What is Project-Based Instruction?

Project SAAS – June 30th, 2015

Project-enhanced Units

A project-enhanced unit is designed to foster common content learning (via benchmark lessons) by all students in the class, and to help students gain a deeper conceptual understanding of a sub-set of the larger content unit (via group project research).

Project-enhanced Units

- Features for a project classroom:
  - Driving Research Question (Krajcik et al. 2006) guided by STEM standards, practices, and crosscutting concepts
  - Sub-driving Research Questions – student-generated
  - Milestones (Polman, 2000) – Serves as a continuous assessment to gauge learning throughout the unit implementation
  - Benchmark Lessons and Innovative Technologies to scaffold understanding

PBI with the REAL Unit
(Realistic Explorations in Astronomical Learning)

The unit and driving question should be guided by standards.

- **Students who demonstrate understanding can (Disciplinary Core Ideas from NGSS):**
  - **MS-ESS1-1.Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases.**
  - **MS-ESS1-3.Analyze and interpret data to determine scale properties of objects in the solar system.**

An example driving question:

○ ***Why does the Moon's appearance always seem to change?***

Comparing the Practices

Mathematical Practices	Scientific & Engineering Practices
1. Make sense of problems and persevere in solving them	1. Asking questions and defining problems.
2. Reason abstractly and quantitatively	2. Developing and using models
3. Construct viable arguments and critique the reasoning of others	3. Planning and carrying out investigations
4. Model with mathematics	4. Analyzing and interpreting data
5. Use appropriate tools strategically	5. Using mathematics and computational thinking
6. Attend to precision	6. Constructing explanations and designing solutions
7. Look for and make use of structure	7. Engaging in argument from evidence
8. Look for and express regularity and repeated reasoning	8. Obtaining, evaluating, and communicating information.

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Next Generation Science Standards: Crosscutting Concepts

- *Patterns*
- *Cause and Effect*
- *Scale, Proportion, and Quantity*
- *Systems and System Models*
- Energy and Matter
- Structure and Function
- Stability and Change

Literature Review
What misconceptions do students hold regarding the content of your unit?

- Research has shown students have difficulty understanding the cause of lunar phases (Abell, Martini, & George, 2001; Lightman & Sadler, 1993; Trundle, Atwood, & Christopher, 2002; Zeilik & Bisard, 2000).
- Students need well-developed spatial skills do understand many astronomical concepts (Plummer, 2014; Wilhelm et al., 2013; Black, 2004)

How do you ensure that students have the opportunity to learn specific content material in a project classroom?

REAL Benchmark Lessons

Lesson One: Can I see the Moon every day and night, and why does it appear to change its shape?

Lesson Two: How do I measure the distance between objects in the sky?

Lesson Three: How can I say where I am on the Earth?

Lesson Four: How can I locate things in the sky?

Lesson Five: What are the Global Features of the Moon?

Lesson Six: What can we learn by examining the Moon's surface?

Lesson Seven: What affects a crater’s size?

Lesson Eight: The Scaling Earth/Moon/Mars NASA Activity

Lesson Eight A: The Moon Finale

- **Lesson nine: What Makes a Planet Geologically Active?**
- **Lesson ten: Surface Activity on Planets and Moons**
- **Lesson eleven: Crater Number Density**
- **Lesson twelve: Experts’ Lesson**
- **Lesson thirteen: Martian Surface Age Exploration**

http://www.uky.edu/~jwi229/real/real_main.html

Components of the Project *(Including your Moon Hoax Project Investigations)*

- Sub-driving Research Question (student-generated question)
- Methods of Investigation and Data Collection
- Analysis of Data
- Data Representation
  - Graphs/Charts/ Models and/or Technology-generated Visuals
- Results and Conclusions
- Follow-up Question

