

Scientific Process

What is the **Scientific Process?**

- It's a logical, problem solving technique.
- **Experimental Design** is an excellent example of scientific process.

What leads to an experimental design?

Having a problem to solve or a question to be answered can lead to experimentation.

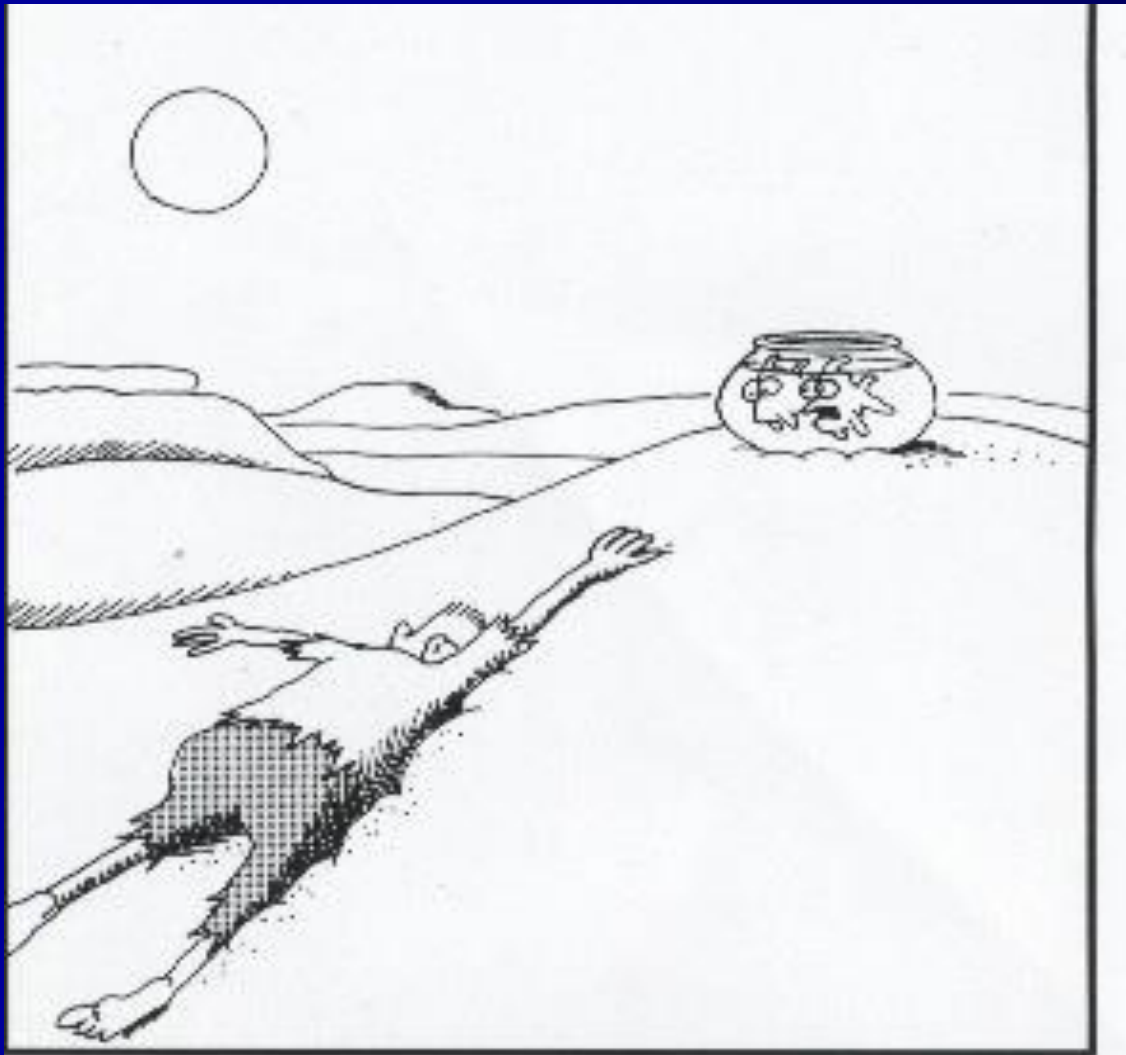
Observations often lead to these questions:

- What caused the worms to come to the surface all at once?**
- Why is the outside of the glass wet?**
- Which habitat do rats prefer?**

Observation vs Inference

- **Observation** is important in the scientific process
- An **observation** is a visible or provable **fact**. There is **NO OPINION** involved.
- An ***inference*** is an **opinion**, or conclusion, based on observed facts.

