Constructing Explanations

BOSTON Public Schools
Focus on Children

Agenda

1. Introduction to “Constructing Explanations”
2. Constructing Explanations Activity
3. Examine Student Work
4. Reflection on Current Instruction

Introduction to “Constructing Explanations”

- The focus of this module is on the practice of “constructing explanations and designing solutions”
  - Constructing explanations pertains to science, while designing solutions pertains to engineering

- Page 104 of the 2016 MA STE Standards explains:
  - *The goal of science is to construct explanations for the causes of phenomenon. Students construct their own explanations, as well as apply standard explanations they learn about through instruction.*

Introduction to “Constructing Explanations”

- Page 104 of the 2016 MA STE Standards continued…
  - *The NRC Framework states the following about explanation: “The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories” (NRC, 2012, p. 52).*
  - *An explanation includes a claim that relates how a variable or variables relate to another variable or set of variables. A claim is often made in response to a question, and in the process of answering the question, scientists often design investigations to generate data.*

Introduction to “Constructing Explanations”

Discussion Questions:

- How is this definition similar to and/or different from how your students construct explanations?
- What are some specific examples of how your students have constructed explanations in the past?

Constructing Explanations Activity

A scientific explanation has three key components:

- Claim – a clear answer to a question about *how* or *why* a phenomenon occurs
- Evidence – data (measurements or observations) that support the claim being made
- Reasoning – an explanation of why the evidence supports the claim, which often includes scientific principles

Constructing Explanations Activity

- This activity targets the following standard:
  - Use evidence to construct an explanation relating the speed of an object to the energy of that object [MA 4-PS3-1]

- We will be using data collected from an investigation that used spool racers to explore how energy enables objects to move

- If you do not know what spool racers are, watch this brief video (click here), which illustrates how spool racers are made and how they work

Source of image: pbskids.org/zoom

Constructing Explanations Activity

Two scientific principles to understand when making sense of this data are:

- Kinetic energy – energy of objects in motion
- Potential energy – stored energy, which can take on many forms (e.g. gravitational, chemical)

***Note:** Potential energy can be converted into kinetic energy. For example, a book on a shelf has potential energy. If the shelf collapses and the book falls, the potential energy of the book converts to kinetic energy.*

Source: http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsplcar/potential-and-kinetic-energy-spool-racer/

Constructing Explanations Activity

The Task:

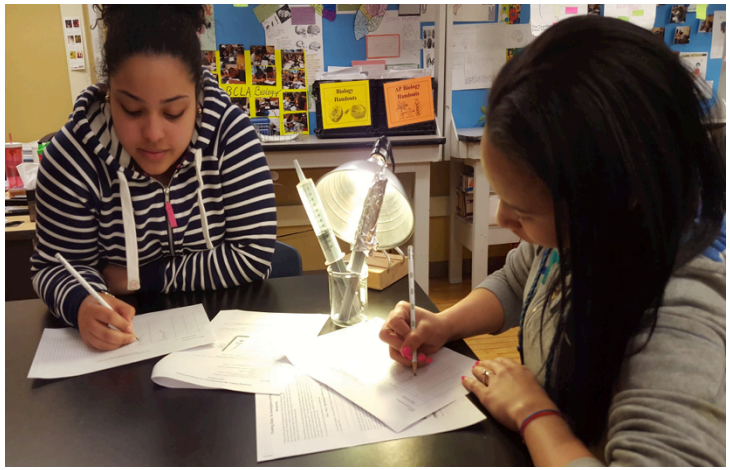
- Use the data from the spool racer investigation to write an explanation that answers - *What happens when you change the number of twists (i.e. winds) in the rubber band? Explain why this occurs.*
- Once you are done, share your explanation with someone else. How are they similar? How are they different?

