*Mathematics Instructional Plan – Algebra I*

Transformation Investigation

**Strand:** Equations and Inequalities

**Topic:** Investing the components of the equation of a line

**Primary SOL:** A.6 The student will

1. graph linear equations in two variables.

**Related SOL:** A.6a, A.7d

## Materials

* Graphing utilities
* Graph paper
* Optional Transformation Investigation Student Activity Sheet

## Vocabulary

transformation, translation, reflection, slope, slope-intercept form, y-intercept (earlier grades)

x-intercept(A.6)

parent function, function families (A.7)

## Student/Teacher Actions: What should students be doing? What should teachers be doing?

*Note: In this activity, students will graph linear equations of the form y = mx + b and investigate transformations in the parent function y = x as m and b change.*

1. Distribute graph paper. On their graphing utilities, have students use an *x*-axis labeled from –10 to 10 and a *y*-axis labeled from –6 to 6. Ask students to sketch a graph of the parent function *y* = *x*. Inform students that the parent function will be used to make comparisons and generalizations throughout this investigation, so they may want to graph it on a separate sheet of graph paper and keep it to the side.
2. Have students sketch a graph for each of the following equations

$y\_{1}=x+1$$y\_{2}=x+4$ $y\_{3}=x-1$ $y\_{4}=x-3$

Direct students to record data in a table, such as the one below, and answer the following questions:

* What effect does changing *b* have on the parent function *y* = *x*?
* What generalizations can you make about the transformation seen when you change the *y*-intercept of a function?

|  | *y* | *y*1 | *y*2 | *y*3 | *y4* |
| --- | --- | --- | --- | --- | --- |
| *y*-intercept |  |  |  |  |  |
| Slope |  |  |  |  |  |

1. Have students sketch a graph for each of the following equations:

$y\_{1}=2x$$y\_{2}=\frac{1}{2}x$ $y\_{3}=-5x$ $y\_{4}=-\frac{2}{3}x$

Direct students to record data in a table and then answer the following questions:

* Compare the data for *y*1, *y*2, *y*3, *y*4 to the data for theparent function. What effect(s) does changing the slope have on the parent function?
* What generalizations can you make about the transformation seen in a graph when you change the slope of a function?
1. Students should become familiar with describing the transformations of linear functions. The following (adapted from the [2016 VDOE Algebra I Vocabulary Word Wall Cards](http://www.doe.virginia.gov/instruction/mathematics/resources/vocab_cards/2016/alg-1-vocab-cards-2016.pdf)) generalize these transformations:

  



1. Have students sketch a graph for each of the following equations. You can use a graphing utility such as <https://www.desmos.com/calculator> to graph linear equations. Students and teachers can find out more about graphing using the Desmos graphing calculator at <http://learn.desmos.com/graphing> .

$y\_{1}=2x$$y\_{3}=-2x$$y\_{2}=\frac{2}{5}x$ $y\_{4}=-\frac{2}{5}x$

Direct students to record data in a table and then answer the following questions:

* What generalizations can you make about the transformation seen when you graph functions with opposite slopes?

## Assessment

* + Questions
* When the slope of a line is +1, what is the result of changing the *y*-intercept?
* When the slope (*m*) of a line is greater than 1, what is the effect on the parent function *y* = *x*?
* When the slope of a line is less than 1 but greater than zero, what is the effect on the parent function *y* = *x*?
* When the slope of a line is −1, what transformation is seen in relation to the parent function *y* = *x*?
	+ Journal/Writing Prompts
		- Compare and contrast the behaviors of the functions *y* = *x* – 2 and y = –2*x* in relation to *y* = *x*.
	+ Extensions and Connections (for all students)
		- Ask students how the graph of the parent function, *y* = *x*, would be transformed when graphing the function *y* = –*x* + 2.

