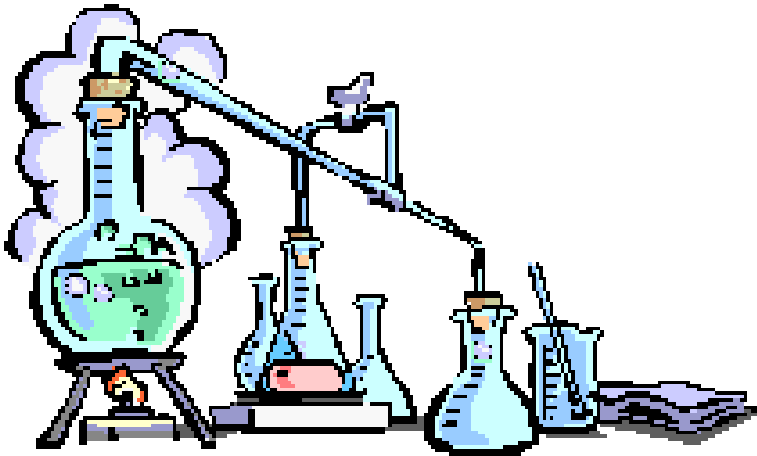# Scientific Method

Steps in the Scientific Method

- **Observation**
- **Problem/question**
- **Hypothesis**
- **Experiment**
- **Data Collection**
- **analysis**
- **Conclusion**

Observations

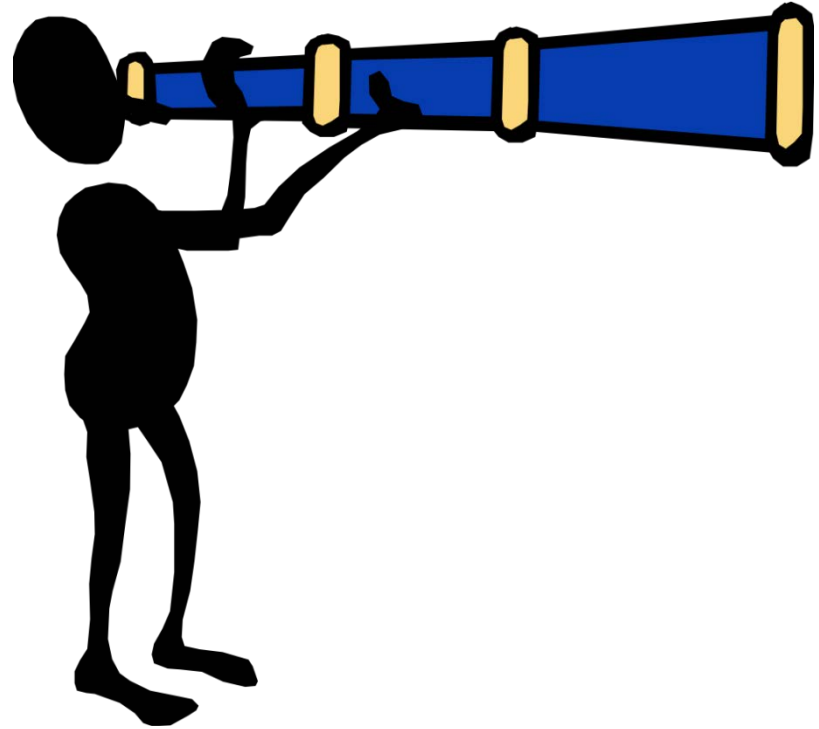- **Gathered through your senses**

- **A scientist notices something in their natural world**
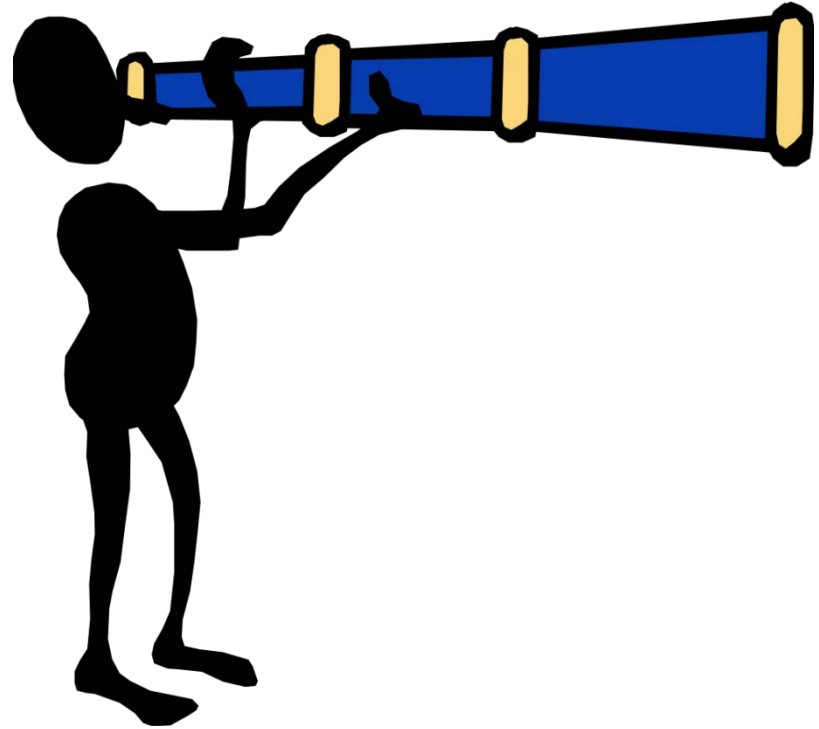
Problem

