Match My Run

ABOUT THIS LESSON

This lesson presents students with various distance-time graphs and asks them to read and interpret various characteristics of the graphs in the context of the real-world scenario. Students sort the graphs by interpreting data points, time and distance intervals, and speed.

OBJECTIVES

Students will

- analyze a distance-time graph for specific characteristics.
- identify key features of linear graphs.

LEVEL

Grade 6 or Grade 7 in a unit on rates or analyzing graphs

MODULE/CONNECTION TO AP*

Analysis of Functions: Curve Sketching

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MODALITY

NMSI emphasizes using multiple representations to connect various approaches to a situation in order to increase student understanding. The lesson provides multiple strategies and models for using those representations indicated by the darkened points of the star to introduce, explore, and reinforce mathematical concepts and to enhance conceptual understanding.
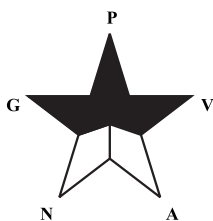
P – Physical
V – Verbal
A – Analytical
N – Numerical
G – Graphical

TEACHER PAGES

COMMON CORE STATE STANDARDS FOR MATHEMATICAL CONTENT

This lesson addresses the following Common Core State Standards for Mathematical Content. The lesson requires that students recall and apply each of these standards rather than providing the initial introduction to the specific skill.

Targeted Standards

6.RP.3b   Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
(b) Solve unit rate problems including those involving unit pricing and constant speed. *For example, If it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*
See questions 4-6, 8-9, 11

7.RP.2b   Recognize and represent proportional relationships between quantities.
(b) Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
See questions 4-6, 8-9, 11

Reinforced/Applied Standards

6.NS.6c   Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.
(c) Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.
See questions 1-15

5.G.2   Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
See questions 1-3, 7, 10, 12-15

COMMON CORE STATE STANDARDS FOR MATHEMATICAL PRACTICE

These standards describe a variety of instructional practices based on processes and proficiencies that are critical for mathematics instruction. NMSI incorporates these important processes and proficiencies to help students develop knowledge and understanding and to assist them in making important connections across grade levels. This lesson allows teachers to address the following Common Core State Standards for Mathematical Practice.

MP.1   Make sense of problems and persevere in solving them.
Students interpret the scenario, consider the constraints of each question, identify the characteristics the graph must exhibit to match the verbal description, and utilize similarities and differences in the graphs to select the appropriate graph.

MP.6   Attend to precision.
Students make use of units in their calculations as a means of checking the reasonableness of their solutions.

MP.8   Look for and express regularity in repeated reasoning.
Students recognize that the repetitive calculations of rate can be shortened by observing regularity in the repeated steps and common characteristics of the graphs.

FOUNDATIONAL SKILLS

The following skills lay the foundation for concepts included in this lesson:

- Interpret a point in terms of the units on the graph
- Determine a unit rate from a graph

ASSESSMENTS

The following formative assessment is embedded in this lesson:

- Students engage in independent practice

The following assessments are located on our website:

- Analysis of Functions: Curve Sketching – Grade 7 Free Response Questions
- Analysis of Functions: Curve Sketching – Grade 7 Multiple Choice Questions

MATERIALS AND RESOURCES

- Student Activity page
- Cards of each of the graphs

ACKNOWLEDGMENTS

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TEACHING SUGGESTIONS

This activity can be used as an assignment or as a game to reinforce the interpretation of distance-time graphs. For an introductory lesson on this topic, see Interpreting Distance Graphs. Student also benefit from the use of a motion detector in this type of context. For a lesson with detailed instructions on using motion detectors, see Detecting Linear Motion on the NMSI website.

This lesson can be used to play two different games. In one game, each student is given one graph (duplicates may be necessary) and the teacher calls out the question and then students holding that graph come to the front of the room. This game would require enlarged versions of the graphs so all students in the class could see them. Another version of the game is to play in pairs. The students match the cards to each question and record their answers. With either version of the game, the students have an opportunity to see a collection of the graphs which meet the given requirement. By examining each collection, the students can make projections of other graphs with similar characteristics.

Many questions ask the student to determine criteria based on the speed of the run for the different time intervals. Select a graph to demonstrate how to determine the speed on a particular interval. All of the motion indicated on the graphs is modeled using a linear segment; the speed is constant for any given interval. Speed is determined by the absolute value of velocity, and therefore speed is always positive. Speed can be determined by the change in distance over the change in time. Call attention to the units for the vertical and horizontal axes. For example, for the interval from 1 to 1 ½ hours on Graph A, the speed would be determined by

$$\frac{\Delta \text{distance}}{\Delta \text{time}} = \frac{2\frac{1}{2}\text{miles}}{\frac{1}{2}\text{hour}} = \frac{\frac{5}{2}\text{miles}}{\frac{1}{2}\text{hour}} = 5\frac{\text{miles}}{\text{hour}}.$$

The axes were purposefully scaled to allow students practice with division of fractions when determining

the speeds. Some students may recognize that the scale on the t-axis is in increments of 10 minutes and count instead of using fractions. If the students have their own copies of the graphs or laminated sets, it is helpful to have the student identify key features of the graph and calculating the speed (rate of change) for each interval. Writing this information directly on each graph will help in the sorting of the cards.

