1.1 Preparing for a Bicycle Tour

Goals

- Collect experimental data and organize it in a table
- Identify patterns and relationships between variables using information in a table

In *Variables and Patterns,* students explore the idea of variables and how two variables change relative to each other. They look for relationships and patterns of change between two variables. In this investigation, students investigate the relationship between elapsed time and the number of jumping jacks they can do.

Launch 1.1

Tell the class about bicycles and the yearly bicycle tour across Iowa. Encourage students to share other facts about organized bicycle tours they might know. Then continue reading about the bicycle trip that the five college students are planning. Have students share their ideas about the questions in the Getting Ready. Students should justify their guesses about the distance they think they could ride in a day and consider ways in which their speed might vary throughout the day.

- *How far do you think you could ride in a day?* (Answers will vary.)
- *How do you think the speed of your ride would change during the course of the day?* (Most students will indicate that their speed would slow down over the course of the day as they grew fatigued. Others might say that they could get surges of energy, especially towards the end.)
- *What conditions would affect the speed and distance you could ride?* (Answers might include the type of terrain (rocky or smooth); how much of the ride is uphill, downhill, or flat; weather conditions and temperature; and how much gear the riders carry.)

After a short class discussion, move on to the stamina experiment. Connect the bike tour and the jumping jack experiment by pointing out that both activities involve physical exertion over a period of time. This experiment works best if students are divided into groups of four. Within the group, each student has a job: performing jumping jacks, counting jumps, timing when 10 seconds have passed, and recording the number of jumping jacks completed at the end of every 10 seconds for the 2-minute time period.

The directions suggest that students do jumping jacks for 2 minutes. If the time limit is too short (say only 1 minute), then the jumping jack rate is not as likely to change. Two minutes has worked well in many classes. We suggest that you tell students to talk to you if they are not physically able to do the experiment. Inform everyone that if they get tired they should stop. Every student does *not* need to jump.

You may wish to have a group of four students model the experiment in order to describe and clarify the roles of each person in the group. Emphasize the following points:

- The *jumper* performs a complete jumping jack when he or she completes these three steps:
  1. Start with feet together and hands at sides.
  2. Jump, landing with legs apart and hands touching above the head.
  3. Jump again, returning to the starting position with feet together and hands at sides.
- The *counter* counts an additional jump each time the jumper returns to the starting position.
- The *timer* calls out "time" when each 10 seconds passes.
- The *recorder* listens for the timer to call "time" and then writes the last number the counter called into the table.

Suggest that students make a table with the times from 10 seconds to 120 seconds, listed in 10-second intervals, *before* conducting the

experiment. After the demonstration, have students perform the experiment and then complete Problem 1.1. Students can work in groups of four to gather the data. Have as many students as possible take a turn at each task. Remind them that they need to count and record the *total* number of jumping jacks their teammates complete by the end of each time interval.

Explore 1.1

As students work, verify their understanding of each role's function.

When groups are finished, give them time to make a copy of each jumper's data for each person who jumped. Encourage students to discuss within their group possible explanations for what they see in their tables. Students should consider all the data sets when answering.

The data students collected for Problem 1.1 are used in Problem 1.2. Be sure to have students keep a record of their own data.

Summarize 1.1

Have groups share their findings about rates of jumping jacks. Some groups may want to share all or part of their data on the board to help them make a point. Ask what the jumping jack experiment suggests about bicycle-riding speed over time. (Usually the rate decreases as time passes.)

Suggested Questions Ask students to review the process of making a table to record data. Ask:

- *The instructions told you to use 10-second intervals. Could you have chosen a different time interval for recording data in your table?*
- *Would your choice have affected your observations in Question B? If so, in what way?*

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At a Glance

PACING 1 day

Mathematical Goals

- Collect experimental data and organize it in a table
- Identify patterns and relationships between variables using information in a table

Launch

Tell the class about bicycles and bicycle tours. Read about the bicycle trip that the five college students are planning. Discuss the questions in the Getting Ready.

- *How far do you think you could ride in a day?*
- *How do you think the speed of your ride would change during the course of the day?*
- *What conditions would affect the speed and distance you could ride?*

Divide students into groups of four for the stamina experiment. Make sure students understand the four tasks: jumper, timer, counter, recorder. Have students perform the experiment and then complete Problem 1.1. Have each student take a turn at each task. Suggest that they organize their table in 10-second intervals.

Materials

- Clock or watch with second hand
- Transparencies 1.1A and 1.1B

Explore

When groups are finished, give them time to make a copy of the data for each person in their group, as the data in Problem 1.1 are used in Problem 1.2.

Encourage students to discuss within their group possible explanations for what they see in their tables. Students should consider all four data sets when answering.

Summarize

Have groups share their findings about rates of jumping jacks. Ask what the jumping jack experiment suggests about bicycle-riding speed over time. (Usually the rate decreases as time passes.)

Ask students to review the process of making a table to record data.

- *The instructions told you to use 10-second intervals. Could you have chosen a different time interval for recording data in your table?*
- *Would your choice have affected your observations in Question B? If so, in what way?*

Materials

- Student notebooks

Vocabulary

- table

ACE Assignment Guide for Problem 1.1

Differentiated Instruction
Solutions for All Learners

Other *Connections* 13–17

Adapted For suggestions about adapting ACE exercises, see the *CMP Special Needs Handbook*.

Connecting to Prior Units 13–15: *Bits and Pieces I*

Answers to Problem 1.1

A. Student data will vary. In one class, several students started jumping at a rate of 10 jumping jacks for every 10 seconds. After 1 minute, they started to slow down slightly. Many had data entries of 107 and 108 jumping jacks for 120 seconds.

B. Some students will have data that show their jumping jack rate decreases as time passes. Even though the total number of jumps increases for each 10-second interval in the table, the rate decreases since the number of jumps in each 10-second interval decreases as time passes.

C. This pattern suggests that the bike-riding speed would probably decrease somewhat over a day's time.