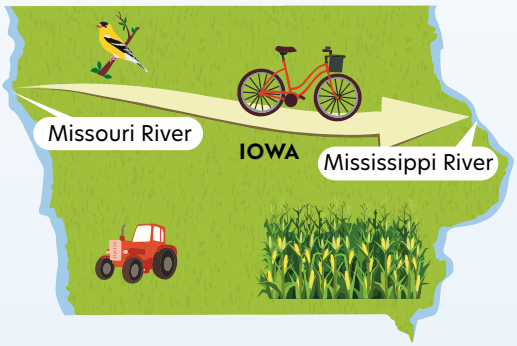
INVESTIGATION 1

Organizing a Bike Tour: Variables, Tables, and Graphs

The bicycle was invented in 1791. Today, people around the world use bicycles for daily transportation and recreation. Many spend their vacations taking organized bicycle tours.

Did You Know?

RAGBRAI, which stands for Register's Annual Great Bicycle Ride Across Iowa, is a weeklong cycling tour across the state of Iowa. The event has been held every summer since 1973. Although the tour follows a different route each year, it always begins with as many as 8,500 participants dipping their back bicycle wheels into the Missouri River along Iowa's western border. It ends with the riders dipping their front wheels in the Mississippi River along the eastern border.



PROBLEM 1.1

Organizing a Bike Tour Experiment: Variables and Tables

Five college students, Sidney, Celia, Liz, Malcolm, and Theo, decide to operate bicycle tours as a summer business. They choose a route from Atlantic City, NJ, to Norfolk, VA. The students name their business Ocean Bike Tours.

While planning their bike tour, the college students need to determine how far the touring group can ride each day. To figure this out, they take test rides around their hometowns. They want to know:

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

Answers to these questions could only come from test ride data. Because this is difficult to do in school, we can get some ideas about endurance patterns by doing an experiment. We will experiment with two quantities, the *number of jumping jacks* and *time*. These two quantities are the variables. A *variable* is a quantity that may take on different values. The number of jumping jacks changes over time.

INITIAL CHALLENGE

Suppose you and your classmates did jumping jacks as fast as possible for a 2-minute test period.

Make a Prediction

- How many jumping jacks do you think you could do in 2 minutes?

Conduct the Experiment

Equipment

- timer, such as a clock or smartphone
- paper to record the results in a table

Jumping Jack Experiment

Time (seconds)	0	10	20	30	40	50	60	70	. . .
Total Number of Jumping Jacks									

Directions

There are four roles:

- A *jumper* to do the jumping jacks
- A *timer* to keep track of time in seconds
- A *counter* to count the jumping jacks
- A *recorder* to write down the number of jumping jacks in a table

Collecting the Data

- The timer says "go," and the jumper begins jumping.
- The jumper continues jumping for 2 minutes.
- The counter counts the jumping jacks out loud.
- Every 10 seconds, the timer says "time," and the recorder records the number of jumping jacks the jumper has done.

Analyze the Data

- For the jumper in your group, how did the number of jumping jacks change as time passed? How is this shown in your table?
- What does this pattern of jumping jacks per second suggest about how bike-riding speed would change over a day's time on the bicycle tour?

1.1

WHAT IF . . . ?

Situation A. Matching Descriptions and Tables

Ms. Park's class collected some interesting jumping jack data. The following are descriptions and tables from several groups. They describe the story told by the pattern of change from their experiments.

1. Match each group's description with the correct table.
2. Describe how you decided that the table matches the story about the variables.

Sam's Group

Sam started out really fast. She did lots of jumps in the first few seconds. As time went on, her number of jumps for every 10 seconds was less and less. She was almost not jumping at the end of the 120 seconds.

Paula's Group

Paula's jumping was very consistent. She did about 10 jumps in every 10 seconds. She was able to keep this pace for 2 minutes.

Li Wei's Group

Li Wei kept a consistent pace. As time increased by 10 seconds, he did 6 more jumps for each time interval.

Jackson's Group

Jackson started with a consistent pace. Then, as time went on, his total number of jumps grew more and more.

Tori's Group

Tori started with consistent jumping. As time increased by 10 seconds, he did about 10 jumps. Near the end of the time, his shoe came untied. So he stopped jumping.

Ana's Group

Ana had a consistent pace for the first 20 seconds. Then the pace slowed down, increased, slowed down, and finally in the last 30 seconds increased a lot.

Table 1

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110	120
Total Number of Jumping Jacks	0	10	20	30	40	50	59	69	80	90	100	110	120

Table 2

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110	120
Total Number of Jumping Jacks	0	10	20	30	40	50	59	69	80	80	80	80	80

Table 3

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110	120
Total Number of Jumping Jacks	0	15	31	44	54	60	65	69	73	79	81	83	84

Table 4

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110	120
Total Number of Jumping Jacks	0	7	13	19	25	31	37	43	49	55	61	67	73

Table 5

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110	120
Total Number of Jumping Jacks	0	5	10	15	20	26	32	39	48	58	68	80	93

Table 6

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110	120
Total Number of Jumping Jacks	0	12	24	30	35	48	59	62	65	68	80	93	107

Situation B. Lashawn's Group

The jumper in Lashawn's group did 8 jumping jacks for every 10 seconds. They used a table to represent the relationship between time and total number of jumping jacks. The lunch bell rang before they finished filling in the table.

1. Fill in the missing entries in the table for the first 60 seconds. How did you decide which numbers to use?
2. How does the relationship in this table compare to those in Situation A?

Lashawn's Group Jumping Jack Experiment

Time (seconds)	0	10	20	30	40	50	60	
Total Number of Jumping Jacks	0	8	16					

NOW WHAT DO YOU KNOW?

How does a table help you make sense of the relationship between two variables in a situation?