

Lesson 10

How Do I Communicate Scientific Arguments and Evidence?

TEKS 8.3(B)
TEKS 8.3(C)

Communicate explanations and solutions individually and collaboratively in a variety of settings and formats.
Engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.



Introduction

Real-World Connection

Learning to communicate information in the scientific field is a crucial skill. Collaboration allows scientists to combine knowledge, which leads to new ideas that may not have been otherwise possible. Collaboration continuously improves scientific processes, ideas, and technologies and leads to a better society. Sharing knowledge also allows the public to become more educated on important topics. In this lesson, you will learn the importance of communicating arguments and evidence in the scientific field. Then, at the end, you will come back to the ideas presented.

Words to Know

jargon
collaboration
inward communication
outward communication
claim
empirical evidence
reasoning
rebuttal

What I May Already Know 7.3(B), 7.3(C)

- I know how to communicate scientific information in a variety of ways.
- I know how to engage respectfully in scientific argumentation.

Understand the TEKS

It is important to know these terms when reading about how to communicate scientific arguments and evidence.

Jargon is special words or expressions that are used in a particular profession or field of study.

Collaboration is working with others to create or produce something.

Inward communication is information shared within a certain profession or field.

Outward communication is information shared beyond a certain profession or field, commonly with the public.

A **claim** is a statement that is backed by data and that answers a specific question.

Empirical evidence is information acquired through observations or experimentation.

Reasoning is when you explain how or why your evidence proves your claim to be true.

A **rebuttal** is when you provide evidence that seeks to disprove someone's argument.



Guided Instruction

Read the following information and answer the questions.

Communication is an incredibly important skill. It takes time to develop but can help you in your personal and professional life. Similarly, communication in science helps scientists in their work. Collaboration, sharing ideas and working with others, allows scientists to form gather reliable and accurate information. There are various ways to communicate scientific information.

Setting

The first thing to consider is the setting in which you will share information. Will you be presenting to your peers in a small group? Your class? A large room of people? Where you share information should determine the format in which you present it. Formats include presentations, speeches, posters, demonstrations, and many other methods. If you were presenting your experiment at a science fair where people are constantly moving around, a slideshow or speech may not be best as it requires people to listen from the beginning. Instead, you could create a poster, where you display all the information. In this way, people can read at their own pace, come and go as they please, and ask you questions as they learn.

Clarity, Accuracy, and Ease

Wherever and however you present your work, you should always ensure that it is clear, accurate, and easy to understand. To do this, provide the following information when possible.

- The question you investigated
- A full, written-out hypothesis
- All the procedures you followed, in order
- The data you collected in an appropriate form (e.g., bar graph, line graph, histogram, and so on)
- The conclusions you formed

Did You Know?

Sharing scientific misinformation can result in extremely negative outcomes. For example, in the 1940s, a cigarette company claimed their brand was the most used by doctors. They hoped to convince people that if doctors used their product, it must be healthy. To this day, smoking directly causes over 400,000 deaths per year.

Your Audience

People do not always share the same level of scientific knowledge. Therefore, be sure to present information in ways that your audience will understand. Pay close attention to the jargon, the special words or expressions used in a particular profession or field of study. For example, in the sentence “Life is not possible at absolute zero,” what is absolute zero? Most people would not know. Instead, rephrase the sentence to “Absolute zero is the coldest temperature possible and measures about -460°F . At this temperature, life is not possible.” This sentence defines absolute zero in a way that many who are not science professionals could understand. You can also use images, videos, examples, and demonstrations to help your audience understand complex or unfamiliar topics.

People Involved

Sometimes you will present information by yourself. Other times, you will work on a team. When you collaborate, you work with others to create or produce something. Listening to others’ perspectives can open your mind to ideas that you may not have considered. If you are working on a team, it is helpful to assign roles. For example, who will create the data tables and graphs? Who will discuss the conclusion? You should also review each other’s work as a team to ensure that everyone is contributing appropriate information.

Sharing scientific information is important in the professional world. Scientists share information through inward and outward communication. Inward communication is information shared within a certain profession or field (for example, studies published in peer-reviewed journals). Outward communication is information shared beyond a certain profession or field.

One of the many benefits of communication in science is that ideas are constantly discussed and debated. Another important skill is the ability to engage respectfully in scientific argumentation. The role of argumentation in science is to ensure that scientific ideas are accurate and reliable.

Claim Evidence Reasoning

To form a strong argument, you should always provide a claim, evidence, and reasoning. A claim is a statement that answers a specific question. Evidence can include a wide variety of things but should always provide proof that your claim is correct. Empirical evidence is information collected through observations or experimentation. Reasoning is a necessary step in scientific argumentation. The role of reasoning is to show how or why the evidence you provide supports your claim. Here is an example of an argument using CER.

- **Claim** – Your body produces more carbon dioxide (CO_2) while exercising.

- **Evidence** – For the non-exercise test, blowing air into the liquid caused it to turn light yellow-green. For the exercise test, blowing air into the liquid after exercising caused it to turn dark green.
- **Reasoning** – The liquid is a CO₂ indicator. This means that the greener the liquid becomes, the more CO₂ in the subject's breath. The liquid turned greener after exercising compared to the non-exercising test. Therefore, the body produced more CO₂ while exercising.

