## Where We’re Headed Today…

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<th>Welcome</th>
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Welcome!

Making Sense of Three-Dimensional Teaching and Learning: Supporting High-Quality STEAM Instruction

Monday, July 29, 2024
Introductions

Michelle Phillips
Education Specialist
mphillips@nsta.org
Collection of Resources

My Library

Making Sense of 3D T&L: Supporting HQ STEAM Instruction Collection

PRIVATE 2 items

Resources in “Making Sense of 3D T&L: Supporting HQ STEAM Instruction” Collection

<table>
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<tr>
<th>Title</th>
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<tr>
<td>Research-and-Policy-Implications-of-STEAM-Education-for-Young-Students.pdf</td>
<td>PDF File</td>
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<tr>
<td>What is STEAM Education?</td>
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https://bit.ly/3SqhtTk
Learning Community Norms

- We come prepared to work toward a common goal.
- We share our own thinking to help us all learn.
- We listen carefully and ask questions to help us understand everyone’s ideas.
- We are open to changing our minds.
- We challenge ourselves to think in new ways.
Meet Our Learning Community

Alone Zone (independent thinking time)

● Why do you think it is important for all students to learn STEAM subjects in an integrated way?
● What are your STEAM goals for your students?
Meet Our Learning Community

**Alone Zone** (independent thinking time)

- Why do you think it is important for all students to learn STEAM subjects in an integrated way?
- What are your STEAM goals for your students?

**Small Group**

- Share your thinking with your group.
- What are your group’s top one or two STEAM goals for your students?
Why STEAM?

“To develop a complete mind: Study the science of art; Study the art of science. Learn how to see. Realize that everything connects to everything else.”

— Leonardo da Vinci

The Rhode Island School of Design (RISD), one of the early champions of adding the arts to the original STEM framework to create STEAM, said that doing so emphasizes the vitally important “symbiosis between the arts and sciences.” According to RISD, “The goal is to foster the true innovation that comes with combining the mind of a scientist or technologist with that of an artist or designer.”

— Why STEAM is so Important to 21st Century Education
Recent research shows that STEAM is a promising approach to positively impacting student achievement and teacher efficacy. In a 2016 study, researchers investigated the impact of STEAM lessons on physical science learning in grades 3 to 5 in high poverty elementary schools in an urban district. Findings indicated that students who received just nine hours of STEAM instruction made improvements in their science achievement (Brouillette, L., & Graham, N. J.).

Another study from 2014 shows the connecting STEAM and literacy can positively impact cognitive development, increase literacy and math skills, and help students reflect meaningfully on their work and that of their peers (Cunnington, Marisol, Andrea Kantrowitz, Susanne Harnett, and Aline Hill-Ries.).

This is further supported by a study on the relationship between theater arts and student literacy and mathematics achievement from 2014. “Results showed that students whose language arts curricula were infused with theater arts often outperformed their control group counterparts, who received no arts integration, in both math and language arts” (Inoa, R., Weltsek, G., & Tabone, C.).
Learning Targets

- Understand STEAM enhancement/integration
- How to intentionally engage students in the practices of two or more STEAM subjects to solve a problem
Meet Ms. Katsanos’ Third-Graders

Students experienced the phenomenon of kidney beans germinating. (The beans look like kidney beans one day and then a few days later some of the kidney beans look like plants.)

Students have completed an investigation in which kidney beans with water and kidney beans without water were placed in sunny places and dark places.
Elementary Students Sensemaking

Students complete two tasks in this classroom video

Task 1. Reach a consensus on what it means for a seed to germinate (0:24-3:25)

Task 2. Make a claim in answer to the question about the phenomenon, “What do kidney beans need to successfully germinate?” (3:40-6:25)
Elementary Students Sensemaking

Alone Zone

1. What are the students doing?

2. What is the teacher doing?

3. Based on what you observed, what is sensemaking?

https://www.teachingchannel.org/video/lesson-claims-evidence-reasoning
Elementary Students Sensemaking
Small Group

1. What are the students doing?

2. What is the teacher doing?

3. Based on what you observed, what is sensemaking?

https://www.teachingchannel.org/video/lesson-claims-evidence-reasoning
What is Sensemaking?

