P. Sci.

Unit 1
Introduction
Chapter 1

What is Science

- Science is a system of knowledge and the methods you use to find that knowledge.
- **Science begins with curiosity and often ends with discovery.**

What is Science?

- Generally scientists believe that the universe can be described by basic rules and these rules can be discovered by careful, methodical study.

Science vs. Technology

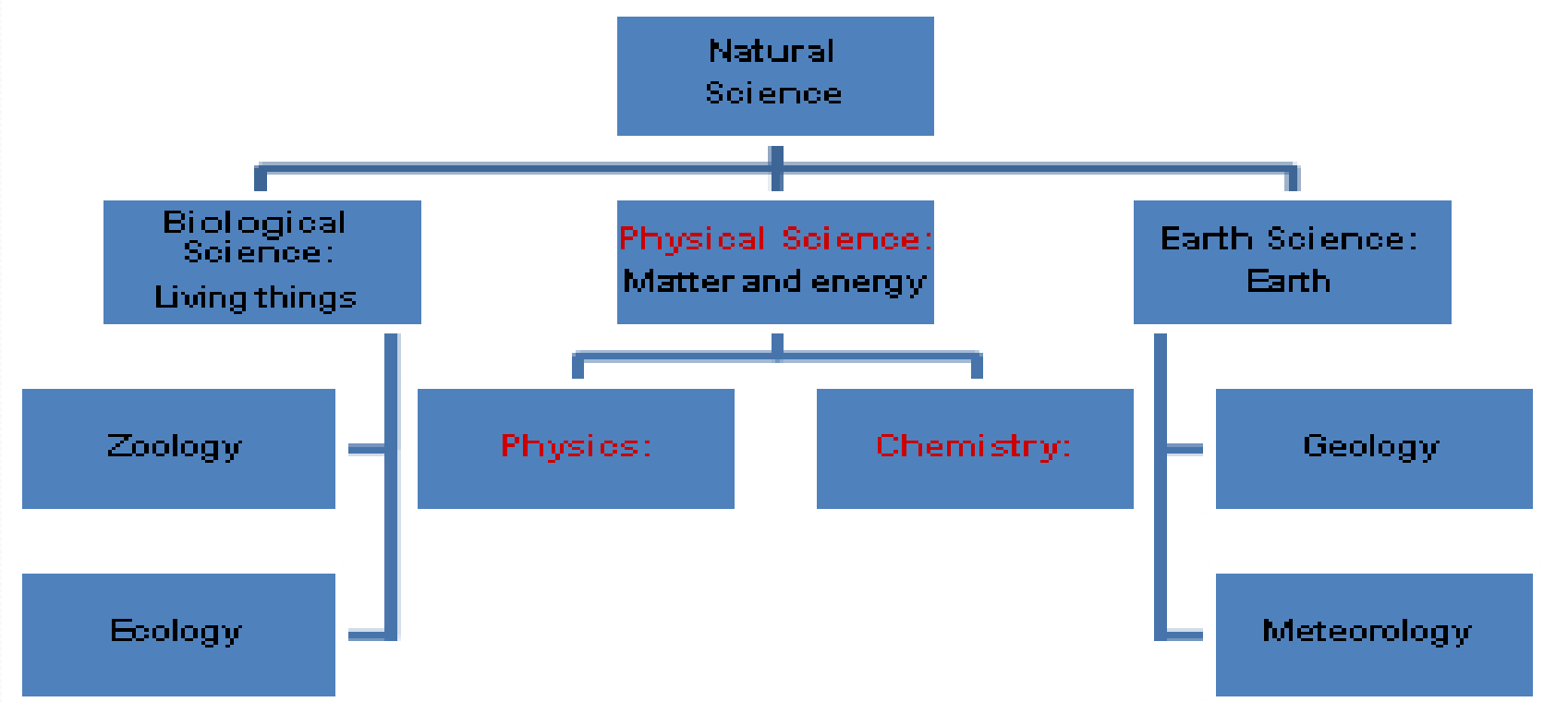
Technology – the application of

science.

Science and technology are interdependent. Advances in one

lead to advances in the o

Branches of Science



Physics: The study of Forces and Energy

Chemistry: The study of Matter and its changes

What is the Scientific Method?

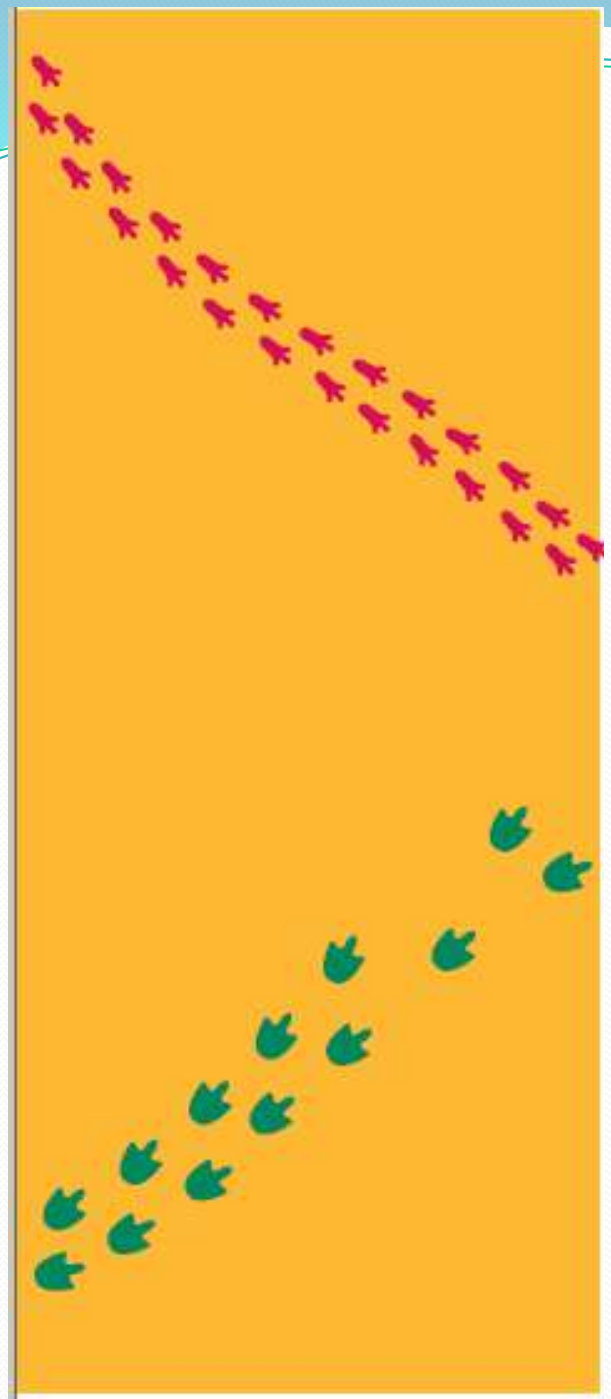
- Scientific method refers to the techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge.
- It's an organized plan for gathering, organizing, and communicating information.
- Everyone can use the scientific method.
- **The goal of any scientific method is to solve a problem or to better understand an observed event.**

How Science is conducted…

- Science is an investigation, which starts with observations leading to inferences.
  - An observation is any information collected with the senses.
  - An inference is a conclusion or deduction based on observations.

