Advanced 7th Science Summer Project

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Due August 9, 2019

Assignments to be completed:

- ❖ Assignment #1: Root Words/Tools for Scientists
- ❖ Assignment #2: Science and the Scientific Method
- ❖ Assignment #3: Scientific Tools, Equipment, and Measurement
- ❖ Assignment #4: Build a Line Graph

- These assignments will be worth 2 test grades:

  Assignments 1 & 2 will count as one test grade

  (50 questions, 2 points each = 100 points total)

  Assignments 3 & 4 will count as another test grade

  (Assignment 3: 42 questions, 1 point each.)

  (Assignment 4: 5 questions = 6 points each / graph = 28 points)

  Assignments 3 & 4 =100 points total

By the end of the summer project you should be able to:

- Recognize any potential hazards associated with science activities and investigations and be able to maintain a safe working environment
- State a problem and formulate a hypothesis
- Design a controlled experiment to test the hypothesis
- Identify a control group and controlled variables
- Differentiate between inferences and observations.
- Differentiate between independent and dependent variables
- Understand the placebo effect and when to use a double-blind study
- Describe how a hypothesis develops into a theory.
- Record measurements and observations using appropriate instruments and equipment
- Create and interpret graphs, charts and experimental data from which predictions and conclusions can be drawn

Assignment 1: Word Roots – Tools for Scientists

Scientists all over the world have to be able to communicate with each other. Standard Scientific names, which you will learn about in the next unit, are one way they can do this. Another is to use common Latin or Greek roots when creating a new scientific term. All languages have their roots in these two languages, so using common roots allow scientists all over the world to interpret their meaning. As new scientists, you will have to memorize a huge quantity of vocabulary words. If you can determine the meaning of the prefix or suffix of the term you are working with, the definition of the entire term often becomes clearer.

Prefix	Meaning	Suffix	Meaning
Hydro -	Related to water	-logy	Study of
Intra -	Within	-phyll	Leaf
Bio-	Related to life	-plast	Organized living material
Proto-	First	-troph	Food
Chloro-	Greenish yellow	-cellular	Having to do with cells
Zoo-	Related to animals	-phyte	Plant
Ex-	Out	-synthesis	To put together
Hetero-	Different	-ation	Process
In-	Inside	-scope	Instrument for viewing
Micro-	Small	-lysis	A releasing or loosening
Photo-	Light	-cretion	The process of separating
Uni-	One	-gestion	To carry
Multi-	Many	-meter	Instrument used to measure
Auto-	Self-operating	-stasis	A stationary condition

Use the meaning of the prefixes and suffixes in the table on the previous page to form words that will match these definitions

1.	_____	Removal of waste products from the body
2.	_____	The study of small forms of life
3.	_____	The study of animals
4.	_____	Instrument used to measure water and other liquids
5.	_____	A plant that grows in water
6.	_____	The process of making something self operating
7.	_____	Small leaf
8.	_____	Within a cell
9.	_____	First organized particle

Each group of words listed below shares certain parts (maybe more than TWO). The first two words in each group are defined for you. The part of the word and the part of the definition that correspond are underlined. Use these definitions to help you to define each word that follows the first two words. These make real words!

10.	Monofilament	A single fiber
	Microscope	Instrument used for looking at small objects
	Microfilament	_____
11.	Phototropism	Response to light
	Chemotherapy	Treatment that involves chemicals
	Chemotropism	_____
12.	Pesticide	An agent used to destroy pests
	Herbaceous	Related to leafy plants
	Herbicide	_____
13.	Dermatology	The study of the structure and diseases of the skin
	Sclerosis	Disease in which body tissues harden
	Scleroderma	_____

14.	Arthritis	Inflammation of the joints
	Podiatrist	Doctor who treats and cares for the human foot
	Arthropod	_____

Assignment #2: Science and the Scientific Method

Directions:

❖ Read the introduction completely before starting this activity. Write in full sentences for credit. Please reread your sentences out loud. Do they make sense to you? Would someone who was not in class with you know what your answers mean? All group members should fill this in – this will become your notes and your reference material on this subject.

Introduction:

Science is more than a lot of information. Science is a way of knowing - it is constantly growing and changing. Scientists carry on an unending search for new information. With that new information, they reevaluate old information to find out if it is still accurate. The scientific method offers a means of testing ideas and solving problems. Experimentation is the foundation upon which all science rests.

Important terminology:

- ***Inference*** - a statement accepted without proof. I *made an inference* that you could read and write when you entered my class. This is usually based on opinion.
- ***Observation***- an observed or measured phenomena. Observations lead to questions.
- ***Hypothesis***–an idea used as the basis for experimentation. Sometimes called an educated guess to the problem, it describes what is happening in a given situation. It is the "If" part of the "If…then," statement. EX–"using dental floss prevents gingivitis" - what you believe to be true
- ***Deduction or prediction*** -a statement that logically follows the hypothesis. It is the "then" part of the "If…then," statement. If the hypothesis is correct, then such and such should happen. The 'such and such' is the deduction. A deduction normally defines how an experiment will be designed.
  EX – "when I use dental floss regularly I should not get gingivitis"
- ***Controlled experiment*** - the procedure designed to determine whether the hypothesis is true. The experiment tests only one variable or factor at a time.

