Practice Block 2: Lines

Activity 1: Slope

- *Objectives*
  1. *Use a slider to explore the slope of a line.*
  2. *Explore the file to answer the questions in the Exeter Lab.*

Preparing the Window

- Open a new GeoGebra file.
- Keep the algebra window open and the axes on. Turn the grid on. Set labeling to new points only.
- Set Point Capture to **on (grid)**

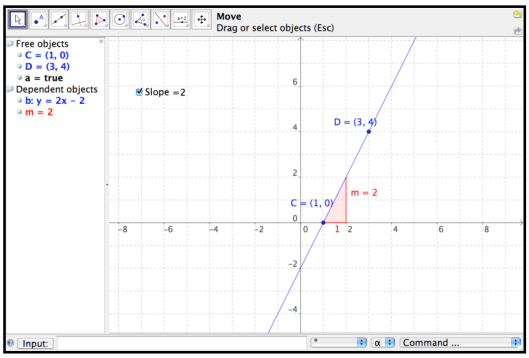
Construction Steps

1		Create a check box and change the caption to Slope (you will link things to the text box later)
2		Create a line with through two points (rename the points C and D and show the lable as name and value)
3		Create the slope by clicking the line created in step 2
4		Create a text box and type "=" + m (the red text will be static text)
5		Link the slope from step 3 and the text box from step 4 by highlighting them in the properties window and in the advanced tab type the name of the Boolean value (check box).

Format the file as you like lock down the text box and the sliders. Next save the file as **Linear41.ggb.** Use this file to complete the following Exeter Lab

Exeter Computer Lab - Slope

1. Once you have launched GeoGebra, click on menu **File/Open**, and choose file entitled ***Linear41.ggb***. When the file opens up, you should see a coordinate grid with a line constructed through the two points labeled C and D. The coordinates of C and D should be displayed next to the actual points. Click on the check box labeled "Slope" to view the slope. Your sketch should like the one displayed at right.



2. Using the Move tool, click on point C and drag it to the origin. Then drag point D to the location (1,1). The program is in a mode that only allows points C and D to land on points with integer coordinates. These points are known as *lattice points*, or *grid points*. Drag C and D to different locations and notice the change in the slope of the line.

   a) How would you describe lines that have positive slope?

   b) How would you describe lines that have negative slope?

   c) How would you describe lines that have a zero slope?

   d) How would you describe lines that have undefined slope?

3. Drag on the line instead of either C or D and observe its behavior and the value of the slope. Summarize your observations below.

4. Move point C to the indicated location in the table below, and then find the coordinates for point D so that the slope of the line CD is the number in the left column.

Slope	Coordinates of C	Coordinates of D
2.000	(0,0)	
-3.000	(2,3)	
0.000	(-1,4)	
1.250	(2,-5)	
Undefined	(3,1)	
-2.667	(-1,-2)	
1.125	(-3,2)	
3.500	(4,0)	

Activity 2: Slope and Lattice Points

- *Objectives*
  1. *Use a slider to explore the slope of a line and its lattice point.*
  2. *Explore the file to answer the questions in the Exeter Lab.*

Preparing the Window

- Open a new GeoGebra file.
- Keep the algebra window open and the axes on. Turn the grid on. Set labeling to new points only.
- Set Point Capture to **on (grid)**

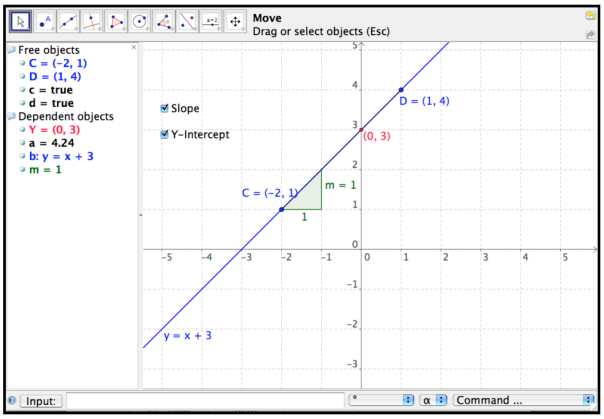
Construction Steps

1		Create a check box and change the caption to Slope (you will link things to the text box later)
2		Create a line with through two points (rename the points C and D and show the lable as name and value)
3		Create the slope by clicking the line created in step 2
4		Create a text box and type "=" + m (the red text will be static text)
5		Link the slope from step 3 and the text box from step 4 by highlighting them in the properties window and in the advanced tab type the name of the Boolean value (check box).
6		Create a check box and change the caption to Y-Intercept
7		Create the intersection point of the line from step 2 and the y axis.

