

A Guide to Developing Argumentation Practices in Science

Reteaching Loop: Using the Reasoning Tool to Develop a Strong Written Argument

Strategy Guide

The Learning Design Group



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: Identifying Basic Components of Strong Argumentation Writing by Analyzing Student Work and Reteaching Loop: Understanding the Role of Relevant Evidence in Supporting a Claim.) 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? Reasoning is an integral part of creating sound, logical, and convincing arguments in science. The Reasoning Tool was created in order to provide students a scaffold for, and an explicit focus on, developing reasoning when making arguments. In this lesson, students practice developing reasoning by first using the Reasoning Tool and then by writing two simple arguments. This strategy guide is intended to support students as they learn to make convincing arguments about more complex scientific phenomena and as they learn that reasoning is the process of making clear how evidence supports a claim.

Addressing Standards

COMMON CORE STATE STANDARDS FOR ELA/LITERACY

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

WHST.6–8.1b: Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices

Engaging in Argument from Evidence. Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Materials and Teaching Considerations

For the class

- Projection: Scientific Argument Diagram
- Projection: Reasoning Tool
- Projection: Argument About Vegetables
- Projection: Reasoning Tool: Vegetables
- Projection: Reasoning Tool: Vegetables (with reasoning)
- Projection: Comparing Arguments About Vegetables
- Projection: Camouflaged Luna Moth
- Projection: Camouflaged Luna Moth Argument
- Projection: Reasoning Tool: Camouflaged Luna Moth
- 1 sheet of chart paper
- Marker, wide tip
- Masking tape

For teacher reference

- Completed Reasoning Tool: Camouflaged Luna Moth

For each student (copymaster)

- Reasoning Tool: Camouflaged Luna Moth

Time frame: 30–40 minutes

Teaching Considerations

This strategy guide can be taught in one day. However, 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

1. Create the Class Reasoning Tool: Camouflaged Luna Moth. On a sheet of chart paper (or on a whiteboard), create the Class Reasoning Tool: Camouflaged Luna Moth. Refer to the Reasoning Tool: Camouflaged Luna Moth copymaster to see how to fill in the first and third columns. During Step 18, you will record (in the middle column) students' thoughts about how the evidence supports the claim. (Note: See Teacher Reference: Completed Reasoning Tool: Camouflaged Luna Moth for guidance about supporting students' thinking while filling out the Reasoning Tool with your class.)
2. Make one copy of the following copymaster for each student:
 - Reasoning Tool: Camouflaged Luna Moth
3. Prepare to project the following:
 - Scientific Argument Diagram
 - Reasoning Tool
 - Argument About Vegetables
 - Reasoning Tool: Vegetables
 - Reasoning Tool: Vegetables (with reasoning)
 - Comparing Arguments About Vegetables
 - Camouflaged Luna Moth
 - Camouflaged Luna Moth Argument
 - Reasoning Tool: Camouflaged Luna Moth

Deepening Students' Understanding of Reasoning in Written Arguments with the Reasoning Tool

1. **Project Scientific Argument Diagram.**
Review the parts of an argument. A scientific argument begins with a question. The question is answered with a claim. The claim is supported with evidence. The author's reasoning is made clear in her writing. (Note: Keep this projected through Step 3.)
2. **Discuss the important task of convincing readers through written arguments.** Remind students that when they write arguments, they want to convince readers that theirs is the strongest argument. Let students know that today, they will focus on *how* they can make their evidence clear and convincing to others when they write. They can do this in many small ways such as the following:
 - Try to find and use the best possible evidence.
 - Write clearly and use words, phrases, and sentences that clearly convey your thinking.
 - Make sure that all your evidence and ideas support your claim.
 - Think about the writing you do that ties your evidence to your claim and that ties each piece, or type, of evidence to the

other pieces (or types) of evidence in the argument. This is called reasoning.

3. Point out the reasoning lines on the Scientific Argument Diagram.

- Explain that a scientific argument that just lists evidence isn't very convincing. A complete and convincing argument includes all the evidence and *how* it connects to the claim—the evidence includes reasoning. The author's job is to make sure that her reasoning is made clear.
- Explain that reasoning is often omitted. Many people, adults and young people alike, often forget to explain their reasoning. When you leave out the reasoning or the logical connections and ideas that hold your argument together, your argument is weak and not very clear or convincing. When you are trying to convince others and make the strongest argument you can, it is very important to include reasoning.