Practice

- Observations:
  - I hear people screaming
  - I smell cotton candy, popcorn, and hamburgers
  - I see a lot of people
- Inference = ?

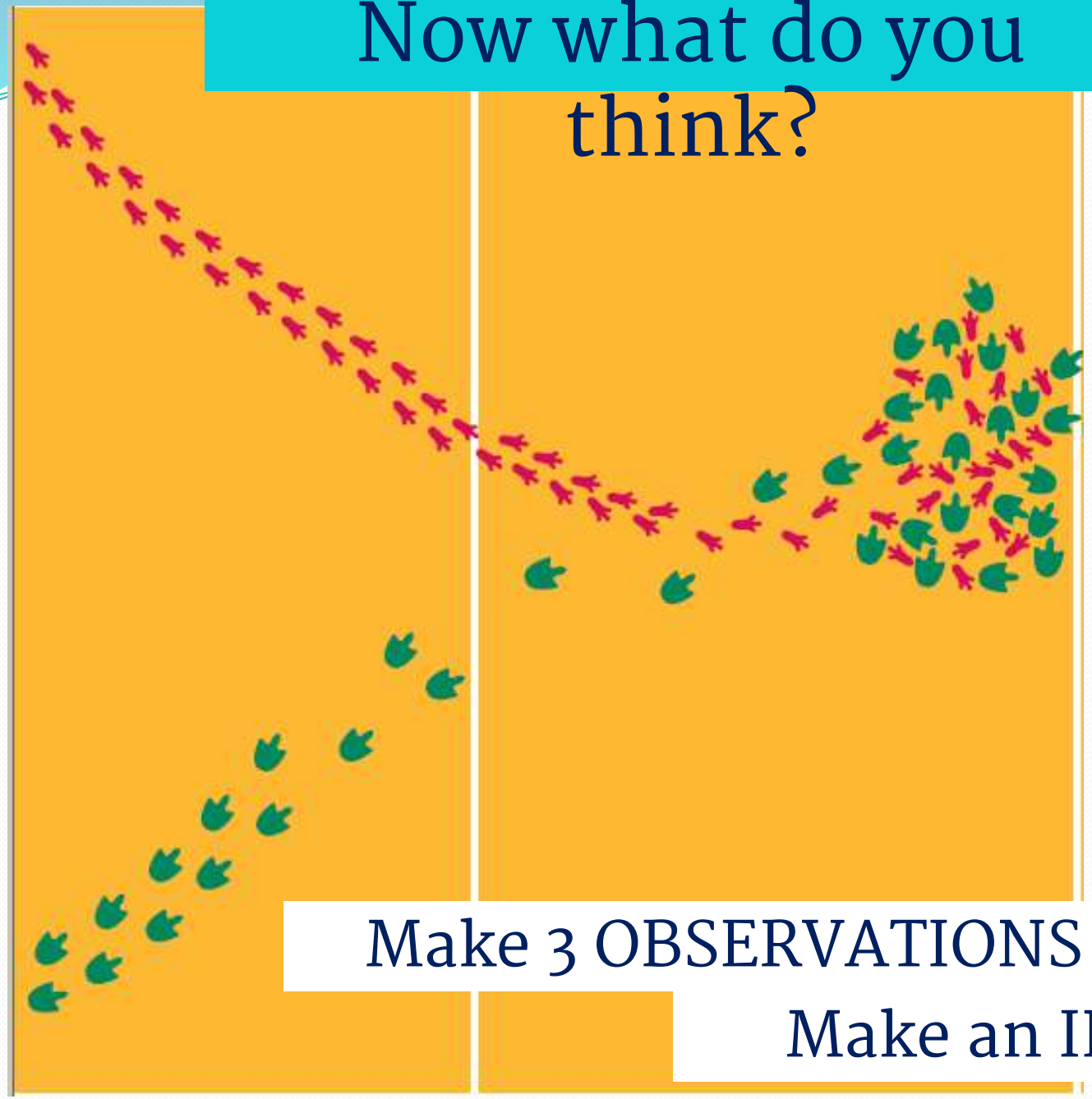


Look at these two sets of animal tracks.

List 3 OBSERVATIONS

Make an INFERENCE

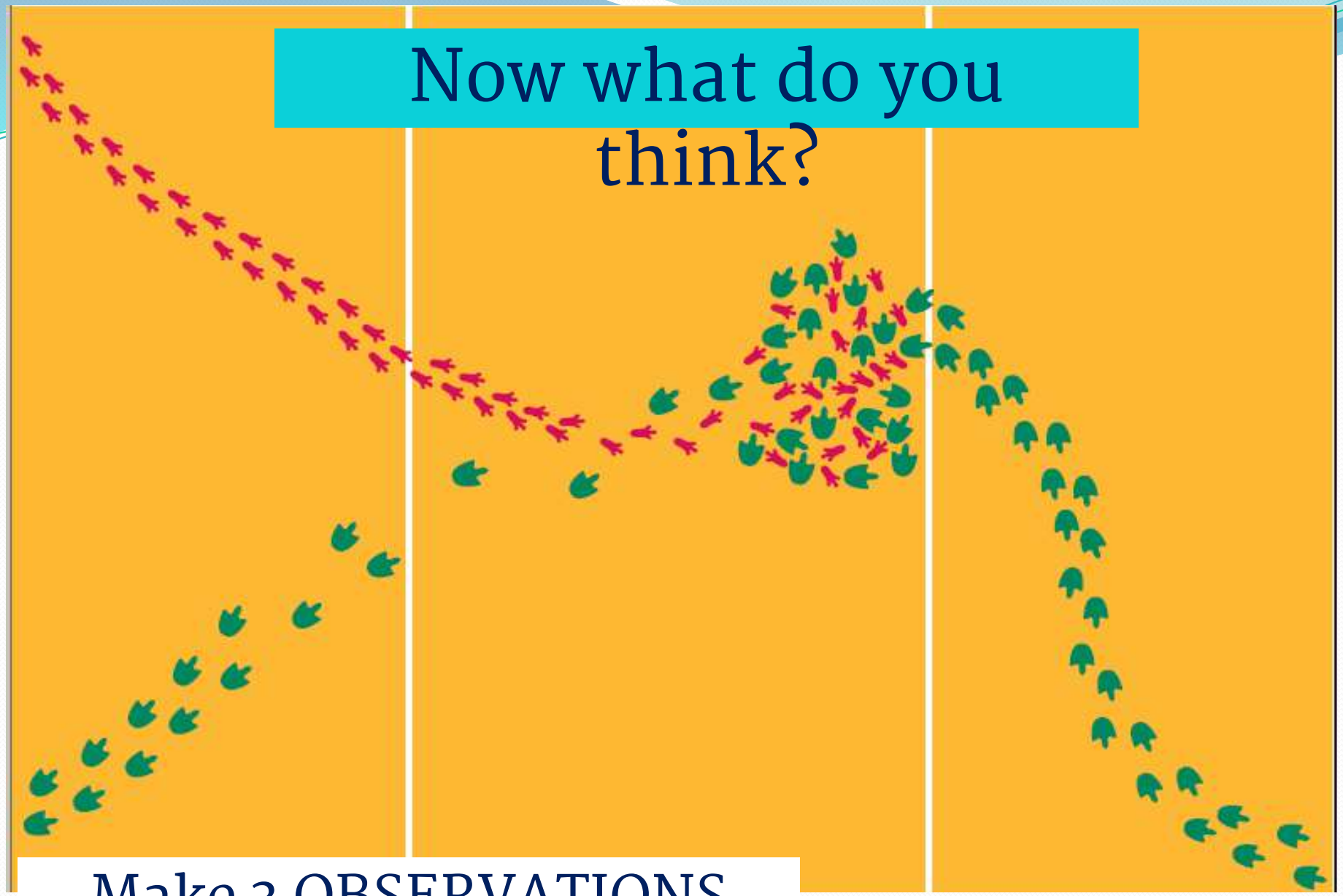
Now what do you think?



