How Do You Know That? Helping Students Write About Claims and Evidence

Presented by: Jodi Wheeler-Toppen

December 12, 2012
7:30 p.m. – 9:00 p.m. Eastern time
Introducing today’s presenter...

Jodi Wheeler-Toppen
• Former science teacher
• NSTA Press author
Welcome!

Quick Poll:
How do you use a claims and evidence approach in your classroom?

a) I’m still learning about it.
b) I talk about it in the context of how science works.
c) Students are required to support claims with evidence in class discussions.
d) Students have to write claims and support them with evidence for some or all labs.
e) We have class discussion and writing activities that revolve around making claims and supporting them with evidence.
This Evening

Claims, Evidence, and Reasoning

• Session Plan
  – Solve a murder mystery
  – Look at the structure for C-E-R arguments and what they look like in science
  – Tackle the practical issues of helping students do this kind of writing
  – Look at a science mystery, with competing claims
“Slip or Trip”

– Adapted from: Hillocks, G. *Teaching Argument Writing: Grades 6-12*. Portsmouth, NH: Heinemann Press.

Use a clip art “hand” to point to any evidence you deem important.
<table>
<thead>
<tr>
<th>Evidence</th>
<th>Reasoning (Why is this evidence important?)</th>
</tr>
</thead>
</table>

Was Queenie telling the truth? (Did Arthur trip and fall to his death?)
Possible Claims

• Queenie is telling the truth. Arthur tripped and fell to his death.

• Queenie is lying. Arthur did not trip and fall to his death.
Is Queenie telling the truth?

Claim:

Evidence:

Reasoning:
Is Queenie telling the truth?
Claims—Evidence—Reasoning (CER)

• Claim
  – Answer to the question!
  – Usually the easiest for students

• Evidence
  – Must be appropriate
  – Must be sufficient

• Reasoning
  – Explains how the evidence supports the claim
  – Often includes scientific principles
Why take a C-E-R Approach?

- Students are more successful understanding what’s going on than with the generic term “Conclusions.”
- This is how you make an argument or explanation convincing.
- This is what scientists do.
- This is the language of both the Common Core and the Next Generation Science Standards.
Common Core Standards:
Writing in History, Science, Technical Subjects

WHST.6-8.1. Write arguments focused on discipline-specific content.

• Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

• Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

• Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.

• Establish and maintain a formal style.

• Provide a concluding statement or section that follows from and supports the argument presented.
Next Generation Science Standards

Scientific and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
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 (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Why write it down?

• Writing is a key science skill. Science depends on the written record to build on existing knowledge.
Why Writing Is Important

• Writing helps students learn.
  – It forces them to organize their thoughts and find the relationships between ideas.
  – Writing holds ideas in place long enough for students to think about them.
  – Writing gets all students to participate.

• Writing helps you (as the teacher) spot misconceptions.
From this FREE Claims and Evidence Unit: Cyber-enabled Earth Exploration Curriculum– www.spatialsci.com/CE3 (covers volcanoes, earthquakes and plate tectonics using Google Earth)
Life Science Example

What Shape are Cells? (student-selected question)

Cells can have lots of different shapes. In this lab, the animal cell was like a wavy circle. The plant cell looked like a rectangle. The bacteria was squiggly like this: &. Since all these cells had different shapes, I can tell that cells don't just have one shape.

(From Cells R Us, Chapter 5 in Once Upon a Life Science Book: 12 Interdisciplinary activities to create confident readers, by Jodi Wheeler-Toppen.)
Physical Science Example

Does a lever make work easier?

Levers sometimes make work easier. (Claim) When we picked up the load without the lever, it was 2.2 N. When the load was 5.0 cm from the fulcrum and the effort was 10 cm from the fulcrum, it was 0.8 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, 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)

Is there something solid under the cardboard sheet? If so what shape is it? [Rutherford’s Atom Simulation]

There is something under there because some of the marbles bounced back. They would go through if there was nothing there. I think it’s square because they came straight back on all sides and we had a square shaped blank spot on our lab sheet.

[Note: an explanation of how marbles bounce against different shapes would complete the reasoning here.]
Questions?

• About the Claims-Evidence-Reasoning approach?
• About writing?
Helping students succeed—Before they write

• Talk about why you’re using the CER framework:
  – This is how you make an argument or explanation convincing.
  – This is what scientists do.

• Help students generate (or give them) a clear question.
Prewriting

• Science Ideas
  – What are some possible claims?
  – Where will you look for your evidence?
  – What reasons show that this is good evidence?
(Gradually reduce support)

• What science words will you want to include?
Prewriting

• Audience: Are you explaining this to the teacher (who really knows what happened) or to an outside audience?

• Language: Should you use casual or formal language?
• What writing words will you want to include?

  – Because
  – Sequencing words: first, second, third
  – “Uncertainty” words: usually, generally; suggests, indicates
  – Therefore
  – If... Then...
  – However
“Therefore”: connects reasoning to the claim

What claim can you make about the movement of water when the egg was in the syrup?

Student: The egg was squished [ie, smaller] and we got more syrup than we started with.

Teacher adds: Therefore, water moved from the egg into the syrup.
“Therefore”: connects reasoning to the claim

- Claim: What makes up the grasshopper’s skeleton?

The skin. We looked and there’s no bones. The muscle connect to the skin. In people, muscle connect to the bones. Bones are our skeleton. Therefore, skin is their skeleton.
If...Then... helps you say what you would predict to happen

There is something under there because some of the marbles bounced back. *They would go through if there was nothing there.* I think it’s square because they came straight back on all sides and we had a square shaped blank spot on our lab sheet.

If there was nothing under the cardboard, then the marble should go straight through.

However...
Prewriting: What can you actually see yourself doing with your class?

