

## Data Analysis

Research involves asking questions, collecting information, and analysing the data to draw conclusions. Businesses and governments use research-based statistics to inform and persuade people. Park wardens use statistics to predict birth rates, death rates, and migration patterns of plant and animal populations. They also use statistics to predict the size of populations such as elk.

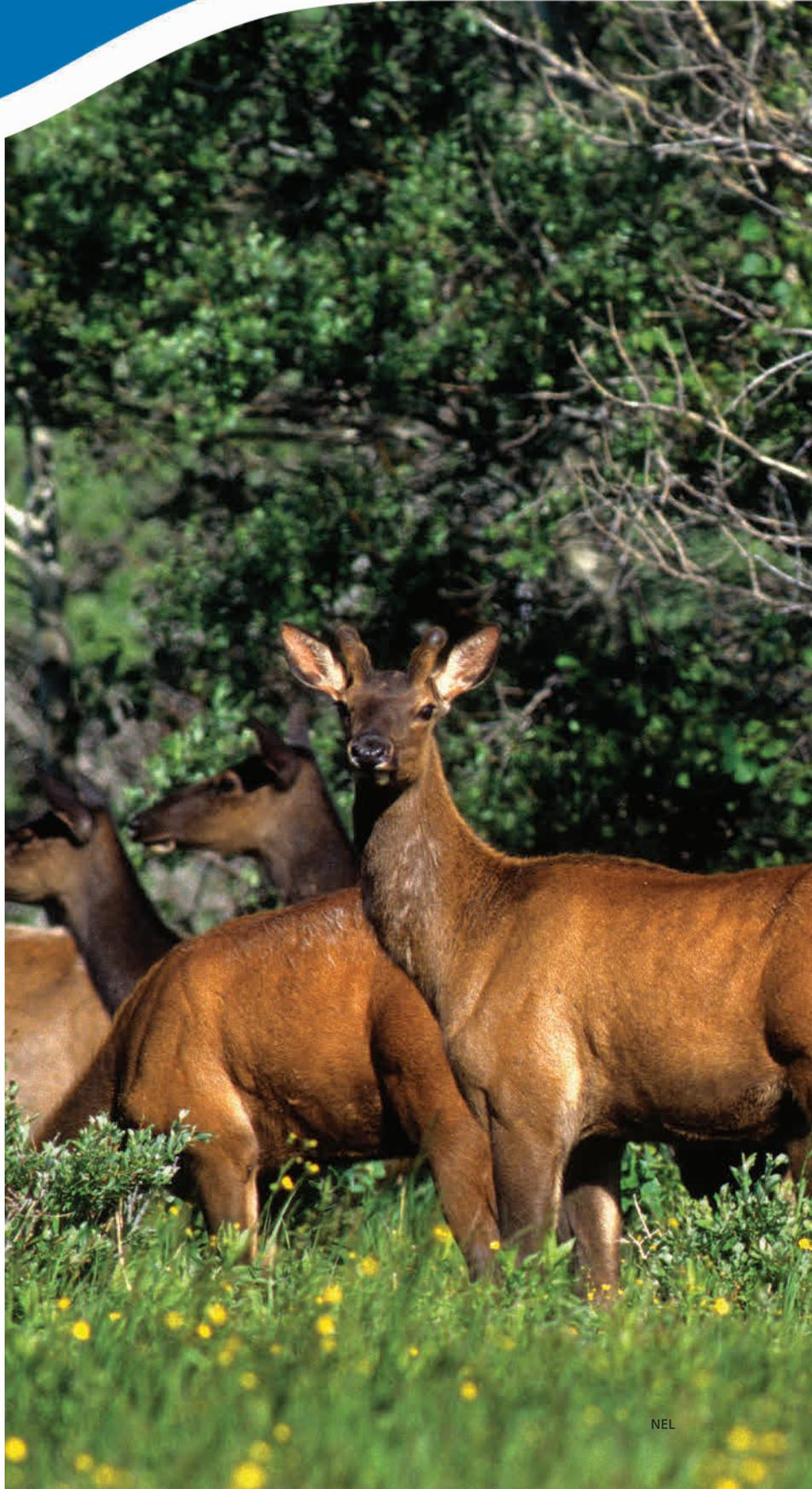
In this chapter, you will learn about factors that influence the collection of data. You will learn about how to reduce the chances of invalid results from a survey. You will collect and display data, and draw conclusions based on the results.

### What You Will Learn

- to identify factors that can affect the collection of data
- to identify the difference between a population and a sample
- to decide whether to use the population or a sample
- to identify different types of samples
- to use data for making predictions
- to develop and carry out a research project
- to assess your research project

#### Did You Know?

The Cree name for elk is *wapiti*.



## Key Words

population  
sample  
convenience  
sample  
random sample

stratified sample  
systematic sample  
voluntary response  
sample  
biased sample

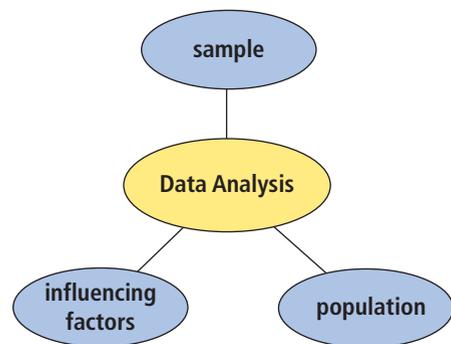
## Literacy Link

A concept map can help you visually organize your understanding of math concepts.

Create a concept map in your math journal or notebook. Make each oval large enough to write in. Leave enough space to draw additional ovals. As you work through the chapter, complete the concept map.

Organize each term you learn by determining which of the three blue ovals it relates to. Then, attach and label an oval for the term and define it.

Discuss your ideas with a classmate. You may wish to add to or correct what you have written.

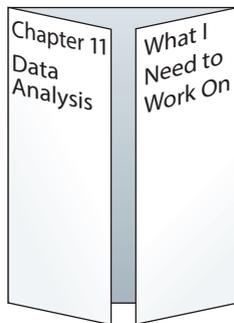


**Materials**

- sheet of 11 × 17 paper
- ruler
- seven sheets of 8.5 × 11 paper
- scissors
- stapler

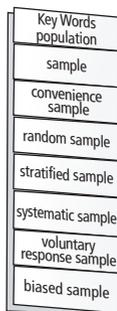
**Step 1**

Fold the long side of a sheet of 11 × 17 paper in half. Pinch it at the midpoint. Fold the outer edges of the paper to meet at the midpoint. Label it as shown.



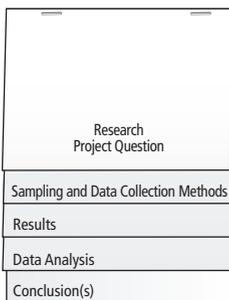
**Step 2**

Fold the short side of a sheet of 8.5 × 11 paper in half. On one side, use a ruler to draw a line 4 cm from the top. Then, draw six more lines at 4-cm intervals. Cut along the lines through one thickness of paper, forming eight tabs. Label the tabs as shown.



**Step 3**

Staple five sheets of 8.5 × 11 paper together along the top edge. Draw a line 15 cm from the bottom of the top sheet. Cut across the entire width of the page at this mark. Make a line 12 cm up from the bottom of the second sheet and cut across the width of the page at this mark. Similarly, cut off 9 cm from the third page, 6 cm from the fourth page, and 3 cm from the fifth page. Label as shown.

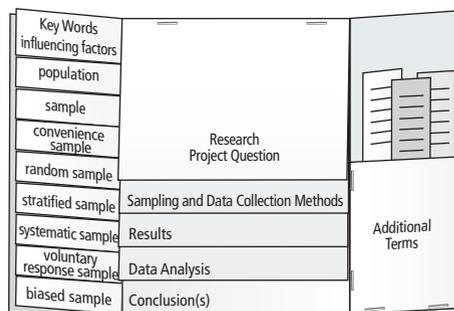


**Step 4**

Use a quarter sheet of 8.5 × 11 paper to create a pocket for storing additional terms. Staple the pocket to the inside right flap of the Foldable as shown below. Use index cards or cut strips of notebook paper to fit inside the pocket.

**Step 5**

Staple the booklets from Steps 2 and 3 into the Foldable from Step 1 as shown.



**Using the Foldable**

As you work through the chapter, define the Key Words beneath the tabs on the left panel. Record notes about the research project under the tabs on the centre panel. Use the pocket to store the definitions for additional terms related to data analysis.

Use the back of your Foldable to create a flow chart to track your progress on the research project. On the front of the Foldable, keep track of what you need to work on. Check off each item as you deal with it.

# Math Link

## Protecting and Managing Wildlife

Elk Island National Park in Alberta is Canada's largest fully enclosed park. It is home to the densest population of ungulates in Canada. These ungulates include plains bison, wood bison, moose, deer, and elk.

Park wardens and naturalists play an important role in studying, monitoring, and managing the wildlife in the park.

Val decided to study the population of the ungulates in Elk Island National Park. The table shows the data she collected from the park warden.



| Ungulate     | Approximate Total Park Count (2007 Fall Count) |
|--------------|--|
| Plains bison | 425  |
| Wood bison   | 400  |
| Elk          | 605  |
| Moose        | 300  |
| Deer         | 558  |

- a) Use at least two different methods to display the data that Val collected.

b) Explain why you chose each method to display the data.
- What is the most common ungulate in the park? Explain.
- Elk Island National park has an area of 194 km<sup>2</sup>. What is the mean number of elk per square kilometre? Show your thinking.
- What percent of the ungulate population do bison represent?

Throughout this chapter, you will study an issue related to wildlife protection and management. As you do, you will develop your own research project. Your project will involve collecting, displaying, and analysing your data. You might study birth rates, death rates, or migration patterns of an animal population. Or, you might consider the effects of tourism, recreation, or environmental factors, such as pollution, on a population.

You might study a wildlife issue in a park. If so, what park will you choose? Where is the park located? What issue interests you? Research at least two areas of interest.



### WWW Web Link

For more information about national parks, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.

### Literacy Link

An *ungulate* is a mammal with hooves. One example is a bison. Most ungulates use the tips of their hooves to hold their body weight as they move.

### Did You Know?

Population density is a measure of the number of individuals living in a defined area. The population density of ungulates in Elk Island National Park is second only to the density in the Serengeti Plains of Africa.

# Factors Affecting Data Collection

## Focus on...

After this lesson, you will be able to...

