INTRODUCTION TO THE SCIENCE OF BIOLOGY

As you begin your journey as a student of science, you may find that your prior experiences or available resources will be helpful in understanding and applying the methods of science to new and previously unexplored ways. Apply your current knowledge by reading the passages provided and then answering the following questions. You may feel free to use any resources you like as you proceed.

Hungry Mice

A scientist observed that white mice that were fed seeds appeared to grow more than mice given leafy green vegetables. The scientist formed a hypothesis that protein in the seeds was responsible for the enhanced growth.

He designed an experiment to test his hypothesis. He divided 200 mice of the same sex, size, health, into two groups of 100 mice each. The mice were kept under identical conditions for fourteen days. One group was given a diet high in protein. The other group was given a normal diet. The mass of each mouse was recorded daily for 180 days.

1. Which group of mice served as a control?
   a) mice given vegetables
   c) mice given low protein diet
   b) mice given high protein diet
   d) mice given normal diet

2. Which group of mice served as an experimental group?
   a) mice given green vegetables
   c) mice given low protein diet
   b) mice given high protein diet
   d) mice given normal diet

3. What was the independent variable?
   a) green vegetables
   c) low protein diet
   b) high protein diet
   d) normal diet

4. What was the dependent variable?
   a) growth of mice
   c) motility of mice
   b) protein levels in mice
   d) reproduction of mice

5. This experiment is properly controlled:
   a) agree
   b) disagree

6. What is the first step of a scientific investigation?
   a) perform the experiment
   c) analyze the experimental data
   b) formulate a hypothesis
   d) make observations and form a question

7. How does the control group in an experiment differ from the experimental groups in the same experiment?
   a) It tests a different hypothesis
   c) It has more variables
   b) It differs in the one variable being tested
   d) It utilizes a different method of data collection.

A study was conducted using two groups of 10 plants of the same species. During the study, the plants were placed in identical environmental conditions. The plants in one group were given a growth solution every 3 days. The heights of the plants in both groups were recorded at the beginning of the study and at the end of a 3-week period. The data showed that the plants given the growth solution grew faster than those not given the solution.

8. When other researchers conduct this study to test the accuracy of the results, they should

a) give growth solution to both groups.

b) give an increased amount of light to both groups of plants.

c) make sure the conditions are identical to those in the first study.

d) double the amount of growth solution given to the first group.

A group of students is about to study the eating habits of frogs.
The students form the following hypothesis: If we feed the frogs extra flies, they will jump higher.

9. The above statement is considered a hypothesis and NOT a theory because:

a) the statement is too short to be a theory, so it must be a hypothesis.
b) students are not allowed to form theories.
c) a theory has been tested repeatedly over time, whereas a hypothesis has not.
d) it is not possible to create a theory about frogs.

Use the information below to answer the questions below.

For Ms. Volesky's research project, she wanted to learn about the squirrels out side her apartment. She collected the following data:

Table 1

Time of Day	Number of Squirrels
8 AM	7
9 AM	8
10 AM	4
11 AM	2
12 PM	1

- All of the squirrels were gray
- each squirrel had a mass of less than 1 kg
- It was hard to tell if they were male or female.
- the squirrels' fur was light grey in color
- Only one of the squirrels was a baby
- A lot of the squirrels carried nuts in their mouth.
- 4 of the squirrels looked sick
- the squirrels spent an average of 437.5 minutes in the trees

10. Which of the following is qualitative data?

a) the squirrels' fur was light grey in color
c) at 8AM, there were 7 squirrels

b) each squirrel had a mass of less than 1 kg
d) squirrels spent an average of 437.5 minutes in trees

Label the parts of the graph using the terms found in the box below for questions 11-14.

