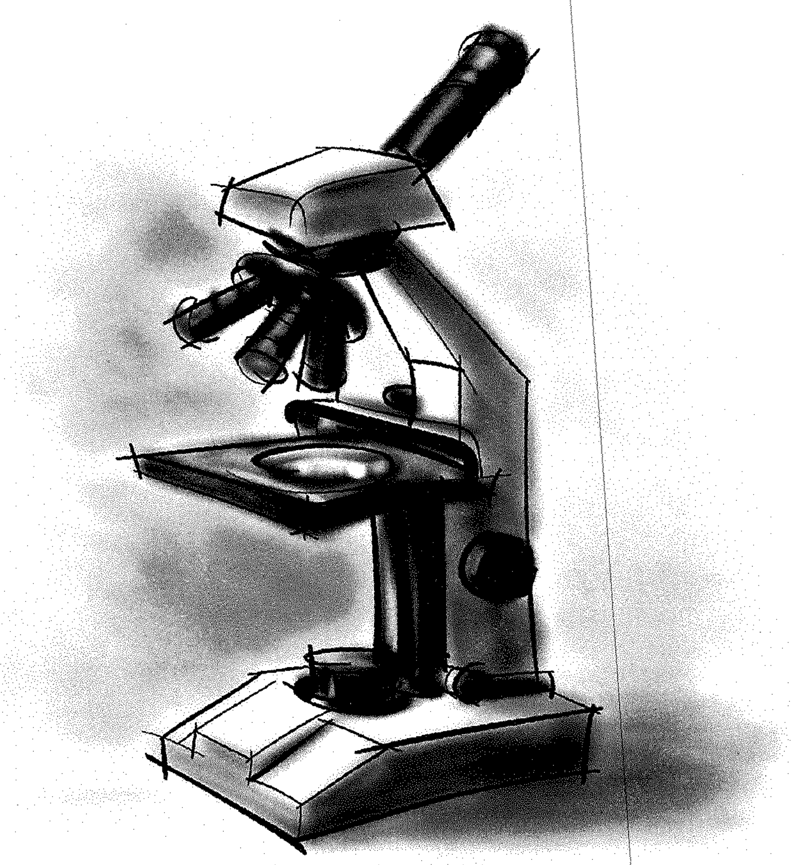
Unit One:



Scientific Method and Tools of the Biologist

NAME: ____________________

ACTIVITY # _____ LABORATORY SAFETY

A research laboratory is a place where discovery leads to knowledge and understanding. It is also a place where caution is essential for safety, and careful attention to detail is necessary for valid results. In the research laboratory as in any other place, there are potential hazards. Familiarity with these potential hazards makes it possible to take the proper precautions to keep laboratory activities safe.

1. Read the laboratory safety precautions listed below and discuss them with the other students in your group.

*S*afety
*A*dvice
*F*or
*E*veryone
*T*o
*Y*ield

General Safety Precautions

a. Follow all instructions carefully, using special care when you see the word *CAUTION* in the instructions for the investigation. Follow additional safety instructions given by the teacher.
b. Never perform unauthorized experiments. Do only those experiments assigned by the teacher.
c. Never work alone in the laboratory, and never work without the teacher's supervision.
d. Never eat, drink, smoke, chew gum, or apply cosmetics in the laboratory. Do not store food or beverages in the lab area.
e. Approach laboratory work with maturity. Never run, push, or engage in horseplay or practical jokes of any kind in the laboratory.
f. Keep your work area clean and uncluttered. Store items such as books, purses, etc., in designated areas.
g. Dispose of used chemicals, matches, and living or preserved specimens only as directed by the teacher.
h. Turn off all electrical equipment, water, and gas when it is not in use, especially at the end of the laboratory period.
i. Know the location and how to operate all safety equipment in the classroom, including fire extinguishers, fire blankets, sand, safety showers, eyewash fountain, and first-aid kit.
j. Do not use the sink to discard matches, filter paper, or other solid or slightly soluble materials.

Laboratory Apparel Precautions

a. Do not wear loose-fitting sleeves, bulky outerwear, or open-toe shoes.
b. Tie back long hair. Tuck long neckties inside your shirt.
c. Wear safety goggles when using chemicals, hot liquids, lab burners, or hot plates.
d. Wear lab aprons when working with chemicals or hot materials.
e. Wear plastic gloves when working with preserved specimens or with poisonous, corrosive, or irritating chemicals.