Observation vs. Inference



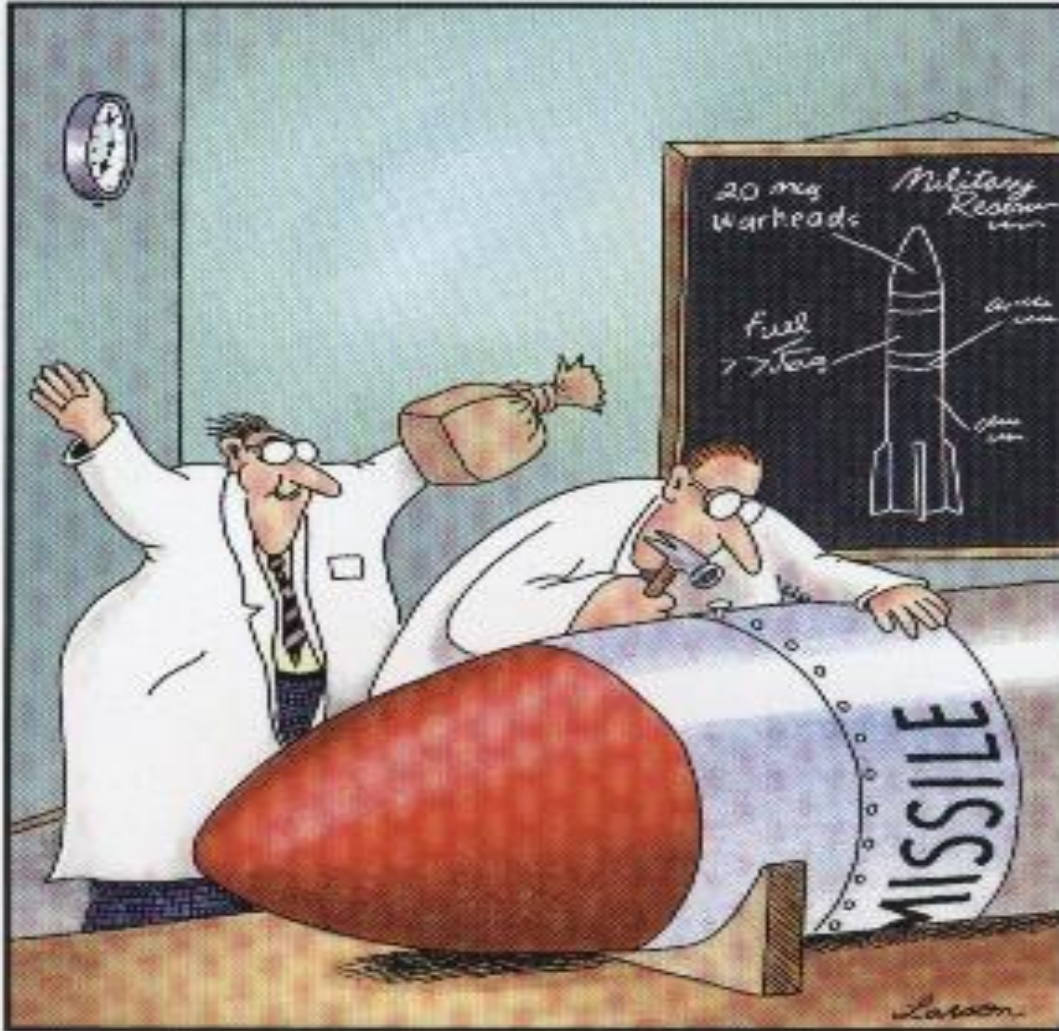
"My word! ... That one came just too close for comfort, if you ask me."

Observation:

Observation:

Inference:

Observation vs. Inference



Observation:

Observation:

Inference:

What's your problem? What do you want answered?

- **Careful observations lead to questions that arise.**
- **A *problem statement* is a question that compares *variables*.**
 - ***Example:* Does the drop height affect the bounce height of a superball?**
 - Example:* How does the percent of dissolved oxygen in water affect the life span of algae?**

What are **Variables**?

- A **variable** is something that changes during your experimental procedure.
 - There are independent variables and dependent variables.
- What is a **control** setup?
- Why is it necessary?
- Do all experiments have a control?

