Integration of Science Standards and CCSS Practices

THURSDAY, NOVEMBER 21

ST. LANDRY PARISH SCHOOLS

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Credits…

Sarah Michaels, Clark University
- NSTA Web Seminar: http://learningcenter.nsta.org/products/symposia_seminars/Ngss/webseminar17.aspx

PBL-Online.org

http://www.bie.org/tools/freebies

Don Yost,
- Modeling workshop leader: http://modeling.asu.edu/Projects-Resources.html

Today…

1. What's common about the Common Core?
2. Project-based learning
3. Science strategies for achieving the core standards & practices

Objectives

1. Identify and develop instructional activities that integrate Common Core practices and standards in high school science courses.
2. Implement strategies for mathematical reasoning and sense-making in analyzing science content and problems.

CCSS Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with math.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

CCSS ELA Competencies
("College and Career Readiness")

1. Demonstrate independence
2. Build strong content knowledge
3. Respond to varying demands of audience, task, purpose, and discipline
4. Comprehend as well as critique
5. Value evidence
6. Use technology and digital media strategically and capably
7. Come to understand other perspectives and cultures

NGSS Science & Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Whiteboard

What are common "threads" between the practices for the various disciplines?

Which of these are ideally suited for the sciences to support?

Evidence

Math Practice #3:

– Construct viable arguments and critique the reasoning of others

ELA Competency #5:

– Value evidence

Science and Engineering Practice #7:

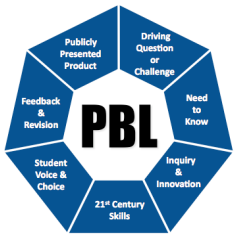
– Engaging in argument from evidence

Practices in Different Disciplines		
Math	**Science**	**English Language Arts**
M1. Make sense of problems and persevere in solving them.	S1. Asking questions (for science) and defining problems (for engineering).	E1. They demonstrate independence.
M2. Reason abstractly and quantitatively.	S2. Developing and using models.	E2. They build strong content knowledge.
M3. Construct viable arguments and critique the reasoning of others.	S3. Planning and carrying out investigations.	E3. They respond to the varying demands of audience, task, purpose, and discipline.
M4. Model with mathematics.	S4. Analyzing and interpreting data.	E4. They comprehend as well as critique.
M5. Use appropriate tools strategically.	S5. Using mathematics, information and computer technology, and computational thinking.	E5. They value evidence.
M6. Attend to precision.	S6. Constructing explanations (for science) and designing solutions (for engineering).	E6. They use technology and digital media strategically and capably.
M7. Look for and make use of structure.	S7. Engaging in argument from evidence.	E7. They come to understanding other perspectives and cultures.
M8. Look for and express regularity in repeated reasoning.	S8. Obtaining, evaluating, and communicating information.	

How?

How can we get students to value and use evidence and reasoning to form arguments, test them, and support their conclusions?

Project-Based Learning



Doing Projects vs. Project Based Learning

Project-Based Learning

Authentic, real-world, or perplexing problems, differentiated according to student interests

Provokes students to grapple with the key concepts of a topic or discipline

Driven by student research, production, and presentation of information

Allows reflection upon decisions and outcomes during the learning process

Many teachers assign projects,

but not all projects lead to learning

Doing Projects

vs.

Project Based Learning

What is Project-Based Learning? (bie.org)

Focus on Significant Content

- The project imparts important, standards-based knowledge and skills

Develop 21st Century Skills

- Critical thinking, problem-solving, collaboration & communication

What is Project-Based Learning? (bie.org)

Engage Students in In-Depth Inquiry

- Rigorous, extended process of asking questions, using resources, and developing answers

Organized Around a Driving Question

- Focused by an open-ended question that captures the task and is explored by students

What is Project-Based Learning? (bie.org)

Establish a Need to Know

- Students see the need to gain knowledge, understand concepts, and apply skills

Encourage Voice & Choice

- Students are allowed to make choices about how they work and the products they create

What is Project-Based Learning? (bie.org)

Incorporate Revision and Reflection

- Use feedback to consider additions and changes; think about what and how they are learning

Include a Public Audience

- Present their work to other people, beyond their classmates and teacher

Successful CCSS Projects

Rigorous: build content knowledge
- Require students to have a thorough understanding of key instructional objectives in order to complete the project

Involve reasoning, critiquing, reflecting, and evaluating evidence

Use technology appropriately and effectively

Think about your favorite project you assign your students…

Rate your project based on the provided criteria

Types of Projects

Investigation of a Historical Event or Natural Phenomenon
- Should the U.S. have dropped the atomic bomb on Japan?
- How might animals evolve in a changing climate?
- How has the model of the atom changed throughout history?

Types of Projects

Problem-Solving Situation

- Where does the mass of a tree come from?
- Inflating an air bag with stoichiometry…
- Genetics with Maury…?

Types of Projects

Examination of a Controversial Issue

- Should the government subsidize production of ethanol?
- Should stem cells be used for medical research?

Types of Projects

Challenge to Design, Plan, Build, or Create Something

- Design and build the strongest bridge from toothpicks, spaghetti, etc.
- Build a device to keep an egg from breaking when dropped from 50 feet.
- Develop a way to evaluate methods of reducing coastal erosion.

Project Upgrade

Choose one project idea at your table.

Think about how you can…

- Make a "dessert" project into a "main course" project
- Integrate more science and CCSS skills and practices into the project
- Guide students toward a product that demonstrates understanding

Be ready to share in 10 minutes…

Critical Friends Protocol

PRESENTATION Presenters explain their project; Audience listens	4 min.
CLARIFICATION Audience asks clarifying questions; Presenters respond	2 min.
"I LIKE" Audience shares what they liked; Presenters listen	2 min.
"I WONDER" Audience shares ideas to strengthen project; Presenters listen	2 min.
REFLECTION & CONCLUSION Presenters reflect on useful feedback; Audience listens	2 min.

