

## Grades 7 – 10

### Algebra

### *That's a Fine Line You're Walking!*

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#### Overview:

Using Texas Instruments CBR-Calculator Based Ranger system, students will experiment with the Hiker program to be introduced to real world applications of linear functions. The concept of slope and y-intercept of a linear equation will be related to speed, direction, and distance with the motion of a walking classmate. With the help of Web sites and worksheets, students will develop their understanding of the mathematical expressions, relationships, and manipulations involved in writing and graphing linear equations in slope-intercept form. Students will then return to the CBR system to test their ability to apply these concepts.

#### Time Allotment:

Four class periods

#### Learning Objectives:

- Students will develop an understanding of the concept of slope of a linear function.
- Students will recognize parts of and be able to write linear equations in slope-intercept form.
- Students will apply their knowledge to solve real world problems involving situations including motion, velocity, and time vs. distance relationships.
- Students will learn how to use TI. CBR system.

#### Standards:

##### National Standards:

*National Council of Teachers of Mathematics*

##### Algebra:

##### Content:

Understand patterns, relations, and functions;  
Explore relationships between symbolic expressions and graphs of lines, paying

particular attention to the meaning of intercept and slope;

Use graphs to analyze the nature of changes in quantities in linear relationships.

Represent and analyze mathematical situations and structures using algebraic symbols

Analyze change in various contexts

##### Process:

Representation

#### Media Components:

##### Web Sites:

<http://www.exploremath.com/activities/ActivityPage.cfm?ActivityID=45>

ExploreMath.com multimedia activities. Slope calculation

<http://www.exploremath.com/activities/ActivityPage.cfm?ActivityID=16>

ExploreMath.com multimedia activities. Slope intercept form

#### Other Technology Components:

Texas Instruments CBR system; Calculator Based Ranger

Individual Student Calculators or T.I. View

Screen with overhead calculator: Texas

Instruments: TI-82,83, 85,86, or 92.

#### Materials:

Day 1:

Texas Instruments CBR system; Calculator Based Ranger

Individual Student Calculators or T.I.View

Screen and overhead calculator: Texas

Instruments: TI-82,83, 85,86, or 92

Overhead Projector

Note: View Screen is best to use so all students can have the fun of watching the pathways classmates walk.

“Focus for Media Interaction” Worksheet #1 ( CBR #1)

Day 2 & 3:

Computers for Web-based learning

“Focus for media interaction” worksheets #2 and #3, calculator, pencil, and additional paper for each student

Day 4:

Same as Day 1 plus “Focus for Media Interaction Worksheet” #4 ( CBR #2)

Calculator, pencil, graph paper for each student



**Prep for Teachers:**

Students should have a basic understanding of the parts of the coordinate plane and how to plot points on the graph.

Teachers should:

Be familiar with use of CBR system. Instructions come with CBR units.

Make sure calculators have plenty of memory space to download CBR programs.

Check working order of Texas Instruments CBR system; Calculator Based Ranger and Individual Student Calculators or T.I.View Screen and overhead calculator:

Texas Instruments: TI-82,83,85,86, or 92

Overhead Projector

Have backup batteries for:

CBR and calculators (AAA)

Preview Web sites: ExploreMath.com requires Shockwave plugin and Adobe Acrobat to work well.

Make copies of “Focus for media interaction” worksheets #1 - #4

Make sure all computers being used have Shockwave plug-in.

A computer attached to overhead would also be great to help guide students through the Web-based activity

**Introductory Activity: Setting the Stage**

Day 1:

Students will use the CBR system with the Hiker program. A copy of “focus for media interaction” worksheet #1 should be given out at the beginning of class to help guide discussion and activity. Ask students to walk in front of the CBR which is connected to the overhead calculator. The students’ motion will be detected by the Ranger and graphed on attached calculator. The students will hopefully all want to have a chance at making their own pathway. Suggest different speeds and starting points so students can see various graphs. The results of this day will hopefully entice the students into learning more about slope and slope-intercept form of linear equations so they can understand modeling of time/distance relationships.

**Learning Activities:**

Day 2:

**Slope Calculation on the Web**

Direct students to go to Slope Calculation activity at following site:

<http://www.exploremath.com/activities/ActivityPage.cfm?ActivityID=45>

Give each student a copy of the worksheet for the lesson. A lesson plan, including worksheet, can be accessed by the teacher if you register for free with ExploreMath.com. If you choose not to register and use site’s worksheet, handout “Slope Calculation Worksheet: Focus for Media Interaction” worksheet #2. Web site’s lesson plan spells out how to manipulate values and graph in activity. If you use “Focus for media” worksheet, be sure you do the initial manipulation instructions of how to move the points on graph and what the checkboxes allow you to do before expecting students to work through the worksheet during class.

Day 3:

**Slope-Intercept Form of a Line on the Web**

Direct students to go to Slope-Intercept Form activity at following site:

<http://www.exploremath.com/activities/ActivityPage.cfm?ActivityID=16>

Give each student a copy of the worksheet for the lesson. A lesson plan, including worksheet can be accessed by the teacher if you register for free with ExploreMath.com. If you choose not to register and use site’s worksheet, handout “Slope-Intercept Form Worksheet: Focus for Media Interaction” worksheet #3. If worksheet #3 is used rather than the Web site’s, additional practice in writing equations from graphs should be assigned.

