PHYSICAL SCIENCE
Chapter 1: The Nature of Science

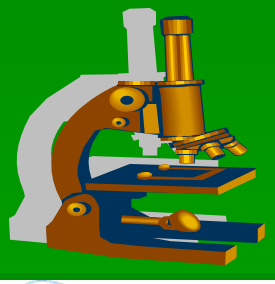
Section 1: The Methods of Science

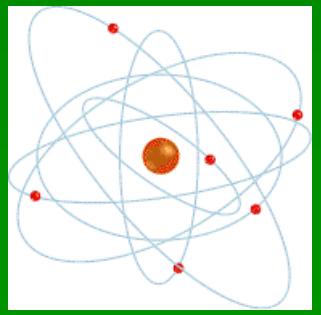
What is science?

- The term science is derived from the latin word scientia, meaning “knowledge.”

There are 3 Major Categories of Science

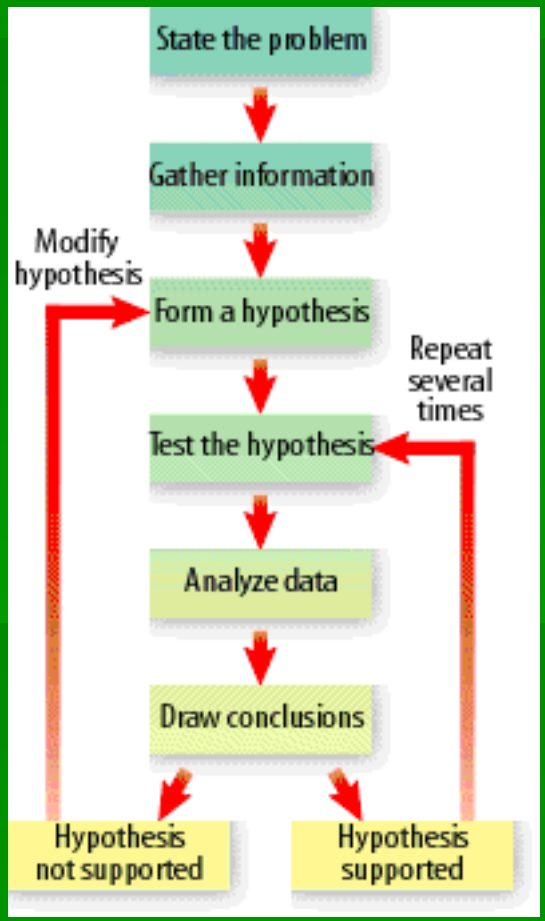
- 1. Earth science—7th grade—investigates Earth and space
- 2. Life science—8th grade—deals with living things
- 3. Physical science—9th grade—study of matter and energy





The Scientific Method

- An organized set of investigation procedures is called the **scientific method.**



STEP 1

- STATE THE PROBLEM (after making observations)
- The problem is often stated in the form of a question (Why…? How…?)

STEP 2

- RESEARCH AND GATHER INFORMATION
- Learn about the background of the problem.
- What other tests have scientists already performed?

STEP 3

- FORM A HYPOTHESIS—A **hypothesis** is a possible explanation for a problem.
- “Educated Guess”
- Prediction

STEP 4

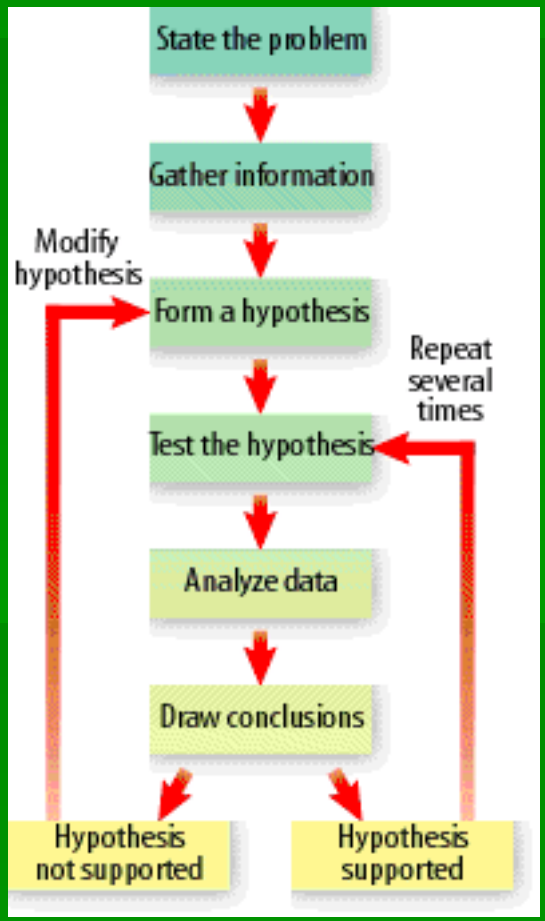
- TESTING A HYPOTHESIS
  - Make observations
  - Build a model
  - Perform an experiment