Small Group

• Discuss with your group members:
  o What were the students doing?
  o What was the teacher doing?

  *Cite specific examples from the classroom video.*

• As a group, describe sensemaking.
What is Sensemaking?

**Information Frame**

- Scientists and Teachers

  - Knowledge of Science Disciplines

  - Some Students

**Sensemaking Frame**

- Students as Scientists and Engineers

  - Making Sense of Phenomena

  - Teachers Facilitate

  - All Students
# Practices in Math, Science and ELA

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Science</th>
<th>English Language Arts</th>
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<tr>
<td><strong>M1.</strong> Make sense of problems and persevere in solving them.</td>
<td><strong>S1.</strong> Asking questions (for science) and defining problems (for engineering).</td>
<td><strong>E1.</strong> They demonstrate independence.</td>
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<tr>
<td><strong>M2.</strong> Reason abstractly and quantitatively.</td>
<td><strong>S2.</strong> Developing and using models.</td>
<td><strong>E2.</strong> They build strong content knowledge.</td>
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<td><strong>M3.</strong> Construct viable arguments and critique the reasoning of others.</td>
<td><strong>S3.</strong> Planning and carrying out investigations.</td>
<td><strong>E3.</strong> They respond to the varying demands of audience, task, purpose, and discipline.</td>
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<tr>
<td><strong>M4.</strong> Model with mathematics.</td>
<td><strong>S4.</strong> Analyzing and interpreting data.</td>
<td><strong>E4.</strong> They comprehend as well as critique.</td>
</tr>
<tr>
<td><strong>M5.</strong> Use appropriate tools strategically.</td>
<td><strong>S5.</strong> Using mathematics and computational thinking.</td>
<td><strong>E5.</strong> They value evidence.</td>
</tr>
<tr>
<td><strong>M6.</strong> Attend to precision.</td>
<td><strong>S6.</strong> Constructing explanations (for science) and designing solutions (for engineering).</td>
<td><strong>E6.</strong> They use technology and digital media strategically and capably.</td>
</tr>
<tr>
<td><strong>M7.</strong> Look for and make use of structure.</td>
<td><strong>S7.</strong> Engaging in argument from evidence.</td>
<td><strong>E7.</strong> They come to understand other perspectives and cultures.</td>
</tr>
<tr>
<td><strong>M8.</strong> Look for and express regularity in repeated reasoning.</td>
<td><strong>S8.</strong> Obtaining, evaluating, and communicating information.</td>
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*The Common Core State Standards, English Language Arts uses the term student capacities rather than the term practices used in Common Core State Standards, Mathematics and the Next Generation Science Standards.*
Integrating Math, Science and ELA

Commonalities Among the Practices in Science, Mathematics, and English Language Arts (ELA)

Source: Based on work by Tina Chen, http://all.stanford.edu/teaching_resources

Math

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

Science

S1: Ask questions and define problems
S2: Develop and use models
S3: Plan and carry out investigations
S4: Analyze and interpret data
S5: Use mathematics, information and computer technology, and computational thinking
S6: Construct explanations and design solutions
S7: Engage in argument from evidence
S8: Obtain, evaluate, and communicate information
E3: Obtain, synthesize, and report findings clearly and effectively in response to task and purpose

ELA

E1: Demonstrate independence in reading complex texts and writing and speaking about them
E2: Build a strong base of knowledge through content-rich texts
E4: Construct viable arguments and critique the reasoning of others
E5: Read, write, and speak grounded in evidence
E6: Use technology and digital media strategically and capably
M3 and M4: Model with mathematics
M5: Use appropriate tools strategically
E7: Come to understand other perspectives and cultures through reading, listening, and collaborating

http://ngss.nsta.org
Math

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

M4: Model with mathematics
S2: Develop and use models
S5: Use mathematics, information and computer technology, and computational thinking

Science

S1: Ask questions and define problems
S3: Plan and carry out investigations
S4: Analyze and interpret data
S6: Construct explanations and design solutions

