

2.5 Worksheet- Experiment Design

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Refer to part 2 of the lesson for help with the following questions

1) An educator wants to compare the effectiveness of computer software for teaching biology with that of a textbook presentation. She gives a biology pretest to each of a group of high school juniors, then randomly divides them into two groups. One group uses the computer, and the other studies the text. At the end of the year, she tests all the students again and compares the increase in biology test scores in the two groups. Is this an observational study or an experiment? Justify your answer.

Experiment, because students were randomly assigned to the different teaching methods.

2) One study of cell phones and the risk of brain cancer looked at a group of 469 people who have brain cancer. The investigators matched each cancer patient with a person of the same age, gender, and race who did not have brain cancer, then asked about the use of cell phones. The results suggested that the use of cell phones is not associated with risk of brain cancer. Is this an observational study or an experiment? Justify your answer.

Observational study, because the researchers did not assign people to either use or not use of cell phones.

3) Do smaller classes in elementary school really benefit students in areas such as scores on standardized tests, staying in school, and going on to college? We might do an observational study that compares students who happened to be in smaller and larger classes in their early school years. Identify a potential variable that may be confounding with the effects of small classes.

Type of school and socioeconomic status are possible confounding variables. Private schools tend to have smaller class sizes and students that come from families with higher socioeconomic status. If these students do better in the future, we wouldn't know if it was due to smaller class sizes or type of school or socioeconomic status.

4) Ability to grow in shade may help pines found in the dry forests of Arizona to resist drought. How well do these pines grow in shade? Investigators planted pine seedlings in a greenhouse in either full light, light reduced to 25% of normal by shade cloth, or light reduced to 5% of normal. At the end of the study, they dried the young trees and weighed them.

a) Identify the experimental units.

Pine seedlings

b) What are the explanatory and response variables?

Explanatory variable: light intensity

Response variable: weight of tree

c) What are the treatments used?

Full light, 25% light, and 5% light

5) You can use Skype to make long-distance calls over the Internet. How will the appearance of ads during calls affect the use of this service? Researchers design an experiment to find out. They recruit 300 people who have not used Skype before to participate. Some people get the current version of Skype with no ads. Others see ads whenever they make calls. The researchers are interested in frequency and length of phone calls.

a) Identify the experimental units.

300 people who haven't used Skype before

b) What are the explanatory and response variables?

Explanatory variable: whether ads are present or not

Response variable: length and frequency of calls

c) What are the treatments used?

No ads shown during calls and ads shown during calls

Refer to part 3 of the lesson for help with the following questions

6) Dr. Linda Stern and her colleagues recruited 132 obese adults at the Philadelphia Veterans Affairs Medical Center in Pennsylvania. Half the participants were randomly assigned to a low-carbohydrate diet and the other half to a low-fat diet. Researchers measured each participant's change in weight and cholesterol level after six months and again after one year. Explain how each of the four principles of experimental design was used in this study.

Comparison: *researchers used a design that compares low-carb diets with low-fat diets.*

Random Assignment: *Subjects were randomly assigned to one of the two diets.*

Control: *The experiment used subjects who were all obese at the beginning of the study and who all lived in the same area.*

Replication: *There were 66 subjects in each treatment group*

7) Does day care help low-income children stay in school and hold good jobs later in life? Carolina Abecedarian Project has followed a group of 111 children since 1972. Back then, these individuals were all healthy but low-income infants in Chapel Hill, North Carolina. All the infants received nutritional supplements and help from social workers. Half were also assigned at random to an intensive preschool program. Explain how each of the four principles of experimental design was used in this study.

Comparison: *Researchers used a design that compared children who were assigned to an intensive preschool program to children who were not enrolled in an intensive preschool program.*

Random Assignment: *Subjects were randomly assigned to be enrolled in the intensive program or not.*

Control: *All subjects were healthy, low-income, and from the same area. Also, all subjects received nutritional supplements and help from social workers.*

Replication: *Over 50 subjects in each group.*

8) Researchers in Japan conducted an experiment on 13 individuals who were extremely allergic to poison ivy. On one arm, each subject was rubbed with a poison ivy leaf and told the leaf was harmless. On the other arm, each subject was rubbed with a harmless leaf and told it was poison ivy. All the subjects developed a rash on the arm where the harmless leaf was rubbed. Of the 13 subjects, 11 did not have any reaction to the real poison ivy leaf. Explain how the results of this study support the idea of a placebo effect.

The subjects developed rashes on the arm exposed to the placebo (a harmless leaf) simply because they thought they were being exposed to a poison ivy leaf. Likewise, most of the subjects didn't develop rashes on the arm that was exposed to poison ivy because they didn't believe they were being exposed to the real thing.

9) The progress of a type of cancer differs in women and men. Researchers want to design an experiment to compare two therapies for this cancer. They recruit 500 male and 300 female patients who are willing to serve as subjects. Which are the block in this experiment: the cancer therapies or the two genders? Why?

The genders, because researchers will randomly assign all three therapies within each gender.

10) A nutrition experimenter intends to compare the weight gain of newly weaned male rats fed Diet A with that of rats fed Diet B. To do this, she will feed each diet to 10 rats. She has available 10 rats from one litter and 10 rats from a second litter. Rats in the first litter appear to be slightly healthier.

a) Why would it be poor design to have the 10 rats from Litter 1 be fed Diet A, and the 10 rats from Litter 2 be fed Diet B?

If one of the groups gained more weight, we would not know if this was because of the diet or because of genetics and initial health. Genetics and diet would be confounded.

b) Describe a better design for this experiment

Use a randomized block design with the litters as blocks. For each of the litters, randomly assign half of the rats to receive Diet A and the other half to receive Diet B. This will allow researchers to account for differences in weight gain caused by differences in genetics.