STEP 5

- ANALYZE THE DATA —Record observations into easy-to-read tables and graphs.
- Include all results, even unexpected ones. (NO BIAS)

STEP 6--DRAW A CONCLUSION—Is your hypothesis supported or not?

- SUPPORTED—REPEAT steps 4-6 several times
- NOT SUPPORTED—REPEAT STEPS 3-6 (if now supported, see above)



VARIABLES

- A **variable** is a quantity that can have more than a single value.
- An experiment usually contains at least 2 variables.

EXPERIMENT

- Which brand of fertilizer helps plants to grow the biggest?

List variables—factors that might cause plants to grow bigger.

- Amount of sunlight
- Amount of water
- Type of fertilizer
- Type of soil
- Room temperature
- Plant type

What is the independent variable?

- The variable you change to see how it will affect the *dependent* variable.
- The scientist is able to choose the independent variable.
- Ex. The brand of fertilizer

What is the dependent variable?

- The dependent variable changes according to the changes in the other variable.
- The scientist is not able to choose the dependent variable.
- Ex. The amount of plant growth

Constants

- A **constant** is a factor that does **not** change when other variables change.
- Constants remain the same throughout the experiment.
- Examples—amount of sunlight, amount of water, room temperature, type of soil, plant type

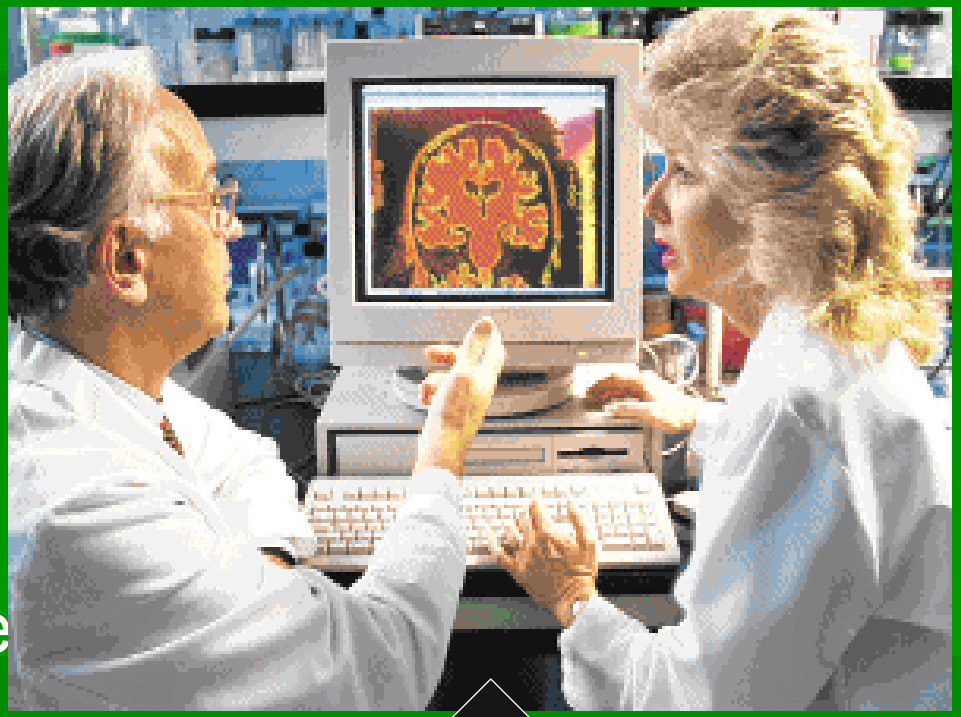
Control

- A **control** is the standard by which the test results can be compared.
- One plant has no fertilizer. This plant is the **control**.
- Ex. Three fertilized plants grow between 2-3 cms. VS. The *unfertilized* plant grows 1.5 cms.