- identify how bias, use of language, ethics, cost, time and timing, privacy, and cultural sensitivity may influence the collection of data
- write and analyse appropriate survey questions



A Super Food employee provides samples of Bob Brat Sausages to customers between 5:00 p.m. and 5:30 p.m. for one day.

Store employees asked customers who buy Bob Brat Sausages the following question.

Did you buy Bob Brat Sausages because they are delicious, quick to prepare, or both delicious and quick to prepare?

The table shows the results from the survey.

| Bob Brat Sausages                   |     |
|-------------------------------------|-----|
| Delicious                           | +++ |
| Quick to prepare                    |     |
| Both delicious and quick to prepare | +++ |

A few weeks later, a store flyer made this advertising claim.

**Over 90% of shoppers love Bob Brat Sausages because they taste great and save time!**

What factors might have influenced the survey responses? How accurate do you think the advertising claim is? Explain.

### Literacy Link

A *survey* is used to collect opinions and/or information.

### Literacy Link

An advertising claim gives information about the performance of a product or service. The claim is designed to encourage you to buy. The claim may be true, false, or a little of both.

## Explore Factors That Affect Survey Responses

1. From the store's point of view, did Super Foods promote Bob Brat sausages well? Explain.
2.
  - a) Did the survey ask a fair question? Explain your reasoning.
  - b) Did the survey sample represent the whole population of shoppers? Explain.
3. Some people who read the flyer said the advertisement was misleading. Do you agree with them? Explain why or why not. Discuss your ideas with your group.

## Reflect and Check

4. Imagine you are hired as the store's public relations consultant.
  - a) What factors do you need to address to make the data collected about the sausages more accurate?
  - b) Develop a survey question you would ask about Bob Brat Sausages. Who would you ask?

## Link the Ideas

Several *influencing factors* affect how data are collected or how responses are obtained.

These include:

- *bias*: Does the question show a preference for a specific product?
- *use of language*: Is the question presented in such a way that people understand what is being asked?
- *ethics*: Does the question refer to inappropriate behaviour?
- *cost*: Does the cost of the study outweigh the benefits?
- *time and timing*: Does the time the data were collected influence the results? Is the timing of the survey appropriate?
- *privacy*: Do people have the right to refuse to answer? Are the responses kept confidential?
- *cultural sensitivity*: Might the question offend people from different cultural groups?

### Literacy Link

*Ethics* involves judgments of right and wrong. For example, cheating on a test is wrong.

### Example 1: Identify Factors Affecting Data Collection

Helen and Andre are reviewing the data collection methods used by a marketing company. For each situation, help them identify any influencing factors. Explain your reasoning.



- a) A sales representative stands in front of a display of different kinds of toothpaste. He asks every person buying toothpaste the following question.
- b) Free samples of sunscreen are sent to every home in fall and winter. A mail reply card asks people if they would use the product again.
- c) A grocery store employee conducts a telephone survey of people living within 10 km of the store. To help determine what meat products to sell, she asks what type of red meat people prefer.
- d) A sales representative conducts a telephone survey. As she poses the question, a person receiving the call says, “I am not interested, thank you.” The sales representative responds, “Why not? Your input provides useful information.” She begins to repeat the survey question.
- e) Your school is under construction and is quite dusty and dirty. A survey is conducted about the environmental health of your school. The survey is done every four years.
- f) A sales representative sets up an online survey. The survey offers a free MP3 file of a song that was downloaded from the Internet to everyone who completes the survey. The company has not bought the rights to the song.

What is your favourite brand of toothpaste? For what reason(s)?

### Solution

- a) There is no bias. Standing in front of a toothpaste display allows the sales representative to survey people who are buying toothpaste.
- b) Fall and winter sun is less intense than spring and summer sun. People may be less likely to wear sunscreen during fall and winter. Therefore, these seasons are not likely the best choice for testing sunscreen. Sending sunscreen products during fall and winter is very costly for the company. In addition, asking people if they would use the product again assumes that they did use it. This may confuse people who have not tested the product. The language is unclear.
- c) The question is biased. It assumes that all people eat red meat, which is not true. Red meat is not acceptable to some people. For these people, this may be a culturally sensitive question.
- d) The sales representative does not respect the individual’s right to refuse to participate in the survey. In addition, any responses obtained under pressure may not truly represent the person’s opinion.
- e) This survey is poorly timed. When a school is under construction, some routines may be disturbed. People may express frustration with the temporary changes. This would reflect in a negative way on the survey.

- f) Offering a reward to participants in the survey is ethically wrong. In addition, it is not ethical to download music from the Internet without buying it. When people do this, musicians are not being paid for their work.

### Show You Know

A marketing firm displayed two sports shirts at a grades 7 to 12 school with 800 students. The first ten grade 12 students who entered the school were asked the following question.

Which one of these two sports shirts would you buy?

A week later, the firm gave this flyer to the student council.

What factors might have affected the data collected and the company's conclusions? Explain.

Over 78% of students at Central High will buy Shirt B.



### Example 2: Write Survey Questions Free of Influencing Factors

A steel milling company conducts a survey.

- a) Does the survey question influence the results? Explain.  
b) Rewrite the question so that it is free of influencing factors.

The proposed mill will produce 250 jobs and economic benefits for your community. Are you in favour of having a forward-thinking steel mill in your community? YES NO

### Solution

- a) Yes, the wording in the question may lead people to answer in a specific way. It implies that due to the economic benefits the company can offer, people should vote in favour of the mill.  
b) A better way to ask the question is, "Are you in favour of having a steel mill in your community?"

### Show You Know

For each situation, explain whether the question has influencing factors. If it does, rewrite the question.

- a) Daniel is studying the population of polar bears in eastern Hudson Bay. He drafts the following question.

Do you think the senseless slaughter of polar bears should be stopped? YES NO

- b) A recent study shows that 45% of Canadians are using the Internet to shop. Amy develops the following question for a class survey.

What kinds of products and services do you buy online?

## Key Ideas

- Survey questions should be worded so they are free from factors influencing the responses.

The survey questions ask about purchases made at a school cafeteria.

1. Do you buy food at the school cafeteria? YES NO
2. If you responded NO, what reason best explains why you do not buy food at the cafeteria? Circle one.  
A The quality of the food is poor.  
B I do not like the food choices.  
C The cafeteria is in an inconvenient location.  
D The prices are too high.  
E Other (Please explain.) \_\_\_\_\_

- Influencing factors include bias, use of language, ethics, cost, time and timing, privacy, and cultural sensitivity.

Which box shows better survey questions? Why?

1. In the past year, how many times did you buy food items at the cafeteria? \_\_\_\_\_

1. In the past week, did you buy any food items at the cafeteria? YES NO
2. If you responded YES, how many times did you buy each of the following food items?  
soup or salad \_\_\_\_\_ main course \_\_\_\_\_ drink \_\_\_\_\_ snack \_\_\_\_\_

## Check Your Understanding

### Communicate the Ideas

1. Your friend is unclear what the term *bias* means. Develop an example to help explain the term.
2. Explain how influencing factors affect the collection of data. Give an example.
3. Shunta and Susan are discussing how to choose the top five lunch specials for the cafeteria menu. Each develops a different survey question. They decide to survey all the students.

Shunta:

What are your top five favourite lunch specials?

Susan:

Which are your top five favourite lunch specials from this menu? Circle your choices.

| LUNCH SPECIALS        |                        |
|-----------------------|------------------------|
| tomato soup and salad | grilled cheese         |
| hamburger             | chicken salad sandwich |
| vegetable lasagna     | turkey hot dog         |
| vegetarian chili      | pepperoni pizza        |

Which survey question do you prefer? Explain why.

## Practise

For help with #4 and #5, refer to Example 1 on pages 416-417.

4. In each case, identify and describe any factors that may affect the collection of data.
- Survey members of the soccer team about new uniforms for the volleyball team.
  - At a truck rally, ask drivers what type of vehicle they prefer to drive.
  - Provide samples of a new granola bar at all conferences and conventions in your community. Ask people who attend the following question.

What is your favourite among the new granola bars you tried in the past month?

- d) Ask customers in a sports store the following question.

Invincible Bikes are the most sturdy and expertly designed bikes on the market. What brand will you buy?

5. For each situation, identify whether there is bias. If so, identify the bias. Then, rewrite the statement to correct it.
- Ask all horse owners if they are willing to pay higher horse-boarding fees.
  - Ask owners of horses boarded in a stable in the city centre if this location is annoying.
  - Ask horseback riders if they would support building a public park on the site of their stable.

For help with #6 to #8, refer to Example 2 on page 417.

6. In each case, describe the effect of any influencing factors on the collection of data. Then, write an improved survey question.
- a) A sales representative asks the following question.

Which do you prefer?  
A Cola  
B Diet Cola

- b) An opposition party member asks the following question.

Is the current prime minister not the best prime minister in Canadian history?  
YES NO

- c) A small business develops the following question.

Do you know about the Hands-On Repair Company and the maintenance your appliances and tools need?  
YES NO

- d) Jennifer asks students the following question.

What is your parents' total income?



7. Rewrite each survey question without any influencing factors.

- a) Sam asks riders of all-terrain vehicles the following question.

Do you support closing some riding trails to save some endangered animals?  
YES NO

- b) A marketer surveys all the people entering a movie theatre.

Who is your favourite male movie star?  
A Brad Pitt  
B Keanu Reeves  
C Matt Damon  
D Other \_\_\_\_\_

- c) A student asks people at an airport the following question.

Do you think flying is still the cheapest way to travel a long distance?  
YES NO

8. Rewrite each survey question so there are no influencing factors.

- a) Do you like to watch hockey, the only great sport?  
YES NO

- b) Most people choose chocolate, but what is your favourite flavour of ice cream?

- c) A recent survey shows that 42% of teens use the Internet to watch TV. What TV shows do you watch most often online?

## Apply

9. For each situation, write two different survey questions that may have resulted in each conclusion.

- a) Most juice lovers prefer apple and orange.  
b) Yellow is the most popular shirt colour.  
c) Four out of five doctors surveyed strongly support a healthy, natural-food diet.

10. Write a survey question for each situation. Identify who you would ask to participate in the survey.

- a) You want to find out which sport teens like best.  
b) You want to find out if price or brand is more important when buying a cell phone.  
c) You want to find out which media source people trust most to give them accurate information.

11. Rewrite each survey question so that it collects more helpful data.

- a) If you are a juice drinker, would you consider switching to Crystal Juice?  
YES NO

- b) Which of the following cough medicines have you tried?