<table>
<thead>
<tr>
<th>Helping them think through the science ideas</th>
<th>Having them list science words to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering audience and/or formality of the language</td>
<td>Talking about a writing word or two they might include</td>
</tr>
</tbody>
</table>
After they give it a try

Look at strong and weak arguments with the class.
Do cockroaches prefer light or dark environments?

Cockroaches prefer dark environments. They want to hide from us. Because cockroaches have those long antennae, maybe they can just feel their way around and don’t need light to see.

Cockroaches prefer dark environments. When we let 10 cockroaches choose between the light and dark side of a box, 9 of them chose the dark side. Since more of the roaches chose the dark, we can tell that is what they prefer.
Evaluation - Don’t get overwhelmed with grading

- Replace lab report (or portion of it) with Claims/Evidence/Reasoning language
- Quickly sort by levels of understanding for short assignments (no grade; just for your own feedback)
- Quickly mark a rubric
- Peer review or self-review using a simple system (underline the claim in green...) or a rubric
- Let some writing just be practice
<table>
<thead>
<tr>
<th>Claim</th>
<th>Evidence</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A statement or conclusion that answers the original question/problem.</td>
<td>Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.</td>
<td>A justification that connects the evidence to the claim. It shows why the data counts as evidence by using appropriate and sufficient scientific principles.</td>
</tr>
<tr>
<td>Does not make a claim.</td>
<td>Does not provide evidence.</td>
<td>Does not provide reasoning.</td>
</tr>
<tr>
<td>Makes an inaccurate claim.</td>
<td>Provides inappropriate evidence. The evidence does not support the claim.</td>
<td>Provides inappropriate reasoning.</td>
</tr>
<tr>
<td>Makes an accurate, but incomplete claim.</td>
<td>Provides appropriate, but insufficient evidence to support claim.</td>
<td>Provides appropriate, but incomplete reasoning (not all evidence is accounted for).</td>
</tr>
<tr>
<td>Makes an accurate and complete claim.</td>
<td>Provided appropriate and sufficient evidence to support claim.</td>
<td>Provides reasoning that connects the evidence to the claim. Includes appropriate and sufficient scientific principles to explain why the evidence supports the claim.</td>
</tr>
</tbody>
</table>
Questions?

• Questions about implementing C-E-R in your classroom?
• Questions about helping the students with writing?
More from the Common Core

Write arguments focused on discipline-specific content:

Grades 9-10:
• Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
• Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns.

Grades 11-12
• 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), counterclaims, reasons, and evidence.
• Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience’s knowledge level, concerns, values, and possible biases.
Science Whodunnit?

• Who (or what!) put the maggots on the meat?
Francisco Redi V.
Spontaneous Generation
Where do flies come from?

Claim

Counter/ competing claim
## Where do flies come from?

<table>
<thead>
<tr>
<th>Claim</th>
<th>Counter/ competing claim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flies only come from other flies</td>
<td>Flies come from rotting meat</td>
</tr>
</tbody>
</table>
Where Do Flies Come From?

You are Redi, addressing a group of scientists familiar with this debate.

• Claim: Flies only come from other flies.
• Evidence
• Reasoning
• Counterclaim
• Evidence against
• Reasoning for evidence against
• Summary statement (a lovely place for a “therefore”)

Flask unsealed
Flask sealed
Flask covered with gauze
Flies only come from other flies. Maggots, which develop into flies, only formed on the meat in the first flask. Flies could land on that meat, and they produced maggots there. Those who support spontaneous generation would say that rotting meat alone or in combination with air creates flies. If rotting meat alone could produce maggots, then there would be maggots in flask 2, which was sealed. If rotting meat in combination with air could produce maggots, then there would be maggots in flask 3, which allowed air, but not flies, through the gauze. However, neither of these flasks had maggots. Therefore, flies are necessary to produce more flies.
Help me find: Claim and counterclaim; Evidence/Evidence against; Reasoning

Flies only come from other flies. Maggots, which develop into flies, only formed on the meat in the first flask. Flies could land on that meat, and they produced maggots there. Those who support spontaneous generation would say that rotting meat alone or in combination with air creates flies. If rotting meat alone could produce maggots, then there would be maggots in flask 2, which was sealed. If rotting meat in combination with air could produce maggots, then there would be maggots in flask 3, which allowed air, but not flies, through the gauze. However, neither of these flasks had maggots. Therefore, flies are necessary to produce more flies.

[Note: 11-12th grade standards would also want the writer to position this within the larger argument of spontaneous generation.]
Further Information

• *Preparing for the Next Generation Science Standards—Engaging in Argument from Evidence* by Joe Krajcik (NSTA Webinar Archive)
• *Teaching Argument Writing: Supporting claims with relevant evidence and clear reasoning* by George Hillocks, Jr. (Heinemann Press)
• Cyber-enabled Earth Exploration Curriculum—*www.spatialsci.com/CE3* (covers volcanoes, earthquakes and plate tectonics using Google Earth)
Final Questions

• On counterclaims?
• On anything else we’ve discussed?
Thanks to today’s presenter!

Jodi Wheeler-Toppen
• Former science teacher
• NSTA Press author
Thank you to the sponsors of today’s web seminar:

This web seminar contains information about programs, products, and services offered by third parties, as well as links to third-party websites. The presence of a listing or such information does not constitute an endorsement by NSTA of a particular company or organization, or its programs, products, or services.
National Science Teachers Association
Gerry Wheeler, Interim Executive Director
Zipporah Miller, Associate Executive Director, Conferences and Programs
Al Byers, Ph.D., Assistant Executive Director, e-Learning and Government Partnerships
Flavio Mendez, Senior Director, NSTA Learning Center

NSTA Web Seminars
Brynn Slate, Manager
Jeff Layman, Technical Coordinator