Are science and technology the same?

- **Science** is acquiring knowledge.

- **Technology** is the application of science to *help* people.



Sweet 80's Picture

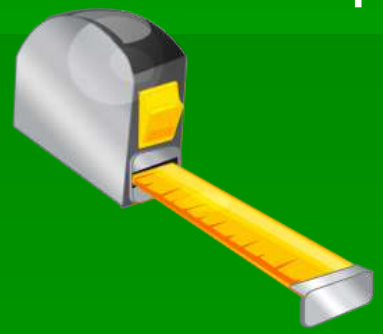
CHAPTER 1: THE NATURE OF SCIENCE

Section 2: Standards of Measurement

A standard is an exact quantity that people agree to use for comparison.

English Measurement System (U.S.A.)

- Milk→gallon
- Lumber→foot
- Potatoes→pound



Metric (Other Nations)

- Based on multiples of 10 and developed in the late 1700's.
- Milk→ Liter
- Lumber→Meter
- Potatoes→ Kilogram

In 1960, an improved version of the metric system was devised, known as the International System of Units, abbreviated SI.

SI BASE UNITS

QUANTITY MEASURED	UNIT	SYMBOL
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K

SI PREFIXES are easy to use, because they are based on multiples of 10.

- The prefix *kilo-* means “1,000”
- 1 kilometer = 1,000 meters
- 1 kilogram = 1,000 grams

- The prefix *deci-* means “one-tenth”
- 1 decimeter = one-tenth of a meter (0.1 m)
- 1 decigram = one-tenth of a gram (0.1 g)

COMMON SI PREFIXES

PREFIX	SYMBOL	MULTIPLYING FACTOR
Kilo-	k	1,000
Hecto-	h	100
Deca-	da	10
BASE UNIT	BASE UNIT	BASE UNIT
Deci-	d	0.1
Centi-	c	0.01
Milli-	m	0.001

CONVERTING BETWEEN SI UNITS

- **Conversion factors** are used to change one unit to another.
- Ex. 1,000 mL = 1 L

$$\frac{1{,}000\ \text{mL}}{1\ \text{L}} = \frac{1\ \text{L}}{1\ \text{L}}$$

- A **conversion factor** is a ratio that is equal to one.
- CF→ $\frac{1{,}000\ \text{mL}}{1\ \text{L}} = 1$
- OR→ $\frac{1\ \text{L}}{1{,}000\ \text{mL}} = 1$

To convert units, you multiply by the appropriate conversion factor.

- Ex. 1.255 L = ? mL

- $1.255\ \text{L} \times \frac{1{,}000\ \text{mL}}{1\ \text{L}} =$

  1,255 mL

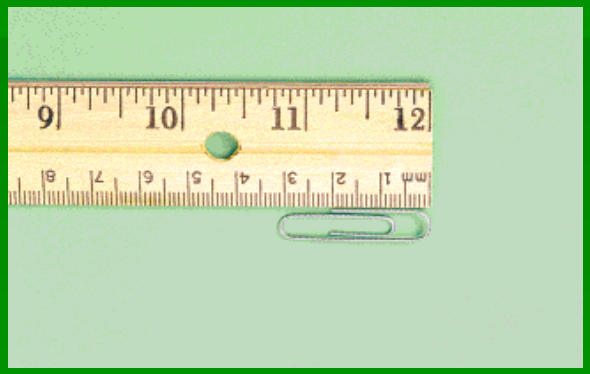
MEASURING DISTANCE

- The SI unit of length is the meter, m.
- Length is measured as the distance between 2 points.

The size of the unit you measure with will depend on the size of the object being measured.