a. X-axis   b. Y-axis
c. Title   d. Key

14

11

12
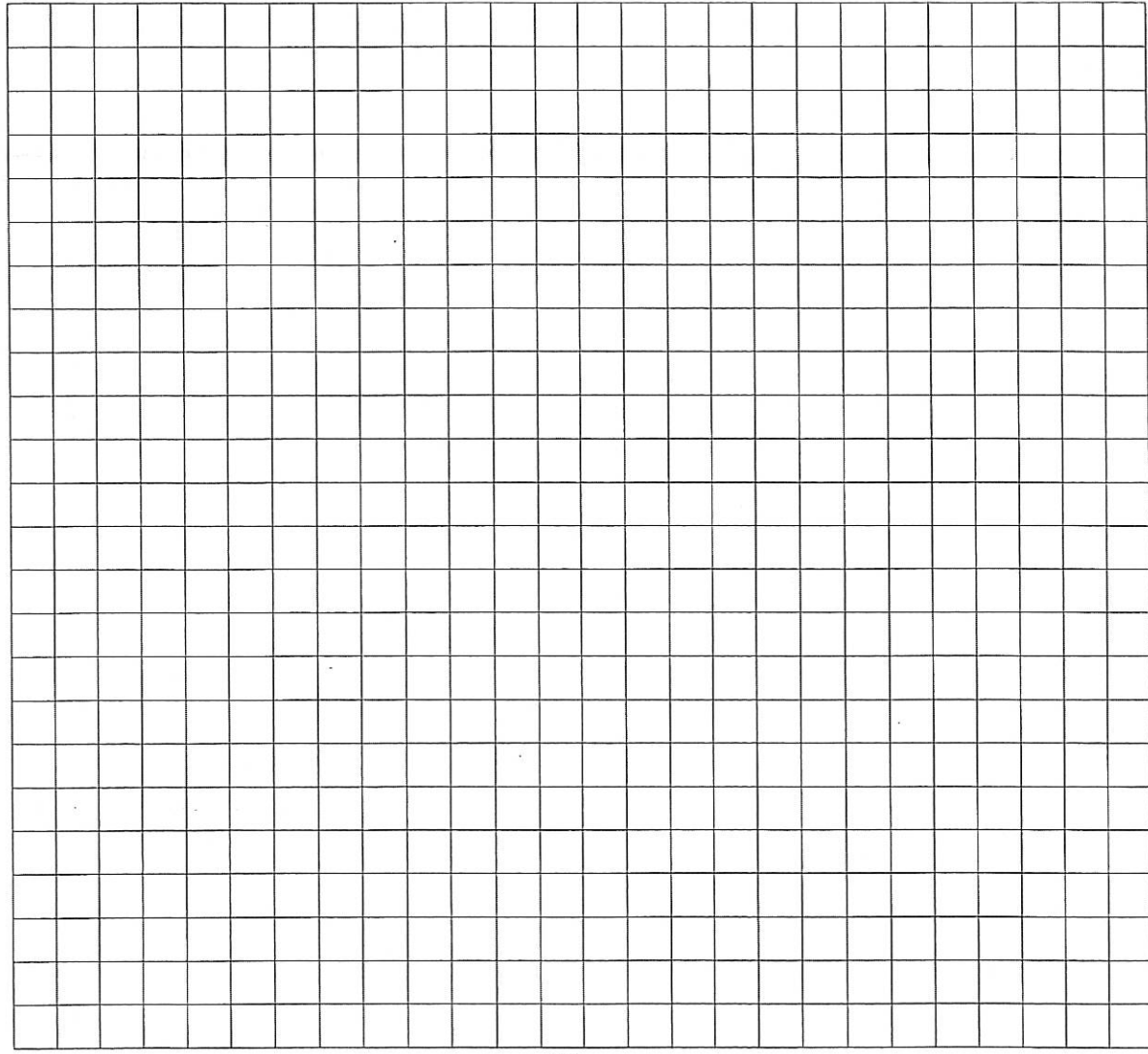
13

15. All of the following are characteristics of living things *except*:

a) ability to reproduce
b) move quickly to meet their needs

c) respond to stimulus in their environment
d) growth and development

16. What is the correct order for the steps of the scientific method?

a) observation, hypothesis, experiment, conclusion
c) conclusion, observation, hypothesis, experiment

b) hypothesis, observation, conclusion, experiment
d) guess, conclude, test, report

Construct a line graph which clearly presents the data found in the table below. Give your graph a title and clearly label each axis.