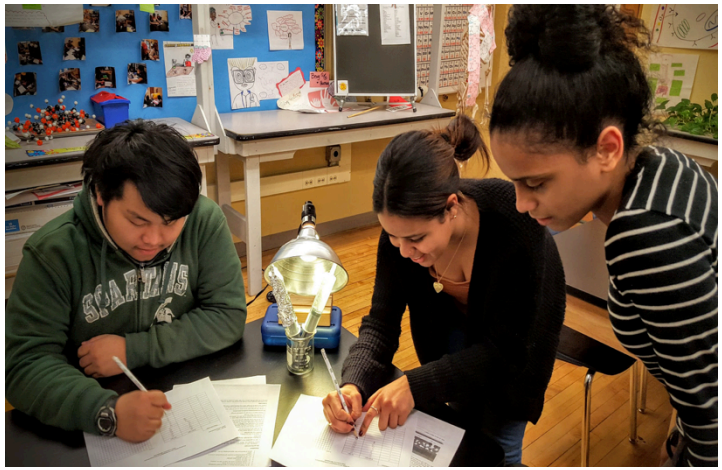
Discussion Questions:

- How was your explanation similar/different from the explanation of the person you shared with?
- Where parts of the explanation (claim, evidence and/or reasoning) easier or more difficult than others? Why?
- How could you envision your students engaged in this science practice? What challenges might they have? How would you address them?

Examine Student Work

We will now examine students' written explanations. This work came from a high school biology classroom in which students engaged in a photosynthesis laboratory activity to explore the question – *How do leaf disks respond to exposure to light?*

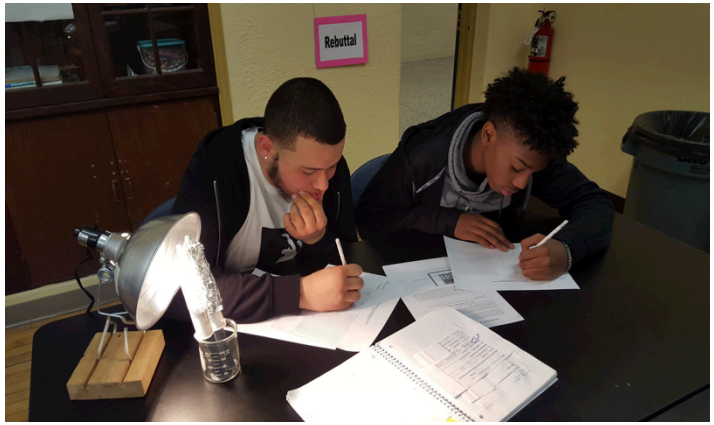




Examine Student Work

The Context:

- Leaf discs were submerged in water with dissolved carbon dioxide and exposed to light. The control for this experiment was a syringe wrapped in foil (no light control). As a result of light exposure, leaf discs produced oxygen which caused them to float. Students collected and graphed their data.
- As an assessment, students were asked to write scientific explanations using their data from the lab.
- **Note: If you want more information about the lesson plan from which this activity came from, see the Photosynthesis Disk Lab handout*



Examine Student Work

The Task:

- Read through the sample student explanations, where they responded to the prompt – *How do leaf disks respond to exposure to light?*

- Annotate these written explanations, identifying the claim, evidence and reasoning. Remember:
  - Claim – a clear answer to a question about *how* or *why* a phenomenon occurs
  - Evidence – data (measurements or observations) that support the claim being made
  - Reasoning – an explanation of why the evidence supports the claim, which often includes scientific principles

- Once you are done, share your annotations with the whole group or with another teacher.

Examine Student Work

Discussion Questions:

- What similarities and differences did you observe in the manner by which students wrote their scientific explanations?
- What do you see as a benefit of using the claim-evidence-reasoning structural format to help students write scientific explanations?
- What other supports might your students need to engage in this science practice?

Reflection on Current Instruction

Think-pair-share:

- Now that you have a better understanding of this science practice, to what extent do you think your students have opportunities to construct explanations in your classroom?
- What are some barriers that you feel interfere with your ability to provide opportunities for students to construct their own scientific explanations?
- What are some ways you might address and overcome these barriers?