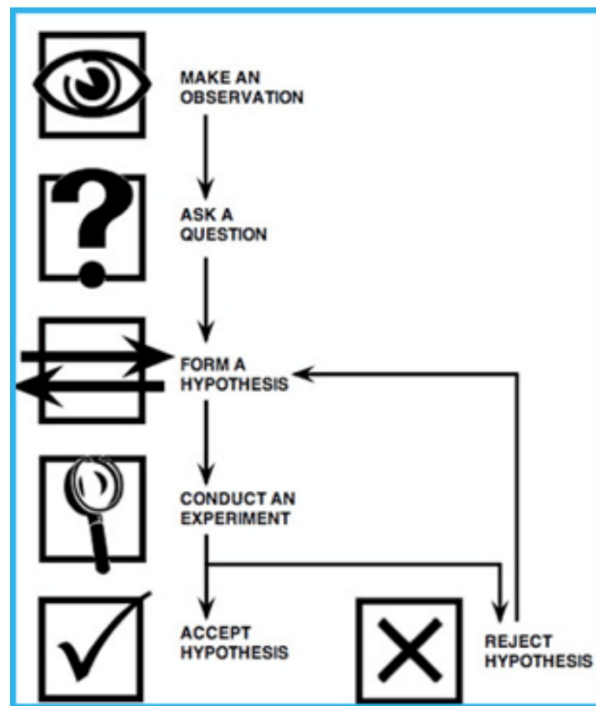# Scientific Methods

8th Grade Earth and Space Science

Scientific Methods

- Scientists work in many different places to gather information and learn about the world around us.

- There is no one "scientific method".
  - Series of problem solving strategies that help scientists conduct experiments.

General Method

Hypotheses

- Scientists first identify a problem and then gather background information on the topic.

- Then they form a *hypothesis*.
  - Testable explanation of a situation that can be supported or disproved by data.

Experimentation

- An *experiment* is an organized procedure that makes observations and measurements to test a hypothesis.

- Experiments usually test only one variable at a time – the *independent variable*.
    - Variable that is the only factor changed in an experiment.
   - This is the factor you are manipulating in an experiment.

Experimentation

- The ***dependent variable*** is the variable affected by changes in the independent variable.
  - This is what is measured or observed!

- ***Controls*** are factors that must be kept constant during an experiment so they do not affect the outcome.

- ***Control group*** is the part of the experiment that is given "normal" treatment and is used for comparison purposes.

Collecting Data

- **Data** is the information collected during an experiment.
    - *Qualitative data* – observations
    - *Quantitative data* – involves numbers

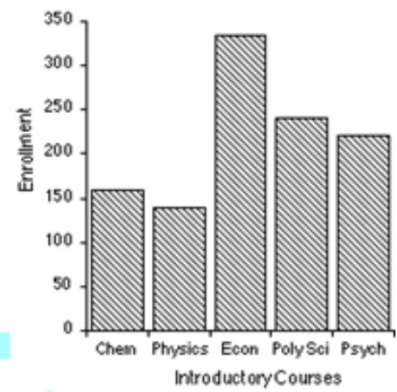- Good experiments will collect different types of data.
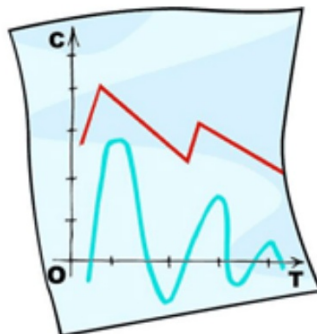
Graphs

- *Graphs* are used a lot of by scientists because they are an easy way to show relationships between data.

- There are three main types of graphs we will use:
    - Line graphs
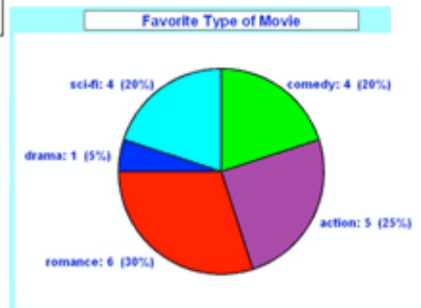   - Circle graphs
    - Bar graphs

Example Graphs

Line Graph

Circle Graph

Bar Graph

Analyzing Data

- After data is collected the hypothesis can be accepted or disproved.

- If the hypothesis is accepted it will be tested by other scientists to verify the results.

- If the hypothesis is disproved, then a new hypothesis will be formed and the process begins again!

Let's Examine an Example Experiment!

