8.3

Who uses this?

Researchers use observational studies to evaluate the effect of earphones on hearing loss. (See Example 3.)

Lesson Objective(s):

- Focus on the commonalities and differences between surveys, experiments, and observational studies.

You have already seen that a survey is one way to collect data. Although surveys are useful, different situations require different techniques for gathering data.

Individuals are people, animals, or objects that are described by data. If you collect data on the fuel efficiency of cars and trucks, the individuals are vehicles. Variables are used to describe individuals. Fuel efficiency, measured in miles per gallon, is an example of a variable.

Data Collection Methods

TERM	EXAMPLE
	A researcher adds acetone to gasoline to measure its effect on fuel efficiency.
	A researcher wants to find out if poor nutrition affects eyesight, but it would be unethical to deliberately subject some individuals to poor nutrition.

EXAMPLE 1

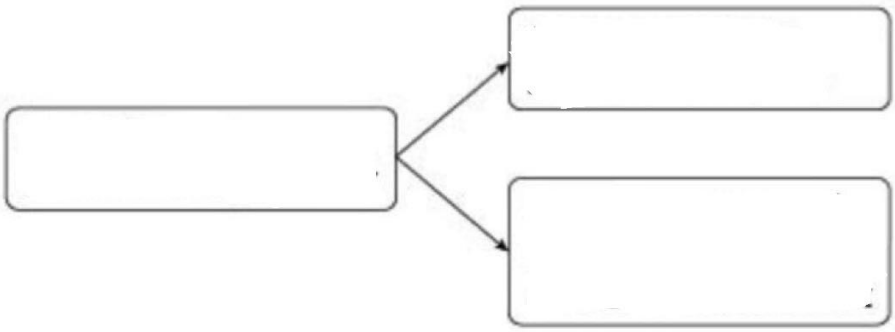
Identifying Experiments and Observational Studies

Explain whether each situation is an experiment or an observational study.

A A researcher asks students the average number of hours of sleep they get per night and examines whether the amount of sleep affects students' grades.

B A park employee wants to know if latex paint is more durable than non-latex paint. She paints 50 benches with latex paint, and 50 with non-latex paint.

For data from an experiment to be useful, the experiment must be carefully designed. In _____ groups are studied under conditions that are identical except for one variable. The effects of the treatment are determined by comparing the *control group* and the *treatment group*.



Often, to demonstrate a cause and effect hypothesis, an experiment must show two things. First, that a phenomenon occurs with the treatment; and second, that the phenomenon does not occur in the absence of the treatment.

In _____ individuals are assigned to the control group or the treatment group at random, in order to minimize bias. An experiment that is not a randomized comparative experiment may be subject to bias, and any conclusions drawn from the experiment may not be valid.

EXAMPLE 2

Evaluating a Published Report

The study described in the report is a randomized comparative experiment. Describe the treatment, the treatment group, and the control group.

Milk Fights Cavities
At Ashland Middle School, fifty randomly chosen students were given milk at lunch every day for a year, and fifty other randomly chosen students were given other beverages. At the end of the year, students in the "milk" group had 15% fewer cavities than students in the other group.

A randomized comparative experiment should be used to gather data whenever feasible because this type of study makes it possible to draw valid cause-and-effect conclusions.

Such experiments are also _____ That is, they can be repeated and can be expected to produce similar results each time. Experiments like these are often performed in duplicate or even triplicate simultaneously.

Randomization is an important feature of experiments. When conclusions are drawn from an experiment using randomization, the results can be counted on to be useful with another, different randomized sample. If the group wasn't chosen randomly, the results would likely not be valid for any other group. Randomization of the experiment allows generalization of the results.

Generally, a controlled, randomized experiment gives the most reliable results. In some situations, however, there may be ethical or practical reasons against using an experiment. If possible, the study should still be comparative.

For example, it would be unethical to ask some individuals to smoke in order to study the effects of nicotine on their health. Therefore, an observational study should be used. To make the study comparative, the researchers should randomly choose one group of people who already smoke and one group of people who do not smoke.

EXAMPLE 3

Designing an Experiment or Observational Study

Explain whether the research topic is best addressed through an experiment or an observational study. Then explain how you would set up the experiment or the observational study.

Does listening to an MP3 player with earphones for more than one hour per day affect a person's hearing?

Another important feature distinguishing surveys from observational studies and experiments is that surveys are not comparative - they draw data from only one group, so they can't make conclusions about cause and effect. Well-designed studies and experiments compare data from two or more groups, allowing them to look for a relationship between variables.

It is possible to give the same survey to two or more groups and compare the results – but that is a type of observational study!

EXAMPLE 4

Evaluating Data Collection Methods

A researcher is considering three methods of evaluating two different cold medicines. Tell whether each method is a survey, an experiment or an observational study. Then explain which method would be most reliable.

Method A	Method B	Method C
Choose 50 people at random. Ask which cold medicines they have taken in the past, and how effective they were.	Monitor 50 people with colds, and measure the length of the symptoms for the individuals who choose to take each type of medicine.	Randomly divide a group of 50 people with colds into two groups. Give each group a different medicine, and measure the length of the symptoms.