# The Nature of Science

## Introductory Concepts

# Basic Concepts Review

**Science** is the observation and investigation of the natural world and the new information that results from those investigations.

**Observation** uses the senses and technology that allows us to extend our senses.

Examples?

Based on our observations, we make **inferences**, logical conclusions drawn from our prior knowledge and experiences.

Worksheet - What Kind of Science

# Making inferences

- You are sitting in the classroom and you hear a siren from outside.
- While you are riding down the highway, you smell smoke. Your windows are open a little bit.
- While you are walking the dog in the evening, you hear a loud bang.
- You see a cat running through the yard. After a moment, you hear 

# The Scientific Process

Observations lead to a **testable** question, which specifically states how one factor will affect another factor.

What helps plants grow?
Does Miracle Gro help plants grow taller than compost?

The **hypothesis** (if, then, because) is an educated prediction based on observations and research.

You are designing an experiment to test the **null hypothesis**, which states there will be no difference caused by the factor we are testing.

# Experimental Design

A controlled experiment is designed to test the effect of one factor on another.

Any factor that changes is a **variable**.

- **Independent variable** is changed by the experimenter - just **ONE**!
- **Dependent variable(s)** is measured by the experimenter. There can be multiple dependent variables

Does Miracle Gro help plants grow taller than compost?

Any factor that remains the same is a **constant**.

The procedure is designed to minimize uncontrolled variables. By changing only one factor, you can be reasonably sure that it is the cause of any other changes you observe.

# Test Groups

**Control group** - a group of subjects that receive no treatment; the standard

**Experimental group(s)** - the group of subjects that receive the treatment

- There can be several experimental groups, each with a variation of the independent variable.
  Example: growing algae in water with 0% oil, 1% oil, and 2% oil

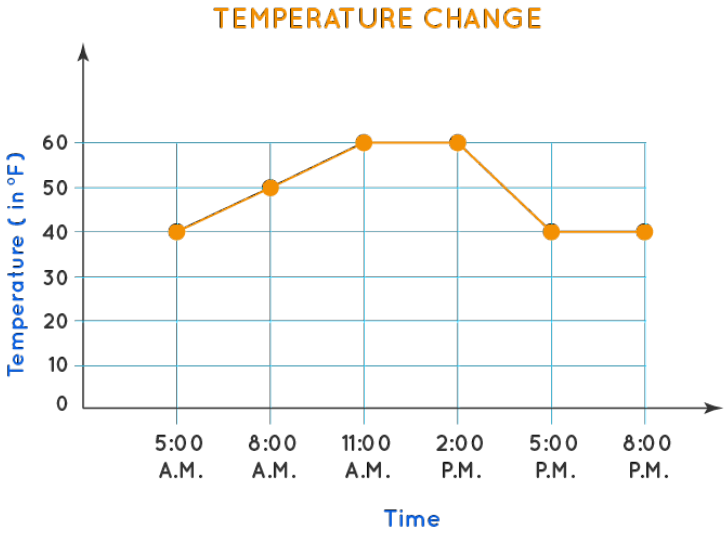
- An array can be used to test 2 variables.
  Example: each % of oil has samples kept at 3 different temperatures

Worksheet - Practice Identifying Parts of an Experiment

# Visualizing Data

Charts and graphs assist in organizing and displaying data in a useful and understandable way.

- **Line graph** - used to show continuously changing data; change (Y) over time (X)



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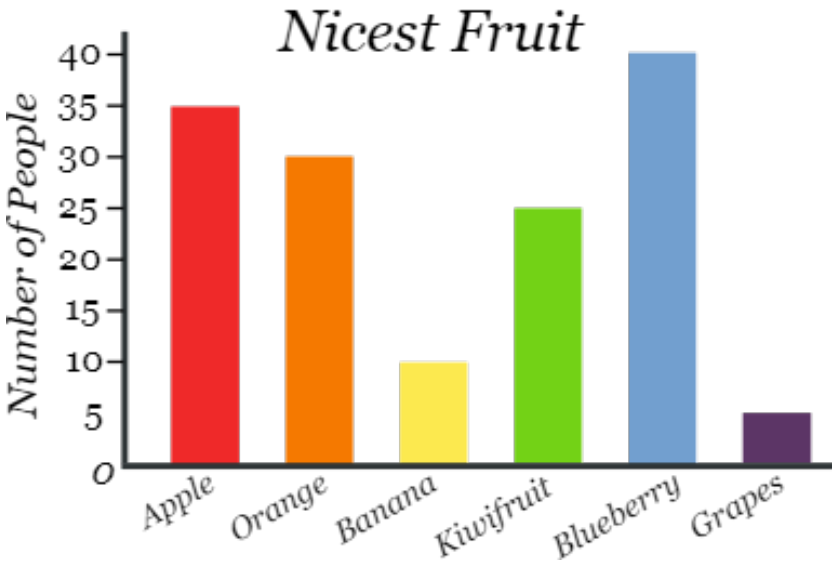

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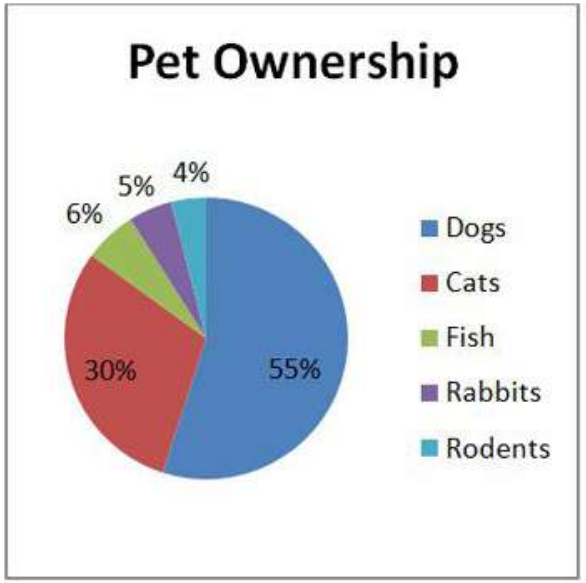
- **Pie Graph** - shows the % of the whole group



# Conclusions, Revisions, and Communication

A **conclusion** is a summary of the information learned from testing the hypothesis.

The conclusion states whether the data supports or does not support the hypothesis. It also explains how the new information fits with what is already known.

Based on the conclusion, the hypothesis may need to be revised and tested again.

# Conclusions, Revisions, and Communication

Scientists communicate new information

- through written papers published in journals
- by giving presentations at conferences
- using media and interviews

**Peer review** – other scientists examine the procedure, data, and analysis to validate the new information and ensure it meets the highest standards.