Interactive Research Planning Form #2 (for rigorously designed experiments)

Name _____
Date _____

1. What question do you plan to investigate? *Example: "At what concentration is copper sulfate toxic to* Daphnia*?"*

2. Why is this question important or relevant to environmental issues? *Example: Copper sulfate is used to kill algae in ponds but may also be toxic to other aquatic organisms.*

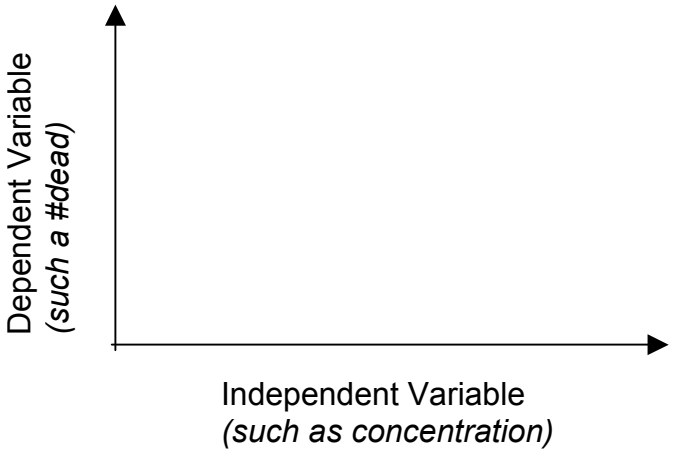
3. Can you find reports by other students or professional scientists on this topic? If so, what can you learn from what has already been done?

4. What is your **hypothesis** (the prediction of what you think will happen, stated in a way that can be tested by doing an experiment)? Why did you choose this prediction? *Example: "The concentration of copper sulfate used to kill algae in ponds will also be toxic to Daphnia. This is my prediction because I have seen some dead fish in my grandparents' pond after they treated it with copper sulfate."*

5. What is your **independent variable** (the factor that that you will change to make one treatment different from another)? *Example: The independent variable in a dose/response experiment is the concentration of the test chemical.*

6. What is your **dependent variable**? (This is the factor you will measure to determine the results of the experiment – it is called "dependent" because the results depend on changes in the independent variable from one treatment to the next.) *Example: The dependent variable in a dose/response experiment could be the number of organisms that survive, or the amount of growth that occurs.*

   If you are confused about the independent and dependent variables, it may help to think back to your research question and then think about how you might want to present the results of your experiment. For example, for a bioassay using Daphnia, you might set up a graph that looks something like this before you've entered the data:



   On the x-axis is your independent variable. These are the numbers that you decide in advance, to create your various treatments. For dose/response experiments, the most common independent variable is the series of concentrations of your test solution.

   On the y-axis is your dependent variable. This is the factor you will be measuring in your experiment, such as the length of the lettuce roots or the number of *Daphnia* that die at each concentration.

7. What **treatments** do you plan? (Each level of your independent variable is a treatment. You should plan to change only the independent variable from one treatment to the next, keeping all other conditions constant.) *Example: What chemical concentrations will you test, or where will your environmental samples come from?*

8. How many **replicates** will you have for each treatment? (These are groups of organisms that are exposed to exactly the same conditions.) *Example: Each beaker containing* Daphnia *is one replicate for that particular concentration of the test solution. In a lettuce seed bioassay, each petri dish containing seeds and test solution is one replicate. The more replicates you can manage, the better, but you will have to figure out how many are possible with the supplies and time you have available.)*

9. What is your **control** (the untreated group that serves as a standard of comparison)? *Example: In bioassays, organisms in the control group are grown in distilled or spring water rather than a chemical solution or an environmental sample. The organisms in the control group should be exposed to all the same conditions as the organisms in the treatment groups, except for the one variable you are testing, such as concentration.*

10. What factors will you keep **constant** for all treatments? (The constants in an experiment are all the factors that do not change.) *Examples: temperature or light.*

11. What equipment and supplies will you need?

12. What schedule will you follow? Think about how many days will be needed for growth of your bioassay organisms.

13. What will you measure, and how will you display your data? Sketch an empty data table here, with the appropriate headings. (Think about what kind of table you will need to record the data from your experiment.)

On this graph, add labels for the x axis and y axis and sketch your expected results.

A Final Check: Evaluate Your Experimental Design

1. Does your planned experiment actually test your *hypothesis*?

2. Are you changing only one *variable* at a time? Which one?

3. Will your *control* be exposed to exactly the same conditions as your *treatment*s (except for the *independent variable*)?

4. How many *replicates* will you have for each *treatment*?

5. Meet with another student or group to discuss these plans using the ***Experimental Design Peer Review Form***. Then describe any changes you've decided to make based on this discussion.