Practicing Groupwork Skills to Construct Scientific Explanations

Unit Essential Question

How do we work productively in groups?

Introduction

Science is about understanding the natural world. Scientists try to explain how and why things happen in the nature. To answer questions, scientists gather evidence by observing carefully, conducting tests, and gathering information. Scientists ask questions and work on problems like these:

- Why are polar bear populations rapidly declining?
- How and why does a star burn out?
- How can we combat the Zika virus?

In this task, students will apply the productive groupwork Behavior Norms learned in the previous four tasks to understand how scientists explain phenomena and events that occur in the natural world. Students will practice constructing scientific explanations using simple questions and predetermined claim, evidence, and reasoning statements. The practice of making claim, evidence, and reasoning statements is not an easy task. Students will have many opportunities to practice using claim, evidence, and reasoning statements over the course of the year.

Objectives

Students will be able to

- Identify the parts of a scientific explanation: claim, evidence, and reasoning.
- Match a scientific question to appropriate claim, evidence, and reasoning statements.
- Evaluate the quality of the scientific explanation.
- Give reasons for their suggestions when matching the statements to the scientific questions.

Academic Vocabulary

- claim
- evidence
- reasoning
- justify
- scientific explanation
- refute

Language of Instruction

- match
- construct
- observation
- data

NOTE

The process of creating scientific explanations is an ideal time to introduce academic language. Students will quickly see that more precise use of words will help their scientific explanations be easier to understand and defend. For example, instead of saying "it got hotter," they can say "the temperature rose 20 degrees."

Timing

This task can be completed in 2 class periods (based on 45-minute periods).

- Part I • Constructing a Scientific Explanation (1 class period)
- Part II • Practicing Constructing Scientific Explanations (1 class period)

Student Materials

- Science notebook (per student)
- Envelope containing question paper strips and the Question, Claim, Evidence, and Reasoning labels (per group)
- Envelope containing claim, evidence, and reasoning paper strips (per group)

Question, Claim, Evidence, and Reasoning Paper Strips and Labels Preparation

- 1 set of Question, Claim, Evidence, and Reasoning Paper Strips at the end of Task 5 (per group)
- 1 set of Question, Claim, Evidence, and Reasoning Labels at the end of Task 5 (per group)
- Scissors
- 2 envelopes (per group)

1. For each group, make one copy of the Question, Claim, Evidence, and Reasoning paper strips and the Question, Claim, Evidence, and Reasoning labels.
2. Cut apart the strips and the labels along the dashed lines.
3. Place the question strips and the Question, Claim, Evidence, and Reasoning labels in one envelope.
4. Mix up the claim, evidence, and reasoning paper strips (the remaining bulleted statements), and put them all in a second envelope.

Teacher Materials

- "Scientific Explanations" digital slide presentation
- 2 clear cups
- 1 bucket or container containing 10 cups of water
- Empty bucket or container to contain the used water
- Behavior Norms poster from Task 1

Background

In this task, students are introduced to constructing scientific explanations.

- Scientists start by making a claim that can be tested.
- To test their claim, scientists gather evidence through careful observations and controlled experiments. They also review data collected by other scientists. Scientists evaluate and organize the evidence and combine it with their prior knowledge.
- This process enables scientists to use their powers of reasoning to show how the evidence supports or refutes their claim.
- The end result is a scientific explanation scientists can share with the world.

It is important to note that scientists often discover their initial claim was incorrect and is not supported by the data they gathered. When this happens, scientists revise their claim and conduct additional research to see if they can find a more reasonable explanation for what they are observing.

NOTE

For many students, using reasoning to defend a claim is often the most challenging part of learning to think like a scientist. Reasoning requires students to connect specific claims and evidence with overarching science concepts. The practice of identifying a science concept and then tying evidence to it takes practice.

Part I • Constructing a Scientific Explanation

NOTE

This part of the task is designed to be a teacher demonstration followed by a whole-class discussion. Students should have their science notebook available to take notes during the demonstration.

1. Set up your demonstration station. You will need two clear cups and a bucket containing at least 10 cups of water. Have an empty bucket available to dump the used water into.
2. Using slides 1–7 in the "Scientific Explanations" digital slide presentation, discuss with students why constructing scientific explanations is so important.

LANGUAGE SUPPORT STRATEGY

Identify and highlight the academic vocabulary as you go through this explanation. Include the words from the language of instruction (from the list) as you talk about it. You may wish to have emerging ELLs repeat the terms aloud and rephrase the explanation to a partner of higher English proficiency. This will require a slight pause (wait time) as you go through slides.

Slide 1: Introduce the concept of scientific explanations: Scientific explanations help us understand how the world works and include evidence so we can decide if the explanations are valid.

Slide 2: Present a claim that needs to be evaluated. The claim is that reduced-fat peanut butter is healthier than regular peanut butter.

Slide 3: Allow students to find evidence to support or refute the claim that the reduced-fat peanut butter is healthier by examining the food labels on the back of the containers.

Slide 4: Identify information on the labels to refute the claim. The uninformed consumer may think, "Great, I will buy the reduced-fat peanut butter because it is healthier." The label supports the claim that the reduced-fat product has less fat than the regular product, but the label does **not** support the claim that the reduced-fat product is healthier. In fact, the label clearly shows that the reduced-fat product is actually higher in sugar and salt. So, the evidence suggests that it may actually be less healthy.