Precautions for Working with Electrical Equipment

a. Never use equipment with frayed insulation or with loose or broken wires.
b. Make sure the area under and around the electrical equipment is dry and free of flammable materials. Never touch electrical equipment with wet hands.
c. Turn off all power switches before plugging an appliance into an outlet. Never jerk wires from outlets or pull appliance plugs out by the wire.

Precautions for Working with a Lab Burner or Hot Plate

a. Wear safety goggles, tie back long hair, and roll up long, loose-fitting sleeves.
b. Never leave a lighted lab burner, hot plate, or any hot object unattended.
c. Never reach over an exposed flame or heat source.
d. Use tongs, test tube holders, or pot holders to handle hot equipment.
e. Never allow flammable materials such as alcohol near a flame.
f. When you heat something in an open container such as a test tube, point the open end of the container away from yourself and others.
g. Use only borosilicate glassware (e.g., Pyrex®) for heating substances.
h. Before lighting a lab burner, close the gas supply valve completely, then open it only slightly.
i. Check lab burner hoses to make sure they fit tightly and that they are not cracked, brittle, or dry.
j. If the burner does not light, or if the flame keeps going out, turn off the gas and ask your teacher for help.

Precautions for Working with Chemicals

a. Never touch or taste substances in the laboratory except as directed by your teacher.
b. Never smell substances in the laboratory without specific instructions. Do not inhale fumes directly; wave the air above the substance toward your nose and sniff carefully.
c. Use materials only from containers that are properly labeled. Be familiar with safety precautions for each chemical to be used.
d. When diluting acid with water, *always add acid to water.*
e. Never return unused chemicals to the stock bottles. Do not put any object into a reagent bottle, except the dropper with which it may be equipped.

Precautions for Working with Glassware and Other Lab Equipment

a. Use only the equipment specified in the laboratory instructions unless the teacher directs otherwise.
b. Never use chipped or broken glassware.
c. Make sure glassware is clean before you use it, and clean before you store it.
d. Keep your hands away from the sharp or pointed ends of equipment such as scalpels, dissecting probes, scissors, or needles.
e. Do not force glass tubing or thermometers into rubber stoppers, and do not twist or turn the glass once it is in place.
f. If you use a microscope which has a mirror, do not aim the mirror directly at the sun. Direct sunlight can damage the eyes.

Precautions for Working with Live or Preserved Specimens

a. Treat live animals gently. Follow instructions for proper care.
b. Always wash your hands with soap and water; use a fingernail brush to clean under your fingernails after working with live or preserved specimens.
c. Specimens for dissection should be properly mounted and supported. Do not cut a specimen while holding it in your hand.
d. Do not open containers of live microorganisms unless you are directed to do so.
e. Wash down your lab surface with a disinfectant solution both before and after using live microorganisms.
f. Dispose of live or preserved specimens as directed by your teacher.

The pictures below were taken of actual John F. Kennedy students before they received their safety guidelines from their science teacher. Choose 3 unsafe situations and in complete sentences describe what the students are doing, why the situation is unsafe, and what action needs to be taken to provide a safe laboratory environment.

Lab Safety Review Questions

Directions: After reading the safety guidelines and using your previous knowledge and common sense, answer the following questions.

PART A

Draw a map of your science laboratory. Indicate the location of each of the following:

fire extinguishers	main gas shut off valve	eyewash station/bottles
fire blanket	first aid kit	exits
gas jets	sinks	

PART B

Look at the cartoon scene in your lab manual. Choose 2 different unsafe situations and in complete sentences describe each of these details:

- what the students are doing (specific names and actions)
- why the situation is unsafe
- what action needs to be taken to provide a safe laboratory environment.

PART C

1. What safety procedures should you follow in each of these situations?
   a. Your clothing is on fire....
   b. A chemical spills on your hand...
   c. Glassware breaks...
   d. You are heating a substance in a test tube...

2. Which laboratory situations require wearing safety goggles?
3. Why should one tie back long hair in the laboratory?
4. Why should you NEVER eat or drink anything in the laboratory?
5. Why should spills be reported and cleaned immediately?

PART D

Write out each statement, state whether it is true or false, and if false, correct it.

1. The laboratory is a good setting for practical jokes.
2. Performing experiments not assigned by your teacher is good creative procedure.
3. No chemicals should ever be tasted.
4. Goggles must be worn at all times in the lab.
5. Only teachers need to know the location of the fire extinguisher and first aid kits.
6. Students are allowed in the laboratory storage area.
7. It is unnecessary to report minor laboratory accidents.
8. Acids should be added to water, not the other way around.

