

Scientific Method



What is Science?

Science is a systematic way to study the natural and physical world through observation, logical reasoning, and investigations using problem solving skills.



Evidence

An important aspect of Science is that any scientific idea is only accepted as fact if it can be backed by evidence.



Evidence is gathered through careful observations or experiments.

One way to gather evidence is through the scientific method.

Scientific Method

The scientific method consists of a set of steps that can be used to investigate observations in nature.



Make Observations

The first step in the scientific method, is to make observations.



Scientists and other curious people often observe something happening and begin to wonder why it's happening or if it can be done differently.

A student watched a video of Mentos candy being placed in a 2 Liter bottle of Diet Coke and wondered if any type of soda would work.

Form a Hypothesis

The second step is to form a hypothesis.



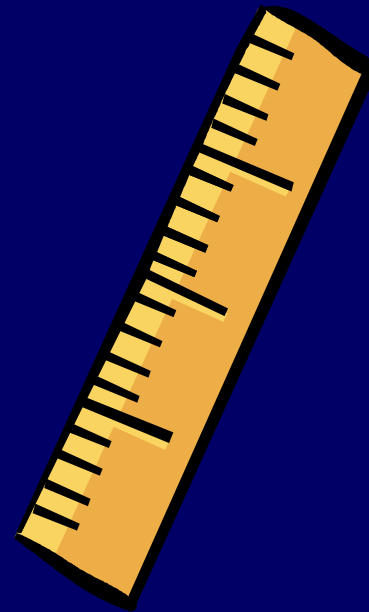
In order to be useful, a hypothesis must be able to be tested.

A hypothesis is usually framed as an 'if... then' statement.

If the type of soda is changed, then the explosion will be the same.

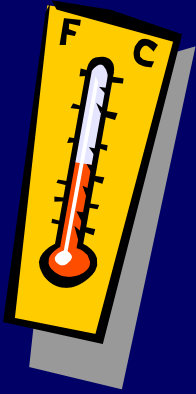
Perform Experiment

The third step is to test the hypothesis by performing an experiment.

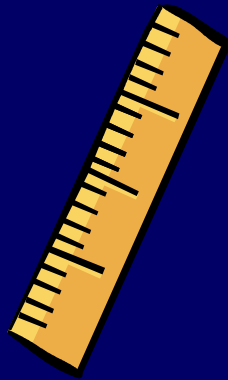


Experimental Process

Experiments test the effect of one variable on another variable using controlled conditions.



Temperature



Height of
Explosion



Type & Amount of
Soft Drink

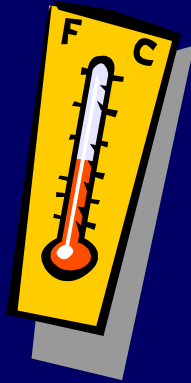


Type & Amount of Candy

In an experiment, anything that can be changed, or can vary, is called a variable.

Controlled Experiment

In a controlled experiment, all the variables must be kept the same except the variable that is being tested.



Temperature



Type & Amount of
Soft Drink

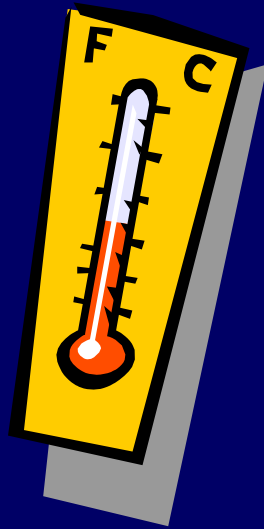


Type & Amount of Candy

Since the student is effect of using a different type of soda, all the other variables need to be kept the same.

Controlled Variables

The variables that are kept the same, in a controlled experiment, are called controlled variables.



The temperature and type and amount of candy used are all controlled variables, in the student's experiment.

Independent Variable

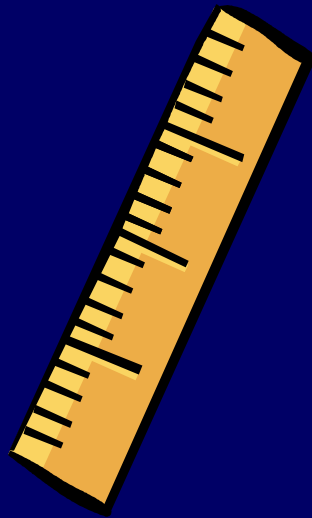
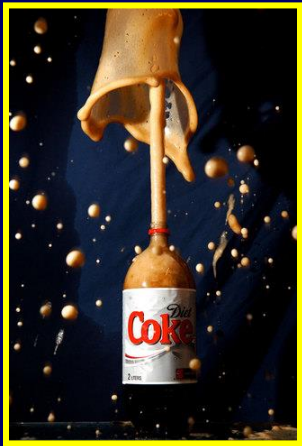
The variable that is being tested or manipulated by the person performing the experiment, is called the independent variable.



In this case, the type of soda is the independent variable.

Dependent Variable

The variable that is measured during the experiment, is called the dependent variable.