How?

How can we get students to value and use evidence and reasoning to form arguments, test them, and support their conclusions?

COMPASS Domains

1c. Setting instructional outcomes

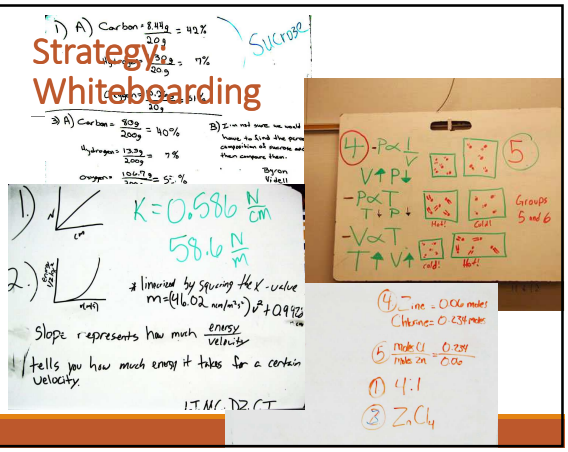
2c. Managing classroom procedures

3b. Using questioning and discussion techniques

3c. Engaging students in learning

3d. Using assessment in instruction

Strategy: Whiteboarding



Whiteboarding Philosophy

Generally, a group of 2-4 students is assigned to work a "problem" on a whiteboard

They later present their solution and answer any questions from the class/teacher

Requires students to

- Discuss (logically) their reasoning and methods
- Analyze and critique others' reasoning
- Ask questions of their peers

Features of Whiteboarding

Active learning process (formative)

Probes students' understanding and promotes deeper comprehension

Use multiple representations

Students practice verbalizing concepts and reasoning

- Often, we are unaware we don't understand until we try to explain it…

Key Benefits of Whiteboarding

A whiteboard is not permanent – more freedom to try and explore

One whiteboard per group forces students to discuss and resolve differences

Gets students talking about the content. Reveals areas where they need more help.

Practically speaking

All groups whiteboard the same problem(s)/question(s)

Split up questions among groups

Works for lab conclusions and reflection questions

** Students must present their whiteboards: helps ensure students apply themselves during whiteboarding time

Activity

Whiteboard your chosen problem.

Try to use multiple representation: graphs, equations, picture diagrams, descriptions, etc.

Show enough detail to demonstrate your understanding – don't kill us with every little detail

Whiteboard presentations

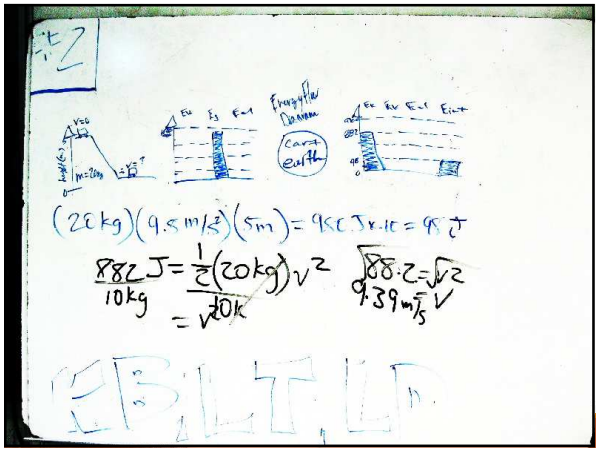
Groups will present their whiteboards.

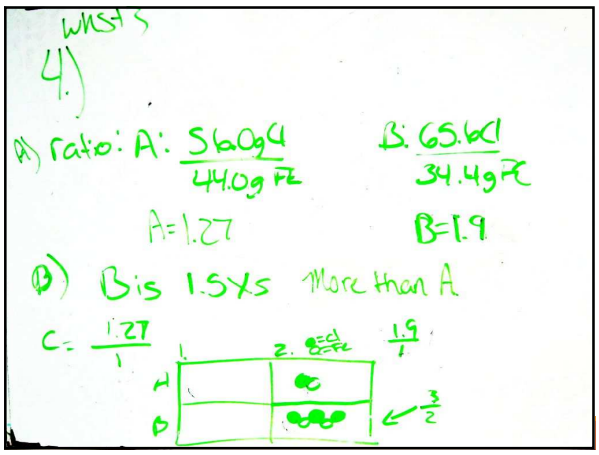
The class can then ask any clarifying questions.

Reflection…

Characteristics of…

- a helpful whiteboard:
- a helpful presentation:





Teacher's Role…

What should the teacher be doing?

- …while students work on whiteboards?
  - Circulate to assist struggling groups and assess understanding. Small-group student conversations about the content reveal much more clearly what students need help with.

Teacher's Role…

What should the teacher be doing?

- …during whiteboard presentations?
  - Listening carefully to students and following their reasoning. Interrupt and make students explain their reasoning – no "glossing over"
  - Avoid the urge to step in and explain when students make mistakes. Instead, ask probing questions that get students to recognize their mistake themselves.
  - Step back from being the "sage on the stage" to the "guide by the side"

Whiteboard meeting

The classroom culture is important.
A successful whiteboard meeting:

- Teacher-led
  - interject questions
  - probe for deeper understanding ("Why did you do ___?" "How do you know ___?")
- Interactive
  - students ask clarifying questions of each other
  - the process is building understanding

Video

Extension… "Mistake Game"

Student groups are told to intentionally make a mistake in their whiteboard solution.

The audience's job is to identify the mistake.

Conclusion

Thank you for your attention and participation!

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