

**Objectives** To identify sampling methods  
To recognize bias in samples and surveys

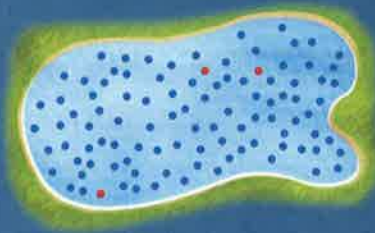


What happened to the other fish you tagged?



### Getting Ready!

One day, you catch 100 fish at random from a lake. You tag the fish and then release them back into the lake. The next day you again catch 100 fish at random, as shown on the map. The red dots indicate the fish that have your tags. What can you conclude? Justify your conclusion.



A **population** is all the members of a set. A **sample** is part of a population. If you determine a sample carefully, the statistics for the sample can be used to make general conclusions about the larger population.

**Essential Understanding** You can get good statistical information about a population by studying a sample of the population.

Suppose you want to know what percent of all voters in your city favor a tax increase to pay for school improvements. It likely would be impossible to ask an opinion of every voter. So instead you select a sample of the voters to estimate the percentage who favor the idea.

You can define different sample types by the methods used to select them.

take note

### Key Concepts

### Sampling Types and Methods

For a **convenience sample**, select any members of the population who are conveniently and readily available.

For a **self-selected sample**, select only members of the population who volunteer for the sample.

For a **systematic sample**, order the population in some way, and then select from it at regular intervals.

In a **random sample**, all members of the population are equally likely to be chosen.

### Lesson Vocabulary

- population
- sample
- convenience sample
- self-selected sample
- systematic sample
- random sample
- bias
- observational study
- controlled experiment
- survey

Samples vary in how well they reflect a population. A sample has a *bias* when a part of a population is overrepresented or underrepresented. A **bias** is a systematic error introduced by the sampling method.

### **Problem 1 Analyzing Sampling Methods**

**Public Opinion** A newspaper wants to find out what percent of the city population favors a property tax increase to raise money for local parks. What is the sampling method used for each situation? Does the sample have a bias? Explain.

**A** A newspaper article on the tax increase invites readers to express their opinions on the newspaper's website.



This is a self-selected sample. It might have a bias, depending on who visits the website. The people who respond may overrepresent or underrepresent some views. For example, some property owners who are against the tax might organize a campaign to get friends and neighbors to visit the website.

**B** A reporter interviews people leaving the city's largest park.

This is a convenience sample, since it is convenient for the reporter to stay in one place. Because the location is near a park, the sample may overrepresent park supporters and the results will have a bias.

**C** A survey service calls every 50th listing from the local phone book.

This is a systematic sample because the phone listing is ordered alphabetically. The regular sampling interval is every 50 listings. This sample may have a bias if there is some link between people who are listed (or not listed) in a phone book and people who pay property taxes.

-   **Got It?** 1. **a.** To survey the eating habits of the community, employees of a local television station interview people visiting a food court in the mall. What sampling method are they using? Does the sample have a bias? Explain.
- b. Reasoning** A poll of every person in the population is a *census*. What is a situation that requires a census instead of a sample?

One way to collect sample information is to perform a study.

 Take note

#### **Key Concepts Study Methods**

In an **observational study**, you measure or observe members of a sample in such a way that they are not affected by the study.

In a **controlled experiment**, you divide the sample into two groups. You impose a treatment on one group but not on the other "control" group. Then you compare the effect on the treated group to the control group.

In a **survey**, you ask every member of the sample a set of questions.

#### Think

##### **Who are the people in the sample?**

The people in the sample are only those who might be selected. In this case, only those who visit the website.

A poorly designed study can result in unreliable statistics. You should always analyze a study's methods before making general conclusions about the population.

### **Problem 2 Analyzing Study Methods**

Which type of study method is described in each situation? Should the sample statistics be used to make a general conclusion about the population?

**A** Researchers randomly choose two groups from 10 volunteers. Over a period of 8 weeks, one group eats ice cream before going to sleep, and the other does not. Volunteers wear monitoring devices while sleeping, and researchers record dream activity.


This is an example of a controlled experiment. The statistics for this study are based on such a small sample that the findings are unreliable as a general conclusion.

**B** Students in a science class record the height of bean plants as they grow.

This is an observational study. The statistics may provide a general conclusion about the growth rate of a bean plant. However, soil type, amount of sunlight and water, fertilizer, and other factors could affect the growth rate.

**C** Student council members ask every tenth student in the lunch line if they like the cafeteria food.


This is a survey. The results are not reliable because people waiting in line are more likely to enjoy the cafeteria food than those who brought their lunch from home.

 **Got It?** 2. A pharmaceutical company asks for volunteers to test a new drug to treat high blood pressure. Half of the volunteers will be given the drug, and half will be given a placebo. The researcher will monitor the blood pressure of each volunteer. Which type of study method is the researcher using? Should the sample statistics be used to make a general conclusion about the effectiveness of the drug in the larger population? Explain.

### **Problem 3 Designing a Survey**

**Sports** During the 2008 Olympic Games, a U.S. swimmer won more medals than any other swimmer in history. What sampling method could you use to find the percent of students in your school who recognize that swimmer from a photograph? What is an example of a survey question that is likely to yield information that has no bias?

A possible sampling method is to question every 10th student entering school in the morning. This is a systematic sampling. It usually contains the least bias. A possible unbiased survey question is, "Who is pictured in this photograph?"

 **Got It?** 3. What sampling method could you use to find the percent of residents in your neighborhood who recognize the governor of your state by name? What is an example of a survey question that is likely to yield information that has no bias?

#### Think

**How can you tell if a sample is a random sample?**

In a random sample, each group of the same size is equally likely to be chosen.

#### Think

**How do you think of a survey question that has no bias?**

Keep it simple. The simplest question is likely to be the least biased.