What is an Independent Variable?

An **independent variable** is a variable that we manipulate - **change on purpose**. There is **ONLY ONE!**

An independent variable is the variable whose **value we know** before we start an experiment.

Example: Does the drop height affect the *bounce height* of a superball?

We know the drop heights we will use.

Example: How does the percent of dissolved oxygen in water affect the life span of algae?

We know the different percentages of oxygen we will use.

What is a Dependent Variable?

A **dependent variable** is a variable that changes depending on what we changed (the independent variable).

The **dependent variable** is the variable whose value we measure – it's the “**results**” we are looking for at the end of the experiment.

Example: Does the drop height affect the **bounce height** of a superball?

*We do not know the **bounce heights** before we start.*

Example: How does the percent of dissolved oxygen in water affect **the life span** of algae?

*We do not know **how long the algae will live.***

What is a **Constant**?

A **constant** is a variable that does not change for the duration of an experiment; a value that remains the same.

Example: Does the drop height affect the bounce height of a **superball**?

The **superball** used does not change during the experiment.

More constants . . .

Example: How does the percent of dissolved oxygen in water affect the life span of algae?

The **amount** and **type** of algae used does not change during the experiment.

Other constants in the experiment:

- * **amount of water**

- * **type of water**

- * **size of aquarium**

- * **time of day measurement taken**

Data – collected during experiment

Qualitative data –

- Deals with descriptions.**
- Data can be observed but not measured.**
- Colors, textures, smells, tastes, appearance, etc.**
- Qualitative → Quality**

Data – collected during experiment

Quantitative data –

- Deals with numbers.**
- Data which can be measured.**
- Length, height, area, volume, weight, speed, time, temperature, humidity, sound levels, cost, members, ages, etc.**
- Quantitative → Quantity**

Hypothesis vs Theory

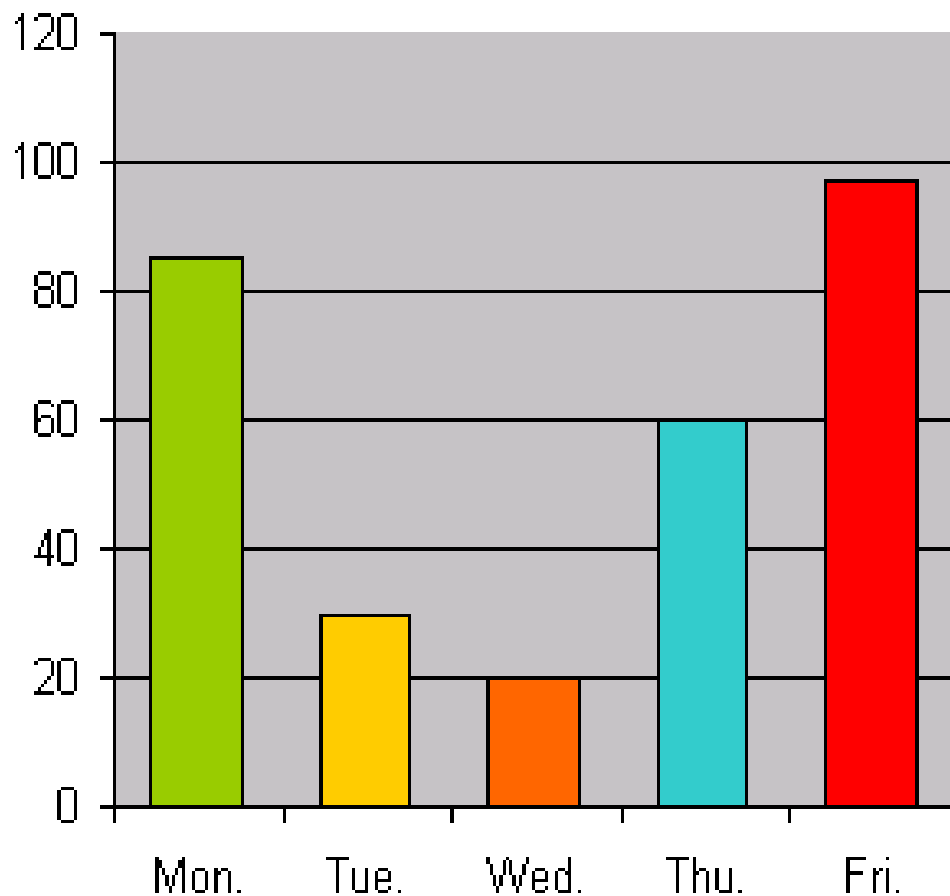
- A **hypothesis** is a suggested explanation based on research and knowledge.
- A **theory** is a tested, well-substantiated, unifying explanation for a set of verified, proven factors. It has NEVER been disproven. Theories hold more weight than facts in science.

