Claim-Evidence-Reasoning

Scientific Explanations of Phenomenon
Learning Goal

Facilitate learning to support using the Explanation Framework for writing evidence-based conclusions that reveal understanding about the a phenomenon.
What do you think?

Look at your card and discuss the following questions with your group.

- What type of document is this?
- Are there any claims being made? If yes, what?
- Is there any incomplete or missing information?
- What is critical thinking?
- What does it mean to be scientifically literate?
- Why should our students learn to think critically or be scientifically literate?
Science seeks to **EXPLAIN** phenomena using observations and investigations.

1. Asking questions
2. Constructing explanations
3. Constructing arguments
The Practices of Scientists & Engineers

- from the K-12 Framework for Science Education

1. **Asking questions** and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. **Constructing explanations** and designing solutions
7. **Engaging in argument from evidence**
8. Obtaining, evaluating, and communicating information
Science education should prepare learners to be scientifically literate citizens able to...

- make informed decisions.
- interpret claims critically.
- evaluate evidence and reasoning presented.
The CER Framework

- A structured writing strategy.
- Helps the learner connect their prior knowledge to their recent investigation experiences.
- Provides learners an opportunity to demonstrate their scientific literacy and ability think critically.
The Phenomenon of Gravitational Potential Energy
How does the drop height of a ball affect the bounce height of the ball?
Let's investigate!

Potential and Kinetic Energy
Ball Bounce Investigation

Problem: How does the drop height of a ball affect the bounce height of the ball?

Materials:
- Racquetball
- Meter Stick
- Post-it tabs

Procedure:
1. With a partner, gather your supplies: a racquetball and a meter stick.
2. Decide who is holding the meter stick, who is dropping the ball, and who is recording the data.
3. Make sure the meter stick is held vertically with the 0 cm down on the floor and the 100 cm toward the ceiling.
4. Start by holding the ball up to the meter stick at 50 cm.
5. Drop the ball and watch how many centimeters the ball bounces back up. (Use the top of the ball for your observation)
6. Repeat 3 more trials at 50 cm and record. Then find the mean.
7. When dropping the ball from 150 cm, you will need to measure 150 cm up from the floor and mark a wall with a post-it and drop the ball from this height.
8. Continue the activity until you've completed all 4 trials for all 3 heights.

<table>
<thead>
<tr>
<th>Height of Drop</th>
<th>Height of Bounce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>Trial 2</td>
</tr>
<tr>
<td>50 cm</td>
<td></td>
</tr>
<tr>
<td>100 cm</td>
<td></td>
</tr>
<tr>
<td>150 cm</td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td>Evidence</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>Step 2</td>
<td>Claim</td>
</tr>
<tr>
<td>Step 3</td>
<td>Reasoning</td>
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Let’s write!

CER Lab Summary

Prompt: Write a scientific explanation for how the drop height of a ball affects the height of the bounce.

Claim: ____________________________

Evidence: ____________________________

Reasoning: ____________________________
Explanation Framework

Claim - solution to a problem or statement, summarizing the evidence. Answers the question!

Evidence - data gathered through observations and interactions with the phenomenon, supporting the claim.

Reasoning - justification (scientific principles) used to support the claim and evidence.

Rebuttal - justification explaining why the evidence supports a different claim.
<table>
<thead>
<tr>
<th>Grade</th>
<th>Progression of Argumentation Focus</th>
</tr>
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</table>
| K-2   | **Claim + Evidence**  
|       | • Claim - Make conclusions from investigations.  
|       | • Evidence - Use observations from investigations. |
| 3-5   | **Claim + Evidence + Reasoning**  
|       | • Claim - Make conclusions.  
|       | • Evidence - Use observations and measurements.  
|       | • Reasoning - Provide a simple connection between claim and evidence using the big ideas they have learned in science. |
| 6-8   | **Claim + Evidence + Reasoning (greater complexity)**  
|       | • Claim - Make conclusions.  
|       | • Evidence - Use observations and measurements. Distinguish between appropriate and inappropriate data. Consider sufficiency of evidence.  
|       | • Reasoning - Provide a justification for why the evidence supports the claim using scientific principles. |
| 9-12  | **Claim + Evidence + Reasoning + Rebuttal**  
|       | • Claim - Make conclusions.  
|       | • Evidence - Use observations and measurements. Distinguish between appropriate and inappropriate data. Consider sufficiency of evidence.  
|       | • Reasoning - Provide a justification for why the evidence supports the claim using scientific principles. Each piece of evidence may have a different justification.  
|       | • **Rebuttal** - Describe why a counter-claim is not appropriate by critiquing the alternative evidence and reasoning. |
Evidence > Claim > Rebuttal

Evidence

Evidence

Evidence

Claim 1

Reasoning

Claim 2

because

Evidence and Reasoning

not
What do you know?  How do you know that?