Strategies for Differentiation

* Review vocabulary taught at earlier grades, if needed.
* Encourage the use of graphing calculators, graph paper, or dry-erase boards with a grid for students to see the transformations.
* Use a demonstration tool (e.g., document camera or digital display) to illustrate procedures in the graphing utility.
* Use different colors for the parent functions and comparison functions.
* Provide steps to follow if students are using a graphing utility.
* Provide copies of the table for students to use for recording information from each set of functions.
* Have students answer all generalization questions individually, in small groups, or in a large group, depending on the needs of the students.
* Have students work in groups of four, with each student graphing a separate function. Then, students can come together as a group to make comparisons between their graphs and the graph of the parent function.

 **Note: The following pages are intended for classroom use for students as a visual aid to learning.**

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**Transformation Investigation – Activity Sheet**

1. Sketch a graph for *y* = *x*. (consider using a regular black lead pencil)
2. Sketch a graph for each of the following equations – use the graphs attached and tables with each graph. (consider using different colored pencils to create each graph)

 $y\_{1}=x+1 y\_{2}=x+4$ $y\_{3}=x-1$ $y\_{4}=x-3$

1. Complete the table below with the *y*-intercept and slopes for each equation.

|  | $$y$$ | $$y\_{1}$$ | $$y\_{2}$$ | $$y\_{3}$$ | $$y\_{4}$$ |
| --- | --- | --- | --- | --- | --- |
| ***y*-intercept** |  |  |  |  |  |
| **Slope** |  |  |  |  |  |

* What effect does changing *b* have on the parent function *y* = *x*?

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* What generalizations can you make about the transformation seen when you change the *y*-intercept of a function?

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1. Sketch a graph for each of the following equations (consider using different colored pencils) – use the graphs and attached tables:

$y\_{1}=2x$$y\_{2}=\frac{1}{2}x$$y\_{3}=-5x$ $y\_{4}=-\frac{2}{3}x$

Record data in the table and then answer the following questions:

|  | $$y$$ | $$y\_{1}$$ | $$y\_{2}$$ | $$y\_{3}$$ | $$y\_{4}$$ |
| --- | --- | --- | --- | --- | --- |
| ***y*-intercept** |  |  |  |  |  |
| **Slope** |  |  |  |  |  |

* Compare the data for *y*1, *y*2, *y*3, *y*4 to the data for theparent function. What effect(s) does changing the slope have on the parent function?

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* What generalizations can you make about the transformation seen in a graph when you change the slope of a function?

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1. Sketch a graph for each of the following equations. Go to www.desmos.com/testing to graph each linear equation. We will do this together… First graph *y* = x, then:

|  | $$y$$ | $$y\_{1}$$ | $$y\_{2}$$ | $$y\_{3}$$ | $$y\_{4}$$ |
| --- | --- | --- | --- | --- | --- |
| ***y*-intercept** |  |  |  |  |  |
| **Slope** |  |  |  |  |  |

$y\_{1}=2x$$y\_{3}=-2x$$y\_{2}=\frac{2}{5}x$ $y\_{4}=-\frac{2}{5}x$

Record data in a table and then answer the following questions:

* What generalizations can you make about the transformation created when you graph two functions with opposite slopes?

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## Assessment

* + Questions
* When the slope of a line is +1, what is the result of changing the *y*-intercept?

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* When the slope (*m*) of a line is greater than 1, what is the effect on the parent function *y* = *x*?

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* When the slope of a line is less than 1 but greater than zero, what is the effect on the parent function *y* = *x*?

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* When the slope of a line is −1, what transformation is seen in relation to the parent function *y* = *x*?

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* + - Compare and contrast the behaviors of the functions *y* = *x* – 2 and y = –2*x* in relation to *y* = *x*.

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* + - How would the graph of the parent function, *y* = *x*, be transformed when graphing the function *y* = –*x* + 2.

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| --- | --- |
| **x** | **y** |
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**Use this graph for sketching the parent function, f(x) = x or y = x.**



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| --- | --- |
| **x** | **y** |
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