- **Your observations raise a question you want to answer, or a problem you want to solve**

Examples:

Hypothesis

- A suggested **solution** to the problem.
- Must be **testable**
- Sometimes written as **If...Then...** statements
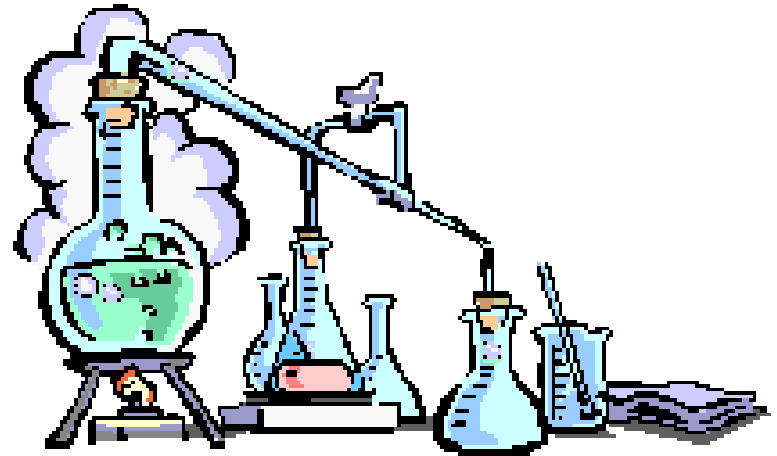- **Predicts** an outcome

Hypothesis

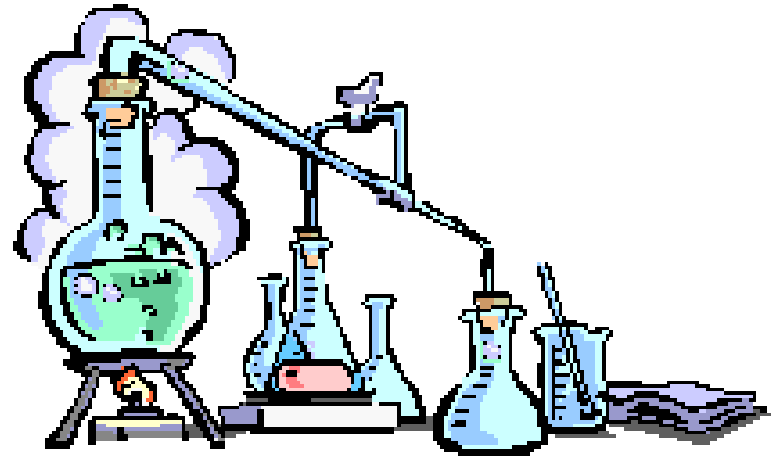- An **example of a hypothesis** might be that…

Experiment

- **A procedure to test the hypothesis.**
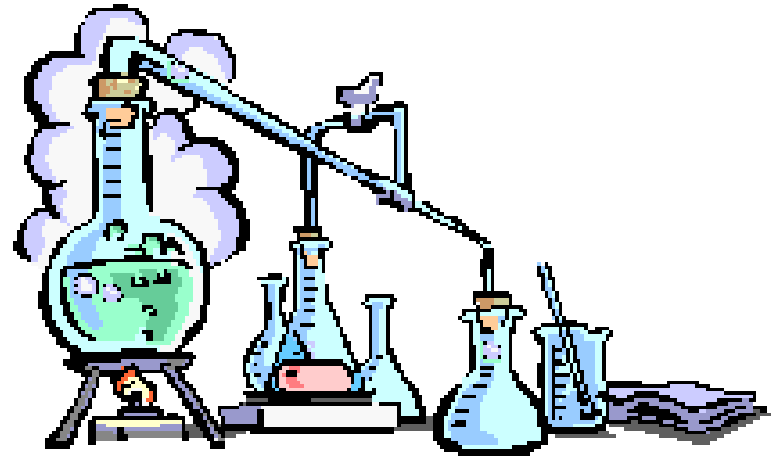
Experiment

Variable – factor in the experiment that is being tested

Experiment

A good or "valid" experiment will only have ONE variable (Thing being tested) changed at a time!