Name:

MAKING METRIC MEASUREMENTS
Human Foot and Hand Bones

INTRODUCTION

The International System of Units, or *SI System*, is a system of measurements you will become more familiar with this year. You may know the SI System as the metric system. This system used by all scientists and most countries outside the United States. The measurements you will make in this lab are SI measurements.

In this lab, you will make length measurements. The basic unit of length in the SI System is the meter. The meter can be divided into one hundred smaller units called *centimeters*. Each centimeter can be divided into ten smaller units called *millimeters*. In this lab, your measurements will be made using centimeters and millimeters.

The measurements you will make in this lab are known as data. Your data (or observations) should *always* be written down. Write your data in a table to help keep it organized.

MATERIALS:

- Metric ruler
- Hand and foot bone diagram
- Colored pencils

PROCEDURE:

1. Look at the diagram of the hand on the next page. Count the number of bones present in the thumb, fingers, palm and wrist. They are shaded in different ways in the diagram to help you. Record your counts in table A in your lab notebook.
2. Look at the diagram of the foot on the next page. Count the number of bones present in the big toe, other toes, center of the foot, ankle and heel. Record your counts in table A in your lab notebook.

HAND		FOOT	
Part	Number of Bones	Part	Number of Bones
Thumb		Big Toe	
Fingers		Other Toes	
Palm of Hand		Center of Foot	
Wrist		Ankle and Heel	

TABLE A- BONE COUNTS

3. Measure (in millimeters) the lengths of the bones marked A, B, C, D and E on the *hand* diagram. Record your measurements in table B in your lab notebook.
4. Measure (in millimeters) the lengths of the bones marked A, B, C, D and E on the *foot* diagram. Record your measurements in table B in your lab notebook..
5. Measure the length of the thumb and record the number in table B in your lab notebook. (HINT: Remember how many bones are in the thumb).
6. Measure the length of the big toe and record the number in table B in your lab notebook. (HINT: Remember how many bones are in the big toe).
7. Measure the lengths of the smallest finger and toe. Record these data in table B in your lab notebook..
8. Change all millimeter measurements to centimeter measurements in table B in your lab notebook.Remember that there are ten millimeters in one centimeter.

TABLE B- BONE LENGTHS

Bone	Hand		Foot	
	Millimeters (mm)	Centimeters (cm)	Millimeters (mm)	Centimeters (cm)
Bone A				
Bone B				
Bone C				
Bone D				
Bone E				
Thumb or Big Toe bones				
Smallest finger or toe bones				

ANALYSIS QUESTIONS:

1. Convert the following:
   a. 2 meters equals ______________ centimeters and ______________ millimeters.
   b. 75 centimeters equals ______________ meters and ______________ millimeters.
   c. 125 millimeters equals ______________ centimeters and ______________ meters.
2. How do bones in the hand and the foot compare in total number?
3. How do bones in the palm of the hand and the center of the foot compare in number?
4. How much longer is Bone A in the foot than Bone A in the hand?
5. How do your measurements of the thumb and big toe compare?
6. How much longer is the smallest finger than the smallest toe?
7. How much longer is Bone E in the foot than Bone E in the hand?
8. Describe the main differences between the lengths of the bones in the hand and in the foot.
9. What could account for these differences in length between the hand and foot bones?

CONCLUSION QUESTIONS:

1. Why are data often kept in tables?
2. Suppose you were working in a department store. What unit of measurement (meter, centimeter, millimeter) would you use to measure the length and width of shoes and window curtains? Explain.
3. Write a one sentence summary of the following terms:
   a. Length
   b. Data
   c. Meter
   d. SI Measurements

Name: Date:

GRAPHING

INTRODUCTION

Graphing is used by scientists to display the data that is collected during a controlled experiment. A line graph must be constructed to accurately depict the data collected. An incorrect graph often leads to the acceptance of an incorrect hypothesis or detracts from the acceptance of a correct hypothesis.

The graph should contain four major parts

- Title
- Independent Variable
- Dependent Variable
- Scales for each Variable

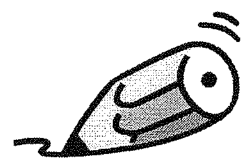
Title – this identifies what the graph shows. Reading the title should give the reader an idea about the graph. It should be a **concise** statement placed above the graph.

Independent Variable – This is the variable (part of the experiment that changes) that can be controlled by the experimenter. This variable is placed on the horizontal, or x-axis.