VARIABLES -

- ***Independent or Experimental variable*** -the single factor that the experiment tests.
- ***Controlled variables***- factors that are kept constant between the experimental and control groups.
- ***Dependent variable or Data*** -the facts collected in an experiment. The data is dependent on the independent variable.

GROUPS -

- ***Control group*** -*the test group that is* the standard of comparison for the experiment. All factors in the control group are the same as in the experimental group *except* the experimental variable.
- ***Experimental group***- the test group that is exposed to all factors the control has *including* the experimental variable.
- ***Qualitative and Quantitative data*** -Qualitative data cannot be measured and is subjective or based on the opinion of the scientist. Quantitative data is objective, not based on opinion and can be measured.
- ***Analysis*** - the interpretation of the data. What do the numbers or observations *mean*?
- ***Conclusion*** -whether the hypothesis has been supported by the data. A conclusion of a controlled experiment is one of the following: The data *supports* the hypothesis, or the data *do not support* or *rejects* the hypothesis

Procedure-

Applying the terms of science

The following fictional experiment demonstrates the use of the scientific method.

Many people in the small Midwestern town of Hootville are stricken with the disease "Buggo." Most of those who get sick recover in seven to nine days.

Buggo has been shown to be caused by a bacterium (single for bacteria) called "Gotcha." Antibiotic "X" is a new drug that has been shown to kill Gotcha bacteria in a test tube. Antibiotic X was also found to cure dogs that were sick with Buggo.

Researchers decided to test the new drug on some of the people in Hootville. They hypothesized that the drug would effectively cure Buggo in humans. They decided that if they gave patients Antibiotic X, the patients would ***recover more quickly*** than those who did not take the antibiotic.

The researchers prepared tablets containing Antibiotic X. They also prepared a second batch that contained all the same ingredients (inactive ingredients) as Antibiotic X without any antibiotic. A table like this that is similar but without medication is called a ***placebo***.

The researchers selected two groups of people who had just contracted the disease. Twenty-five people in group A were given tablets containing the drug antibiotic X. Twenty-five people in group B were given the placebos.

Twenty of the twenty-five people given the drug recovered within one day. The other five people took seven to nine days to recover - the normal recovery time for people sick with Buggo.

One of the people given the placebo recovered in one day. The rest of the people in group B took from seven to nine days to recover.

15. *List* three facts that were known before the start of the experiment.

_____

_____

_____

16. One assumption is, "Antibiotic X is not lethal to humans." List two other ***assumptions*** that were made.

_____

_____

17. What do you think the researcher's hypothesis is? RE: hypothesis is not an If....then. An hypothesis is a "this is what I believe to be true" statement.

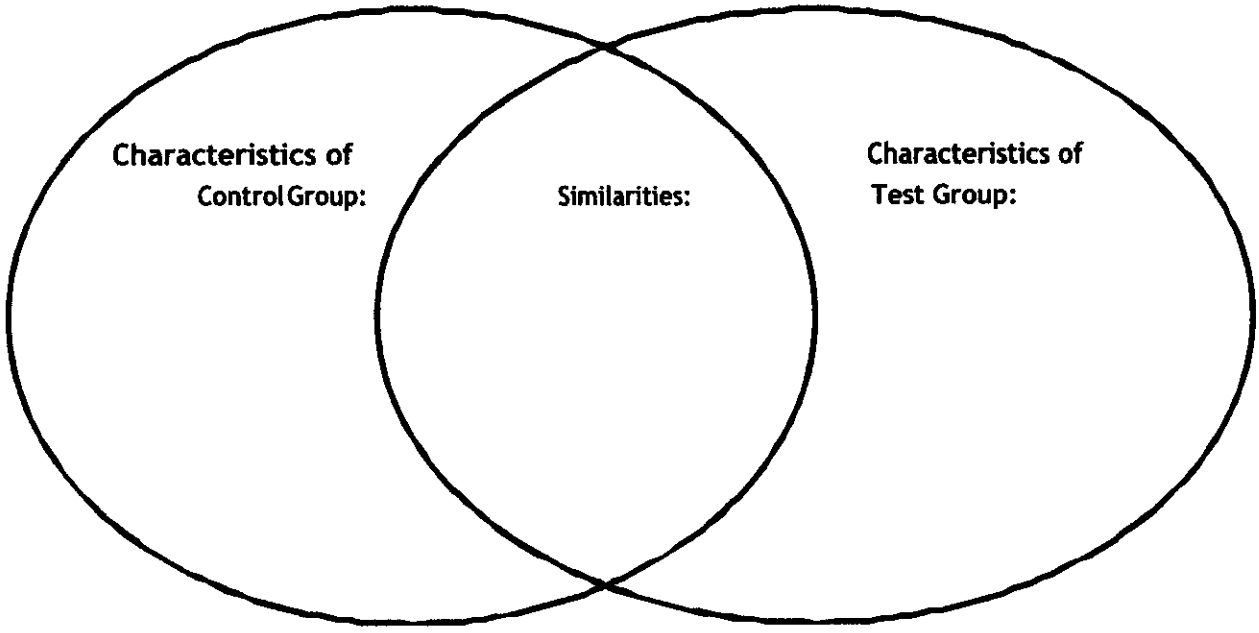
_____

18. One prediction is, "People given a tablet with Antibiotic X, will be cured of Buggo." There can be more than one prediction for a given hypothesis. *List* one other prediction.