**Culminating Activity:**

Day 4:

Students return to CBR Hiker program with worksheet #1 for reference and are given “Focus for media interaction” worksheet #4. The worksheet will ask students to first answer questions on hypothetical “hiking” situations from the worksheet. They are then asked to actually “take that hike” in front of the Ranger. This should be a fairly lively day! Various starting points and speeds are suggested so that students will have to write equations with both positive and negative slopes, steep and gradual slopes, and varying y-intercepts. These directions are meant to determine if students can apply



meaning of slope and y-intercept to starting point, direction, and speed of walking path.

**Cross Curricular Extensions:**

**English/ Writing:**

Have students make up stories of where and what was happening along the line of their hikes.

**Science:**

The concept of velocity can be emphasized and related to motion problems in physics classes.

**Math:**

More complicated graph simulations can be suggested for advanced algebra students.

**Student Materials:**

Graphing calculators, graph paper, pencils  
“Focus for Interaction” worksheets #1 through #4



**Focus for Media Interaction Worksheet #1 (CBR #1)**  
**“Where Are You Headed?”**

1. What physical property is represented on the x-axis?
2. What are the units of the property on the x-axis?
3. How many units does each tick mark on the x-axis stand for?
4. What physical property is represented on the y-axis?
5. What are the units of the property on the y-axis?
6. How many units does each tick mark on the y-axis stand for?
7. In what direction does the line go when you start right in front of the Ranger and then you walk away from it?
8. In what direction does the line go when you start far away from the Ranger and then walk toward it?
9. How does the line change as you change the speed of your walking?
10. What happens to the line when you stop for a second or two during your walk?



## Focus for Media Interaction Worksheet #2

### Slope Calculations

Answer the following questions on a separate piece of paper.

1. Click on the checkboxes that say show  $\Delta x$  and  $\Delta y$  and compute slope. Describe the meaning of  $\Delta x$  and  $\Delta y$  on the graph.
2. How do you know when  $\Delta x$  and  $\Delta y$  are positive? How do you know when they are negative? Explain in terms of the graph and the values of the coordinates.
3. Click on the compute slope checkbox and move the points on the graph until there is a line with a positive slope. Describe the graph of a line with a positive slope.
4. Now move the points on the graph until there is a line with a negative slope. Describe the graph of a line with a negative slope.
5. Now move the points on the graph until there is a line with a slope equal to zero. Describe the graph of a line with a slope equal to zero.

Turn off the checkboxes that show  $\Delta x$  and  $\Delta y$  values and compute slope. Move the points so they are on the coordinates (6, 8) and (2, 4).

6. Calculate the  $\Delta x$  and  $\Delta y$  values between these two points and the slope of the line that passes through these two points. Check your answer by clicking on the appropriate checkboxes. What kind of a slope do you have?

Turn off the checkboxes again. Now move the points on the graph so they are on the coordinates (2, 3) and (1, 5).

7. Calculate the  $\Delta x$  and  $\Delta y$  values between these two points and the slope of the line that passes through these two points. Check your answer by clicking on the appropriate checkboxes. What kind of a slope do you have?
8. Summarize this activity by describing at least three things that you have learned about slopes.



**Focus for Media Interaction Worksheet #3**  
**Slope Intercept Form of a Line**

**Find the meaning of 'b'**

1. On the y-axis of the graph is a green point. Drag the green point up the y-axis to the point (0, 2). What is the value of the slide bar labeled b? \_\_\_\_\_ Now move the green point to (0, -3). Now what is the value of the slide bar labeled b? \_\_\_\_\_

2. What happens to the value of b as the line moves up and down?

3. If the equation of a line is  $y = 4x + 3$ , what would be the value of the y-intercept, b?

4. If the equation of a line is  $y = 4x - 3$ , what would be the value of the y-intercept, b?

**Find the meaning of 'm'**

5. Click on the line on the graph so that you have the pointing finger symbol and move the line in various ways. What happens to the value of m to the right of the m slide bar as you make the line "steeper" or "flatter"?

6. Is the value of m positive or negative when the line rises from left to right?

7. Is the value of m positive or negative when the line falls from left to right?



**Focus for Media Interaction Worksheet #4 ( CBR #2)**  
**Tracking the Hikers**

Let's see how well you can use your understanding of slope,  $m$ , and  $y$ -intercept,  $b$ .

On separate piece of graph paper try to complete directions a, b, and c for each hiking situation:  
We will all be given a few minutes to try to complete a, b, and c for "Expedition #1" We will then have volunteers carry out the expedition to see how well our predictions relate to our actual hikes. We will then proceed in same fashion for Expeditions #2 – 4.

a. Draw the graph of a hiker who walks each of the following pathways.

b. Write the equation formed by each route in slope-intercept form.

c. State the value of the slope  $m$ , and  $y$ -intercept  $b$ .

1. Starts directly in front of the Ranger unit and walks at the speed of one meter per second.

2. Starts directly in front of the Ranger unit and walks at the speed of 3 meters per second.

3. Starts 8 meters away from Ranger and walks toward the unit at a speed of .5 meters/second.

4. Starts 8 meters away from the Ranger and walks toward the unit at a speed of 2 meters/second.

Challenge:

Draw the general graph of the following situation:

A student starts walking away from the Ranger, stops for 3 seconds to try to remember an important linear function idea, then goes back to the beginning to try to start all over.

