Name: _____**ANSWER KEY**_____ Date:_____

Living Environment 2018

Introduction to Living Environment & Scientific Methods

In order to successfully conduct investigations in Living Environment, we need to develop proficiency in certain laboratory skills. In our first Unit and throughout the school year, we will perform each of the laboratory skills listed below. We will check off each one of these skills as we learn and practice them.

- ☐ Follow safety rules in the laboratory
- ☐ Select and use correct instruments
- ☐ Use graduated cylinders to measure volume
- ☐ Use metric ruler to measure length
- ☐ Use thermometer to measure temperature
- ☐ Use electronic balance to measure mass
- ☐ Design and carry out a controlled, scientific experiment based on biological processes
- ☐ State an appropriate hypothesis
- ☐ Differentiate between independent and dependent variables
- ☐ Identify the control group and/or controlled variables
- ☐ Collect, organize, and analyze data, using a computer and/or other laboratory equipment
- ☐ Organize data through the use of data tables and graphs
- ☐ Analyze results from observations/expressed data
- ☐ Formulate an appropriate conclusion from the results of an experiment
- ☐ Recognize assumptions, limitations, and improvement of the experiment

Notes on the Characteristics of Living Things

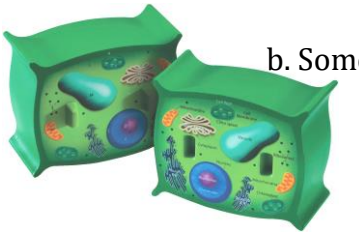
1. **Biology** is the study of ___**LIFE**_____.

How can we tell the difference between something that is living and something that is non living?

→ → All living things have several characteristics in common.

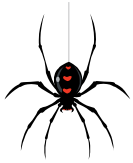
2. The characteristics of a living organism are:

1. **Made of one or more cells.**
   a. A cell is the __**BUILDING BLOCK OF LIVING THINGS**___.



   b. Some organisms are unicellular or __**MADE OF ONE CELL**_____.
   Example: Paramecium

   c. Other organisms are multicellular or __**MADE OF MANY CELLS**___.



   Example: Spider

2. **Displays organization.**
   a. Each part of the living organism has a specialized
   Example: A human's legs are used for movement.

3. **Grows and develops.**
   a. Growing means to increase in __**SIZE**_____.
   b. Development means an increase in an organism's __**COMPLEXITY**____.

For example: an infant cannot hold a spoon and feed itself, but overtime, the brain and muscles in the hands ***develop*** and the infant will learn to feed itself.

4. **Reproduces.**

   a. To reproduce means to produce __OFFSPRING____.
   An individual does not need to reproduce, but some species have to have offspring.

5. **Responds to stimuli.**

   a. Internal and external stimuli (__SIGNALS FROM ENVIRONMENT___)
   that cause the organism to respond (react).

Example: A hawk feels hungry (an internal stimuli), and hunts (response to stimuli) for field mice. The field mice responds by running away.

6. **Requires energy.**

   a. Organisms must eat.

   b. Autotrophs: _MAKE OWN FOOD_____
   Ex: _____

   c. Heterotrophs: __HAVE TO EAT FOOD__
   Ex: You and me

7. **Maintains homeostasis-** to maintain a steady or stable environment. Maintain balance in a system

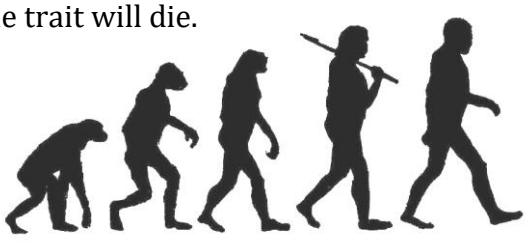
HOMEOSTASIS comes from two LATIN root words:

HOMEO = __SAME_____ **STASIS =** ___STATE_____

   a. Internal conditions must stay _BALANCED__.

   Ex: A human sweats to stop their body temperature from rising too high.

8. **Evolves overtime.**
   As an organism reproduces, it passes on traits. Organisms with traits that help the organism survive in its environment will thrive, reproduce and pass along this trait. Organisms without the favorable trait will die.



Once we know that something is alive, there are __7___ processes that keep the organism living.

A process is _AN ACTION THAT A BODY TAKES TO STAY ALIVE__

1. MOVEMENT
2. EXCRETION
3. RESPIRATION (BREATHING)
4. REPRODUCE
5. EAT (NUTRITION)
6. RESPOND TO STIMULI
7. GROW

Summary Questions:

1. Which term includes ALL the activities required to keep an organism alive?

(1.) metabolism (2.) growth (3.) nutrition (4.) excretion

Metabolic Waste- Waste created when your body's cells create and provide energy to survive

2. Which life process prevents the accumulation of metabolic wastes in a bald eagle?

(1.) nutrition (2.) excretion (3.) digestion (4.) ingestion

Completion Section:

1. The taking in of food is called _NUTRITION_____.

2. The study of living things is called ___BIOLOGY_____.

3. The sum total of ALL life processes or activities is known as ___METABOLISM_____.

4. The increase in size of a living thing is called _____GROWTH_____.

5. The removal of wastes from an organism is called ____EXCRETION_____.

6. This is the one life process not necessary for any individual organism. This life process where by organisms make more of their own kind is called ___REPRODUCTION____.

7. The tendency of organisms to maintain a stable internal environment or "steady state" is called ___HOMEOSTASIS_____.

8. Disruptions in homeostasis may result in death or _____ILLNESS_____.

9. What may happen to a species if it does not have favorable traits which lead to evolution?EXTINCTION

Notes on Graphing

Unit Question: Why do humans create models?
Content Question: Is a picture really worth a thousand words?
AOI: Human Ingenuity

Why do we use graphs and tables? Use page 20 in the textbook (**Analyze the Data**) to find the answer, then check with your partner's response:

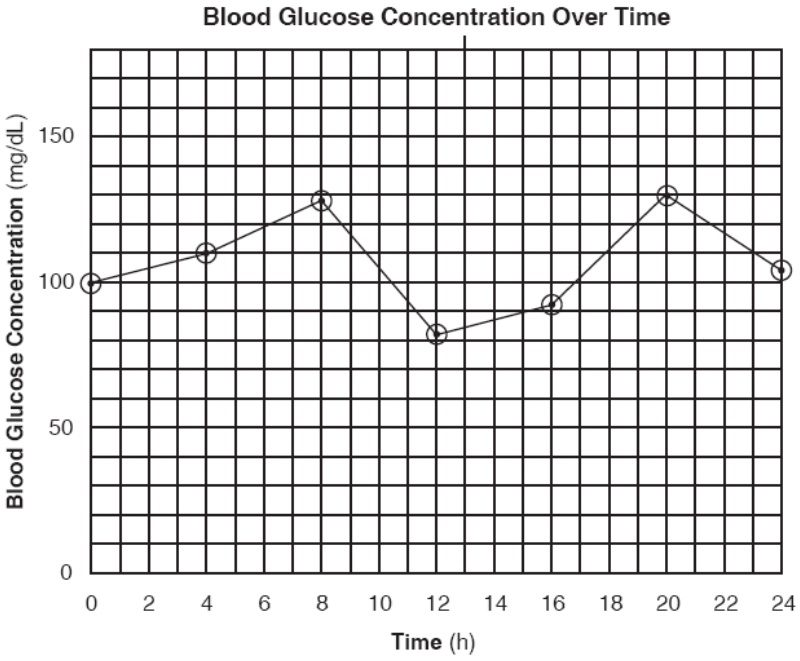
Reading or interpreting a graph is typically much easier than creating a graph from scratch, so we will start there….

Two key skills when reading line graphs are below:

1. **Interpolation** is determined by reading a value on your line in-between the points you graphed.

2. **Extrapolation** is to **predict** a value that is not on your line (beyond your line) based on the graphed data.

There are many different factors you must consider when you construct and read a graph. Below you will find some graphs (some are from the lab that you worked on in class). Use the graphs to answer the questions that follow.



