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All Kinds of Text: Investigating a Phenomenon Through Multimodal Media

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Explanations about real-world phenomena are frequently challenging for students in this time when they can ask Siri or Google for the answer to a question like, “How far away is the moon?” Many of the worthwhile scientific questions are more complex, dependent on numerous conditions, subject to individual interpretations, and requiring attention to the credibility of the resource that is answering the question. The typical approach of elementary and middle school learners to an informational text is an open-ended or exploratory one in which they read a text with attention to the main idea and supporting details. The purpose of reading is usually for the learner to look at explanations of concepts, facts, and ideas in these expository texts. In this article, we approach text using the Next Generation Science Standards (NGSS) Science and Engineering Practice of Obtaining, Evaluating, and Communicating Information to interact with a variety of information sources with the purpose of investigating a phenomenon.

***Keywords*: multimodal text, universal design, Next Generation Science Standards, phenomenon**

> *When we moved to our new house, I planted a garden, and I got some plants that I could use to make salsa. I bought some jalapeno pepper plants, some tomato plants, and a cilantro plant. But the one I was really excited about was a tomatillo! This plant would give me some delicious green fruit that I could use to make salsa verde. I planted the tomatillo near the tomatoes and peppers in a raised planter bed, and it grew quickly with regular watering in the warm spring air of central California. Soon the plant had spread out a lot in a sort of “viney” way, and had lots of yellow flowers, which the bees enjoyed visiting. I had flowers and pollinators, so the tomatillos couldn’t be far behind. Little did I know, there would be no fruit on these plants. Despite the best suggestions of my friends, such as “hit the stems with a stick to loosen the pollen,” and “use a little paint brush to transfer the pollen from one flower to another,” not one fruit ever set. What had I done wrong?*

The situation I describe is an authentic one that I experienced and later shared with my preservice elementary teachers in the science methods class I teach. It is presented as an example of a *phenomenon* that learners can investigate using the Science and Engineering Practices (SEPs) of the Next Generation Science Standards (National Research Council, 2013). Specifically, this activity makes use of SEP 8, Obtaining, Evaluating, and Communicating Information.

In this practice, learners engage in communication skills, including critical review of information about science, considering important ideas and potential sources of error. They

duplicate the actions of practicing scientists by synthesizing numerous information sources, while considering the relevance and value of each in the communication of a conclusion or explanation.

The lesson presented in this article focuses on these specific components of SEP 8 at the Grade 6-8 developmental level:

- Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.
- Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.
- Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations (NGSS Lead States, 2013, Appendix F, p. 15).

A typical way for learners to obtain information is from reading informational text to develop connections for making sense of phenomena (Krajcik & Sutherland, 2010). These formal content sources, such as traditional textbooks, may be lacking in modes of representation other than words (CAST, 2018.). I approach text in this activity with a more inclusive and multimodal definition, agreeing that "students' primary texts may be the physical world itself as they read landscapes, internal organs, lunar phases, or cells underneath a microscope" (Alvermann & Wilson, 2011, p. 118). My list of multimodal texts that learners explore in order to make sense of the phenomenon includes web pages, drawings, photographs, videos, blogs, and even a live interview. The activity aligns readily with the three dimensions of the *Next Generation Science Standards* (Table 1) and Common Core State Standards for Literacy.

Table 1

Next Generation Science Standards dimensions aligned to the tomatillo lesson.

PE: MS-LS1-4 From Molecules to Organisms: Structures and Processes–Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.		
SEP8: Obtaining, Evaluating, and Communicating Information SEP6: Constructing Explanations and Designing Solutions	DCI LS1.B: Growth and Development of Organisms–Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	CCC: Structure and Function

Table 2

Common Core English Language Arts Standards relevant to the tomatillo lesson.

Research to Build and Present Knowledge: CCSS.ELA-LITERACY.WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation (California Department of Education, 2011, p. 89).
Integration of Knowledge and Ideas: CCSS.ELA-LITERACY.RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic (California Department of Education, 2011, p. 89).

The Phenomenon

Rather than confirming a scientific principle like conservation of momentum or gathering information on a disciplinary topic like the water cycle, this investigation engages learners in examining a phenomenon. Penuel and Bell (2016) advocate for the coherence of instruction when learners confront "anchor" phenomena, including these selected characteristics:

- Builds on authentic personal or family experiences.
- Observable to students. "Observable" can be with the aid of scientific procedures (e.g., in the lab) or technological devices to see things at very large and very small scales (telescopes, microscopes), video presentations, demonstrations, or surface patterns in data.
- Can be a case, something that is puzzling, or a wonderment.
- Has relevant data, images, and text to engage students in the range of ideas students need to understand. It should allow them to use a broad sequence of science and engineering practices to learn science through first-hand or second-hand investigations.
- Has an audience or stakeholder community that cares about the findings or products (Penuel & Bell, 2016).

The phenomenon learners investigate in this activity concerns the growing, flowering, but non-fruiting tomatillo described in the introduction, which satisfies many of these attributes.

