November 9, 2015

Broadening Conceptions of Writing in the Science Classroom
AAPT eMentoring Webinar
8:00 EST (5:00pm PST)

tinyurl.com/aapt110915
#AAPTK12

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Webinar Overview
Join this one-hour webinar about writing and literacy in science classrooms. Teachers will discuss ways in which writing can be used to support development of conceptual understanding of core disciplinary ideas in science, to engage students in the practices of doing science, and to provide opportunities for students to use science knowledge and practices as members of classroom, local, and global communities. This webinar will also include a brief overview of the Common Core State Standards for ELA Reading and Writing in the Sciences and Technical Subjects.
ENGAGE
Take a look at the documents and links below.

What do these documents have in common? What’s different about them?

| Diagrams of optical phenomena, including the rainbow, the double Icelandic spar, and prism refraction, Isaac Newton, 1704 | Image 21 of Notebook by Alexander Graham Bell, from 1875 to 1876 | Light consumes coal - Save light, save coal, United States Fuel Administration, 1917 |
EXPLORE
Think about your own classroom…

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What</strong> are students writing?</td>
<td><strong>Who</strong> is the intended audience?</td>
<td><strong>Why</strong> are students writing? (purpose)</td>
<td><strong>When</strong> are students writing?</td>
<td><strong>Where and how</strong> is the writing shared?</td>
</tr>
<tr>
<td>Answers, questions, observations, thoughts, ideas, rebuttals.</td>
<td>Instructor, classmates, themselves.</td>
<td>To explain, to justify, to flesh out their ideas and findings. To record their questions, and answers received.</td>
<td>During and after lab experiments; on assignments; during boarding.</td>
<td>In class during boarding discussions.</td>
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<tr>
<td>labs, explanations, answers to conceptual questions, procedures for labs</td>
<td>teacher, AP readers (AP Physics 1 Test has lots of Writing!)</td>
<td>To show an understanding of scientific concepts</td>
<td>for labs and on tests</td>
<td>labs are shared in report form or on tests</td>
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<tr>
<td>definitions, diagrams, abstracts, lab notebooks, whiteboards</td>
<td>their peers (and me)</td>
<td>mostly: to figure out their own ideas; somewhat: to share and vet those ideas; somewhat: to critique others’ ideas</td>
<td>always - in their lab notebooks, whiteboards, homework</td>
<td>usually in class. sometimes in a google doc with their peers. rarely outside of the class.</td>
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<tr>
<td>lab reports, research papers</td>
<td>Teacher, classmates</td>
<td>To express their understanding of concepts; to argue their opinion</td>
<td>Assessment, after labs</td>
<td>Labs are sometimes collaborative with Google Docs</td>
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<tr>
<td>lab reports; justification on tests; quizzes; thinking problems at the</td>
<td>peers and teacher and self</td>
<td>To share data and think about what graphs from labs tell us; to</td>
<td>In class; Homework; on tests/quizzes; to communicate with</td>
<td>whiteboard info is shared with everyone in a circle; tests/quizzes</td>
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<td></td>
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</tr>
<tr>
<td>Activity</td>
<td>Type</td>
<td>Description</td>
<td>Where/How</td>
<td>Comment</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
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<tr>
<td>beginning of class</td>
<td>discussion</td>
<td>(predictions); writing on the board; whiteboarding lab data and problem sets; taking notes</td>
<td>online</td>
<td>on papers handed in to me; sharing problem solving with peers in class</td>
</tr>
<tr>
<td>Lab reports; Cornell notes; real life examples</td>
<td>discussion</td>
<td>self; teacher; peers</td>
<td>in notebooks</td>
<td>only with teachers and perhaps with peers</td>
</tr>
<tr>
<td>explanations of experiments</td>
<td>discussion</td>
<td>peers, teacher</td>
<td>in notebooks</td>
<td>on whiteboards, in notebooks</td>
</tr>
<tr>
<td>Free response questions, experimental conclusions</td>
<td>discussion</td>
<td>Teacher, AP readers (eventually), classmates</td>
<td>in notebooks</td>
<td>Not shared (except for with me), unless it’s through whiteboarding sessions...which typically isn’t a lot of writing - it’s more speaking.</td>
</tr>
<tr>
<td>Lab reports; lab summaries; paragraph questions; graphic organizers</td>
<td>discussion</td>
<td>Students; teachers</td>
<td>in notebooks</td>
<td>Google docs, peer editing; pass around; in science journals, on whiteboards</td>
</tr>
<tr>
<td>Summaries and QCERRS - Question, Claim, Evidence,</td>
<td>discussion</td>
<td>The teacher, team members, and other class members</td>
<td>in notebooks</td>
<td>Self reflection, Team reflection, Peer Reflection and Teacher</td>
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<tr>
<td></td>
<td></td>
<td>Important to be able to communicate clearly in science and this format</td>
<td>in notebooks</td>
<td></td>
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What do you notice? Are there patterns?
- Lots of writing for people in the room… and AP readers, but maybe not for others outside the classroom.
- A lot of writing around labs, but not in other areas - problem solving, exams, etc.
- Some people have said “write to figure out what they know” some people have said “write to show what they know” how are those two writing experiences similar or different?
- Lots of whiteboarding!!! Yay!
- Writing for the teacher
- writing for tests and labs
Here are some ways we’ve been thinking about writing in the science classroom:

**Related considerations:**

- When is writing scientific? When is it not? And when might non-scientific writing be appropriate in a science classroom?
- What are the expectations for students in the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS)?
- How might this framework relate to teaching a diverse range of students?
- Both CCSS and NGSS push students to make arguments from evidence. How does this fit with the framework?
- What role does educational technology play?
TYPE V
Support factual recall and development of academic and disciplinary vocabulary

(Think: mode, genre, audience, purpose, medium)
★ Classroom
★ Student and teachers

Examples:
● Semantic feature analysis charts
  ○ Examples from middle school science: States of matter, classification, cells, precipitation
● Frayer model
  ○ Teacher blog post: Frayer models for science (To the Square Inch)
● Other examples? (comment here)

CCSS Literacy in Science and Technical Subjects:
⇒ CCSS.ELA-LITERACY.RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

**Modify conceptual understanding and mental models of disciplinary core ideas and crosscutting concepts in science**

(Think: mode, genre, audience, purpose, medium)
- ★ To express their understanding of concepts
- ★ To help clarify understanding
- ★ demonstrate understanding of principles
- ★ Located mainly in the classroom
- ★ Created for others in the classroom and the teacher

Examples:
- Inquiry-based learning and discrepant events as a starting point for writing and making visible mental models
  - Video: Physics: The Cartesian Diver (Teaching Channel)
  - Video: Good Thinking! Conceptual Change: How New Ideas Take Root (Smithsonian Institute)
  - Video: Good Thinking! Fired Up About Energy (Smithsonian Institute)
- Open-ended responses, constructed responses, and formative assessment
  - Example student and teacher page: Just Rolling Along (NSTA)
- Other examples? (from participants)
  - NTIPERS
  - Elicitation Questions (a la Diagnoser Tools)

**CCSS Literacy in Science and Technical Subjects:**

➔ CCSS.ELA-LITERACY.RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Engage in scientific practices as participants in a scientific community


(Think: mode, genre, audience, purpose, medium)

Examples:
- Inquiry-based learning, labs, lab reports, and lab notebooks
- Model-based learning
- Science fair
- Reading, summarizing, analyzing, and reflecting on scientific writing
  - Jigsaw activity
  - Whiteboarding summaries
  - Argument Driven Inquiry style lab reports.

