Full STEAM Ahead:

Designing and Implementing an Integrated Science, Technology, Engineering, Arts, and Mathematics High School Curriculum part 2

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A Workshop for St. Hubert Catholic High School for Girls

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Workshop Goals

1.To engage in an integrated STEAM modeling activity as a learner.

2. To identify and review different types of models and make connections to the arts.

3. To apply design criteria for STEAM projects and units and make modifications to activities based upon criteria.

4.To make progress planning for integrated STEAM activity/unit in teams.

Agenda

1. *Welcome and Review*
2. *Activity:* Defining “developing and using models”
3. *STEAM Activity:* Make your own model
4. *Activity:* Analyze classroom vignette
5. *Application:* STEAM Project Planning
6. *Closing*

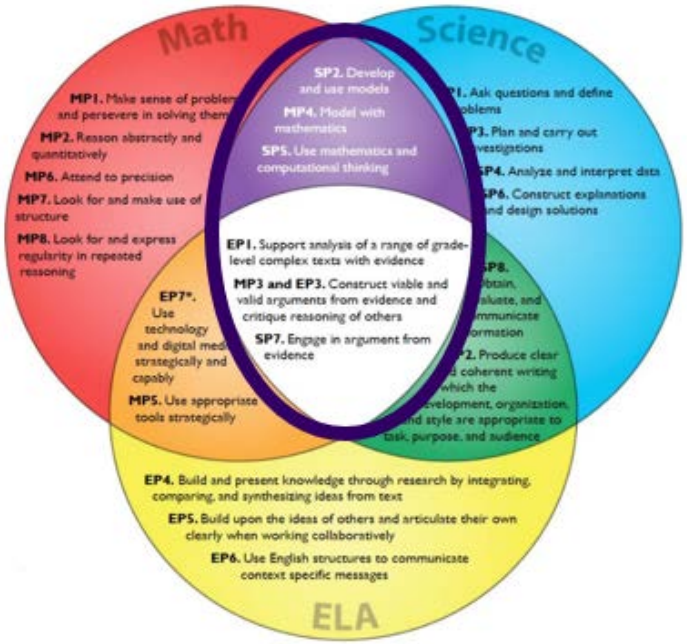
Warm Up

Think-Pair-Share

What big ideas have stuck with you from the session in November? (activities, criteria, ideas you had)

Warm Up

de.wikipedia/Tribal



1. Explanation and argumentation
2. Modeling
3. Engineering design

CRITERIA FOR DESIGNING STEAM TASKS

St. Hubert's Full STEAM Ahead Workshop #1, 11/22/19: Marco-Bujosa

STEAM education refers to an integrated approach to science, technology, the arts, and mathematics. The "arts" includes the humanities, language arts, dance, drama, music, visual arts, design and new media.

High quality STEAM tasks and projects address the following 4 design criteria:

Design Criteria #1: Addresses a real-world problem through integrated thinking	• The problem is authentic and connected to real-world contexts • The problem is open-ended and there is no one "correct" answer; the problem should allow for multiple solutions and creativity
Design Criteria #2: Encourage student-driven inquiry	• Students, not the teacher, should be leading and carrying out the task to solve the problem • Inquiry, problem solving and process-based learning are emphasized through completing the task • Involves the use of disciplinary practices in science and engineering, math, and/or language arts
Design Criteria #3: Requires the combination of STEM and arts-based knowledge and skills to address the problem	• The integration of the arts purposefully enhances meaning and student demonstration of knowledge and skill • Students will apply skills or processes learned from previous instruction in STEM and arts classes • Both STEM content and the arts are held to equal standards
Design Criteria #4: Necessitates the use of 21st century skills	• One or more the following is required to address the problem: collaboration, creativity, critical thinking, and communication

Other things to consider when designing STEAM projects and tasks:

- What content standard(s) do you want to emphasize and support?
- What disciplinary practice(s) do you want to emphasize and support?
- What are the needs of your students (e.g. English language learners, experience with inquiry)?
- Where are the overlaps and opportunities in existing curriculum for students to engage in authentic STEAM projects?
- How do you want students to engage in the arts (i.e. writing, performance)?
- How can the project be broken into discrete instructional chunks addressing core content and skills student will need to address the problem?