Controls and Variables

Scientific Experiments Follow Rules

- An experimenter **changes one factor** and **observes or measures** what happens.

The Control

- **The experimenter makes a special effort to keep other factors constant so that they will not effect the outcome.**

- **Those factors are called controls.**

What is the Purpose of a Control?

- Controls are **NOT** being tested
- Controls are used for **COMPARISON**

Other Variables

- The factor that is changed is known as the **independent variable**.

- The factor that is measured or observed is called the **dependent variable or responding variable**

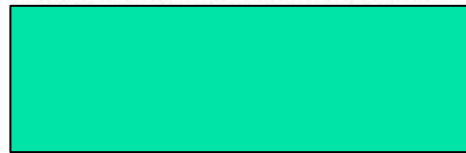One more thing… it is best to make **several trials** with each independent variable.

Redi's Experiment on Spontaneous Generation

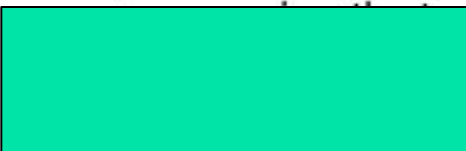OBSERVATIONS: Flies land on meat that is left uncovered. Later, maggots appear on the meat.

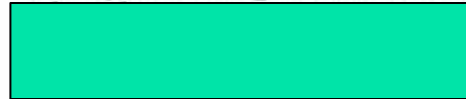HYPOTHESIS: Flies produce maggots.

PROCEDURE

Controlled Variables:

Manipulated Variables:

Responding Variable:

Uncovered jars

Covered jars

Several days pass

Maggots appear

No maggots appear

CONCLUSION: Maggots form only when flies come in contact with meat. Spontaneous generation of maggots did not occur.
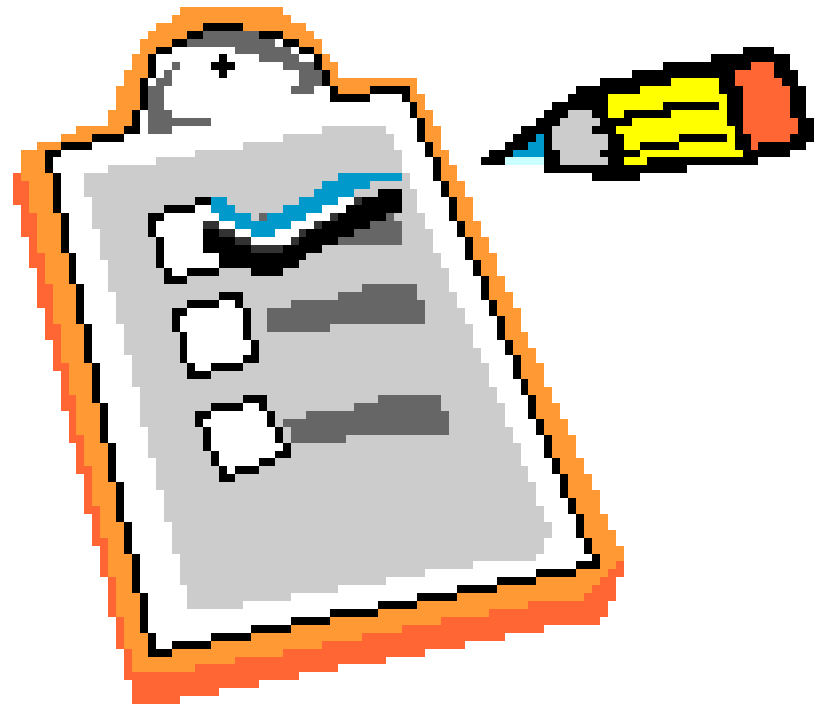
Remember: To be a Valid Experiment:

- **Two groups** are required --- the **control & experimental groups**
- There should be only **one variable**

Data

- **Results** of the experiment
- May be **quantitative** (numbers) or **qualitative**

Data

Qualitative	Quantitative
Like Easy Awkward Slow Squirrel Efficient Ambiguous How Confusing	23,406 4.3 2m32s 76.8% $45,849 1,127 3.76% €12.75