Make 3 OBSERVATIONS

Make an INFERENCE

Now what do you think?



Make 3 OBSERVATIONS

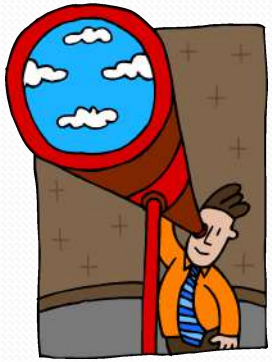
Make an INFERENCE

Basic steps of Scientific Method

1. Make an observation
2. Ask a question
3. Form a hypothesis
4. Test hypothesis/Experiment
5. Analyze data/draw conclusion
6. Develop theory

Scientific Method Steps 1-3

- Begins with an observation (I see smoke in the distance)…
- …that leads to a question. (what's causing the smoke)
- Form a hypothesis – a possible answer that you can test. (Some one is burning leaves.)



Scientific Method Step 4
Conduct an Experiment

- A good experiment tests only one variable at a time.
- No experiment is a failure.

Variables

Variable – anything that can change in an experiment.

- Independent variable – what you change. (manipulated)
- Dependent variable – what changes because of the independent variable. (responding/what is measured)
- Control–what you keep the same.

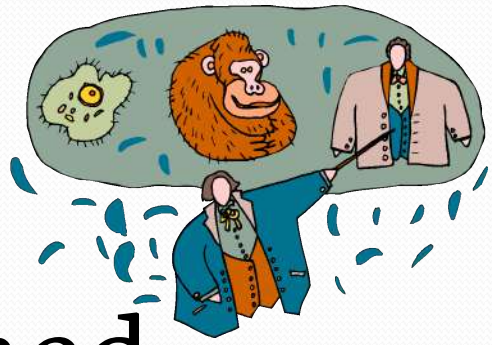
Scientific Method Step 5

- Analyze data
  - If data **DOESN'T** support hypothesis then you need to revise the hypothesis and retest
  - If data **DOES** support hypothesis then additional testing is needed before developing a theory

Scientific Method Step 6

Scientific Theory

- Is an explanation that has been tested by repeated observations.
- Are always being questioned and examined.
- To be valid, a theory must continue to pass each test.

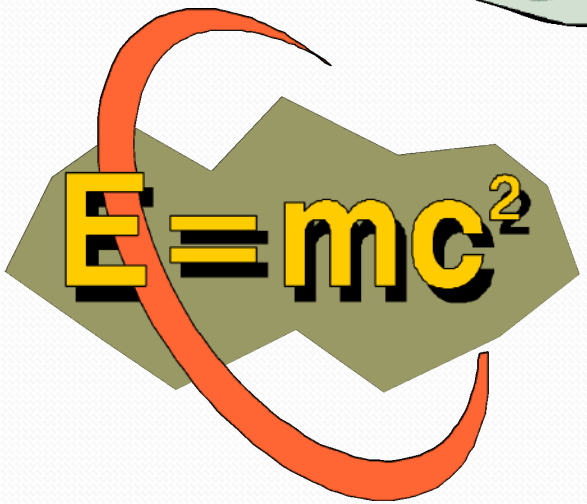


Scientific Theory (cont.)

- A theory must explain observations simply and clearly..
- Experiments that illustrate the theory must be repeatable.
- You must be able to predict from the theory.

Scientific Law

- States a repeated observation about nature.
- Does **not** explain why an event happens.

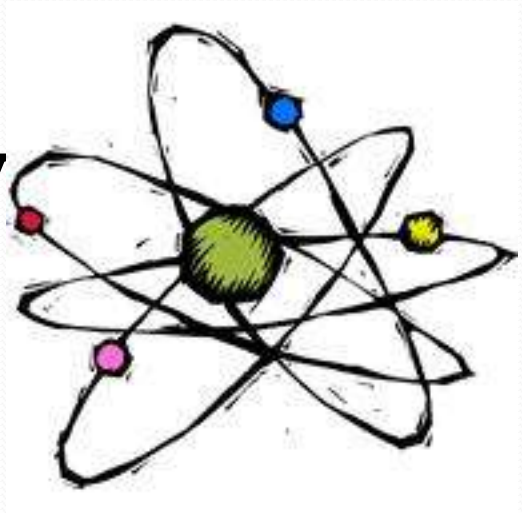


Theories and Laws are not absolute.