- Distance from home to school

=km

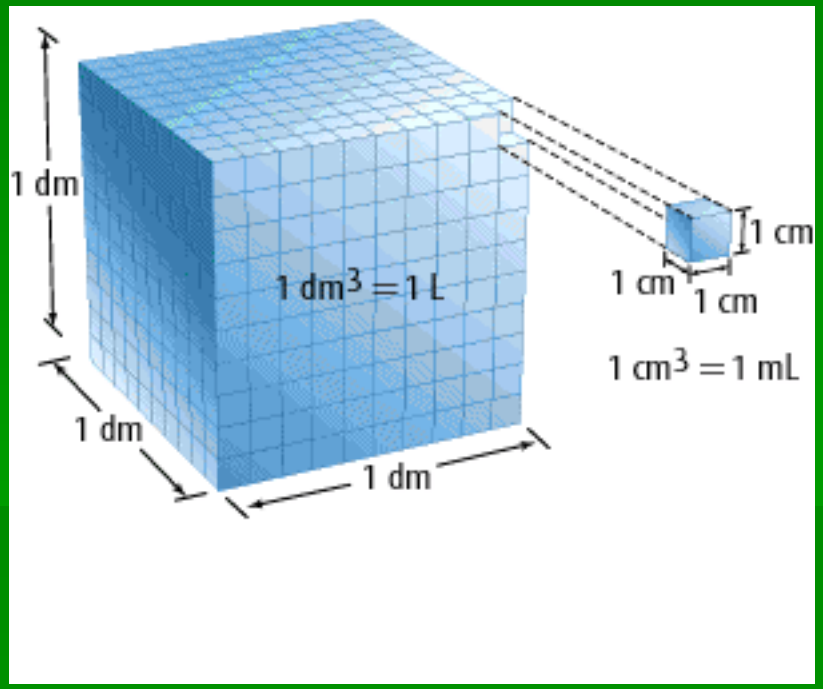


- Length of your pencil

= cm

MEASURING VOLUME

- The amount of space occupied by an object is called its **volume**. (Solids, liquids, and gases)



Ex. VOLUME OF A BOX

- Measure its length, width, height
- Multiply the 3 numbers and add their units together
- V = l x w x h

- V = 13 cm x 5 cm x 3 cm
- V = 195 cm^3

Measuring Matter

Mass is a measurement of the quantity of matter in an object.

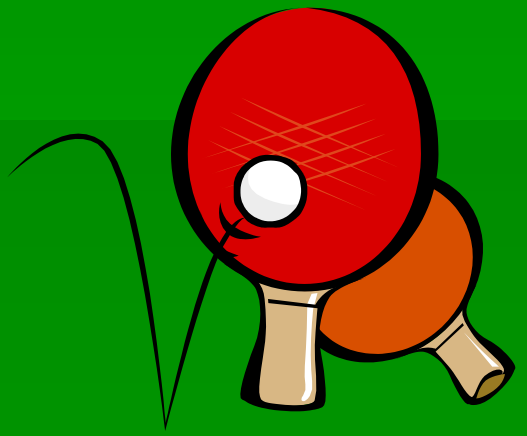
- A table-tennis (ping pong) ball and a golf ball have about the same **volume**.

- The golf ball has more **mass**.

The mass of a golf ball is almost 18 times the mass of a ping pong ball.

- GOLF BALL
  = 45 g

- PING PONG BALL
  = 2.5 g



DENSITY
Cube of Aluminum vs. Cube of Copper

- Same
SIZE

- Same
VOLUME

- Different
MASS

- Different
DENSITY

WHAT IS DENSITY?

Density is the mass per unit volume of a material.

- Density (D) = $\frac{\text{mass (m)}}{\text{volume (v)}}$
- D = $\frac{10\ \text{g}}{2\ \text{cm}^3}$
- D = $5\ \text{g/cm}^3$