1. The ***independent variable*** for an experiment is always placed on the x axis of a graph.

Identify the independent variable on this graph. **TIME**

2. The ***dependent variable*** for an experiment is always placed on the y axis of a graph.

Identify the dependent variable on this graph. **BLOOD GLUCOSE CONCENTRATION**

3. Based on the trend shown in the graph, what is the blood glucose concentration at a time of 6 hours? **120 mg/dL**

4. Based on the trend shown in the graph, what is the blood glucose concentration at a time of 23 hours? **110 mg/dL**

5. Identify the ***independent variable*** on this graph.
__YEAR_____

6. Based on the trend shown in the graph, what is the pH level in 1987? __6.3_____

7. Based on the trend shown in the graph, what is the pH level in 1993? __5.5_____

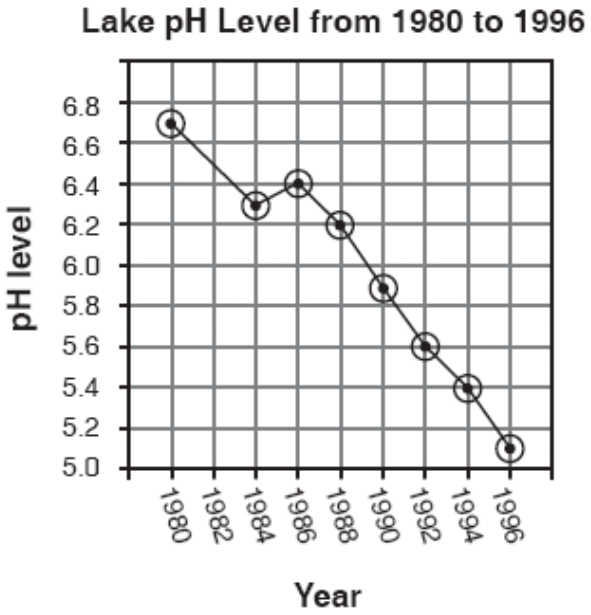
8. What are the numbers on the x-axis doing?
_INCREASING_____

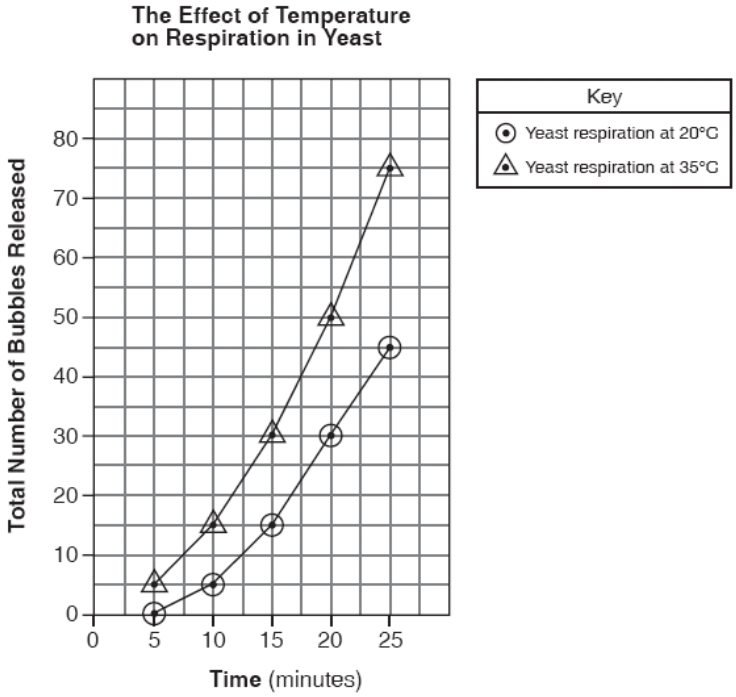
9. What are the numbers on the y-axis doing?
__DECREASING_____

10. State the relationship between the variables on this graph:

As Year (x) _INCREASES__, pH level (y) __DECREASES____.

11. What type of relationship is this? ___INDIRECT____



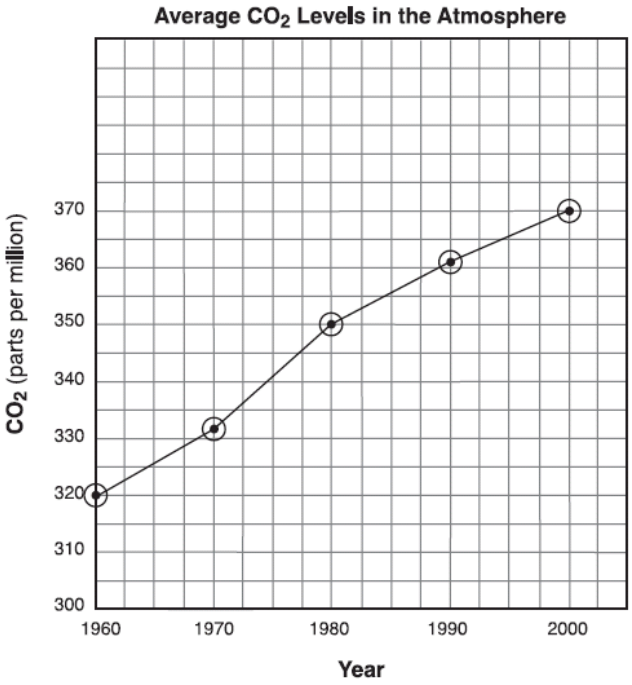


8. If the trend continues as shown in the data, what would be the total number of bubbles released at 20° C at ***30 minutes***? __60 BUBBLES____

9. Identify the ***dependent variable*** on this graph. __# OF BUBBLES____

10. State the relationship between time and the total number of bubbles released. __AS TIME INCREASES TOTAL NUMBER OF BUBBLES INCREASE.

11. What type of relationship is this?
__DIRECT_____
DIRECT



15. If the trend continues as shown in the data, what would be the amount of CO^2 in the year 2005?
___375 PPM_____

16. State the relationship between years and CO^2 shown on the graph. __AS YEAR INCREASES CO2 INCREASES____

17. Identify the ***independent variable*** on the graph. _YEAR_____

18. What was the CO2 concentration in 1975?
_____341 PPM_____

Creating a Graph:

- **Bar graphs** – compare values in a category or between categories. Bar graphs need to be colored.
- **Line graphs** – are a way to show the relationship between two variables.

Graphing Key Points-
1. USE PENCIL!!!

Both the x and y axis of the graph must be labeled or titled. These labels are typically the same ones used in the data table.

2. The ___INDEPENDENT_____ is always plotted on the **x-axis**.

3. The ____DEPENDENT_____ always plotted on the **y-axis**.

4. The x and y axis must be numbered.

a. **These numbers must increase by a ___UNIFORM OR EVEN_____ increment** (you must count by__THE SAME NUMBER FOR EVERY LINE___).

b. **Your numerical scales should take up most of the axes**. Squeezing it all into the bottom corner makes the graph impossible to read and no credit will be given.

c. **The numbers must line up with the grid lines** of the graph, not with spaces between them.

d. **You do not need to start numbering your axis with __ZERO_____!!!!!**

5. Once you have plottd your points, PLAY CONNECT THE DOTS! ONLY connect the points you have plotted. DO NOT extend lines! DO NOT connect line to the "origin" (0,0) unless you have plotted a point there.

6. **Practice!!!** – Create a line graph using the data in the table above.

Data Tables:

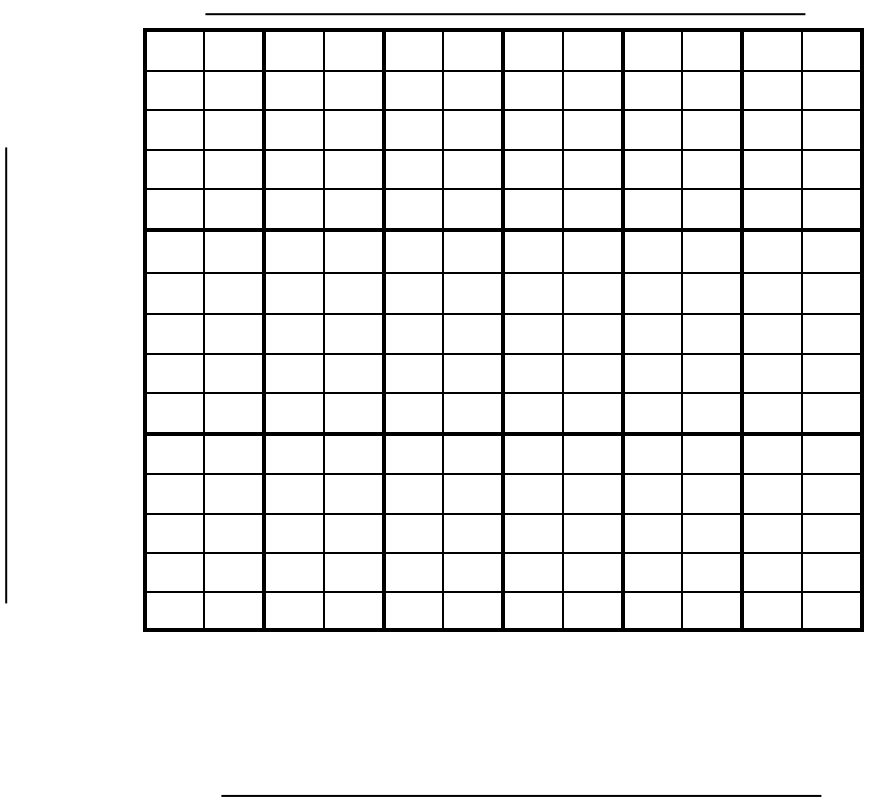
Data tables are used to ___ORGANIZE_____ data which will be plotted in a graph.