As an extension, student can write a detailed scenario for each of the graphs including where Liam began, time intervals when he stopped, speeds for each of the intervals, and his ending minute. If used with 8th grade or Algebra 1, students could write the piecewise functions for each graph. The equations for these graphs are listed in the answer section.

Suggested modifications for additional scaffolding include the following:

1-15   Provide graphs with the rates of change (in miles per hour) written on the intervals. Label the graphs with either "starts at school" or "starts at home."

NMSI CONTENT PROGRESSION CHART

In the spirit of NMSI's goal to connect mathematics across grade levels, a Content Progression Chart for each module demonstrates how specific skills build and develop from sixth grade through pre-calculus in an accelerated program that enables students to take college-level courses in high school, using a faster pace to compress content. In this sequence, Grades 6, 7, 8, and Algebra 1 are compacted into three courses. Grade 6 includes all of the Grade 6 content and some of the content from Grade 7, Grade 7 contains the remainder of the Grade 7 content and some of the content from Grade 8, and Algebra 1 includes the remainder of the content from Grade 8 and all of the Algebra 1 content.

The complete Content Progression Chart for this module is provided on our website and at the beginning of the training manual. This portion of the chart illustrates how the skills included in this particular lesson develop as students advance through this accelerated course sequence.

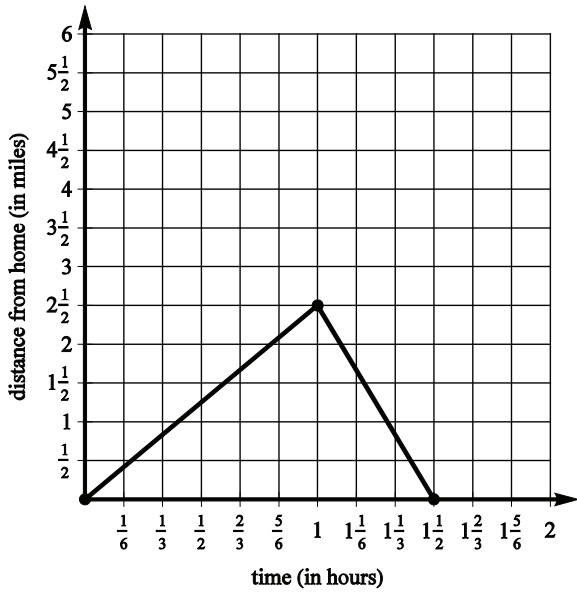| 6th Grade Skills/Objectives	7th Grade Skills/Objectives	Algebra 1 Skills/Objectives	Geometry Skills/Objectives	Algebra 2 Skills/Objectives	Pre-Calculus Skills/Objectives
Analyze characteristics of graphs.	Analyze characteristics of graphs.	Analyze characteristics of graphs.	Analyze characteristics of graphs.	Analyze characteristics of graphs.	Analyze characteristics of graphs.

TEACHER PAGES

Match My Run

Liam is an exercise fanatic. As part of his training, he walks and/or runs a straight-line path between his house and the school. Sometimes, he stops to rest along the way. Liam's house is 6 miles from the school. Some days, he begins his run at the school, while on other days, he begins his run from home. The distance from home versus time graphs are provided.
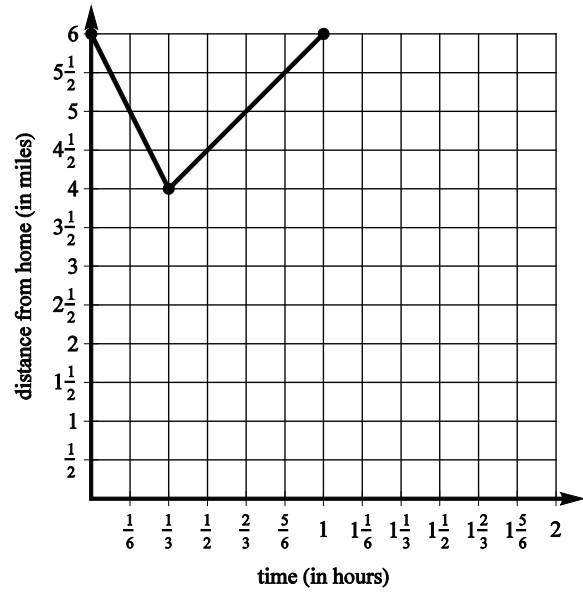
Which of the graphs show Liam …

1. started from school?

2. ran part of the way and returned to the starting point?

3. stopped during his run?

4. ran faster at the beginning of his run than toward the end of his run?

5. ran 3 miles per hour for at least one time interval during his run?

6. ran faster than 3 miles per hour for at least one time interval during his run?

7. rested for at most a total of 30 minutes on his route?

8. ran 6 miles per hour toward his home for at least one time interval during his run?

9. at 10 minutes, running at a speed of 6 miles per hour?