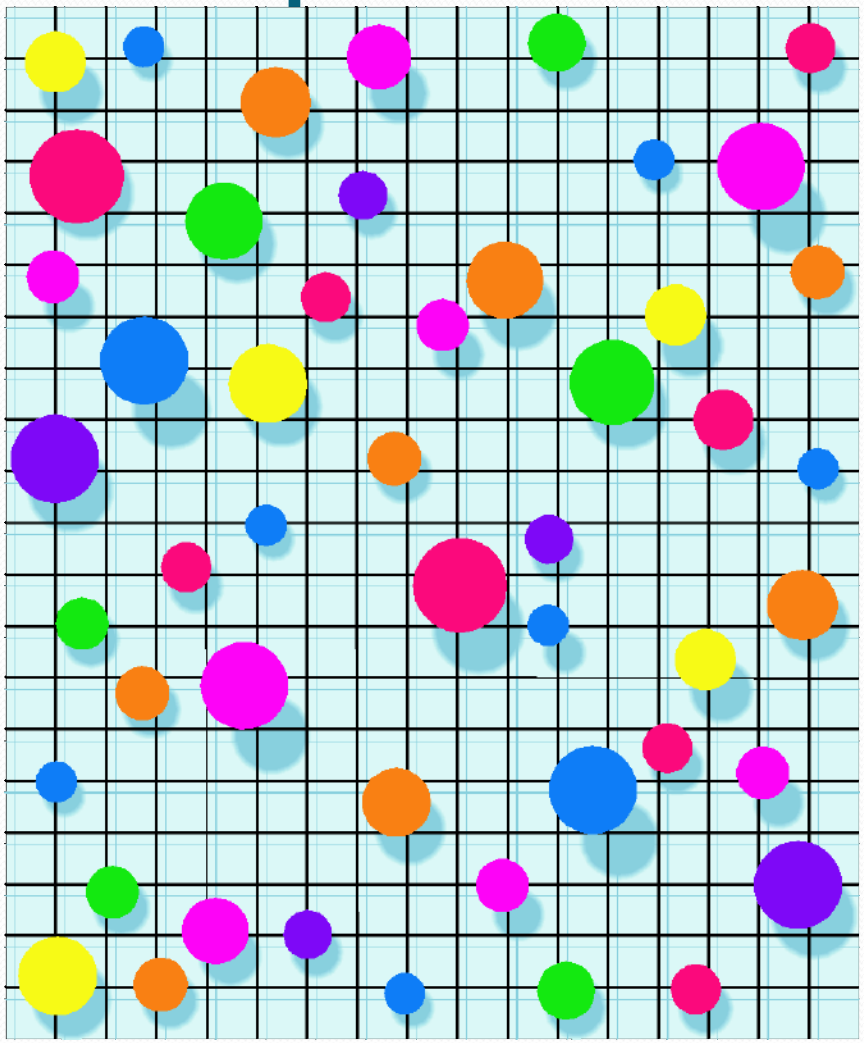
- Sometimes theories or Laws have to be changed or replaced completely when new discoveries are made.

Scientific Model

- Model is a representation of an object or event.
- **Scientific models make it easier to understand things that might be too difficult to observe directly.**



Graphs



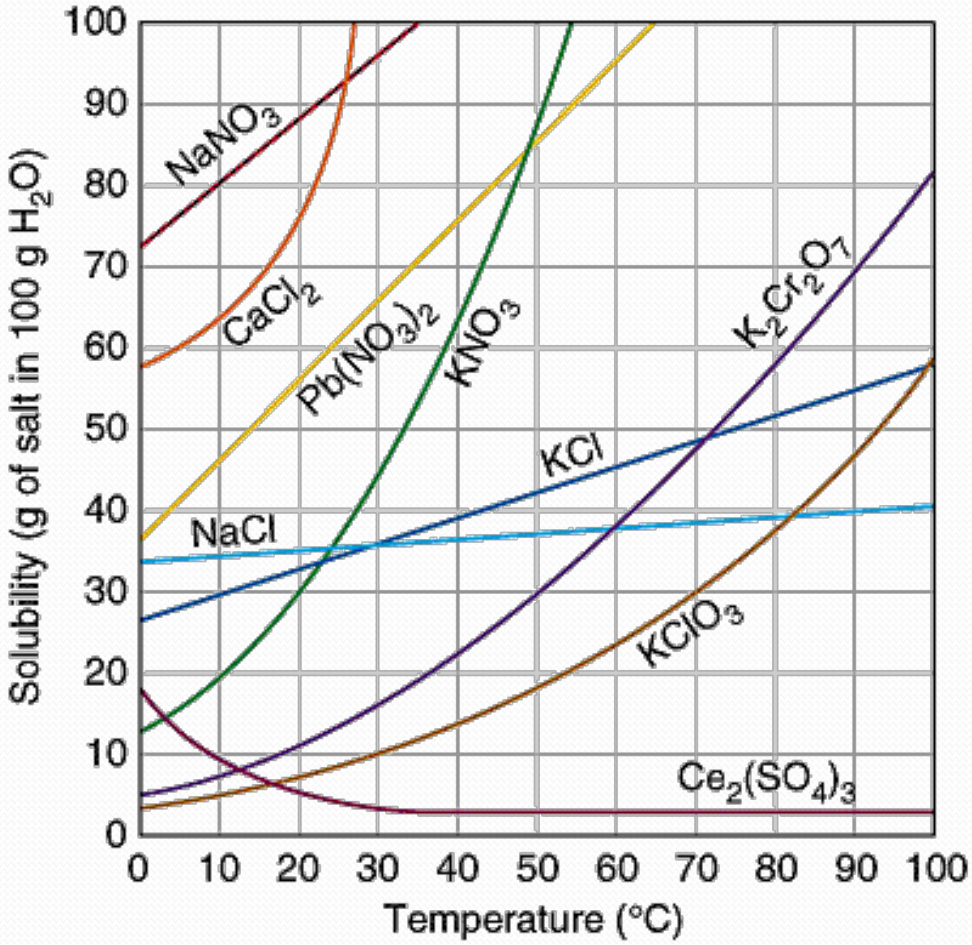
- A way of organizing and presenting data.
- Makes relationships more evident.