STEAM Tasks Design Criteria

Design Criteria #1: Addresses a real-world problem through integrated thinking

Design Criteria #2: Encourage student-driven inquiry

Design Criteria #3: Requires the combination of STEM and arts-based knowledge and skills to address the problem

Design Criteria #4: Necessitates the use of 21st century skills

Defining and Developing Models

The Task:

- Brainstorm examples of models.

Modeling in the Standards

NGSS

"A model is an abstract representation of phenomena that is a tool used to predict or explain the world. Models can be represented as diagrams, 3-D objects, mathematical representations, analogies or computer simulations" where "students create or use models to explain and/or predict scientific phenomena, processes, or relationships" and "evaluate the merits and limitations of models."

Common Core Math

"Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods… technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data.

Defining and Developing Models

The Task:

- Brainstorm examples of models.
- How does our current understanding compare to the definition of modeling?

Consider these questions as you look through the examples of models that we brainstormed:

- Do students create or use it to describe natural phenomena?
- Do students create or use it to explain natural phenomena?
- Do students create or use it to predict natural phenomena?
- Can students evaluate it for merits and/or limitations?

Activity: Making Your Own Model

The Task:

- Using the materials given, work in small groups to create a model that explains why people on Earth experience day and night
- When everyone is done, we will do a gallery walk

Activity: Making Your Own Model

This activity targets the following standards:

PA Standard - 3.3.7.B3 Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories.

PA Standard S7.D.3.1.1 Describe the patterns of Earth's rotation and revolution in relation to the Sun and Moon (i.e., solar eclipse, lunar eclipse, phases of the Moon, and time).

- Clarification – Models should illustrate that the Earth, Sun, and Moon are spheres; include orbits of the Earth around the Sun and of the Moon around Earth; and demonstrate Earth's rotation about its axis

Activity: Making Your Own Model

The Task:

- Using the materials given, work in small groups to create a model that explains why people on Earth experience day and night
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Activity: Making Your Own Model

Discuss:

1. What are the strengths and limitations of the various models?
2. How could developing and using these models help further your students' understanding of this phenomena beyond reading or writing?

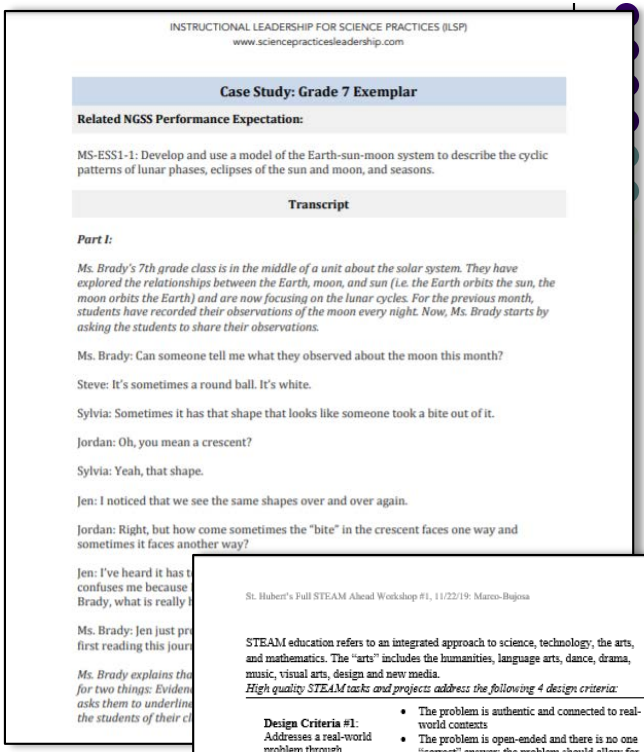
Application: Classroom Vignette

The Task:

- Read a vignette of a 7th grade classroom engaged in modeling.

