Engaging students in argumentation across elementary, middle and high school

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Agenda
- Presentation NGSS and ELA common core
- Presentation on the claim, evidence and reasoning framework
- Analyze student writing across grades
- Watch classroom video – Kindergarten & 7th grade
- Discuss learning progression across K-12

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Common Core ELA Standards
- Grades 11-12 students (Reading):
  - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

- Grades 11-12 students (Writing):
  - Write arguments focused on discipline-specific content. Introduce precise, knowledgeable claim(s); establish the significance of the claim(s); distinguish the claim(s) from alternate or opposing claims; and create an organization that logically sequences the claim(s), counter-claim(s), reasons and evidence.

- Grades 11-12 students (Talking and Listening):
  - Propose conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.

Next Generation Science Standards (NGSS)
- Grade 9-12 Students
  - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
  - Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
  - Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions.
Next Generation Science Standards (NGSS)

Grade 9-12 Students

- Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Reading & Listening
- Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. Writing & Talking
- Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions. Writing, Talking & Listening

CER Framework
Adapted from Toulmin (1958)

- Claim
  - a conclusion about a problem
- Evidence
  - scientific data that is appropriate and sufficient to support the claim
- Reasoning
  - a justification that shows why the data counts as evidence to support the claim and includes appropriate scientific principles
- Rebuttal
  - describes alternative explanations and provides counter evidence and reasoning for why the alternative is not appropriate.
Physics Example

Does a lever make work easier?

Lever sometimes make work easier. (Claim) When we picked up the load without the lever, it was 2.2 N. When the load was 20 cm from the fulcrum and the effort was 10 cm from the fulcrum, it was 4.3 N. When the load was 10 cm from the fulcrum and the effort was 5.0 cm from the fulcrum, it was 5.3 N. When the load was 10 cm from the fulcrum and the effort was 20 cm, it was 1.3 N. (Evidence) Doing work is the ability to move an object. If it takes less force, the work is easier. A lever can make work easier depending on the position of the fulcrum, effort and load. When the fulcrum is close to the load and far from the effort, the work is easier. (Reasoning)

Biology Example

What will happen to the shark population if the phytoplankton populations die out?

The shark population will die out. (Claim) The shark eats other fish such as the ocean fish and the lantern fish. The ocean fish and the lantern fish eat other organisms such as shrimp and copepods. The shrimp and copepods eat the phytoplankton. (Evidence) Phytoplankton are producers and they make their own food from the sun. All of the other organisms in the food web depend on the phytoplankton, even if they do not directly eat them. If the phytoplankton die, primary consumers (shrimp and copepods) will die because they will have no food which will cause the secondary consumers (ocean fish and lantern fish) to die, which will cause the shark to die. (Reasoning)

Environmental Science Example

Mr. Garcia: Do you think the climate is changing? Make sure you support your idea with evidence and reasoning.

Olivia: I think the climate is changing (Claim) because this fall has been really warm (Evidence).

Mariela: Does being warm just one fall count as evidence for climate change?

Nate: No, climate is long term changes. It is just weather if it is one day or a month or a season (Reasoning). So I agree with Olivia that the climate is changing (Claim). But I think it is changing because the air temperature has slowly gotten warmer over a long time. The average temperature has increased like 2 degrees in the last 100 years (Evidence).
CER Framework  Adapted from Toulmin (1958)

Examine Student Work
- Look at the two examples of student work (Ex. A and Ex. B) from the following grades – 2nd grade, 4th grade, 8th grade, 10th grade.
- Select one grade level to analyze more closely.
- Work with your group to fill in the table for that grade level.
  - What are the strengths of the student work?
  - What are the weaknesses of the student work?
- If you have time, select a second grade level to examine and consider how the writing looks different at the different grade levels.

Additional Examples
- Kindergarten Classroom
  - How are all the sounds made?
  - Classroom discussion
  - Teacher records claim and 3 pieces of evidence
- 7th Grade Classroom
  - Chemistry Unit – Are fat and soap the same or different substances?
  - Students write individual arguments
  - Students engage in peer critique of their written arguments
  - Circle claim, # evidence and underline reasoning

Kindergarten Example
**Additional Examples**

- Kindergarten Classroom
  - How are all the sounds made?
  - Classroom discussion
  - Teacher records claim and 3 pieces of evidence

- 7th Grade Classroom
  - Chemistry Unit – Are fat and soap the same or different substances?
  - Engaging in peer critique of their written arguments
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**BPS Progression for Argumentation k-12**

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

- The claim, evidence and reasoning (CER) framework can be used to support students in constructing arguments in science.
- The CER framework can be used across reading, writing, talking and listening.
- The complexity of the CER framework and students’ work should increase over elementary, middle and high school.
- A variety of experiences and instructional supports can help students gain greater expertise.

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Download Powerpoint:
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