Name:

Summer Science Packet 2019

The Science Department at Immaculate Heart Academy welcomes you! We are excited to meet you and work with you this school year. In preparation for your freshman year, you are expected to complete this Summer Science Packet. This packet will be collected by your Biology teacher during the first week of the school year.

Scientific Method

While you are a student at IHA, we hope that you develop or foster a love of science. We hope to help you to think like a scientist. Scientists utilize the Scientific Method when they are approaching a problem, setting up an experiment or designing a research project. It is a practical and logical way of approaching a problem or an area of study. There are five basic steps that are utilized in the Scientific Method.

Step 1: Scientists must first decide on an area of focus for their investigation. Scientists start by trying to learn as much as they can about a topic in science that interests them. They will read and review any research that has already been done in this area of interest. They will make observations. They will try to discover a question that they would like to answer or explain through their experiments.

There are two types of observations that can be made. Quantitative observations are observations that can be measured. They are precise. Taking a patient's blood pressure or temperature are ways to make quantitative observations. Qualitative observations are those made with your senses. They are not as precise. Observing that someone looks ill or feels hot is a qualitative observation.

Maybe you want to research the effects of fertilizer on flowers in your yard. You would spend time learning all about the specific species of flowering plant that you have in your yard. You would want to learn all about this plant's normal appearance and growth and about this plant's requirements for growth (how many hours of sunlight or how much water it requires, for example). Then you would research all that you could about different types of fertilizer. You would want to know the contents of the fertilizer and how those contents can affect a plant. You would need to make observations of your plant, and you need to read any research that has been published about your plant and about your fertilizer.

Step 2: Once scientists have done this preliminary step, they can then form a hypothesis. A hypothesis can be thought of as the specific question that scientists want to answer through their investigation. It is a question to be answered, but it is written as an unproven conclusion. A hypothesis should be based on previous observations and it must be testable. It is best written as an "If….then…"statement.

Maybe your question about your flowers in your yard is "Will fertilizer increase the number of blooms on each plant?" This question must be written as an unproven conclusion.

Fertilizer may increase the number of blooms on each plant. This is good but an even better way of writing this hypothesis would be:
If fertilizer increases blooms in plants, then unfertilized plants will have fewer blooms than fertilized plants.

Maybe your question about the plant is “Does the fertilizer make the leaves greener?”.

The hypothesis could be written as:
If the fertilizer increases the green color in the leaves of plants, then those plants that were treated with fertilizer will be greener then the plants not treated with fertilizer.

Try writing a hypothesis for the following questions:

a. Does ultraviolet light cause skin cancer?

b. Do temperature changes cause leaves to change color?

c. Does eating chocolate cause pimples?

d. Does salt in soil affect plant growth?

Step 3: The scientists must then design an experiment that will test their hypothesis. The results of the experiment will either support the hypothesis or disprove the hypothesis. When designing the experiments, scientists must consider the different variables that can affect the outcome of the experiment.

In an investigation, there should be only one Independent Variable. The independent variable is the variable that the researcher or scientist manipulates. In the study of the fertilizer and the plants, the independent variable would be the fertilizer.

The dependent variable is the variable that the investigator is measuring, counting or recording. The value of the dependent variable is dependent on the independent variable. In our study, the number of blooms on a plant or the intensity of the green color of the leaves would be the dependent variable.
When setting up an experiment there will typically be an experimental group and a control group. Only one variable will be different between the control and the experimental group. The control group is used as a basis for comparison. It is used to determine if any change in the dependent variable can be attributed to the independent variable.

In our study, an experimental group will consist of the plants that we will treat with fertilizer. The results for the experimental group will be compared to the results of the control group. The control group will not receive the fertilizer. We must control all other factors or variables that might affect our results. We must control the variables so that the only difference between the experimental group and the control group is the application of fertilizer. We must make sure that both groups

get the same hours of sunlight per day, the same amount of water and that they are at the same temperature and planted in the same type of soil.
Consider an experiment for your hypothesis about pimples and chocolate:

a. What would constitute your experimental group and your control group?

b. What would your independent variable be?

c. Your dependent variable?

d. What variables would you control for both groups?

Step 4: Now the scientist will perform the experiment. They will collect and analyze their data. The raw data must be carefully recorded. The scientists accurately record their data. They do not try to fit their data to their hypothesis. An investigation is not a failure if the hypothesis is not supported. Data that is collected is often recorded in tables and then used to make graphs. Graphs help scientists interpret their data, helps them see relationships between variables. Scientists will also analyze their data by looking at the range (difference between the highest and the lowest), mean (the average) or looking at percentages.

