

Developing Reasoning Skills



THE LAWRENCE
HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

The Learning
Design Group



THE
ARGUMENTATION
TOOLKIT

© 2014 by The Regents of the University of California. All Rights Reserved.

Reasoning

Reasoning is the process of making clear how your evidence supports your claim.

- In scientific argumentation, clear reasoning can include using scientific ideas or principles to make logical connections between evidence and a claim.
- The overall quality of an argument is dependent on having strong evidence and clear reasoning.

Reasoning Challenges

- Students often provide evidence for a claim, but don't provide clear reasoning showing how their evidence supports the claim.
- Teachers and students alike don't always know what clear reasoning should look (or sound) like.

Students often assume that their audience already

- understands what they are talking about so they don't fully explain their reasoning.

Ways to Encourage Clear Reasoning

- Provide students with argumentation opportunities so they can practice making their reasoning clear.
- Model for students what clear reasoning looks like.
- Use questions like “How does your evidence connect to your claim?”

Ways to Encourage Clear Reasoning

- Provide students with argumentation opportunities so they can practice making their reasoning clear.
- Model for students what clear reasoning looks like.
- Use questions like “How does your evidence connect to your claim?”

Ways to Encourage Clear Reasoning Continued

- Make sure students consider their audience and don't assume that their audience already understands the connections between evidence and the claim.
- Encourage students to look for clear reasoning and to critique each other's arguments.
- Point out clear reasoning to the class.

Discussing with Reasoning



The following slides provide examples of student's use of reasoning in oral argumentation. There are also tips for how teachers might improve student's reasoning.

Whole Class Share-Out

Here a student is trying to explain how evidence of yeast bubbling more with Ingredient A supports the claim that Ingredient A provides more energy than Ingredient B (her partner had just provided evidence). Her reasoning is not very clear. A teacher might recommend that this student break down the parts of the argument: “What is your claim?” “What is your evidence?” and “Explain how your evidence supports your claim.”

“The yeast need sugar, well the yeast sort of uses sugar as fuel and energy to like and it bubbles up when it’s happy I guess. Or when it’s like has the most sugar and energy and bubbles up and that’s how we can tell ingredient A has more energy-calories-energy.” - 7th-grade student

Group Discussion

Here a student is making an argument that soccer players at high altitude cannot play soccer as well as players at low altitude. She provides evidence from a simulation. Notice that she does not explain how her results from the simulation lead her to believe that soccer players can't play as well as high altitude. A teacher might ask for the student to explain how her evidence connects to the claim. *What does it mean that the sim "died" earlier at high altitude? How does this support the claim?*

"For us we got the same thing, claim B, soccer players at high altitudes cannot play soccer as well as players at low altitude and well, our evidence, kind of the same as them, our sim extreme at low altitude it lasted for 1 minute and 15 seconds and breath rate was 44 and heart rate was 177 and then when it was high altitude it died and 44 seconds and the breath rate was 59 and the heart rate was 179." - 7th-grade student

Peer Review

In this activity, this student was sharing an argument to receive feedback from his peer. Notice that he does not make his reasoning very clear, although he does include some explanation of how the evidence supports the claim. It would be more clear if he further explained that igneous rock is formed from cooling lava or magma. A teacher might recommend that the student use what he knows about igneous rock to be more explicit about how each of his pieces of evidence supports the claim.

“I did the Zoroaster Granite and my claim is the Zoroaster Granite is an igneous rock. And my evidence is that it has like luster and it’s shiny and it looks a lot like the rocks were like melted into one. And my reasoning is like it was deep in a canyon so it could have been heated by like some lava just below the surface, but it may like no longer be there cause there’s water there now, so it could have like taken out the water. Or the water could have taken out the lava.” - 6th-grade student

Science Seminar

In this example, during a science seminar about what killed the dinosaurs, a student references evidence provided by the teacher, but does not offer a clear explanation as to how the evidence of volcanoes erupting for long periods would lead to the extinction of the dinosaurs. A teacher might encourage this student to express more clearly how the evidence supports the claim and to consider a hypothetical audience that does not know much about the topic.

“Yeah, but they said that those volcanoes would erupt for a long time and stuff so like if it erupted at first it would kill the first wave of dinosaurs and then a second wave would come and it said, somewhere here that it erupted for 10,000-100,000 years and stuff and that could have killed the dinosaurs.”- 6th-grade student

Writing with Reasoning

The following slides provide examples of student's use of reasoning in written argumentation. There are also tips for how teachers might improve student's reasoning skills.



A Scientific Argument About Rock in the Grand Canyon

Question: What type of rock is Dox Sandstone?

Claim: The Dox Sandstone is a sedimentary rock. Evidence: My first piece of evidence is that the Dox sandstone had many lines in it. The excerpt from "Geologic History of the Grand Canyon" said that the Grand Canyon was covered by sea. The sea must have taken sediment from other places and deposited it in layers. After it hardened, the different layers would be visible. The sample of the rock we saw had many visible lines. My second piece of evidence is that it has many different colors and rock sizes. The sea can't choose what type of rock it will deposit, so many different types could have been used to make one rock. Many different colors and textures is a characteristic of sedimentary rock. I also don't think that it is Metamorphic, because then the stripes would probably be wavier. Our sample had straight lines.

This student offers clear reasoning and science ideas to explain how her evidence relates to the claim. At the end of her argument she begins to refute other possible claims. A teacher might encourage this student to make her argument even stronger by including more explanation for why wavier lines would indicate that the rock is metamorphic.

A Scientific Argument About Rock in the Grand Canyon

Question: What type of rock is Zoroaster Granite?

Claim: My claim is that the Zoroaster Granite rock is Igneous.

Evidence: My first peice of evidence, is that it is light and dark color. It is also very glossy. Anouther peice of evidence is that it is ragid. The rock cooled and hardened.

In this argument, the student offers several pieces of evidence, but with no real explanation for how the evidence supports the claim. A teacher might recommend that this student elaborate on the last sentence to explain how the rock cooling and hardening is related to the evidence and how that supports the claim that the rock is igneous.

Gravity Argument

Question: How are the ball's weight and mass affected when dropped on different planets/moons?

Well, the weight is greatly effected when it is dropped in different places. However, the mass is not effected at all by different places, because it will always be the same ball. It will have the same amount of stuff in it. And the weight changes because when we wrote down that on earth it was 1.00 lb then it was 0.165 lb on the moon and then on Jupiter it was 2.64 lbs.

In this argument, the student provides the claim, with supporting evidence from a simulation about how weight changes on different planets. However, this student does not use science ideas about gravity to explain why the weight is affected when the ball is dropped in different places. A teacher might ask this student to write an additional sentence connecting the evidence back to the claim.

Summary



Reasoning is the process of making clear how your evidence supports your claim. Teachers can develop student's reasoning skills through providing opportunities for argumentation, encouraging students to explain how their evidence connects to their claim and pointing out strong examples of reasoning.



The Learning
Design Group



PARTNERS AND RECOGNITION



Developed in collaboration
with Boston College



Funding provided by
National Science Foundation

NSF DRL-1119584

Any opinion, findings, and conclusions or
recommendations expressed in this material are those of
the author(s) and do not necessarily reflect the views of
the National Science Foundation.