Scientific Method

Scientific Method
Metric System
Graphing
Tools
Microscope

Tools

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Scientific Method

- **Scientific method**: a process by which scientists do experimental research
  - 6 steps
    - State the problem
    - Forming a hypothesis
    - Experiment
    - Collect and record data
    - Analyze
    - Conclude

Step #1: State the problem/Ask a Question

- Question/observe something
- Want to figure something out
- Must do Research
- Example
  - Which type of fertilizer will make my sunflowers grow the tallest?

Step #2: Form a Hypothesis

- An educated guess based on prior knowledge
- Must be able to be tested
- How to write it:
  - If……. then…….
- Example:
  - If I put fertilizer A on the sunflower plant then it will grow the tallest.

Variables

- A factor that changes in an experiment
  - **Independent Variable (IV):** the variable that is **purposely** changed or manipulated
  - **Dependent Variable (DV):** the variable that **responds** to the IV
  - **Constants(3)**: all other factors that remain the **same** and have a **fixed** value
  - **Control**: the **standard**/recommended factor used for **comparing** experimental effects (the do nothing)

In a science fair, Jordan asks the question “Does caffeine increase the heart rate of an earthworm?” In Test 1, he measures the heart rate by looking at the earthworm under a microscope, the earthworm has a heart rate of 50 bpm (beats per minute). In Test 2, he places a few drops of caffeine on the earthworm’s skin and measures the rate again. In this test, the heart rate is 68 bpm.

1) What is the control group?
2) What is the IV?
3) What is the DV?
4) What should Jordan’s conclusion be?
5) Jordan needs to repeat the experiment, but his teacher says that he needs to improve his design. In his second experiment, what should he do differently.

Find the IV, DV, control and constants

- Does heating a cup of water allow it to dissolve more sugar?
- What are the effects of the amount of pollution produced by cars using gasoline containing different amounts of lead?
- Two groups of students were tested to compare their speed working math problems. Each group was given the same problems. One group used calculators and the other group computed without calculators.

Variable Practice

- Complete
  - IV
  - DV
  - Control
  - Contstants$_3$

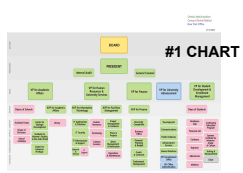
Step #3: Create and Perform Experiment

- The process of testing a hypothesis by carrying out data-gathering procedures under controlled conditions
  - Must include a **Material’s List** and a How to **Procedure**
  - Example:
    - I will test 4 different types of fertilizers on sunflower plants and measure the height of each plant

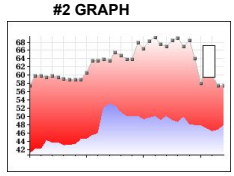
Step 4: Collect & Record Data

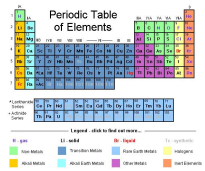
- This is the experiments results
- *2 types of data collecting methods*
  - **Qualitative**
    - “L”
    - The measurement using your senses (it is like…)
  - **Quantitative**
    - “N”
    - The measurement using numbers

4 Ways to record data



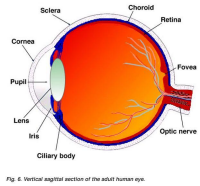
#2 GRAPH





#3 TABLE

#4 DIAGRAM



Step #5: Analyze

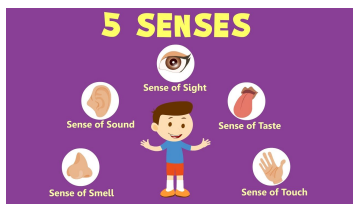
- To interpret the results
- Sum up the experiment
  - Use your graphs for this
- Example
  - My data shows that Miracle-Gro fertilizer works the best since my sunflower grew the tallest using it.

Step #6: Conclusion

- Support/refute your hypothesis
- Communicate the results
- How can we improve this experiment?
- Example
  - I wrote a paper and will present my project at the science fair.

Other important Terms

- **Observation**:
  - to gather factual information about your surroundings using your 5 senses
- Example
  - The sunflower blooms in Pot A are more vibrant than the other pots.



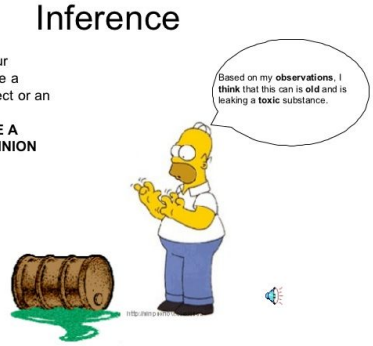
Inference

- to infer means to use the information gathered during **observation** to make an **opinion** about things that are not necessarily seen or known
- this is our way of interpreting the data we collect as we draw conclusions about a situation
- inferences can be wrong and often change as new observations are made
- Example
  - Mom is baking some cookies.

