A Guide to Developing Argumentation Practices in Science

Reteaching Loop: Identifying Basic Components of Strong Argumentation Writing by Analyzing Student Work

Strategy Guide

The Learning Design Group

THE LAWRENCE HALL OF SCIENCE

Grades 6–8

Overview

About the Reteaching Loops collection: Reteaching Loops are instructional sequences that focus on areas in which your students need more support. This collection of strategy guides provides ways for teachers to support deeper and more sophisticated understanding about several foundational aspects of argumentation in science. Each guide assumes that students have been introduced to the basic components of argumentation and that they need more practice and guidance in order to progress further with their skills. The following topics are addressed in this collection of Reteaching Loops: reading arguments, writing (basic components, relevant evidence, reasoning), and discourse.

Why provide extra support with this Reteaching Loop? Writing scientific arguments is often difficult for students. This genre of writing is especially hard to master because it has many essential component parts (claims, evidence, reasoning) that can be difficult to understand on their own. Additionally, the content about which the argument is being constructed is often difficult to comprehend and synthesize. Offering students' guided support and practice in breaking down some of the important aspects of scientific argumentation writing can help build their capacity to write arguments independently. This strategy guide is one of three Reteaching Loops for writing. (The other two are: Reteaching Loop: Understanding the Role of Relevant Evidence in Supporting a Claim and Reteaching Loop: Using the Reasoning Tool to Develop a Strong Written Argument.) In this series of Reteaching Loops for writing, students do very little writing. Instead, they participate in activities that build their capacity to understand the important components of scientific argument writing The three strategy guides in this Reteaching Loops series will provide students and teachers with shared background experiences to which they can refer as they work on writing throughout the year.

How do I use this strategy guide? This strategy guide introduces an approach to supporting students as they gain proficiency in particular aspects of argumentation writing. The two-day instructional sequence provides students with simple arguments that they compare during the lesson. They are prompted to identify and analyze specific elements of these arguments that make the arguments stronger or weaker. Through this analysis, students compile a checklist of elements that make strong arguments. By co-constructing a checklist with the teacher through a directed discussion, students start to internalize the expectations of a written argument. This lesson provides students with a baseline understanding of the components of argumentation writing that they can apply to more complex arguments they will write on their own in the future.

Addressing Standards

COMMON CORE STATE STANDARDS FOR ELA/LITERACY

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6–12

WHST.6–8.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices

Engaging in Argument from Evidence: Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.

Materials and Teaching Considerations

For the class

Part 1

- Projection: Scientific Argument Diagram
- Projection: Scientific Argument Checklist
- Projection: Cut Finger Illustration
- Projection: Cut Finger: Argument 1
- Projection: Cut Finger: Argument 2
- Projection: Cut Finger: Arguments 1 and 2
- 1 sheet of chart paper
- Marker, wide tip
- Masking tape

Part 2

- Projection: Rock Layers

For teacher reference

- Possible Scientific Argument Checklist

For each pair of students (copymaster)

Part 2

- Rock Layers: Arguments 1 and 2

Time frame

- Part 1: 30 minutes
- Part 2: 20 minutes

Teaching Considerations

Both Parts 1 and 2 of this strategy guide can be taught in one day. However, if you choose to compile students' ideas and create a Scientific Argument Checklist to distribute to students, it is probably best to spread out the teaching over two days. Although this strategy guide is intended for whole-class work, it can be adapted for smaller groups as well.

Getting Ready: Part 1

1. Create Scientific Argument Checklist. On a sheet of chart paper, create this poster. Refer to the projection (with the same name) to see what it should look like. You will write the heading and the first two items on the chart paper. (Note: You will need to create a new checklist for each of your classes since students' input will vary. On the back of each poster, write the class period.)
2. Review Teacher Reference: Possible Scientific Argument Checklist. This checklist is meant to be a guide for possible ideas that might come up during your class discussions. Note that every checklist you make with different groups of students will vary and that you can add to and modify these checklists over time. It will feel more valuable and authentic to students if you create the checklist according to what they say in class. Eventually, you can compile all students' ideas across classes into one shared checklist if you prefer, but it is important for all classes to independently experience the creation of their own checklists, since much of the learning about what makes a good argument is done collaboratively and orally. Feel free to refer to Teacher Reference: Possible Scientific Argument Checklist to help you to figure out important ideas that students might share. This reference document can provide you with some language to help you translate what students say into more succinct language.
3. Prepare to project the following:
    - Scientific Argument Diagram
    - Scientific Argument Checklist
    - Cut Finger Illustration
    - Cut Finger: Argument 1
    - Cut Finger: Argument 2
    - Cut Finger: Arguments 1 and 2

