

Trains In Motion

ID: 11195

Time Required

15 minutes

Activity Overview

In this activity, students will make observations about the motion of two objects. They will compare and contrast this motion and consider how it corresponds to a graph representing the distance as a function of time. Students will explore the relationship between slope and rate.

Topic: Linear Equations & Functions

- Motion, $\text{distance} = \text{rate} \times \text{time}$
- Slope, graphically expressing data

Teacher Preparation and Notes

- It would be beneficial for students to be familiar with navigating between pages ($\text{ctrl} + \blacktriangleright$ or \blacktriangleleft), using sliders when they are minimized (click the associated up or down arrow), grabbing ($\text{ctrl} + \text{mouse icon}$), and toggling ($\text{ctrl} + \text{tab}$) between applications on the same page.
- This activity can serve as a nice introductory activity to using formula and graphs to represent a real-life situation.
- Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.
- **To download the student worksheet and student and solution TI-Nspire documents (.tns files), go to education.ti.com/exchange and enter “11195” in the quick search box.**

Associated Materials

- *Trains_In_Motion_Student.doc*
- *TrainsInMotion.tns*

Suggested Related Activities

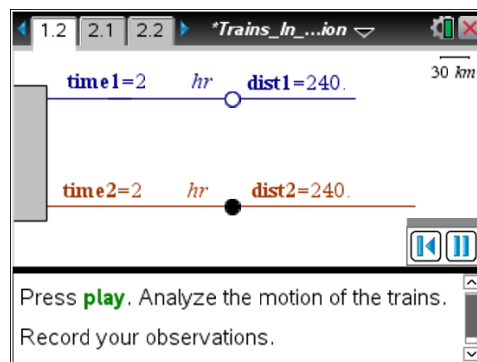
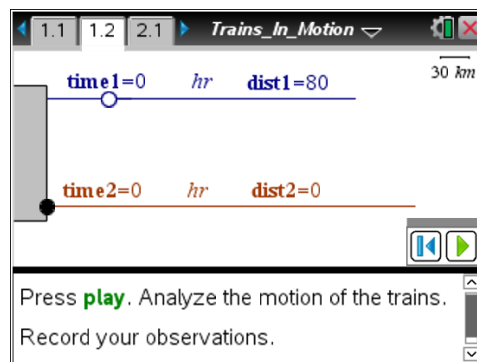
To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Linear Functions: Slope as Rate of Change (TI-84 Plus)* — 4419
- *Walk This Way: Definition of Rate (TI-84 Plus)* — 3971
- *Tables and Linear Relationships (TI-Nspire technology)* — 10884

Problem 1 – Observe Motion

On page 1.2, students press play and make observations about the motion. The gray box represents the train station.

1. Answers will vary, but the following questions should complement their answers.
2. When $t = 0$, train 1 is 80 km from the station.
3. When $t = 0$, train 2 is at 0 km. It is at the station.
4. Train 2 is moving at a faster rate.
5. Train 2 is traveling at 120 km/hr.
6. Train 1 traveled 80 km in one hour.
7. Train 1's speed is 80 km/hr.
8. They are at the same distance from the station at 240 km.
9. This occurs at 2 hours.

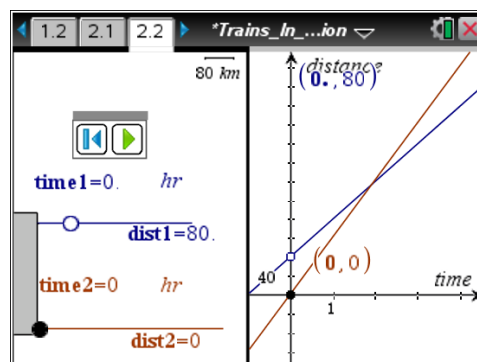


TI-Nspire Navigator Opportunity: Quick Poll
See Note 1 at the end of this lesson.

Problem 2 – Graph of $d = r \cdot t$

Students are instructed to click play and make observations.

10. Train 2 has the graph with a steeper slope.
11. The slope is the speed or *rate* of change of the distance with respect to time.
12. a) y-intercept of train 1 is 80 km ((0, 80)).
 b) y-intercept of train 2 is 0 km ((0, 0)).
13. This indicates their starting location.
14. train 1: $d = 80t + 80$, train 2: $d = 120t$
 Also acceptable are $y = 80x + 80$ and $y = 120x$
15. $80t + 80 = 120t \rightarrow 80 = 40t \rightarrow t = 2$ hrs. At 2 hours, the distance for each train is 240 km.