Month	Average Temperature in Vanuatu
January	84 °F
March	83 °F
May	78 °F
July	75 °F
September	76 °F
November	81 °F
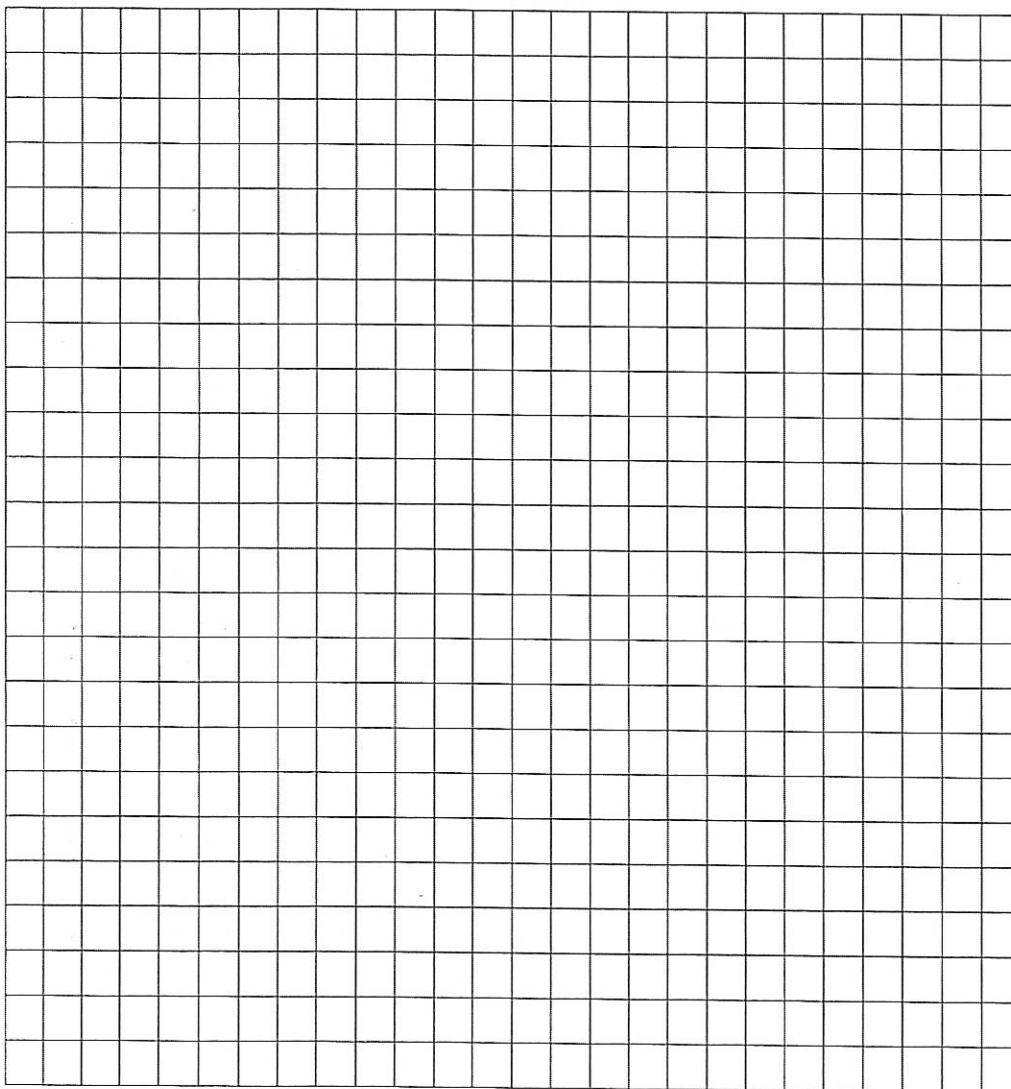
THE LANGUAGE OF SCIENCE

The main reason students find it difficult to understand science is because of all the hard to write, spell and read words. Actually, scientific vocabulary is a hodge-podge of little words that are linked together to have different meanings. If you learn the meanings of the little words, you'll find scientific vocabulary much easier to understand.