- First column in the table is for the _____INDEPENDENT_____ variable.
- Second column is for the _____DEPENDENT____ variable.
- Each column should be titled, and include _____UNITS____ of measurement.
- Data in the table must be arranged in ascending or descending order.

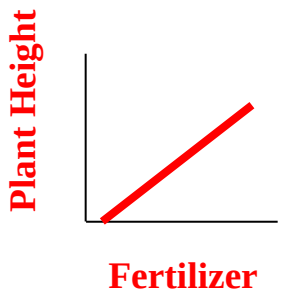
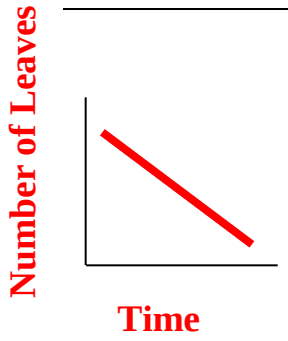
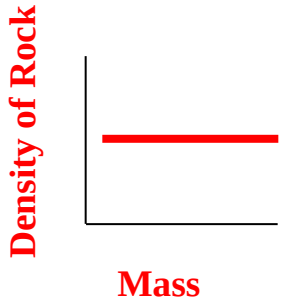
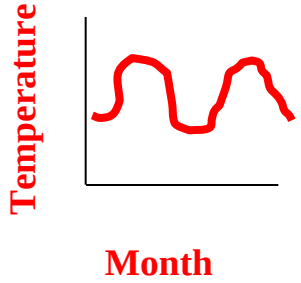
Data Table

Temperature (°C)	Heart Rate (beats/min)
5	108
10	150
15	180
20	270
25	300

Ascending Order or Descending Order



Relationships:

1. Direct: As the measurements for one variable increase, so do the values for the other. **AS [X] INCREASES, [Y] INCREASES** **As fertilizer increases, height of plant increases**	
2. Inverse: As the measurement for one variable increases, those for the other decrease. **AS [X] INCREASES, [Y] DECREASES** **As time increases, number of leaves decreases.**	
3. **Constant or Static:** As the values for one variable change, those for the other stay the same. **AS [X] INCREASES, [Y] STAYS THE SAME** **As mass of rock increases, density of rock stays the same.**	
4. Cyclic: A relationship which shows an orderly series of events that repeats at regular intervals. **AS [X] INCREASES, [Y] INCREASES AND DECREASES IN A REPEATING CYCLE** **As months increase, temperature increases and decreases repeatedly.**	

Name: _____ Date: _____

Biological Lab Tools and Measuring

Lab Investigation

Introduction:

Instruments and tools are used to extend our ***observations*** in order to make them more accurate. They are also used to aid us in scientific investigation and experimentation. With your partner, identify and write the name of each instrument below, then discuss what each is used for.

1. **graduated cylinder** **Measure volume of liquids** 	2. **microscope** **Observe objects too small to see** 	3. **thermometer** **measure temperature of air/liquid** 
4. **scale** **Measure mass** 	5. **magnifying glass** **Observe small objects** 	6.**mortar and pestle** **Crush/grind** 
7. **test tube with holder/clamp** **hold and heat small amounts of liquid** 	8. **beaker and Erlenmeyer flask** **Store/ mix liquids, measure volume** 	9. **hot plate** **heat** 
10. **ruler** **Measure length** 	11. **pipette/ eye dropper** **Transfer small amounts or liquid** 	12. **tweezer/ forceps** **Pick up small objects** 

Word Bank: Beakers/Flasks, Pipette, Microscope, Ruler, Scale, Forceps/Tweezers, Graduated cylinder, Magnifying lens, Test tube, Thermometer, Hot plate, Mortar/Pestle

Matching - Match the instrument with two letters- type of measurement and the proper unit.

Instrument	
1. Ruler _B___ E____	A) Mass
	B) Length
2. Graduated Cylinder _D___ _F___	C) Temperature
	D) Volume
3. Digital Scale A____ __H___	E) cm, m
	F) L, mL
4. Thermometer _C___ _G___	G) °C , °F
	H) g

Key Points in Measuring

1. The METRIC SYSTEM (SI) is preferred in science because it is the official system of measurement in most countries worldwide. It is also easy to convert between units because each prefix corresponds to a multiple or division of ten.

2. Length is measured with instruments like _RULERS___. Typical metric units of length values are METERS (m) , CENTIMETERS (cm) , KILOMETERS (km).

3. Volume is typically measured with tools such as __GRADUATED CYLINDER___. Units of volume are LITER(l), MILLILITER (mL), CUBIC CENTIMETERS (cm^3).

4. Temperature is measured with a ___THERMOMETER_____.
   Some key Celsius temperatures and their equal values in the Fahrenheit scale are below.
   a. 0° C = 32° F (the _____ point of water)
   b. 37° C = 98.6° F (the _____ temperature)
   c. 100° C = 212° F (the _____ point of water at sea level)

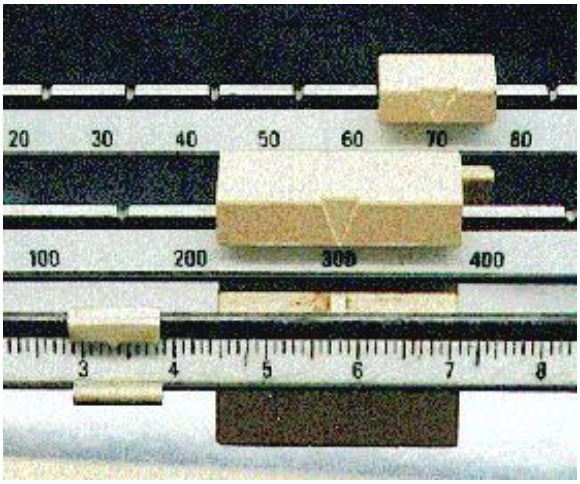
5. Mass is typically measured using _BALANCE_____. Units for mass are ___GRAM (g), KILOGRAM (kg).

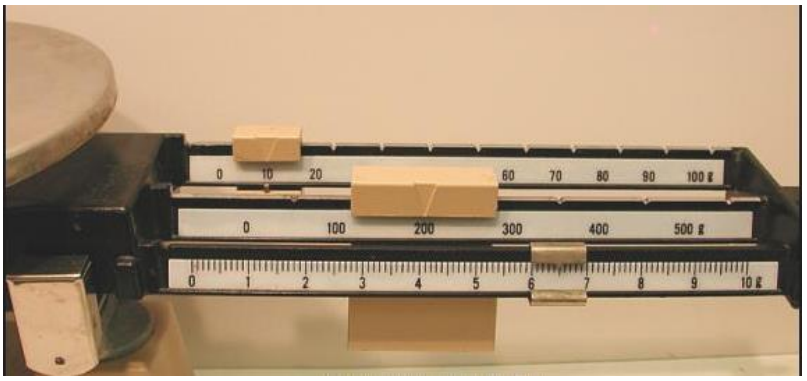
6. METRIC CONVERSIONS:
   a. How many mm are in a cm? __10___How many cm are in a m? ___100___
   b. 1 cm = ___10_____mm To convert from cm to mm you have to multiply by 10
   c. 100cm = __1_____m To convert from cm to m you have to __divide by 100_

Directions: Using the tools provided to you, measure the following objects in the classroom. All measurements must be *expressed* (written) the ***nearest tenth***, unless otherwise noted.