The results of the dependent variable will depend upon the independent variable.

In this case, the height of the explosion is the dependent variable.

Control Group

A control group is an experimental set up in which no variable is changed, not even the independent variable.

Control
Group



Diet Coke

Regular Coke

Control groups are used for comparison and to ensure that what is being tested is really causing the change and it is not just a fluke.

Gather and Analyze Data

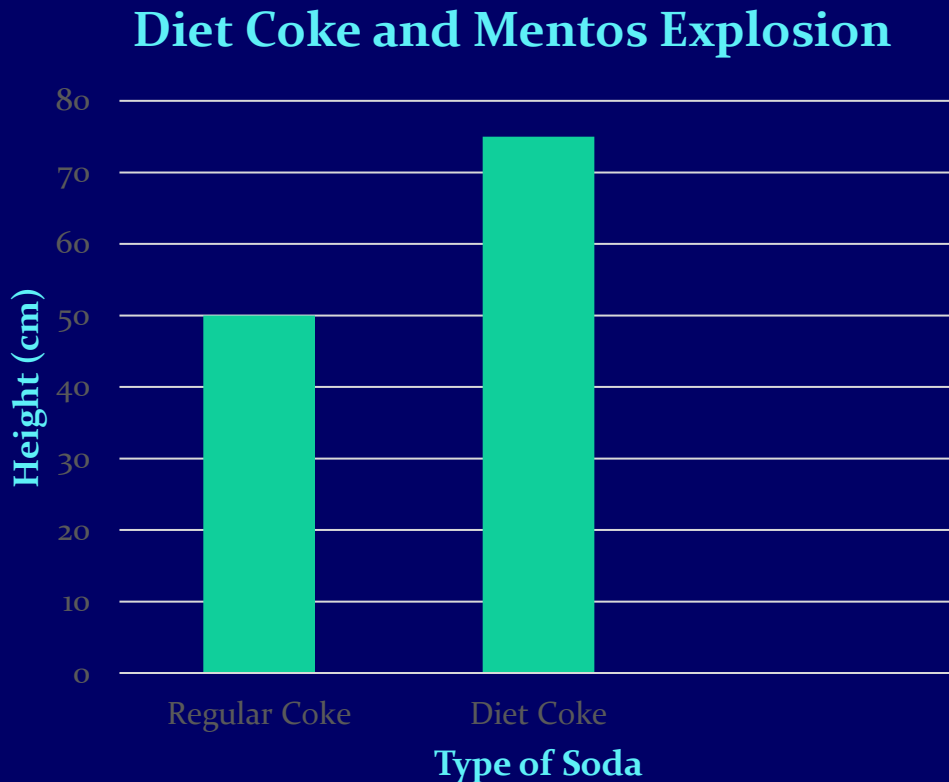
The fourth step is to gather and analyze the data, or the information, collected during an experiment.

| Temperature | Height (cm) |
|--------------|-------------|
| Diet Coke | ? |
| Regular Coke | ? |

In order to keep the data organized, the student is going to use a data table to record the measurements.

Analyze the Data

Graphs are often used, when analyzing the data, to show and compare relationships between the variables.



The independent variable, temperature, is placed on the X axis.

The dependent variable, height, is placed on the Y axis.

Draw a Conclusion

The fifth step is to draw a conclusion by deciding if the hypothesis was supported or not supported, based on the facts you gathered.

Original Hypothesis

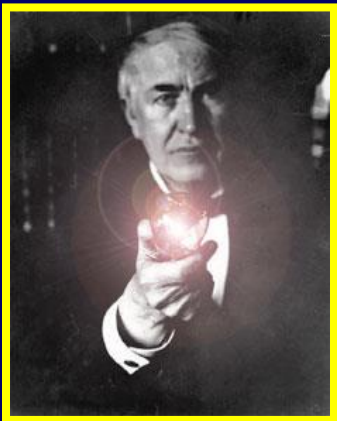
If the type of soda is changed , the explosion will be the same.

Hypothesis was not supported

Hypothesis Not Supported

If the hypothesis is not supported, then the hypothesis can be revised or the hypothesis may just be rejected.

Unsupported hypotheses are still helpful because they tell us what doesn't happen.



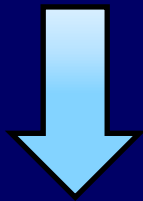
“We have not failed, we have found over 1,000 ways how not to build a light bulb”

Thomas Edison's encouraging words to an assistant.

Hypothesis Supported

In the scientific community, when a hypothesis is supported, other scientist would also run the same experiment.

Hypothesis



Theory

If after many retests, the hypothesis was always supported, then the hypothesis can become a theory.

Theory

In everyday language, a theory is often a very good guess, but it is not based on evidence.

