Full “STEAM” Ahead: Engaging All Learners

Tiffany S. Powell, PhD
NYSRA Conference
November 12, 2017
WELCOME!
What to expect?

– This interactive session explores creative integrative, pedagogical strategies for literacy that enhances and unpacks STEAM content for elementary-middle school students.
– Participants will discuss effective ways that literacy strategies can be beneficial for engaging all learners and fostering a learning environment for access to these critical areas.
STEM is an acronym for Science, Technology, Engineering and Math education.

We focus on these areas together not only because the skills and knowledge in each discipline are essential for student success, but also because these fields are deeply intertwined in the real world and in how students learn most effectively.

STEM is an interdisciplinary and applied approach that is coupled with hands-on, problem-based learning.

http://www.cslnet.org/our-agenda/what-is-stem/
STEAM

Science • Technology • Engineering • Art • Mathematics
Entrance slip
Making connections/Communication

Estimating Fractional Amounts

Estimate the fractional part that is yellow. Turn and discuss your answer and how you figured it out with your partner.
What is Literacy?
Science
Reading + Science

Trade Books
→ Use evidence from book to develop theories
→ Especially useful in early years because there is no science textbook used
→ Fun way to introduce concepts
→ Be sure information is accurate!

Research
→ Definition hunt – research the definition of vocabulary words
→ Informational search – research concepts or an animal to learn about
→ Experiments – research experiments that are similar to what students conducted and have them compare the results of their experiment to the one they researched
Writing + Science

Science Inquiry

→ using evidence to create explanations/justify explanations
→ connecting to prior knowledge
→ Recording Predictions (model sentence structure i.e. “I think...because...”)
→ Observation notes (incorporate graphic organizer to organize writing)
→ Writing Conclusions (reflect on the experiment!)
Take Away’s

Unaware of

- studies show trade books positively affect self-esteem/social skills – How do they do this?

Interesting to learn

- that trade books generally have more up to date information than a science textbook
- Story line of a trade book enhances student understanding & memory of concept
What If There Were No Bees?

A Book about the Grasslands Ecosystem

By: Suzanne Buckingham

Grade Level: 2-4
Concept: Honeybees are significant to our ecosystem

**Reading Activities**

→ **Partner reading** – Read the book with a partner, taking turns reading each page. Provide students with questions to help guide a discussion between the partners.

→ **Vocabulary Counting** – Use a chart to record the number of times you see each vocabulary word in the story. This can be done through an independent read or a group read.

→ **Research** – Select a specific bee type and research it to learn more about it.

**Writing Activities**

**Honey Sampling** – Have students taste test a variety of honey types and write to describe the taste of each one.

**Bee Observation** – Have students observe bees and record their observations. They can write about their observations and why they think the bees were doing certain things.

**Research!** – Have students research another type of insect. Compare and contrast bees and the insect of their choice. Use a venn diagram to help organize information prior to writing.

Why do we need bees? – Write out a list that explains why we need bees!

What If There Were No Bees?

A Book about the Grasslands Ecosystem

By: Suzanne Buckingham

Grade Level: 2-4

Concept: Honeybees are significant to our ecosystem

**Reading Activities**

→ **Partner reading** – Read the book with a partner, taking turns reading each page. Provide students with questions to help guide a discussion between the partners.

→ **Vocabulary Counting** – Use a chart to record the number of times you see each vocabulary word in the story. This can be done through an independent read or a group read.

→ **Research** – Select a specific bee type and research it to learn more about it.

**Writing Activities**

**Honey Sampling** – Have students taste test a variety of honey types and write to describe the taste of each one.

**Bee Observation** – Have students observe bees and record their observations. They can write about their observations and why they think the bees were doing certain things.

**Research!** – Have students research another type of insect. Compare and contrast bees and the insect of their choice. Use a venn diagram to help organize information prior to writing.