Step 5: The last step is for the scientists to draw conclusions from their results. They need to determine if their hypothesis was supported or not supported by the results of their experiment. They attempt to explain unexpected results. They compare their results with results of similar experiments. Scientists will also look at ways to improve their experiment and develop further questions that they would like to investigate.

If a hypothesis can be validated by many different investigators, it may become a Theory.

Questions:
1. List the Steps of the Scientific Method:

2. You want to test the effect on body temperature on respiratory rate (breaths /minutes) in dogs.

a. Write a hypothesis:

b. Independent variable:

c. Dependent variable:

d. Variables to control:

3. Answer the following true or false questions:

   a. If a scientist's results do not support the hypothesis, the experiment was a failure. True or False

   b. If the results do no support the hypothesis, the hypothesis or the results should be altered. True or False

   c. Using a ruler to measure the length of a bird's wingspan would be a qualitative observation. True or False

   d. The independent variable is the variable that the researcher manipulates. True or False

Graphing

Graphs are used to display data collected during an experiment. There are several parts that must be included in a graph. Many times scientists will use line graphs but they may also use bar or circle graphs.

1. Title: A title should be placed above the graph and should give the reader a concise idea about the graph.

2. The Independent Variable: The independent variable is the variable manipulated by the experimenter. It should be placed on the horizontal or x-axis.

3. The Dependent Variable: The dependent variable is directly affected by the independent variable. It is the variable that the scientist measures. It should be placed on the vertical or y-axis.

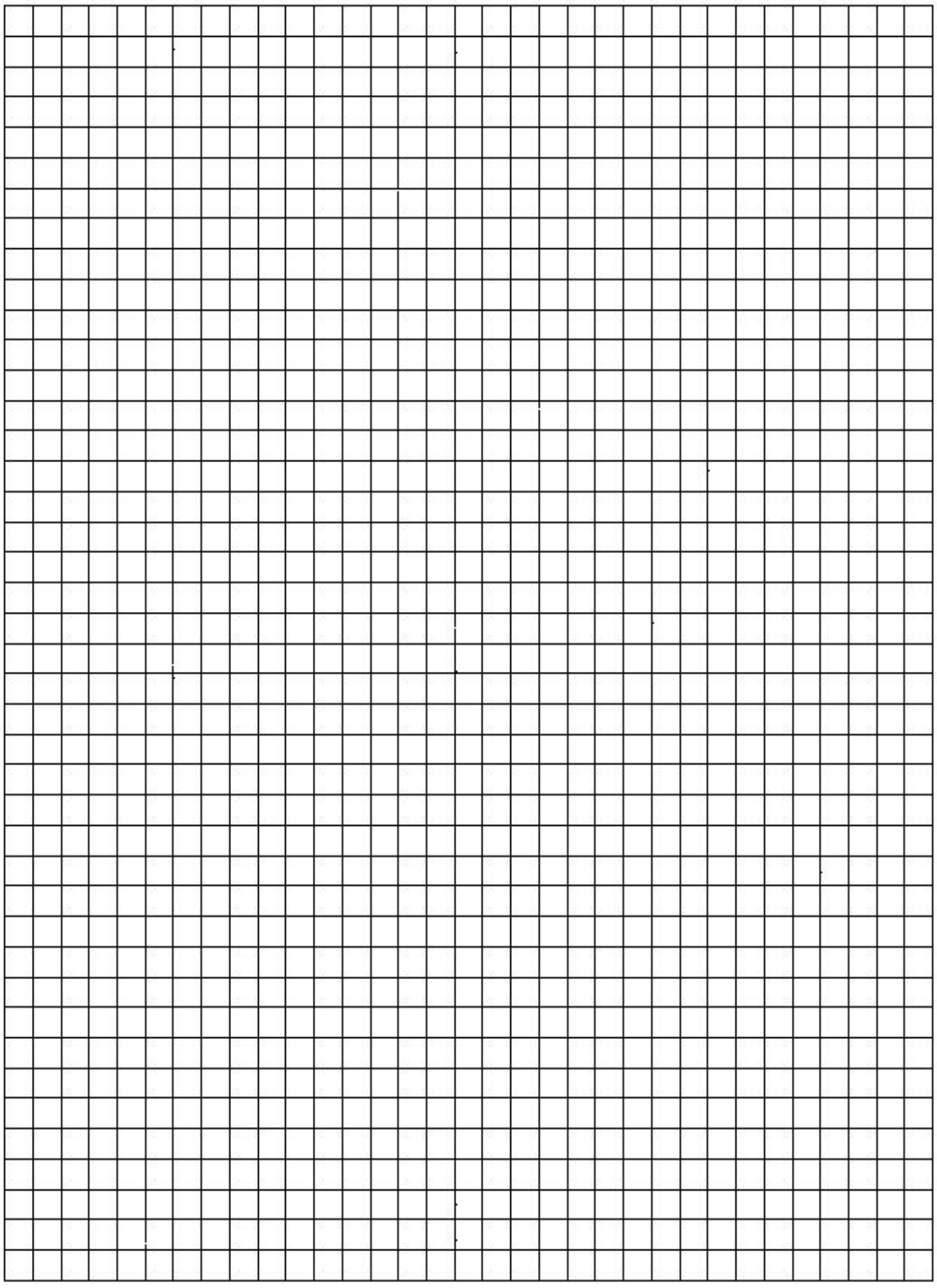
4. Scales for each variable: In constructing a graph, one needs to know where to plot the points representing the data. In order to do this a scale must be utilized that will include all the data points. Each block should have a consistent amount or increment on a particular axis.