_____

_____

19. Your prediction statement should be, "If antibiotic X cures Buggo, then people with Buggo will recover more quickly when given antibiotic X compared to those given a placebo." Use the following Venn Diagram to compare and contrast the experimental group from the control group. Include the ***factors*** in the experiment that are similar and different between both groups. DON'T include any results in your diagram.



20. What is the independent variable in this study? _____

21. Describe a dependent variable for this experiment. Will the data be quantitative or qualitative?

_____

_____

22. What analysis do you think the researchers made of the data? _____

_____

_____

23. What conclusion do you think they reached? _____

_____

_____

Designing your own experiment.

Now it is your turn. Design an experiment to test the effect of aspirin in the water of cut roses. The story is: A florist at Flower Feats thinks she can increase the life of cut roses with the addition of an aspirin table to the water they are kept in. The florist has asked you to test this on roses.

24. Design an experiment to test the florists' hypothesis. Include independent and dependent variables, several controlled variables and the number of flowers in the control and test groups. Do you need to use a placebo? Why or why not?

_____

_____

_____

_____

_____

_____

_____

_____

_____

25. What is the hypothesis for your experiment? _____

_____

26. Write your hypothesis and prediction in an "If...then,..." statement.

_____

_____

27. What would the data look like if it supported the hypothesis? _____

_____

28. In a controlled experiment, why is there only <u>one</u> experimental variable?

_____

_____

_____

_____

29. Why is a control necessary?

_____

_____

_____

For each example below, provide the part of the experiment that matches the supplied term.

A farmer tests the effect of a pesticide on the yield of apples in his fruit orchard.

30. experimental variable: _____
31. data being collected: _____
32. experimental group: _____
33. control group: _____

An instructor tests to see if pop quizzes improve student grades.

34. independent variable: _____
35. dependent variable: _____
36. experimental variable: _____
37. controlled variables: _____

_____

A physician wants to determine if a placebo is as effective as surgery for knee problems.

38. experimental group: _____
39. control group: _____
40. dependent variable: _____

A wildlife specialist tests to determine if deer are repelled from tree seedlings by tiger urine.

41. experimental variable: _____
42. independent variable: _____
43. dependent variable: _____
44. control group: _____
45. controlled variables: _____

Write a Prediction Statement!

Directions: Given the information provided for each scenario below, write a valid prediction statement that the scientist might have made to answer their question. Be sure to use the If..then..format (***If your hypothesis Then this will happen when you do this...***). You have to make a prediction about what you think is going to happen –it doesn't matter if you are right or not, but make an educated guess!!

Scenario A:
A scientist wants to know which of the three kinds of bird seed attract cardinals the best.

46. Hypothesis: _____

47. Prediction: _____

Scenario B:
People who live in a particular area are having problems with too many mosquitoes in their backyards. A group of them decide to design an experiment to test four different kinds of mosquito repellent: a chemical spray, a sound emitting device, planting citronella plants, and installing a bat house (bats eat bugs).

48. Hypothesis: _____

49. Prediction: _____

Scenario C:
I want to know what candy will make the trick-or-treaters the happiest come Halloween. I have a few pieces of 5 different kinds of candy; Snickers, Mars bars, M&Ms, Peanut Chews, and Butterfingers. I figured I'd let my students pick, and then I'd know which kind of candy makes kids the happiest.

50. Hypothesis: _____

Prediction: _____

_____

_____

Assignment #3

SCIENTIFIC TOOLS, EQUIPMENT, and MEASUREMENT

When a cook follows a recipe, the appropriate equipment is essential. It would be difficult to bake cupcakes without an oven, or roll pie dough without a rolling pin. Laboratory procedures in biology require similar tools. Scientific tools and equipment can be used to

- **Measure, observe, and manipulate (hold, transport, heat, cut, etc.) various items, as well as**
- **Maintain safety for the experimenter.**

It is important to select the correct item that you need for each part of a laboratory procedure. As you study the following items you will use in class, determine when and why each is used.

1) Linear Measurement:

The ruler is used to **measure** length. Rulers come in different types and sizes. They can be used to measure inches, centimeters and millimeters.

Metric Ruler - We will use metric rulers to determine linear measurement. Metric rulers are usually divided into millimeters (mm) and centimeters (cm). They range in size from 15centimeters to one meter. Metric rulers have a high level of precision. Always use the metric side of the ruler for measurements.