Why do we need bees? – Write out a list that explains why we need bees!
Technology
What is technology anyway?  
https://www.youtube.com/watch?v=Giiz81_uzK8
Technology

Student Standards
- Creativity and Innovation
- Communication and Collaboration
- Research and Information Literacy
- Communication and Collaboration
- Critical thinking, Problem Solving and Critical Thinking

Teacher Standards
- Facilitate and inspire student learning and creativity
- Design and develop digital age learning experiences and assessments
- Model digital age work and learning

Reference: http://www.iste.org/resources
Faces of Technology

– 10 Awesome Latino Inventors

http://www.huffingtonpost.com/2013/05/16/10-awesome-latino-inventions_n_3288733.html
Engineering
Engineering

What comes to your mind when you think of “Engineering”?

https://www.youtube.com/watch?v=owHF9iLyxic
Engineering Design Process

1. Define the Problem
2. Brainstorm
3. Research
4. Develop Ideas
5. Model or Prototype
6. Test & Evaluate
7. Communicate Results

Civil
Computer
Electrical
Nuclear
Software
Mechanical
Chemical
Getting Students Geared Up for Engineering?

- The Minority Gap:  
  https://www.youtube.com/watch?v=-NNW8gsMTqo
- Introducing Ursula Burns-Mechanical Engineer  
  https://www.youtube.com/watch?v=LHHBtB2B5X4  
  https://www.youtube.com/watch?v=WOIoSjAQ2t0  
  https://www.youtube.com/watch?v=tNIL-b8iv-Q
Arts
What do you mean by the arts?

- Music
- Art (drawing, artistic process)
- Movement (Dancing)

Your Experience:

- In what ways have you experienced the integration of the arts in your personal education?
- What are your thoughts/perspective on how you can integrate the arts? Do you have apprehensions? Why/why not?
Arts Education
(Smith, 2009)

– "Art does not solve problems, but makes us aware of their existence" Magdalena Abakanowicz, Sculptor
– Arts education, on the other hand, does solve problems.
– Involvement in the arts is associated with gains in math, reading, cognitive ability, critical thinking, and verbal skill.
– Arts learning can also improve motivation, concentration, confidence, and teamwork.
Q & A

Q: What are the benefits to Arts Integration?
A: Studies have shown the many positive effects of an arts-rich school environment on both students and teachers, such as higher job satisfaction for teachers, enhanced critical thinking and problem solving skills in students, along with the ability to make stronger, meaningful connections between academic disciplines, the outside world, and to everyday life. Research has also revealed the positive impact that a strong arts curriculum has on learning in other academic subjects, attitudes, and behaviors among pre-school, general K-12, and at-risk students. The act of artistic creation is critical to students’ biological, emotional, and cognitive development.

Q: How do I get started?
A: Visit the NYS Arts Learning Standards, NYS Learning Standards online for information about the arts and academic area you would like to integrate with the arts. Then meet with fellow teachers to discuss the difficulties they have encountered in teaching certain topics to their students. This is the first step in brainstorming for ideas on content to integrate with the arts.
The Standards

- There are learning standards for the ARTs and these include: dance, music, theatre and visual arts
  - Elementary Level: All Four Discipline Areas
  - Intermediate Level: Two of the Four Discipline Areas
  - High School/Commencement Level: One of the Four Areas
The Four Disciplines

Standard 1 - Creating, Performing, and Participating in The Arts
- Students will actively engage in the processes that constitute creation and performance in the arts (dance, music, theatre, and visual arts) and participate in various roles in the arts.

Standard 2 - Knowing and Using Arts Materials and Resources
- Students will be knowledgeable about and make use of the materials and resources available for participation in arts in various roles.

Standard 3 - Responding To and Analyzing Works of Art
- Students will respond critically to a variety of works in the arts, connecting the individual work to other works and to other aspects of human endeavor and thought.

