Following Jack: Part 1

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 how Jack was moving (walking) while she was talking. If Josey follows the drips, what can they tell her about Jack's motion? Circle the answer that best shows how Jack moved (walked) while Josey stopped to talk to her friend.

A The drips show that Jack started walking really slowly and then went faster and faster.

B The drips show Jack started out walking really fast and then slowed down and went slower and slower.

C The drips show that Jack started out walking slowly, then walked faster and continued to walk at that same speed.

D The drips show that Jack started out walking fast, slowed down, and then continued to walk at that same, steady speed.

Explain your thinking. Provide an explanation for your answer.

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Teacher Notes

Purpose

The purpose of this assessment probe is to identify how students interpret a motion diagram and whether they have an operational understanding of the concept of speed. The probe is designed to show whether students can interpret the intervals (i.e., the spaces between the dots) and distinguish between slow versus fast speed and increasing speed versus constant speed using a motion diagram.

Related Concepts

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

Explanation

The best answer is C: The drips show that Jack started out walking slowly, then walked faster and continued to walk at that same speed. Because each pair of dots—that is, a set of two dots; the distance between each two dots shows how far Jack traveled in one unit of time—represents the same time interval, Jack did not travel far when the dots are closer together. This means he started by moving very slowly. As the dots get farther apart, Jack was increasing his speed. When the dots become equally spaced apart, Jack was traveling *the same distance in the same amount of time.* This means he started to move at a constant and unchanging speed.

Administering the Probe

This probe can be used before or after middle and high school students have been introduced to ticker tape–types of representations. Although ice cream may not normally drip at a steady, constant rate, for the purpose of this probe, make sure students recognize that the drip time intervals are the same. You may want to use an arrow pointing to the increasingly spaced dots to indicate the direction in which Josey's brother is walking.

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 Motions and Forces

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

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

K–2 Motion

- Things move in many different ways, such as straight, zigzag, round and round, back and forth, and fast and slowly.

3–5 Models

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

6–8 Communication

- Students should understand writing that incorporates circle charts, bar and line graphs, two-way data tables, diagrams, and symbols.

6–8 Displacing the Earth From the Center of the Universe

★ The motion of an object is always judged with respect to some other object or point.

Related Research

- Naturally, children's ideas and descriptions of motion tend to be less differentiated than those of a physicist. They tend to see objects either at rest or moving. The period of change is less frequently focused on by children. They use everyday terms such as *going faster* in ambiguous ways, sometimes referring to the magnitude of the speed of an object and at other times referring to the speed increasing with time (Driver et al. 1994, p. 155).
- A similar task, called the "Ticker-Tape Puzzle," was used in the 1970s to identify student levels of reasoning from concrete to formal operational (Fuller, Karplus, and Lawson 1977).

Suggestions for Instruction and Assessment

- To create their own motion graphs, students, while walking, can drop beans, small rocks, or other objects in equal time intervals as they speed up or slow down.
- Motion diagrams can be generated with time-lapsed strobe photographs (also available on the internet) or by using a ticker tape, a timer, and a long strip of paper.
- Provide students with different ticker tape–type motion diagrams and ask them to interpret the motions.
- Use the probe "Following Jack: Part 2," page 27, to determine whether students can translate a ticker tape representation of motion into a graph.

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*

Driver, R., A. Squires, P. Rushworth, and V. Wood-Robinson. 1994. *Making sense of secondary science: Research into children's ideas.* London: RoutledgeFalmer.

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