Line graphs

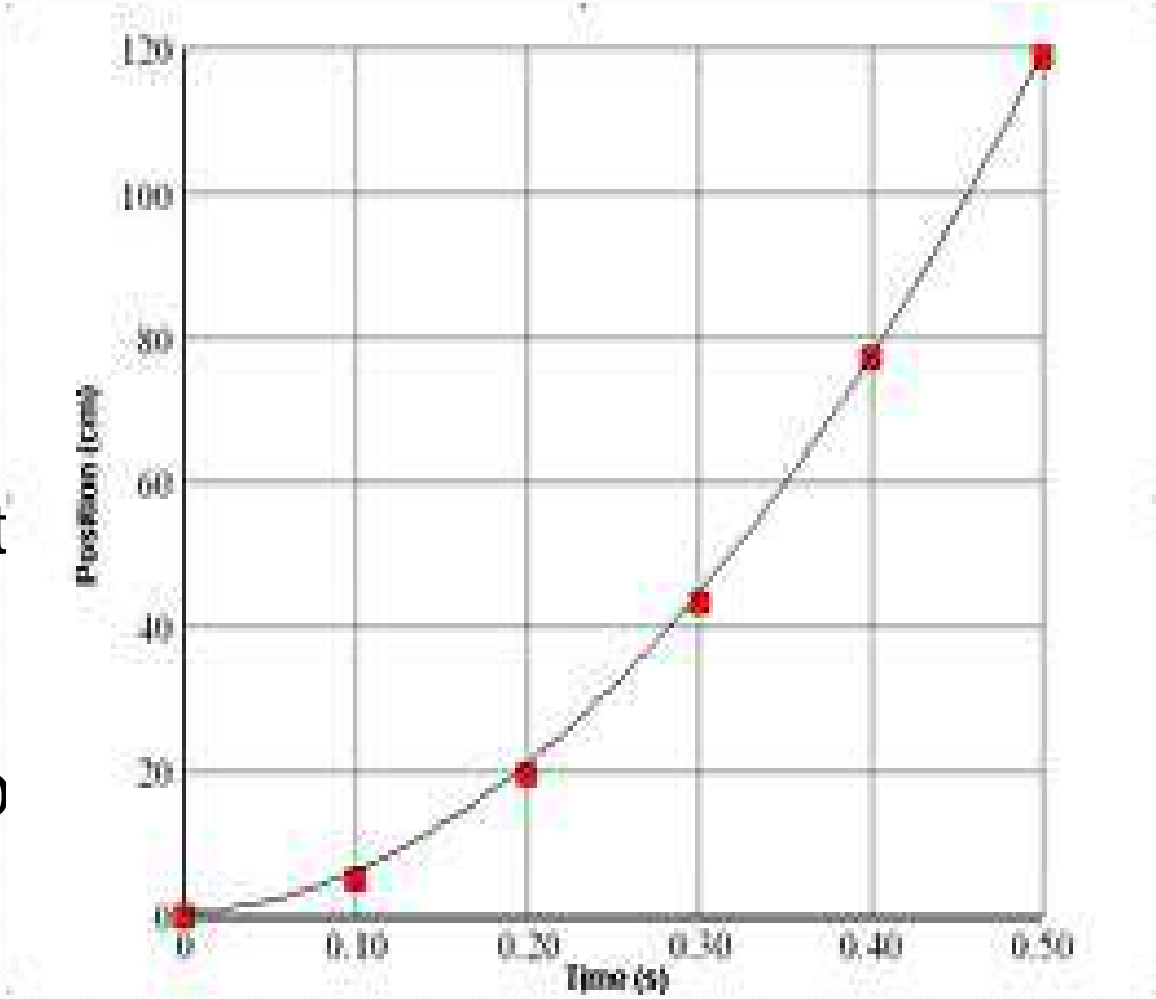
- Best for displaying data that changes. (anything over time)
- Numerical vs. Numerical

Multiple Line Graphs

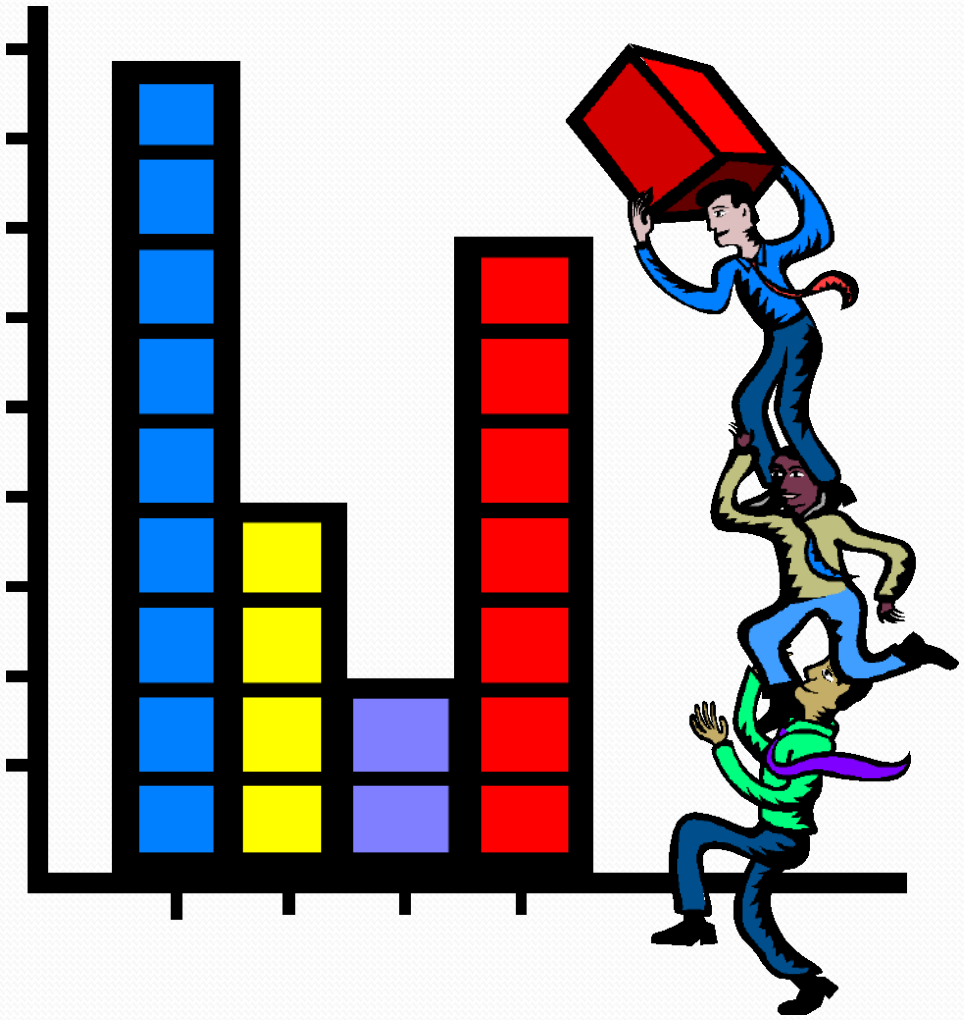
- Best for comparing multiple values and distributions.



- What is being measured?
- What is independent variable?
- What is dependent variable?
- Slope (rise/run) from 0.10 s to 0.40 s