4. Project and introduce the Reasoning Tool.

Explain that this is a visual representation called a Reasoning Tool, and it will help students ensure that they include and explain their reasoning as they craft their arguments. The Reasoning Tool will help students think carefully about how their arguments hold together. It also helps students explain their thinking more clearly. Let students know that today, they will practice using the Reasoning Tool. Later, they will use it to help them think about their own independent writing.

5. Project Argument About Vegetables. Read aloud the simple argument once through. Ask students what they think about this argument. Allow a minute or two for students to share their initial reactions and opinions.

6. Read aloud the argument again. Summarize students' thinking by saying, **"This argument is leaving out a lot of information that would make it really convincing. For example, there is no information to answer the following questions: *Why is fiber good for you? What does Vitamin C do that makes it good for you? If the argument answered these questions, then I might be more convinced that I should eat vegetables every day***

because I would know the good things that fiber and Vitamin C do for my body."

7. Explain relevance to scientific arguments in general. Say, **"Many people just make arguments about the world. Sometimes in their arguments, they even provide evidence. However, if they leave out the thinking that connects the evidence to the claim, then they aren't making very strong or convincing arguments."**

8. Project Reasoning Tool: Vegetables. Explain that this is an example of how the Reasoning Tool can help students write richer, more convincing arguments. Remind students that in order to write strong arguments, they can't just make a claim and list the evidence. Rather, students need to explain *why* the evidence matters by describing *how* it supports the claim or *how* it is related to other evidence. The Reasoning Tool can help students ensure that they are including all these important aspects that make an argument strong.

9. Project Reasoning Tool: Vegetables (with reasoning). Read aloud the reasoning that has been added to the middle column. Ask students to share their thinking about the following questions:

- **"How did the additional thinking that has been added to the Reasoning Tool change the argument as a whole?"**
- **"Is the argument stronger? If so, how?"**
- **"Is the argument more convincing? If so, how?"**

10. Project Comparing Arguments About Vegetables. Explain that after working with the Reasoning Tool, it is a lot easier to write a convincing argument. On the projection, point out the original argument—Argument #1. Point out Argument #2, which is the argument that was written by using the Reasoning Tool.

11. Read aloud both arguments. Discuss with students why Argument #2 is much better than Argument #1. Help students see that Argument #2 is much better not only because it is longer than Argument #1, but because it is clear, connected, and convincing, and that makes it the stronger argument.

Practice Using the Reasoning Tool

- 1. Introduce new argument.** Explain that in a few minutes, students will work with the Reasoning Tool and a new argument. Let them know that they will record the argument in the Reasoning Tool and try to add reasoning to make the argument better, more complete, and more convincing.
- 2. Project Camouflaged Luna Moth.** Explain that this image of a camouflaged luna moth is what the next argument is about.
- 3. Project and discuss Camouflaged Luna Moth Argument.** Read aloud the argument and compare the argument to the photograph. Help students see that although the observations used as evidence are accurate, the argument itself isn't very convincing because the reasons for including these pieces of evidence are not clear in the writing.
- 4. Project the Reasoning Tool: Camouflaged Luna Moth.** Point out that the Reasoning Tool has been filled in with the original argument. Read aloud the information in the first and third columns. Let students know that their job will be to complete the middle column of the Reasoning Tool in order to make each piece of the argument clear and convincing. As needed, ask a few students for initial ideas about what they might record in each row.
- 5. Project Camouflaged Luna Moth again.** Let students know that you will keep this projected while they record in the Reasoning Tool so they can think about how to make the evidence more connected to the claim.
- 6. Distribute Reasoning Tool: Camouflaged Luna Moth.** Distribute one copy of the Reasoning Tool to each student and have them begin. Encourage pairs to discuss and share their thinking as they work, since peer interaction and oral practice can strengthen students' abilities to write clear statements during this activity. Circulate and offer support as necessary. If students need help, ask them to orally explain how or why the evidence they are considering supports the claim (e.g., *Why is the green coloring important? How does this support the claim about camouflage?*). Often, once a student has explained his thinking aloud, it is easier to figure out how to express the same thinking in writing.
- 7. Discuss and complete Class Reasoning Tool: Camouflaged Luna Moth.** When students have finished completing the Reasoning Tool independently, call their attention to the Class Reasoning Tool: Camouflaged Luna Moth that you created on chart paper (or on the whiteboard). Have a whole-class discussion about how students' filled in the middle column. As you discuss, record students' thinking in note form (so the entire argument isn't written out for them) in the middle column of the Class Reasoning Tool: Camouflaged Luna Moth. (Note: See Teacher Reference: Completed Reasoning Tool: Camouflaged Luna Moth for guidance about supporting students' thinking.)
- 8. Project Camouflaged Luna Moth Argument again.** Explain that the next step is to use the completed Reasoning Tool to help write a better argument. Explain that the thinking in the middle column provides the connections and important information that is needed to make a much better argument.
- 9. Model first steps for rewriting the argument.** As needed, discuss following:
 - The claim can be the same as the one in the Reasoning Tool. If students want to refine or reword the claim, they can do so. Students can start their written arguments by using the claim you agreed upon as a class, or they can use a new claim of their own.
 - To write the body of the argument, students should use the ideas in the Reasoning Tool and flesh them out by writing complete sentences. Each row of the Reasoning Tool should contain relevant evidence and reasoning. Therefore, in order to make a complete written argument, students just need to reword their notes and make them into full sentences. They can work across each row and use the notes in each row to create a written description of each kind of evidence and how that evidence supports the claim.
- 10. Model creating the start of an argument from the information on the Class Reasoning Tool.** Depending on the needs of your students, you may choose to do your modeling orally or in writing (on the board or by projecting with a document camera). Students needing less support or who process oral information easily