Follow along and see if you can pick out the various parts of a controlled experiment!

Identify a Problem/Ask a Question

• John watches his grandmother bake bread. He asks his grandmother what makes the bread rise.

• Do you remember what organism makes bread rise?

Identify a Problem/Ask a Question

Yeast feed on the sugar provided. John wonders if the amount of sugar in a recipe will affect the size of the bread.

Research

- John researches the areas of baking and fermentation and tries to come up with a way to test his question.
- He keeps all of his information on this topic in a journal.

Formulate a Hypothesis

- After talking with his teacher and conducting further research, he comes up with a hypothesis.
- "If more sugar is added, then the bread will rise higher."

Identify an Independent Variable

- The independent, or manipulated variable, is a factor that's intentionally varied by the experimenter.

- What is the independent variable in this experiment?

Identify the Dependent Variable

- The dependent, or responding variable, is the factor that may change as a result of changes made in the independent variable.

- What would the dependent variable be in this experiment?

Setting Up the Experiment

- His teacher helps him come up with a procedure and list of needed materials.
- She discusses with John how to determine the control group.

Control Group

- In a scientific experiment, the control is the group that serves as the standard of comparison.

- What would the control group be in this experiment?

Control Group

- Because his grandmother always used 50g. of sugar in her recipe, John is going to use that amount in his control group.

- All good experiments will have a control group!!

Controls/Constants

- John's teacher reminds him to keep all other factors the same so that any observed changes in the bread can be attributed to the variation in the amount of sugar.

Controls/Constants

• The constants in an experiment are all the factors that the experimenter attempts to keep the same.

• What are some controls we need in this experiment?

Carry Out the Experiment

- John writes out his procedure for his experiment along with a materials list in his journal.
- He has both of these checked by his teacher where she checks for any safety concerns.

Trials

- Trials refer to the number of groups that are exposed to the same conditions in an experiment.
- John is going to test each sugar variable 3 times.
- Why should we do multiple trials?

Collect and Analyze Results

- John comes up with a table he can use to record his data.
- John gets all his materials together and carries out his experiment.

Size of Baked Bread (LxWxH) cm^3

Size of Bread Loaf (cm^3) Trials			
Amt. of Sugar (g.)	1	2	3	Average Size (cm^3)
25	768	744	761	758
50 Control group	1296	1188	1296	1260
100	1188	1080	1080	1116
250	672	576	588	612
500	432	504	360	432

Collect and Analyze Results

- John examines his data.
- Which group had the largest bread?
- Are there any other patterns or trends you see?

Conclusion

- Conclusions refer back to the hypothesis.
- Is John's hypothesis supported or rejected?
- What should John do next?

Communicate the Results

- John tells his grandmother about his findings and prepares to present his project in Science class.
- The whole point of doing science is to share what you learn!

Scientific Models

- Sometimes your data will be represented better by a ***scientific model***.
    - An idea picture, a system, or mathematical expression that represents the idea being explained.
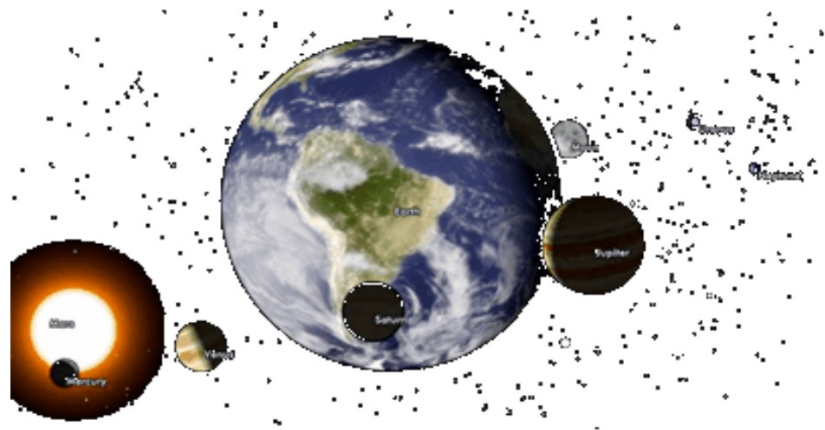
Scientific Theories and Laws

- *Scientific theories* are explanations based on many observations during repeated investigations.
  - Think of it as the "best available explanation".
  - Big Bang Theory

- *Scientific laws* are principles that describes the behavior of a natural phenomenon.
  - Cause of the law is not always known
  - Theories are often used to explain laws.
  - Newton's Laws of Motion, Universal Law of Gravitation