Lesson 9

What makes a planet geologically active?

Ronald Wilhelm & Jennifer Wilhelm, University of Kentucky © 2007

This activity teaches students about the important variables which keep a planet geologically active. It also introduces the concept of surface area, volume and the nonlinear relationship between these two variables.

Today we will conduct a series of experiments which will help to demonstrate the way in which objects cool and what variables the rate of cooling depends on.

Experiment #1

Equipment: One graduated cylinder, one beaker, two thermometers, and hot water.

What are the physical differences between the graduated cylinder and the beaker?

What is the unit of measure printed on each of the containers? What does this unit measure?

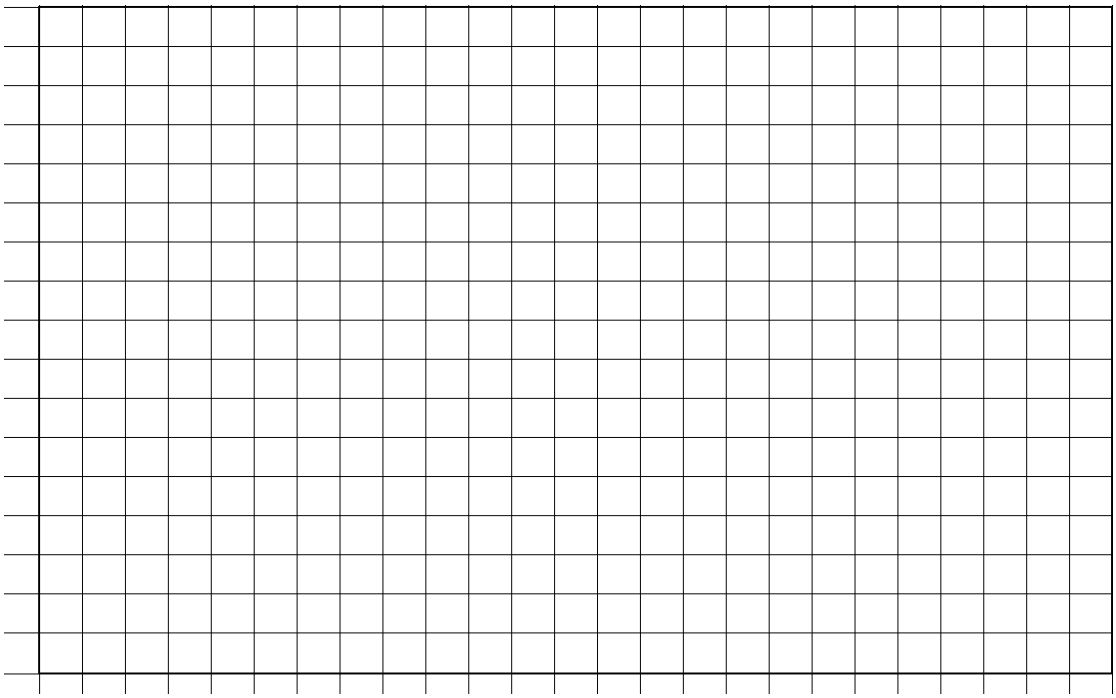
You are next going to put hot water in each of the containers, being careful to pour the same amount of water into each container. How will you do this?

Now make a prediction. Which of the two containers will cool more rapidly, or do you think they will both cool at the same rate? Explain your answer.

Immediately make a temperature reading once the water is poured. Make temperature readings every minute for six minutes.

Time	0 mins	1 mins	2 mins	3 mins	4 mins	5 mins	6 mins
Temperature (°F) Beaker							
Temperature (°F) Graduated Cylinder							

When you are finished make a plot of the data for each container, with temperature on the y-axis and time on the x-axis. (see next page)



What did you find? Try to come up with an explanation for your results.

What does it mean for the water to cool? What is happening when something cools?

Experiment #2

Now you will conduct the same experiment a second time, using the same two containers. This time use a different volume of water than the last experiment in each container, but be sure to keep the volume of water the same for each container.

What do you predict will happen this time? Explain your answer.

Conduct the experiment measuring the temperature once every minute for six minutes.

Time	0 mins	1 mins	2 mins	3 mins	4 mins	5 mins	6 mins
Temperature (°F) Beaker							
Temperature (°F) Graduated Cylinder							

Plot your results on the same plot as before but in a different color so that you can tell the two experiments apart. (see previous page) What did you find when you compare the results for the two containers?