2) Volume Measurement:

Glass and plastic containers are used to **measure** and **manipulate** substances. They come in various sizes usually marked by milliliters. It is best to use the size closest to the volume you will be working with.

Erlenmeyer Flask - Erlenmeyer flasks have an "upside down Y shape"—the base is wide, with a small, narrow mouth. These flasks are used when **holding, transporting or heating** liquids. A piece of foil or a stopper can easily fit into the top of the flask. Erlenmeyer flasks are not as accurate as graduated cylinders and have a medium level of precision.

Beaker - Beakers have a wide mouth and a "lip" for easier pouring. They are commonly used for **holding, transporting or heating** liquids. Beakers have a medium level of precision in measuring.

Graduated Cylinder - This is a tall cylinder used for precise volume **measurement** of liquids. It has a high level of precision.

To determine the volume of liquid, read the position of the bottom of the *meniscus* formed by the liquid in the cylinder.

Graduated cylinders come in different sizes. An appropriate sized graduated cylinder will hold a volume equal to or slightly more than what you need to measure. Measure 8 ml of liquid in a 10 ml cylinder, not a 100 ml cylinder.

2) Volume Measurement (Continued)

Dropper and Barnes Bottles - A useful way to **transport** materials from one source to another. Droppers have a low level of precision.

3) Weight Measurement:

Balances and digital electronic scales are used to **measure** the mass of materials in grams.

Balance - A metric balance is used to **measure** the mass of a sample. The sample is placed on the pan and small weights are moved to determine the mass. Measurements using the balance are made in grams and milligrams ($1/1000^{th}$ of a gram). The two major types are the **Triple Beam Balance** and the **Electronic Balance.** Both have a high level of precision.

4) Temperature Measurement:

Thermometers are used to **measure** temperatures of gasses, solids and liquids. Temperature can be measured in Celsius and Farenheight.

Thermometer - A thermometer is a glass rod that is filled with a substance that expands (rises) and contracts (falls) with a change in temperature. There is a scale on the thermometer that corresponds with the temperature given the level of the substance.

There are two types of thermometers—those filled with mercury, and those filled with alcohol. Mercury is a silver colored, toxic metal. Alcohol in thermometers is usually colored red. It is not as toxic as mercury but you should treat ALL thermometers with extreme care. NEVER use a thermometer to stir a sample. Use a glass stirring rod or a spoon. If you break a thermometer, it is important to notify your teacher immediately.

Scientists use the Celsius scale to **measure** temperature. Thermometers have a high level of precision.

5) Tools for Observation

Microscopes are used to observe items that are too small to be seen with the naked eye.

Compound or Light Microscope The light microscope is used to **observe** and magnify a very small, thin specimen. The specimen is placed on a slide and the light from the bottom of the microscope **passes through** the sample and to your eye. This microscope usually magnifies from 40 to 1000x.

Dissecting Microscope The dissecting microscope is used to observe larger objects such as your hand or an entire insect. The objects can be very thick because light does not have to pass through them for you to view the object.

6) Tools used for Manipulation

Many different types of equipment are used to **manipulate** items in a science lab. They or **hold, transport, heat, cut, etc.,** items. The following are a few of the tool you will use in this course.

Test Tubes and Rack Test tubes can be used to **hold, transport or heat** items in the laboratory. They can be labeled with a china marker. Cleaning is accomplished with the use of a test tube brush and glassware soap. When using more than one tube, a rack can be used to hold the tubes and keep them in order.

Petri Dish Flat, circular dishes with loose-fitting covers used for **holding** and **transporting** items. Living specimens can be observed in petri dishes; they can also be used in a similar fashion as watch glasses for viewing specimens under the dissecting scope. The most common use for petri dishes is for *culturing* (growing) microscopic organisms such as bacteria and fungi. To do this, a growth medium (food) is poured in the bottom of the dish. Microorganisms grow on the medium and can be studied.

Beaker Tongs and **Test Tube Clamps** These tools are a must when **transporting** hot glassware. Always use tongs or a clamp when placing glassware onto or into a hot area, and when removing the glassware from the hot area.

Hot Plate We will be using electric hot plates to **heat** substances in this lab. Hot plates conduct heat just like any other heating tool, so use extreme caution when working with them. Note: We won't be using open flame burners in class.

Dissecting Tools Forceps, scalpels, scissors and probes are commonly used to **cut** and **manipulate** dissections. These instruments are sharp and must be used with extreme care.

7) Safety Equipment

Goggles, aprons and plastic gloves are used as additional protection during dissections and procedures.

Scientific Tools and Equipment

Directions: Fill in the numbered blanks in the following chart with information from the information above in Assignment #3.