10. ran a total of 4 miles?

11. ran twice as fast toward home as he did running toward school?

12. increased his distance from home for at least one time interval during his run?

13. had a maximum distance from his starting point of 2 miles?

14. decreased his distance from school during the time interval from 50 minutes to 1 hour?

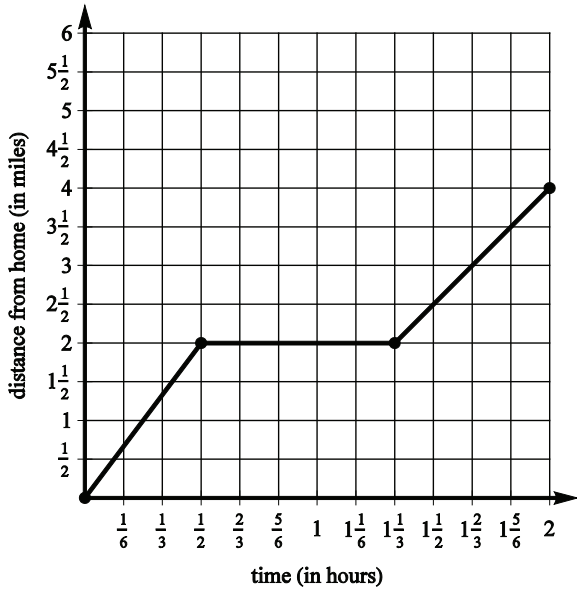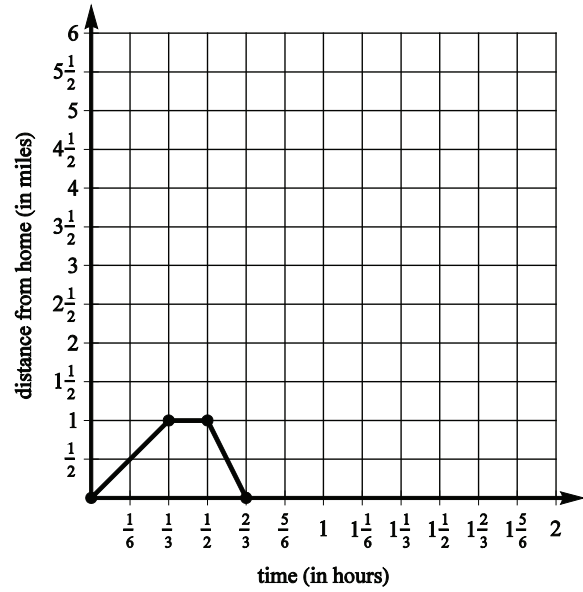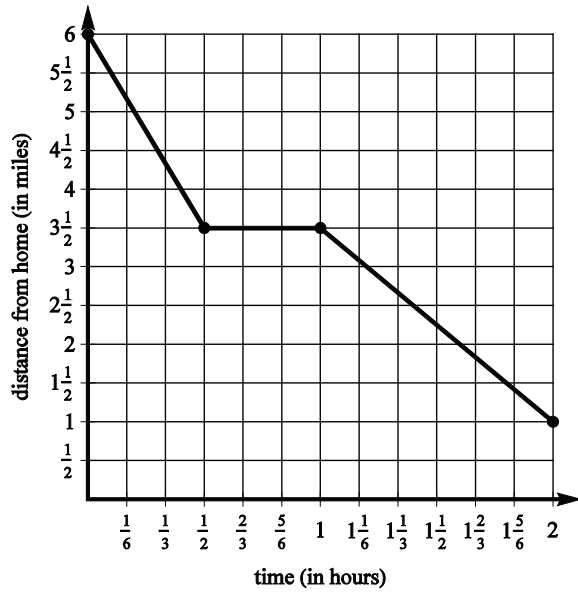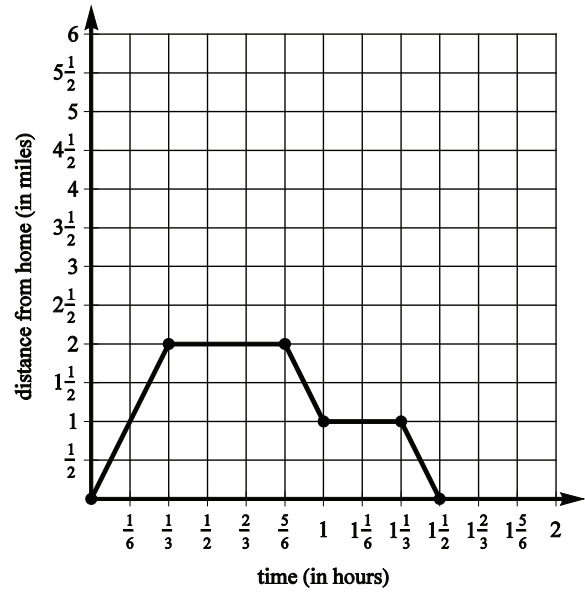15. spent 1 to 1.5 hours on his route?

A.

B.

C.

D.

E.

F.

G.

H.