What do you find when you compare the results of the two experiments? Try to come up with a reason for the results that you found.

Reflect on these two experiments. What variables affect how fast something cools? Explain your answer.

Experiment #3

For this experiment you will measure the size of four different boxes. You are going to then calculate the surface area and the volume of each of the boxes.

Measure the length, width and height of the smallest box and record your results using the table on the next page.

You will next calculate the total surface area of this box. How can you do this? (Hint: What is the area of one side of the box? How many sides does the box have?)

Next you will compute the volume of this box. Record your results.

	Length	Width	Height	Surface Area	Volume	Ratio of Surface Area/Volume
Box 1						
Box 2						
Box 3						
Box 4						

Now make a prediction. If you were to double the length, width and height of the box, how do you think the surface area will change?

Test your prediction and record your results. Is it what you expected?

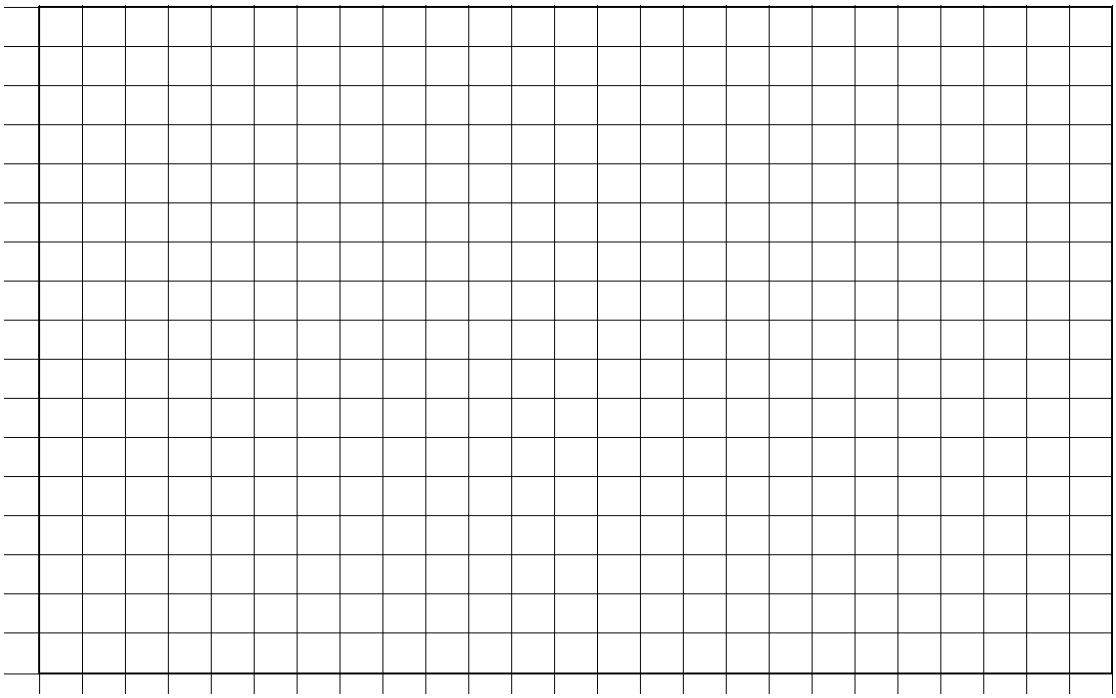
	Double Length	Double Width	Double Height	New Surface Area	New Volume
Box 1					
Box 2					
Box 3					
Box 4					

Now consider the volume. If you double the length, width and height, what will happen to the volume?

Test this prediction and record your results. Is it what you expected?

Make a plot of surface area verses volume for the four boxes. What can you conclude about this plot?

Calculate the ratio of surface area to volume for each of the four boxes. What do you find happening?



The relation that you found is very similar to the relation that you would find if you conducted this experiment with a sphere (a ball). In other words the surface area and the volume would grow in a similar fashion if you measure these variables for a bigger and bigger sphere.

Reflection: Reconsider the first two experiments. Which variable tells you the amount of hot water that you have?

When something cools it has to give up its heat to the environment around it. Where does this transfer of heat take place?

Imagine you had a little box filled with a hot liquid and you had a second box that was much bigger, filled with the same hot liquid. Which do you expect will cool faster? Think very carefully about this. The larger box will be able to contain more liquid, but it will also have a larger surface area then the smaller box.