Type of Measurement	**Tool(s)**	**Unit of Metric Measurement**	**Level of Precision (high, med., low)**
Linear (length)	ruler	mm/cm	high
Volumetric (volume of a liquid)	graduated cylinder	1)_____	2) _____
	3)_____	ml, L	med
	4)_____	5)_____	6)_____
	medicine dropper	7)_____	low
Mass (weight)	triple-beam balance	mg, g, kg	high
	8) _____	9) _____	10) _____
Temperature	mercury thermometer	11) _____	12)_____
	13) _____	14) _____	high

15) Make distinctions between **tools** and **units** of measurement:
Name the **tool** of measurement you would use to describe the length of an ant_____,
the amount of liquid in a coconut_____, or a dolphin's mass_____.

16) Name the **unit** of measurement you would use to describe the length of an ant_____,
the amount of liquid in a coconut_____, or a dolphin's mass_____.

17) What is the **MOST IMPORTANT** thing to consider when using a metric ruler that has both inches and centimeters listed on the ruler? _____

18) Which of the following graduated cylinders would be best to use to measure 62 ml of oil?

a. A 500 L cylinder that measures in 5 ml increments.
b. A 50 ml cylinder that measures in two ml increments.
c. A 25 ml cylinder that measures in 0.2 ml increments.
d. A 100 ml cylinder that measures in one ml increments.

19) Which of the following thermometers would you use to measure a solution at 25.8 °C?

a. A thermometer that ranges from 0 to 100 °F with 1 degree increments.
b. A thermometer that ranges from 0 to 50 °C with 0.2 degree increments.
c. A thermometer that ranges from 0 to 50 °F with 1 degree increments.
d. A thermometer that ranges from 0 to 100 °C with 5 degree increments.

20) Which of the following balances would be most accurate?

a. A balance that ranges from one g to one kg with one gram increments.
b. A balance that measures from one mg to one kg with one mg increments.

21) Which tool of observation would a scientist use to look at skin cells?_____

22) List three pieces of equipment you might use if you are dissecting a frog, and you don't want to get any preservative on your hands, clothes, or in your eyes.

a. _____
b. _____
c. _____

Metric Measurement

Scientists use metric measurement as a way of describing and comparing things. For example, linear measurements can identify and distinguish between male and female skeletons: The female skeleton has a wider pelvis than the male.

In biology, we use the **metric system** of measurement for two reasons:

1. The units of measurement are based on multiples of 10, and it is easy to make conversions from one unit (such as a millimeter) to another unit (such as a centimeter).

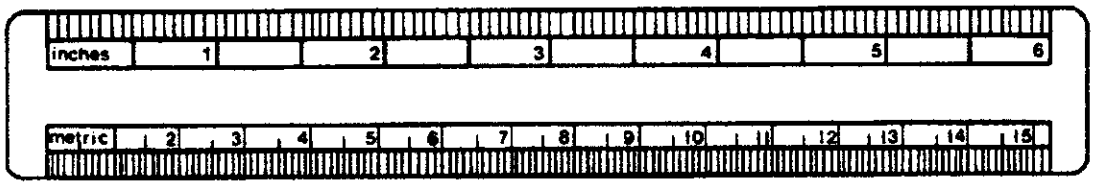
2. The things we measure in biology are often very small (such as the length of a cell or the weight of a single seed). The smallest units in the English measurement system, the inch and ounce, are not easily divided into smaller units and are impractical to use.

In this class you will be determining **linear**, **volume**, **mass** and **temperature** measurements. Linear, volume and mass measurements are metric. We will be using the **Celsius or Centigrade** scale for measuring temperature. The following tables show simple conversions for different units of measurement.

Type of Measurement	Some Conversions	Examples
Linear: measured in divisions of a **meter (m)**	1 meter=100 centimeters (cm) 1 meter=1,000 millimeters (mm) 1 meter=1,000,000 micrometers (μm) 1 mm=1,000 μm	One meter is a little over 3 feet. A centimeter is slightly less than one-half an inch. We use micrometers (μm) to measure cells and microorganisms such as bacteria.
Volume: measured in divisions of a **liter (L)**	1 liter=1,000 milliliter (ml or mL)	Coke comes in one-liter bottles. Poland Spring water can be purchased in 500 ml or half-liter bottles.
Mass: measured in divisions of a **gram (g)**	1,000 grams=1kilogram (kg) 1 gram=1000 milligram (mg) 0.1 gram=100 mg 0.001 gram=1 mg	A small paper clip or a packet of sugar weigh approximately one gram.
Temperature measured in degrees **Celsius (°C)**	0 ° C 22 ° C 37 ° C 100 ° C	Freezing point of water Room temperature Normal body temperature Boiling point of water

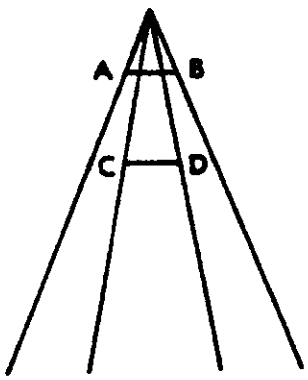
Linear Measurement

Examine a metric ruler. Starting from the left edge, the smallest unit is the millimeter (mm). Notice that 10 mm are equal to a centimeter. Focus on a single mm. If you divide it into 1,000 equal parts, each part would be a micrometer (μm).