Part 1 (30 minutes)
Whole-Class Creation of a Scientific Argument Checklist

1. **Review arguments and the purpose of arguments. Optional: Project Scientific Argument Diagram, if useful.** Begin this lesson by reviewing what students already know about arguments and what the purpose of arguments is for scientists. [To convince others that yours is the best explanation of a phenomenon.] Explain that today, students will be reading and critiquing two sample arguments written by students. This will help students be better prepared to identify what makes an argument stronger and, therefore, can help them write stronger arguments on their own.
2. **Project Scientific Argument Checklist.** Explain that this is the beginning of a checklist that will be useful for students' writing. Read aloud the two items and let students know that

these are the minimal things that need to be included in an argument. Explain that today, as students' understanding becomes more clear about what makes a strong argument, they will discuss ways to revise the checklist. Let them know that you will work with them to create a better, more comprehensive checklist and that you will be adding to it by recording their ideas.

3. **Project Cut Finger Illustration.** Explain that this illustration was presented to a classroom of students about their age who were asked to write an argument about what they think might explain this boy's cut finger.

4. **Project Cut Finger: Argument 1.** Read aloud Argument 1. Ask students the following questions and have them explain their answers by referring to the argument.
   - **"Does the argument answer the question it is supposed to answer?"**
   - **"Is there a claim?"**
   - **"Is this a strong argument? Why or why not?"**

5. **Project Cut Finger Argument 2.** Read aloud Argument 2. Ask students the same questions as you did with Argument 1 and have them explain their answers by referring to the argument.
   - **"Does this argument answer the question it is supposed to answer?"**
   - **"Is there a claim?"**
   - **"Is this a strong argument? Why or why not?"**

6. **Project Cut Finger: Arguments 1 and 2.** Compare the two arguments. Ask the following questions and have students refer to the arguments as they discuss.
   - **"Which argument is stronger, Argument 1 or Argument 2? Why do you think this?"**

7. **Students come to consensus about which argument is stronger.** After a brief discussion, ask students to vote on which argument is stronger. Assuming that most students have agreed that Argument 2 is stronger, explain that there must be aspects of this second argument that make it better/stronger. Let students know that together, you will try to figure out what these better/stronger aspects are. If some students aren't convinced that Argument 2 is stronger, ask them to clearly explain what they find appealing about Argument 1. Let them know that they can use their rationale about Argument 1 as the class revises/adds to the checklist.

8. **Whole-class discussion and recording of students' thinking.** Use the following questions to guide the discussion. As students share their thinking and point out features of the arguments, record their thinking on the board. Use student-friendly language as you record.
   - **"Let's look at the claims. Which claim is stronger? Why?"** [Argument 2 because it's more specific. It addresses the question more specifically.]
   - **"What are some differences in the body of the argument that make Argument 2 better?"** [Argument 2 is much more detailed, clearly tells the reader what the connections are between what the author is observing and what she thinks happened in the room. All evidence and thinking supports the claim. Argument 1 does not explain how the evidence is connected to the claim or why it is important to think about.]

9. **Post the Scientific Argument Checklist poster for this class.** Remind students that one goal for today's lesson is to come up with a list of things that make arguments strong and convincing. Point out that the two items on the poster are the same as students saw on the projection at the beginning of the lesson. Remind students that these two items are the two minimal aspects that should be included in an argument.

10. **Ask students for suggested revisions and additions to the checklist.** Ask students to review the notes you just recorded on the board as well as the two items on the checklist. Say, **"Is there anything on the checklist that you would want to add or change?"** If students are reluctant to begin, you can start them off by saying, **"For example, let's think about this second item: *has a claim*. We talked about how Argument 2 has a stronger claim because it is more clear and more specific. How might we change this point to say something that is more accurate?"** [Has a claim that is specific and addresses the question being asked.]

11. **Discuss other ideas surfaced from the notes you recorded on the board.** When the class

has agreed on three or four points, add those points to the Scientific Argument Checklist poster. Ask students to help you with the wording so each point remains accessible and student friendly.

12. **Emphasize Scientific Argument Checklist as a reference.** Explain that students will be referring to this same checklist when they create their own argumentation writing.

Getting Ready: Part 2

1. Make one copy of the following copymaster for each student:
   - Rock Layers: Arguments 1 and 2
2. Prepare to project the following:
   - Rock Layers
3. Optional: Type up a version of the checklist that you feel will be most useful for your students to use throughout the year and make one copy for each student. You can have students refer to the checklist whenever there is time to have students offer peer editing or if you want students to practice critiquing their own argumentation writing or the writing of others.