Standard 4 - Understanding The Cultural Dimensions and Contributions of The Arts
- Students will develop an understanding of the personal and cultural forces that shape artistic communication and how the arts in turn shape the diverse cultures of past and present society.
Arts Education

– Integration that Impacts Learning (video):
http://www.edutopia.org/stw-arts-integration-video
A lesson without the opportunity for learners to generalise is not a mathematics lesson.

- J Mason, 1996, p.65

http://math4teaching.com
Literacy Connection

Half and Halving

Doubling

Time

Share

https://www.youtube.com/watch?v=d8b0brKPf_g
Mathematical Processes

3. Construct viable arguments and critique the reasoning of others.
   – Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions.
   – Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades.
   – Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.
5 Components for Building Math Vocabulary

- Modeling
- Discourse
- Multiple Representations
- Writing
- Assessment
Modeling

- Teachers intentionally use **targeted vocabulary** within a **meaningful** context
- Taking opportunities to “**revoice**” the student’s informal language with the formal mathematical terminology
Teachers orchestrate activities and pose questions that elicit student “talk about” math ideas as they arise during the lesson.

Example: The teacher writes to fractions on the board (1/2 and ¾) and asks: “Are these two fractions “equivalent”?”
<table>
<thead>
<tr>
<th>Informal Vocabulary</th>
<th>Formal Mathematical Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split</td>
<td></td>
</tr>
<tr>
<td>Take Away</td>
<td></td>
</tr>
<tr>
<td>Slide</td>
<td></td>
</tr>
<tr>
<td>Turn</td>
<td></td>
</tr>
<tr>
<td>Flip</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td></td>
</tr>
<tr>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>More</td>
<td></td>
</tr>
<tr>
<td>Less</td>
<td></td>
</tr>
<tr>
<td>Holds</td>
<td></td>
</tr>
<tr>
<td>Cross</td>
<td></td>
</tr>
</tbody>
</table>
Multiple Representations

- Teacher uses various instructional tools (i.e., graphic organizers and displays) to reinforce targeted vocabulary.
Students use the targeted vocabulary to reflect on and organize their thoughts around related mathematical ideas—i.e.: journals, justifying solution strategies, etc.

<table>
<thead>
<tr>
<th>I thought</th>
<th>I wrote</th>
</tr>
</thead>
<tbody>
<tr>
<td>I need to find the perimeter — add all the sides</td>
<td>$115 + 15 + 115 + 15 = 380$</td>
</tr>
</tbody>
</table>
Assessment

Teacher uses informal observation and formal assessment tools to determine the depth to which the student understands and explains his/her understanding using the targeted vocabulary.
Building a Bridge

The 5 components for ‘scaffolding: formal mathematical vocabulary are not necessarily sequential. Instead, they are recursive and ongoing.

- Multiple Representations
- Discourse
- Writing
- Modeling
- Assessment

Informal Language

Where students start

Formal Vocabulary

Destination
APPLICATION
<table>
<thead>
<tr>
<th>Math Concept:</th>
<th>1. Integrated Thematic Topic:</th>
<th>Technology Concept:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Essential Questions:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Essential Academic Terms:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Learning Outcomes/Objectives:</td>
<td></td>
</tr>
<tr>
<td>Science Concept:</td>
<td>5. Assessment:</td>
<td>Engineering Concept:</td>
</tr>
</tbody>
</table>

**Guiding Questions for Project-Based or Inquiry-Based Activities:**

- What is the problem (question) that needs to be solved (answered)?
- Who has the problem (question)?
- Why is this problem (question) important to solve (answer)?
“STEAM”
Thematic Approaches

– Divide into small groups
– Investigate the THEME through the lens of STEAM
– Brainstorm instructional elements related to the THEME
– Be prepared to share your thinking with the rest of the group
STEAM Congress

- Make comparisons
- Question the connections
- Make conjectures
- Compare to the THEME you selected
Thank You!

Tiffany Powell
Email: drtiffanypowell@gmail.com