23. How many mm are in 1 cm? _____
24. How many mm are in 30 cm?_____
25. Can you see a μm easily with your naked eye?____
26. How many μm are in 4 mm?_____

27. Measurements can be deceiving. Look at the figure below. Line AB appears to be longer than line CD. Prove, by measuring with a metric ruler, the length of each line. Be sure to include the unit of measurement in your answer and in all future answers!



Length of AB_____

Length of CD_____

28. The shaded circles in the figures below do not appear to be the same size. Measure them to find out.
    Diameter of the shaded circle in figure 1_____cm

    Diameter of the shaded circle in figure 2_____

Figure 1

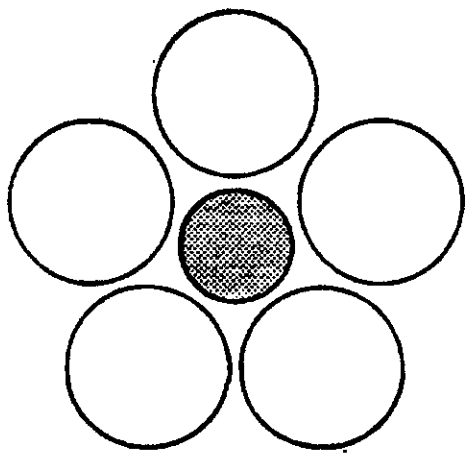
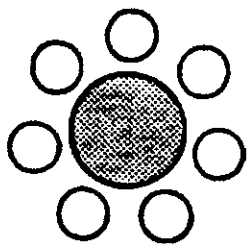


Figure 2



Volume Measurement

The most common tool for liquid measurement is the graduated cylinder. **Volume is measured in milliliters (ml).** Do not confuse ml with mm. Graduated cylinders are the most accurate tools for measuring volume.

Graduated cylinders come in many different sizes. The maximum volume of a graduated cylinder can range from 5 ml to 1 L. Each line in a graduated cylinder represents the smallest unit of measurement. It can range from 0.1 to 5 ml or more. You must look at the markings on the side of the graduated cylinder that you are using to determine what unit each line represents.

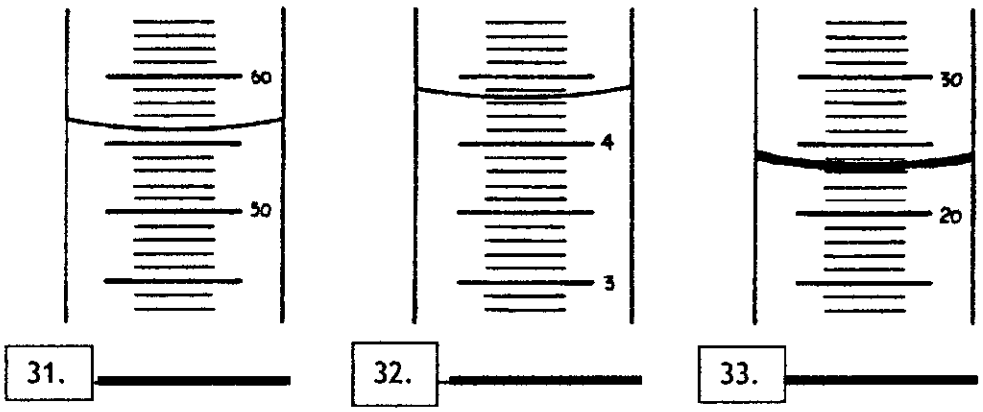
For example: The volume between two lines in example "a" below is equal to one ml.

29. The volume between two lines in example b) below is equal to____ml .

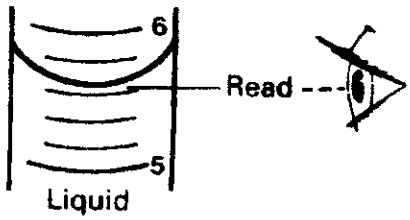
30. The volume between two lines in example c) below is equal to_____.

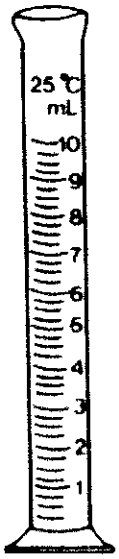
MEASURING LIQUID VOLUME

What volume is indicated on each of the graduated cylinders below? The unit of volume is mL.



When determining the amount of liquid in a graduated cylinder, sight along the bottom of the curved line called the **meniscus** formed at the surface of the liquid.