Part 2 (20 minutes)
Practice Analyzing Arguments with the Scientific Argument Checklist

1. **Project Rock Layers.** Explain that the image shows a rock formation with four different layers of rock. Let students know that in a minute, they will receive two student-written arguments, each of which answers the question *Which rock layer in this diagram is the oldest—the bottom layer or the top layer?* Explain that students will first annotate both arguments by circling, underlining, or writing short notes. Their annotations should explain their thinking about what is good or not so good about each argument. Next, students will practice using the Scientific Argument Checklist (either the poster or the checklist you typed up) as they work independently to critique these two new arguments.
2. **Distribute arguments and have students annotate.** Distribute one copy of Rock Layers: Arguments 1 and 2 to each student. Have students annotate the arguments by circling, underlining, or writing notes about what is good or not so good about each argument.
3. **Optional: Distribute individual checklists.** If you decided to create a checklist from the notes you recorded during the whole-class discussion, distribute one copy of the checklist to each student.
4. **Have pairs discuss each argument as it relates to items on the Scientific Argument Checklist.** Once all students have analyzed and annotated the two arguments, ask pairs to go over each argument together and consider which aspects of the checklist are represented in each argument. They can do this orally or, if you created individual checklists, they can do this together on paper.
5. **Wrap up activity with a whole-class discussion.** Once students seem ready to move on, have them share their annotations and thinking about each argument as it relates to the Scientific Argument Checklist. Have a discussion about the relative strengths and weaknesses of each argument. If there is time, you may also want to add to the checklist and/or ask students to rewrite or revise Argument 2 (as a class or independently) in order to make it a better exemplar argument.

Educative Notes

Instructional Strategy: Comparing Arguments

The purpose of comparing arguments is twofold. First, students respond well, both in terms of motivation and learning, to activities in which they are asked to contrast two things *and* explain why one is better than the other. This can be an especially effective strategy for teaching about writing, since students rarely respond well to descriptors of good and bad writing and need examples to highlight these in order to fully appreciate writing suggestions and advice. Second, for specifically learning about writing arguments, this activity allows you to demonstrate some specific attributes of convincing argumentation writing. For example, arguments are easier to understand when they describe how pieces of evidence are connected. This happens when the evidence is linked to the claim in a sound and cohesive way. Often, students who are just beginning to learn about argumentation will simply list the evidence that supports the claim and may not include their thinking about *why* pieces of evidence support the claim. Modeling how to make the argument clearer will help students include this type of language in their own writing.

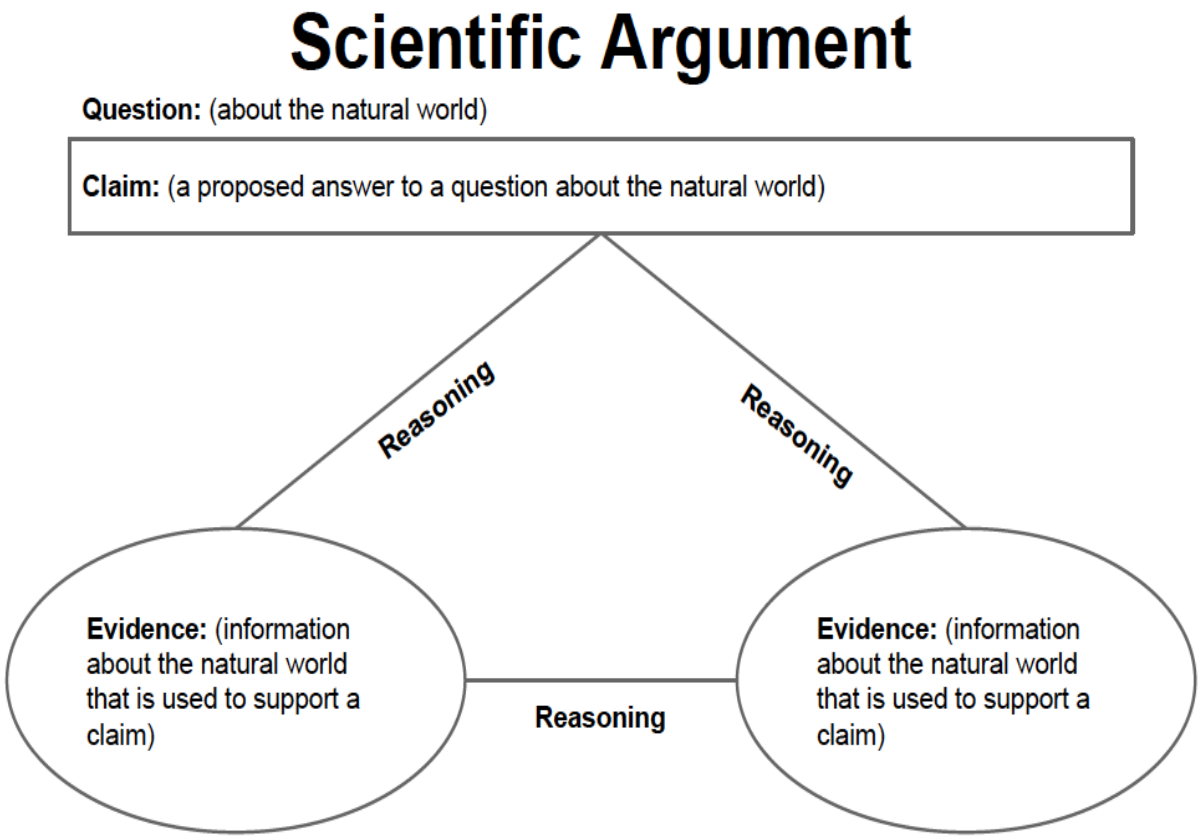
Supporting English Learners: Using Model Texts

