

The Process of Science



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In 1928, Alexander Fleming noticed that bacteria he was studying did not grow in the presence of a yellow-green mold. In 1945, Fleming shared a Nobel Prize for Medicine with Howard Florey and Ernst Chain, who led the team that isolated penicillin.



What is science?

Science is a system of knowledge or a way of knowing that requires observation and experimentation.

How do you *DO* science?

The **scientific method** is an organized process used by scientists to do research, and provides methods for scientists to verify the work of others.

Scientific Method

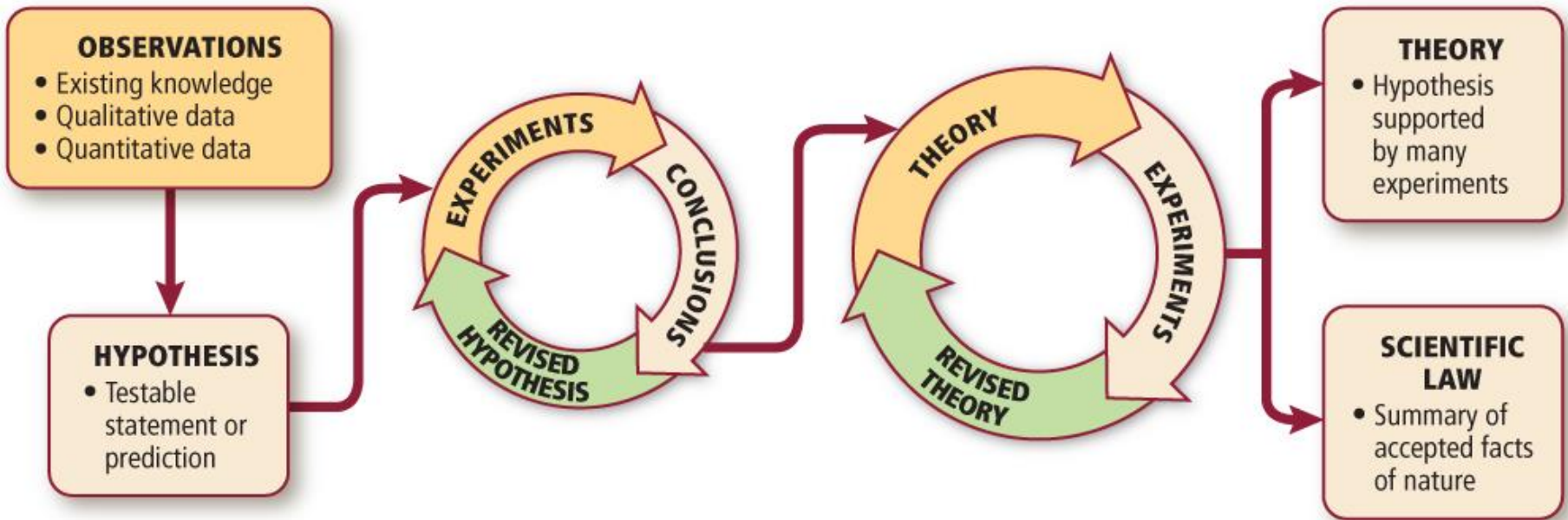
What are the steps?

1. Make an observation.
2. Write a hypothesis.
3. Perform an experiment.
4. Analyze data and make conclusions.
5. Communicate results with other scientists.

The steps in a scientific method are repeated until a hypothesis is supported or discarded.

Scientific Method

What are the steps?



Making Observations

The act of gathering information.

Qualitative data – any observation (color changes, release of heat, etc.)

Quantitative data – any measurement you make (mass, volume, temperature, etc.)

Making Observations



Suppose you try to turn on a flashlight and it doesn't light. An observation can lead to a question:

What's wrong with the flashlight?

Testing Hypotheses

A hypothesis is a proposed explanation for an observation.

You guess that the batteries might be dead.

If the batteries are out of power, then by replacing them, the flashlight will light up.

Test your hypothesis by putting new batteries in the flashlight. If the flashlight lights, you can be fairly certain that your hypothesis is correct.

Designing Experiments

An experiment is used to test a hypothesis.
When you design experiments, you deal with variables, or factors that can change.

- You change the independent variable.
- You observe the dependent variable.
(it depends on what you changed)
- The controlled variables do not change.

The data will support the hypothesis, or will cause it to be revised and retested.

Controlled Experiment

- 1) **Control Group** – part of the experiment that represents standard conditions (receives no experimental treatment)
- 2) **Experimental Group** – the test group that receives experimental treatment

Example – You want to know the effect salt has on the freezing point of water.

Control group - water without salt

Experimental group - salt water.

Developing Theories

Once a hypothesis is supported by repeated experimentation, it may become a theory.

- A theory is a well-tested explanation for a set of observations
- A theory may need to be revised to explain new observations or new experimental results

Scientific Laws

A scientific law summarizes the results of many observations and experiments.

Theories do NOT become laws!

A scientific law doesn't try to explain, explanation requires a theory.

Successful models can help visualize difficult concepts and predict new observations.

Quick Quiz!

1. A hypothesis is

Observation

a. information obtained from the senses.

b. a proposed explanation for observations.

Theory

c. a thoroughly tested explanation for a broad set of observations.

Law

d. a concise statement that summarizes the results of many of experiments.

Quick Quiz

2. What are two steps in the process of science?
 - a. ask questions and make up answers.
 - b. observe and experiment.
 - c. ask a question and propose a theory.
 - d. test a hypothesis and prove it is *true*.