- c) Would you run if you came across a moose?  
YES NO

- d) Are you satisfied with your Internet access?  
Circle one response.  
A Excellent  
B Good  
C Poor

- 12.** For each case, identify the influencing factors that may affect the collection of data. Then, write a survey question that is free of influencing factors and is clearly written.
- Teens are asked about which clothing items they have bought at an expensive store in the past year.
  - The members of a golf club are asked if they are in favour of a proposed highway. It will reduce traffic jams by going through the golf course.
- 14. a)** You have been hired to develop Arctic adventure tours. Develop three survey questions to help determine the activities that appeal to tourists.
- Exchange your questions with a classmate. Critique each other's questions for clarity and the presence of any influencing factors.
  - Based on the feedback, revise your survey questions so they are clearly written and free of influencing factors.

## Extend

- 13. a)** Write two survey questions that relate to a topic of your choice, such as sports, fashion, movies, or games.
- Develop a question that contains bias.
  - Develop a different question that is free of influencing factors.
- b)** Use the first question to survey 20 friends or classmates. Use the second question to survey 20 different friends or classmates.
- c)** Compare the results. Identify the bias in the first question. Explain how its wording may have affected the results.

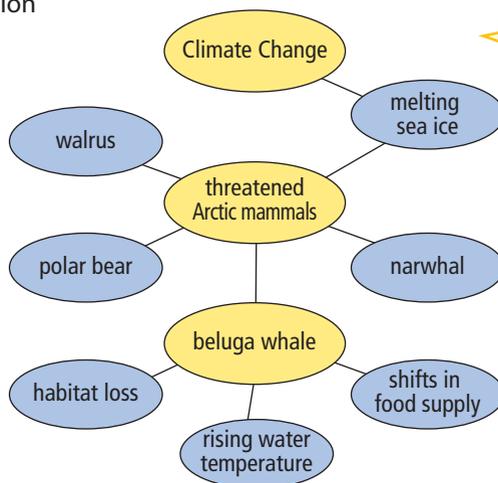


- 15.** When interpreting the results of a political poll, why is it important to know the source of the poll?

## Math Link

For your research project, select a wildlife protection or management topic.

- Use a graphic organizer such as the concept map shown here to help you organize ideas for your topic. Record subtopics and connecting details and facts.
- Choose a subtopic to study.
- Consider what data you need to obtain related to your topic. Then, write three possible research questions.
- Exchange your questions with a classmate to check that they are free of influencing factors. Revise your questions if necessary.



I am interested in the effects of climate change on Arctic mammals, in particular, the beluga whale.

## WWW Web Link

For information about national and provincial parks in Canada, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.

**Research Questions:** How does melting sea ice threaten Arctic mammals?  
Which Arctic mammals are most threatened by melting sea ice?  
What are the population trends for beluga whales in Canada?

**Focus On ...**

After this lesson you will be able to...

- identify the difference between a population and a sample
- identify different types of samples
- justify using a population or a sample for given situations
- determine whether results from a sample can be applied to a population

**Did You Know?**

An Internet forum allows people to participate in online discussions. There are forums for many topics, including sports, fashion, and politics.

Do Internet forums accurately reflect the opinions of all their readers? Do these people share the same opinions as those who do not read the forums?

How can you reduce the chances of making inaccurate predictions from a survey?

**Explore Using Survey Data to Make Predictions**

Work as a class. Develop a question to determine the opinions of students at your school about a topic of your choice. For a topic, you might choose favourite foods, sports, actors, or musicians.

1. Write and edit your survey question.
2. Survey everyone in your class.
3. **a)** Organize the results.  
**b)** Based on the results of the class survey, predict the whole school's response to your question.
4. Does your prediction accurately reflect the opinions of all students in your school? Explain.

## Reflect and Check

5. Is your class a **population** or a **sample**? Explain.
6. How else might you choose people for your survey to reflect the opinions of all students in your school?
7. How can you reduce the chances of making inaccurate predictions using a survey?

## Link the Ideas

There are several different types of samples.

### *convenience sample*

- a sample created by choosing individuals from the population who are easy to access

### *random sample*

- a sample created by choosing a specific number of individuals randomly from the whole population. *Random* means that each individual has an equal chance of being chosen. As a result, a random sample is likely to represent the whole population. Data from a random sample can be used to make predictions about the population. Stratified samples and systematic samples are types of random samples.

### *stratified sample*

- a sample created by dividing the whole population into distinct groups, and then choosing the same fraction of members from each group

### *systematic sample*

- a sample created by choosing individuals at fixed intervals from an ordered list of the whole population

### *voluntary response sample*

- a sample created by inviting the whole population to participate

## Example 1: Identify the Population

Identify the population for each situation. Then, state whether you would survey the population or a sample of the population. Explain your reasoning.

- a) A bicycle store owner wants to know which brand of mountain bike her customers prefer.
- b) The school board wants to know how many hours of homework students do each day.
- c) A candle manufacturer wants to know how many of its candles are made with flaws.



### population

- all of the individuals in the group being studied
- for example, the population in a federal election is all eligible voters

### sample

- any group of individuals selected from the population
- for example, a sample of the population in a federal election might be 100 individuals chosen from each province or territory

### Solution

- a) The population is the store's customers. It depends on the size of the store. A small store might survey all of its customers. A large, busy store would likely survey a sample of customers. For them it would be time-consuming and costly to survey all of the customers.
- b) The population is students in schools within the school board. The school board would likely survey a stratified sample of its students. They would want to include the same fraction of students at various grade levels because the amount of homework done varies from grade to grade.
- c) The population is all candles made by the company. A small company might check each candle made. A large company might check every tenth candle. It would be costly and time-consuming to check every item.

### Show You Know

For each scenario, identify the population. Then, indicate whether you would survey the population or a sample. Explain your reasoning.

- a) The Royal Garden restaurant needs to know which main dish its customers favour.
- b) Stephan wants to find out if teachers in Canada prefer to wear glasses or contact lenses.
- c) A junior hockey team wants to find out why some people who bought season tickets last year are not buying them this year.

### Example 2: Identify a Sample

For each situation, describe how the sample could be selected. Identify the type of sample.

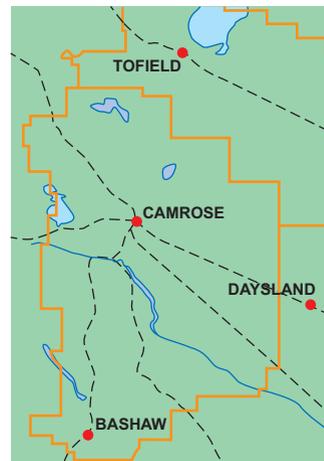
- a) A teacher wishes to get feedback from her class about the school dance. She plans to survey 5 students out of a class of 30.
- b) A telephone company wants to determine whether a fitness centre would be well used by its 3000 employees. The company plans to survey 300 employees.
- c) A chain store is trying to decide whether to open a store in Camrose, Alberta. The company decides to survey people in Camrose and three nearby towns. The population of each location is shown in the table.
- d) A marketing research company mails surveys to all of the adult residents in a town. The survey asks about brands of consumer products. The residents are asked to mail their responses in a prepaid envelope.
- e) A restaurant owner wants to know the favourite pizza topping of his customers. He plans to survey every customer who orders a pizza in his restaurant between 5:00 p.m. and 10:00 p.m. one evening.

| Location | Population |
|----------|------------|
| Camrose  | 16 000     |
| Bashaw   | 825        |
| Tofield  | 1 876      |
| Daysland | 876        |

## Solution

You can use different types of samples in a survey. These are some possible solutions.

- a) The teacher could put all the students' names in a box and draw five names. This is a *random sample*.
- b) The company plans to survey 300 out of their 3000 employees. To ensure that the sample fairly represents the population, the company might interview every tenth person on the payroll list. This is a *systematic sample*. This type of sample is time and cost efficient.
- c) Since the city has more people who use the company's products than the nearby towns, the company could survey 25% of the population in each location. This is a *stratified sample*. Since 25% of each group is surveyed, the same proportion of each town is represented in the sample. In this case, the company would survey 4000 people from Camrose, 206 people from Bashaw, 469 people from Tofield, and 219 people from Daysland.
- d) The marketing research company is inviting all residents to participate. This is a *voluntary response sample*. This sample may not represent the population because only those who are interested will respond.
- e) This is a *convenience sample*. It is not random since only customers who order pizza are surveyed. However, the sample does target customers who will provide useful input. These customers are easily accessible. The sample provides the owner with information right away and costs no extra money.



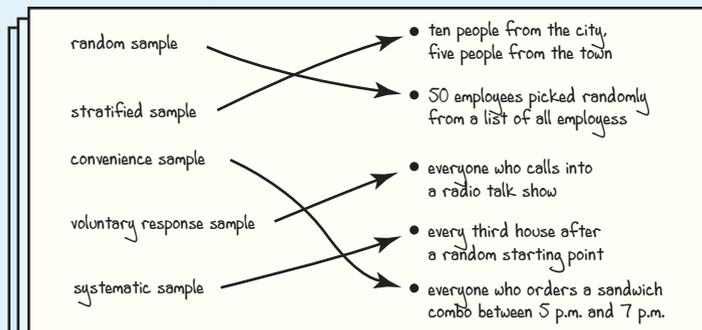
For each situation, is there a different type of sample that might be used? If so, explain what type of sample and how you would organize it.

## Show You Know

- a) For each scenario, what type of sample would you use? How would you select the sample?
  - A marketing firm plans to conduct a telephone survey in a city of 800 000 people. The survey asks whether there is interest in a new art gallery.
  - A student wants to know the most popular cell phone provider that grade 9 students use.
- b) In each case, identify the type of sample.
  - A coach puts the names of all of the basketball players into a hat and draws one name for a free basketball.
  - A questionnaire is sent to every ninth person on an alphabetical list of a store's credit card customers.
  - The student council invites all students to provide ideas for activities.

## Key Ideas

- A population is the whole group of individuals being studied. It is not always practical or cost effective to survey everyone in a large population. You might survey a sample of the population.
- A sample is any part of the population.
- A random sample ensures that all people have an equal chance of being selected for a study. You can use data from a random sample to make predictions about the population. Systematic samples and stratified samples are types of random samples.
- Voluntary response samples and convenience samples are types of non-random samples.



