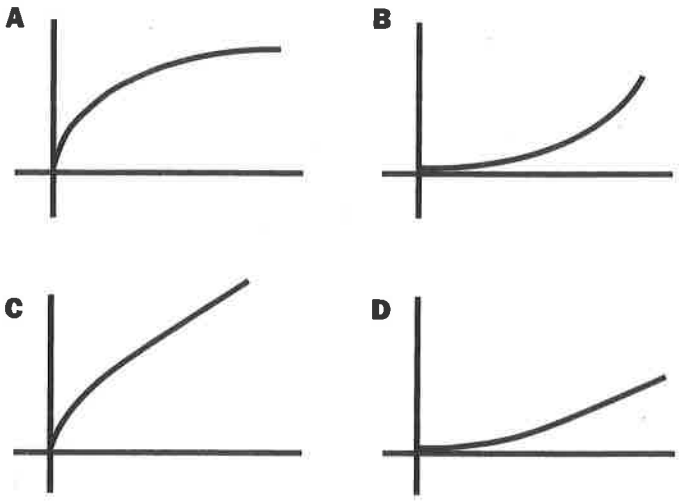
# Following Jack: Part 2

Josey and her little brother Jack are walking side by side, eating ice cream cones. Josey stops to talk to a friend. While she is talking, Jack's ice cream cone starts to drip at a steady rate as Jack walks away. When Josey finishes talking to her friend and realizes that Jack is no longer next to her, she looks down and notices these drops of ice cream on the ground from Jack's ice cream cone:

●●● ● ● ● ● ● ● ● ● ● ●

Josey needs help figuring out what Jack was doing. Which of the following position versus time graphs best shows how Jack moved (was walking) while he was eating his ice cream cone? Circle the letter of the best graph.




Explain your thinking. Describe how the graph you chose best matches Jack's motion.

# Following Jack: Part 2

## Teacher Notes

### Purpose

The purpose of this assessment probe is to determine whether students can translate a motion diagram into a graph—a position versus time graph—to represent the motion of a moving object.

### Related Concepts

constant speed, distance, graph, position, time, time intervals, speed, uniform motion

### Explanation

The best answer is graph D. The steepness of the curve on a position versus time graph indicates the speed of an object. Graph D starts out almost flat (slow), as indicated by the closely spaced dots in the illustration on page 27. It then slightly curves to show how Jack speeds up as the dots spread out more within each interval. Finally, the graph becomes a straight line showing that Jack's speed eventually does not change (does not speed up or slow down).

### Administering the Probe

This probe is best used with middle and high school students. It should be given after students have had an opportunity to qualitatively describe the representation on probe #3. Note that in physics, these graphs are typically referred to as position versus time graphs. However, in most middle school curriculum materials, these graphs are commonly referred to as distance versus time graphs. See the section on stepping-stone concepts in this book's introduction, page 5, for a discussion of *distance* and *position*.

### Related Ideas in *National Science Education Standards* (NRC 1996)

#### K–4 Position and Motion of Objects

- An object's motion can be described by tracing and measuring its position over time.

### 5–8 Abilities of Inquiry

★ Use appropriate tools and techniques (including mathematics) to gather, analyze, and interpret data.

★ Use mathematics on all aspects of scientific inquiry.

### 5–8 Motions and Forces

★ The motion of an object can be described by its position, direction of motion, and speed.

### 9–12 Abilities of Inquiry

• Use technology and mathematics to improve investigations and communications.

## Related Ideas in *Benchmarks for Science Literacy* (AAAS 1993, 2009)

### 3–5 Models

• Diagrams, sketches, and stories can be used to represent objects, events, and processes in the real world.

### 3–5 Constancy and Change

★ Often the best way to tell which kinds of change are happening is to make a table or graph of measurements.

### 6–8 Symbolic Relationships

★ Graphs can show a variety of possible relationships between two variables.

### 9–12 Symbolic Relationships

★ Tables, graphs, and symbols are alternative ways of representing data and relationships that can be translated from one to another.

## Related Research

• A study by Boulanger (1976) found that training in proportional reasoning resulted in improved differentiation of speed, distance, and time among a group of 74 nine-year-old students (Driver et al. 1994).

• Students often experience difficulty interpreting the slope of a graph and sometimes confuse the height of the graph with the slope. Many students interpret graphs as literal pictures rather than symbolic representations (McDermott, Rosenquist, and van Zee 1987).

• Many students interpret distance/time graphs as the paths of actual journeys (Kerslake 1981). In addition, students confuse the slope of a graph and the graph's maximum or minimum value and do not know that the slope of a graph is a measure of rate (McDermott, Rosenquist, and van Zee 1987; Clement 1989).

## Suggestions for Instruction and Assessment

• Before using this probe, use "Following Jack: Part 1" (pp. 23–26) to determine how students read a motion diagram.

• Reverse the task and challenge students to draw a motion diagram, using interval dots, for each of the four graphs.

• Students need tools to describe motion appropriately, including relevant vocabulary, graphical representations, and numerical formulas (Driver et al. 1994).

## References

American Association for the Advancement of Science (AAAS). 1993. *Benchmarks for science literacy.* New York: Oxford University Press.

American Association for the Advancement of Science (AAAS). 2009. Benchmarks for science literacy online. *www.project2061.org/publications/bsl/online*

Boulanger, F. 1976. The effects of training in the proportional reasoning associated with the concept of speed. *Journal of Research in Science Teaching* 13 (2): 145–154.

Clement, J. 1989. The concept of variation and misconceptions in Cartesian graphing. *Focus on Learning Problems in Mathematics* 11 (1–2): 77–87.

★ Indicates a strong match between the ideas elicited by the probe and a national standard's learning goal.