Using model texts to support students' language use can be an especially important scaffold for many students including those ELs who are less familiar with scientific and/or academic language. For students who may have difficulty converting their evidence into written paragraphs, use the arguments from this lesson as models and reference them as students start to write more complex arguments. Spend more time discussing how Cut Finger: Argument 2 and Rock Layers: Argument 1 are both models of stronger arguments because they are more specific in their details, they answer the questions more clearly with focused claims, etc. Point out the claims and explain how the evidence is used to support the claims. Highlight words and phrases in the arguments that signal connections between the evidence and the claims. Encourage students to refer to these model arguments (Cut Finger: Argument 2 and Rock Layers: Argument 1) to help with the transitions and structures of their own written arguments. If you have time and your students have the content knowledge to do so, you can create even better versions of both of these exemplar arguments with your students.

Instructional Rationale: Using Everyday Examples

We have found that using an everyday example (one that does not rely on students' science content knowledge to understand and is likely familiar to most students) can help students improve their argumentation skills. They can learn about a specific aspect of argumentation without having to learn or process new science content at the same time. After the experience with an everyday example, students are better prepared to read arguments that contain relevant science content.

Scientific Argument Diagram



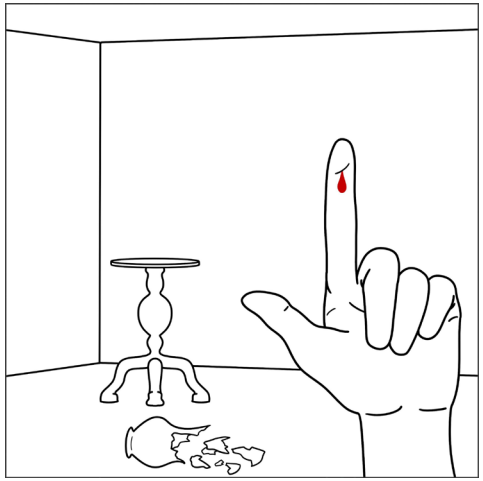
Scientific Argument Checklist

A scientific argument . . .

- ☐ answers a question.
- ☐ has a claim.

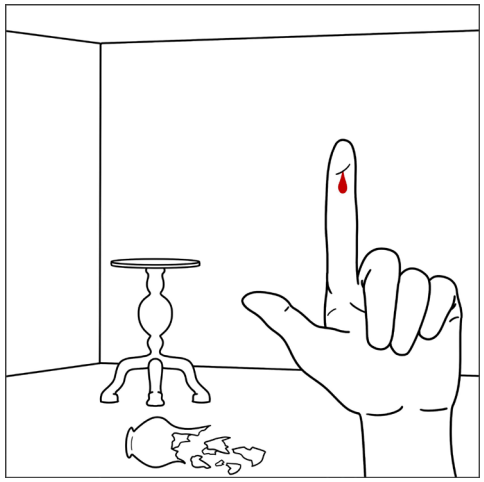
Cut Finger Illustration

Question: How did this boy cut his finger?



Cut Finger: Argument 1

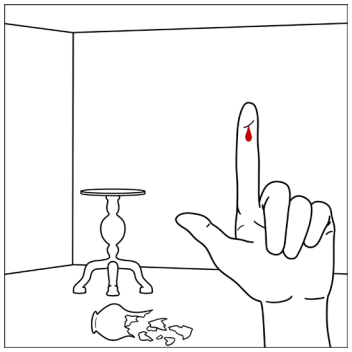
Question: How did this boy cut his finger?