Inference

Inference: using your observations to make a **guess** about an object or an outcome

THIS CAN BE A SCIENTIFIC OPINION

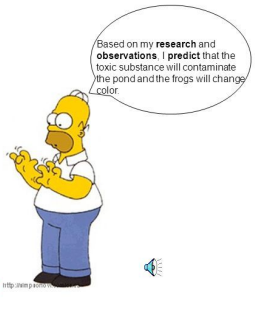


Prediction

- a predication is a **forecast** of what **will** happen in the **future** based on past experience.
- To predict are attempts to determine the future
- Example:
  - I predict that it will rain since the sky is very dark.

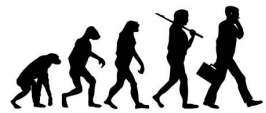
Prediction

Prediction:
• a statement or claim that a particular event will occur in the future.
•Scientists use research and many observations to make predictions.
•**THIS IS AN EDUCATED GUESS.**



Theory

- Is a **well tested** explanation that unifies a broad range of observations and hypotheses and that enables scientists to make **accurate** predictions about new situations
- Example
  - Big Bang
  - Theory of Evolution



Law

- a law is a statement that describes what is **expected** to happen under certain sets of conditions

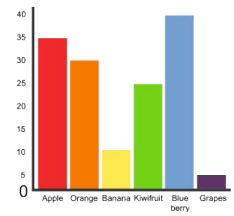
Practice

- Complete the scientific method worksheets
  - A Dogged Investigation
  - Scenarios for homework

GRAPHING NOTES

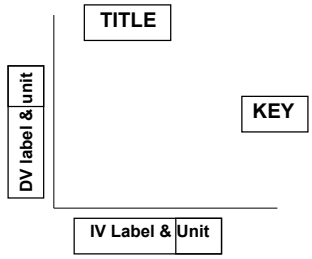
Graphing Notes

- A graph shows data in **picture** form
- The graph allows us to make
  - Interpretations
  - Visually see differences
  - Make comparisons
  - Draw conclusions



How to Label Graphs

- **All graphs must have 6 things**
  - Title
  - IV label
  - IV unit
  - DV label
  - DV unit
  - *Key/legend*



IV is placed on the x-axis
DV is placed on the y-axis

When do you use a BAR Graph or LINE Graph

- **Bar Graphs** are used with qualitative data
  - One set of data uses "likes"
  - One set of data is numbers
- **Line Graphs** are used with quantitative data
  - Both sets of data are numbers

Bar Graph vs Line Graph

- The effect of coloration on the number of kittens sold at a pet store
- The effect of concentration of sugar water on the number of visits of hummingbirds to a feeder.
- The effectiveness of different brands of paper towels on the absorption of water.
- The effect of the horsepower of a tractor on the mass of a sled it can pull.

Practice making graphs

Plan An Investigation Worksheet

Metric System

Metric System

- *A decimal system based on a scale of multiples of 10*
  - AKA: International System of Units (SI)
  - No naked numbers allowed!
  - When measuring: all measurements must include a **UNIT** of measurement and a **NUMBER** stating how many of the units are present
    - Example:
      - The tree is 30 cm tall.

NUMBER

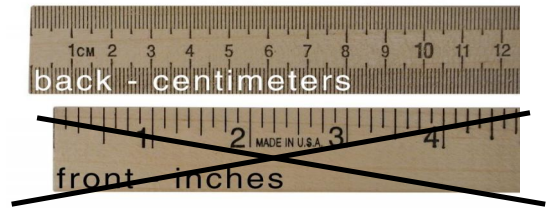
UNIT

Metric System

- Types of measurement
  - **LENGTH**
  - **VOLUME**
  - **MASS/WEIGHT**
  - **TEMPERATURE**
  - **TIME**

Length

- The measurement of how long (length), wide (width), or tall (height) something is
- Basic unit is the meter (m)

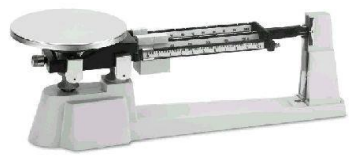


How small is small?

- http://learn.genetics.utah.edu/content/begin/cells/scale/
- Terrific journey power point

Mass

- The amount of **matter** in an object
- Basic unit is the gram (g)
- Will always stay **constant**

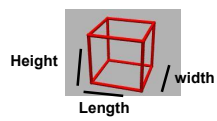


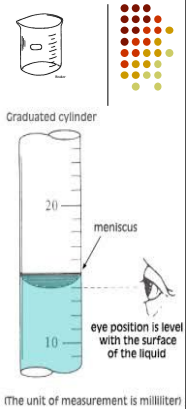
Weight

- The measure of the **pull of gravity** on an object
- Basic unit is the Kilogram (Kg)
- Does not stay **constant**

Volume

- The amount of **space** an object occupies
- Basic unit is the liter for **liquids** (L)
- Basic unit is the (cm^3) centimeter cubed for **solids** ….
  - must measure all 3
  - (Length x Width x Height)





Temperature

- The measurement of the amount of heat in an object
- Basic unit is degree Celsius

- **Freezing point** = 0 degrees Celsius/ 32 deg F
- **Boiling point** = 100 degrees Celsius/212 deg F

- **Body temp**= 37 degrees Celsius/98.6 deg F
- **Room temp** = 21 degrees Celsius/70 deg F

CONVERSIONS:

Celsius to Fahrenheit: (1.8 * Celsius) + 32

Fahrenheit to Celsius: (F-32) / 1.8

Time

- The measurement of the **span** between two events **(start and stop)**
- Basic unit is the **second**
- How many seconds in an minutes?
- How many minutes in a day?
- How many seconds in a day?