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

E6: Use technology and digital media strategically and capably
M5: Use appropriate tools strategically

E3: Obtain, synthesize, and report findings clearly and effectively in response to task and purpose
S8: Obtain, evaluate, and communicate information

ELA

E1: Demonstrate independence in reading complex texts and writing and speaking about them
E7: Come to understand other perspectives and cultures through reading, listening, and collaborating

Source: Based on work by Tina Cheuk,
http://ell.stanford.edu/teaching_resources

NGSS@NSTA
STEM STARTS HERE
http://ngss.nsta.org
Elementary Students Sensemaking

Small Group
Look back at your examples of what students are doing to figure out what kidney beans need to germinate.

- Post examples of students engaged in two or more STEAM practices on the Venn diagram on YELLOW sticky notes.

- Post ideas on GREEN notes about how you might intentionally engage students in other STEAM subjects to help them answer their question, What do kidney beans need to germinate?
Continuum of STEAM Instruction

Single Subject

- Learning to identify and categorize shapes, lines, and patterns.
- Practicing identification of relative spatial position such as over, under, and next to.

Enhanced Subjects

- Using a Matisse collage to offer examples of patterns, categories, and relative positions of shapes.

Integrated Subjects

- Learning about the art of Matisse. Identifying shapes, patterns and relative position of objects in a Matisse collage.
- Creating and categorizing shape cut outs, then using those cutouts to create a Matisse-inspired collage.
- Description the types of and relative positions of the shapes and lines in their artwork. Describing how Matisse inspired their collage.
Continuum of STEAM Instruction

Single Subject

Learning how choreographers use time, space, and energy to create dances.
Discussing how a choreographic ideas can be inspired by an array of sources.

Enhanced Subjects

Viewing photos and videos of the solar system to inform the creation of a dance.

Integrated Subjects

Figuring out the objects in the solar system, including planets, their moons, and asteroids, are held in orbit around the sun by its gravitational pull on them. Learning about how choreographers use time, space and energy to create dance. Students create a group dance that uses knowledge of the solar system (parts and relationships) and the dance elements or space, time, and energy.
Continuum of STEAM Instruction

Single Subject

Using standards to deepen understanding and develop mastery within the content area.

Enhanced Subjects

Using ideas and/or practices from another subject area to increase student engagement in the focal content area.

Integrated Subjects

Interdisciplinary teaching practice through which two or more subject areas are taught and assessed equitably to deepen students’ understanding of both.
Shifting Toward STEAM Integration

Phenomenon: Spiders look very different than people.

Problem: People are afraid of spiders.
Shifting Toward STEAM Integration

Alone Zone

- Can you identify big ideas or practices in two or more STEAM subjects students are using to solve the problem?
- How are these STEAM subjects intentionally working together? Give examples from the video.
- Do you see an opportunity to engage students in another STEAM subject that would support students in solving the problem?
Where does solving the problem of people thinking spiders are scary fall along the continuum?

Use your subject area expertise and examples from the video to support your thinking.
Phenomenon: The Anacostia River is not swimmable or fishable.

Problem: The Anacostia River ecosystem is unhealthy.
Shifting Toward STEAM Integration

Alone Zone

- Can you identify **big ideas or practices in** two or more **STEAM subjects** students are using to solve the problem?
- How are these **STEAM subjects** *intentionally* working together? Give examples from the video.
- Do you see an opportunity to engage students in another **STEAM subject** that would support students in solving the problem?
Where does solving the problem of the poor health of the Anacostia River ecosystem fall along the continuum?

Use your subject area expertise and examples from the video to support your thinking.
STEM Integration at Patrick Henry

Create a poster outlining an introductory plan for enhanced/integrated STEAM lessons.

Include HOW you will intentionally engage students in the practices of 2 or more STEAM subjects to solve a problem.

You may want to use diagrams such as Venn, or spider to illustrate your thinking.