Argument 1
The boy cut his finger on the vase. The vase is broken.

Cut Finger: Argument 2

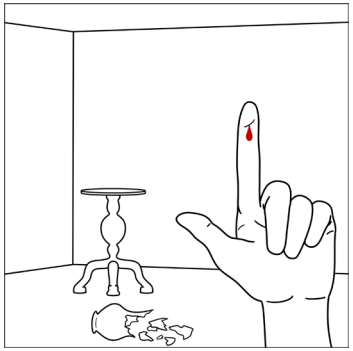
Question: How did this boy cut his finger?



Argument 2
The boy cut his finger when he tried to pick up the vase. I observed that the vase is broken. The broken pieces look sharp enough to cut someone, so I think he cut his hand when he picked up a piece of the broken vase.

Cut Finger: Arguments 1 and 2

Question: How did this boy cut his finger?



Argument 1
The boy cut his finger on the vase. The vase is broken.

Argument 2
The boy cut his finger when he tried to pick up the vase. I observed that the vase is broken. The broken pieces look sharp enough to cut someone, so I think he cut his hand when he picked up a piece of the broken vase.

Rock Layers

Question: Which rock layer in this diagram is the oldest—the bottom layer or the top layer?

Possible Scientific Argument Checklist

(Answers will vary depending on students' responses.)

A scientific argument . . .

- ☐ has a specific claim.
- ☐ answers the question being asked.
- ☐ contains evidence that supports the claim.
- ☐ connects observations with what the author thinks happened.
- ☐ uses language that is clear and descriptive.
- ☐ uses scientific terms (such as *observe*).

Name: _____ **Date:** _____

Rock Layers: Arguments 1 and 2

Argument 1

The rock layer on the bottom is the oldest. Rock layers form in a similar way as layers on a cake. To build a cake, you have to put the bottom layer down first, then the next layer on top of that, and the next layer on top of that. With rocks, this idea is called superposition. The oldest layer is the one on the bottom, then the next oldest layer is the one on top of that, and so on.

Argument 2

The bottom layer. It is under all the others. The top layer is the newest one. The middle layer is between them. That is superposition.

About Argumentation in the Science Classroom

Recently, in both science education research and the new Next Generation Science Standards (NGSS), argumentation has been increasingly emphasized as an important practice for students to learn. The NGSS give argumentation a central role as the way that scientific knowledge is developed and refined within the scientific community and, therefore, a fundamental way for students to both learn about science and develop scientific knowledge themselves. In addition, the Common Core State Standards-English Language Arts/Literacy (CCSS-ELA/Literacy) have placed the role of argumentation at the forefront in core disciplinary subjects such as science and history. Clearly, many associated with education—teachers, researchers, and policy makers—are converging on the importance of ensuring that our students can think about and represent their thinking in the clear, logical ways that the practice of argumentation represents. By providing students with a collection of lessons aimed at breaking apart and understanding the basic components of argumentation—reading, writing, and speaking—teachers can make it much more likely that students will have and feel success participating in this central scientific practice of argumentation, even when content becomes more and more complex.

Resources

- **Scientific Argument Assessments for Middle School Students.** A collaborative project between the Lawrence Hall of Science at the University of California, Berkeley and Katherine McNeill and colleagues at Boston College. Funding from Carnegie Corporation of New York. One product of this grant is a series of formative assessments along with corresponding teaching suggestions. These products can be found on the team's website (http://scienceaguments.weebly.com).
- **Constructing and Critiquing Arguments in Middle School Science Classrooms: Supporting Teachers with Multimedia Educative Curriculum Materials (MECMs).** A collaborative project between the Lawrence Hall of Science at the University of California, Berkeley and Katherine McNeill and colleagues at Boston College. Funding from the National Science Foundation. Products for this grant include professional-development videos, podcasts, and short animations that support teacher growth in understanding and teaching argumentation in the classroom. These products will be available in late 2015. Check the website for updates (http://learningdesigngroup.org).

About Us

The Learning Design Group, led by Jacqueline Barber, is a curriculum design and research group at the Lawrence Hall of Science at the University of California, Berkeley. Our mission is to create high-quality, next-generation science curriculum with explicit emphasis on disciplinary literacy and to bring these programs to schools nationwide. Our collaborative team includes researchers, curriculum designers, and former teachers as well as science, literacy, assessment, and curriculum-implementation experts.

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