Dependent Variable – This is the variable (part of the experiment that changes) that is controlled directly by the independent variable. It is the result of changes made to the independent variable. This variable is placed on the vertical, or y-axis.

Scales for each Variable – When constructing a graph, one needs to know where to plot the points representing data. In order to do this, a scale must be used that will include all data points. Each axis should have a consistent scale, and it is a good idea to use a scale that is easy to use. For example, multiples of 5, 10, etc. are good, while multiples of 0.68 or 1.22 are not! The scale should allow as much of the graph to be used as possible. If your scale does not fit, do not add extra lines to your graph but erase your scale and start again using a different increment (number of blocks in between each number) or a different scale.

IMPORTANT TIP



When graphing, always make sure to use a pencil! It is much faster and easier to correct mistakes when you can use an eraser. If you graph in pen, mistakes cannot easily be corrected, and you usually have to start over

PROCEDURE:

GRAPH ONE

Use the data in the table below to complete the graph on the paper provided. Remember to title your graph, label each axis properly when setting up your scale, and to make a key for your graph.

Depth (m)	Number of bubbles/min Plant A	Number of bubbles/min Plant B
2	29	21
5	36	27
10	45	40
16	32	50
25	20	34
30	10	20

ANALYSIS QUESTIONS FOR GRAPH ONE:

1. What is the independent variable?
2. Why is this variable the independent variable?
3. What is the dependent variable?
4. Why is this variable the dependent variable?
5. Use one or more complete sentences to state a conclusion about the data in this graph.

GRAPH TWO

Diabetes is a disease affecting the insulin producing glands in the pancreas. If there is not enough insulin being produced by these glands, the amount of glucose in the blood remains high. A blood glucose level above 140 for an extended period of time is not considered normal. This disease, if not brought under control, will lead to severe complications and even death.

Use the data in the table below to complete the graph on the paper provided. Remember to title your graph, label each axis properly when setting up your scale, and to make a key for your graph. Circle each data point with a circle.

Time After Eating (hrs.)	Glucose Level ml/L in blood Person A (ml/L)	Glucose Level in blood Person B (ml/L)
0.5	170	180
1	155	195
1.5	140	230
2	135	245
2.5	140	235
3	135	225
4	130	200

ANALYSIS QUESTIONS FOR GRAPH TWO:

1. What is the independent variable?
2. Why is this variable the independent variable?
3. What is the dependent variable?
4. Why is this variable the dependent variable?
5. Use one or more complete sentences to state a conclusion about the data in this graph.
6. Which, if any of the individuals has diabetes? Justify your answer.
7. If the time period were extended to 6 hours, what would be the expected blood sugar level for Person B?
8. What would be a probable blood glucose level for Person B at 3.5 hours

CONCLUSION QUESTIONS:

1. Write a one sentence summary of the following terms:
   a. Title
   b. Independent Axis
   c. Dependent Axis
   d. Scale
2. What is the different between a data table and a graph? How are each used?

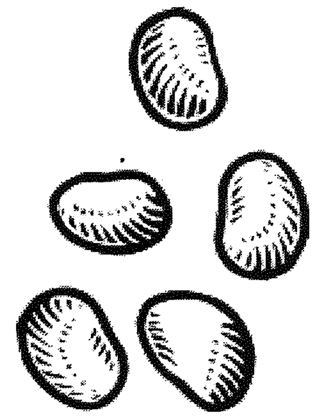
Name: Date:

THE LUCKY LIMA BEAN

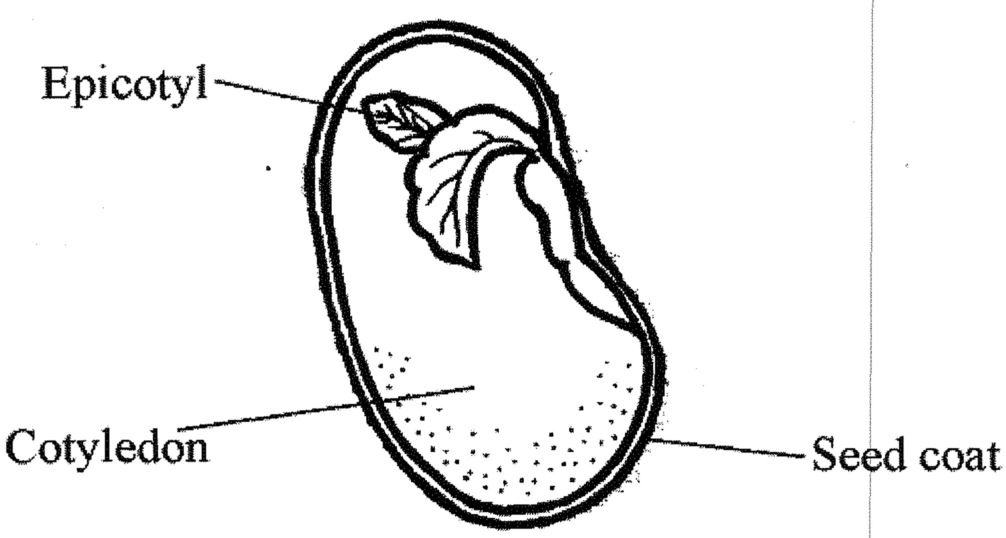
A Study of Experimental Design

INTRODUCTION:

You are the head of research at the Lucky Lima Bean Company. Your company is experimenting with different methods of growing lima beans. Currently, a potting soil mixture is used. The president of the company has asked you to look into using vermiculite (lightweight, sponge-like granules capable of holding both water and air) as a growth medium. It is your responsibility to determine how environmental conditions such as pH, temperature and light affect the growth and development of plants.



STRUCTURE OF THE LIMA BEAN SEED:



Structure	Function
Seed Coat	The protective outer covering of the lima bean seed
Coteyledon	The provides food for the growing lima bean seedling (embryo)
Epicotyl	The upper part of the seedling (embryo)

Experimental Design

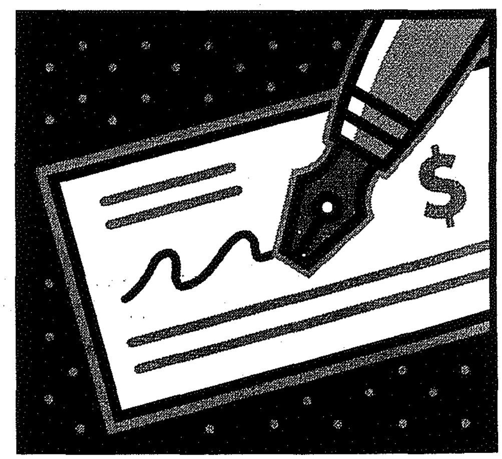
Plants respond to their environment in many different ways. Design an experiment in your lab notebook. to test the effects of one of the environmental factors listed below on plant growth. Your experiment must include the following information:

- What environmental factor did you choose?
- What problem or question will be answered?
- What is your hypothesis?
- List materials needed to complete the experiment.
- Describe the plants you would use as a basis for comparison.
- Describe the plants that are being tested in the experiment.
- What factors will you keep the same between the plants that you are using as a basis for comparison and the plants being tested?
- What characteristic of the plants will you measure in the experiment?
- Describe the steps in your experiment (use a numbered list):
- How will you organize your plant measurements (data)?
- Data will be recorded for 3 weeks. Construct a data table in your lab notebook.

Name:

FOLLOWING THE PAPER TRAIL:
A Study of Scientific Inquiry

INTRODUCTION



Science is the process of observing the natural world, collecting evidence and building an explanation. Another name for a scientific explanation is a hypothesis which must then be tested.

As with everything in life, evidence can sometimes be confusing, seemingly conflicting, and apparently random. Furthermore, each new bit of evidence often creates more questions than it answers. This activity is designed to help you understand the nature of science and to illustrate that scientific explanations are only tentative explanations, because new discoveries may show that previous hypothesis were incorrect.
In addition, science is not a solo activity- no scientist or scientific group works alone. This activity will demonstrate the value of collaboration in the sciences.

DIRECTIONS

In your group, you have an envelope which contains a total of 16 checks written by fictional character(s). Do not look at the checks until instructed to do so. When directed, and without looking, remove four of the checks from the envelope and place them on the lab table. In addition, throughout the activity, do not allow other groups to examine your data at this time.

DATA AND OBSERVATIONS

PART ONE-
Observe the information on the checks. Try to formulate a tentative hypothesis that explains the storyline represented by the checks. This is your original hypothesis. Label and record your first hypothesis in your lab notebook.

PART TWO-
When directed, remove four more checks from the envelope. Use this new information to formulate a second tentative hypothesis that explains the storyline. Label and record your second hypothesis in your lab notebook.