Quantitative Data

are made with instruments such as rulers, balances, graduated cylinders, beakers, and thermometers.
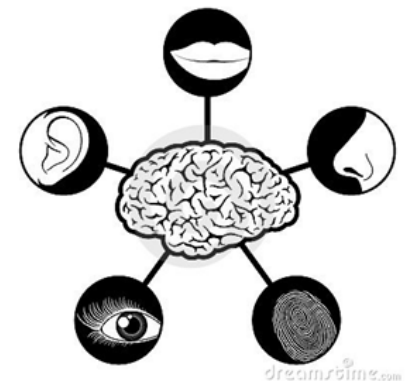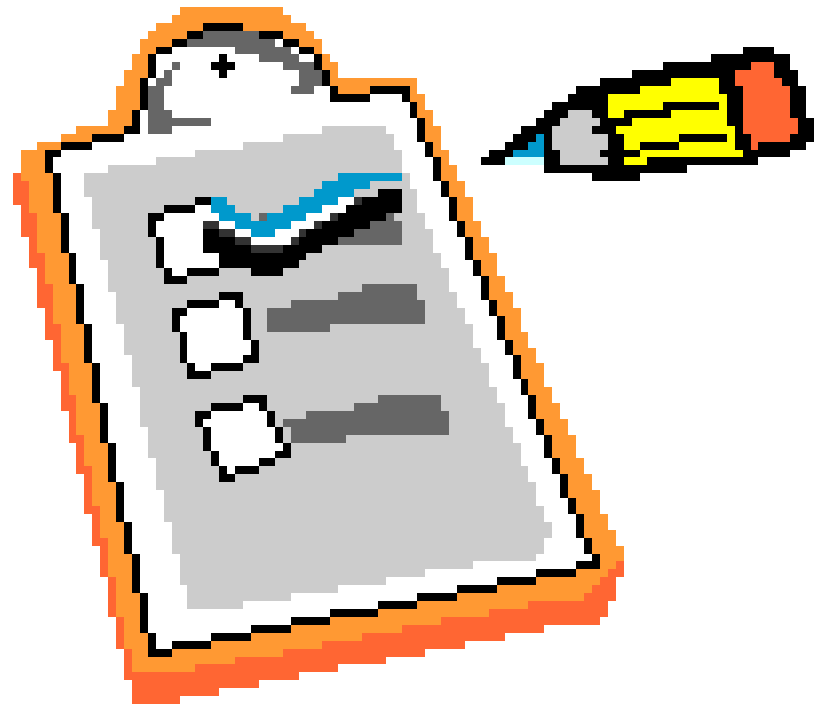These results are **measurable.**
(numbers)

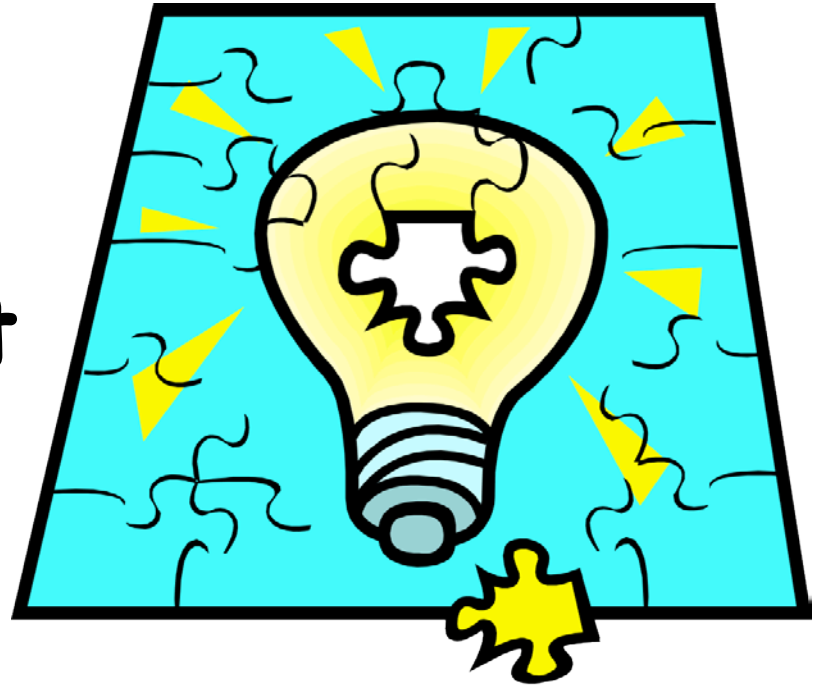**Qualitative Data**

use your senses to observe the results.

Data analysis

- **Must be organized**
- **Can be organized into charts, tables, or graphs**

Conclusion

- The **answer** to the hypothesis based on the **data** obtained from the experiment

How a theory develops

- **A theory**: a broad and extensively tested explanation of why experiments give certain results.

- 5. **Scientific Law**: a concise statement that summarizes the results of many observations and experiments.

- *Laws state what happen, theories explain why they happen.

Solving a Problem

1) **Identify** a Problem

2) State **Observations** about the problem

3) Form a **Hypothesis** about the problem (if…then…)

4) Design an **Experiment to test the hypothesis**

5) Collect **Data**

6) Form a **Conclusion**