would only need the oral version; students needing more support could use the more complete modeling offered by a written example.

- Begin by pointing out that the claim comes from the last column in the Reasoning Tool. Record this or make this suggestion orally.
 - Beginning with the first row of the Reasoning Tool, model how to turn the information from this row (including the notes you recorded during Step 7) into full sentences. Record this or make this suggestion orally.
- 11. Students write arguments.** Encourage students to use their own notes and/or the recorded notes from the Class Reasoning Tool. Circulate and offer support as needed.
 - 12. Wrap up activity.** When students have finished writing, hold a short debrief discussion. Ask students to think about and discuss how or why the Reasoning Tool was helpful for making clear and more developed written arguments.

Educative Notes

Support for English Learners: Using Graphic Organizers

Graphic organizers are tools that can help ELs understand abstract ideas. The use of graphic organizers (such as the Reasoning Tool used in this lesson) is useful for all students but may be especially important for some ELs. As students complete their Reasoning Tools independently, check in with ELs. Help them articulate and then record their ideas in the second column. As you continue to write arguments over the course of the year, consider providing blank Reasoning Tools for those ELs who respond well to using it, as well as other students who need this support.

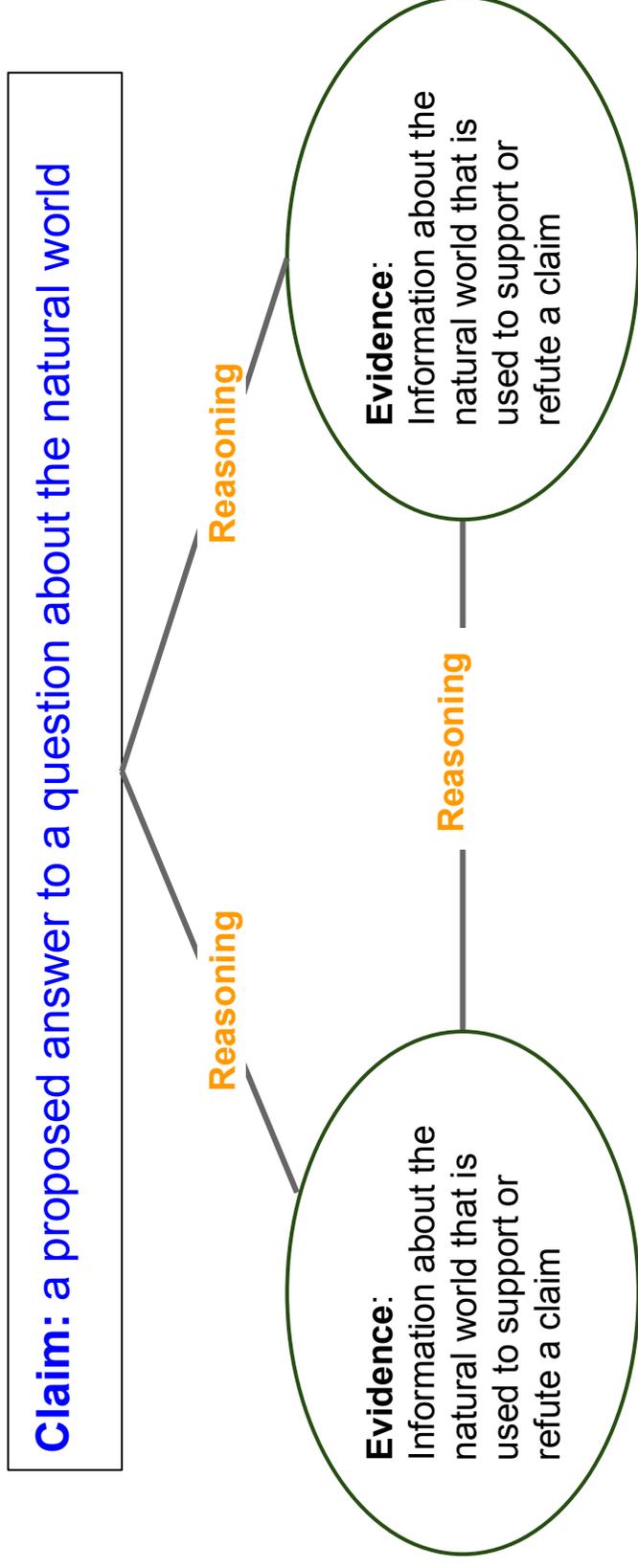
More Support: Struggling Writers

Some students may find writing a daunting task. Provide support by discussing the evidence and reasoning from the Reasoning Tool before a student begins writing. Then, help her by repeating what she told you while she records the information in the body of the written argument. You might also consider providing sentence starters such as *Vegetables are good for you because . . .* Both of these suggestions allow the student ownership of her work while scaffolding academic writing.

Scientific Argument Diagram

Scientific Argument

Question: about the natural world



Reasoning Tool

Evidence	This evidence matters because . . .	Therefore, . . .

Argument About Vegetables

Claim: Vegetables are good for you.

Evidence used in argument: Vegetables contain fiber and vitamins, such as Vitamin C.



Reasoning Tool: Vegetables

Evidence	This evidence matters because . . .	Therefore, . . .
Vegetables contain Vitamin C.		Vegetables are good for you. 
Vegetables contain fiber.		

Reasoning Tool: Vegetables (with reasoning)

Evidence	This evidence matters because . . .	Therefore, . . .
Vegetables contain Vitamin C.	Eating vegetables and fruits that contain a lot of Vitamin C can help heal wounds and protect against colds and allergies.	Vegetables are good for you. 