PART THREE-
When directed, remove two final checks from the envelope. Use this new information to formulate a third tentative hypothesis that explains the storyline Label and record your third hypothesis in your lab notebook.

Do NOT remove any more!

DISCUSSION

Scientists never have all the data they might need to reach the highest level of confidence in their explanations. To simulate the expanded collaborative nature of science, each group will be given a few minutes to with other groups to compare data. Remember, since each group drew at random, all groups may have some different data. (This simulates the sharing of data and ideas by scientists by way of personal communications, email, etc.)

After you have completed discussion, come back together with your group to formulate a final hypothesis based upon all of the available data. This hypothesis should attempt to explain the events in the life of the character(s) who wrote the checks. Label and record this final hypothesis in your lab notebook.

CONCLUSIONS

Choose a spokesperson to present the group's final hypothesis to the class. This simulates the sharing process of scientists at symposia and by publishing. Keep in mind that scientific explanations are tentative because we can never be absolutely sure that all of the information about a problem is known and that new information may be discovered later.

Answer the questions below regarding the nature of science in your lab notebook-

1. Does your explanation exactly match the other groups? What is similar? What is different?
2. Did you have the same evidence? Explain why your explanations may be different.
3. What bits of information on the checks were valuable to your group in formulating a hypothesis?
4. What information was useless?
5. List any misleading information that was presented.
6. Why do we say that a hypothesis in science is "tentative?
7. Is your final hypothesis "correct"? Explain.
8. Write a paragraph describing the nature of science. Specifically, what THREE things did you learn about the nature of science?

Name ______________________________ Date _______________ Period __________

The Scientific Method

Purpose: This lab will help us to see that scientific inferences and conclusions are reached by putting together information we already know, and adding more and more information as it becomes available. Scientific theories may be modified when new evidence is found. Remember that a theory is an educated guess, which we also call an inference or hypothesis. A theory can change and become more and more accurate as we continue to make observations. Science is always changing because all possible information or data is often not available.

Background: The scientific method is used to reach conclusions and to develop theories to explain things that happen in the physical world. Inferences and scientific theories are based on evidence. In this case, the evidence will be a series of written checks. We will try to put together an explanation (conclusion) explaining what may have happened in the lives of the Science family. You will receive part of the evidence to begin your observations and then you will be given an additional set of checks to modify your conclusion.

Materials: 2 envelopes of bank checks, pen

Procedure

1. Each team is given an envelope containing checks. The checks have been randomly selected so *no group receives the same combination of checks. In the first envelope your team will get 5* checks.
2. The team will observe the checks and write 5 observations about the checks and at least 5 inferences that would explain what you have learned from the check data (information). For example, if the memo on the check says "congratulations" (this is an observation), you might infer (make the inference) that the check was given to someone as a gift for something they had accomplished. This is what the entry in your data table would look like.

   Example:

Round 1 Data

Observation	Inference	Evidence for Inference
The word congratulations	The check must have been a gift for an accomplishment	The memo on the check

3. Be certain that your inferences are supported by your observations. Come up with a conclusion by putting together a logical scenario that is supported by the observations and inferences you made. Record your conclusion in the data table.
4. Record your inferences and also list the evidence that allowed your team to reach the inferences in the data table (for round 1 data). You will be given another envelope with checks.
5. Round 2 – you will be able to reevaluate your round 1 inferences after observing the new checks. You may either restate or add to your list of inferences. Record your inferences in the data table (round 2), then write your conclusion. You conclusion may be more detailed, or completely different after you receive the second round of checks.
6. There are a total of 15 different checks. No two groups have all 15 checks and no two groups have the same 10 checks.

7. Based on the evidence each team has been able to observe, inferences and conclusions may be dramatically different. Not all the available evidence was revealed to any team. Your final conclusions may be very different.
8. You will write a conclusion (story) based on the evidence you evaluated after round 1. Each student must write his or her own story.
9. You will then write a second conclusion (story) based on the new evidence you evaluated in round 2. The second story may include conclusions drawn from evidence in both rounds and must be different from the first story.

ANALYSIS QUESTIONS:

1. You only saw 10 out of the 15 checks. How does this affect your conclusions?

2. Which parts of the checks contained the most helpful evidence that you used to make your inferences? Why did you find that most useful?

3. What details did you change about your story after round 2? What piece of evidence caused you to change you conclusion. Be specific.

Name:___________________________
Lab: ______

Using the Scientific Method

Problem: How does soap affect the surface tension of water?