Why Do We Use Graphs?

- **Graphs help us visualize numerical data.**
- **There are several different types of graphs:**
 - **Bar graphs**
 - **Pie graphs**
 - **Line graphs**

Bar Graphs

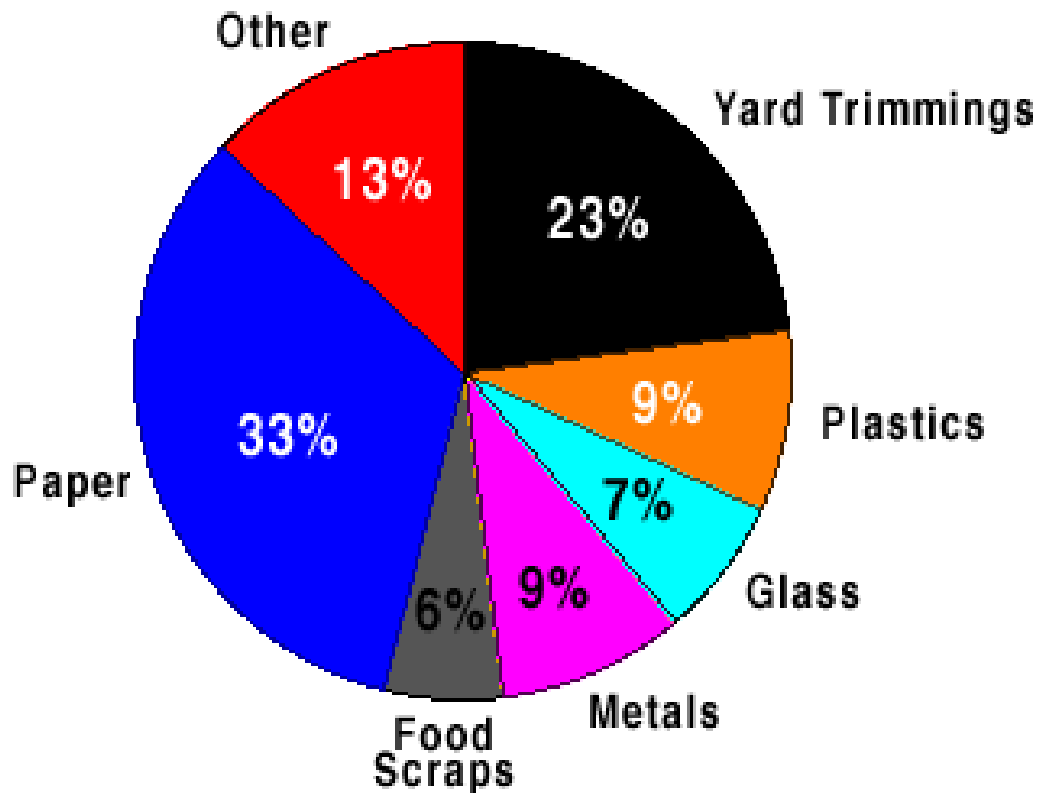
Absences at City H.S.