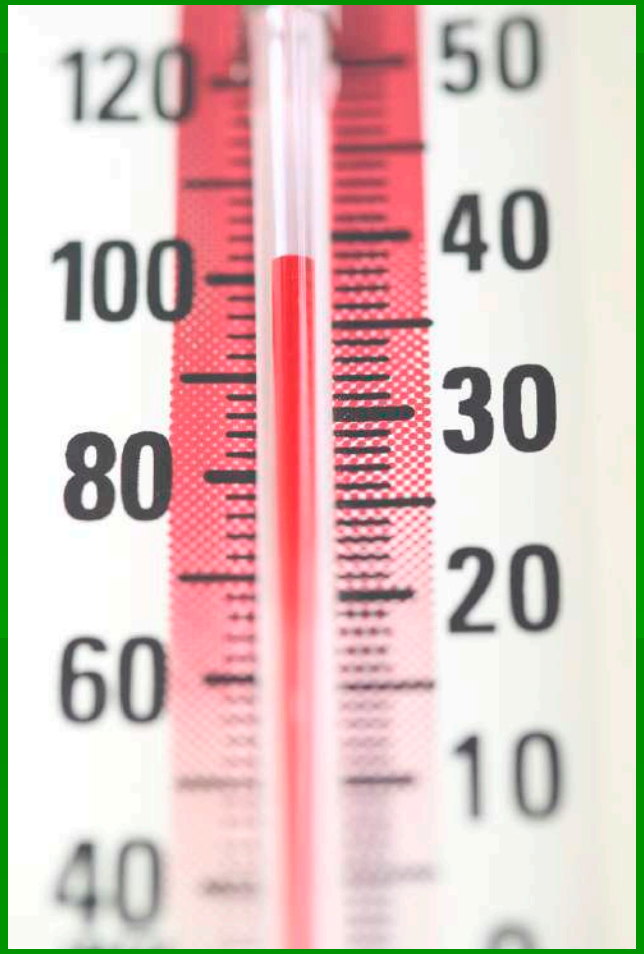
- The measurement unit for density, g/cm^3, is a combination of SI units.
- A unit obtained by combining different SI units is called a derived unit.

TIME

- **Time** is the interval between 2 events.
- The **SI** unit for time is the second.

TEMPERATURE

- For most scientific work, temperature is measured on the **Celsius (C)** scale.
- The **SI** unit of temperature is the **kelvin (K)**.



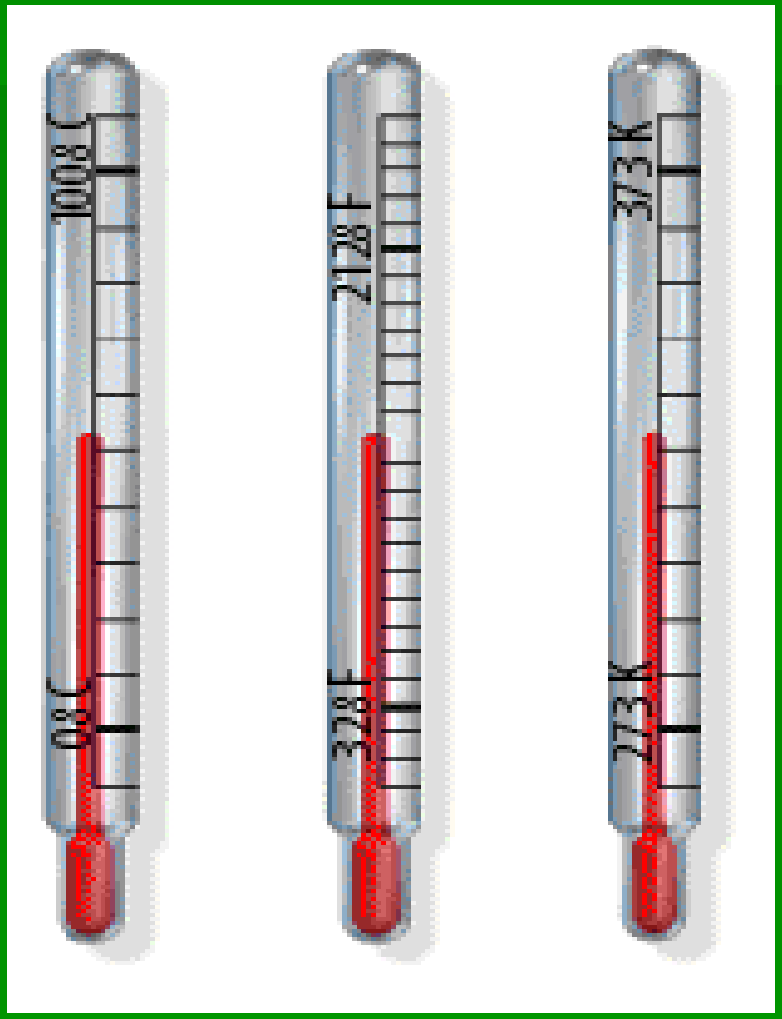
THE 3 TEMPERATURE SCALES

- FREEZING POINT OF WATER→

0°C, 32°F, or 273K

- BOILING POINT OF WATER→

100°C, 212°F, or 373K



Converting Fahrenheit (F) to Celsius (C)