5. Legend: This is a short descriptive narrative concerning the graph's data. It should be short and to the point and placed directly under the graph.

Graphing Activities

1. The data table shows water temperatures at various depths in an ocean. Use this table to make a graph on the following page. Use the graph to answer the questions that follow. Be sure to title the graph and to label and scale the y-axis and the x-axis.

Water Depth (meters)	Temperature (°C)
50	18
75	15
100	12
150	5
200	4



Using a complete sentence, state the general relationship between temperature and water depth.

_____

_____

_____

The approximate water temperature at a depth of 125 meters would be closest to:

(1) 15°C (2) 8°C (3) 13°C (4) 3°C

2. Use the following table to create a bar graph on the following graph sheet.

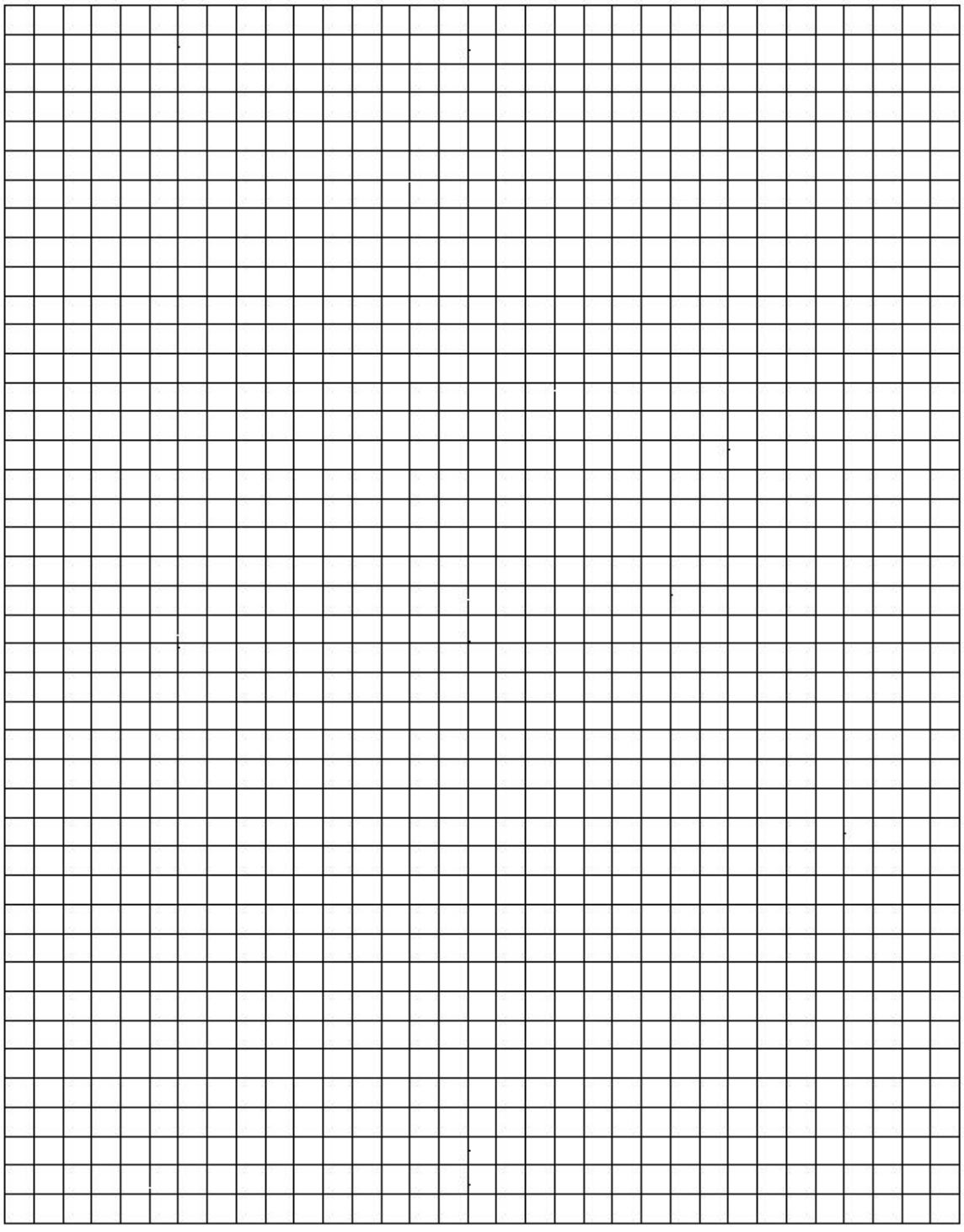
Treatment with fertilizer	Plant – Daisies Average flowers/plant	Plant- Black-eyed Susan Average flowers/plant
None	10	10
One application	20	10
Two applications	25	10