Word	Meaning	Word	Meaning
a or an	not or non	hemo	blood
meso	middle	hyper	above
endo	inner, inside	hypo	below
aero	needing oxygen or air	intra	within, inside
anti	against	itis	disease, inflammation
amphi	both, doubly	lateral	side
aqua	water	logy	study of
arthro	joint	lys	break down
auto	self	meter	measurement
bi	two, twice, double	mono	one, single
bio	life, living	morph	form
cephal	head	micro	small
chloro	green	macro	large
chromo	color	multi	many
cide	killer, kill, killing	pod	foot
cyto	cell	phobia	dislike, fear
derm	skin	philia	like
di	two, double	proto	first
ecto (exo)	outer, external	photo	light
endo	internal	poly	many
epi	above	synthesis	to make
gastro	stomach	sub	lesser, below
genesis	origin, beginning	troph	eat, consume
herba (herbi)	plants	therm	heat
hetero	different	tri	three
homo	alike, similar	vore	eat
hydro	water	zoo, zoa	animal

Use the list provided to guess the meaning of each of the following terms. Once you have come up with your own "best guest" definition, use a reliable source to look up the meaning of each term.

1. Hydrology

2. Cytology

3. Protozoa

4. Epidermis

5. Spermatogenesis

6. Cytoskeleton

7. Abiotic

8. Dermatitis

9. Hypodermic

10. Hemophilia

11. Endocystosis

12. Insecticide

13. Anaerobic

14. Endotherm

15. Subspecies

16. Arthropod

17. Micrometer

18. Hypothermia

19. Bilateral

20. Herbivore

Science Journal: Observations Entries

The first step in scientific investigation is observation. If conducted correctly, observation leads researchers to develop questions and possible outcomes of their work. Observation ensures a solid foundation as you experiment and use the scientific process.

How to Make Observations

Follow the steps outlined below when completing your observations for your **Science Journal observation** entries.

Step 1: Gather as much information about the phenomenon you are observing as possible. The more information you have on the subject, the better your experimental design. Gather information from experience, books, the Internet, other experiments, instructors and librarians.

Step 2: Observe the phenomena you are interested in studying using one or all of your five senses. Use the senses that are the most appropriate to the given situation. What you see, hear, taste, smell and feel are all very important tools in collecting good data.

Step 3: Separate your observations into two sections: qualitative and quantitative. Qualitative observations describe what you see while quantitative observations measure what you see.

Step 4: Use your sensory observations to generate as many questions as possible about your subject. The purpose of your observations is to develop research questions that guide your hypothesis, which is the next step in the scientific method. The more questions you have, the easier it is to devise a valid hypothesis. The better your hypothesis, the stronger your experimental design.

Tip: *Collect as much information in the observation stage as possible. Collecting data is easiest and the most useful at the beginning stage when you still have control over the circumstances.*

Assignment:

- Keep a science journal throughout the summer documenting events that are occurring in the natural world they live in.
- Write down 1 page observations about specific occurrences in your environment.
- Document a minimal 5 observations a week.
- Read over observations and select one observation a week and develop a question that addresses a problem or gap of knowledge related to the observation.
- Develop 1 testable explanation or prediction to explain the observation.

Making Predictions: Problem Solving Lab

Complete the activity below. It will help you to think about predictions in a new way, and help you to understand that a flip of coin is not always your best bet.