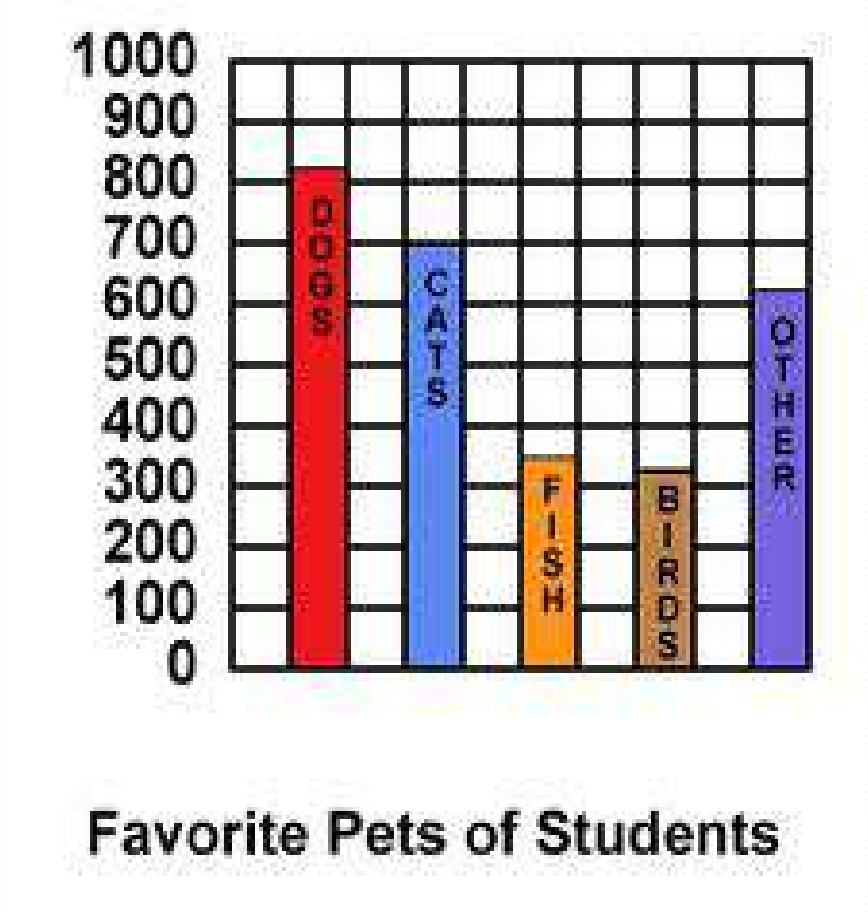


Bar Graphs



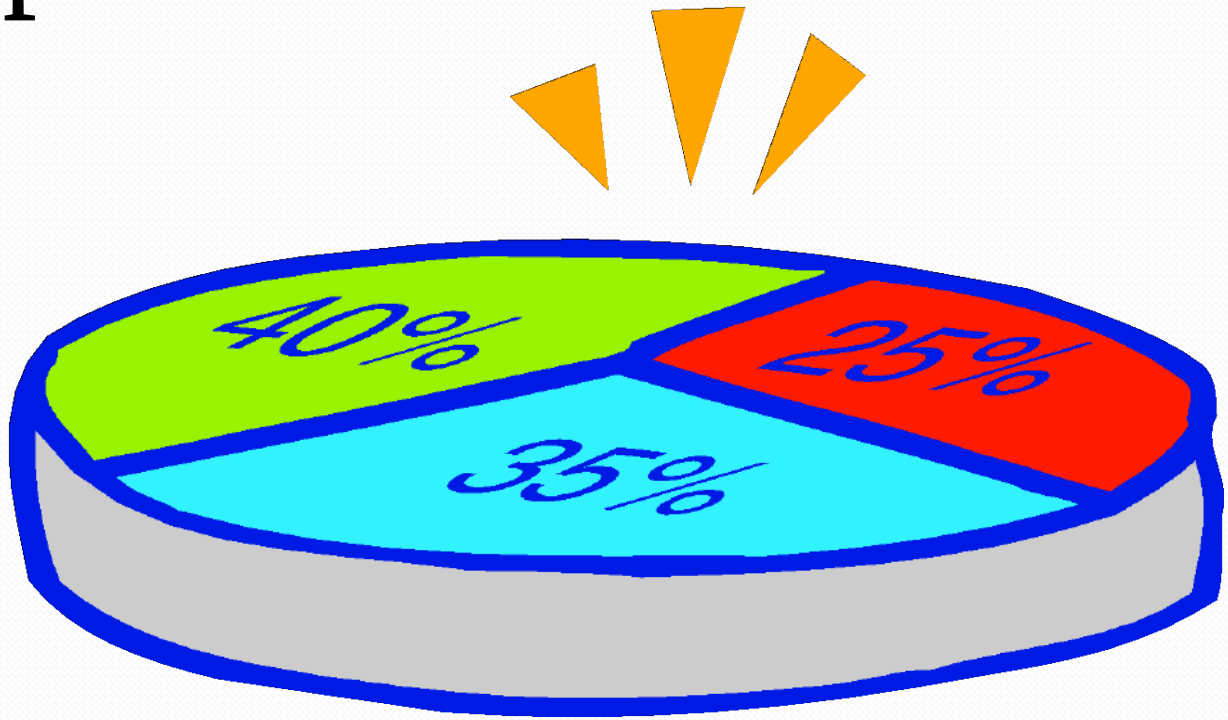
- Best when comparing data for several individual items or events.
- Numerical

- What is being measured?
- What is independent variable?
- What is dependent variable?

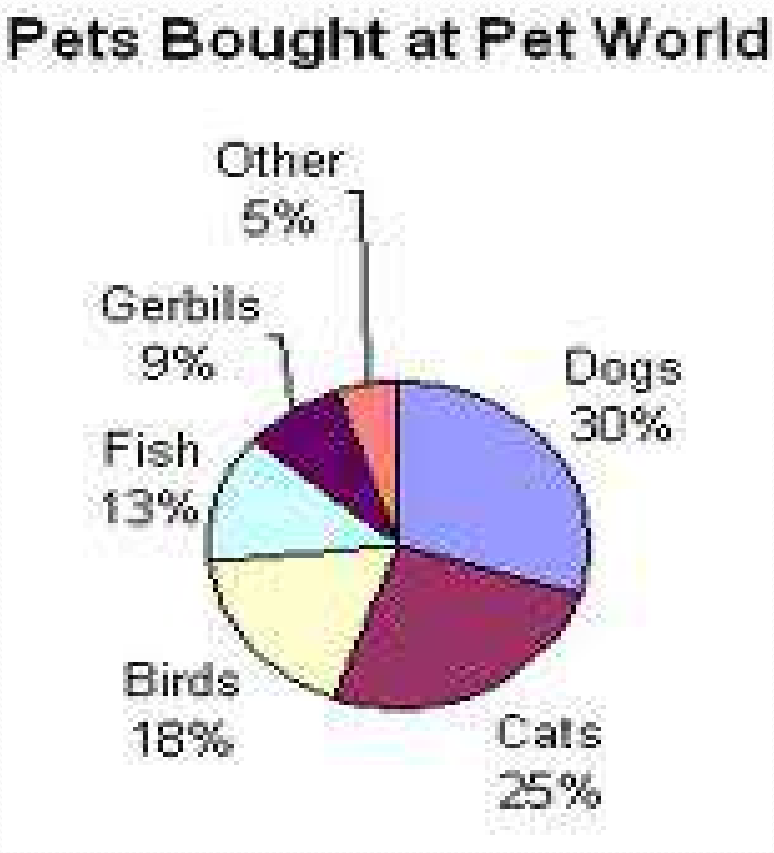


Circle Graphs (AKA Pie Charts)