Background Information:

Surface tension is defined as a property of liquids caused by intermolecular forces near the surface leading to the apparent presence of a surface film and to capillarity. Basically, it refers to water's ability to "stick to itself." Surface tension can be measured and observed by dropping water (one drop at a time) onto the flat surface of a penny.

Materials: Soapy water, plain tap water, pipettes, penny, metric ruler, paper towels

PRE-LAB QUESTIONS

1) State a Hypothesis (Remember, this may NOT be in the form of a question, try an "If....then..." statement)

2) Measure and calculate the surface area of the part of the penny that will hold water drops. (Hint: the formula for finding the area of a circle = Πr^2 where r = the radius of the penny. Describe the necessary procedure and show your work. Your final calculation should be in the units of cm^2

3) Describe at least 3 things we should do to make this experiment more valid. Be specific to this experiment.

PROCEDURE & DATA COLLECTION

Test your hypothesis by comparing the number of drops of tap water that can fit on a penny's surface to the number of drops of soapy water that can fit on a penny's surface. Because water drops may vary depending on how well you use a pipette, it is best to run as many trials as possible and take an average. Construct and record your data in a table like the one below.

Type of Water	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average (# of drops/cm^2)
Tap Water						
Soapy Water						

Survey each of the other groups in your class to collect data needed to calculate the class average. Construct and record your data in a table like the one following. Create as many rows necessary to collect data from each group in your class. Remember to include your own averages in the class data!

Group #	Tap Water Average (# of drops/cm^2)	Soapy Water Average (# of drops/cm^2)
1		
2		
3		
4		
5		
Etc…		
Class Average:		

Create a **BAR GRAPH** to illustrate the class average for tap water compared to the class average for soapy water. Be sure to include a title for your graph and label each axis including appropriate units. (Hint: It's always a good idea to use PENCIL when constructing a graph)

POST LAB QUESTIONS

1) Why were many trials performed and averaged together?

2) What was the control group in this experiment? What was the purpose for having this control?

3) Identify the independent and dependent variables in this experiment. (Hint: Remember, an experiment can often be titled "The affect of the independent variable on the dependent variable")

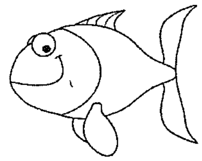
4) Which variable would be changing if the problem question was, "How does sugar affect the surface tension of water?"

ANALYSIS and CONCLUSION

Write a paragraph (using complete sentences) that explains how soap affects the surface tension of water. Refer to the specific data you collected and address whether your hypothesis was supported or rejected. Suggest reasons for your observations (why did it happen). You also may include a discussion of possible sources of error, suggestions for additional data that should be collected to further support your findings, suggestions for other investigations that may me done on the same topic, how the information you learned can be applied to the "real world" or connected to examples from your own life.

Name: Lab #_____

Exploring the Scientific Method Using Fortune Teller Fish



Purpose: To use the scientific method to test a hypothesis using Fortune Teller Fish

Background Information: One criteria of science is that there is a scientific explanation for everything that occurs in nature. This means that we cannot use a "miracle" or other supernatural event to explain an occurrence in the science classroom. Instead, one can use the scientific method to state a problem, make observations/conduct background research, formulate a hypothesis, separate out variables, record and analyze data, and finally draw a conclusion based on the data collected.

Pre-Lab Questions:

1) Define Independent Variable and Dependent Variable
2) Describe the importance of a control group
3) How are constants different from the control group?
4) Why is it important to keep all variables constant except the one which is being tested?

Safety: You may be working with heat lamps. Do NOT touch the heat lamps!

Procedure:

1) Read the instructions on the back of the package and observe the behavior of your fish in your steady hand for 30 seconds.
2) Record a description of the behavior in your lab notebook (ex. My fish curled up completely, touching its head to its tail)
3) Record what the fish envelope says about your personality.
4) Form 3 separate hypotheses to account for the fish's behavior. In science, these must be testable hypotheses! Remember: a good experiment only tests one variable at a time.

   Ex. Hypothesis 1: Moisture from my hand made the fish curl from head to tail

5) Rotate through the testing stations designated by your teacher. Record your observations for each test in the following manner:

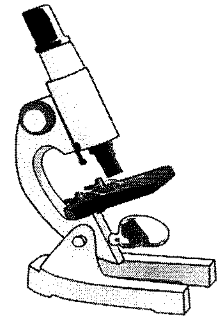
Hypothesis 1: **Independent variable being tested:** **Observations:** (describe in detail the behavior of the fish, in at least 2 sentences) **Conclusion:** (Did the data support the hypothesis? Why or why not?