1. Length of black lab desk:
   _____ cm
2. Length of one floor tile:
   _____ cm
3. Length of science textbook:
   _____ cm
   Width of science textbook:
   _____ cm
   Thickness of science textbook
   _____ cm
4. Height of black lab desk:
   _____ cm
5. Volume of red liquid:
   _____ mL
6. Volume of blue liquid:
   _____ mL
7. Mass of the metal bar:
   _____ g
8. Mass of the fossil sample:
   _____ g
9. Volume of the sample: (use the water displacement method) _____mL or cm^3
10. Temperature of yellow liquid:
    _____ °C
11. Temperature of green liquid:
    _____ °C
12. Temperature of air:
    _____ °C
13. The time right now:
    _____hr_____min_____sec
14. Mass of the sand alone: (using the "zero" function on the balance) _____g

15. What is the mass shown on these balances? ___**373.4 g**____ _____**216.5g**_____



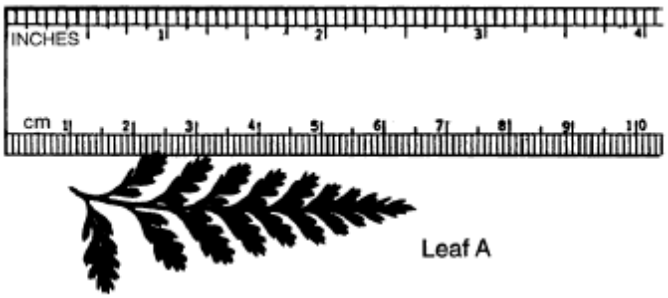


16.

(A) How long is leaf A

in centimeters? _5.5 cm_____

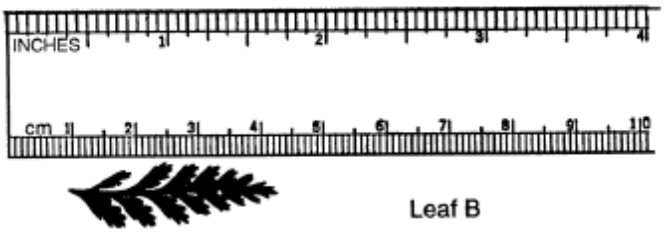
in millimeters? _55.0 mm_____



(B) How long is leaf B

in centimeters? _3.3 cm_____

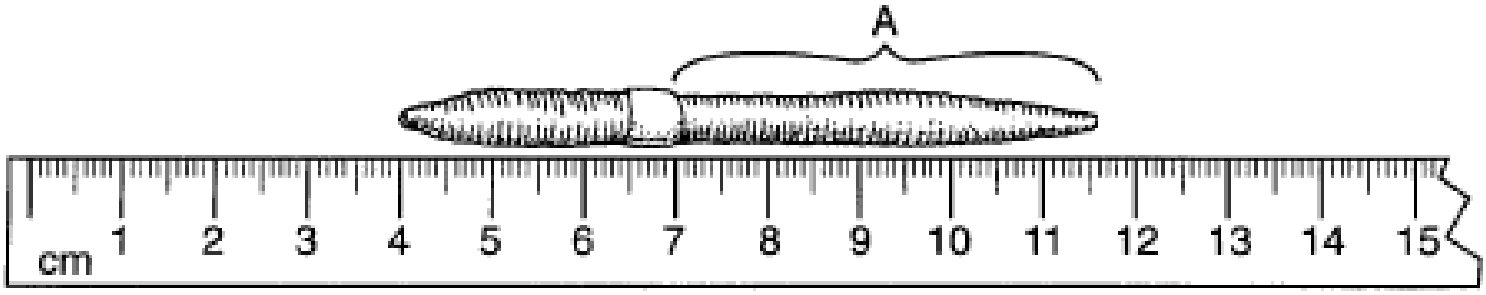
in millimeters? _33.0 mm_____



(C) What is the difference in length between leaf A and B in centimeters?

5.5 – 3.3 = 2.2cm

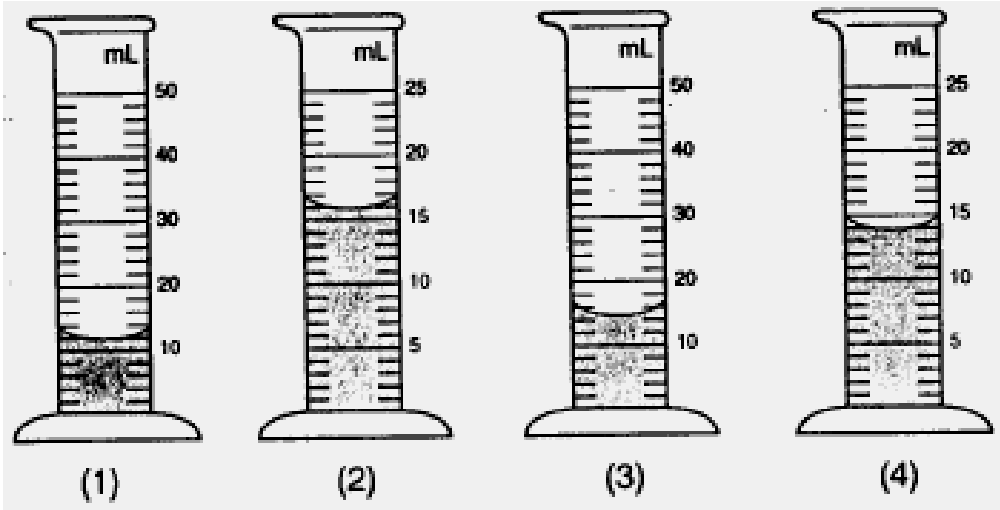
17.



How long is segment A on this earthworm in

cm? __4.6 cm_____ in meters? ___.046 m_____ in millimeters?__46.0 mm_____

Label the scale next to each graduated cylinder



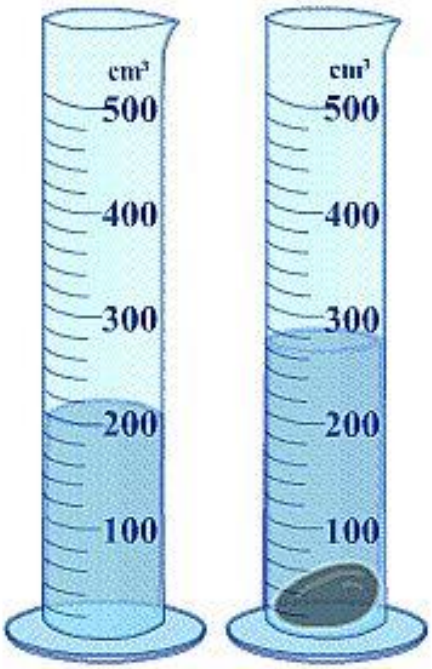
18. State the volume of each liquid:

(1) 12.0 mL

(2) 16.0 mL

(3) 14.0 mL

(4) 14.0 mL



19. A) Write out a method to determine the volume of the rock.

- Fill a graduated cylinder with water and record the initial volume.
- Place rock in graduated cylinder and observe the water rise.
- Record the volume after rock is placed in.
- Subtract the starting volume from the final volume to find the volume of the rock.

B) What is the volume of the rock?

