Scientific Explanation Tool
Guide for Teachers

The scientific explanation tool gives students the framework to build scientific explanations that include evidence and reasoning to support their ideas—a hallmark of scientific reasoning. You can use this tool anytime you ask students to use their own data, or data that they have gained from other sources, to form conclusions or state a claim. This tool is based on work done by Kuhn and Reiser (2006), McNeill and Krajcik (2007), and Rosenshine and Meister (1994).

Using the Explanation Tool
The Explanation Tool has five basic parts. Following is a summary of the basic parts of the tool.

1. The question that students are trying to answer or the problem they want to solve.
Doing science involves answering questions about the world. Testable questions in science are those that one can answer by investigations. The questions that you ask help you decide what data students will collect.

2. The evidence that students gather. This part of the template includes the data students have collected that will help you answer the question. You may collect a lot of data in an investigation. But some of that data will not help students answer the question. Data become evidence when they help answer your question. This evidence may come from a number of sources like the investigation, observations, readings or simulations, or investigations that others have done.

3. Reasoning. In this part, students should explain why each piece of evidence helps them answer the question. For each piece of evidence in the left column, there should be a corresponding statement of reasoning on the same row in the right column. The reasoning is a justification that logically links the answer to the question to the evidence. These statements show why the data count as evidence to help answer the question. The statements should include any scientific principles.

4. The claim or claims. A claim is an answer to the question that one is trying to answer. The claim should be stated in one or two sentences. A claim should make a statement that answers the question or addresses the original problem. This may be in the form of a trend, a behavior, or a generality that the evidence supports.

5. The scientific explanation. This is the most important work that students will do—creating the scientific explanation. As they get better at writing scientific explanations, they may only need to complete this part of the tool. The previous parts are to help students with this final step. The explanation will likely be a short paragraph. There are two goals to writing a strong scientific explanation. The first goal is to write a logical explanation that includes a claim that is supported with your evidence and reasoning. Students should connect each piece of evidence and reasoning to the claim. The second goal is to use appropriate scientific principles in the reasoning. When using a scientific principle, students should show how the evidence supports their claim.

You may notice that the claim comes after the “evidence” and “reasoning” parts. For teachers who are accustomed to teaching students to write scientific explanations using claim, evidence, and reasoning, this may seem strange. The reason for putting the claim in this location is to help emphasize to students that the claim must be based on evidence and reasoning. Scientists do not make a claim, and then look

for evidence to support it; rather they begin with a question or a problem to solve and then conduct investigations. Some of the data they collect will help them answer the question or solve the problem. These data become the evidence that they use, along with reasoning, to formulate a claim that will answer the question or address the problem. When you use this tool, there may be times when students already have the evidence and the first task you want them to do is to make a claim. Do not let the structure of the template force you to use it in only one way.

Reasoning is the most difficult part of writing a strong scientific explanation. And it may be the most difficult for you to teach. Modeling both strong examples of effective reasoning and examples of explanations that lack reasoning is a good way to teach students about reasoning. Reasoning is the link that connects the evidence to the claim. The first important part of reasoning is the logical way in which students present their arguments. Students should develop a logical argument to justify why the data they are using support their claims. The second part of reasoning is using appropriate scientific principles. If your students have had the opportunity to learn appropriate scientific principles that will strengthen their arguments, they should include them. A strong scientific explanation uses appropriate scientific principles to justify that the evidence supports the claim. However, you may want students to begin constructing explanations from their experiences before they have learned the related scientific principles. In this case, an explanation that is logical and relates the students' experiences to the claim is acceptable.

Use this template to help students organize their work so that they can create a strong and convincing scientific explanation. As your students become more proficient in generating scientific explanations, they may not need to use the template and can develop strong and convincing scientific explanations on their own. The goal for using the template is for students to eventually form habits of mind that include all the key elements for developing a scientific explanation.

References

Kuhn, L., & Reiser, B. (2006). Structuring activities to foster argumentative discourse. Paper presented at the American Educational Research Association. San Francisco, CA.

McNeill, K. L., & Krajcik, J. (2007). Instructional strategies to support students writing scientific explanations. In J. Luft, J. Gess-Newsome & R. Bell (Eds.). Science as inquiry in the secondary setting. Washington, DC: National Science Foundation.

Rosenshine, B., & Meister, C. (1994). Reciprocal teaching: A review of the research. Review of Educational Research, 64(4): 479–530.

How to Write a Scientific Explanation

Components

- Make a claim about the problem.
- Provide evidence for the claim.
- Provide reasoning that links the evidence to the claim.

Definitions

- Claim: An assertion or conclusion that answers the original question
- Evidence: Scientific data that supports the student's claim that must be appropriate and sufficient. Can come from an investigation or other source such as observations, reading material, archived data, or other
- Reasoning: Justification that links the claim and evidence. Shows why the data counts as evidence to support the claim, using appropriate scientific principles.

Qualities of Communication

Write the explanation so others can understand it.

- Use precise and accurate scientific language.
- Write clearly so that anyone interested in the explanation can understand it.
- Articulate your logic.

Explanation Tool

Question	
Evidence from data and observations	**Science ideas or concepts or principles**
Claim *(Your claim should answer the question.)*	
Explanation *(Make sure to link your claim, evidence, and science ideas.)*	