Transitioning to NGSS
What STEAM really means..

Presented by:
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Sessions Goals

• Three dimensions
• Introduce the practices
• Creating discourse and using multiple resources.
• Understand the 5 E Model
Grade Level/Band & Title

Performance Expectations

Describe student knowledge after instruction.

Foundation Boxes list the SEP’s, DCI’s and XCC’s aligned with the PE’s

Top Connections Box: Assists development sequence. Provides articulation of DCI’s

Bottom Connection Box: Common Corfe Standards either previous or concurrent to instruction.
Three Dimensions Intertwined

Lessons must have all three dimensions

NGSS will require contextual application of the 3 dimensions by students.

Focus is on how and why as well as what.
Coordinated Practices

• Students learn science best by engaging in the practices of science.

• Classrooms can productively be considered scientific communities, where students engage in sustained investigations involving a full set of coordinated practices.
• Most people think:

• Successful people know:

start

Failure or success

Success!
Practice Commonalities

MATH

M1. Make sense of problems and persevere in solving them.
M6. Attend to precision
M7. Look for and make use of structure.
M8. Look for and express regularity in repeated reasoning
M2. Reason abstractly & quantitatively

SCIENCE

S2. Develop & use models
M4. Model with mathematics
S5. Use mathematics and computational thinking
S1. Ask questions & define problems
S3. Plan & carry out investigations
S4. Analyze & interpret data
S6. Construct explanations & design solutions

E6. Use technology & digital media strategically & capably
M5. Use appropriate tools strategically

ELA

E2. Build a strong base of knowledge through content rich texts
E5. Read, write, & speak grounded in evidence
M3 & E4. Construct viable arguments & critique reasoning of others
S7. Engage in argument from evidence

E1. Demonstrate independence in reading complex texts, & writing & speaking about them
E7. Come to understand other perspectives & cultures through reading, listening, & collaborations

S8. Obtain, evaluate & communicate information
E3. Obtain, synthesize & report findings clearly & effectively in response to task
Taking it into the classroom

• Instructors need to help make the scientific investigation meaningful, not rote steps.
• Create a need for the investigation through rich questions applied to phenomena.
• Engage cooperation.
• Instructors need to support multiple aspects of doing the work.
• Supporting social interactions that help get the work done.
• Supporting discourse in communicating to get the work done.
Questions are the engine that drive science and engineering. Asking scientific questions is essential to developing scientific habits of mind. It is a basic element of scientific literacy.

Science education should develop students’ ability to ask well-formulated questions that can be investigated empirically.
Practice 2: Developing and Using Models

Scientists and engineers construct conceptual and mental models of phenomena. Conceptual models are explicit representations that are in some ways analogous to the phenomena they represent. They include diagrams, physical replicas, math representations, analogies, and computer simulations/models.

Students should represent and explain phenomena using multiple kinds of models, learn to use modeling tools, and come to understand the limitations and level of precision of particular models. Always comparing the limitation of the model to the system in the natural world.
Interpreting can mean all the difference

- Teachers, coaches and principals’ interpretations of the standards shape classroom practices.

Spillane, et al, 2006
Using mathematics and computational thinking (MCC) Developing explanations (science) and designing solutions (engineering)

- Through out the NGSS there is deliberate Math and ELA Common Core alignment.
- Once the investigation has taken place, the students will look at lots of data, will seek out more, and will begin to form conclusions, but will NOT YET have assembled all their ideas into arguments.
- Designing solutions from the data and research.
Engaging in argument (ELACC)
Obtaining, evaluating, and communicating information (ELACC)

- Supporting claims with evidence.
- Developing chains of cause and effect with multiple steps.
- Comparing alternative possible explanations.
- Using other students’ critiques to clarify explanations (instructor can help…)

5 E’s Model

**Engage**: activities capture the students attention, connect their thinking to the situation, and help them access current knowledge.

**Exploration**: Students investigate initial ideas and solutions in meaningful contexts.

**Explanation**: Based on an analysis of the exploration, students develop an explanation for the concept and practices. Their understanding is clarified and modified through the teacher’s descriptions and definitions. Additional reading.

**Elaboration**: Students have opportunity to expand and apply their understanding of the concepts within new context and situations, real world application.