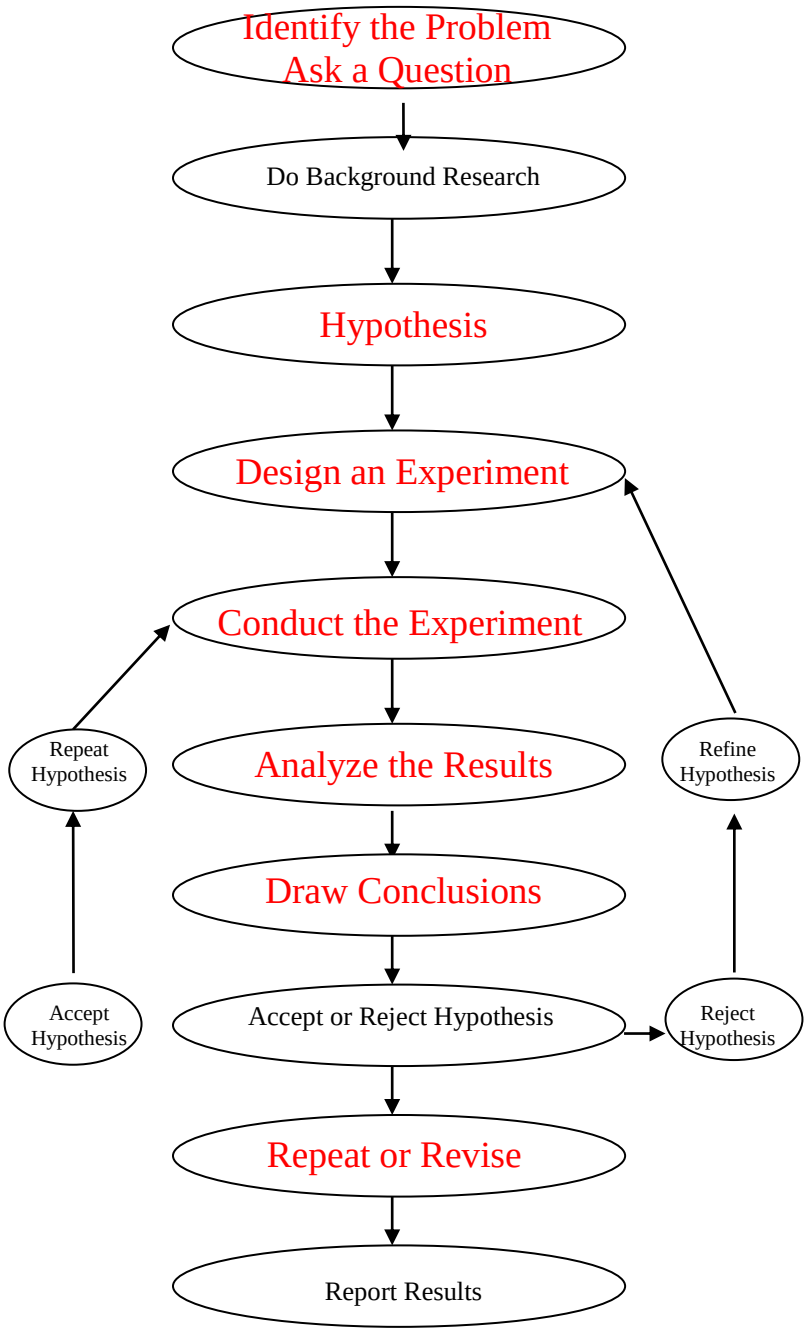
270.0 – 200.0 = 70.0 mL

**Bonus- what is this method called?

Water Displacement

The Scientific Method

Science is defined as "learning about the natural world using evidence" AND there is still a lot more to learn about our natural world! When people interact with their environment they become curious about what they are observing. This leads them to question why different things happen. You will be asked to discover answers for many questions this year in science. In order to do this in a thoughtful and organized way, the scientific method will be used. Good science is a combination of questioning, experiments, evidence, logical arguments, ingenuity, and skeptical peer-review. The **Scientific Method** can be used in scientific investigation and in every-day decision making. It involves a series of steps to make an investigation easy to follow and scientifically valid. The steps of the scientific method that we will be modeling include:

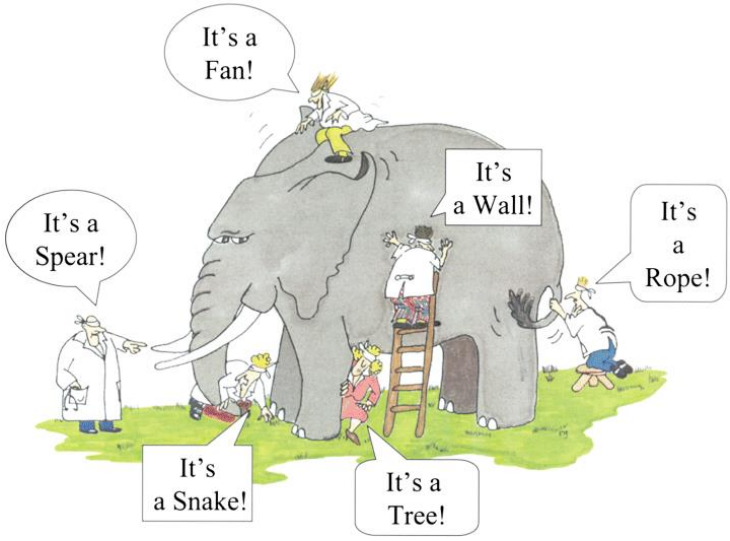


Observation vs. Inference

Observation: **Data collected using the 5 senses and tools (equipment)**
Measurements are observations

Inference: **A conclusion or prediction based on observations and past experiences**

Long ago in a distant land, six blind men lived together. All of them had heard of elephants, but they had never "seen" one. When they heard that an elephant and his trainer would be visiting their village, they all wanted an encounter with this beast. They made their way to the site where the elephant was being kept. Each blind man touched the elephant and made his observations. The observations are listed below.



One man touched the elephant's side and said,

"An elephant is like a wall."

Another man touched the trunk and said,

"An elephant is like a snake."

Another man touched a tusk and said,

"An elephant is like a spear."

Another man touched a leg and said,

"An elephant is like a tree."

Another man touched an ear and said,

"An elephant is like a fan."

The last man touched the tail and said,

"An elephant is like a rope."

Seven Blind Mice by Ed Young (Philomel, 1992) offers another delightful rendition of this tale.

Discussion Questions:

1. Did the blind men make appropriate inferences? Explain.

2. How might the blind men improve their inferences?

3. One of the characteristics of science is that scientists communicate their ideas, observation, results, and inferences with each other. Why is this a good idea?

Practice: Qualitative data vs. Quantitative data
Read the following examples and decide if it is either QUALITATIVE (QL) or QUANTITATIVE (QNT).

_____The candy was sour

_____She is 150 cm tall

_____The bug was 5 cm long

_____My fingernail is 2 cm long

_____The flower is red

_____His hair is black

Practice: Find the inference
Each question has four sentences. Three of the sentences are observations. One of the sentences is an inference based on those observations. *Circle* the one sentence that is an ***inference.***

1. The bird feels cold.
   I see the bird lying on the floor.
   The bird is dead.
   I do not see the bird breathing.

2. I see the sun.
   It is summertime.
   It feels hot.
   I see people wearing shorts.

3. There is sweat on Sara's skin.
   Sara just went for a run.
   Sara is breathing fast.
   Sara's face looks red.

4. I see sand on the ground.
   I see no water around.
   I feel very hot.
   This place is a desert.

Practice: Making inferences
Base your answer to the following observations. Use an **"If…then"** statement. An example of the proper format has been given. Use your prior knowledge or experience!!!

Observation #1: You observe that the sky at noon is darkening.
Your Inference: ***If*** *the sky darkens at noon* ***then*** *there must be a storm approaching.*

Observation #2: The principal interrupts class and calls a student from the room.

Your Inference: ***If*** *the principal calls a student from the room* ***then***

_____

Observation #4: A former rock and roll band member has poor hearing.

Your Inference: ***If*** *a former rock and roll band member has poor hearing* ***then***

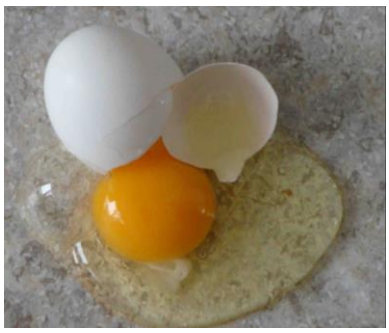
_____

<u>Practicing writing observations and inferences:</u> Use the pictures that follow to make observations and inferences.

1. 

Observation:_____

Inference:_____

2. 

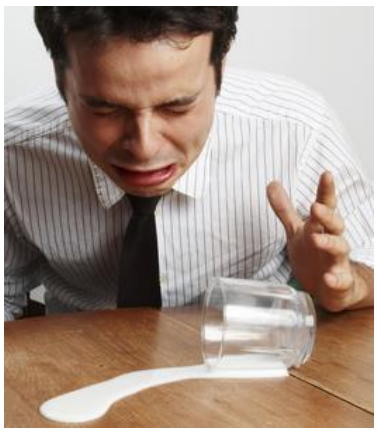
Observation:_____

Inference:_____

3. 

Observation:_____

Inference: _____

4. 

Observation:_____

Inference:_____

Notes on Independent and Dependent Variables, Constants, and Controls

A. In a scientific investigation there are __3__ kinds of variables.

1. ***Independent Variable*** **(_MANIPULATED_ variable):**

   Intentionally, purposely _CHANGED BY THE SCIENTIST__in an experiment.

2. ***Dependent Variable*** **(_RESPONDING_ variable):**
   Condition that might be affected after the change in the independent variable.
   What is being measured, or counted, or timed.
   Dependent Variable is the ___DATA___ collected during the experiment.

3. ***Constants:***
   A factor/condition that is __NOT CHANGED___ or is kept the ___SAME__ for every set up in the experiment.

B. Control Group v. Experimental Group

1. ***Control Group:*** The group that experiences __NORMAL, UNCHANGED___conditions.
2. ***Experimental Group:*** The group that experiences the _CHANGE or TREATMENT__ in the Independent Variable

Consider the following example: A student wanted to test how the mass of a paper airplane affected the distance it would fly. Paper clips were added before each test flight. As each paper clip was added, the plane was tested to determine how far it would fly.

→The mass of the plane (number of paper clips added) was the __INDEPENDENT__ variable.
→The distance flown was the __DEPENDENT___ variable. **(DATA COLLECTED!!)**
→The same piece of paper was used for the plane for each trial. This is a __CONSTANT___ in the experiment.