Discussion Questions:

1. What are the strengths of the activity? (STEAM design criteria)
2. How could the activity be improved? (STEAM design criteria)
3. Brainstorm some other models students could create and use in your class to represent STEAM knowledge.



INSTRUCTIONAL LEADERSHIP FOR SCIENCE PRACTICES (ILSP)
www.sciencepracticesleadership.com

Case Study: Grade 7 Exemplar

Related NGSS Performance Expectation:

MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

Transcript

Part I:

Ms. Brady's 7th grade class is in the middle of a unit about the solar system. They have explored the relationships between the Earth, moon, and sun (i.e. the Earth orbits the sun, the moon orbits the Earth) and are now focusing on the lunar cycles. For the previous month, students have recorded their observations of the moon every night. Now, Ms. Brady starts by asking the students to share their observations.

Ms. Brady: Can someone tell me what they observed about the moon this month?

Steve: It's sometimes a round ball. It's white.

Sylvia: Sometimes it has that shape that looks like someone took a bite out of it.

Jordan: Oh, you mean a crescent?

Sylvia: Yeah, that shape.

Jen: I noticed that we see the same shapes over and over again.

Jordan: Right, but how come sometimes the "bite" in the crescent faces one way and sometimes it faces another way?

Jen: I've heard it has t
confuses me because
Brady, what is really l

Ms. Brady: Jen just pr
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Ms. Brady explains tho
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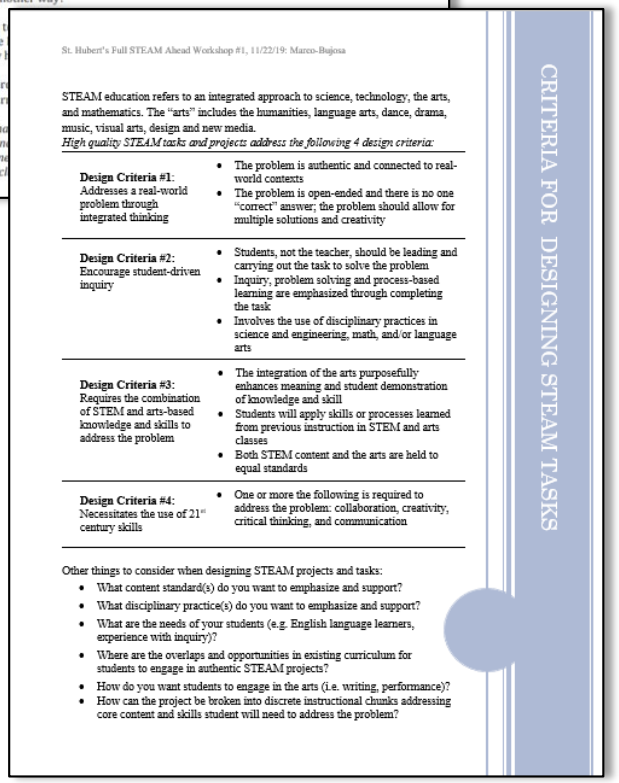

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Exploring Different Types of Models

There are many different types of models that students might use in the science classroom, including computer simulation models, structural models, and mathematical models.

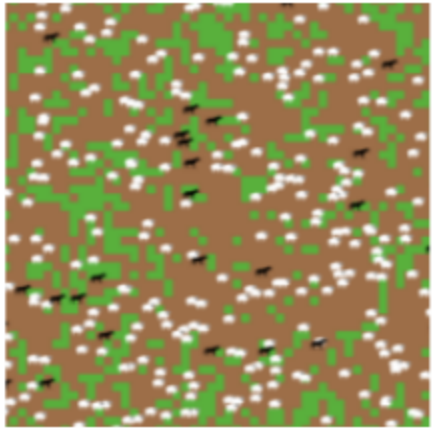
For each of the following examples, consider:

- How can students use the model to explain or predict natural phenomena?
- Can students evaluate the merit and/or limitations of the model?