Assessments in Project-enhanced Classrooms

Example Assessments

- Concept Maps
- Project Rubrics
- Pre/post surveys
- Journaling

Facets of Understanding

- Explain
- Interpret
- Apply
- Perspective
- Empathetic
- Self-knowledge

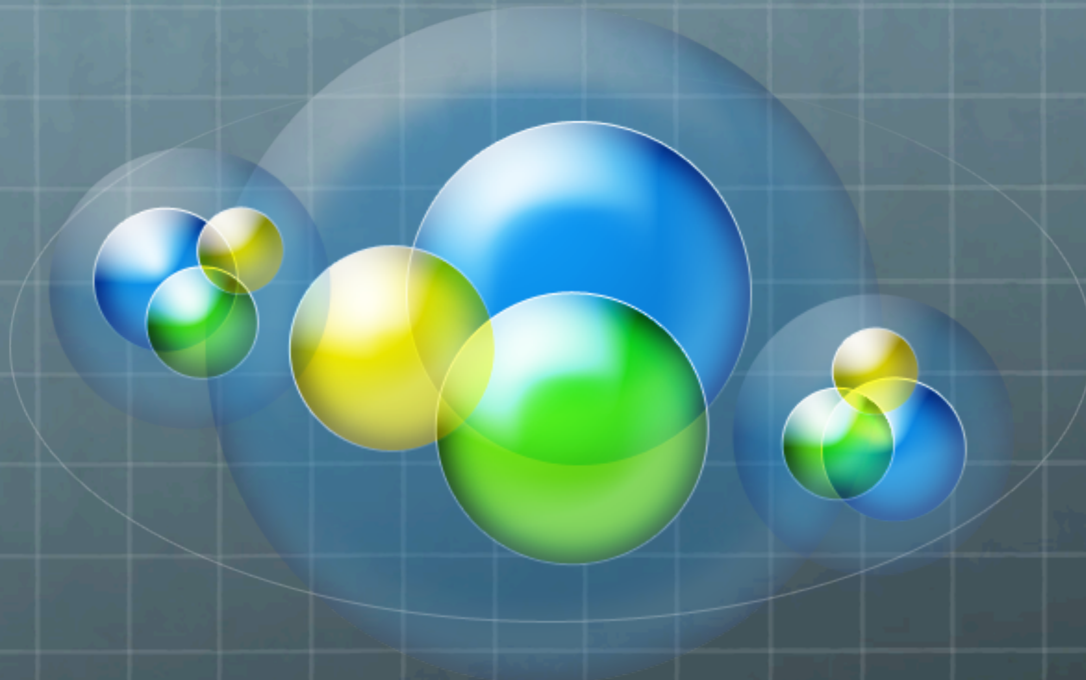
Project Rubric

	4 (high)	3	2	1 (low)
Hypothesis/Conjecture/ Sub-Driving Research Question	Student(s) posed a thoughtful, creative question that engaged them in challenging or provocative research. The question breaks new ground or contributes to knowledge in a focused, specific area.	Student(s) posed a focused question involving them in challenging research.	Student(s) constructed a question that lends itself to readily available answers.	Student(s) relied on teacher-generated questions or developed a question requiring little creative thought.
Methods of Investigation and Data Collection	Student(s) gathered their own data as well as information from a variety of quality electronic and print sources, including appropriate licensed databases. Sources are relevant, balanced and include critical readings relating to the research question or problem. Primary sources were included (if appropriate).	Student(s) gathered information from a variety of relevant sources--print and electronic sources.	Student(s) gathered information from a limited range of sources and displayed minimal effort in selecting quality resources.	Student(s) gathered information that lacked relevance, quality, depth and balance.
Analysis of Data	Student(s) carefully analyzed the information collected and drew appropriate and inventive conclusions supported by evidence. Voice of the student writer is evident.	Student (s) product shows good effort was made in analyzing the evidence collected	Student(s) conclusions could be supported by stronger evidence. Level of analysis could have been deeper.	Student(s) conclusions simply involved restating information. Conclusions were not supported by evidence.
Data Representation/ Graphs/Charts/Models and/or Technologically-generated Visuals	Student(s) thoughtfully used representations and/or technologically produced visuals to assist them in their own understandings of the project research and to assist in the communication of their research findings.	Student(s) representations related to their research project.	Student(s) used visuals but did not adequately support or add to their research project.	Student(s) used no representations of technologically produced visuals.
Synthesis	Student(s) developed appropriate structure for communicating project findings, incorporating a variety of quality information. Logically and creatively organized with smooth transitions.	Student(s) logically organized the product and made good connections among ideas	Student(s) could have put greater effort into organizing the product	Student(s) work is not logically or effectively structured.
Documentation	Student(s) documented all sources. Sources are properly cited, both in-text/in-product and on Works-Cited/Works-Consulted pages/slides. Documentation is error-free.	Student(s) documented sources with some care, Sources are cited, both in-text/in-product and on Works-Cited/Works-Consulted pages/slides. Few errors noted.	Student(s) need to use greater care in documenting sources. Documentation was poorly constructed or absent.	Student(s) need to work on communicating more effectively and relate their findings to their original research question.
Product/Process	Student(s) effectively and creatively used appropriate communication tools to convey their conclusions and demonstrated thorough, effective research techniques. Student(s)	Student(s) effectively communicated the results of research to the audience.	Student(s) showed limited evidence of thoughtful research.	Student(s) showed little evidence of thoughtful research. Product does not effectively communicate research findings.

What is a Driving Question?

Characteristics of Driving Questions

- Feasible: Students can design and perform investigations to answer the questions.
- Worthwhile: They contain rich science and/or mathematics content, relate to what scientists or mathematicians really do, and can be broken down into smaller questions.
- Contextualized: They are pertinent to the world, nontrivial, and important.
- Meaningful: They are interesting and exciting to learners.
- Sustainable: They lead to the pursuit of detailed answers over time.



Let's examine some driving questions:

Are they good driving questions?

Crafting your PBI Unit and Overarching Driving Question

- Brainstorm with your group about a potential PBI unit that you would like to design.

By End of Workshop

- Overall goal of unit (See PBI template)
- Driving question
- 2 potential Sub-driving questions
- 1 Benchmark lesson
  - 5 E's

(Engagement, Exploration, Explanation, Elaboration, and Evaluation)

By August Meeting (Be prepared to share)

- 1 Benchmark Lesson that utilizes technology
- 1 type of Assessment
- Locate, read, and summarize one article concerning misconceptions concerning your unit's topic. This should be done by each person in your group of 3 or 4.

By December Meeting

- Complete Unit
  - Overarching Goal
  - Driving Question
  - STEM Standards and Practices (and Crosscutting Concepts)
  - Potential Student sub-driving questions
  - Benchmark Lessons (at least three with one utilizing technology)
  - Formative and Summative Assessments (Milestones)