

# Scientific Methods

Science is a way of learning about the world around us as well as the knowledge gained through these processes.

Scientists observe the world around them and ask questions (the **PROBLEM**). *Why does my neighbor have so many birds in his yard?*

A scientist then makes a prediction based on what he already knows (the **HYPOTHESIS**). *If I put out the same type of bird feed he uses, then I will have as many birds in my yard.*

He then makes a plan (the **PROCEDURE or EXPERIMENT**).

1. Buy the bird feed.
2. Place 40 grams of the bird feed in each of three bird feeders in my back yard.
3. Each morning, at 8 am, 10 am, and noon, I will take a picture of my backyard and my neighbor's back yard.
4. I will count the number of birds in each picture. (the **DATA**)
5. Repeat steps 1-4 each day for one week.

After one week, he determines the average number of birds in his yard to the average number of birds in his neighbors yard (the **DATA**). *He finds that the average number of birds in his neighbor's yard is still WAY higher.*

The scientist thinks about how his data relates to the question (the **CONCLUSION**). *My hypothesis was wrong. I used the same kind of birdseed, and he has still got more birds. The type of food must not be the problem. There MUST be something else. Why does my neighbor have so many birds in his yard?*

The conclusion states whether or not the data supports the hypothesis and what possible mistakes were made. It also discusses how this could be tested better.

AND HE GOES THROUGH THE WHOLE PROCESS AGAIN! He may be wrong MANY times, but he might eventually get to the RIGHT answer.

## Controlled Experiments

Anything that MIGHT affect the outcome of an experiment is a **VARIABLE**. *The number of cats, trees, and bushes in the yard; water; type of bird food; etc.*

The **INDEPENDENT VARIABLE** is the one thing you change on purpose. *The type of bird food.* All other variables need to be the same.

The result you observe because of your changes is the **DEPENDENT VARIABLE**. *The number of birds in my yard.*

The **CONTROL** is the portion of the experiment where you leave out the independent variable. *How many birds show up when neither of us puts out bird seed?*

**REMEMBER** the difference between **OBSERVATIONS** and **INFERENCES**. Observations are what you see, hear, count, measure, etc. When you make an **INFERENCE**, you are deciding **WHAT** your observations **MEAN!**

# Measurements and Metrics

**LINEAR MEASUREMENTS** – measurements of the distance from one point to another

Examples: Length, width, height, diameter, circumference

Basic Units: Meter

Estimations: 1 km is a little more than ½ mile, 1 meter is the height of a doorknob, 1 cm is about the width of your pinky finger, 1 mm is about the thickness of a dime

Tool used: meter stick, metric ruler

**MASS** – “the amount of matter in an object” or “the amount of stuff that makes something up”

Basic Units: Gram

Estimations: 1 kg is about 2.2 pounds, 1 g is about the mass of a paper clip, milligrams would be used to measure the mass of salt in a potato chip

Tool used: **triple beam balance** (always remember to START with the heaviest weight)

Weight and Mass are NOT the same thing. Weight is the effect of gravity on mass.

**AREA** – the amount of surface that a thing has

Examples: the AREA to be covered by carpet, the AREA of a table top

Basic units: square meters (m<sup>2</sup>), square centimeters (cm<sup>2</sup>), etc

Tools: metric ruler or meter stick (area is calculated using LINEAR measurements – Length x Width)

**VOLUME** – the amount of space an object takes up

Examples – you take up less space than an elephant...the elephant has a larger volume

Basic Units: For solids - Cubic Meters (m<sup>3</sup>), cubic centimeters (cm<sup>3</sup>)

For liquids and gases – Liters (L)

Estimations: 1 mL is about 10 drops of water, 1 L is a little less than a quart, 1 cm<sup>3</sup> is about the size of a sugar cube, the teacher’s desk is a little more than 1m<sup>3</sup>

Tools: -**Graduated cylinder** (for liquids) the **MENISCUS** is the curved surface of the water in a graduated cylinder.

-The volume of solids can be measured using the **displacement method** with a graduated cylinder

**DENSITY** – the relationship between the mass of an object and its volume

Density tells us how tightly packed the stuff is that makes up an object

Formula: Density = Mass divided by volume ( $d=m/v$ )

Examples: The density of pure water is 1 g/cm<sup>3</sup>. An object with a higher density will sink, and an object with a lower density will float. Styrofoam has a lower density than steel. A block of Styrofoam and a block of steel of the same volume would have VERY different masses. The particles of steel are much more tightly packed together than the particles of Styrofoam.

Tools: use the tools listed above for mass and volume, brain or calculator to do the math.

*Converting Metric*

Kilo- King	Hecto- Henry	Deca- Died	BASE before	Deci- Drinking	Centi- Chocolate	Milli- Milk
---------------	-----------------	---------------	----------------	-------------------	---------------------	----------------