The Nature of Science

The Scientific Method

The Nature of Science

- Continuous process that seeks to answer **questions** about the natural world.
- Science only deals with things that are **TESTABLE**

The Nature of Science

1. Science is subject to **change**.

- Pulling medicine off shelves because researchers found out it harms people.
- Scientists thought the world was once flat
- Pluto is no longer considered a planet

The Nature of Science

2. Does not always provide **complete** answers to all questions.

- What happened to the dinosaurs?
  - No one knows for sure!

The Nature of Science

3. Science demands **<u>evidence</u>** – i.e. **<u>DATA</u>**!!!

- What certain medicines will treat

The Nature of Science

4. **<u>Creativity</u>**

- Doctors and scientists have to think on their feet; not all cases are the same for doctors
- Scientist have to be able to trouble shoot.

The Nature of Science

5. **Explains** and **predicts**
6. Scientist try to identify and AVOID **bias**

Theory vs. Law vs. Principle

- **Theory**-is an explanation based on many observations (hypothesis is repeatedly verified over time and through may separate experiments)
- Enable scientists to predict new facts and relationships of natural phenomenon
- Often revised as new information is gathered.
  - Ex: Cell Theory, Theory of Evolution

Theory vs. Law vs. Principle

- **Law** = describes relationships under certain conditions in nature
  - -Ex: Law of Gravity; Law of Conservation of Matter
- **Principle** = A concept based on scientific laws and axioms (rules assumed to be present, true, and valid) where general agreement is present.

The Scientific Method

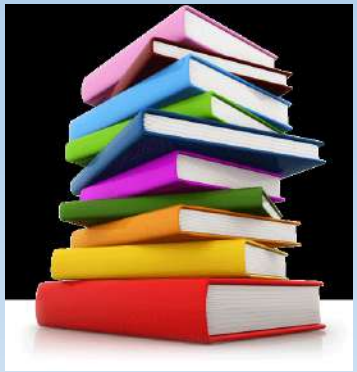
Steps of the Scientific Method

1. State the **Problem**

   -Ex: How does red light effect plant growth?

2. Gather **Information**

   -About the problem



Steps of the Scientific Method

3. Form a **Hypothesis** (educated guess)

– A hypothesis must be:

- **Testable**
- Related to the **problem**
- Written in " **IF …, THEN** "format
  - Ex: If a plant is placed under red light, then the plant will not grow very tall.

Steps of the Scientific Method

4. Perform the **Experiment**

A. Make **OBSERVATIONS**!!

Steps of the Scientific Method

B. Choose the **variables**:

a) Your **Independent** variable is the factor that you will change in your experiment. (The factor being tested)

- NOT controlled or influenced by something else
- Ex: Red light

Steps of the Scientific Method

b) The **Dependent** variable is what you predict will change as a result of variation in your experiment.

- Is controlled or influenced by something else (independent variable)
- Ex: Plant Growth

Note: the **independent** variable influences the **dependent** variable!

Steps of the Scientific Method

c) A **Control**

- The control is a group that serves as a standard of **comparison**.
- It is exposed to the same conditions as the treatment groups except for the variable being tested.
- Ex: a plant placed in regular sunlight (not exposed to red light)

Steps of the Scientific Method

C. Decide the number of **REPLICATIONS**

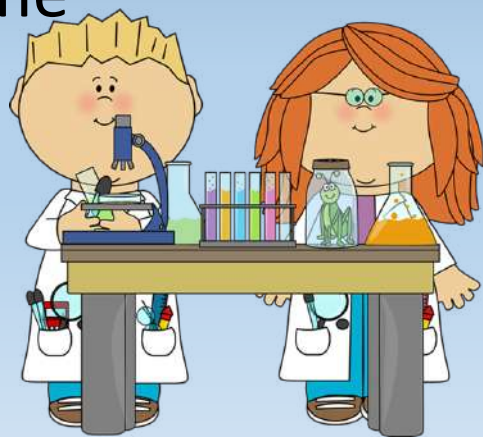
Replications are the repetition of an experiment (**trials**) and the same conditions are kept in the experiment.

Provides better statistical data (**averages**)

Steps of the Scientific Method

D. Specify the **CONSTANTS**

- The constants in an experiment are the factors that DO NOT change. (Ex: temperature, equipment, etc.)
- What your constants will be will depend on what question you are asking.
- Ex: type of plant, amount of water, type of soil, amount of fertilizer, keeping plants at same temperature, same size pots, etc.



Steps of the Scientific Method

5. **Collect** and **analyze** the **data**

Steps of the Scientific Method

6. Draw **Conclusions**
   - –Describe what happened
   - –Restate the hypothesis
   - –Explain the results using the data and research
   - –Propose an alternative hypothesis, if original one was incorrect) based on the data that was collected

There are no wrong answers to questions, only answers that provide scientists with more information about those questions.

Questions and collected information help scientists form hypotheses. As experiments are conducted, hypotheses might or might not be supported.