

Scientific Process and Questioning

TEKS

- **B.2B** know that **hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence**. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories;
- **B.2C** know **scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers**. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but **they may be subject to change as new areas of science and new technologies are developed**
- **B.2D** distinguish between scientific hypotheses and scientific theories

Vocabulary

- Hypothesis
- Theory
- Scientific Method

Prerequisite Questions

- What are the steps to the scientific method?

Essential Question #1

- Why is the scientific method necessary for solving a problem?

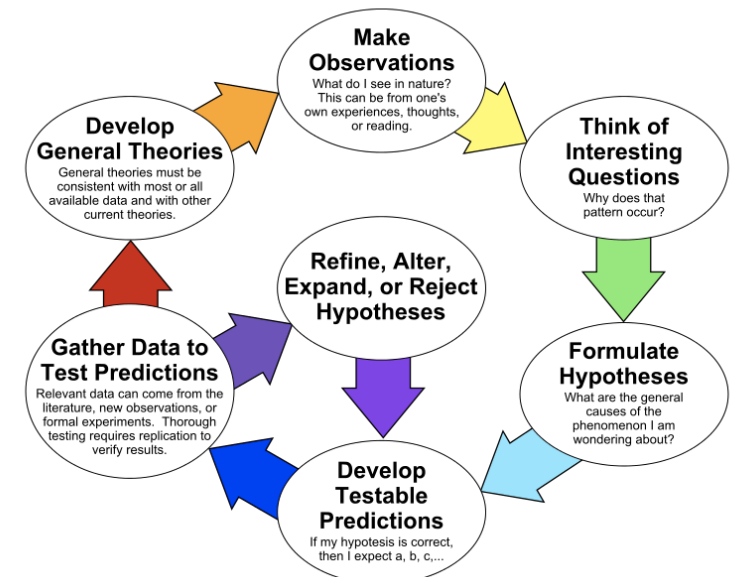
Scientific Method

- A systematic process that is used to answer a question about a problem.

Steps:

1. State the problem/Ask a question (Observation)
2. Create a hypothetical answer (Hypothesis)
3. Experiment to test hypothesis
4. Collect and Analyze data
5. Explain conclusion
 - a. If the conclusion lines up with/supports the hypothesis, you are done.
 - b. If the conclusion does not agree with the hypothesis, return to step 2.

The Scientific Method as an Ongoing Process



Example 1

Problem: Your cell phone is dead, what do you do?

Hypothesis: If the phone is plugged in, it will recharge.

Experiment: Plug in phone and wait for results.

Collect Data: the phone did not charge, so this hypothesis must be rejected.

Recreate hypothesis and test again: The battery might be broken...

Example 2

Problem: You broke a beaker during a lab.

Hypothesis: If I tell my teacher, they will clean it up for me.

Experiment: Have a friend keep people away while you tell the teacher.

Collect Data: The teacher thanks you for letting them know and cleans up the broken glass.

Hypothesis was accepted, no need to revisit the hypothesis. You are done!

Practice

- Write a problem that you want to solve with the scientific method.
- Use the steps of the scientific method to solve the problem/question.
- Be ready to share your work.

Essential Question #2

- How are Hypothesis and Theory used differently in science?

Hypothesis vs Theory

- Most people use the term Theory incorrectly.
- They use *theory* in place of the idea of a hypothesis.
- Ex: **“I don’t know how this works, but I have a theory.”**
- What should be said is **“I don’t know how this works, but I have a hypothesis”** – this is the correct way, because a hypothesis is an educated guess to a problem or question.

Hypothesis vs Theory

- The purpose of a hypothesis is to be an educated guess to a potential question or observed problem.
- A hypothesis can be either accepted or rejected, depending on the data that is collected.
- A theory is an accepted statement about a set of scientific observations based on multiple experiments providing the same results.
- A theory is not a fact. Facts are always true; however, theories can be disproven when scientific processes improve over time.

Example: For almost 2000 years, the Catholic church taught that the Earth was the center of the universe, and everything revolved around us. In 1543 Nicolaus Copernicus hypothesized that the Earth revolved around the sun. It would be almost 100 years later that Galileo Galilei would collect evidence using a new invention called the telescope that would show that the Earth, along with all the other planets, are revolving around the sun.

Theories can change when new technology pushed the scientific boundaries.

Concept Mastery Questions

- How can the scientific method be used to advance scientific knowledge?
- What is the difference between hypothesis and theory in science?
- How do theories change?