Solving Systems of Linear Equations Graphically

Opener

***Mathematics 10,* pages 414–415**

Suggested Timing

30–40 min

Blackline Masters

BLM 8–2 Chapter 8 Prerequisite Skills
BLM 8–4 Chapter 8 Unit 4 Project
BLM U4–2 Unit 4 Project Checklist

Key Terms

point of intersection
system of linear equations
solution (to a system of linear equations)
coincident lines

What's Ahead

In this chapter, students graph and solve systems of linear equations in two variables. Students graph systems by hand, as well as using technology. They work with systems expressed algebraically, as well as in words. In sections 8.2 and 8.3, students interpret situations in order to develop a system of linear equations, then interpret the solution to the system within the context of the situation. The chapter concludes with a thorough examination of the possible types of systems of equations and the possible numbers of solutions, including applications to real-world situations.

Planning Notes

The chapter opener begins by discussing cell phones, transportation, and business. You could have students briefly participate in a placemat activity to start the chapter. Students sit in small groups of four to six students, with at least four groups within a class. Place a large sheet of paper in the centre of each group. Have students read the chapter opener. Students then write, in the space in front of them, everything that they know about the topics mentioned in the chapter opener. Students are not familiar with systems of equations, but they have lots of experience with linear equations. Allow a short time, no more than 3 min, for this activity.

Then, each group moves to the placemat of a different group. Looking at that group's work, they add anything that they can to that placemat. Allow up to 2 min for this rotation. In the third rotation, each group moves to a new placemat and repeats the task one last time. Finally, each group returns to its own placemat. Allow a few minutes for each group to read its placemat and see the contributions of other students.

You can choose one or two of the placemats and then begin a class discussion to highlight the Key Terms and Big Ideas. For example, look for student work that will lead to the idea of a solution, or point of intersection. Have students recall and discuss instances of using a graph to model a problem. Ask them to remember how they used graphs in this way in the past. You may want to have them recall some of the Key Terms from their past experience, for example, slope, intercepts, and tables of values. This discussion could lead into the Investigate in section 8.1.

Unit Project

The Unit 4 project focuses on water and its use by wildlife and humans. The project was introduced prior to the chapter opener. Embedded in each section of the student resource are questions that will help students as they work on the project. In particular, #16 in section 8.1, and #9 and 12 in section 8.2 are related to the unit project. While students may not need to complete these questions to successfully complete the project, they are intended to be helpful and it is recommended that students complete them whenever possible.

Foldables™ Study Tool

Discuss with students the benefits of keeping a summary of what they are learning in the chapter. If they have used Foldables before, you may wish to have them report on how useful they found various designs.

- What designs have they used?
- Which designs were the most useful?
- Which, if any, designs were hard to use?
- What disadvantages do Foldables have?
- What other method(s) could they use to summarize their learning?

Discuss the Foldable design on page 415 and how it might be used to summarize Chapter 8. Encourage students to suggest revisions for this Foldable, or to replace this Foldable with another design of their choice. Allowing personal choice in this way will increase student ownership in their work.

Give students time to develop the summary method they have chosen. Ask them to include some method of keeping track of what they need to work on; discuss the advantage of doing this.

Ensure students understand how to do the following:
- isolate a variable in an equation
- identify a slope and interpret its meaning
- determine and locate the y-intercept
- use the form $y = mx + b$ for graphing.

Students may benefit from reactivating some of these skills and modelling their understanding through some opening questions. A tab in the Foldable has been set aside for such a review.

Section 8.1 Systems of Linear Equations and Graphs introduces students to finding the point of intersection of a system of linear equations in a variety of ways and then asks them to identify multiple approaches to verifying whether the solution is correct. This section has been divided into two tabs to provide students sufficient space to model multiple approaches to both solutions and verification. The use of the 0.5-cm grid paper will provide a place that is unlined for work to be shown and an attached grid area for ease of graphing. A similar approach is taken for section 8.3 Number of Solutions for Systems of Linear Equations, where both graphs and equations are used to determine whether there are zero, one, or an infinite number of solutions to a system.

The first tab of the Foldable will provide a space for recording information regarding any concepts students find difficult or would need more practice in. As students progress through the chapter, provide time for them to keep track of what they need to work on. This will assist them in identifying and solving any difficulties with concepts, skills, and processes. Have them check off each item as they deal with it.

Meeting Student Needs

- Consider having students complete the questions on **BLM 8–2 Chapter 8 Prerequisite Skills** to activate the prerequisite skills for this chapter.
- Consider having students staple or tape **BLM U4–2 Unit 4 Project Checklist** to the back of their Foldable. This checklist will help students keep track of the project-related questions and concepts that they have completed.
- Some students may benefit from completing all unit project questions.
- **BLM 8–4 Chapter 8 Unit 4 Project** includes all of the unit project questions for this chapter. These questions provide a beginning for the Unit 4 project.
- Demonstrate what a system of linear equations can represent. Create a set of posters that illustrates solving linear systems graphically as well as algebraically, by substitution and by elimination. You could use these posters to introduce the student learning outcomes for the chapter and unit.
- Post the student learning outcomes for the entire chapter. You may also wish to post the Key Terms for students to view prior to starting.
- You may wish to discuss the decisions involved in buying a snowmobile or ATV. Hybrid cars are not feasible in the Arctic, given the price of electricity; and leasing cars is likely not an option, due to the condition of most roads.

ELL

- Some students may not understand what is meant by a *system of linear equations* or the term *two-variable*. You may wish to discuss these concepts before beginning the lesson.

Enrichment

- Ask students to consider the following questions:
  - On a graph of speed versus time, what does the point of intersection of the lines that represent two race cars mean? (the time at which they are travelling at the same speed)
  - On a graph of distance versus time, what is the point of intersection if one line represents the travel of a person riding a bike and the other line represents a person who left before the cyclist walking along the same path as the cyclist? (the point where the cyclist meets the walker)

Gifted

- Have students solve the following problem: A wealthy financier invests $12 000 in two investments. One pays 5% when sold after one year and the other pays 10%. If the total interest earned is $900, write and graph two equations that represent the situation. What part of the graph shows the amount actually invested in each investment? (The two equations are $x + y = 12\,000$ and $0.05x + 0.10y = 900$. $6000 is invested in each investment.)

Career Connection

The photo in the chapter opener shows Dr. Ian Stirling removing a satellite collar from a polar bear in the Arctic. Dr. Stirling is doing work for Environment Canada in the Wildlife Research Division. Many students are familiar with the science of biology, but may not understand the importance of mathematics within the field. When students have a few minutes to research, you could direct them to try to discover how mathematics is used to perform the following tasks:

- estimate the size of a particular population
- analyse DNA
- determine the number of organisms an ecosystem can support
- evaluate the effect of climate change on coral reefs
- design footwear for specific uses

Web Link

For information about biologists, go www.mhrmath10.ca and follow the links.