## Check Your Understanding

### Communicate the Ideas

1. Your friend sends you this e-mail.  
Write your response.

|   |
|---|
| FROM: Nick  |
| TO: Jonah   |
| I am confused about populations and samples. Would you please explain the difference? It would help if you gave an example of each. |
| Nick  |

2. A group can be the population or a sample, depending on the survey question. Do you agree? Give examples to support your opinion.
3. Kim and Scott want to know how many people took public transit to come to the sold-out concert. The seating capacity at the venue is 18 000 people.

Kim:

I plan to ask the first 20 people who arrive.

Scott:

I plan to ask the first 200 people.

- a) Whose sample would provide a more accurate representation of the population? Explain why.
- b) Recommend a different type of sample that would give more accurate results. Explain your reasoning.

## Practise

For help with #4 and #5, refer to Example 1 on pages 423-424.

4. Identify the population for each survey question. Indicate whether the population or a sample should be used for the survey. Justify your choice.

- a) Which band rocks like no other?
- b) Who will be next year's grade 10 representative on student council?
- c) Which styles of soccer shirts should be sold at Sports R Us?
- d) What brand of shampoo do you prefer?

5. In each case, identify the population. State whether you would survey the population or a sample of the population. Justify your choice.

- a) A newspaper wants to know the online activities of Internet users at home.
- b) The principal wants to know if people associated with the school are in favour of school uniforms.
- c) An electronics store needs to find out whether its customers are satisfied with the repairs and services department.
- d) The municipal government wants to determine if bus transit is needed for people with special needs.



For help with #6 and #7, refer to Example 2 on pages 424-425.

- 6. For each situation in #5, what type of sample would you use? How would you select the sample?
- 7. For each context, identify and describe the sample you would select for a survey.
  - a) A radio talk-show host wants listeners' views on a proposed by-law about watering lawns and gardens.
  - b) A province wants to select 25 schools to participate in a new physical education program.
  - c) A marketing firm wants to know teens' favourite magazines.
  - d) A reporter wants to ask people downtown about their plans to participate in the Big Valley Jamboree.

### Did You Know?

The Big Valley Jamboree, which is held in Camrose, Alberta, is Canada's biggest country music show. It was voted the Canadian Country Music Association's Country Music Event of the Year in 2006.

## Apply

- 8. For each context, would you recommend surveying the population or a sample? Justify your choice.
  - a) You want to determine the air quality in hospitals in Edmonton, Alberta.
  - b) You want to know post-secondary plans of grade 9 students.
  - c) You want to test the quality of parachutes.
  - d) You want to test the quality of bike tires.
- 9. Kristi wants to create a menu for a family picnic that will appeal to adults, teens, and children. Her family includes 20 adults, 8 teens, and 12 children. If she has time to talk to only 10 people, how should she choose her sample? Explain.

10. Jason, a member of the Graduation Committee, plans to ask each student who enters the cafeteria the following questions.

What is your favourite paint colour for the cafeteria walls? \_\_\_\_\_

Should the cafeteria be used for graduation? YES NO

- Identify the population.
  - Identify the sample.
  - Will the results of his survey accurately represent the population? Explain.
  - Is Jason correct in using the same sample for both questions? Explain your thinking.
11. The student council plans to survey students about how best to spend the budget for activities. Enzo prefers to spend the money on baseball equipment. He decides to randomly survey students at a baseball game.
- Is there a bias in Enzo's sample? If so, what is the bias?
  - Describe a sample that would reflect the overall opinion of students. Explain your thinking.



12. Anita and Cindi are asked to find out what type of mural to paint in the entrance of their office tower. There are 1400 employees. Cindi proposes using a random sample of 20 employees. Anita suggests using a stratified sample to get input from every department. Whose sampling method is better? Explain your reasoning.

13. Erin plans to survey her friends to determine the average number of children per household in Canada. Is this a random sample? Explain your reasoning.

14. Ben asked 50 people at random in a mall the following question.

Are you allergic to any of these animals?

- cats
- dogs
- birds
- gerbils
- hedgehogs

His results are displayed.

| Animal Allergy | Frequency | Total |
|----------------|-----------|-------|
| Cats           |           | 26    |
| Dogs           |           | 12    |
| Birds          |           | 8     |
| Gerbils        |           | 4     |
| Hedgehogs      |           | 0     |

- Ben made the following predictions based on his data. Do you agree with each prediction? Explain.
  - Almost 25% of the population is allergic to dogs.
  - Hedgehogs do not cause allergies.
- Improve the survey question. Explain your reasoning.

### Extend

15. Search various media for information about a recent survey. Use sources such as magazine and newspaper articles, or radio, television, and Internet reports.
- Identify and comment on the population and the sample.
  - Are the predictions valid for the population? Explain your reasoning.
  - Was the survey well conducted? What improvements, if any, would you recommend?

16. Five firefighters conducted a survey to assess how well the fire department is performing. They asked local residents the following question.

Which of the following choices best describes your opinion of how well the fire department is doing?

- A Excellent
- B Very Good
- C Good
- D Poor

A week later, the local paper has the headline as shown.

## THE DAILY NEWS

### Survey Reveals Majority Very Satisfied With Fire Department



- a) How might the wording of the question affect the collection of data? Rewrite the question to produce more accurate responses.
- b) What else may have influenced the collection of data? Describe how to conduct a survey that would reflect opinions more accurately.

### Math Link

For your research project, choose one of the research questions you wrote for the Math Link on page 421.

- a) What is your question?
- b) Write a hypothesis that clearly states what you want to prove or disprove.
- c) Identify and describe the population for your question.
- d) To answer your question, you will need to find data from studies and surveys that have already been done. You will do the research in the Math Link on page 439. What sampling methods do you think would be used to collect data related to your question? Explain your reasoning.

An example is shown.

**Research Question:** What are the population trends for beluga whales in Canada?

We predict that all beluga whale populations in Canada are threatened.

We hypothesize that there are few differences in the population trends for the whale populations in Canada.

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The beluga whale populations in Canada can be organized into seven groups.



- 1. St. Lawrence
- 2. Ungava Bay
- 3. Eastern Hudson Bay
- 4. Western Hudson Bay
- 5. Cumberland Sound
- 6. High Arctic
- 7. Beaufort Sea

We expect that studies will use samples of beluga whale populations since there are large numbers of whales spread out over large areas.

### Literacy Link

A *hypothesis* is a statement put forward to guide an investigation.

**Focus On...**

After this lesson, you will be able to...

- identify and explain assumptions linked to probabilities
- explain decisions based on probabilities



When planning an outdoor event, knowing the probability of a rain shower or a thunderstorm can be helpful. Forecasters often use probability to express their degree of certainty in the chance of a weather event occurring. For example, a 30% probability of rain today means that there are 3 chances in 10 that you will get wet today.

To produce a probability forecast, the forecaster studies the current weather situation, including wind and moisture patterns and determines how these patterns will change over time. What assumptions might a weather forecaster make when making a probability forecast?

**Explore Making Decisions Based on Probability**

You are a town planner and need to know if people want walking trails or bike paths along the nearby river. There are 15 000 people in the town. You decide to survey 1500 people.

1. Identify the population.
2. Describe how you might select the sample and how you could conduct the survey.
3. **a)** As a result of the survey, suppose 60% of people prefer bike paths. What prediction would you make about the preference of the town's population?  
**b)** What assumptions did you make in your prediction?

**Reflect and Check**

4. **a)** Exchange your sample with the one of a classmate. Does your classmate's sample represent the population? Explain your reasoning.  
**b)** Based on the sample, what decision will you make about walking trails or bike paths?

**Literacy Link**

An *assumption* is something taken for granted, as if it were true.

## Link the Ideas

### Example 1: Use a Sample to Make a Prediction About the Population

Ruth wants to determine the most common eye colour of students. All grade 12 students in five of seven high schools in a city recorded their eye colour. A total of 2300 students were surveyed. The results are shown in the table.

| Eye Colour | Total |
|------------|-------|
| Brown      | 1656  |
| Blue       | 483   |
| Green      | 115   |
| Other      | 46    |

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- From the results, predict how many of the 7200 students at the local college will have brown eyes. Show your thinking.
- Is your prediction reasonable? Explain why or why not.

#### Solution

- Of the 2300 students surveyed, 1656 students have brown eyes.

$$\begin{aligned}\text{Percent with brown eyes} &= \frac{1656}{2300} \times 100 \\ &= 72\end{aligned}$$

Calculate 72% of 7200.

$$0.72 \times 7200 = 5184$$

Based on the results, approximately 5200 students at the local college will have brown eyes.

- No, not necessarily. An assumption was made that the high school sample represents the college population.

The sample represents the local grade 12 population by surveying all students in five out of seven schools. The sample may not represent the college student population. A college often has many students who come from other parts of the province or territory, and other provinces and countries. In this case, the sample could be a **biased sample**. As a result, the prediction may not be valid for the college population.

You can be more confident that the prediction is reasonable by revising the prediction statement to include a limitation. “If the student population in the high schools and the college are similar, based on the results, there are approximately 5200 college students who have brown eyes.”

#### WWW Web Link

For information about gene types that determine eye colour, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.

#### Strategies

##### Estimate and Check

Over half of the surveyed students have brown eyes. This means that at least 3600 students at the college have brown eyes.



#### biased sample

- does not represent the population
- can make survey results inaccurate

### Literacy Link

To *generalize* means to make a broad statement from known facts.

### Did You Know?

Advertising and marketing agencies often generalize results from a sample that does not represent the population. They do this in order to promote a product or service. Consumers need to consider advertising claims carefully.

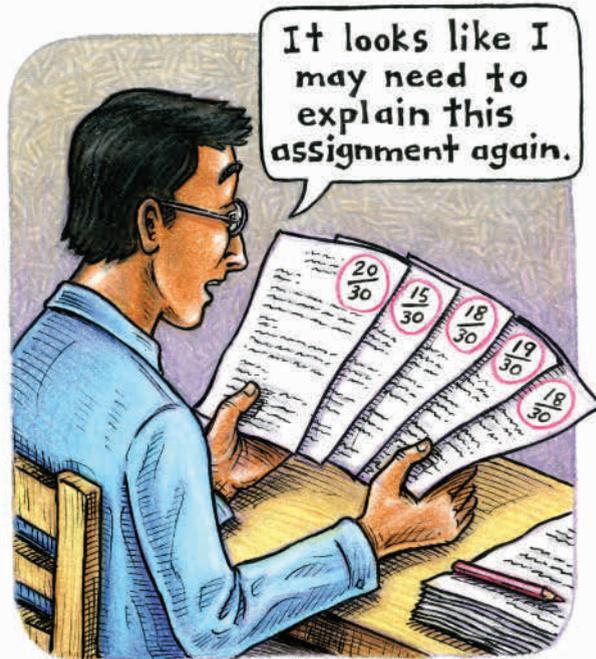
### Show You Know

Use the information in Example 1 to help answer the following.