Mass Measurement

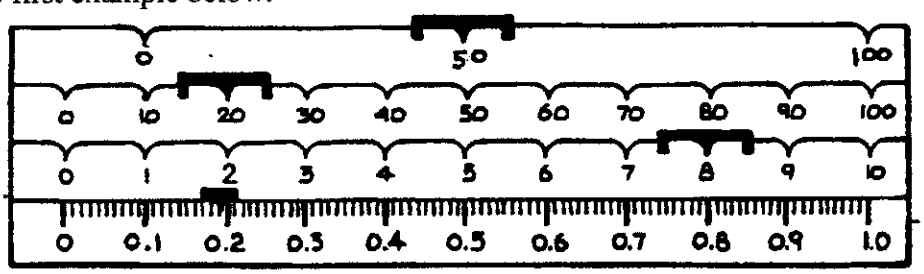
In this class, we will use an **electronic balance** that automatically provides a digital reading of the correct mass in grams (accurate to the nearest hundredth, such as 5.34g). You may also be using the **pan balance,** also called the **triple beam balance**.

Determining the Tare Weight: Before measuring any dry substance on a balance, a container should be placed on the balance to hold the material being weighed. You can use a petri dish or a piece of paper towel. In order to get the correct measurement, the weight of the container must be subtracted from the weight of the substance you want to weigh. A button on the electronic balance will automatically zero the machine when the container is on the balance. With a triple beam balance, the weight of the paper must be subtracted from the final weight of the material.

Electronic Balance: Depending on the balance, weights are read directly from the digital readout.

Triple Beam Balance: The top of the triple beam balance below shows the three beams with four weights called **riders** positioned along each of the beams. After the tare weight is determined, the sample is placed on the pan and the riders are moved in order from largest to smallest to balance the beams so the pointer at the right side of the balance points to zero. Once the beam is balanced, the mass is read by adding the values of each rider.

Look at the first example below.

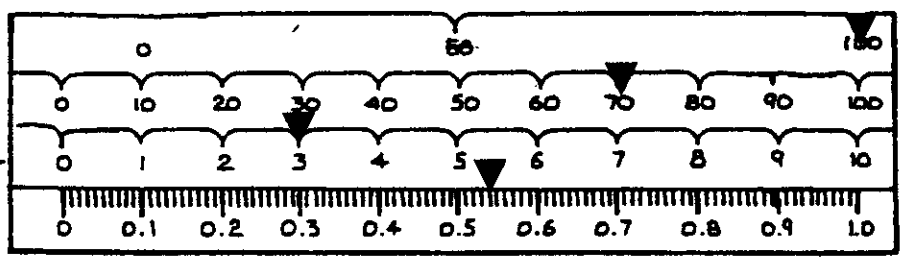


To read the value on the beam, add the largest weight (50g) to the next three (20g, 8g and 0.19g)

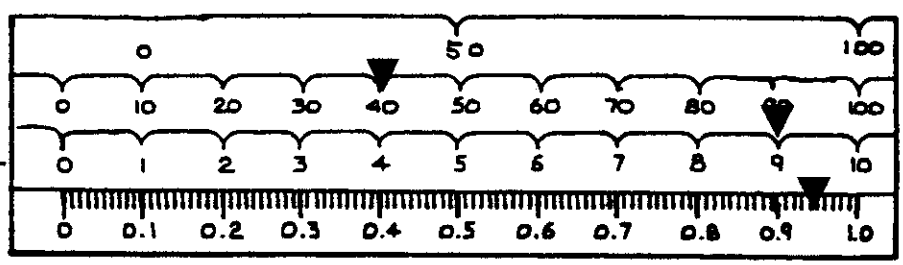
34. What is the total mass value of the sample above?_____

Determine the mass (in grams) shown on the following balance drawings:

35. _____



36. _____



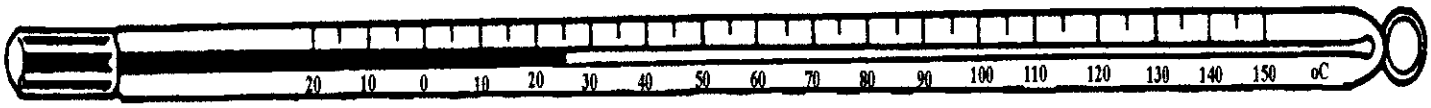
A thermometer is a glass tube filled with a material that expands or contracts depending on the temperature. Temperature is measured in degrees Centigrade or Celsius (° C).

Types: Mercury (a silvery, toxic material) or alcohol (less toxic and red in color) is used in thermometers. Extreme care must be used when working with mercury thermometers. If they break, inform the teacher and do not try to clean up the broken pieces by yourself. Alcohol thermometers are not as dangerous but broken thermometers can cause dangerous punctures.

Reading a Thermometer: The side of a thermometer is marked to indicate the temperature at different expansion levels of the alcohol or mercury. As the temperature rises, the level of mercury or alcohol moves further from the end of the thermometer. The temperature is read when the level of mercury is stable.