Vegetables contain fiber.	Eating vegetables that contain fiber can reduce the risk of heart disease, obesity, and type 2 diabetes.	

Comparing Arguments About Vegetables

Argument #1

Vegetables are good for you. They contain fiber and vitamins, such as Vitamin C. You should eat vegetables every day.

Argument #2

Vegetables are good for you. They contain fiber. Scientists have found that fiber can reduce the risk of heart disease, obesity, and type 2 diabetes.

Vegetables also contain important vitamins, such as vitamin C. Vitamin C has been shown to heal wounds and may even help protect us against colds and allergies. Since they have so many health benefits, you should eat vegetables every day.

Camouflaged Luna Moth



Camouflaged Luna Moth Argument

Luna moths have camouflage to help them avoid predators. The luna moth has green, yellow, and brown coloring, brown spots, and a long brown stripe on top. The wings are curved and shaped like leaves. The wings look like they are piled on top of each other.



Reasoning Tool: Camouflaged Luna Moth

Evidence	This evidence matters because . . .	Therefore, . . .
It has green and yellow coloring, brown spots, and a long brown stripe on top.		Luna moths are camouflaged to look like leaves so when they sit on trees, they can avoid predators.
The wings are curved and shaped like leaves. The wings are piled on top of each other.		

Completed Reasoning Tool: Camouflaged Luna Moth

Evidence	This evidence matters because . . .	Therefore, . . .
<p>It has green and yellow coloring, brown spots, and a long brown stripe on top.</p>	<p>The coloring makes the moth look the same as the colors found on the tree on which the moth is sitting. The tree is brown, green, and yellow and has brown spots. The brown stripe on the moth looks like a stick on the tree. This helps the moth blend in.</p>	<p>Luna moths have camouflage to help them avoid predators.</p>
<p>The wings are curved and shaped like leaves. The wings are piled on top of each other.</p>	<p>The leaves on the tree that the moth is on are layered on top of each other. The shape of the leaves is similar to the shape of the moth's wings .</p>	

Names: _____ Date: _____

Reasoning Tool: Camouflaged Luna Moth

Evidence	This evidence matters because . . .	Therefore, . . .
It has green and yellow coloring, brown spots, and a long brown stripe on top.		Luna moths have camouflage to help them avoid predators.
The wings are curved and shaped like leaves. The wings are piled on top of each other.		

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://sciencearguments.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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The Learning
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