- Predict how many of the local college students have blue eyes or green eyes. Show your work.
- Can you generalize the results from the sample to the local college population? Explain.
- What limitation might you include to make your prediction more accurate?

### Example 2: Avoid Making a False Prediction

Mr. Krutz gave an assignment worth 30 marks. After marking the first five papers, he was concerned that the students did not understand the assignment. He predicted most students would not do well.



- Based on Mr. Krutz's sample, predict the "average" mark for the whole class on the assignment as a percent.

- The scores for all 30 students in the class are:

20 15 18 19 18 16 17 23 24 30  
22 24 21 20 24 25 19 24 15 28  
27 28 22 24 19  
13 28 22 24 20

Why does Mr. Krutz's sample lead him to make a false prediction?

### Solution

- a) To predict the average mark, Mr. Krutz could use the measures of central tendency.

Mean:

$$\text{Mean} = \frac{20 + 15 + 18 + 19 + 18}{5}$$
$$= 18$$

The mean is 18.

Median:

The median is 18.

Mode:

The mode is 18.

The mean, median, and mode for the sample scores are 18.

Based on the sample statistics, the “average” mark on the assignment is predicted to be

$$\frac{18}{30} \times 100 \text{ or } 60\%.$$

- b) The mean, median, and mode for the class population are 22, 22, and 24, respectively.

Mr. Krutz assumed that the sample consisting of the first five papers was representative of the entire class. This is false. The mean score in the sample is 60%. The mean score in the population is approximately 73%. The most frequent score is 80%.

Mr. Krutz may have considered too few members of the class. The sample does not represent the population.

How did Mr. Krutz determine these values?

### Strategies

Organize, Analyse,  
and Solve

### Show You Know

Use the data in Example 2.

What if Mr. Krutz had marked the last five papers first?

Do they give a more reasonable prediction of the class average? Explain.

### Example 3: Make a Decision Based on Probability

A youth association surveys its 400 members about their preferred activity. There are 100 members in each of four groups. The activities were chosen from a youth activities resource. The table displays the survey results.

| Group  | Swimming | Rock Climbing | Watching Movies | Bowling | Total |
|--------|----------|---------------|-----------------|---------|-------|
| Red    | 14       | 9             | 40              | 37      | 100   |
| Blue   | 11       | 19            | 59              | 11      | 100   |
| Green  | 27       | 12            | 57              | 4       | 100   |
| Yellow | 13       | 24            | 44              | 19      | 100   |

- What is the probability that a member of any group will choose swimming? Based on this, predict how many of the 400 members will choose swimming.
- What assumptions did you make?
- Based on the survey results, predict the probability that a member will choose swimming.
- Compare your answers for parts a) and c). Explain any differences.

#### Solution

- a) The theoretical probability of choosing any one of the four activities is equally likely.

$$P(\text{swimming}) = \frac{1}{4} \text{ or } 25\%$$

The probability that a member of any group will choose swimming is  $\frac{1}{4}$ .

Since there are 400 members, 100 will probably choose swimming.

- b) The assumptions are as follows:
- Every activity has an equal chance of being selected.
  - Members have an equal level of interest in each activity.

- c) The survey results reflect the experimental probability.

$$\begin{aligned} P(\text{swimming}) &= \frac{14 + 11 + 27 + 13}{400} \\ &= \frac{65}{400} \end{aligned}$$

$$\frac{65}{400} = 16.25\%$$

The experimental probability that a member will choose swimming is 16.25%.

- d)  $25\% > 16.25\%$ .

The theoretical probability is greater than the experimental probability. Watching movies has the greatest probability. The group of students who answered this survey appear to prefer watching movies to swimming, rock climbing, or bowling. The experimental probability gives a truer reflection of the youths' interests.

### Show You Know

Refer to the information in Example 3.

- Based on the survey results, what is the probability that a member will choose watching movies? bowling?
- If you were the youth coordinator planning the activities, how would you determine the favourite activity? Explain your reasoning.

### Key Ideas

- A biased sample can make survey results inaccurate.
- When a sample represents the population, you can generalize the results to the population.
- You can use experimental probability and theoretical probability to help make decisions based on probability.

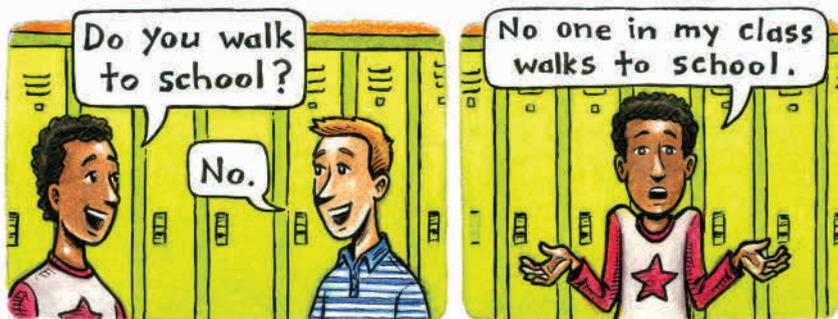
A biased sample may result when a large percent of individuals in a sample refuse to participate in a survey.

## Check Your Understanding

### Communicate the Ideas

- Kelly is confused about the difference between a sample that represents the population and one that does not. Use an example to help explain the difference to him.

- Use the cartoon to explain how a sample might result in a false prediction.



- How might you use experimental probability and theoretical probability to help make a decision about what flavours of ice cream to offer at a sport tournament?

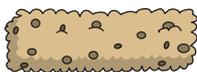
### Practise

For help with #4 and #5, refer to Example 1 on page 431.

- A light bulb factory samples light bulbs as they come off the assembly line. A random sample shows that 1 bulb out of every 20 is defective. In a run of 1380 bulbs, the quality manager predicts that 69 bulbs will be defective. What assumptions did the quality manager make in his prediction?
- A toothpick factory samples every 100th toothpick for damage. The sample shows a 0.17% probability of damage. How many toothpicks would you predict to be damaged in the daily production of 2.4 million toothpicks? Include any assumptions you made in your prediction.

For help with #6 and #7, refer to Example 2 on pages 432-433.

6. A cafeteria supervisor asked three students who are vegetarians about their preference for a lunch menu. All three chose garden salad, tomato soup, and garlic bread. The supervisor plans to serve their menu choice the next day, thinking that it will sell well.
- Did the sample lead the supervisor to make a false prediction? Explain.
  - If the prediction is false, explain how you might make a more accurate one.
7. A manufacturer makes the following claim about the mass of its health bars.



Each bar has a mass of at least 50 g.

Erika and Brett weighed ten health bars to check the claim. Three bars had a mass less than 50 g and one bar had a mass of exactly 50 g. The students predicted that 30% of the health bars made by the company would not meet the claim.

- Did the sample lead the students to make a false prediction? Explain.
- If the prediction is false, explain how you might make a more accurate one.

For help with #8 and #9, refer to Example 3 on page 434.

8. Greenville, a town with 4000 people, is having an election for mayor. A reporter polled 40 people and found 53% chose Candidate A, 23% chose Candidate B, and the rest chose Candidate C.
- How many people polled chose Candidate C?
  - What is the theoretical probability that a voter will choose Candidate A? What assumptions did you make?
  - Compare the experimental and theoretical probabilities of Candidate A winning.
  - The reporter predicts that Candidate A will win the election. Do you agree with his prediction? Explain your reasoning.

9. A movie rental company has five types of movies. They are drama, comedy, horror, action, and science fiction/fantasy movies.
- What is the theoretical probability that a person will choose a comedy?
  - What assumptions did you make?
  - The table displays the movie preferences from a random survey of 50 customers. Predict the probability that a customer will choose a comedy movie.

| Movie Type              | Responses |
|-------------------------|-----------|
| Drama                   | 15        |
| Comedy                  | 10        |
| Horror                  | 12        |
| Action                  | 11        |
| Science fiction/Fantasy | 2         |

- Compare your answers for parts a) and c). Explain any differences.
- About how many rentals out of a total of 2000 movies will be drama movies?

### Apply

10. Miya received the following scores from ten judges in a skating competition. Skating performances are given a score out of 10.

| Judge | 1   | 2 | 3   | 4   | 5   | 6 | 7 | 8   | 9   | 10 |
|-------|-----|---|-----|-----|-----|---|---|-----|-----|----|
| Score | 8.5 | 6 | 6.5 | 6.5 | 6.5 | 7 | 6 | 6.5 | 4.5 | 7  |

- Calculate Miya's mean score based on all ten judges.
- Use the first three judges' scores as a sample. Calculate the mean.
- Use the last three judges' scores as a sample. Calculate the mean.
- Compare the mean from each sample to the mean for all judges. Are the samples a good predictor for Miya's overall score? Explain.

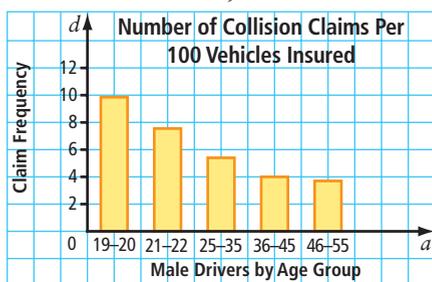


11. Jack wants to know the weekly earnings of grade 9 students who work part-time in the summer. He surveyed five grade 9 students. Here are the results: \$75, \$120, \$45, \$250, and \$85.
- Is this a biased sample? Explain your reasoning.
  - Jack concluded that grade 9 students earn an average of \$115 per week. Do you agree with his conclusion? Explain.

12. Colin read an article that claims that more girls are born than boys. Colin predicted that a couple has a 50% chance of having a boy. He tested the prediction by tossing a coin 100 times for each of 10 trials. Here are the results.
- Do these experimental results confirm Colin's prediction or the article's claim? Show your thinking.

| Trial | Boys | Girls |
|-------|------|-------|
| 1     | 40   | 60    |
| 2     | 43   | 57    |
| 3     | 50   | 50    |
| 4     | 46   | 54    |
| 5     | 48   | 52    |
| 6     | 58   | 42    |
| 7     | 50   | 50    |
| 8     | 49   | 51    |
| 9     | 50   | 50    |
| 10    | 53   | 47    |

13. The graph shows the number of collision claims per 100 vehicles insured for male drivers in Alberta, in 2004.



Many insurance companies charge drivers under the age of 25 higher insurance premiums based on the probability of accidents. Find information about car insurance costs based on the probability of collision. Paste the article into your notebook.