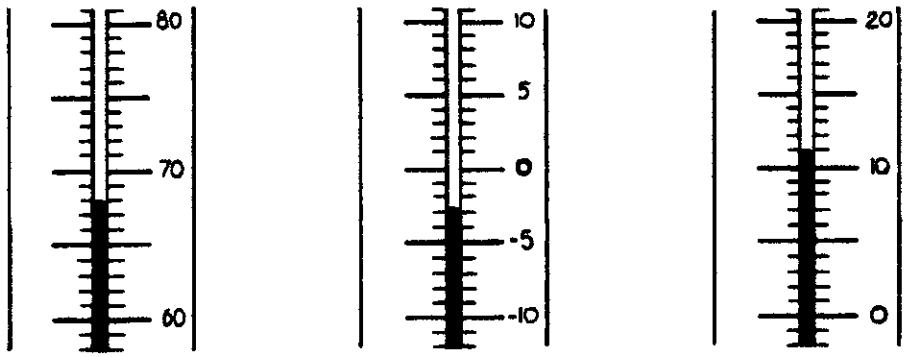
Scientists use a Celsius or Centigrade thermometer to measure temperature in units called degrees Celsius or Centigrade (° C).

37. What temperature is shown on the thermometer below?_____



READING THERMOMETERS

What temperature is indicated on each of the thermometers below?



38. _____ 39. _____ 40. _____

Temperature Conversions: In the United States, temperature is commonly measured in degrees Fahrenheit (° F). Use the following calculations to convert between the two units of measurement.

$^{o}C = (^{o}F - 32) \times 5/9$ and $^{o}F = (^{o}C \times 9/5) + 32$

41. What is the temperature in degrees Celsius if it is 98.6 °F? _____

42. What is the temperature in degrees Fahrenheit if it is 0 °C? _____

Assignment #4: How to Build a Line Graph/Rules of Graphing

Here are some rules to follow when building a line graph. **Unless specifically allowed by the teacher, ALL GRAPHS ALL YEAR must be done BY HAND. Do not create your graphs on a computer.**

1. Title –
   Does the graph have an appropriate title that tells the reader what the graph is about and includes both the **independent and dependent** variable? *Not just "Graph #4" or "Turtle Graph". These are POOR titles and convey zero information. A better title is "How Temperature Affects the Rate of Egg Hatching in Green Sea Turtles"*

2. Axes –
   Did you label the X and Y axes correctly? *Dependent variable data goes on the Y axis. Independent variable goes on the X axis. If you have more than one independent variable, they are all graphed on the X axis. Be sure that the axes are labeled correctly, for example "Number of eggs hatched" or "Temperature in Celsius"*

3. Scales –
   Did you use appropriate scales? *Scales are the measurement charts along the X and Y axes. Your scale should be properly spaced and in regular intervals. The purpose of a graph is to see a pattern, without appropriate scales, you do not see a true picture of the data. If your data doesn't start at zero, your graph does not have to start at zero, but you cannot skip sections of data in the middle!*

4. Size –
   Is your graph appropriately sized? *Your graph should be large – use the entire sheet of paper. Space out your scales to use as much of the paper as possible.*

5. Points Plotted –
   Did you plot your points properly? *Double check to make sure your data points are properly placed. Since your data will never be perfect, it is better to see the overall trends of your data, instead of focusing on EXACT numbers. Draw a line or curve that follows that data as well as possible. Most experiments have "outlier" data, one or more data points that don't "fit the curve". These can be ignored so that you get an appropriate picture of your data, just be sure to explain what may have CAUSED those outliers in your lab report/questions.*

6. Neatness –
   Is your graph neat and complete? *The writing should be legible, the points should be clear. There should be no stray marks on the paper. Be sure to use a key if you have more than one line.*

You may print out graph paper off the internet if you don't have it at home. Just be sure that the graph is the full size of the paper.

Directions – Read the questions and write the answers below. Use the graphing rules provided in Assignment #4.

Materials – this sheet, graph paper, ruler

Task 1

Suppose you are studying the effects of a nutrient substance on plant growth. You want to know the optimum concentration of the substance. You grow a series of plants on liquid medium to which you add various concentrations of the nutrient. You measure the weight of the plants after a set time of growth. The data is shown in the table below.

Amount of Nutrient (ml) per liter of water	Weight (g)
5	*6.8*
10	*9.3*
15	*12.1*
20	*15.8*
25	*15.9*

1. Based on the data make a conclusion. What can you say about the effects of the varying amount of nutrients on weight?

2. How many mL of nutrients seems to grow a plant the absolute best?

Task 2

On the basis of these observations, you decide to repeat the experiment using smaller increments of concentration as well as a slightly wider range of concentrations. This time the data are as follows:

Concentration (mM)	Weight (g)
0	2.0
2.5	2.0
5	1.9
7.5	2.2
10	5.0
12.5	6.8
15	7.9
17.5	8.9
20	10.0
22.5	11.0
25	12.1
27.5	13.3
30	14.8
32.5	16.7
35	19.6
37.5	15.9
40	5.4

3. How does this new data affect your interpretations?

4. Why may it be wrong when extrapolating information from certain graphs?

5. What does this indicate about experimental procedures?

TASK 3 -

Graph the data Found in the Table on Task 2. Be sure to print out a piece of graph paper if you need one – do NOT do this on unlined paper.

FOLLOW ALL RULES OF GRAPHING found in Assignment #4.