

Scientific Method

Ck12 Science

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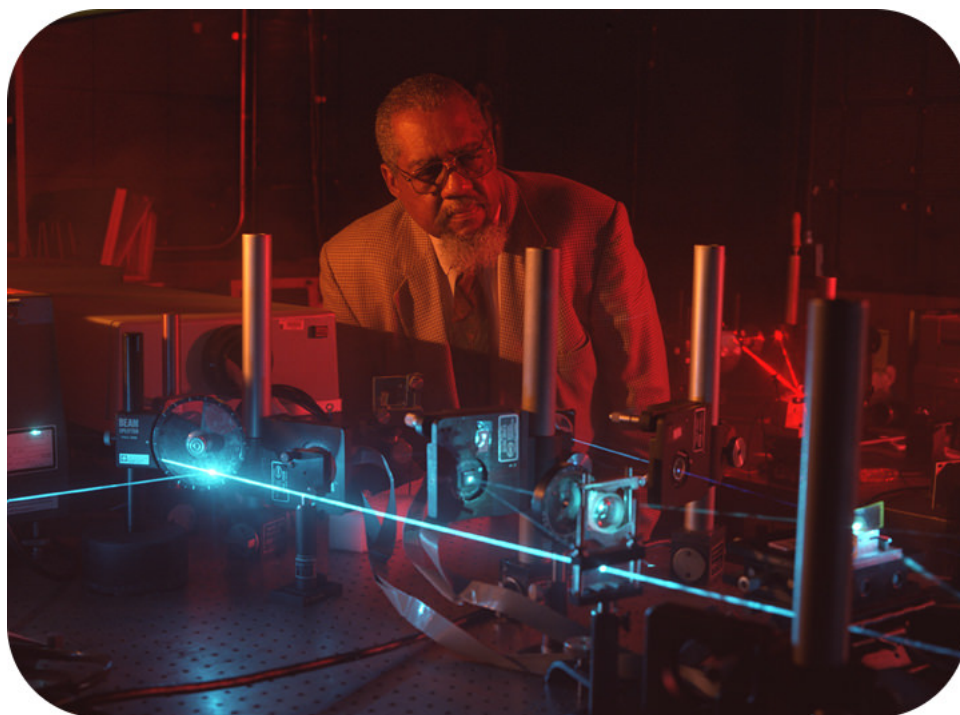
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CHAPTER 1

Scientific Method



Don Frazier, a NASA chemist, conducting an experiment using a laser imaging system.

In science, we need to make observations on various phenomena to form and test hypotheses. Some phenomena can be found and studied in nature, but scientists often need to create an **experiment**. Experiments are tests under controlled conditions designed to demonstrate something scientists already know or to test something scientists wish to know. Experiments vary greatly in their goal and scale, but always rely on repeatable procedure and logical analysis of the results. The process of designing and performing experiments is a part of the scientific method.

The Scientific Method

The **scientific method** is the process used by scientists to acquire new knowledge and improve our understanding of the universe. It involves making observations on the phenomenon being studied, suggesting explanations for the observations, and testing these possible explanations, also called **hypotheses**, by making new observations. A hypothesis is a scientist's proposed explanation of a phenomenon which still must be tested.



The scientific method is employed by scientists around the world, but it is not always conducted in the order above. Sometimes, hypothesis are formulated before observations are collected; sometimes observations are made before hypothesis are created. Regardless, it is important that scientists record their procedures carefully, allowing others to reproduce and verify the experimental data and results. After many experiments provide results supporting a hypothesis, the hypothesis becomes a **theory**. Theories remain theories forever, and are constantly being retested with every experiment and observation. Theories can never become fact or **law**.

In science, a law is a mathematical relationship that exists between observations under a given set of conditions. There is a fundamental difference between observations of the physical world and explanations of the nature of the physical world. Hypotheses and theories are explanations, whereas laws and measurements are observational.

Summary

- The scientific method consists of making observations, formulating a hypothesis, testing the hypothesis with new observations, making a new hypothesis if the new observations contradict the old hypothesis, or continuing to test the hypothesis if the observations agree.
- A hypothesis is a tentative explanation that can be tested by further observation.
- A theory is a hypothesis that has been supported with repeated testing.
- A scientific law is a statement that summarizes the results of many observations.
- Experimental data must be verified by reproduction from other scientists.
- Theories must agree with all observations made on the phenomenon under study.
- Theories are continually tested, forever.

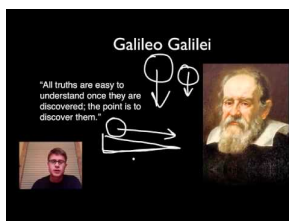
Review

1. A scientific investigation is not valid unless every step in the scientific method is present and carried out in the exact order listed in this lesson.

1. True
 2. False
2. When a theory has been known for a long time, it becomes a law.
1. True
 2. False
3. Which of the following is closest in meaning to the word “hypothesis”?
1. Fact
 2. Law
 3. Formula
 4. Suggested explanation
 5. Conclusion
4. Why do scientists sometimes discard theories?
1. The steps in the scientific method were not followed.
 2. Public opinion disagrees with the theory.
 3. The theory is opposed by the church.
 4. Contradictory observations are found.
 5. Congress voted against it.
5. If a hypothesis is rejected by the observations from an experiment, then the experiment
1. May have been a success.
 2. Was a failure.
 3. Must have been poorly designed.
 4. Didn't follow the scientific method.

Explore More

Use this resource to answer the questions that follow.



MEDIA

Click image to the left or use the URL below.

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1. What are the first two examples of possible questions that the scientific method can be used to answer?
2. Which two Greek philosophers are mentioned in the video?
3. Which scientist disproved Aristotle's idea that heavy objects fall faster than lighter objects? How?
4. How can you remember the difference between an independent, dependent, and controlled variable?

References

1. Courtesy of NASA. <http://www.nasa.gov/centers/marshall/about/marshallfaces/frazier.html> .
2. Christopher Auyeung. [CK-12 Foundation](#) .