For each experiment below, specify the independent and dependent variables, 1-2 constant(s) and the control group.

1. Three groups of 8th grade students added calcium chloride to water to see if it increased the temperature of the water. Each group added a different amount of scoops of calcium chloride. The temperature of the water was tested after two minutes. Each group started with 75 ml of room temperature water.

Independent variable: __AMOUNT OF CALCIUM CHLORIDE___

Dependent variable: ____TEMPERATURE OF WATER___

Constant(s): __75 mL OF WATER, ROOM TEMP WATER, SAME CHEMICAL_____

Control Group:___A GROUP WITH ZERO SCOOPS, OR THE INITIAL TEMPERATURE OF THE WATER__

2. The drugs used to treat high blood pressure do not normally affect blood vessels in the lungs. Bosentan is a new drug being studied as a treatment for high blood pressure in the lungs. Two groups of 50-60 year old males were studied. One group was given the drug Bosentan, and the other was given a placebo.

Placebo: **AN FAKE OR INEFFECCTIVE DRUG GIVEN TO SIMULATE A REAL TREATMENT**

Why are placebos used? **GIVEN TO THE CONTROL GROUP SO THAT ALL SUBJECTS ARE TREATED EQUALLY.**

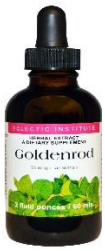
Independent variable: **THE DRUG, BOSENTAN**
Dependent variable: **BLOOD PRESSURE IN LUNGS**
Constant(s): **SAME AGE, MEN**
Control Group: **GROUP GIVEN THE PLACEBO**

3. Let's try some regents questions…

1. Many plants can affect the growth of other plants near them. This can occur when one plant produces a chemical that affects another plant. Design an experiment to determine if a solution containing ground-up goldenrod plants has an effect on the growth of radish seedlings.

FIRST Let's model or illustrate what this experiment set-up may look like:

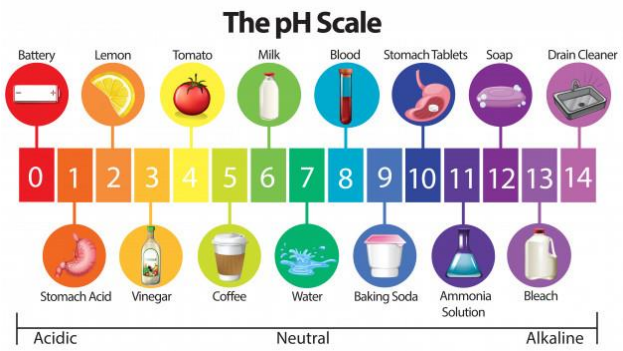




• state the dependent variable in this experiment
PLANT HEIGHT, PLANT MASS, # of LEAVES, ETC…
• state the independent variable in this experiment
GROUND-UP GOLDENROD
• state the control in this experiment
A GROUP OF PLANTS NOT GIVEN THE GROUND-UP GOLDENROD
• state the constants in this experiment
SAME TYPE OF PLANT (RADISH), SAME POTS, SAME SOIL, SAME SUNLIGHT, SAME AMOUNT OF WATER, SAME LOCATION

2. A certain plant has white flower petals and it usually grows in soil that is slightly basic. Sometimes the plant produces flowers with red petals. A company that sells the plant wants to know if soil pH affects the color of the petals in this plant. Design a controlled experiment to determine if soil pH affects petal color.

FIRST Model or illustrate what this experiment set-up may look like:



• state the dependent variable in this experiment
__**COLOR OF FLOWER PETALS**____

• state the independent variable in this experiment
__**pH OF THE SOIL (ACIDIC OR BASIC)**_____

• state the control in this experiment
__**PLANTS GROWN IN THEIR NORMAL (SLIGHTLY BASIC SOIL)**___

• state the constants in this experiment
__**SAME PLANTS, SAME POTS, SAME AMOUNT OF WATER, SAME SUNLIGHT**, _____

Notes on Hypothesizing

You have learned that variables are important not only in science experiments but also in making predictions.

Predicting is the process of using *observations* or *data* along with other kinds of knowledge to forecast future events or relationships.

A **hypothesis** is a special kind of prediction that forecasts how one variable will affect a second variable.

These variables are the **independent** variable, which is changed intentionally by the investigator, and the **dependent** variable, which is observed or measured to determine if or how much it is affected.

Hypotheses are logical explanations that can be tested. Where else have we seen the definition "logical explanation"? _____

Here is an example of a hypothesis…

If the temperature of sea water increases, **then** the amount of salt that will dissolve in that water increases.

Independent variable: _TEMPERATURE OF SEA WATER_____

Dependent variable: ____AMOUNT OF SALT THAT CAN DISSOLVE_____

Notice that the sample hypothesis is expressed as an **"If…, then…"** sentence. This form, while not always necessary, is a helpful way to learn to write a hypothesis.

Example One
Some students want to find out if Gatorade is better for an athlete compared to normal water. What measure would we look for in the athlete to determine if Gatorade is "better"?

_____

This is your (circle one)
Independent Variable Dependent Variable

Now, let's write a Hypothesis for this problem using the format given in the box:

If the [independent variable] increases or decreases or changes in *SOME* way, then the [dependent variable] will increase, decrease or remain the same.

If _____

then _____

Steps for Writing a Good Hypothesis

- Identify variables in a given event or relationship.
- Identify a pair of variables that might be logically related.
- Identify the independent and dependent variables
- Write the hypothesis using the following format

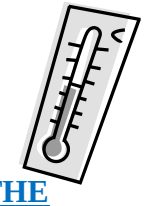
Directions: Write hypotheses for the following.

1. **Independent variable:** length of paper helicopter blades
   Dependent variable: rotational speed

Hypothesis: _IF THE LENGTH OF THE HELICOPTER BLADES INCREASE, THEN THE ROTATIONAL SPEED WILL INCREASE. __

2. **Independent variable:** baseball batting practice
   Dependent variable: batting average

Hypothesis: ___IF THE BATTING PRACTICE DECREASES, THEN THE BATTING AVERAGE WILL DECREASE. _



3. **Independent variable:** temperature of solution
   Dependent variable: dissolving time of powdered drink mix

Hypothesis: _IF THE TEMPERATURE OF THE SOLUTION INCREASES, THAN THE DISSOLVING TIME WILL DECREASE. __

4. **Independent variable:** depth of Lake Conroe
   Dependent variable: water temperature

Hypothesis: __IF THE DEPTH OF LAKE CONROE INCREASES, THEN THE WATER TEMPERATURE WILL DECREASE. __

5. Many plants can affect the growth of other plants near them. This can occur when one plant produces a chemical that affects another plant. Design an experiment to determine if a solution containing ground-up goldenrod plants has an effect on the growth of radish seedlings. In your experimental design be sure to:

• state a hypothesis to be tested

_IF GROUND-UP GOLDENROD IS GIVEN TO RADISH SEEDLINGS, THEN THEY WILL GROW TALLER THAN PLANTS NOT GIVEN GROUND-UP GOLDENROD. _____

6. A certain plant has white flower petals and it usually grows in soil that is slightly basic. Sometimes the plant produces flowers with red petals. A company that sells the plant wants to know if soil pH affects the color of the petals in this plant. Design a controlled experiment to determine if soil pH affects petal color. In your experimental design be sure to:

• state the hypothesis to be tested in the experiment

_IF THE SOIL pH DECREASES (BECOMES ACIDIC), THEN THE PETAL FLOWERS WILL TURN TO RED.

Notes on Scientific Method

Unit Question: Why do humans create models?
Content Question: Is there a method to the madness?
AOI: Human Ingenuity

When people interact with their environment they become curious about what they are observing. This leads them to question why different things happen. You will be asked to discover answers for many questions this year in science. In order to do this in a thoughtful and organized way, the scientific method will be used.

There are many important aspects of a good experiment. You will need to know what each is, in order to conduct experiments throughout the year.
A good experiment has a…

1. Hypothesis: **a prediction of the outcome of the experiment based on research and past experiences.**

→It is what you ***predict*** your experiment will show. You make a hypothesis before you begin your experiment. It is usually in the form of an "If and then" **statement**. It is NEVER a **question**!

Which of the following sentences represents a hypothesis?

a) Boil 100 mL of water, let it cool, then add 10 seeds to the water.
b) Environmental conditions affect germination.
c) Is the water depth in a lake related to available light in the water?
d) A lamp, 2 beakers, and elodea plants are selected for the investigation.