NGSS Performance Expectations: Physical Science:
- **HS-PS2-5.** Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
- **HS-PS4-1.** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

CCSS Literacy in Science and Technical Subjects:
- **CCSS.ELA-LITERACY.RST.11-12.2.** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **CCSS.ELA-LITERACY.RST.9-10.9.** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
Draw upon science and engineering to participate within and contribute to a community beyond the scientific community (classroom, local, global, cultural)

(Think: mode, genre, audience, purpose, medium)
★ Purposes outside of the discipline of science (for art, policy, business)
★ Enter into debates and discussions
★ Working toward social justice

Examples:
● STEAM, STREAM, STR²EAM, STEM-C
  ○ Making movies about science concepts
    ■ Making Molecular Movies (NSTA)
    ■ The Special Theory of Relativity (Breakthrough Junior Challenge)
● Making, fab labs, and makerspaces
  ○ 13 Year old invents braille printer with legos
● Place, project-, and problem-based learning (P³BL)
  ○ How I teach kids to love science (TED Talk)
  ○ Wearables: Teaching Physics with Felt (Edutopia)
  ○ Designing a better wheelchair (Tufts University)
● Interdisciplinary units with colleagues in other disciplines
● Career and Technical Education (CTE) integration

CCSS Literacy in Science and Technical Subjects:
→ CCSS.ELA-LITERACY.RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.


Share practices with others as a reflective practitioner or teacher researcher

(Think: mode, genre, audience, purpose, medium)

Examples:
- Blogging and publishing online
  - Primary Sources in Science Classrooms (Library of Congress)
  - Making the Most of Mitosis (Philadelphia Writing Project)
  - Quantum Progress
  - Physics! Blog!
  - Newton’s Minions
- Writing for periodicals and books
- Presenting at conferences


**TESTING THE FRAMEWORK**

Let’s consider the framework in light of some concerns related to teaching and learning science?

### Q6
How might this framework—and the uses of different genres of writing—affect diverse ranges of learners?

- Video: *Why aren’t girls taking physics?* (Teaching Channel)
- Video: *Full interview on how language, identity, and cognition impact students’ learning* (Stanford University)
- Chapter 8: *Students with Disabilities and the Next Generation Science Standards* (NSTA)


### Q7
In what ways are arguments and evidence (an emphasis in NGSS and CCSS) used in the writing students do? In what ways are arguments different in science compared to other disciplines?

- Compare (A) analyzing data to understand thermodynamics with (B) analyzing data to advocate for a specific energy policy.
- Key idea: argumentation is different in different disciplines; science classrooms should teach students about scientific argumentation but may also choose to engage students in different kinds of argumentation that would be appropriate in other disciplines and non-science settings → However, students should learn the differences and should be able to argue in science

### Q8
How might educational technology support the 3 types of writing outlined in the framework?
- Google docs support access and collaboration *(Digital Is, National Writing Project)*

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### Q9
In what ways does this framework fit with other frameworks for designing classroom learning?
- Connected Learning Framework *(Digital Media & Learning Research Hub)*
- Rigor and Relevance Framework *(International Center for Leadership in Education)*
- 4MAT *(About Learning)*
- Partnership for 21st Century Learning

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### Q10
How does framework help us make sense of example lessons?
- History of Atomic Theory Social Media Project

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### Q11
Is one type of writing described in the framework better than the other types? Should I incorporate all three types into every lesson? Can Type 1 be taught without Type 2?
- All three types have the potential to engage different kinds of learners in different ways.
- NGSS primarily addresses a combination of Type 1 and Type 2 writing (in combination called 3-dimensional learning that simultaneously engages disciplinary core ideas, crosscutting concepts, and science and engineering practices).
- CCSS leaves room to engage with Types 1, 2, and 3.

**USING THE FRAMEWORK TO DESIGN LEARNING EXPERIENCES**

How might the infusion of writing extend / improve / deepen this assignment?

Speakers from Paper Plates (Museum of Science, Boston)

Video: Rockin' Paper Plate Speaker

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<td>Drawing upon science and engineering to participate within and contribute to a community beyond the scientific community (classroom, local, global, cultural)</td>
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- Explain how/why the cone modifies sound.
- How do the physics concepts help explain how it works? Draw a diagram and explain the energy transformations

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</tr>
</thead>
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<td>Engineering notebooks: Keeping track. What works? What doesn’t?</td>
<td>Explain the PURPOSE. IF you were stuck on an island</td>
</tr>
<tr>
<td>Experimental procedures - description of process after collaboration with classmates.</td>
<td>Create an advertisement to sell your speaker while explaining why it is superior to others</td>
</tr>
</tbody>
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- PREDICT what happens if you make your cone narrower or wider? Test it. Describe what happened.