a. What is the independent variable?

b. What is the dependent variable?

c. What conclusions can be drawn from the table and the graph?

d. On the following page create a bar graph for the above data.



3. The graph below represents the typical day of a teenager. Answer these questions:

a. What percent of the day is spent watching TV?

b. How many hours are spent sleeping?

c. What activity takes up the least amount of time?

d. What activity takes up a quarter of the day?

e. What two activities take up 50% of the day?

f. What two activities take up 25% of the day?

Metric System

In 1790, the Academy of Science was asked to design a decimal-based system for measurement that would give the world a common measuring system. In 1960, the metric system that they developed was officially named Système International d'Unités, which is abbreviated as SI. Most countries fully adopted the metric system. Unfortunately, the United States did not fully adopt this system. It is the system that is utilized in the scientific community because it enables scientists around the world to better communicate and collaborate. The Metric System is what you will use in your laboratory experiences at IHA.

During grammar school, you should have been exposed to the metric system and should have performed conversions utilizing the metric system. You may want to view some of the many tutorials on the metric system that are available online. In the fall we will practice taking measurements utilizing this system.

In the Metric System there is a base unit of measurement for length, volume and mass:

Length-measure of how long something is or how far apart things are
Base unit is a meter (m)

Volume- the amount of space an object or a liquid occupies
Base unit is a liter (L)

Mass-the quantity of matter in an object
Base unit is a gram(g)

We put prefixes in front of the base unit. For example kilo means 1,000, so a kilometer is made up of 1,000 meters. Centi means 1/100, so a centimeter is 1/100 of a meter or 0.01 m or there are 100 centimeters in a meter.

Common Metric Prefixes that you will utilize:

Kilo (k)- 1 thousand base units

Centi (c)-1 hundredth of a base unit

Milli(m)-1 thousandth of a base unit

Micro (μ-) -1 millionth of a base unit

When doing conversions, to convert to a smaller unit you will want to multiply (there will be more of that smaller unit) or move the decimal to the right. If you are converting to a larger unit, you will want to divide (there will be less of that larger unit) or move the decimal to the left. For example, you are given a mass in grams and asked to convert to kilograms. Kilograms are larger than grams. You would divide your gram measurement by 1,000. There will be less kilograms than there are grams. You could get the same answer by moving your decimal point three places to the left.

Metric Practice

Complete the following conversions:

1. 88.5mm= _____cm =_____m =_____km

2. 6.5L= _____mL

3. 19.87kg = _____g = _____ µg

Compare the following using <, > or =.

1. 7.8mm 78cm

2. 5678m 56.7.8km

3. 20.5m 205cm

4. 34.9mL 3.49L

Since the United States does not utilize the metric system, you will often need to convert between the two measuring systems.

Abbreviations include:

Inches = in.

Feet/Foot = ft.

Pound = lb

Gallon = gal

Quart = qt.

Cup = c

Some common conversions you will use:

12 in. = 1 ft.

1 m = 39.37 in.

kg = 2.2 lb

1 L = 0.264 gal

4 quarts = 1 gal

1 quart = 4 cups

When doing conversions, to convert to a smaller unit you will want to multiply (there will be more of that smaller unit). If you are converting to a larger unit, you will want to divide (there will be less of that larger unit). For example, you are given a mass in kilograms and asked to convert to pounds. Kilograms are larger than pounds. You would multiply your kilogram measurement by 2.2. Notice in the set-up below that kg cancel out so you are left with lbs.

$$5\ kg\ x\ \frac{2.2\ lbs}{1\ kg}\ =\ 11\ lbs.$$

Conversion Practice

Complete the following conversions:

1. 57 quarts= _____ gal = _____ L
2. 8 ft. = _____ in = _____m
3. 59 kg = _____ lbs
4. 37.3 lbs = _____ kg = _____ g
5. 45 in. = _____ m = _____ cm