Scientific Method Worksheet

Name _____
Biology _____ Date _____

1. Hypotheses are made from observing, inferring, estimating, & predicting. Hypotheses must be testable; that is, it must be possible to make observations that will either support a hypothesis or not support it. Because hypotheses are tested, they must be worded carefully and them they must deal with things that can be measured. The following list of things may or may not be measurable.

▶ Place a "√" next to those items that **can** be measured.
▶ Place a **"?"** next to those items that **must be explained or compared to something** before being measured.
▶ Place an **"X"** beside those items that **cannot** be measured.

_____ length of hair
_____ height of trees
_____ weight of mice
_____ beauty of roses
_____ strength of a horse
_____ speed of a fish in water
_____ saltiness of fluids
_____ happiness

2. An experiment is conducted to determine the effects of alcohol on individuals driving ability. Groups A & B have been matched for all factors such as age & sex. Each person in group A is given the amount of flavorless alcohol in soda needed to raise the blood alcohol level to 0.08%. Each person in group B is given the same quantity of soda to drink. Each person in groups A & B is given a driving test The results are recorded.

a. The above experiment is controlled or uncontrolled (does is have a control & variable group?).
b. The independent/manipulated variable _____ c. The dependent/responding variable _____
d. Identify the control group _____ e. Identify the experimental group _____
f. State one possible hypothesis that is being tested by the above experiment. (Use the if, then, will, because format) _____
_____
g. Identify the controlled variables:_____
_____
_____
h. Identify uncontrollable variables/factors:_____

3. An experiment is conducted to determine the effect of classical music on the growth rate of marigolds. Two groups of plants are grown from seed in identical soil types, exposed to identical light conditions and given the same nutrients. Group A is in a quiet atmosphere. The plants in group B are provided with the same atmosphere, except that classical music is played for 12 hours daily in this area. The scientist measures the plants in both groups each day and records the data.

a. The above experiment is controlled or uncontrolled?
b. The independent/manipulated variable _____ c. The dependent/responding variable _____ d. Identify the control group _____ e. Identify the experimental group _____
f. State one possible hypothesis that is being tested by the above experiment. (Use the if, then, because format)
_____
_____
g. Identify the controlled variables:_____
_____
_____
h. Identify uncontrollable variables:_____

4. Use the following hypothesis to make an experimental design diagram. Be very specific in how you are going to carry out the experiment. Be sure to consider the following in your controlled variable table: type of rats, length of study, type & length of smoke exposure, controlled living conditions, type & amount of data collection.

Hypothesis: If rats are exposed to cigarette smoke then their blood will have higher carbon monoxide(CO) levels than rats who are not exposed because the rats blood will absorb the CO.

5. Constructing data tables:

▶The **manipulated/independent variable is almost always recorded in the left column.**

▶The **responding/dependent variable in the right.**

▶When repeated trails are conducted, they are recorded in subdivisions of the responding variable column.

▶If **derived quantities (such as the average height) are calculated, they are recorded in an additional column to the far right.**

▶The **title of the data table should clearly communicate the purpose of the experiment through specific references to the Independent and Dependent variables** under investigation.

Title of the Data Table

Column for IV/MV	**Column for DV/RV Subdivide into Trials**	**Column for Derived Quantity**

Example:

The Effect of Temperature on the Time (sec) it Takes a Sugar Cube to Dissolve

Temp of Water C	Time (sec) Trial 1	Time (sec) Trial 2	Time (sec) Trial 3	Average Time to Dissolve (sec)
0	98	104	107	103
21	43	35	46	41.3
100	24	27	19	23.3

5a. Construct a Data Table for the following lab procedure:

Cut a paper towel into strips, 2 cm by 22 cm. Fill a container with water. Place the towel strip 1 cm into the colored water for 10 seconds. Quickly mark the water level with a pencil. Then, measure the height the liquid rose in mm and record the data. Repeat for 3 trials. Test strips for 20 and 30 seconds in the same manner. **Extra Credit** awarded for actually doing the procedure and collecting the data.

6. Graphing: A well-constructed graph communicates experimental findings better than a data table.

▶Scientists place the **manipulated/independent variable, on the X or horizontal axis.**
Label the axis, include units ( ).

▶Scientists place the **responding/dependent variable, on the Y or vertical axis.**
Label the axis, include units ( ).

▶The unit of measurement is placed in parentheses next to or beneath the variable.