- In the article, what are the assumptions associated with each probability? Is each probability accurate? Explain.
- In your opinion, is there a bias against young drivers? Explain your reasoning.
- “Decisions about car insurance costs are based on a combination of experimental probability, theoretical probability, and biased judgment.” Do you agree or disagree with this statement? Explain your reasoning.

**WWW Web Link**

For information about road safety, risk factors, and factors affecting car insurance rates, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.

14. Cathy and John are waiting for the bus. John predicts that one of the next five vehicles to pass the bus stop will be a minivan. Cathy predicts two of the next five vehicles will be minivans. John made his prediction based on five types of vehicles on the road: cars, sport utility vehicles (SUVs), buses, minivans, and trucks.
- How do you think John and Cathy made their predictions?
  - John and Cathy decided to test their predictions by conducting a survey. They observed vehicles passing the bus stop for 1 h at the same time each day for five days. The table shows their results.

| Type    | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 |
|---------|-------|-------|-------|-------|-------|
| Car     | 30    | 28    | 25    | 27    | 25    |
| SUV     | 20    | 25    | 18    | 22    | 18    |
| Bus     | 4     | 4     | 3     | 4     | 4     |
| Minivan | 8     | 10    | 12    | 9     | 7     |
| Truck   | 10    | 7     | 11    | 8     | 10    |

From the results, whose prediction was more accurate? Explain.

- In one day, 800 vehicles passed the bus stop. Based on the survey results, predict the number of trucks.

- 15.** The Jackson family is celebrating the coming birth of triplets. They currently have two boys. Mrs. Jackson is hoping for three girls.
- What is the theoretical probability that she will have three girls? Show your thinking.
  - The Jacksons used a random number generator to simulate the situation. They decide that 1 indicates a girl and 0 indicates a boy. The table shows the results for ten trials. What is the experimental probability of three girls?

| Trial | Experimental Results |   |   |
|-------|----------------------|---|---|
| 1     | 0                    | 0 | 0 |
| 2     | 0                    | 1 | 1 |
| 3     | 0                    | 1 | 0 |
| 4     | 1                    | 0 | 1 |
| 5     | 1                    | 0 | 1 |
| 6     | 1                    | 1 | 0 |
| 7     | 1                    | 0 | 0 |
| 8     | 1                    | 1 | 0 |
| 9     | 0                    | 0 | 0 |
| 10    | 0                    | 1 | 0 |

- Compare the experimental probability and the theoretical probability.
- The boys predict that their mother will have three more boys. Do you agree with their prediction? Justify your answer.
- What assumptions did you make?

### Extend

- 16.** A random sample of 160 students out of 2100 participants in a summer youth program responded to a survey.

|                                   | Yes | No  |
|-----------------------------------|-----|-----|
| Do you play a musical instrument? | 40  | 120 |
| Do you play on a sports team?     | 25  | 135 |

- Does the sample represent the population? Explain.
- Based on the data, what is the probability that a participant, chosen at random, will play a musical instrument?

- Of the 160 students interviewed, 20 students played a musical instrument and were on a sports team. Predict how many of the 2100 youth group members do not play a musical instrument or play on a sports team.
- What assumptions did you make in part c)?



- 17.** Search magazines, newspapers, or the Internet. Look for an article that uses probability to make a prediction for a population.
- Identify the assumptions associated with the probability.
  - Explain the limitations of each assumption.
  - In your opinion, is the prediction accurate? Justify your answer.
- 18.** Search magazines, newspapers, or the Internet for an issue of personal interest.
- Take a stand on the issue. Write an argument that includes a probability statement to support your stand. Use methods of your choice to display your data.
  - Take the opposite stand. Using the same data, or new data, write an argument that includes a probability statement to support your new stand.
  - Present your arguments to a classmate. Have your classmate point out the strengths and weaknesses of both arguments.

## Math Link

For your research project, collect data from studies and surveys that have been done. Use sources such as scientific publications and the Internet. Depending on the data that you find, you may need to revise your research question.

- a) Describe the data you will look for. Where will you look?
- b) Record notes for at least three studies related to your question. Include the following information for each study:
  - Describe the sampling method used. Did it involve the population or a sample?
  - For a study involving a sample, discuss whether the results can be generalized to the population.
  - Describe the method used to collect the data.
  - Summarize the results.
  - Describe any assumptions that were made. Explain the limitations of each assumption.
  - Discuss the accuracy of any predictions made about the population.
  - Provide complete source information.

A summary of a whale population study is shown.

We researched a study done by the Committee on the Status of Endangered Wildlife in Canada. The table shows the estimated whale populations.

| Beluga Whale Population | Estimated Population (2004) | Population Compared to Pre-Whaling | Trend  |
|-------------------------|-----------------------------|------------------------------------|--|
| St. Lawrence            | 950                         | low                                | <ul style="list-style-type: none"> <li>• endangered</li> <li>• stable or increasing</li> </ul> |
| Ungava Bay              | too small to estimate       | very low, or may no longer exist   | <ul style="list-style-type: none"> <li>• may no longer exist</li> </ul>                        |
| Eastern Hudson Bay      | 2000                        | low                                | <ul style="list-style-type: none"> <li>• decreasing rapidly</li> </ul>                         |
| Western Hudson Bay      | 23 000                      | large                              | <ul style="list-style-type: none"> <li>• unknown</li> </ul>                                    |
| Cumberland Sound        | 1500                        | low                                | <ul style="list-style-type: none"> <li>• endangered</li> <li>• stable or increasing</li> </ul> |
| High Arctic             | 20 000                      | unknown                            | <ul style="list-style-type: none"> <li>• unknown</li> </ul>                                    |
| Beaufort Sea            | 39 000                      | large                              | <ul style="list-style-type: none"> <li>• not threatened</li> <li>• increasing</li> </ul>       |

Smith, T. G. "COSEWIC Assessment and Update Status Report on the Beluga Whale *Delphinapterus leucas* in Canada." 2004. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 20 Oct 2008 <<http://dsp-psd.pwgsc.gc.ca/Collection/CW69-14-170-2004E.pdf>>.

# 11.4

## Developing and Implementing a Project Plan

### Focus on...

After this lesson, you will be able to...

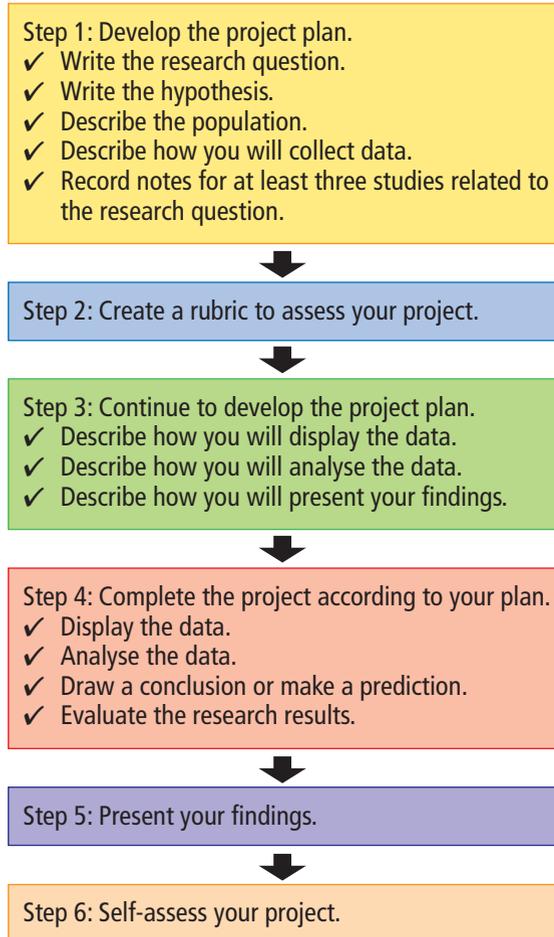
- develop a research project plan
- complete a research project according to a plan, draw conclusions, and communicate findings
- self-assess a research project by applying a rubric

### Materials

- blank Research Project Rubric 

Developing and carrying out a research project requires careful planning. During the Math Links on pages 421, 429, and 439, you worked on Step 1, as shown in the flow chart. Use your work to continue to develop your project plan. In this section, you will also develop a rubric, carry out your plan, and then assess your project using your rubric.

Use the flow chart to help organize your research project and carry out your plan.



### Step 1

Complete the research for your project.

## Step 2

Develop a rubric so that you know what is expected. Use the following example and a copy of the blank Research Project Rubric to help develop your own.

- List the criteria in column 1. You may find it useful to order the criteria according to the sequence of the project.
- For each criterion, record an indicator for each of four levels of performance. See how the first row in the example below is completed to give you ideas for your own rubric.
  - Level 1 reflects work that shows little evidence of expected results.
  - Level 2 reflects work that meets the minimum expected standard.
  - Level 3 reflects work that meets the expected standard.
  - Level 4 reflects work that is beyond the expected standard.

| Criteria  | Level 1   | Level 2  | Level 3  | Level 4  |
|---|---|--|--|--|
| Planning <ul style="list-style-type: none"> <li>• question and hypothesis</li> <li>• description of population</li> </ul> | <ul style="list-style-type: none"> <li>• not clear and not related</li> <li>• limited or missing</li> </ul> | <ul style="list-style-type: none"> <li>• fairly clear but not related</li> <li>• some description</li> </ul> | <ul style="list-style-type: none"> <li>• mostly clear and related</li> <li>• adequate description</li> </ul> | <ul style="list-style-type: none"> <li>• very clear, concise, and related</li> <li>• detailed description</li> </ul> |
| Performing <ul style="list-style-type: none"> <li>• research and data collection</li> </ul>                               |   |  |  |  |
| Recording <ul style="list-style-type: none"> <li>• data display</li> </ul>  |   |  |  |  |
| Analysing <ul style="list-style-type: none"> <li>• analysis</li> <li>• conclusion(s)</li> </ul>                           |   |  |  |  |
| Presenting <ul style="list-style-type: none"> <li>• project plan and evaluation of results</li> </ul>                     |   |  |  |  |

### Step 3

Continue to develop the project plan.

