Scientific Laws and Theories

Unit 0 Lesson 4

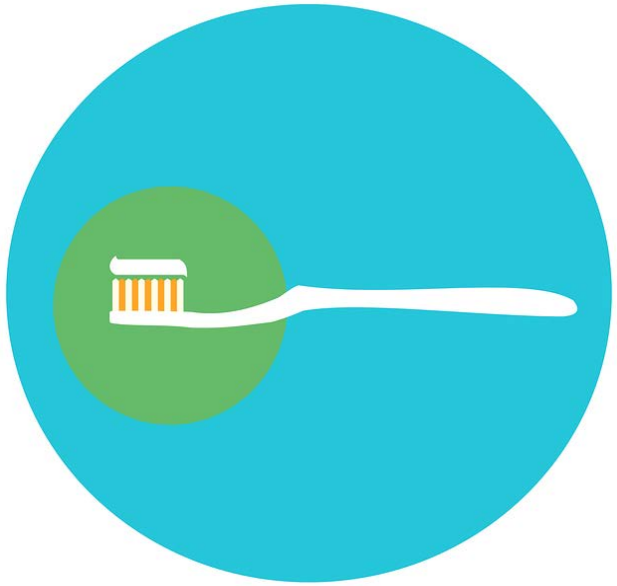
Penguin Bay Biology
- Biology Class, Simplified -

HYPOTHESES

A **hypothesis** is an educated guess that must be tested in order to be proven correct or incorrect.

- **Example:** If I use a toothpaste containing fluoride, then I will develop fewer cavities.

A ‘guess’ is only a hypothesis if it is testable.

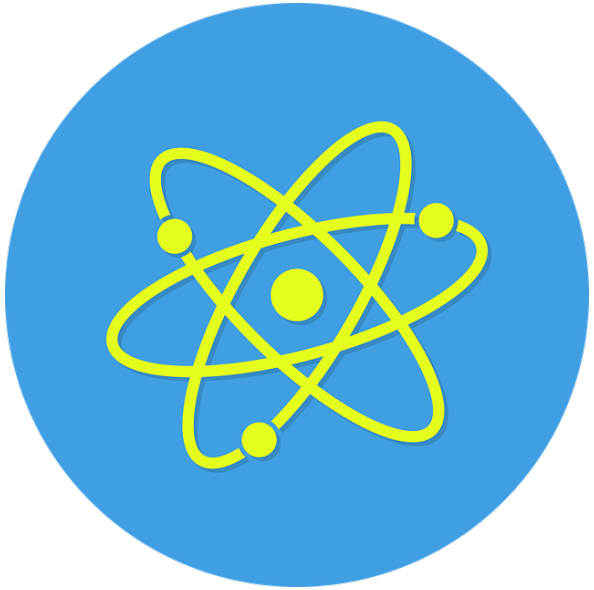


THEORIES

A **theory** is a well-tested explanation of experimental data.

Scientific theories are created by repeatedly testing a hypothesis through the formula outlined in the scientific method.

One scientist alone cannot create a theory. In science, a theory implies that something has been confirmed through experimentation.



THEORIES

Theories must **always**:

- Be totally supported by data.
- Be verified by repeated testing.
- Be subject to review by peers.

A theory can be modified if additional data is found.

In order for a hypothesis to become a theory, every scientist who tests the hypothesis must come up with exactly the same conclusion.

LAWS

Laws are statements based on repeated experimental observations that are:

- Based on proven, reliable evidence.
- Accepted to be true because they are consistently observed to be true.
- Different from theories because they are conclusions based on **observations** of phenomena, rather than explanations of phenomena.

PURE AND APPLIED SCIENCE

Pure science is a field of natural science.

- **Example:** Biology, Chemistry, Geology, etc.

Applied science uses the knowledge from pure science to solve practical problems.

- **Example:** Engineering, Medicine, Forensics, etc.

EXPERIMENTATION

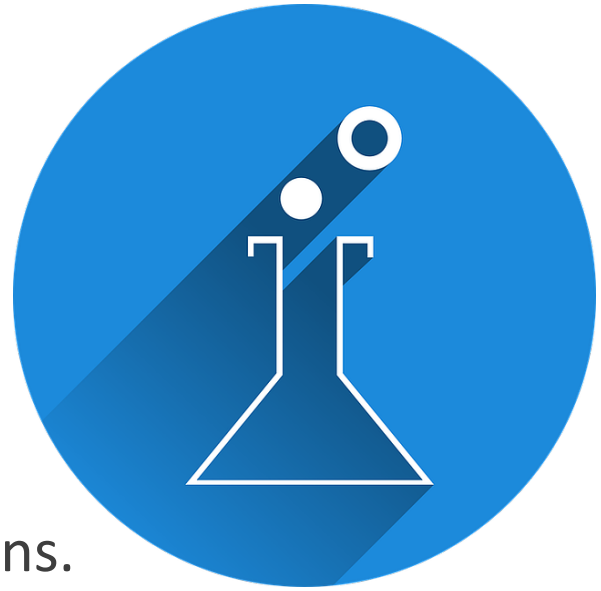
A valid scientific experiment must test only one variable at a time and include a control group to compare the variable with.

- **Example:** When testing a new drug, the test group is given the medication and the control group is given a placebo (fake drug).

EXPERIMENTATION

The data obtained by experimentation will be either **quantitative** or **qualitative**.

Quantitative data is obtained by making measurements which result in reproducible sets of numeric information.



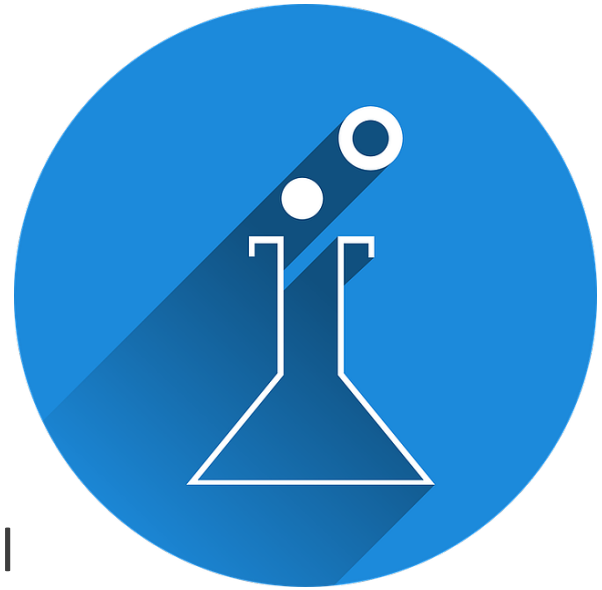
- **Example:** Measuring the height of everyone in class to the nearest centimeter.

Qualitative data is obtained by observation or approximations.

- **Example:** Most of the shirts in the room are green.

EXPERIMENTATION

Quantitative and **qualitative** data are both valid and useful if collected carefully following the scientific method.



Well-planned experimentation is vital for reaching an accurate conclusion. You should be able to use your data to reach a factual conclusion that others can confirm by following your methods.

Representing your data in an understandable way is a critical step in the process of reporting your results. **Graphing** is often a good way of accomplishing this.

GRAPHING DATA

Y axis: the vertical axis where the dependent variable is placed.

X axis: the horizontal axis where the independent variable is placed.

- **Example:** In an experiment measuring the effect of water quality on plant growth, the water quality would be the independent variable and the plant growth would be the dependent variable.