**Evaluation**: Students assess their understanding of the concepts, and teachers have the opportunity to assess student learning.
How does a seed become a full sized plant?

Where does the additional matter come from?

How is the energy from the sun used by the plant?
Engage

Examine the corn kernel. Only water has been provided.

With a partner, discuss surrounding the phenomena of a seed developing into a full sized corn plant.

Where does the additional matter come from?
What are the needs of plants?
What does light energy allow the plant to do?

5 E Format based on the work of Bybee (BSCS)
*Translating the NGSS for Classroom Instruction* (NSTA Press, 2013)
Explore

Students are provided with materials to explore their own ideas:
Aquatic plants, indicator that shows presence of CO2 in water, Test tubes, stoppers, variety of light conditions.

In groups, students develop a question to test and a method to gather Data that will provide an answer. Students predict the outcome.
1. Fill in 6 tubes with an equal amount of yellow Bromothymol blue. Put a stock of elodea in 5 of the 6 tubes.
2. Put the test tube with no elodea out in the Classroom light. Put 4 under ultra violet light and One in the dark.
Hypothesize regarding the color of the Bromothymol blue. I think the BB elodea in the dark will turn back blue. Next day, see color of yellow BB in test tube with No elodea, with elodea, and in the dark.
Explain

Students observe the results of their test.

Using evidence from the results, students develop an explanation of what happened.

Groups extend their research by digging deeper into text to support or disprove their hypothesis.

The investigation findings and the text are combined by groups. Groups share their claims with supporting evidence.

Their idea is drawn in a model to make their understanding of the matter and Energy inputs/outputs visible.

Students record other questions about the phenomena that may develop.
To understand the process of photosynthesis, students access resources that provide explanations.

Students watch a 4 minute Ted Ed Video of how photosynthesis allows plants to make molecules from substances in their environment.

Students use an online simulation of photosynthesis to further test and support their findings.

What if I reduce amount of water?
What if I increase amount of water?

Set up experiments testing the variables outside in the garden using natural settings, i.e.: shade, amount of water, air (can plant many seeds in small area to prove they need space… etc.)
**Evaluate**

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<thead>
<tr>
<th>CLAIMS</th>
<th>EVIDENCE</th>
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Claim: a statement believed to be true; Should answer a question or explain an idea.

Evidence: the data that proves or disproves your claim. This can be quantitative or qualitative that you observe or gather from a reliable source.

Begin with: This focus was about:
My claim was:
I did the following activities:
My evidence is:
I learned:
I still wonder:
Was that 5 E lesson aligned?

PE: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

<table>
<thead>
<tr>
<th>SEP</th>
<th>DCI</th>
<th>XCC</th>
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<tbody>
<tr>
<td>Construct</td>
<td>Matter and Energy Flow</td>
<td>Energy</td>
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<tr>
<td>Explanations</td>
<td>Energy Flow In organisms</td>
<td>and Matter</td>
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<td>and Design</td>
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<td>Solutions</td>
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<td>Energy in Chemical Process</td>
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<td>and Everyday life</td>
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Compared to old photosynthesis lesson

Assign reading and complete questions.

Teacher reviews process and explains input and output

Teacher directs students to memorize terms, etc.

Students complete a scripted lab activity to view the process occurring and collect data.

Give summative assessment that focus on recall and some explanations of what the process showed, why it is important.
# How will science education change with the NGSS?

Implications of the Vision of the Framework for K-12 Science Education and the Next Generation Science Standards

<table>
<thead>
<tr>
<th>SCIENCE EDUCATION WILL INVOLVE LESS:</th>
<th>SCIENCE EDUCATION WILL INVOLVE MORE:</th>
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<tbody>
<tr>
<td>Rote memorization of facts and terminology</td>
<td>Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.</td>
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<td>Learning of ideas disconnected from questions about phenomena</td>
<td>Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned</td>
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<td>Teachers providing information to the whole class</td>
<td>Students conducting investigations, solving problems, and engaging in discussions with teachers’ guidance</td>
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<td>Teachers posing questions with only one right answer</td>
<td>Students discussing open-ended questions that focus on the strength of the evidence used to generate claims</td>
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Questions/ Comments