Exploring Different Types of Models

Example of a Computer Simulation Model:

- NetLogo's sheep-wolf predation simulation can be used to examine and predict the stability of predator-prey ecosystems
- Specifically, this model explores the relationship between sheep and wolf
- If you would like to learn more about this simulation model, click on this link:
  - http://ccl.northwestern.edu/netlogo/models/WolfSheepPredation



This image is from Northwestern's NetLogo website

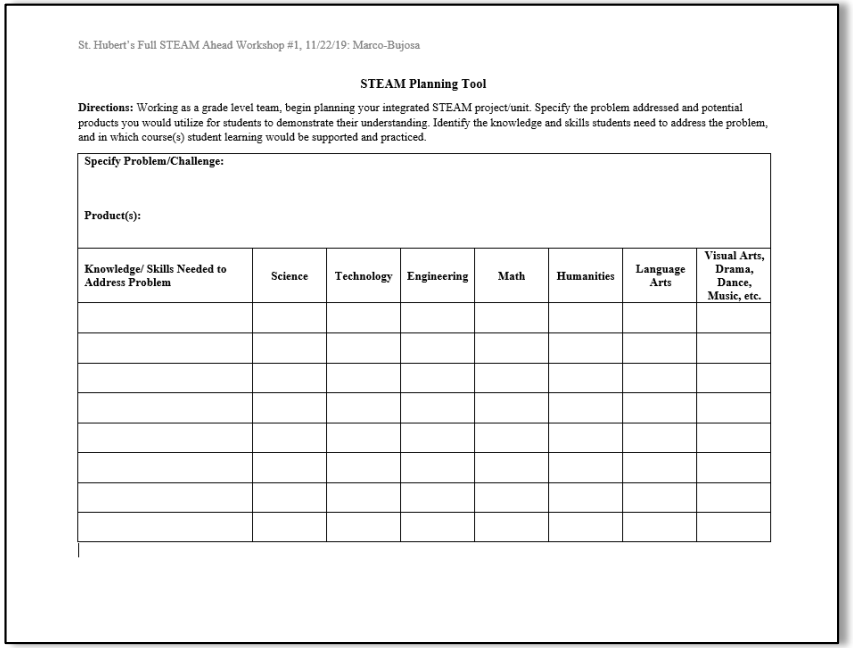
Exploring Different Types of Models

Example of a Structural Model:

- The LEGO DNA Learning Center sets are models that can be used to explain what molecules are doing inside of cells
- If you would like to learn more about these models, click on this link:
  - https://www.youtube.com/watch?v=Mv0ldAHQRAI

The above image is from this Youtube video

Application: STEAM Project Planning



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STEAM Planning Tool

Directions: Working as a grade level team, begin planning your integrated STEAM project/unit. Specify the problem addressed and potential products you would utilize for students to demonstrate their understanding. Identify the knowledge and skills students need to address the problem, and in which course(s) student learning would be supported and practiced.

Specify Problem/Challenge:

Product(s):

Knowledge/ Skills Needed to Address Problem	Science	Technology	Engineering	Math	Humanities	Language Arts	Visual Arts, Drama, Dance, Music, etc.

The Task:

- Continue planning your

STEAM project (see the planning sheet)

1. Review and brainstorm potential problems (global, local, personal) that align with content and skills.
2. What would the final product be? (could be options)
3. What content and skills do students need to be successful in the final product?
4. How will these content and skills be scaffolded in your courses?
5. Review the STEAM criteria

Popcorn

Share one of the following:

- One new approach/skill you have learned from this workshop that you plan to use in your classes;
- One big idea you would like to discuss further to integrate into the schoolwide STEAM program;
- One lingering question you still have.

Workshop Take Aways

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