Be ready to share your thinking with the group.
Article Seven Myths of STEM

Teaching Teachers

Seven Myths of STEM

By Karen Ansberry and Emily Morgan

Are you an elementary teacher challenged with integrating STEM into your already full instructional day? Are you wondering how to give equal weight to all four of the STEM disciplines, how to fit an engineering design challenge into every lesson, how to obtain all of the expensive, high-tech materials necessary to teach STEM, and how to prepare each and every one of your students to enter a career in the STEM fields? No worries … these are just a few of the many myths that surround the teaching of STEM. In this article, we share seven common myths of STEM education—and then bust those myths!

**MYTH #1:**
In every STEM lesson, the four disciplines should be equally重视

Engineering standards provide the learning framework, while reading strategies, technology, and mathematics are used as tools within this framework to support and extend student learning. It is important that the connections among the four disciplines are natural, not forced. For example, mathematics should be applied where it fits within the overall goal of the lesson (not simply to meet a mathematics objective). So, don’t worry if you are not giving all four STEM disciplines equal emphasis in every lesson.

When creating a STEM lesson, we recommend choosing standards from one or two of the STEM disciplines to serve as the focus of the lesson. Then consider where natural overlap occurs and how connections can be made to other disciplines (including reading, writing, and the arts). We like how a STEM lesson. Using this thinking ensures that the standards you have selected are being appropriately emphasized, without the lesson losing the interdisciplinary, real-world application component that is a feature of good STEM instruction.

**MYTH #2:**
All STEM lessons should include an engineering challenge that follows a standard design process. This myth can be addressed in two parts:
1. It is not necessary for every STEM lesson to include a start-to-finish design challenge. Rather, the engineering component of a lesson can be addressed in a number of ways—by simply identifying the criteria and constraints of a design challenge or problem.
Feedback Survey

Your feedback is valuable to us! We use it to provide follow-up support as well as inform choices about future professional learning opportunities.

Presenter 1: Michelle Phillips
Where this workshop took place: Patrick Henry

For Presenter 2 and Presenter 3:

Thank you for your participation!

Michelle Phillips
Education Specialist
mphillips@nsta.org
Together, we are NSTA.

Please review this session.
Algorithms and Programming

K.1 The student will construct sets of step-by-step instructions (algorithms) either independently or collaboratively including sequencing that emphasize the beginning, middle, and end.

K.2 The student will construct programs to accomplish tasks as a means of creative expression using a block-based programming language or unplugged activities, either independently or collaboratively, including sequencing, emphasizing the beginning, middle, and end.

K.3 The student will create a design document to illustrate thoughts, ideas, and stories in a sequential (step-by-step) manner (e.g., story map, storyboard, and sequential graphic organizer).

K.4 The student will categorize a group of items based on one attribute or the action of each item, with or without a computing device.
Patterns, Functions, and Algebra

K.PFA.1 The student will identify, describe, extend, and create simple repeating patterns using various representations.

Students will demonstrate the following Knowledge and Skills:

a) Identify and describe the core found in repeating patterns.

b) Extend a repeating pattern by adding at least two complete repetitions of the core to the pattern.

c) Create and describe a repeating pattern using objects, colors, sounds, movements, or pictures.
Probability and Statistics

K.PS.1 The student will apply the data cycle (pose questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on object graphs and picture graphs.

Students will demonstrate the following Knowledge and Skills:

a) Sort and classify concrete objects into appropriate subsets (categories) based on one attribute (e.g., size, shape, color, thickness).

b) Describe and label attributes (e.g., size, color, shape) of a set of objects (e.g., coins, counters, buttons) that has been sorted.

c) Pose questions, given a predetermined context, that require the collection of data (limited to 25 or fewer data points for no more than four categories).

d) Determine the data needed to answer a posed question, and collect the data using various methods (e.g., counting objects, drawing pictures).

e) Organize and represent a data set (vertically or horizontally) by sorting concrete objects into organized groups to form a simple object graph.

f) Organize and represent a data set (vertically or horizontally) using pictures to form a simple picture graph.

g) Analyze data represented in object graphs and picture graphs and communicate results:

   i) ask and answer questions about the data represented in object graphs and picture graphs (e.g., how many in each category, which categories have the greatest, least, or the same amount of data); and