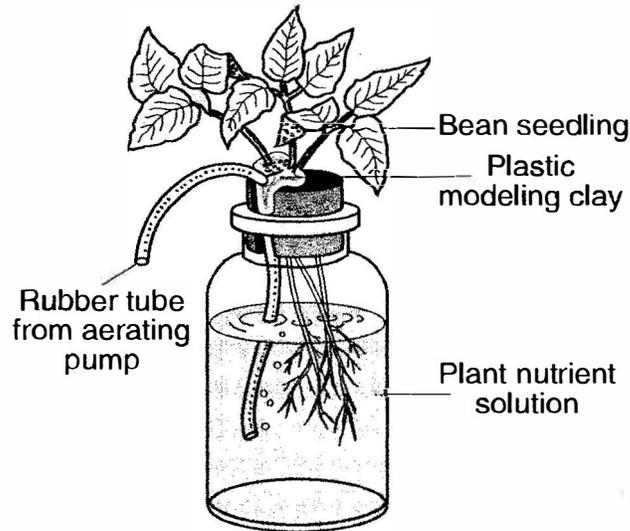


Name: _____

Do Now B

Base your answer to question 1-5 on the information and diagram below and on your knowledge of biology.

The presence of air is believed to be important for root growth in bean plants. The apparatus available to conduct an investigation is shown below. There are enough bottles and other materials to have multiple setups. Air (for aeration) can be bubbled into the bottle through the rubber tube.



Source: Biology Handbook, SED 1960

1-5 Design an experiment to test the effect of aeration (air) on the growth of roots of bean seedlings. In your answer, be sure to:

- 1 • state *one hypothesis* the experiment would test [1]
- 2 • describe how the control group will be treated differently from the experimental group [1]
- 3 • identify the dependent variable in the experiment [1]
- 4 • state *one* reason why many setups should be used in both the experimental and control groups [1]
- 5 • state *one* reason why several different kinds of seedlings were not tested in this experiment [1]

1. Hypothesis: If there is _____ in the nutrient solution, then the growth of roots will _____.

2. The control group: Nutrient solution without _____.

3. Dependent variable: _____.

4. The reason why there are many setups used because _____.

5. The reason why several different kinds of seedlings were not tested because _____.

The Nature of Science, Part 1

By Trista L. Pollard

Name: _____

¹ Our fascination with nature begins with our first observation of a butterfly gliding freely through air or of our first mud pie standing at attention on the pavement. We are natural-born scientists! Once we enter school, we begin our formal study of science disciplines. Teachers explain the nature of science (observation and experimentation), and we are taught to model the **scientific process** when we conduct our research. Within the model of the scientific process, there are clear logical guidelines for solving scientific problems called the **scientific method**. However, before you go out testing and researching every observation you make in nature, you should know a few scientific terms.

² As scientists, you have already made two important assumptions about nature- it is understandable and predictable. You have also figured out that even though this is true, nature also has complex systems. This is why you need those logical and clear steps to conduct research. Take for example, the cafeteria at lunchtime. Everyday, you make careful **observations** about the behavior of your peers during your forty minutes of freedom. If you are bored, you even use your observations to develop questions about your peers' activities. After the simple questions are asked (in your mind of course), you develop a **hypothesis** to explain these questions. Of course, your hypothesis is based on facts you have collected from witnessing these events each day.

³ If you were to test your hypothesis, you would conduct experiments that include specific factors or variables. **Independent variables** are the factors that you would change during your experiment. When you change your independent variables, you would also expect to see a change in your **dependent variables**. Most experiments only test one independent variable at a time. You would also need a **control group** for your experiment. A control group is a group that represents a standard for comparison to another group. Both groups are identical except for one factor. Experiments on human and animal behavior frequently use control groups. Your experiment would be classified as a **controlled experiment** because it contains a control group.

⁴ Let's say your cafeteria is embracing the new nationwide health-kick. On Wednesdays, they serve "Surprise Lasagna" which tastes decent. However, this Wednesday, you find out (from an inside source) that the head cook will be using nonfat (in your mind, cardboard) cheese in one of the two king-size pans they prepare. They have made the decision to try the new recipe on half of the unsuspecting freshmen (you're a sophomore so you're safe). The independent variable is the cheese (nonfat versus regular fat). The dependent variable will be the response of the freshmen to the new recipe. The freshmen who get the same old recipe are the control group. Now, if nature is predictable, the test group will notice the new taste. Their responses may vary, but you may expect to

see freshmen throwing away their unfinished meals or making strange facial expressions as they eat the lasagna. The control group should respond normally since their lasagna did not change. Once the experiment concludes, the cooks can analyze the results and draw conclusions: should they forgo healthy living and serve the regular lasagna or try the nonfat version? Their analysis may also lead to other questions about food preparation. Before you are caught up in the suspense of the lasagna question, we will take a break to ponder this portion of the scientific process. In *The Nature of Science, Part 2*, we will discuss scientific measurement and the impact of science on society.

<p>1. Complete the sentence: Scientists' hypotheses are based on _____.</p> <hr/> <hr/>	<p>2. Independent variables are the factors that are _____.</p> <p><input type="radio"/> (A) Changed after the conclusion of the experiment</p> <p><input type="radio"/> (B) Changed in response to dependent variables</p> <p><input type="radio"/> (C) Changed during the experiment</p> <p><input type="radio"/> (D) None of the above</p>
<p>3. What if scientists did not use clear logical guidelines for solving scientific problems; how would that affect scientific research?</p> <hr/> <hr/>	<p>4. What is the purpose of a control group?</p> <hr/> <hr/>
<p>5. Your class is researching the evaporation rates of liquids in two different containers. You use the same measurement of water in each container, and both containers are placed in the same area for observation. What are the dependent and independent variables in the experiment?</p> <hr/> <hr/>	<p>6. Which statement is not a hypothesis?</p> <p><input type="radio"/> (A) Shorelines where construction of houses has increased will experience a greater amount of erosion than shorelines that have not experienced increased housing construction.</p> <p><input type="radio"/> (B) Houseplants given a smaller amount of sunlight will grow slower than plants given a larger amount of sunlight.</p> <p><input type="radio"/> (C) Energy is transferred between systems, but it cannot be created or destroyed.</p> <p><input type="radio"/> (D) Water will evaporate more quickly in open containers with smaller surface areas than in open containers with larger surface areas.</p>

The Nature of Science, Part 1

7. You are testing the effects of Vitamin E on adolescents (ages 12-14). You would like to study a small group of 12- to 14-year olds over the course of three months to study the effects of daily doses of Vitamin E (one tablet each day). Define your control group and your non-control group.

8. Your group is testing the effects of load on the motion of vehicles. You have built model cars in class and will be using a weight pulley system to move your vehicle. You will be adding one to three blocks to your vehicle to test the effects of the added load. What are your independent and dependent variables?

- A Number of blocks (independent) and speed of vehicle (dependent)
- B The vehicle's speed (independent) and number of blocks (dependent)
- C The vehicle weight (independent) and the vehicle's speed (dependent)
- D A and C

9. Discuss one example on how you can use the scientific method in solving one of your real life problems.

10. Do we need to solve problems using the scientific method? Explain your answer.