- Ex. 70°F = ? °C
- **C = 5(F-32)**
9
- C = 5(**70**-32)
9
- C = 5(38)
9
- C = 190
9
- C = 21.1 or 21°C

CONVERTING CELSIUS (C) TO FAHRENHEIT (F)

- Ex. 21°C = ? °F
- **°F = 32 + (9x°C)**
  5
- °F = 32 + (9x21)
  5
- °F = 32 + 189
  5
- °F = 32 + 37.8
- °F = 69.8 or 70°F

CHAPTER 1: THE NATURE OF SCIENCE

Section 3—Communicating with Graphs

A VISUAL DISPLAY

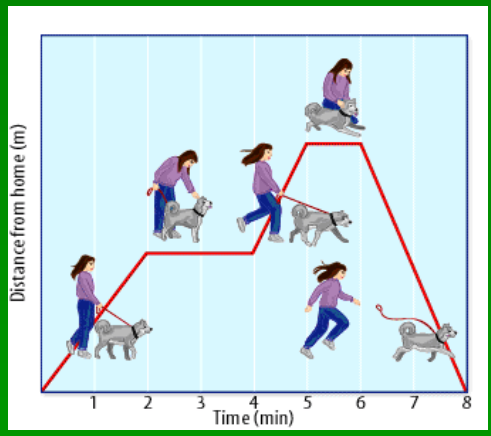
- Scientists often graph the results of their experiments because they can detect *patterns* in the data easier in a graph than in a table.
- A **graph** is a visual display of information or data.

- Why are graphs important?

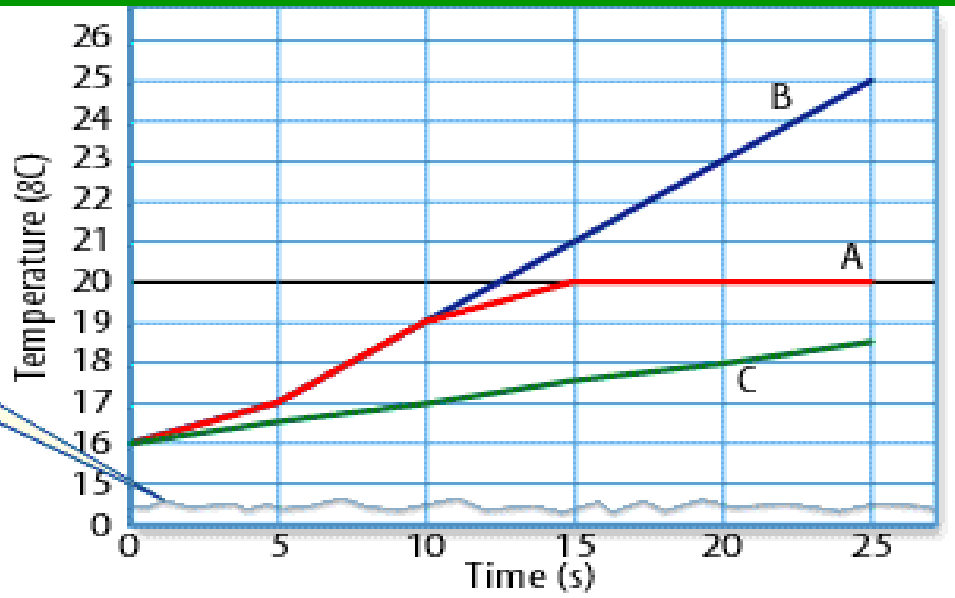
Graphs are a quick way to communicate a lot of information in a small amount of space.

There are 3 types of graphs--line, bar, and circle (pie).