Claim + Evidence + Reasoning = Explanation

Why does your evidence support your claim?
## Scoring Rubric

<table>
<thead>
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<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Claim</strong></td>
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<td>Answers the question but is inaccurate based on data</td>
<td>No claim, or does not answer the question</td>
</tr>
<tr>
<td><strong>Evidence</strong></td>
<td>Cites data and patterns within the data, and uses labels accurately</td>
<td>Cites data from the data source, but not within the context of the prompt</td>
<td>No evidence, or cites changes, but does not use data from the data source</td>
</tr>
<tr>
<td><strong>Reasoning</strong></td>
<td>Cites the scientifically accurate reason using correct vocabulary and connects this to the claim; shows accurate understanding of the concept</td>
<td>Cites a reason, but it is inaccurate or does not support the claim. Reasoning does not use scientific terminology or uses it inaccurately.</td>
<td>No reasoning, or restates the claim but offers no reasoning</td>
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1. Be explicit in your expectations.

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How does the drop height of a ball affect the bounce height of the ball?
2. Provide constructive feedback.
3. Scaffold.

**Writing Scaffolds**

*Use Sentence Starters:*
- My evidence to support my claim is...
- The data...
- According to the text...
- On page ___, it said ...
- For instance...
- From the reading, I know that...
- The graphic showed...
- For example...
- My evidence supports my claim because...

**Claim + Evidence + Reasoning**

- **THE QUESTION / PROBLEM**
- **CLAIM** A statement that answers the question or problem.
- **EVIDENCE** Data and observations from the investigator that support the claim.
- **REASONING** An explanation for why the evidence supports the claim using science terms.
The teacher is...  
- providing opportunities for students to collect evidence in a scientific setting.  
- providing opportunities for students to complete scientific writings using the CER method.  
- walking around the room, assisting where necessary, utilizing charts to assist with teaching the CER method.  
- listening to students as they share their groups’ data.  
- listening to students as they share and perfect their CER.  
- discussing the CER method with students.  
- teaching the rubric to students prior to asking them to write a CER.  
- creating rubrics to use to determine CER level of mastery.  
- creating investigations that are challenging, interesting to students, capable of producing a wide range of data and evidence for students to use and analyze.  

The student is...  
- gathering evidence from investigations.  
- writing scientific explanations.  
- using rubrics to self evaluate.  
- using rubrics to peer evaluate.  
- listening to other groups share the evidence they collected.  
- sharing their CER’s with classmates.  
- offering feedback to help with peer editing.  
- using scientific vocabulary in their reasonings.  
- participating in meaningful discourse.  
- analyzing evidence in order to make a claim in answer to the prompt or question being addressed.  
- providing a reason which links the evidence to the claim.  
- thinking critically to connect a claim, evidence, and reasoning to the scientific phenomenon being studied.  
- creating rebuttals where necessary.  

The observer...  
- notices students working in groups of 2-4 as they gather evidence from their investigations.  
- notices students working independently as they write their own CER.  
- notices the teacher allowing students to peer edit based on rubrics.  
- notices students correcting their own work based on the feedback provided by their peers.  
- notices both the teacher and students listening to the various ideas of the classroom.  
- notices whole class discourse as students share out their results and the differences that might exist.  
- notices student lead discussions that appear to be more sophisticated.  
- notices students capable of transferring their own understandings of science as well as their experiences to use during class argument and discourse.  
- notices students making inferences in their reasonings.  
- notices students comfortable with data analysis.  
- notices teachers creating opportunities that are challenging and thought provoking; allowing students to become better scientific writers in the process.
Thank you for your attention and participation!