

Name: \_\_\_\_\_

Period: \_\_\_\_\_ Date: \_\_\_\_\_

# The Scientific Method and Experimental Design, 1

## Part I: The Scientific Method and Experimental Design

1. It hasn't always been known that smoking tobacco caused lung-cancer. Back in the 1500s, tobacco was thought to be healthy!

Lung cancer itself was once extremely rare. But factory production of cigarettes, free distribution of cigarettes to soldiers, and mass marketing caused a global lung cancer epidemic that began in the 1900s and continues today.

Speculate: How do you think that the connection between lung cancer and tobacco smoke was discovered?

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2. What are the steps of the scientific method?

1. \_\_\_\_\_
2. \_\_\_\_\_: an \_\_\_\_\_ guess that includes a \_\_\_\_\_.
3. \_\_\_\_\_: a form of controlled observation where you can examine \_\_\_\_\_ thing at a time.

3. State your hypothesis in if...then [prediction] form

a. **Observation:** *My car won't start. Make a hypothesis about how you can get it started.*

**Hypothesis 1**(about gasoline) : If \_\_\_\_\_

Hypothesis 2 (about the battery): If \_\_\_\_\_

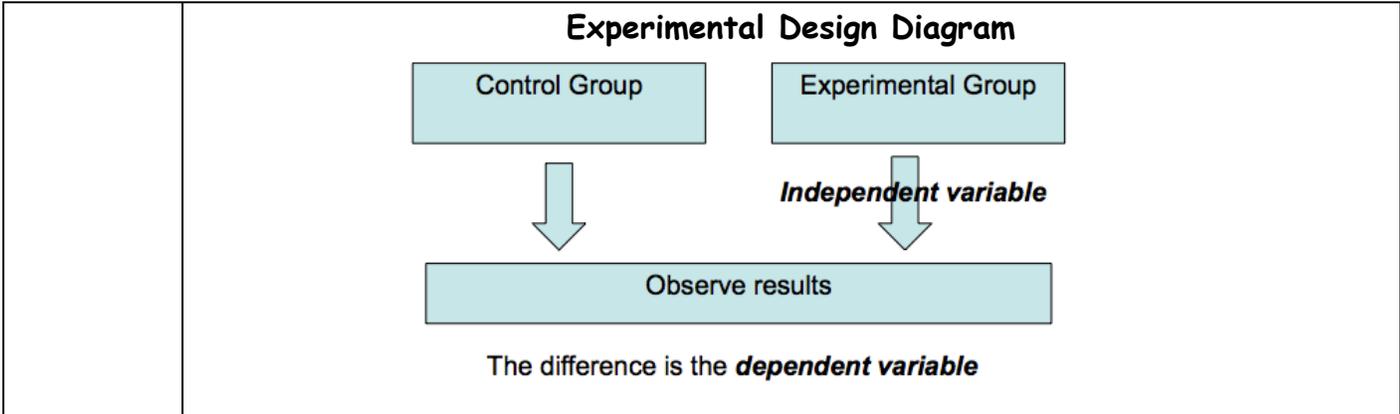
b. **Observation:** *For lunch, I ate a bag of Hot Cheetos and a Coke. My stomach hurts.*

**Hypothesis:** \_\_\_\_\_

4. Diagram of experimental design.

Key term: *variable*: Something that \_\_\_\_\_. The opposite of a variable is a \_\_\_\_\_: something that \_\_\_\_\_.

Examples: In education, one of the most important variables is the \_\_\_\_\_. The size of an engine is a key \_\_\_\_\_ in a car's acceleration.



5. Example:

*Maya and Jamal want to test the hypothesis that vitamin water increases the growth of stems in germinating radishes. They take two trays, each lined with four paper towels, and put twenty radish seeds in each one. In tray 1, they add 100 mL (about 7 tablespoons) of water. In tray 2, they add 100mL of Vitamin Water. They place both trays in the same windowsill. Over the next week, they measure the growth of the stems in each tray.*

1. Rewrite the hypothesis in an if...then form:
2. What's the independent variable?
3. What's the dependent variable?
4. What is the experimental group?
5. What is the control group?
6. What are some constants?

