

5.10 Technology: Using Digital Probes to Collect Periodic Data

Specific Expectations

The following expectations are common to both the Functions and Relations course and the Functions course.

- TF2.07 demonstrate facility in the use of radian measure in solving equations and in graphing
- TF3.03 determine the amplitude, period, phase shift, domain, and range of sinusoidal functions whose equations are given in the form $y = a \sin(kx + d) + c$ or $y = a \cos(kx + d) + c$
- TF3.04 sketch the graphs of simple sinusoidal functions [e.g., $y = a \sin x$, $y = \cos kx$, $y = \sin(x + d)$, $y = a \cos kx + c$]
- TF3.05 write the equation of a sinusoidal function, given its graph and given its properties
- TF4.01 determine, through investigation, the periodic properties of various models (e.g., the table of values, the graph, the equation) of sinusoidal functions drawn from a variety of applications
- TF4.02 explain the relationship between the properties of a sinusoidal function and the parameters of its equation, within the context of an application, and over a restricted domain
- TF4.04 pose and solve problems related to models of sinusoidal functions drawn from a variety of applications, and communicate the solutions with clarity and justification, using appropriate mathematical forms

Evidence of Learning

Students should be able to

use the CBL or CBR to collect data from an experiment and generate models (lists, graphs, and equations) for periodic phenomena
interpret periodic models in terms of simple harmonic motion

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Time Required Functions and Relations: 75 min

Time Required Functions: 150 min

Materials and Equipment

- Calculator-Based Laboratory (CBL) or Calculator-Based Ranger (CBR)
- TI 83 Plus calculator, unit-to-unit link cable
- a microphone/amplifier with CBL DIN adapter
- two different tuning forks, a rubber tuning fork hammer
- BEATS and SOUND programs for the CBL, HIKER program with the CBL, RANGER program with the CBR

Overview

- Collect data from experiments using the CBL/CBR, plot the data, and determine the equation that best fits the data.
- Collect data from two different experiments about simple harmonic motion.
- Model periodic data as lists, graphs, and functions.

Using Digital Probes

In this section, students take a hands-on approach to collecting physical data and exploring periodic phenomena. The link between science and mathematics is very strong in this section. Allow time for students to do the experiments using the suggested technology.

Management Options

Groups – Arrange the class into groups of four the previous day and ask one student from each group to observe as you demonstrate how to set up the equipment. The rest of the students can be working on homework. In the next class, give each group the required equipment for the experiment and demonstrate the set-up again. Rely on those students who have prior knowledge to help guide their groups during the experiments.

For students in the Functions and Relations course, assign one experiment to half the groups and assign the other experiment to the other half. Once students are finished, ask the groups to summarize and consolidate their learning.

For students in the Functions course, spend one class on each experiment, reviewing and summarizing at the end of each experiment.

Teacher Demonstration – For each experiment, set up the first experiment and collect the necessary data by demonstration. Use a TI-83 view screen to display the lists so that students can enter the data into their calculators. If unit-to-unit link cables are available, consider transferring data directly to students. This will take extra time, but you might transfer data to some students' calculators and then ask these students to transfer the data to other students' calculators, and so on, to speed up the transfer.

ASSESSING LEARNING SKILLS

Teamwork

Ask each member of a group how they used the equipment. Look for a fair sharing of the work and active involvement on the part of each member. Use the Generic Rubric for Teamwork for assessment.

EXTENSION

Ask students to design a different CBL or CBR experiment for data which they predict is periodic. Then they can conduct the experiment and confirm or reject their hypothesis.

Questions with a Functions and Relations: or Functions Focus:

Experiments 1 and 2