- **Bar graphs are used to show a comparison of multiple objects.**

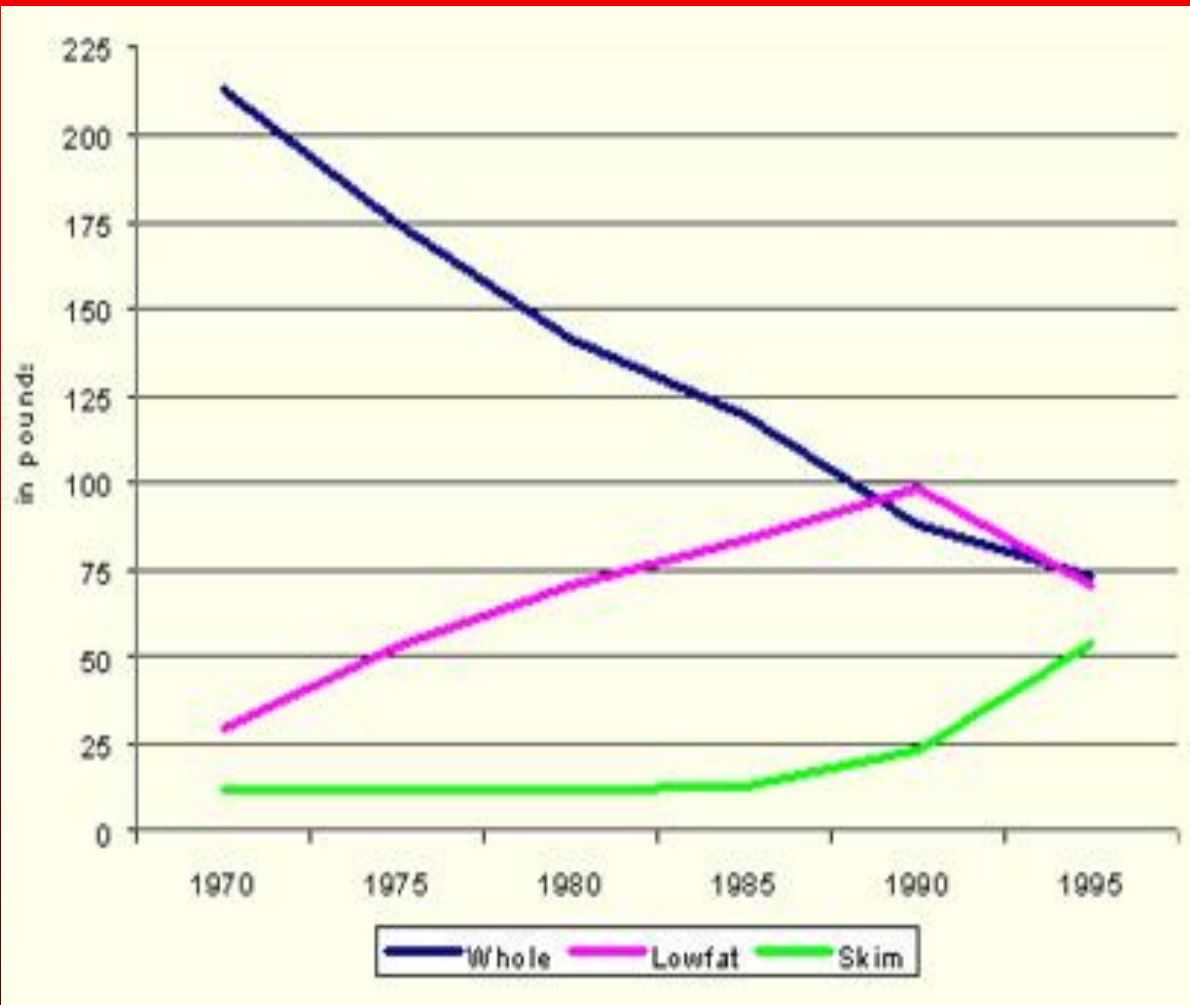
Pie Graphs

Norman Trash



- **Pie graphs are used to compare the parts of a whole.**

Line Graphs



Line graphs are used to show the relationship between 2 variables (independent and dependent).

Identify the Independent and Dependent variables:

- A scientist studies the impact of 3 different drugs on cancer.
- Independent variable – drug type
- Dependent variable – reaction of cancer cells

Identify the Independent and Dependent variables:

- A scientist conducts an experiment to test the claim that a vitamin could extend a person's life-expectancy.
- Independent variable – vitamin
- Dependent variable – life span

Identify the Independent and Dependent variables:

- A student wants to know what her little sister's favorite apple is.
- Independent variable – type of apple
- Dependent variable – likability by sister

Identify the Independent and Dependent variables:

- Carlos wanted to know which of his spinners would spin the longest on his desk top.
- Independent variable – spinner
- Dependent variable – spinning time
- What are the constants of this experiment?

Carlos wanted to know which of his spinners would spin the longest on his desk top.

- Desk surface
- Location on desk the spinner is placed
- Force used to start spinner
- What else?
- Sadly, Carlos never did find his answer because his teacher picked up his spinners!! Poor Carlos!