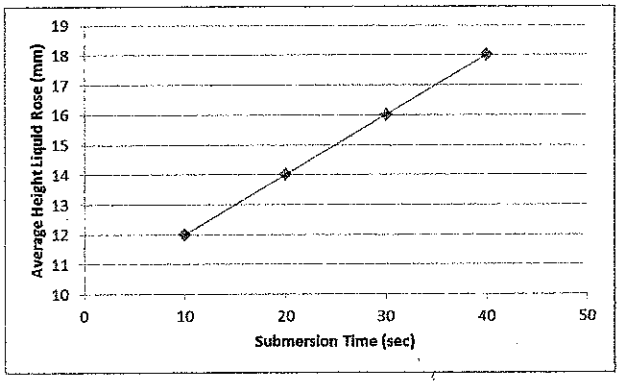
▶The **title of the graph should clearly communicate the purpose of the experiment through specific references to the Independent and Dependent variables** under investigation.

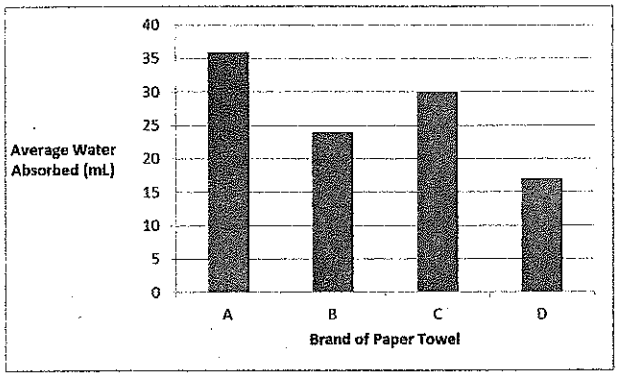
Example:
The Effect of Different Brands of Paper Towels on the Amount of Water that is Absorbed.

Brand of Paper Towel	Amount of Water Absorbed(mL) Trial #1	Trial #2	Trial #3	Average Amount of Water Absorbed (mL)
A	39	35	34	36
B	21	25	26	24
C	31	29	30	30
D	18	15	18	17

Provide a Title for each graph illustrated below.

6a. Title _____ **b. Title** _____





▶Because experimental data sets are subject to error, data points on a graph are not directly connected. Instead a line-of-best-fit is used to communicate the general data pattern. To construct a line-of-best-fit, draw a line about which an equal number of data points fall to either side. Excel will construct a line of best fit for you.

▶All tables and graphs should be constructed using a computer. This will be reviewed in class.

▶Sometimes, you may not be sure whether to make a **bar graph or a scatter graph**. The type depends on the type of data collected. Observations & measurements of variables can be discrete or continuous. Discrete data are categorical or counted like days of the week, gender, kind of animal, brand of battery, or color. Bar graphs are appropriate for these types of variables. Other variables are continuous and associated with measurements involving a standard scale with equal intervals. Examples include the height of plants in cm, the amount of fertilizer in g, and the length of time in sec. When the data may be any value in a continuous range of measurements, a scatter graph is a better way to show the data.

6c. For each experiment title listed, state whether the experiment should be graphed as a bar or scatter graph.

A. _____ The Effect of Coloration on the Number of Kittens Sold at the Pet Store
B. _____ The Effect of Concentration of Sugar Water on the Number of Visits of Hummingbirds to a Feeder
C. _____ The Effectiveness of Different Types of Birdfeeders on the Number of Different Kinds of Birds that Visit the Feeder
D. _____ The Effect of the Horsepower of a Tractor on the Mass of a Sled it Can Pull

7. Data Collection

Beginning at 6:00 AM on January 27, 1993, I recorded the temperature on the hour in Chicago, Illinois, for six straight hours. I used a Celsius thermometer. The first temperature reading was –5 degrees. The second reading was also –5. The third reading was higher: -1. The fourth reading was even higher: 1. The next-to-last temperature reading was 2 . The final temperature I recorded was 3 .

a. Using a computer graphing program like excel make a data table and graph (with a line of best fit) for the above data collected. Attach below.

