**Unit 4: Investigation 6 (4 Days)**

**POINT-SLOPE FORM OF LINEAR EQUATIONS**

***CCSS:*** F-LE5, F-LE2, F-IF8, F-LE1

**Overview**

Students learn to use the point-slope form of a linear equation and develop a deeper understanding of functions as they solve a variety of contextual problems. Students discover that the slope-intercept, point-slope and standard forms of a linear equation are equivalent, and students learn to select a form that best fits the data or the question to be answered.

**Assessment Activities**

**Evidence of Success: What Will Students Be Able to Do?**

* Write an equation of a line in the context of a real world problem.
* Write the equation of a line in slope-intercept form, point-slope form, or standard form given (1) the slope and *y*-intercept, (2) the slope and one ordered pair on the line, (3) two ordered pairs or (4) an ordered pair and an equation of a parallel or perpendicular line.
* Transform an equation from slope-intercept form or point-slope form to standard form.
* Transform an equation from point-slope form or standard form to slope-intercept form.
* Make predictions based on the meaning of the function.
* Use slope and intercepts to analyze real world problems.

**Assessment Strategies: How Will They Show What They Know?**

**Exit Slip 4.6.1** assesses fundamental understanding of the point-slope form by asking students to identify the slope and the point from an equation and to write an equation given the slope and one point.

**Journal Entry 1** asks students to explain the meaning of point-slope form.

**Exit Slip 4.6.2** has students apply point-slope form in a real world context.

**Journal Entry 2** asks students to evaluate advantages and disadvantages of point-slope form.

**Launch Notes**

Open this investigation with a discussion about the issue of bottled water vs. tap water, which was introduced in Unit 3. To prepare for this discussion the teacher may wish to ask students to visit web sites on the issue as homework the previous day. A current news story may be used to introduce the assignment. For example, in May 2009 the governor of New York banned state agencies from purchasing bottled water. Ivy League colleges are distributing reusable water bottles and creating public hydrating stations. For more information search “bottled water ban in….” or the New York Times archives on bottled water:

<http://topics.nytimes.com/topics/reference/timestopics/subjects/w/water/bottled_water/index.html?offset=0&s=newest>

You could facilitate a class debate or small group discussions. Reasons favoring bottled water include convenience, taste, and possible water quality. Reasons favoring tap water include cost and the problem of recycling plastic bottles.

**Closure Notes**

By the end of this investigation, students should have facility with the three forms of linear equations: slope-intercept, standard and point-slope. They should be able to articulate the benefits of each of the three forms, choose among them according to the dictates of the problem at hand, and recognize the mathematical equivalence of an equation in the three forms. Tell students to focus on finding the slope and a point if they want to find an equation of a line.

**Teaching Strategies**

1. Following the discussion, have students work through **Activity 4.6.1 Trends in Bottled Water Consumption** which provides a review of previous work with linear functions, practice with general numeracy and estimation, and introduces the point-slope form of the line.

The last form of the linear equation to be studied is the *point-slope form.* Introduce the key idea that the slope between any point and a fixed point on a line will be constant. Using the formula for slope and the characterization of a linear function as having a constant rate of change, guide the students to discover the point-slope form of the line. Students should recognize that since the slope is the same between the point $(x\_{1},y\_{1})$ and any other point (*x, y*) on the line, then

$(y-y\_{1})/(x-x\_{1})=m$ where *x* and *y* vary, but *m* is a constant. Multiplying both sides of the equation by the denominator will give the point slope form:

$y-y\_{1}=m(x-x\_{1})$. Students should find any ordered pair (*x, y*) by substituting a value of *x* and solving for *y*. Have students use a point and the slope from the point-slope form to graph the equation. Students should note that when the given point is (0, b) the point-slope of the equation becomes *y* – *b* = *m*(*x* – 0) and thus

*y* = *mx* + *b*. While the slope-intercept form highlights the slope and *y*-intercept, the point-slope form highlights ANY point on the line we want to draw attention to and the slope.

Students then have numerous opportunities in **Activity 4.6.2 Point-Slope Form of an Equation** to explore the point-slope form in greater depth. You may use **Exit Slip 4.6.1** **Point-Slope Form** to check for basic understanding of the point-slope form.

Although we want to emphasize writing equations to model real world problems, some of the problems can be solved without writing equations. Since this lesson is about writing equations, it is important to do so, but teachers should acknowledge the thinking process of students who choose other approaches.

**Differentiated Instruction (For Learners Needing More Help)**

Add to the arsenal of the students’ notecards by filling out cards for point-slope form: how to read a point and the slope from an equation in point slope, how to write the equation of a line given a point and the slope, how to transform equations from one form to another.

