5.5 Make Connections With Sine Functions

Student Text Pages
264–267

Suggested Timing
80 min

Materials and Technology Tools
- graphing calculators

Related Resources
- BLM A–8 Application General Scoring Rubric
- BLM 5–11 Section 5.5 Make Connections With Sine Functions

Teaching Suggestions

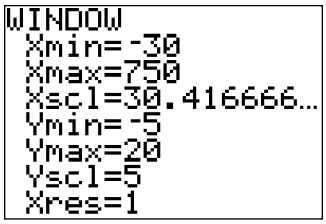
- Expectations state that transformations are to be done by hand only on an individual basis. The connections involving multiple transformations should be done with a graphing calculator.
- Emphasis should be placed on the interpretation of the individual situations by reading the graphs on a graphing calculator.

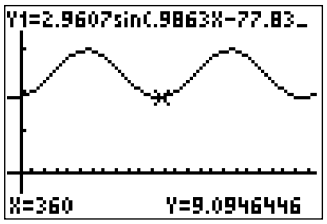
Investigate

- For step 1, remind students to consider the number of days in a year.
- For step 2, the **Maximum** operation is available by pressing 2nd [CALC].
- Once students have completed the Investigate, engage them in a discussion on how to determine the key features of a function with multiple transformations.

Investigate Responses (page 264)

1. The window settings should be set to show a vertical axis at Jan.1 and mark off average months on the x-axis by dividing 365 by 12 in the Xscl line. The horizontal axis and amplitude suggest a maximum y-value of about 16. Setting Ymin = 0 shows the horizontal axis with month markings.





2. Expect the maximum number of daylight hours to occur about June 21, which is the 172nd day of the year. The calculator gives a maximum when $x = 170.3$ and $y = 14.99$. This corresponds to a date of June 19. If you check the second maximum you find $x = 535.5$ which corresponds to a date one year later.
3. The minimum number of hours should occur in late December. This would correspond to a day number of about -10. The calculator gives a minimum when $x = -12.3$ and $y = 9.07$. This corresponds to a date of about December 19.
4. The number of daylight hours is increasing from December 19 until June 19 according to this model. The number of daylight hours decreases from June 19 until December 19.
5. The horizontal axis has equation $y = 12.03$. This corresponds to about twelve hours of daylight, which occurs at the equinoxes in March and September.
6. The period of the graph is 365 days, which corresponds to the number of days in a year. If the equation had been of the form $y = 2.9607 \sin x$ you would have had a period of 360 days with an equinox on Jan 1. If you divide 360 by 0.9856 you get the needed adjustment to correspond to a year of 365.25 days. The number subtracted inside the bracket moves the spring equinox to its proper position in the year.

Example

- The **Example** provides the appropriate graphing calculator keystrokes to help analyse a sine curve in a contextual setting.
- After you have worked through the **Example** as a class, ask students these follow-up questions:
  - Does the phase shift change the period or amplitude? [No]
  - How does the amplitude of the curve relate to the Ferris wheel ride? [height = 2 × amplitude]
  - What is the next rotational angle when the rider will be at the same height as at 300°? [390°]

Communicate Your Understanding

- Have the students answer each question individually. You may want to have them write their answers in their journal.
- You may wish to use **BLM 5–11 Section 5.5 Make Connections With Sine Functions** for remediation or extra practice.

Communicate Your Understanding Responses (page 266)

C1 To find the maximum and minimum values of the function I do not need a graphing calculator. The maximum value will be the value for the horizontal axis plus the amplitude, which is 16. The minimum value will be the difference of the axis value and the amplitude, which is 4. But to find the x-values at which the maximum and minimum occur follow these steps.

- Check that the calculator is set to degrees by pressing MODE.
- Next, press Y= and input the given function.
- Using window settings Xmin = 0 and Xmax = 720 will give several periods to look at. A choice of Ymin = 0 and Ymax = 20 will display the curve clearly.
- Press GRAPH to display the function.
- Press 2nd [CALC] to access the menu for finding minimum and maximum values.
- Choose a left bound to the left of your target point and then press ENTER then cursor over to the right side of the target point and press ENTER twice. The calculator will display the angle and the maximum or minimum value as requested.

With these window settings, the first maximum of 16 is at an angle of 65° with additional solutions occurring every 180° following. The first minimum will be found at 155° with additional solutions every 180° following.

C2 The sine function is an appropriate choice because the number of hours of daylight is a periodic function. Working from the observed data for daylight hours, identify suitable values for a, d, and c to get a sine graph which fits the data.

Practise, Connect and Apply, Extend

- The Practise questions supplement the concepts covered in the Investigate and Example. Both questions should be assigned and taken up before moving on to the rest of the homework.
- There is a wide variety of Connect and Apply questions that should be of interest to most students in the class. These questions may be assigned as group work and taken up by group presentations after some related research on the topic of the question. Alternatively, you might want to have students place solutions on large sheets of graph paper for display on the bulletin board.

Ongoing Assessment

- You may wish to use **BLM A–8 Application General Scoring Rubric** to assess students' responses to **question 6**.

Accommodations

Gifted and Enrichment–challenge students to explore horizontal stretches and compressions of the function $y = \sin x$

Motor–give students extra time to complete the questions in this section. Allow students to work with a partner when using a graphing calculator.

Language/ESL–allow students to work in pairs to provide support in reading the questions

- **Question 7** refers to the Chapter Problem. You may wish to ask students to flag their answer for reference when answering the Chapter Problem Wrap-Up.
- For **question 9**, students should refer to **question 3** and the Investigate from Section 5.3.
- For **question 10**, suggest to students that they consider each transformation separately and draw the graphs in stages.

Mathematical Processes Integration

The table shows questions that provide good opportunities for students to use the mathematical processes.

Process Expectations	Selected Questions
Problem Solving	1–9
Reasoning and Proving	1, 2, 7, 9
Reflecting	10
Selecting Tools and Computational Strategies	1–8
Connecting	1–9
Representing	1–8, 10
Communicating	1, 2, 7, 9