Name _____ Date _____ Class _____

Tech Prep Applications

ACTIVITY 25 RELIEF FROM A PATCH

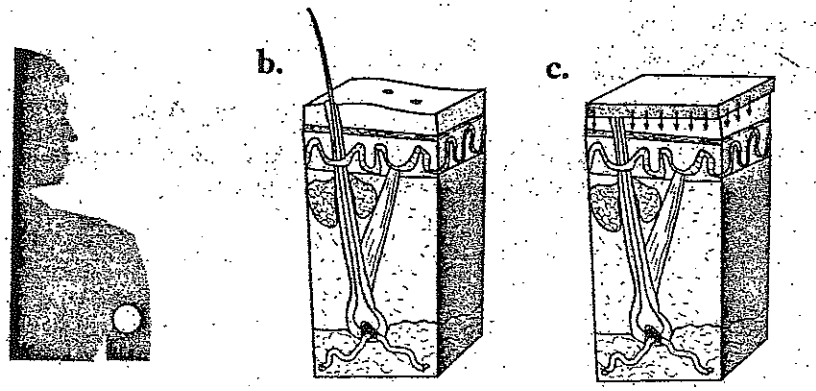
USE WITH CHAPTER 40: THE NERVOUS SYSTEM AND THE EFFECTS OF DRUGS

According to surveys, many of the nation's 50 million cigarette smokers would like to eliminate cigarettes from their lives. However, people's attempts to quit smoking often fall short because of the addictive properties of nicotine, a major component of cigarette smoke. So what can a cigarette smoker do? If you open many popular magazines or newspapers these days, you're likely to see one possible source of help—the nicotine skin patch! Nicotine patches are palm-sized circular pads that, when applied to the skin of the upper arm or back, release a stream of nicotine into the bloodstream. Although their use as an aid to help people quit smoking began only a few years ago, they have already shown encouraging results. In this activity, you'll investigate how nicotine skin patches work and examine a recent study on their effectiveness.

Part A: How Does the Nicotine Skin Patch Work?

Figure 1 illustrates how nicotine skin patches work. Study the diagram and then answer the questions below.

Figure 1



a. Smoker decides to quit smoking and is prescribed a nicotine patch. Patches are prescribed in heavy (21 mg), medium (14 mg), or light (7 mg) doses. Patch is applied to skin on upper arm or back every 24 hours.
b. Nicotine patches take advantage of the fact that the skin is not a uniform barrier. Rather, skin is penetrated by millions of tiny pores such as hair follicles, sweat glands, and oil glands.
c. As nicotine is released from the patch, it penetrates the pores and is absorbed by the bloodstream. The structural properties of the patch determine the rate at which nicotine is released into the blood. After a month of daily use, ex-smokers gradually withdraw from nicotine by applying successively smaller patches.

1. In your opinion, what is the major benefit of nicotine patches?

_____

_____

2. In your own words, describe the purpose of applying patches with successively lower doses of nicotine.

_____

_____

_____

Part B: Are Nicotine Patches Effective?

Figure 2 shows data from a recent study on the effectiveness of nicotine patches for smoking cessation. Analyze the graphs and then answer the questions below.

Figure 2a

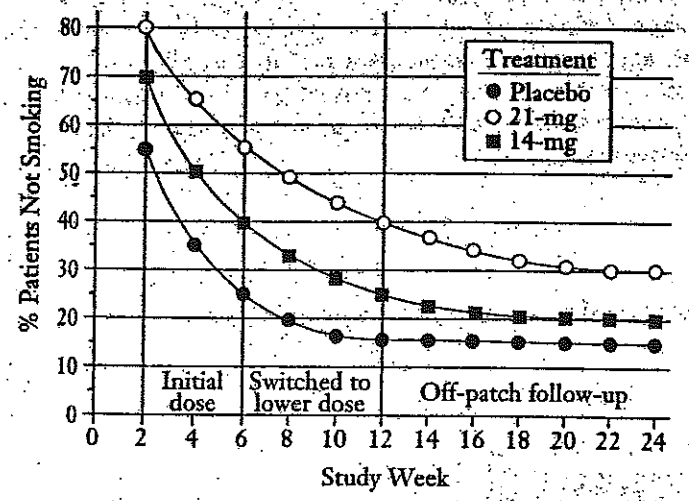
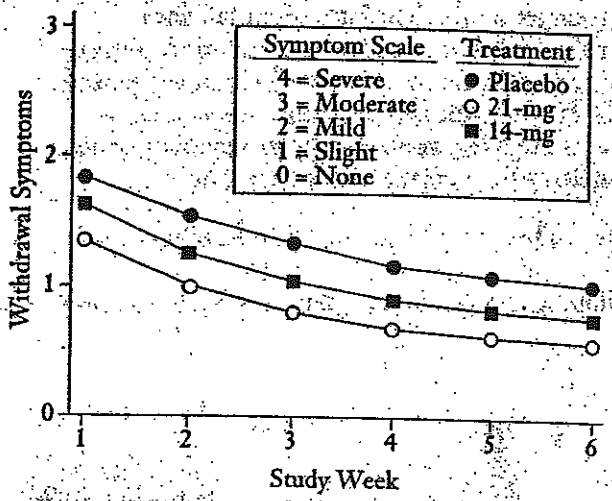


Figure 2b



1. According to Figure 2a, what percentage of patients receiving the 21-mg nicotine patches remained off cigarettes after 6 months? Answer the same question for 14-mg nicotine patches and placebo patches.

2. What was the purpose of the placebo group?

3. Figure 2b shows a graph of the withdrawal symptoms reported by the patients during the first 6 weeks of patching. What do these data indicate about the effectiveness of nicotine patches for reducing withdrawal symptoms?

4. What do these data suggest about the effectiveness of nicotine patches? Explain your answer.