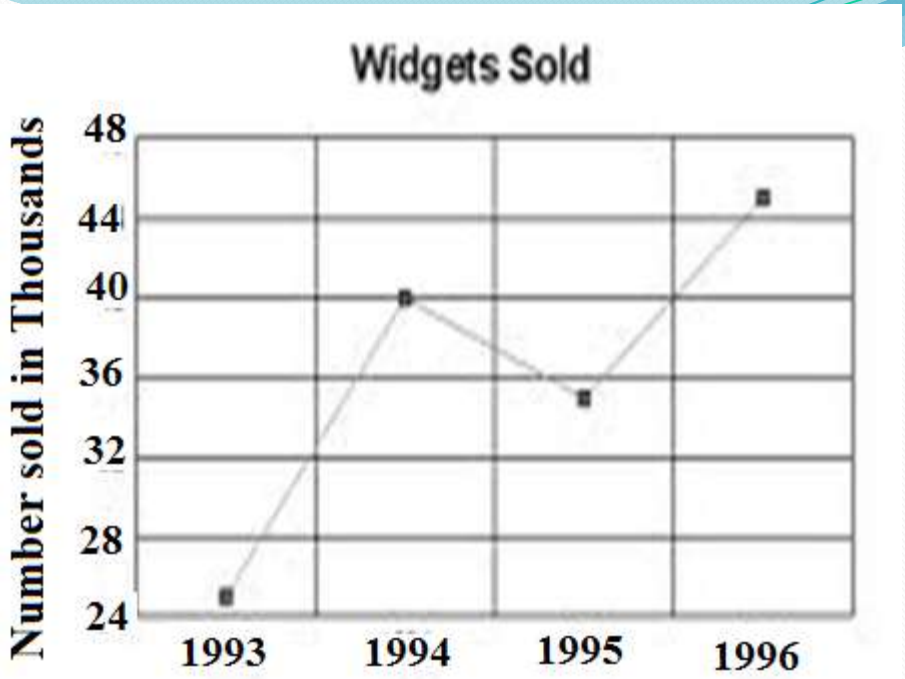
- Best for displaying data that are parts of a whole.

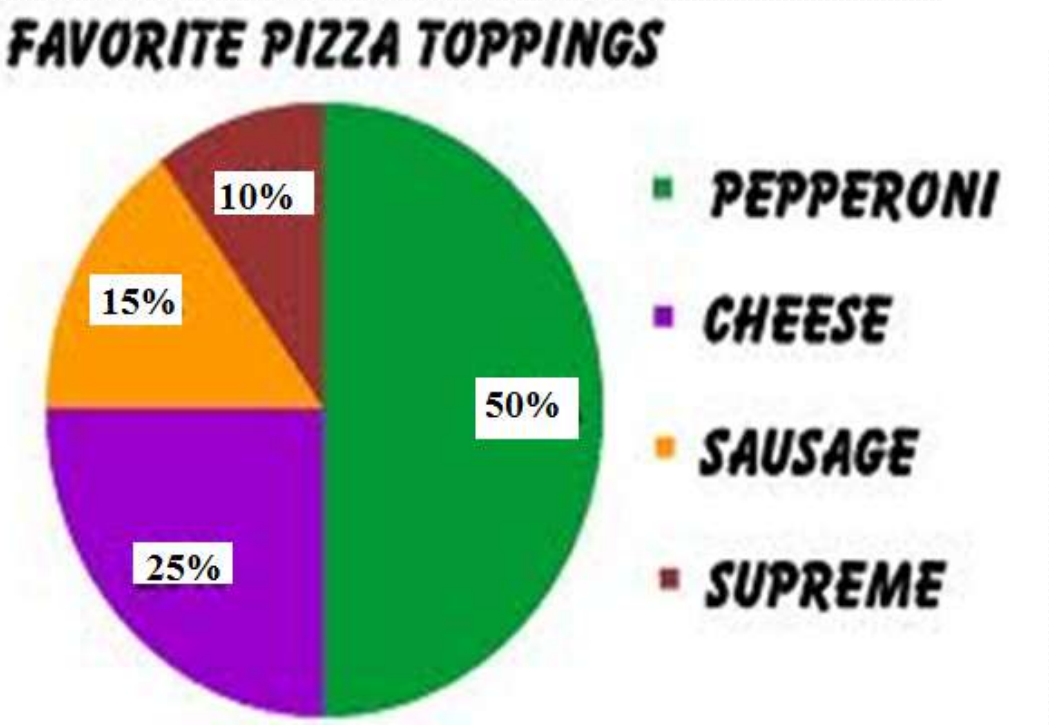


- What is being measured?
- What is independent variable?
- What is dependent variable?



Graphing Practice





Units of Measurement

- Scientists use the International System of Units (SI units) for measurements.
- When everyone uses the same units, sharing data and results is easier – less mistakes.

Base Units

- The official SI units to measure:
  - Length = meter (m)
  - Volume = liter (L)
  - Mass = gram (g)
  - Time = seconds (s)
  - Temperature = Kelvin (K)

Derived Unit

- Derived units, are made from combinations of base units.
  - **Area: square meter (m^2)**
  - **Volume: cubic meter (m^3)**
  - **Density: kilograms per cubic meter (kg/m^3) [a measurement of mass/volume]**
  - Pressure: pascal (Pa) [a measurement of force/area]
  - Energy: Hertz (Hz) [a measurement of force/distance]
  - Electric charge: coulomb (C) [is a measurement of current /time]

Metric Prefixes

Metric prefixes allow for more convenient ways to express SI base and derived units.

Prefix	Kilo	Hecto	Deca	Base	Deci	Centi	Milli
Symbol	k	h	da		d	c	m
meaning	10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}

King Henry - Conversions

- Use the sentence "King Henry Died by Drinking Chocolate Milk." to remember the order of prefixes.

Kilo Hecto Deca base Deci Centi Milli

mete
r
liter
gra

King Henry - Conversions

- Remembering the prefixes in order is the key to doing ANY metric conversion.
  1. Write the prefixes in order.
  2. Count the number of "JUMPS" between the two prefixes.
  3. If going **up** the prefixes move the decimal to the left the same number of spaces as "JUMPS"
  4. If going **down** the prefixes move the decimal to the right the same number of spaces as "JUMPS"

K h da base d c m

- Convert 2.45 hm to cm
  - Going down the prefixes so move the decimal 4 spaces to the right
  - 2.45 hm = 24500 cm

- Convert 526 mg to g
  - Going up the prefixes so move the decimal 3 spaces to the left.
  - 526 mg = 0.526 g

K h da base d c m

Practice

- Convert 3.876 Kg to dg
  - Moves to the right = 38760 dg
- Convert 526 dL to hL
  - Moves to the left = 0.526 hL
- Convert 2.8 s to ms
  - Moves to the right =2800 ms
- Convert 45 g to Kg
  - Moves to the left = 0.045 Kg

Scientific Notation

- When writing very large or very small numbers, scientists use a kind of shorthand called scientific notation.
- This is a way of writing a number without so many zeros.