6) Do not "kill" your fish! You will only get one to test.
7) Answer all analysis questions completely in your lab notebook.

Analysis:

1) After testing your three hypotheses, which variable do you think most likely caused the fish to react? Explain.
2) Compare you data with your group members and the class as a whole. How does your data compare?
3) What would be an appropriate control group for this experiment?
4) Explain why it may be difficult to control some variables while testing others in the class environment.

Introduction to the Compound Light Microscope



Introduction:

"Micro" refers to **tiny**, "scope" refers to **view or look** at. Microscopes are tools used to enlarge images of small objects so as they can be studied. The compound light microscope is an instrument containing **two lenses** to magnify, and a variety of **knobs to resolve (focus)** the picture. Because it uses more than one lens, it is sometimes called the compound microscope in addition to being referred to as being a light microscope. In this lab, we will learn about the proper use and handling of the microscope.

Purpose:

Demonstrate the proper procedures for correctly using the compound light microscope.

Materials:

- Compound microscope
- Glass slides
- Cover slips
- Eye dropper
- Beaker of water
- The letter "e"
- Prepared specimens

Procedure:

Part I. Microscope Parts and Function

1. Carry the microscope with two hands, one holding the arm with one hand and placing the other under the base of the microscope. One person from each pair will go to the microscope storage area and properly transport one microscope to your work area.

2. Make sure your microscope is clean. Gently wipe lenses with lens paper.

3. Plug in your microscope and familiarize yourself with it. Record the magnification of the:

    - Scanning Objective alone:_______ Scanning Objective TOTAL:_______
    - Low power Objective alone:_______ Low Power TOTAL:_______
    - High Power Objective alone:_______ High Power TOTAL:_______
    - Ocular alone:_______

4. Examine the Diaphragm. The numbers on the edge range from _____ to _____.

Part II. Examining the Letter "e".

1. Obtain a prepared slide of the letter "e".
2. Turn on the microscope and place the slide on the stage; making sure the "e" is facing the normal reading position (right side up with your naked eye). Always start with the scanning objective. Using the course focus, adjust your view until the "e" can be seen clearly. Center the "e" in the middle of

the field of view. **Draw** what you see in your lab notebook. Be sure to draw your field of view circle large enough; it is recommended to make your field of view take up between 8-10 lines on your paper. You must also label the total magnification and name of your specimen (Letter "e" 40x)

3. Be sure the "e" is in the center and rotate the nosepiece to the low power objective. You will notice the "e" is out of focus. Focus with the coarse adjustment knob and re-center the "e." **Draw** the image you see of the letter "e" (or part of it) on low power. Label the drawing with its name and total magnification.
4. Be sure that a part of the "e" is in the center and switch to the high power objective. DO NOT touch the coarse adjustment knob while on high power! Instead use only the fine adjustment to resolve/focus the picture. **Draw** what you see under high power. Label the drawing with its name and total magnification.
5. Locate the diaphragm under the stage. Move it and notice the changes in light intensity as you do so.

Part III. Observing Specimens

1. Choose 2 specimens to observe from the options provided by your teacher.
2. Follow appropriate steps for microscope usage to observe and **draw** each specimen under scanning power, low power, and high power. Be sure to label each drawing with the name of the specimen and the total magnification of each objective used.
3. Use proper care when returning your microscope to the storage area. Neatly wrap the cord, avoid touching the bottom of the light bulb as it may be hot, and carry it carefully with two hands. Place it carefully and gently on its storage shelf.

Part IV – Questions

Always write out or fully restate the question with your answer in your lab report.

1. State TWO procedures that should be used to properly handle a light microscope.

2. Explain why the light microscope is also called the compound microscope.

3. Images observed under the light microscope are reversed and inverted. Explain what this means.

4. Explain why the specimen must be centered in the field of view on low power before going to high power.

5. If a microscope has a 20 X ocular (eyepiece) and two objectives of 10 X and 43 X respectively:

   a) Calculate the low power magnification of this microscope. Show your calculation.

   b) Calculate the high power magnification of this microscope. Show your calculation.

6. Describe the changes in the size of the field of view and the amount of available light when going from low power to high power using the compound microscope.

7. Explain what the microscope user may have to do to combat the problems incurred in question # 6.

8. How does the procedure for using the microscope differ under high power as opposed to low power?