Building the Skills of Argumentation

Claims, Evidence and Reasoning (Rebuttal)

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Driving Questions

What is an argument?

When should students use argumentation?
Pre-Test

- Get a Post-it Note
- Write your name and email on it.
- Write you level of proficiency in your ability to engage in discourse and argumentation based-on data or evidence.
- Place your Post-it on the bar graph.

**Argumentation**
The ability to justify a claim through use of evidence

- Novice
- Gaining Skill
- Proficient
When to Use Argumentation

- To refute claims made by others
- To defend claims, designs, and ask questions
- Science is about evidence and reasoning so students should never argue to prove a point
Worlds 10 Best Inventions

1976
- Phonograph

1878
- Steam Engine

1877
- Printing Press

1872
- Compass

1912
- Telephone

1903
- Airplanes

1901
- Personal Computer

1990
- World Wide Web

1712
- Paper
Collaboration

- Groups should place the cards in order based on

  - The magnitude of impact on the world in the year they were invented.

- Use Consensus to place them in order of impact.
Are you using Consensus?

Can you define it?
Consensus
You have consensus of you can state the following:

- I have been heard and understood
- I have heard and understand
- I can live with the decision made
- I can (and will) publicly support the decisions made

Capturing Kids Hearts
Protocol for Discourse

- One person distributes the cards evenly to all group members. Do not reveal your cards until it is your turn.
- Person #1 places one card in the center of the table.
  - Make a **claim** “This invention had the greatest impact on the word when it was incented....”
  - State **evidence** to support the claim.
  - Team members take turns to provide additional evidence to support or refute the claim.
  - Once consensus is reached, a new card is placed and the process repeats until all cards have been displayed and ordered.
What does it mean to engage in Argumentation?

Scientists engage in argument to

- Defend claims using evidence and reasoning
- Defend models using evidence
  - Critique the claims of other scientists
- Look for sufficient and appropriate evidence
- Argument to defend
  - Interpretation of data
  - Experimental designs
  - Method of data analysis
- The appropriateness of a question
In science, the production of knowledge is dependent on a process of reasoning from evidence that requires a scientist to justify a claim about the world. In response, other scientists attempt to identify the claim’s weaknesses and limitations to obtain the best possible explanation.
Interdisciplinary Arguments

The process of defending those explanations by carefully ruling out other alternative explanations and building the case that the data collected is sufficient and appropriate to serve as evidence for the current claim.
Scientific & Engineering Practices

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking

- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, & Communicating Information
Importance of Arguments

- Utilizes 21st century skills across disciplines and outside of the classroom setting
- Promotes literacy development
- Decreases Teacher Talk and Increases Student Talk
- Allows students to make meaning by seeking a consensus
Constructing Non-Scientific Explanations

- Providing a Definition
- Identifying something that has occurred
- Justifying why you think a certain way
Constructing Scientific Explanations

- Identifies the underlying chain of events in the causes and effects

- Sites primary and secondary scientific evidence and models to support or refute an explanation of a phenomenon

- Identifies gaps or weaknesses in the accounts of others

- Provides a link to scientific theory with scientific observations and phenomena
Using Argumentation to Evaluate Student Learning

- Science is about explaining phenomenon
- Science instruction is about changing a student’s image of science
- Students’ writing and talking about what they know allows an instructor to identify misconceptions and guide students to reconstruct concepts correctly
CER Framework

Adapted from Toulmin (1958)

- **Claim** - a conclusion about a problem (answers a question)

- **Evidence** - scientific data that is *appropriate* and *sufficient* to support the claim

- **Reasoning** - justification that shows why the data counts as evidence to support the claim and includes appropriate scientific principles

- **Counter claim/Rebuttal** - describes other plausible claims with counter evidence and reasoning (evidence of higher levels of cognitive development)
By evaluating evidence to determine if it is reasonable based on scientific knowledge, a claim can be made,

--McNeill, Supporting Student Explanations in Science, 2012
## Assessment Rubric

<table>
<thead>
<tr>
<th>Component</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claim</td>
<td>Does not make a claim, or makes an inaccurate claim.</td>
<td>Makes an accurate but incomplete claim.</td>
<td>Makes an accurate and complete claim.</td>
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<tr>
<td>Evidence</td>
<td>Does not provide evidence, or only provides inappropriate evidence. (Evidence that does not support the claim.)</td>
<td>Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.</td>
<td>Provides appropriate and sufficient evidence to support claim.</td>
<td></td>
</tr>
<tr>
<td>Reasoning</td>
<td>Does not provide reasoning, or only provides reasoning that does not link evidence to claim.</td>
<td>Provides reasoning that links the claim and evidence. Repeats the evidence and/or includes some scientific principles, not sufficient.</td>
<td>Provides reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.</td>
<td></td>
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</tbody>
</table>

Claim: __________________________________________________________

Cite 3 pieces of Evidence: ______________________________________________

Write out the Reasoning: ______________________________________________
Differentiated Learning Progression for Scientific Explanations

<table>
<thead>
<tr>
<th>Level of Complexity</th>
<th>Framework Sequence</th>
<th>Description of Framework for Students</th>
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<tbody>
<tr>
<td>Simple</td>
<td>Variation #1</td>
<td>Claim</td>
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<td></td>
<td>1. Claim</td>
<td>a statement that answers the question</td>
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<td>2. Evidence</td>
<td>Evidence</td>
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<td></td>
<td>• Appropriate</td>
<td>scientific data that supports the claim</td>
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<td></td>
<td>• Sufficient</td>
<td>Reasoning</td>
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<td>3. Reasoning</td>
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<td></td>
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<td>2. Evidence</td>
<td>Evidence</td>
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<td>• Appropriate</td>
<td>scientific data that supports the claim</td>
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<td></td>
<td>• Sufficient</td>
<td>data needs to be appropriate</td>
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<td>• a justification for why the evidence supports the claim using scientific principles</td>
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<td>Variation #4</td>
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**Claim**
- a statement that answers the question

**Evidence**
- scientific data that supports the claim
- data needs to be appropriate
- data needs to be sufficient

**Reasoning**
- a justification for why the evidence supports the claim using scientific principles
- each piece of evidence may have a different justification for why it supports the claim

**Rebuttal**
- describes alternative explanations, and provides counter evidence and reasoning for why the alternative explanation is not appropriate.
Sample Argumentation
Small Group Collaboration

- Make a claim “The graph....”

- State evidence to support the claim

- Team members take turns to provide additional evidence to support or refute the claim

- Once consensus is reached, spokesperson will make the groups claim to the larger group (4 minutes)
Large Group Collaboration

- Make a claim “The graph....”
- State evidence to support the claim
- Take turns to provide additional evidence to support or refute the claim
- The group will have 4 minutes to reach a consensus
Figure 9.24  Prior to construction of the Aswan Dam, the discharge of the Nile River varied seasonally, with peak discharge coming during the late summer and early fall interval of flooding. Controlled release of water after the dam was built greatly reduced the seasonal variability in discharge.
Argumentation Post Test

- Write your level of Proficiency in your ability to engage in discourse and argumentation based on data or evidence on a post-it note.

- Place your post-it on the bar graph
Thank you

- Thank you for your active Engagement and Participation!

- You will receive your certificate via email—please be certain that you have signed in

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