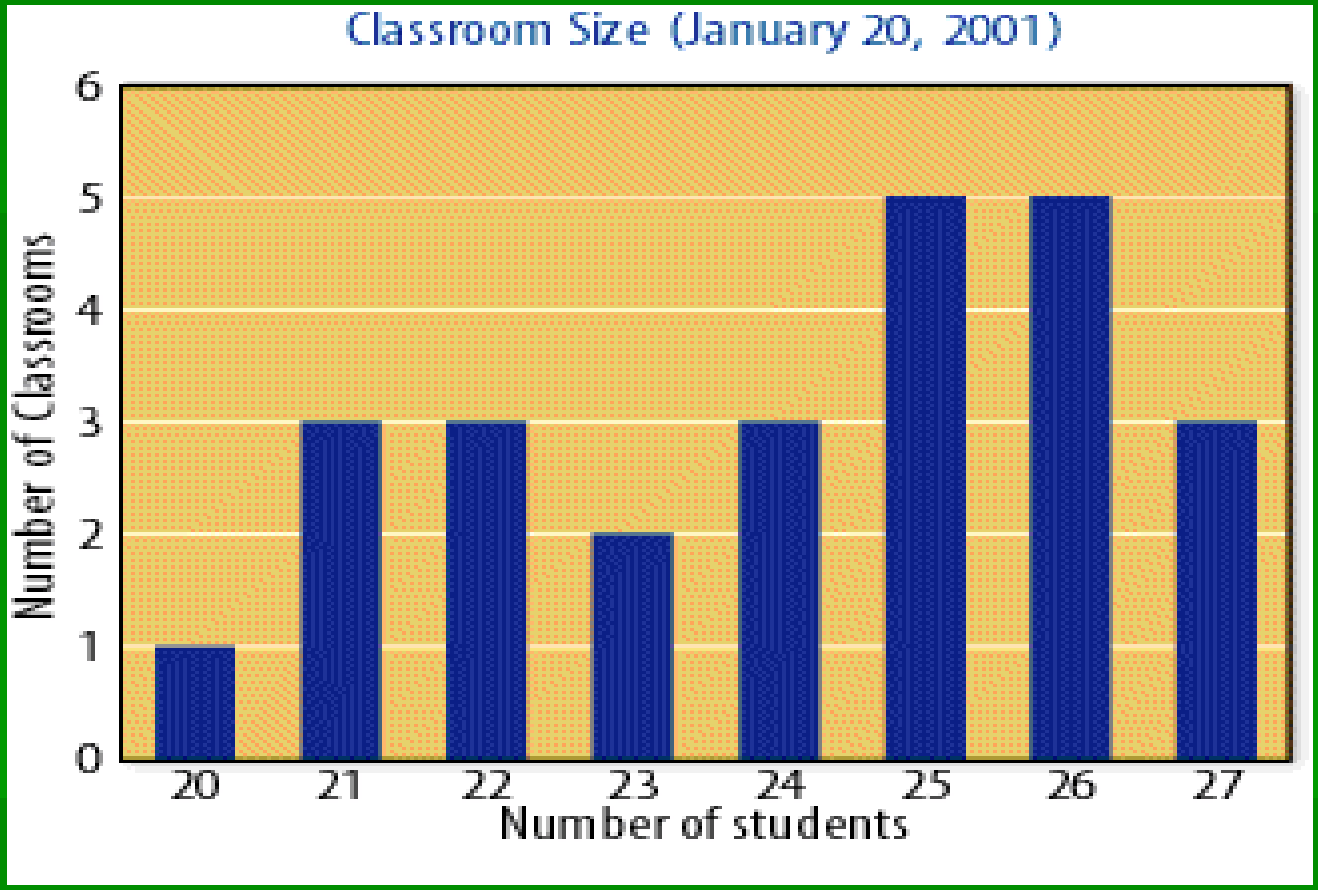
- **<u>Line</u> graphs** show how a relationship between variables changes over ***time.***



The break in the vertical axis between 0 and 15 means that numbers in this range are left out. This leaves room to spread the scale where the data points lie, making the graph easier to read.



Bar Graphs



- A **bar** graph is useful for ***comparing*** information collected by ***counting.***

Circle Graphs

- A **circle** graph or pie graph is used to show how some fixed quantity is broken down into parts.
- The circular pie represents the ***total***.
- The slices represent the ***parts*** (percentages of the total).