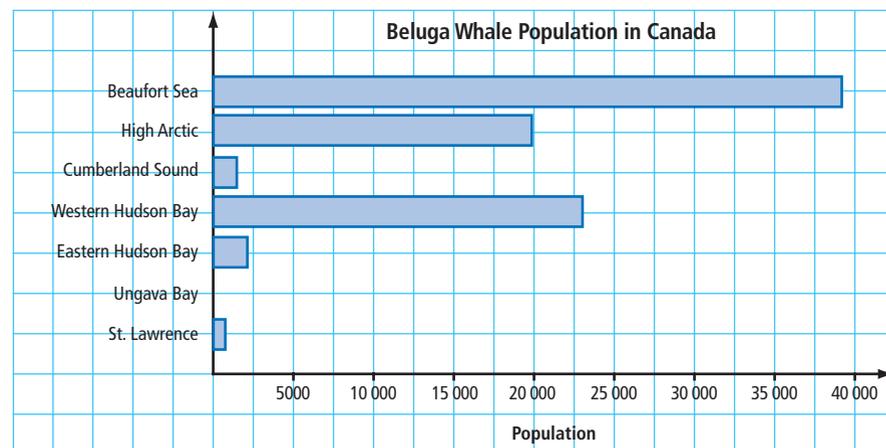
- a) Describe how you will organize and display your data. Select only data that help you answer your question.
- b) Describe your method for analysing the data from the studies you find. Consider the following ideas.
  - Describe any assumptions that were made. Explain the limitations of each assumption.
  - Discuss the accuracy of any predictions made about the population.
- c) Describe how you will present your findings.

### Step 4

Complete the project.

- a) Display the data.
- b) Analyse the data. Draw a conclusion or a prediction you can make from the data.
- c) Evaluate your research results. Consider using the following questions.
  - Do the data answer your question or do you need to do further research?
  - Do the data support your hypothesis? Explain.
  - Are the data biased? Explain.
  - What questions could you ask as a result of your research?
  - What other sampling methods could have been considered?
  - Troubleshoot any problems you may have encountered, such as the following: Did you use too few resources? Was your research question too broad? How well was the data collected? Were there influencing factors on the collection of data?

We used a graph to display data about beluga whale populations.



The data show significant differences in the size and population trends for the beluga populations in Canada. We would need to do further research to find the reasons for the differences.

The data do not support our hypothesis.

We had difficulty finding population counts. The estimates for whale populations range widely from a total of 72 000 to 144 000 belugas in Canadian waters.

There are problems in conducting whale counts using boat and aerial surveys. These methods are limited because they can count whales only near the surface. Studies that use satellite tracking, time-depth recording of animals, and aerial surveys are the most promising for future research.

There may have been a bias in the data due to the web sites we were able to access.

As a result of our research we could ask these questions:

- What factors affect the beluga whale population in each Canadian location?
- Conservation efforts for the St. Lawrence population appear to have helped maintain the numbers. Why have they not helped the Ungava Bay population?
- What are the trends for the populations of beluga whales in other locations in the world?

### Step 5

Present your findings in a format of your choice. You might choose a written or oral report, use technology, or use a combination of formats.

Your presentation needs to outline your project plan and your conclusions. It should include:

- a title that indicates the purpose of your project
- a research question and a hypothesis
- a description of the population
- for the studies researched,
  - the sampling methods used
  - the methods used to collect data
  - the results and conclusions
- your display of the data and data sources
- your conclusion to answer your research question
- your evaluation of the research results
- a bibliography of all sources

### Math Link: Wrap It Up!

You have arrived at the final step of your research project. You will assess your project.

#### Step 6

- a) Use the rubric you developed to assess your research project. Identify your project's strengths and weaknesses.
- b) Identify two things you liked about your project. Identify one thing you would do differently next time.
- c) Have a classmate who read or watched your presentation assess your project using the rubric. Ask for constructive feedback on how to improve the project.

# Chapter 11 Review

## Key Words

For #1 to #9, choose the letter representing the term that best matches each description.

- |   |                                    |
|---|------------------------------------|
| 1. an example is every tenth person in a line-up  | <b>A</b> convenience sample        |
| 2. privacy and cost are examples that affect data collection  | <b>B</b> population                |
| 3. an example is polling 2 students out of 100 students about who will win an election  | <b>C</b> influencing factors       |
| 4. an example is the first 30 people entering the gates at a football game  | <b>D</b> sample                    |
| 5. a sample in which all members of a population have an equal chance of being selected   | <b>E</b> biased sample             |
| 6. any group selected from a population   | <b>F</b> voluntary response sample |
| 7. the whole group of people being studied  | <b>G</b> random sample             |
| 8. an example is dividing the population into males and females and then randomly selecting a proportional number from each group | <b>H</b> systematic sample         |
| 9. an example is a population invited to call in a response to a radio talk show  | <b>I</b> stratified sample         |

### 11.1 Factors Affecting Data Collection, pages 414–421

10. For each situation, identify and describe any influencing factors that affect a survey.
- Ask the first 40 people entering a park office if they are willing to pay increased rates to help offset increased costs.
  - Ask ten people selected at random in a grocery store if they like store-bought bread.
- c) Ask 15 juice drinkers if they would support replacing the juice in the vending machine with bottled water.
11. Identify any factors that may influence data collection. Then, write an improved survey question.
- Which do you prefer: chocolate cheesecake or strawberry cheesecake?
  - Everybody loves The Rockets, but who is your favourite rock group?
  - A recent survey shows that 45% of Internet users download music. What music did you download in the past month?

### 11.2 Collecting Data, pages 422–429

12. Identify the population for each situation. Then, describe how you would select a sample for each.
- the spending habits of teens in Canada
  - the popularity of different kinds of music in your school
  - the cost of gasoline in your community
13. For each situation, identify the type of sample. Identify any bias in each sample.
- The first 20 shoppers to enter the north entrance of a mall are surveyed.
  - Youth conference delegates are divided into groups according to the western province or territory where they live. Then, 20 youths from each group are randomly selected.
  - The area supervisor for a fast-food chain selects employees at one store location.

14. What type of sample do you recommend for each situation? Explain why.
- a survey of doctors, nurses, and hospital administrators to determine whether the hospital needs an additional wing
  - a survey of customers to determine the favourite sundae topping
15. To check the spread of a disease among trees in a forest, a forester wants to inspect 10% of the trees. Identify each of the following types of samples the forester could use.
- Sample 10% of the trees closest to the logging road.
  - Divide the forest into sections and randomly select 10% of the trees in each section.
  - Give each tree a number. Randomly select a starting tree and then select every tenth tree after the starting number.

### 11.3 Probability in Society, pages 430–439

16. A biologist captures, tags, and releases 85 bull trout in a stream. A month later, she returns and captures 100 bull trout and notes that 28 of them have tags.
- Based on this result, predict how many bull trout fish are in the stream.
  - What assumptions did you make?
  - What could the biologist do differently to make the prediction more accurate?

#### Did You Know?

Bull trout, lake trout, and Arctic char belong to a subgroup of the salmon family. Bull trout that live in lakes can grow to more than 9 kg. Those that live in streams rarely grow to more than 2 kg.



Bull trout, Oldman River, Alberta

17. Nancy is running for treasurer on student council. She surveys 20 people in her class about who they will vote for. Based on her survey results, Nancy predicts that 75% of the 328 grade 9 students will vote for her.
- Is her prediction reasonable? Explain.
  - Explain how she could ensure a more accurate prediction.
18. Students in two grade 9 classes in a school were asked what item they spend most money on. The results are posted here.

| Item       | Number of Students |
|------------|--------------------|
| Movies     | 11                 |
| Cell phone | 13                 |
| Music      | 11                 |
| Clothes    | 6                  |
| Other      | 7                  |

The students were divided into four groups and asked to make a prediction for all grade 9 students based on the results.

Group 1: Grade 9s like buying other items more than clothes.

Group 2: Cell phones are more important to grade 9s than any other form of entertainment.



Group 3: Of the 500 grade 9 students in the city, it is likely that 135 will have cell phones.

Group 4: It is likely that a grade 9 student will spend his or her money on either movies or music.

Explain why you agree or disagree with each prediction.

# Chapter 11 Practice Test

For #1 to #4, choose the best answer.

1. Linda and Matt each survey 20 people about the carving in front of the post office. Linda was in the mall entrance and Matt was in the entrance to the fine arts centre. When they compared their results, the responses were very different. What influencing factor(s) may have caused the difference?  
**A** cultural sensitivity  
**B** timing  
**C** use of language  
**D** all of the above
2. Diana wants to survey grade 9 students about their favourite flavour of soft drink. Which question is most appropriate?  
**A** Is cola your favourite type of soft drink?  
**B** Do you like soft drinks?  
**C** What is your favourite flavour of soft drink?  
**D** What brand of soft drink do you prefer?
3. An eco-tourism company is researching how to expand its tours. They divide the western provinces into eight areas. Then, they survey 10% of the population in each area. Which sampling method is this?  
**A** convenience sample  
**B** stratified sample  
**C** systematic sample  
**D** voluntary response sample



4. A business sends questionnaires to 50% of its employees randomly selected from a list. Which sampling method is this?  
**A** convenience sample  
**B** stratified sample  
**C** systematic sample  
**D** voluntary response sample

Complete the statements in #5 to #7.

5. A small group that represents a population is a .
6. Choosing members of the population at fixed intervals from a membership list describes a .
7. A web site that asks browsers to fill out an online survey is using a .

## Short Answer

8. Cheyenne wants to survey students in her high school about types of music for a school dance. They can choose from rap, alternative, rock, and country.
  - a) What is the population for this study?
  - b) Write a survey question that is clearly stated and free from influencing factors.
  - c) Describe two sampling methods she could use for her survey.
9. Read the survey question.

Do you think students should take Physical Education in school?

YES NO

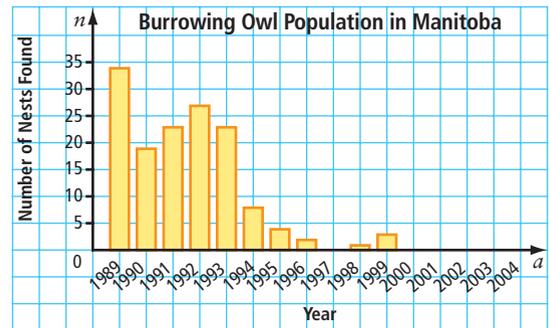
- a) The school sports coaches are randomly surveyed. Is this sample biased? Explain.
- b) The school sports teams are randomly surveyed. Is this sample biased? Explain.
- c) Describe a sample that is free from bias.