A rebuttal is when you provide information that seeks to disprove what someone else said. A strong rebuttal addresses exactly what someone says and provides multiple pieces of evidence to prove it wrong.

Critical Thinking

1. What format would you use to communicate information to people across the United States and why?

2. Write a sentence using jargon from an area of your expertise. Then rephrase the sentence so people outside the area can understand what you are saying.

3. Provide an example of two perspectives that differ on the same topic.

How Am I Doing?

- ★ What questions do you have?

- ★ Fill in the circle that shows how you are doing with the skill.

I am stuck.

I almost have it.

I understand the skill.



★ Practice

DIRECTIONS Read and answer each question carefully.

1 Which of the following is a claim?

- Ⓐ The solution turned blue.
- Ⓑ Water boiled, resulting in heat.
- Ⓒ Why does the sun appear to set?
- Ⓓ Dogs have trouble seeing the color red.



2 Lee says a research team's presentation to experts in the field is more reliable. Katya says a published article in a scientific journal is more reliable. Which person is correct and why?

- Ⓐ Lee is correct because the presentation will be peer reviewed by the experts.
- Ⓑ Katya is correct because being published in a journal requires meeting more expectations.
- Ⓒ Lee is correct because presented information is more reliable than written information.
- Ⓓ Katya is correct because the information in the journal will be shared with the public.

3 Which scenario is inward communication?

- Ⓐ A doctor teaching a nurse about a new medication
- Ⓑ A doctor telling a patient the diagnosis
- Ⓒ A nurse describing research to friends
- Ⓓ A patient telling a receptionist the symptoms



4 Select the **BEST** rebuttal to the argument below?

Social media is good. It allows people to stay in touch with friends. Because social media maintains friendships, it is good.

- Ⓐ Phones make social media popular. Phones give people access to apps. Because phones allow more people to use apps, they make social media popular.
- Ⓑ Social media is damaging. People feel insecure looking at others' lives. Because social media exposes people to others' lives, it is damaging for people.
- Ⓒ Social media is bad. Getting "likes" on photos makes people happy. Because posting impacts people's emotions, social media is bad.
- Ⓓ Social media causes drama and is, therefore, not good for people.

5 Which is **NOT** empirical evidence?

- Ⓐ A chemist observed a red vapor from the chemical reaction.
- Ⓑ A biologist heard a rare bird chirping.
- Ⓒ A physicist felt a stronger magnetic pull between two magnets.
- Ⓓ An engineer thought of an idea about how to solve a problem.



★ Assessment

DIRECTIONS Read and answer each question carefully.

- 1 Two scientists presented a research poster, but the parts on which they individually worked did not fit together. What **MOST LIKELY** went wrong?
- (A) They did not seek other perspectives to form new ideas.
 - (B) Their work was not based on empirical evidence.
 - (C) They did not review each other’s work as a team.
 - (D) The jargon they used was too complex.

- 2 Match the following sentences to the appropriate category. Use the letters shown.

Write **ONE** correct answer in each box.

- (A) Oak trees produce the strongest wood.
- (B) Plant A grew taller, so the fertilizer worked.
- (C) Steam came out of the beaker.
- (D) Dolphins are the smartest sea creatures.

Claims	Evidence	Reasoning
[]	[]	[]

- 3 Arya is sharing her new research with 100 experts in a conference hall. Which format would be **MOST** appropriate?
- (A) A poster
 - (B) A research paper
 - (C) A slideshow presentation
 - (D) A video of Arya speaking

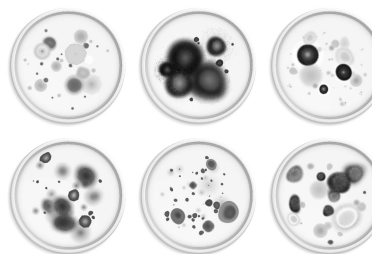
- 4 The object the scientists collected was taken to a lab, where they determined that it was made up of phospholipids.

Which word is jargon?

Write your answer in the box.

- 5 Mira conducted her own experiment and presented the following information at a science fair.

I sought to answer which cleaning product worked best. I separated my desk into six areas and cleaned each area with a different solution. Then, I took a bacteria swab of each section and observed which sample had the most bacteria on it. Here are the samples I collected.



What should Mira add to increase the clarity or accuracy of her communication?

- (A) A conclusion so people understand the results and importance of her work
- (B) The cited sources so people trust her information more
- (C) A hypothesis so people can better understand the purpose of her work
- (D) A graph so people can see the pattern within her data

**Exit Ticket**

Now you understand how to communicate scientific arguments and evidence. Using your knowledge on a topic, use CER for a short explanation of a phenomenon or solution to a problem. Some possible topics are the environment, safety in sports, or the importance of taking good care of your pet.

1. What is the topic?

2. What is your claim?

3. Provide one piece of evidence.

4. Provide a short reason (no more than two sentences).