TI-Nspire Navigator Opportunity: Quick Poll
See Note 2 at the end of this lesson.

Extension: Problem 3 – List of $d = r \cdot t$ Data

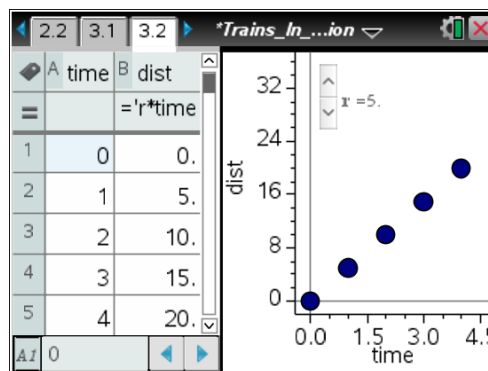
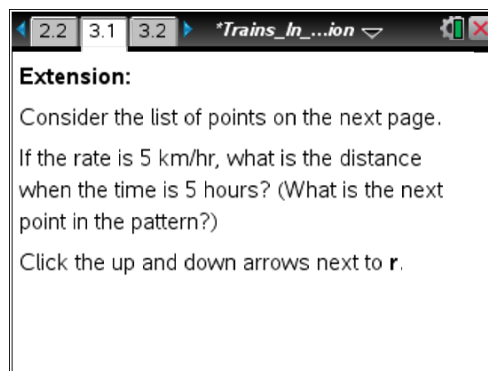
Page 3.1 introduces this numeric and graphical exploration. Students begin by determining what the next time and distance value would be in the list.

16. 5 hours, 25 km.

Students are then instructed to click the up and down arrows next to r and observe both the graph and the data.

17a. When r increases, the slope increases and the distances increase.

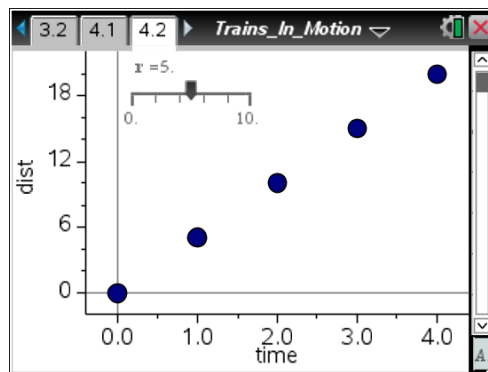
17b. When r decreases, the slope decreases and the distances decrease.



Extension: Problem 4 – Data & Statistics page

Page 4.1 introduces the next interactive *Data & Statistics* page. Advancing to page 4.2, students are instructed to click on one of the five points and drag it around. They are then asked if the ratio of the distance to the time changes.

18. The ratio is the speed. No matter where a point is moved, it continues to be a data point that satisfies $d = r \cdot t$ for the current value of r .



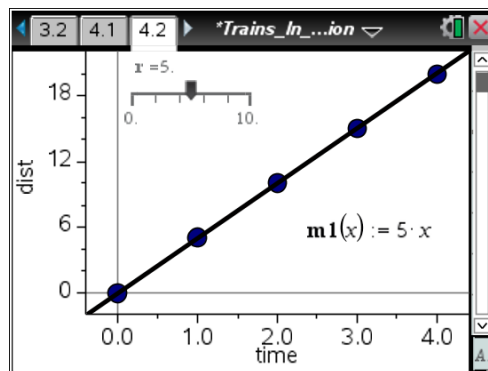
TI-Nspire Navigator Opportunity: *Class Capture*
See Note 3 at the end of this lesson.

Students are instructed to select **Add Movable Line** and **Lock Intercept at Zero** from the Analyze menu.

(Note: If students press Menu and Analyze is not a menu option, have them to click in an empty space on the graph and then press Menu.)

Students drag the slider bar to change the value of r and readjust the movable line to discover/reinforce the relationship between the rate r and the slope of the line.

19. The slope of a distance-time graph is the rate r .



TI-Nspire Navigator Opportunities

Note 1: Quick Poll

You can use Quick Poll to assess student understanding. You could ask questions from the student worksheet or introduction questions as the students view the animation.

- Will train 1 always be ahead of train 2? (Answer: *No*)
- Which train is moving faster? (Answer: *Train 2*)

Note 2: Quick Poll

This is another good place to ask a Quick Poll to assess student understanding of the worksheet questions about the train graphs.

Note 3: Class Capture

You may choose to use Class Capture to make sure students have correctly placed the line through the points and through the origin. If you have a projector, flip through the different student screens for students to see the relationship between the value of r and the slope of the line.