Examples:

- The speed of light is about 300,000,000 m/s
  - Or 3.0×10^{8} m/s
- The mass of a proton is 0.000000000000000000000000 1673 $= 1.673 \times 10^{-24}$

All you do is move the decimal so that you **only have one** number before the decimal.

- 850,000,000.0

$$8\,5\,0\,0\,0\,0\,0\,0\,0.0$$

$$= 8.5 \times 10^{8}$$

For large numbers the exponent is positive!!

All you do is move the decimal so that you **only have one** number before the decimal.

- 0.000,000,025

0.000000025

$= 2.5 \times 10^{-8}$

The exponent is negative!!

For small numbers the exponent is negative!!

Scientific Notation Examples

- 0.007899 = ?
  - Small number = - exponent 7.899×10^{-3}
- 898745.30 = ?
  - Large number = + exponent 8.9874530×10^{5}
- 0.00003657= ?
  - Small number = - exponent 3.657×10^{-5}
- 531120 = ?
  - Large number = + exponent 5.31120×10^{5}

Getting numbers **out of** Scientific Notation

- Look at the exponent of the number to determine if it needs to get smaller or larger.
  - Positive exponent means the number gets larger so the decimal moves to the right.
  - Negative exponent means the number gets smaller so the decimal moves to the left.
- Add zeros to fill in any "BLANK" spaces.

- Example 1: 2.35×10^5
  - The exponent is positive so the number needs to get larger
  - 2 3 5 .
    
  - 2 3 5 0 0 0. or 235000
- Example 2: 8.68×10^{-4}
  - The exponent is negative so the number needs to get smaller
  - . 8 6 8
    
  - 0. 0 0 0 8 6 8 or 0.000868

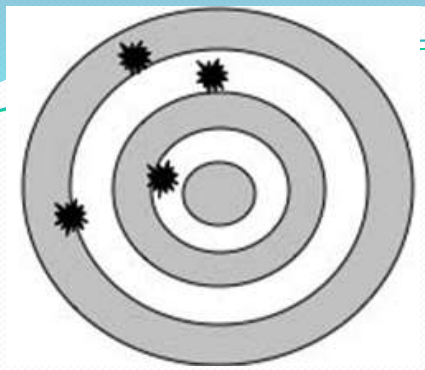
Scientific Notation Examples

- 3.256×10^{4}
  - positive exponent = large number 3256
- 9.78×10^{9}
  - positive exponent = large number 978000000000
- 5.24×10^{-3}
  - Negative exponent = small number 0.00524
- 2.41×10^{-7}
  - Negative exponent = small number 0.000000241

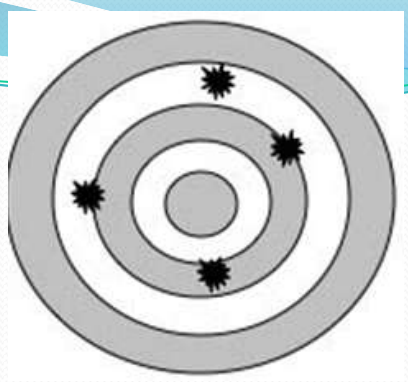
Limits of Measurement

- **Precision** is a gauge of how exact a measurement is.
- Precise measurements are close to each other.
- MUST have more than one measurement.

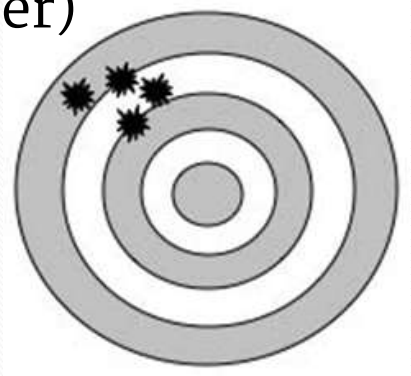
- **Accuracy** is the closeness of a measurement to the actual value of what is being measured.
- An accurate measure is close to the true or expected value.
- MUST have true or expected value.



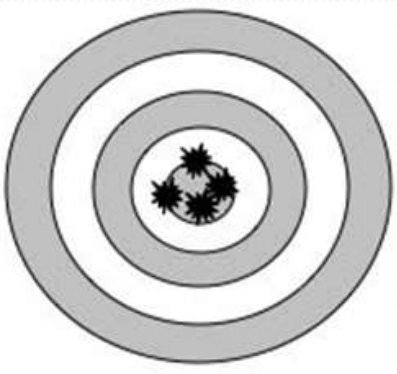
NOT Accurate (not near center)
NOT precise (not near each other)



Accurate (closer to center)
NOT precise (not near each other)



NOT Accurate (not near center)
Precise (close to each other)



Accurate (Near center)
Precise (close to each other)

Sally	Annie	Travis	Jeff
1.95 g/cm^3	2.69 g/cm^3	3.12 g/cm^3	2.71 g/cm^3
1.89 g/cm^3	2.73 g/cm^3	2.70 g/cm^3	
1.92 g/cm^3	2.65 g/cm^3	2.25 g/cm^3	

To the right is the data collected by students during a lab.
Actual Density of Aluminum is 2.70 g/cm^3

1. Which student's data is accurate and precise?
2. Which student's data is accurate but NOT precise?
3. Which student's data is NOT accurate but IS precise?
4. Which student's data is NEITHER accurate nor precise?

1. Annie
2. Jeff
3. Sally
4. Travis

Density

- Density is defined as a unit of mass per unit volume.
  - Generally is gram/cm^3 or gram/ml but other units are used.
  - $Density = \frac{mass}{volume}$ $or\ D = \frac{m}{v}$
- Example 1: Robin measured the mass of a metal cube to be 25.48 g and the cube measures 3 cm on each side. What is the cube's density?

Given	Equation	Solve

Solving word problems

- Example 1: Robin measured the mass of a metal cube to be 25.48 g and the cube measures 3.0 cm on each side. What is the cube density?

Given Mass= 25.48 g Length= 3.0 cm Width = 3.0 cm Height = 3.0 cm Volume= ? Density= ?		

Density Examples continued…

- A block of wood has a volume of 28.5 m^3 and a mass of 14.05 Kg. What is it's density?

- A marble has a mass of 2.48 grams and when placed in a graduated cylinder with 20 mL the volume increased to 24.5 mL. What is the marble's density?

- A block of wood has a volume of 28.5 m and a mass of 14.05 Kg. What is its density?

Given v= 28.5 m^3 m= 14.05 Kg D= ?		

- A marble has a mass of 12.48 grams and when placed in a graduated cylinder with 20.0 mL the volume increased to 24.5 mL. What is the marble's density?

Given m= 12.48g V initial= 20.0 mL V final= 24.5 mL D = ?		

The End