Assign students to update the bulletin board.

**Differentiated Instruction (Enrichment)**

Students may research water facts and create word problems for the class to solve with the data they uncover. A group may decide to collect empty water bottles school wide. Have them research how to recycle water bottles and caps. Forest Elementary students made a green house out of empty water bottles. <http://www.hometownlife.com/article/20120603/NEWS06/206030372/Forest-students-recycle-water-bottles-make-greenhouse>

As the students collect water bottles, they are collecting data that may be used in a future math investigation.

**Journal Prompt 1**

A wise person once said that to get somewhere, you need to know where you are starting from and how to move. How is this like graphing a line in point-slope form?

1. **Activity 4.6.3 Practice with Point-Slope Form** provides students additional exercises on point-slope form. Guide students toward the idea that all they need to determine an equation of a line is a point and the slope. If the slope is missing, they should look for a hint as to how to find it. For example, they may be given two points to which they can apply the slope formula, or they may be given a rate or a line parallel to the given line from which they can infer the correct slope. If a point is missing, sometimes it is disguised as a starting value or a fixed cost. If the directions give the *x-*intercept, students may recall that the *x*-intercept is indeed a point in the form (*c*,0). Contextual problems involving point-slope form are interspersed throughout the activities. The wind chill application in **Exit Slip 4.6.2 Wind Chill** provides an opportunity to assess students’ ability to create a linear function.

When students ask the question “Does it matter which point I use when finding the equation of a line between two points?” have them do **Activity 4.6.4 Can We Both Be Right?** There are two versions of this activity. **Activity 4.6.4a** involves an integral slope; **Activity 4.6.4b** has a fractional slope. Use **Activity 4.6.4a** for students who struggle with fractions, so that they can more easily access the main idea.

**Differentiated Instruction (For Learners Needing More Help)**

Use **Activity 4.6.4a** rather than Activity **4.6.4b**.

1. As needed, provide more practice transforming equations from point-slope form and standard form to slope-intercept form and from standard form and point-slope form to slope-intercept form by assigning **Activity 4.6.5 Transforming Linear Forms.**

**Group Activity**

Make up several sets of cards, one set for each of several functions. Each set will consist of 5 cards for a given function: Card 1 has the word problem on it. Card 2 has the corresponding function in standard form. Card 3 has the graph of the function. Card 4 has the function in slope-intercept form and Card 5 has the function in point-slope form. If you have 30 students you will need 6 sets of 5 cards. Randomly distribute one card to each student. Have the students walk around the room trying to find the other 4 people that are mathematically equivalent to their function. When they have found their matches have each group report back to the class and explain why their cards match.

1. Students should identify the advantages of using each form of the equation of the line. Lead a class discussion on which form to use in the problems in **Activity 4.6.6 Finding and Using Linear Functions.** Note that question 3(d) asks students to find the slope of an equation in standard form, which may prove to be a challenge. In question 4, students are given two points and asked to write equations in at least two of the three forms.

Have students complete a journal entry to assess student understanding of the advantages of each form of a linear equation and how to discern which relevant information is given in a real life problem and which form(s) of the equation to use. **Activity 4.6.7 You Choose** can be used in class for group work or homework. The water theme is continued in some of the problems.

Additional homework may include problems in which students practice the skills of finding equations for lines (a) given slope and *y*-intercept, (b) given one point and the slope, (c) given two points, and (d) given one point and a parallel or perpendicular line.

**Journal Prompt 2**

State the relative advantages and disadvantages of the point-slope form of an equation compared with the slope-intercept and standard forms.

**Resources and Materials**

* **Activity 4.6.1** Trends in Bottled Water Consumption
* **Activity 4.6.2** Point-Slope Form of an Equation
* **Activity 4.6.3** Practice with Point-Slope Form
* **Activity 4.6.4a** Can We Both Be Right?
* **Activity 4.6.4b** Can We Both Be Right?
* **Activity 4.6.5** Transforming Linear Forms
* **Activity 4.6.6** Finding and Using Linear Functions
* **Activity 4.6.7** You Choose
* **Exit Slip 4.6.1** Point-Slope Form
* **Exit Slip 4.6.2** Wind Chill
* Rulers
* Bulletin Board for key concepts
* Student Journals
* Forest Elementary Students: <http://www.hometownlife.com/article/20120603/NEWS06/206030372/Forest-students-recycle-water-bottles-make-greenhouse>
* NY Times Bottled Water Archive: <http://topics.nytimes.com/topics/reference/timestopics/subjects/w/water/bottled_water/index.html?offset=0&s=newest>