6. Key points about experiments

**TWO KEY POINTS:**  
 1) Test only \_\_\_\_\_ thing. That's your \_\_\_\_\_  
 2) Have something to compare to. That's your \_\_\_\_\_.

**7. Checking understanding:**

1. What's a good definition of an experiment? \_\_\_\_\_

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2. Why do you need to have a control group? \_\_\_\_\_
3. What's the difference between an independent variable and the dependent variable?  
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4. Why would it have been a bad idea for Maya and Jamal to have used only **one** radish seed in their control group, and one in their experimental group? \_\_\_\_\_

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<p><b>8. Application:</b> design an experiment to test the effectiveness of <b>golden rice</b>, a genetically engineered variety of rice that prevents vitamin A deficiency (which can cause blindness, especially in children)</p>	<p><b>Your Design</b>          Independent variable: _____          Experimental group: _____          Control group: _____          _____          Dependent variable: _____</p>
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<p><b>9. Application:</b> Design an experiment to test the effectiveness of a new drug that improves memory in people suffering from early stages of Alzheimer's disease.</p>	<p><b>Your design</b>          Independent variable _____          _____          Experimental group: _____          _____          Control group: _____          _____          Dependent variable: _____          _____</p>	<p><b>Notes from class discussion</b></p>
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<p>10. Application: Ernesto claims that seeds need light in order to germinate. You think that he's wrong. Design an experiment to test the hypothesis that <i>if seeds are kept in the dark, they won't sprout.</i></p>	<p><b>Your design</b>          Independent variable _____          _____          Experimental group: _____          _____          Control group: _____          _____          Dependent variable: _____          _____</p>
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<p>11. Get creative. Think of something that you want to test: I want to see if _____          _____          has this effect: _____          _____          _____          In the space on the right, design an experiment.</p>	<p><b>Your design</b>          Independent variable _____          _____          Experimental group: _____          _____          Control group: _____          _____          Dependent variable: _____          _____</p>
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**12. Checking Understanding:**

1. The group not exposed to the independent variable is the \_\_\_\_\_ group.
2. The measured outcome in an experiment is the \_\_\_\_\_ variable.
3. The thing that you're testing in an experiment is the \_\_\_\_\_ variable.
4. The group exposed to the independent variable is the \_\_\_\_\_ group.
5. The number of independent variables in a well-designed experiment is exactly \_\_\_\_\_.
6. Use the word "experiment" in an original sentence:

**Part II: More Issues in Experimental Design**

**Issue 1: Avoiding chance variation**

18. Key points about control and experimental groups	<ol style="list-style-type: none"> <li>1. The subjects in each group in an experiment must be _____</li> <li>2. Groups must be large enough to overcome random _____</li> </ol>
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**Issue 2: Avoiding Bias**

\_\_\_\_\_ : Prejudice in favor of or against one thing, person, or group compared with another, usually in a way considered to be unfair.

My Example: When I grade papers, I try really hard not to be \_\_\_\_\_. That's why I have a scoring guide.

**Your Example of a sentence with the word "bias":**

1. What is observation bias?	Investigators tend to _____
2. What's a placebo	A _____ substance intended to _____. Usually a _____
3. What's a single blind experiment?	The investigators give a _____ to the _____, and the _____ to the experimental group.
10. What's a double blind experiment?	_____ don't tell the _____ whether they're giving their patients the _____ or the _____.

**CHALLENGE:**

Imagine that you work in a laboratory that has designed a new potential treatment for cancer. The treatment can be delivered in the form of a pill taken once each day. You want to test it. Design and write out a *double blind experiment* to test the effectiveness of this drug. Include a hypothesis, a control group, an experimental group. Describe your dependent and independent variables. Explain how you'll make this a double blind experiment.

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