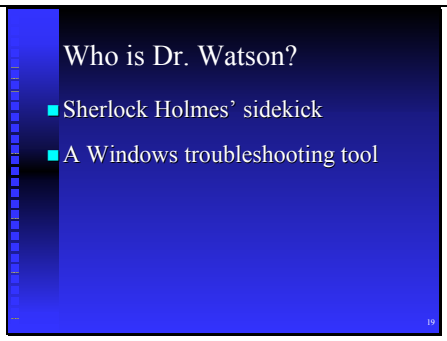
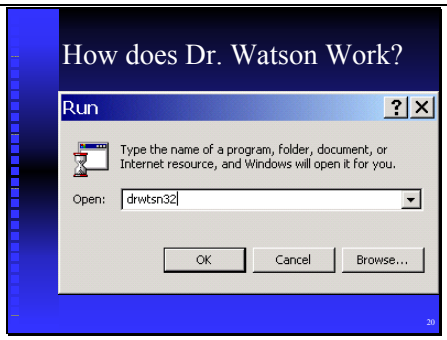
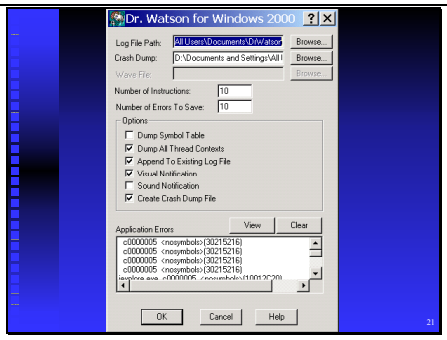
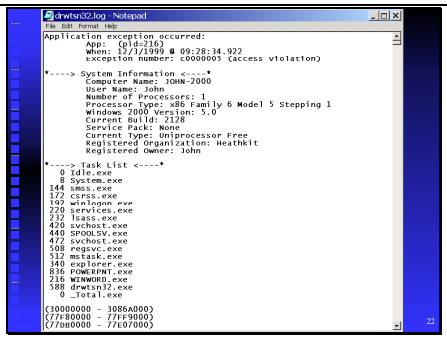
Log files can be useful if you know how to use them. Naturally they can provide help when troubleshooting. And, they can be used to analyze the security of a system or LAN. In many cases they are used in the early days of a newly installed LAN to evaluate usage patterns. Once you analyze the patterns, you can adjust the system to optimize performance.

Slide 18



Yes, there is a drawback to Event logs. If you record an event you are using CPU time. Record enough events, and you can create a measurable hit on system performance. In addition, you can easily create huge log files. Stories of multi-gigabyte files bringing servers to their knees are common.

And finally, useful event logs must be configured to collect useful data. What makes data useful is determined by you, and what you are trying to accomplish.

Slide 19		The original Dr. John Watson was Sherlock Holmes' sidekick in the Sir Arthur Conan Doyle mysteries. What does this have to do with Windows? Not much, except that Microsoft borrowed the name to create a tool that sneaks a snapshot of your system when an application crashes. The tool is called Dr. Watson.
Slide 20		Dr. Watson doesn't do anything until you enable it. Typically you notice that an application is crashing for some reason. Maybe you have no idea why, but possibly you can record a snapshot of the system as the crash occurs.
Slide 21		There aren't many configuration options for Dr. Watson, so going with the defaults is probably a good idea. Click OK, and Dr. Watson awaits. Keep an eye on that "Create Crash Dump File" option. A crash dump file is huge…these files can be over 200 MB! Look for files with a .DMP extension. If your computer is working properly, and that .DMP file is old, then delete it and save the disk space.
Slide 22		Once you have enabled Dr. Watson, it sits in the background waiting for the OS to signal a program error. Should that error occur, Dr. Watson wakes up and makes a record of what was happening when the error occurred. From this log you can determine the what was running at the time of the error, and as you scroll down the log, you'll find there is plenty of information for the programmer.

Slide 23		We looked at several management and information tools. There are several we didn't touch on. Those are covered in the exercise.