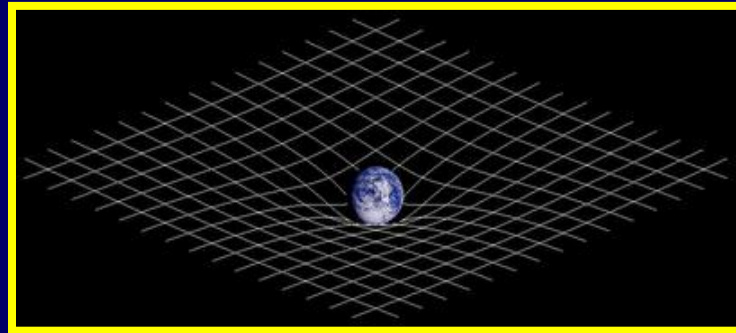


For example: a detective may have a theory on who murdered a victim, but they don't have any evidence to prove it.

In everyday language, if there was evidence, a theory would no longer be a theory, but would instead be a fact.

Scientific Theory

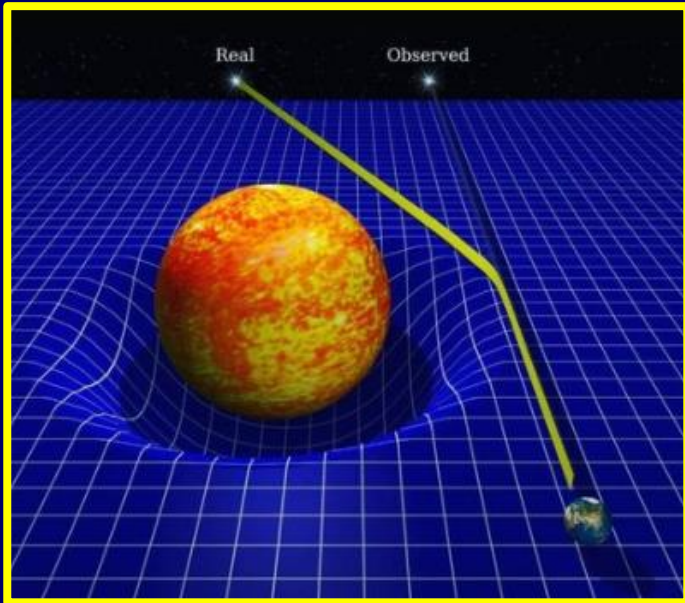
In science, a theory is an explanation for how something works, in nature, that is supported by a large body of evidence.



For example, the theory of gravity explains that objects bend the space around them, with larger objects bending the space more than smaller objects.

Scientific Theory

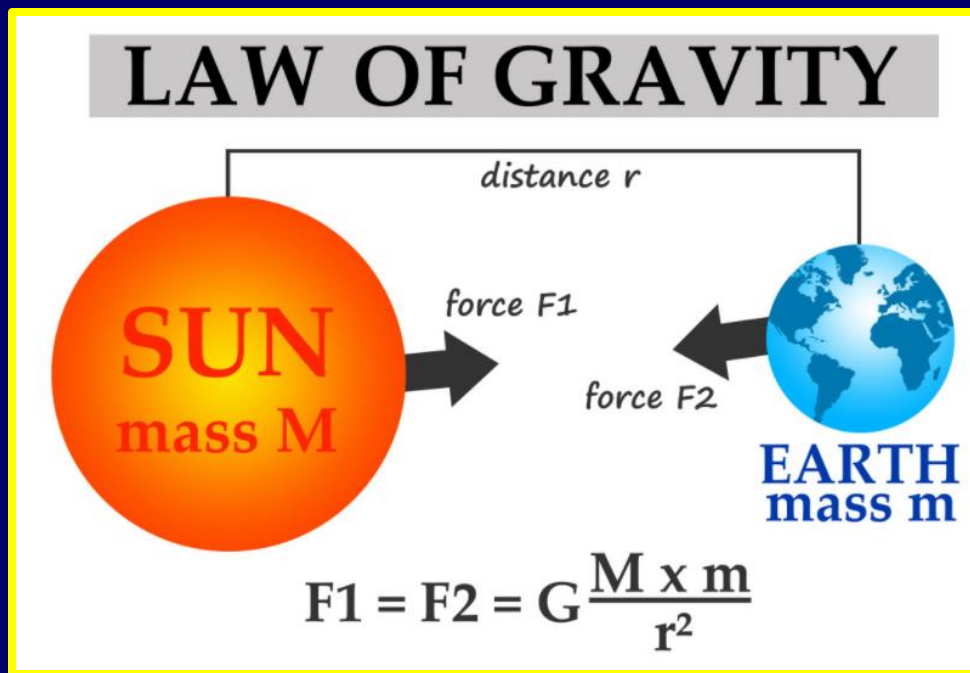
The evidence behind the theory of gravity is that light waves bend as they travel around objects, due to the bending of space.



There is a star located behind the Sun. However, from Earth, the star appears to be located next to the Sun. This is because the Sun's gravity causes the light waves to bend.

Scientific Law

A scientific law is a prediction of what will happen and appears to be true all the time. But a law doesn't explain why something happens.



The law of gravity doesn't explain how or why gravity works, it just predicts the force of gravity between any two objects.

The End