Slides 5 and 6: Summarize the parts of a scientific explanation, which may be different from an everyday explanation.

NOTE

Stress the point that scientific explanations are based on very specific and valid evidence.

A scientific explanation includes these parts:

• **Claim:** Provides a possible answer to a question or a potential solution to a problem.

• **Evidence:** Provides data that supports or refutes the claim. The evidence can come from an investigation, observations, reading materials, and/or published data.

• **Reasoning:** Provides a justification that links the claim and the evidence. The reasoning should involve a scientific principle or idea to describe why the evidence supports the claim.

3. Lead students through an interactive construction of a scientific explanation using the cup of water demonstration (digital slides 7–10). Introduce students to their use of the science notebook during tasks. Explain that when students see the notebook icon, it means that those answers should go in their science notebook.

   Slide 7: Make a claim about what will happen when the teacher turns a cup of water that has no lid upside down.

- Show students two cups full of water. One cup is in your hand, and the other is sitting on the desk.
- Ask students to write down a **claim** in their science notebook:
  "If my teacher turns the cup of water upside down, the water will _____."

Slide 8: Discuss possible **evidence** that could be gathered.

- Students know from experience what will happen when you turn a cup of water upside down: it will spill out. That is a valid observation. We can add validity to the observation by systematically collecting data. Lead students to the idea that to gather evidence, one should turn over the cup of water a number of times. The "control cup of water" is the one sitting on the desk. This cup proves that the water does not fall out of the cup by itself.
- Discuss the meaning of the words *observation*, *data*, and *evidence*.

Slide 9: Write out the **evidence** in the science notebook.

- Turn the cup of water over at least 10 times, and have students record their observations (data) in their science notebook. When you turn over the cup of water, the contents will spill out 10 out of 10 times, or 100 percent of the time.

Slide 10: Discuss the possible **reasoning** that links the evidence with the claim.

- What do you know about how the world works that explains why this happens?
  (Things typically fall down, not up.)
- What is the science concept that explains why the water spills out?
  (Students should say something about gravity, the force that attracts a body toward the center of Earth or toward any other physical body having mass.)

4. Discuss the validity of the reasoning.

Slide 11: Discuss the validity of reasoning made from a claim. For example, in this slide, the experiment may not have controlled for socioeconomic issues. Children who eat a lot of leafy greens may live in areas with more access to fresh vegetables. Maybe some children can afford the vegetables and maybe some cannot. Also, some children may be getting more of other things, like more food in general, more nutritional food (less junk food), and more exercise.

Slide 12: Help guide the discussion for slide 11.

- Do you agree or disagree with this scientific explanation? Why or why not?
- What might be some other interpretations of the evidence?
- Are there other reasons or factors in the study that may impact the accuracy of the scientific explanation?

LANGUAGE SUPPORT STRATEGY
Offer ELLs sentence frames to prompt the oral discussion.

Emerging →	Expanding →	Bridging →
I agree/disagree with the scientific explanation because _____. A different interpretation could be that _____. Another reason that might impact the accuracy of the	I agree/disagree with the scientific explanation because _____. A different interpretation could be that _____. Another reason that might impact the accuracy of the scientific	The sentence frames at the Expanding level can be used at this level as well.

scientific explanation is _____.	explanation is _____.	

Part II • Practicing Constructing Scientific Explanations

1. Assign groupwork roles and remind students about the Behavior Norms they have practiced previously by referring to the Behavior Norms poster.
   - Pay attention to what other group members need.
   - No one is done until everyone is done.
   - Play your role in the group.
   - Help other students do things for themselves.
   - Listen and pay attention to what is being said.
   - Explain by telling how.
   - Be concise.
   - Rephrase and build on others' ideas.
   - Everyone contributes.
   - Everybody helps.
2. Have the groups discuss how the pill bug example represents a scientific explanation that includes a claim, evidence, and reasoning.
3. Give the two envelopes to each group (i.e., one containing the question strips and the labels and the other containing the claim, evidence, and reasoning statements). Tell students what is in each envelope.
4. Instruct students to empty the contents of the two envelopes into two separate piles on their desk. They should not mix up the contents of the two envelopes right away.
5. Slide 13: Use the model on the digital slide presentation to show that the label goes in front of the strip.

   Example:

QUESTION	**Question 1: Do plants need the sun to grow?**
CLAIM	• Plants cannot grow without sun.
EVIDENCE	• We planted and watered 10 sunflower seeds. We put 5 seeds in a dark closet and 5 seeds next to our classroom window. All the seeds sprouted. The seeds in the dark closet stopped growing
REASONING	• There was only one thing different between the two groups of plants: Some had light and some did not. The ones in the dark could not keep growing after they sprouted because the sun is

LANGUAGE SUPPORT STRATEGY

Include the words from the language of instruction (from the list) as you talk about how to proceed. Again, you may wish to have emerging ELLs repeat the terms aloud and rephrase the explanation to a partner of higher English proficiency. This will require a slight pause (wait time) as you go through the explanation.

6. Give groups 10 minutes to work together to match each question with the appropriate claim, evidence, and reasoning statements.

7. As students work in their groups, note when students are using the productive group Behavior Norms that they learned in previous tasks.
8. Provide groups with specific feedback about the productive group Behavior Norms that you observed.
9. Debrief students by having each group discuss one of their question, claim, evidence, and reasoning groupings.
10. Ask students to discuss whether they think the scientific explanations in this activity are strong or valid. Why or why not?