Tomatillos are a plant in the nightshade family with a small fruit, usually green. They are sometimes called husk tomatoes, due to the papery pouch in which the fruit grows. The majority of elementary learners in California's Central Valley are of Hispanic heritage, and the ingredient of tomatillos in salsa verde is familiar to them. Also, many families work in agriculture, so there are frequently rich funds of knowledge that learners bring into the classroom from the experiences

of siblings, parents, and grandparents. Many features of the "life cycle" of a tomatillo can be explored through physical examination, including "dissecting" the fruit and viewing the flower and husk through a magnifier. The puzzle of "so many flowers, why no fruit?" presents an authentic challenge for learners to solve, and the answer is not found with a simple online search. Instead, learners need to consider multiple sources of information and make decisions about the relevance, accessibility, and credibility of those sources. The activity begins with a brief presentation from the gardener (me) about the tomatillo failure.

The Texts

Learners work in small groups of two or three to explore the texts. They are discouraged from asking "why" questions and instead create a set of collaborative notes that record the questions asked of each text and where the answers located. They are also encouraged to take note of the words they encounter that seem relevant or important to the phenomenon. After working on the first text for a few minutes, groups are selected to share their findings with the whole class. The discussion emphasizes the questions that the text was able to answer, with learners recognizing that the phenomenon question (Why wasn't there any fruit?) will require more and different kinds of texts to construct an explanation. I also record the important words they have identified, and then move on to the next text.

Figure 1

Honeybee (Apis mellifera) visits tomatillo flowers.

(Dartrider, 2015)

Here is the list of multimodal texts learners explore:

1. Graphic of a tomatillo plant from the label of a packet of tomatillo seeds. The image provides some brief information about planting (after the last spring frost) and harvesting (65 days from transplanting).

2. Picture of a bee and tomatillo flowers, showing the pouch the tomatillo grows in (Figure 1).
3. Link to an article about tomatillos (https://en.wikipedia.org/wiki/Tomatillo).
4. A list of garden-related online resources (select 1):
    a. Bonnie Plants Growing Tomatillos website (https://bonnieplants.com/how-to-grow/growing-tomatillos/)
    b. My Gardener's Path: How to Grow and Harvest Tomatillos (https://gardenerspath.com/plants/vegetables/tomatillos/)
    c. Gardening Know How–Empty Tomatillo Husks (https://www.gardeningknowhow.com/edible/vegetables/tomatillo/empty-tomatillo-husks.htm)
    d. Houzz Discussion Board–Tomatillos tons of flowers . . . No fruit? (https://www.houzz.com/discussions/1485346/tomatillos-tons-of-flowers-no-fruit)
5. YouTube video of a gardener talking about how tomatillos grow (https://youtu.be/hX5_kpAQ7Fc)
6. Dissection of a tomatillo. Learners have tomatillos, tomatillo flowers, plastic knives, forks, toothpicks, magnifiers, and paper plates. They are encouraged to cut into the tomatillos, examine under magnification, and make drawings of what they observe.
7. Interview with the gardener (me). I also show a couple of actual photographs of my garden, identifying the tomatillo plant. I encourage the learners to ask questions about my gardening practices, based on what they have discovered from the other texts.

After all of the texts have been explored, learners are directed to construct an explanation of the phenomenon.

The Explanation

To address the mystery of the non-fruit bearing tomatillos, learners engage in the Science and Engineering Practice of Constructing Explanations. This practice asks learners to consider "describe phenomena," use "models or representations," and "apply scientific ideas, principles, and/or evidence to construct, revise, and/or use an explanation for real-world phenomena" (NGSS Lead States, 2013, Appendix F, p. 11),

Learners make decisions about the communication of their explanations, selecting an appropriate mode of action and expression to demonstrate their understanding (CAST, 2018). These modes of communication may include textual, kinesthetic models, visual presentations, and other designs approved by me.

Table 3

Selected questions about the texts.

Text	Questions to Ask	Questions Remaining	Words Encountered
Tomatillo graphic	What does a tomatillo plant look like? What does the fruit look like? What are some of the growing conditions? When is the fruit ready?	How big is the plant? Does it produce fruit like other plants (tomatoes, peppers)?	Warm season Transplanting
Bee picture	How big is a tomatillo flower? Are bees attracted to the flowers? Where on the plant does the fruit grow?	What function does the bee have with the tomatillo? What is the connection between the flower and the fruit?	Pollen

More Phenomena, More Texts

This learning activity models the use of multimodal texts to investigate a phenomenon for preservice teachers therefore, the next step is to engage those future teachers in the construction of their own lessons. Phenomena for exploration include the variety of objects that wash up on a beach, the rotting of a jack-o-lantern, and the movement of sunflowers.

This approach to interrogating the text for specific answers situates the learner as an investigator, rather than more traditional assignments with a purpose to "explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why" (California Department of Education, 2013, p. 15); often a summary of the provided text. The affordances of this lesson design provide rich opportunities for authentic investigation and connection to learners' funds of knowledge, powerful access points for NGSS.

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