Metric System Units

Kilo-	**Hecto-**	**Deka-**	**standard/ base**	**deci-**	**centi-**	**milli-**
King	*Henry*	*Died*	*slowly*	*drinking*	*chocolate*	*milk*
Km Kg KL	Hm Hg HL	Dm Dg DL	meter (m) Gram (g) Liter (L)	dm dg dL	cm cg cL	mm mg mL
thousand	hundred	ten	one	tenth	hundredth	thousandth
0.001 Km= 1m	0.01Hm= 1m	0.1Dm = 1m	1.0	10 dm = 1m	100cm= 1m	1000mm= 1m

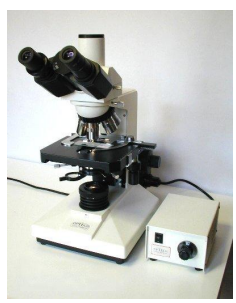
When moving from small to large move the decimal point to the LEFT

When moving from large to small move the decimal point to the RIGHT

Metric System practice

- 26.4 m **2,640** cm
- 127. 45 mm **12.745** cm
- 45.01 L **45,010** mL
- 0.0034 Kg **3,400** mg
- 100 Hm **10,000** m
- 0.00456 Dg **4.56** cg
- 57 g **0.057** Kg

The Microscope



Types of Microscopes

- Electron Microscope
  - Uses electrons & magnets
  - SEM
  - TEM

- Light Microscope
  - Uses lights and lenses

Types of Microscopes

- **<u>Light</u> microscope**:
  - Uses light as its source
  - Resolution limited to light blurring
- **<u>Electron</u> microscope**:
  - Uses magnets to aim beams of electrons
  - Very detailed

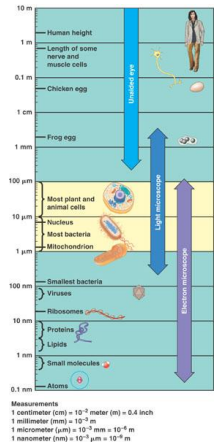


Fig. 6.1

Microscope

- 1. Eyepiece
- 2. Coarse Focus Adjustment
- 3. Fine Focus Adjustment
- 4. Revolving Nosepiece
- 5. High power objective
- 6. Low power objective
- 7. Arm
- 8. Stage
- 9. Diaphragm
- 10. Base
- 11. Light source
- 12. Stage clips

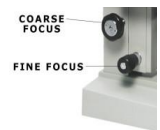
- Move the slide to the Right and see it move **LEFT**
- Move left and see it move **RIGHT**

Parts of the Microscope

- **1. EYEPIECE**
  - What you look thru
  - Holds the ocular lens
  - Magnification power of 10x by itself
  - AKA Ocular

Parts of the Microscope

- **2. COARSE FOCUS ADJUSTMENT**
  - Always use this first
  - Helps you to find the image
  - The "big" knob
- **3. FINE FOCUS ADJUSTMENT**
  - Always use this second
  - Helps to make the image clear
  - The smaller knob



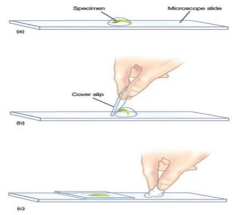
Parts of the Microscope

- 4. **REVOLVING NOSEPIECE**
  - Rotates the objective lenses
- 5. **HIGH POWER OBJECTIVE**
  - The highest magnification power
  - The longer objective
  - ____x
  - Total Magnification Power or TMP
    to find TMP= Eyepiece power X objective power
- 6. **LOW POWER OBJECTIVE**
  - The lowest magnification power
  - The shortest objective
  - ____ x
  - TMP of low power = _____

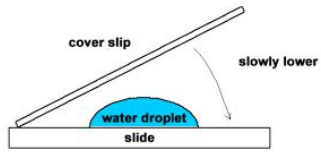
Parts of the Microscope

- 7. **Arm**
  - Supports all components above the base
  - You must hold this part while carrying
- **8. Stage**
  - Holds the slide
- **12. Stage Clips**
  - Hold the slide in place
- **9. Diaphragm**
  - Adjusts the amount of light shown thru the stage hold
- **10. Base**
  - Is the foundation of the microscope
  - One hand must be on this when carrying it

What do you do with a slide, coverslip, and stain?



How to make a wet mount



SOL REVIEW QUESTIONS

- Here are some review questions for this chapter
  - Click on the frog for a review
  - Review #2, 3, and 4

Review

- Please review your notes, review guide, and any journal entries.
- All is fair game for the test
- Good luck…. Study and you will do great!