10. For each situation, decide if you would survey the population or a sample. Give a reason.
- A truck loaded with fresh produce arrives for inspection.
  - Are the smoke detectors in the office tower working?
  - How much exercise do students get?
11. On an assembly line for cell phones, a random sample shows 3% of the units are defective. How many are likely to be defective in a run of 3248 cell phones? Include any assumptions you made in your prediction.

### Extended Response

12. Paul knew the theoretical probability of getting heads when he tossed a coin was 50%. After conducting an experiment of ten trials, his experimental probability of getting heads was 60%. He concluded that the more times he tosses the coin, the more likely he will get heads. Do you agree? Why or why not?
13. Greg is researching to what extent programs are successful in protecting burrowing owls. Burrowing owls are considered endangered in Canada. In 1977, there were about 2000 breeding pairs of burrowing owls in Canada. By 2003, the population was reduced to less than 500 pairs. Greg found data from the Manitoba Wildlife Branch that has been monitoring and protecting these owls since 1982.

The graph shows data about the burrowing owl population in Manitoba since 1989.



Based on the data, Greg concludes that programs in place to protect burrowing owls are not successful in increasing the population. Provide feedback to Greg about his question, data, and conclusion. What conclusion might you suggest to Greg? What further advice might you give?



# Challenges

## Global Warming

Tornados, floods, droughts, tsunami, killer heat waves, and other extreme weather events often make headlines. Many climate scientists have linked extreme weather events to global warming.

You be the climate scientist. Collect and analyse weather data to help you determine whether or not there is a warming trend in your area.

1. Collect climate data such as air temperature or ocean temperature for an area of your choice. Critique the quality of your data. Possible questions to consider include:
  - What sources did you use?
  - How was the data collected?
  - How far back in time does the data go?
2. Graph your data.
3.
  - a) Is there a warming trend in the area you analysed? Justify your answer.
  - b) What are the limitations of your data?
  - c) Do your findings support global warming? Explain.
4. Exchange your data and graph(s) with those of a classmate. Assess the limitations of the data.



### Did You Know?

Climate scientists or climatologists measure weather patterns and how they change over time in order to forecast the weather. They analyse and interpret maps, charts, photographs, and other data that include temperature, rain and snowfall, and wind.

### Web Link

For Environment Canada's climate data for specific locations and dates going back to 1840, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.

## Probability in Society

Read these headlines.



Almost half of the people did not like this movie. No way that I will watch it!

Most people liked this movie. I want to watch this one!

This is terrible. Almost half of all Canadians do not care about conserving water.

We are doing well. More than half of all Canadians are conserving water.

Headlines such as these can be used to support different points of view. You be the researcher. Search newspapers, magazines, or the Internet for two different headlines that include a probability statement.

1. For each headline, state whether you think experimental probability or theoretical probability is involved. Explain your thinking.
2. a) Identify the assumptions associated with each probability.  
b) Describe the limitations of each assumption.
3. a) Use the probability statement from one headline to develop two opposing positions you could take.  
b) Write an argument to support each position.  
c) Identify one strength and one weakness of each argument.

### WWW Web Link

For sources of online headlines, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.

For online newspapers, go to [www.mathlinks9.ca](http://www.mathlinks9.ca) and follow the links.



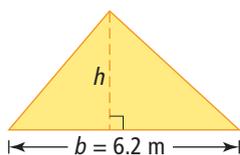
# Chapters 8–11 Review

## Chapter 8

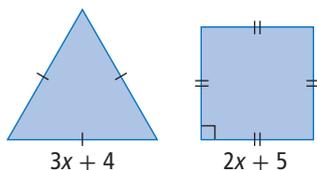
- For each equation:
  - Without solving, predict whether the value of  $x$  is greater than 1 or less than 1. Explain your reasoning.
  - Solve to verify your prediction.

a)  $8x = \frac{2}{5}$                       b)  $\frac{x}{9} = \frac{5}{6}$

c)  $\frac{7}{x} = \frac{1}{4}$                         d)  $\frac{1}{x} = \frac{5}{2}$
- The formula for the area of a triangle is  $A = \frac{1}{2}bh$ , where  $b$  is the length of the base and  $h$  is the altitude. A triangle has an area of  $10.54 \text{ m}^2$  and a base length of  $6.2 \text{ m}$ . What is the altitude of the triangle?

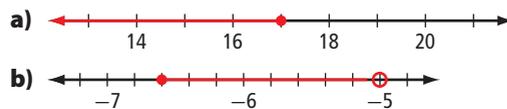


- Bruno bought four identical boxes of granola. He received \$6.04 in change from a \$20.00 bill. How much did he pay for each box of granola?
- Two electricians both charge a fee for a service call, plus an hourly rate for their work. Theo charges a \$49.95 fee plus \$40.00 per hour. Vita charges a \$69.95 fee plus \$32.00 per hour. For what length of service call do Theo and Vita charge the same amount?
- The equilateral triangle and the square have equal perimeters. What is the side length of the square?



## Chapter 9

- What is the algebraic form of the inequality represented on each number line?



- Represent each inequality graphically.
 

a)  $x < -6$                       b)  $2.4 \leq x$
- Write an inequality to represent each election promise that a politician made.
  - At least eight new highways projects will be started.
  - There will be a budget surplus of over 1.3 million this year.
  - Unemployment will be no more than 3.7%.
  - Taxes will be lowered by as much as 10%.
- Solve each inequality. Express the solution algebraically and graphically.
 

a)  $15 > x + 6.2$                       b)  $-25x < 40$

c)  $\frac{x}{5} \geq -10$                           d)  $20 - x \leq 8$
- Solve each inequality and verify the solution.
 

a)  $4x + 17 \geq 35$

b)  $8 < \frac{x}{4} + 3$

c)  $5x + 30 > 8x - 9$

d)  $2(3 - 4x) \leq 3(8 - 2x)$
- Linda needs to hire a rubbish removal service to clean up a construction site. The Junk King charges \$325 plus \$110/t. The Clean Queen charges \$145/t. How many tonnes of rubbish would make The Junk King the better option?

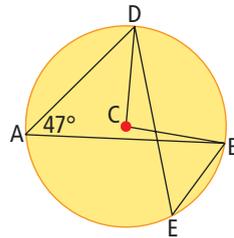
12. Lori is going to rent a climbing wall for a school fun night. The rental charge for the wall is \$145/h. She has at most \$800 to spend.
- What is an inequality that can be used to model the situation?
  - For how many hours could Lori rent the wall and stay within her spending limit?



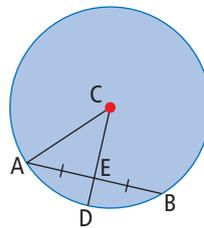
13. A company uses two different machines to make items they sell. The first machine has made 2000 items so far and produces new items at a rate of 25/h. The second machine has made 1200 items so far and produces new items at a rate of 45/h. When will the second machine have made more items than the first machine?

## Chapter 10

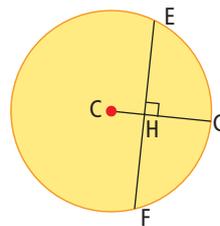
14. Point C is the centre of the circle.  $\angle DAB = 47^\circ$ . What are the measures of angles  $\angle DEB$  and  $\angle DCB$ ? Justify your answers.



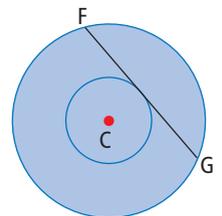
15. In the diagram, CD bisects chord AB. The radius of the circle is 7 cm, and chord  $AB = 9$  cm. What is the length of CE? Express your answer to the nearest tenth of a centimetre.



16. The radius of the circle shown is 25 mm. The radius CG is perpendicular to the chord EF. Chord EF is 7 mm from the centre at C. What is the length of the chord EF?



17. Point C is the centre of two concentric circles. The radius of the smaller circle is 9 cm. The length of chord FG is 40 cm and it is tangent to the smaller circle. What is the circumference of the larger circle? Express your answer to the nearest centimetre.



## Chapter 11

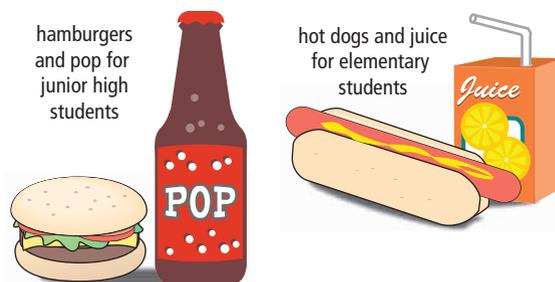
18. For each survey question:
- Describe any influencing factor(s).
  - Rewrite the question so it is clearly stated and free from influencing factors.

a)  Do you like to play cards, the greatest indoor game?  
YES NO

b)  What type of milk do you prefer to drink?

19. You decide to survey students about their online activities.
- What is the population?
  - Describe two different sampling methods you could use.
20. Identify the population and describe a sample for each situation. Justify your choice.
- A television talk-show host asks the audience their views on a media story.
  - An author plans to survey people in a bookstore about whether they have read his book.
  - The sports coordinator at a school needs to find out how to improve services for students.
21. A marketer conducting a survey randomly selects 40 departments in 20 city stores in western Canada. From the 40 departments, she randomly selects 20 department managers and 6 sales associates.
- Describe the population.
  - Describe the sampling method.
  - Is there more than one possible sample? Explain your thinking.

22. The grade 9 students organized a barbecue for kindergarten to grade 9 students. All grade 9 students were surveyed about the menu. Based on the survey, the students decided on the following menu.



At the barbecue, the elementary students were served before the junior high students. By the time that the junior high students were served, there were no hamburgers or pop left. They had to eat hot dogs and drink juice.

- How did the sampling method used lead to a false prediction?
  - Describe a sampling method that would allow students to make an accurate prediction. Explain how you would conduct the survey.
23. A quiz has ten true/false questions.
- What is the theoretical probability of answering each question correctly by guessing?
  - What assumptions have you made?
  - Model an experiment of ten trials to represent the quiz. Describe your model and complete the trials. Record your data.
  - What is your experimental probability of getting five out of ten questions correct?
  - Can you use these results to predict how well a student who guesses will do on the quiz? Explain.