Analyze the Problem

1. Predict the chance that a coin, when flipped, will come up heads.

2. How many heads should come up if a coin is flipped 10 times?

3. How many heads should come up if a coin is flipped 100 times?

Solve the Problem

1. Use the table below to record observations from coin flip.

2. Carry out coin tosses - 10 times and 100 times.

3. Record with a tick mark in the appropriate box each time you get heads or tells.

# of Flips	Heads	Tails
10x		
100x		

4. Record the number of heads observed for 10x and 100x for three other classmates.

5. Calculate the average (total # / 4) number of heads observed for your group for 10x and 100x.

Thinking Critically

1. Which set of coin tosses more closely matched the prediction made based on chance?

2. Is there an advantage to using large samples in an experiment?

3. Based on what you have observed can scientists predict the results of an experiment with 100% certainty?

Is It A Cookie? Scientific Method

In this activity you will use scientific methods to investigate what exactly is a cookie. Science is a process by which tests are used to evaluate hypotheses. A hypothesis is a guess or prediction of what will happen based on past experiences or available knowledge. Complete the steps below to engage in the science of cookie analysis; make sure to look up any terms you are unfamiliar with using a reliable source. And if you have to eat a few samples to make accurate observations, you can truly say it's all in the name of science!

1. Make observation and define a cookie (empirical / observational research)
What can I learn from a cookie from using my five senses?

2. Write out set criteria for a cookie (theory / assumption)
What do reliable sources say a cookie is? What must a cookie have to be considered a cookie?

3. Imagine you were conducting an experiment to determine if a fig newton is a cookie. Read the recipes provided for each and complete each step in the Scientific method to carry out your investigation:

    a. State the problem (what question needs to be answered)

    b. Create a hypothesis (what is your prediction of the outcome based on your knowledge)

    c. Develop an experiment (how can you test this)

    d. Establish a control (how can you make sure your collecting the right data)

    e. Conduct a test / collect data (record observations, review samples)

    f. Analyze data / results (what patterns do you see)

    g. Draw a conclusion (what does your data tell you about your problem)

    h. Report data (tell somebody, anybody)

Chocolate Chip Cookies

Ingredients
4 ½ cups all-purpose flour
2 teaspoons baking soda
2 cups butter, softened
1 ½ cups packed brown sugar

½ cup white sugar
4 eggs
2 teaspoons vanilla extract
4 cups semisweet chocolate chips

Directions
1. Preheat oven to 350 degrees F (175 degrees C). Sift together the flour and baking soda, set aside.
2. In a large bowl, cream together the butter, brown sugar, and white sugar. Stir in the eggs and vanilla. Blend in the flour mixture. Finally, stir in the chocolate chips and nuts.
3. Drop cookies by rounded spoonfuls onto ungreased cookie sheets.
4. Bake for 10 to 12 minutes in the preheated oven. Edges should be golden brown.

Fig Newtons

Ingredients Dough:
½ cup butter
½ cup margarine
½ cup sugar
½ cup honey
2 large eggs
4½ cup self-rising flour

Ingredients Filling:
2 Cups of strawberry preserves
½ Cup Sugar
½ Cup Cold Black Tea
½ Cup Finely Ground Pecans
¼ Teaspoon Cinnamon
¼ Teaspoon Ground Ginger

Directions
1. Cream butter and margarine with sugar a spoonful at a time on medium speed. Beat in honey and eggs. Work in flour. Blend thoroughly. Refrigerate 1 hour.
2. Put preserves, sugar, and tea into a double boiler and cook over simmering water stirring often until the sugar dissolves. While stirring after sugar dissolves add cinnamon, ginger, and pecans.
3. Continue stirring and blend well. Let cook about 15 minutes. Take off of heat.
4. Roll out dough on floured surface about 1/4 inch thick and about 5 inches wide. Spread filling down center of dough, leaving a margin on dough.
5. Fold in half from longest side to longest side so that it is about 2 1/2 inches wide. Slice into 3 inch bars.
6. Arrange 1 inch apart on a foil covered cookie sheet. Spray foil with cooking spray. Bake at 400°F about 8-10 minutes or until golden brown. Cool.