Follow this suggested format for making your hypotheses whenever possible.

IF the (insert independent variable here) increase OR decreases, **THEN** the (insert the dependent variable here) increase OR decreases OR remains the same.

A variable is any factor that can influence an event or system. Variables can change or be changed. *What are some variables that can affect the growth of a plant?*
Amount of Sunlight, amount of fertilizer, temperature, size of the pot its growing in, etc…

2. Dependent Variable: The part of the experiment that you are ***measuring*** and ***collecting data*** on. The dependent variable always goes on the ***y-axis*** of your graph.

3. Independent Variable: It is the factor that **the experimenter** ***changes*** in the experiment. It usually ***causes the dependent variable to respond*** to that change. Amount of fertilizer is a common independent variable, and goes on the *x-axis* of your graph. The independent variable is also called the **experimental** variable *(because it is what you are testing or what the experiment is about)*.

→ A good experiment only tests 1 variable at a time.

4. Control (Group): The setup or group in the experiment that does not include the variable that you are testing. The control is exposed to the same conditions as the experimental group ***except for the variable being tested***. This setup is what you will ***compare*** your results from your experiment to. It is the ***standard*** or **normal** in an experiment. The control if very often thought of as the **normal** conditions for your test subjects.

5. Constants: The factors or conditions that are kept the ***same*** in your experiment. You can have **many** constants in an experiment.

6. **Now let's practice!** For the following experiment, specify the independent and dependent variables and the constant(s)

Students of different ages were given the same puzzle to assemble. The puzzle assembly time was measured.

Independent variable: **ages of the students**
Dependent variable: **time to complete the puzzle**
Constants: **type of puzzle, amount of pieces in the puzzle**

7. Now, let's give this a try! Identify the independent and dependent variables in each experiment listed below, **and** label the axes of the graph appropriately.

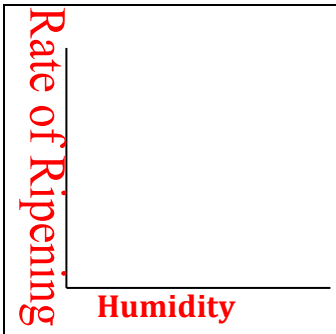
1. What effect does age have on the rate of eye blinking?

Rate of eye blinking **Age**	Independent variable: **Age**
	Dependent variable: **Rate of eye blinking**
	Hypothesis: **As age increases, then the slower you will blink**
	Constants: **amount of time each person blinks for, time of day, location**

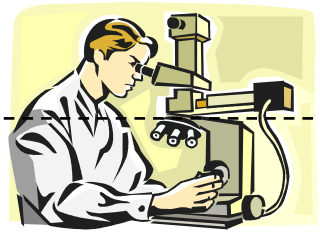
2. How does the temperature of a room affect the rate of the blooming of a flower?

Bloom Rate **Temperature**	Independent variable: **Temperature**
	Dependent variable: **Blooming Rate of a flower**
	Hypothesis: **If the temperature increases, then the faster the flowers will bloom.**
	Constants: **Amount of sunlight, amount of water, soil**

3. How does humidity affect the rate at which fruit ripens?

	Independent variable: **Humidity**
	Dependent variable: **Ripening rate**
	Hypothesis: **If the humidity increases, then the ripening rate will increase also.**
	Constants: temperature, amount of sunlight, soil

Notes on What Makes a Good Experiment



Unit Question: Why do humans create models?
Content Question: What makes an experiment valid?
AOI: Human Ingenuity

We have already discussed the many factors that are important parts of a good experiment. They are:

- A testable hypothesis (written as an ***If, and Then*** statement)
- An experiment group
- An independent variable (***Only One!)
- A control group
- Constants

But there are other important factors to consider when developing an experimental design.

1. **Sample Size**: how many subjects you are testing your variable on. It is the number of organisms you are using in your experiment.

A good experiment has a __**LARGE**__ sample size. A large sample size increases the __**VALIDITY**__ of your experiment and conclusions.

Validity is how accurate or true your conclusions are.

If you have a large sample size, then the estimations, predictions or inferences that can be made from your data are more accurate!

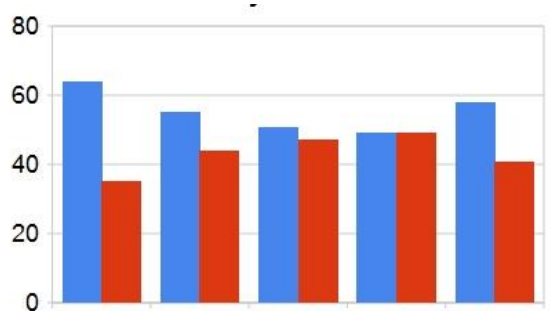
Also, there are sometimes factors outside of your control that may harm the organisms you are testing. These might be: ___**DISEASE, BAD GROWING SEASON, PREDATORS, ETC…**_____

If you are only testing two plants and one dies, will your results be very accurate or valid?
_**NO!!!**_

2. **Ignore small differences in data**

There is always some error in the data we collect. This is due to _**HUMAN ERROR, FAULTY EQUIMENT**____

If your data shows a very slight difference, then often you should treat it as if there is _**NO DIFFERENCE**___, or that your results from all setups are the __**SAME**__.



3. **No Bias:** no prejudice, and having the ability to be fair. If you are bias, you are not open-minded. Having bias **DECREASES** the validity of your experiment.

4. **Repeatable by peers:** An experiment's procedure should be written in a way that others can re-perform it. This is done to make sure there are no **ERRORS** in data, conclusions, and format or to check for bias.

5. **Variety of tests subjects**

Populations have variety therefore your test subjects should mimic (**COPY**) that variety, so your results are more **ACCURATE**. This **INCREASES** the validity of your experiment.

However, sometimes an experiment is purposefully done on one specific type of organism, or one specific gender or age group!

6. **More than one trial**

Repetition of your experiment helps **INCREASE** the validity. This is because there is always some amount of error in our observations. The **MORE** trials you do, the **LESS** chance you have of repeating a mistake. Therefore your data becomes more reliable.

7. **Ethical:** **WHAT SOCIETY THINKS IS "RIGHT" & "WRONG"**

An unethical experiment is usual one that is controversial. Some controversial topics related to the living environment include**: Cloning, mixing genetic material between species, GMO's, etc**

8. **Conclusions must be supported by data**

A scientist can not draw conclusions based on data that does not exist. If they did, this would **DECREASE** the validity of the experiment.

Now let's try and see if we can find the errors in the experiments shown below.
During a laboratory activity, a group of students obtained the data shown below.

Pulse Rate Before and After Exercise

Student Tested	Pulse Rate at Rest (beats/min)	Pulse Rate After Exercise (beats/min)
A	70	97
B	74	106
C	83	120
D	60	91
E	78	122
Group Average		107

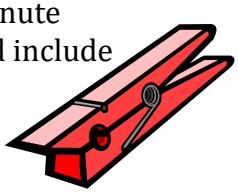
1. Which procedure would **increase the validity** of the conclusions drawn from the results of this experiment?
(1) increasing the number of times the activity is repeated
(2) changing the temperature in the room
(3) decreasing the number of students participating in the activity
(4) eliminating the rest period before the resting pulse rate is taken

2. Complete the table by finding the Group Average for Pulse Rate at Rest.

3. In the United States, there has been relatively little experimentation involving the insertion of genes from other species into human DNA. One reason for the lack of these experiments is that
(1) the subunits of human DNA are different from the DNA subunits of other species
(2) there are many ethical questions to be answered before inserting foreign genes into human DNA
(3) inserting foreign DNA into human DNA would require using techniques completely different from those used to insert foreign DNA into the DNA of other mammals
(4) human DNA always promotes human survival, so there is no need to alter it

4. A student hypothesized that the pulse rate in humans would increase 1 hour after eating a meal. Pulse rates were obtained from nine classmates 1 hour after eating lunch.
The data in beats per minute were recorded as: 60, 64, 56, 68, 72, 76, 72, 80, and 68.
State one error in this experiment.
THEY DID NOT TAKE A RESTING PULSE RATE (PULSE RATE BEFORE EATING), NOT ENOUGH STUDENTS, NO CONTROL GROUP. ___

5. Students were asked to determine if they could squeeze a clothespin more times in a minute after resting than after exercising. An experiment that accurately tests this question should include **all of the following except**



(1) a hypothesis on which to base the design of the experiment
(2) a large number of students
(3) two sets of clothespins, one that is easy to open and one that is more difficult to open
(4) a control group and an experimental group with equal numbers of students of approximately the same age

6. A science researcher is reviewing another scientist's experiment and conclusion. The reviewer would most likely consider the experiment **invalid** if
(1) the sample size produced a great deal of data
(2) other individuals are able to duplicate the results
(3) it contains conclusions not explained by the evidence given
(4) the hypothesis was not supported by the data obtained

7. A student performed an experiment to determine if treating 500 tomato plants with an auxin (a plant growth hormone) will make them grow faster. The results are shown in the table below

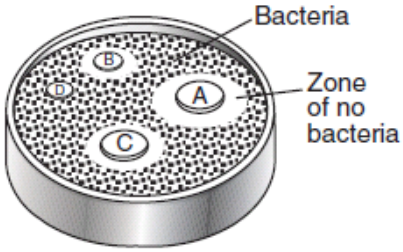
Days	Average Stem Height (cm)
1	10
5	13
10	19
15	26
20	32
25	40

Explain why the student can *not* draw a valid conclusion from these results.
NO CONTROL GROUP TO COMPARE

8. Reasons for conducting peer review include all of the following *except*
(1) analyzing the experimental design
(2) pointing out possible bias
(3) identifying an illogical conclusion
(4) changing data to support the hypothesis

9. Researchers performing a well-designed experiment should base their conclusions on
(1) the hypothesis of the experiment
(2) data from repeated trials of the experiment
(3) a small sample size to insure a reliable outcome of the experiment
(4) results predicted before performing the experiment

10. An experiment was carried out to determine which mouthwash was most effective against bacteria commonly found in the mouth. Four paper discs were each dipped into a different brand of mouthwash. The discs were then placed onto the surface of a culture plate that contained food, moisture, and bacteria commonly found in the mouth. The diagram below shows the growth of bacteria on the plate after 24 hours



Which change in procedure would have improved the experiment?

(1) using a smaller plate with less food and moisture

(2) using bacteria from many habitats other than the mouth

(3) using the same size paper discs for each mouthwash

(4) using the same type of mouthwash on each disc

Name: _____ Date: _____

Homework/Classwork

Scientific Method Practice

Homework: Scientific Method

Directions: Answer the questions below based on your knowledge of the Living Environment. Record all answers in the space provided.

1. An experiment was carried out to determine how competition for living space affects plant height. Different numbers of plants were grown in three pots, *A*, *B*, and *C*. All three pots were the same size. The data collected are shown in the table below.

	Average Daily Plant Height (mm)						
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Pot A—5 plants	2	4	6	8	10	14	16
Pot B—10 plants	2	4	6	8	10	12	12
Pot C—20 plants	2	2	2	6	6	8	8

Analyze the experiment that produced the data shown in the table by:

a. Stating a hypothesis for the experiment:
__**IF LIVING SPACE INCREASES, THEN THE PLANTS WILL GROW TALLER**. __
(Remember: If_____, then_____)

b. Identifying *one* factor, other than pot size, that should have been kept the same in each experimental group (constant):
___**SAME SOIL, SAME TYPE OF PLANT, SAME WATER, SAME LOCATION, SAME TEMP, SAME SUNLIGHT, ETC….**

c. Identifying the dependent variable: _**HEIGHT OF PLANT**

d. Stating whether the data supports or fails to support your hypothesis and justify your answer:
__**YES, MY HYPOTHESIS IS SUPPORTED BY THE DATA. FOR EXAMPLE ON DAY 7 POT A (WITH MORE LIVING SPACE) GREW TO 16 MM and POT C (WITH LESS LVING SPACE) GREW TO 8MM.** _____

2. A scientist wants to determine the best conditions for hatching brine shrimp eggs. In a laboratory, brine shrimp hatch at room temperature in glass containers of salt water. The concentration of salt in the water is known to affect how many brine shrimp eggs will hatch. Design an experiment to determine which of three saltwater concentrations (2%, 4%, or 6%) is best for hatching brine shrimp eggs. In your experimental design, be sure to:

a. State how many containers to use in the experiment, and describe what would be added to each container in addition to the eggs:
4 CONTAINERS: 2%, 4%, 6% SALTWATER SOLUTIONS AND ONE WITH 0% SALTWATER AS A CONTROL GROUP. _____

b. State *two* factors that must be kept constant in all the containers:
TEMPERATURE OF WATER (ROOM TEMPERATURE), SAME # OF EGGS,

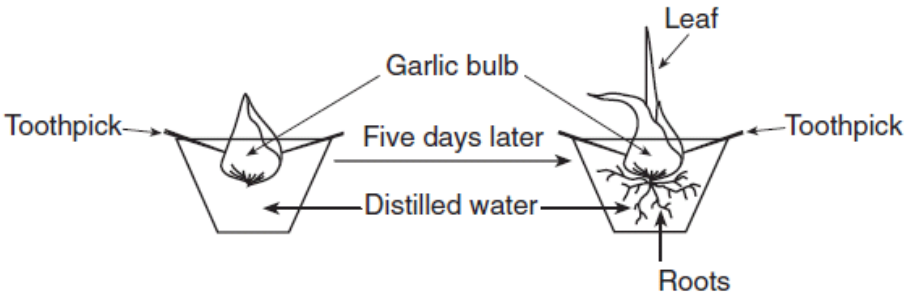
c. State what data must be collected during this experiment: **NUMBER OF EGGS THAT HATCH**

d. State *one* way to organize the data so that they will be easy to analyze: **USE A DATA TABLE THAT LOOKS LIKE THE ONE BELOW**

e. Describe a result that would indicate the best salt solution for hatching brine shrimp eggs: **THE SOLUTION THA HAS THE MOST EGGS HATCHING WOULD BE THE SOLUTION THAT IS BEST.**

Scientific Method Practice Homework

3. The diagram below illustrates the result of growing a garlic bulb in a cup of distilled water over five days.



Design an experiment consisting of a control and three different experimental groups to test the prediction, "Garlic grows better as the salt concentration of the solution in which it is grown increases." In your answer, be sure to:

- describe the control to be used in the experiment [1]
- describe the difference between the three experimental groups [1]
- state *one* type of measurement that should be made to determine if the prediction is accurate [1]
- describe *one* example of experimental results that would support the prediction [1]

- **__THE GARLIC BULB GROWING IN A CUP OF DISTILLED or NORMAL WATER_____**
- **__THE CUPS WILL HAVE DIFFERENT CONCENTRATIONS OF SALT WATER. FOR EXAMPLE 2%, 4%, AND 6%__**
- **__HEIGHT OF THE LEAF_____**
- **__THE HIGHEST CONCENTRATION OF SALTWATER (6%) WILL GROW THE TALLEST._____**

4. A television advertisement claims that a certain brand of cough drop reduces coughing for 8 hours. Describe an investigation that could be used to determine if this claim is valid. In your answer, include at least a description of:

• the treatment to be given to the experimental group [1]

• the treatment to be given to the control group [1]

• the data to be collected [1]

• when the data should be collected [1]

• *one* observation that would lead to the conclusion that the claim is valid [1]

- **__THE COUGH DROP____**
- **__A PLACEBO OR A COUGH DROP WITH NO MEDICINE IN IT_____**
- **__NUMBER OF COUGHS OVER 8 HOURS____**
- **__DURING THE 8 HOURS OF TESTING _____**
- **__THE GROUP GIVEN THE REAL COUGH DROP SHOULD HAVE LESS COUGHS THAN THE CONTROL GROUP. __**

5. Which statement about the use of independent variables in controlled experiments is correct?
(1) A different independent variable must be used each time an experiment is repeated.
(2) The independent variables must involve time.
(3) Only one independent variable is used for each experiment.
(4) The independent variables state the problem being tested.

6. The development of an experimental research plan should *not* include a
(1) list of safety precautions for the experiment
(2) list of equipment needed for conducting the experiment
(3) procedure for the use of technologies needed for the experiment
(4) conclusion based on data expected to be collected in the experiment

7. A biologist used the Internet to contact scientists around the world to obtain information about declining amphibian populations. He was able to gather data on 936 populations of amphibians, consisting of 157 species from 37 countries. Results showed that the overall numbers of amphibians dropped 15% a year from 1960 to 1966 and continued to decline about 2% a year through 1997.

What is the importance of collecting an extensive amount of data such as this?
(1) Researchers will now be certain that the decline in the amphibian populations is due to pesticides.
(2) The data collected will prove that all animal populations around the world are threatened.
(3) Results from all parts of the world will be found to be identical.
(4) The quantity of data will lead to a better understanding of the extent of the problem.

8. The first trial of a controlled experiment allows a scientist to isolate and test
(1) a logical conclusion
(2) a variety of information
(3) a single variable
(4) several variables