Format the file as you like lock down the text box and the sliders. Next save the file as **Linear42.ggb.** Use this file to complete the following Exeter Lab

Exeter Computer Lab #2 – Slope and Lattice Points

1. Once you have launched GeoGebra, click on menu **File/Open**, and choose file entitled ***Linear42.ggb***. When the file opens, you should see a coordinate grid with a line constructed through the two points labeled C and D. The coordinates of C and D should be displayed next to the points. Click the check boxes entitled "Slope" and "*Y*-Intercept." The equation of the line will be displayed in slope-intercept form, $y = mx + b$, near the edge of the window.



2. Points C and D completely determine the line. The program is in a mode that only allows points C and D to be dragged to locations with integer coordinates. However, the *y*-intercept may end up at a non-integer location, but not through dragging on it. Only points C and D are to be moved in the exercises that follow. Drag point C to the origin, and then move D to the appropriate location so as to produce the line whose equations are given below. Record the location of point D for each of these lines.

Equation of Line	**Coordinates of C**	**Coordinates of D**
$y = 4.000x$	(0,0)	
$y = -3.000x$	(0,0)	
$y = 1.500x$	(0,0)	
$y = 0.000$	(0,0)	
$y = -1.400x$	(0,0)	
$x = 0.000$	(0,0)	
$y = 2.750x$	(0,0)	
$y = -0.\overline{33}x$	(0,0)	
$y = 0.375x$	(0,0)	

3. Complete the chart below by filling in locations for both C and D so as to produce the line whose equation is given in the first column of the table.

Equation of Line	Coordinates of C	Coordinates of D
$y = 2.000x - 3.000$		
$y = -1.500x + 4.000$		
$y = 2.000$		
$y = 1.750x - 1.000$		
$x = 4.000$		
$y = -1.600x + 1.000$		
$y = 1.333x - 5.000$		

4. This exercise is exactly like #3 above, except the y-intercepts are not at lattice points. This only means that neither C nor D will be located on the y-axis. Find locations for C and D that will form the line given in the left column of the table below.

Equation of Line	Coordinates of C	Coordinates of D
$y = 1.500x - 2.500$		
$y = -0.600x + 1.800$		
$y = 2.750x + 0.500$		
$y = 1.333x - 2.667$		
$y = -0.375x + 1.250$		

5. Explain in the space below why there are an infinite number of lattice points on any one of the lines given above.

6. In the space below, explain or demonstrate why there are no lattice points on the line:

$$y = 1.2x + 1.5$$

Activity 3: Slope-Intercept Sliders

- *Objectives*
  1. *Use a slider to explore the slope and y-intercept of a line.*
  2. *Explore the file to answer the questions in the Exeter Lab.*

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Preparing the Window

- Open a new GeoGebra file.
- Keep the algebra window open and the axes on. Turn the grid on. Set labeling to new points only.

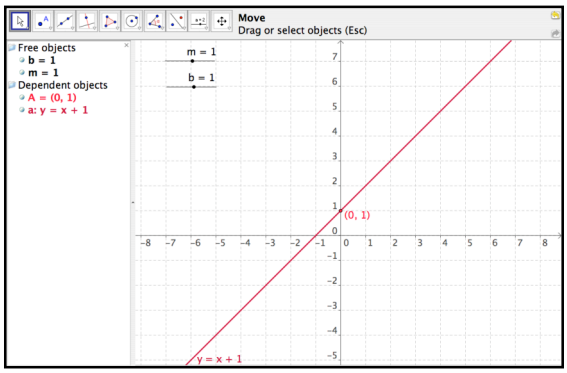
Construction Steps

1		Create sliders m and b. Set the minimum at -10 and the maximum at 10. Set the increment to 0.1.
2		Into the input field, enter the formula: f(x) = m*x+b
3		Create the intersection of the line from step 2 and the y axis (show the label as value)

Format the file as you like lock down the text box and the sliders. Next save the file as **Linear43.ggb.** Use this file to complete the following Exeter Lab

Exeter Computer Lab #3 – Slope-Intercept Sliders

Once you have opened GeoGebra, click on the menu **File/Open**, and choose the file entitled ***Linear43.ggb***. When the file on the screen opens up, you should see a sketch like the one on the right. There are two "*sliders*" that you will use to change the value of the *parameters m* and *b* in the equation $y = mx + b$. These two parameters control the line in red that is displayed on the screen. Also displayed are the values for *m*, *b*, and the *y*-intercept of the red line.



General Instructions: The initial values for *m* and *b* are initially set to 1.0. For the purpose of this worksheet, the accuracy for these parameters has been purposefully chosen to be one decimal place. It is important for you to realize this limitation on the accuracy, so that for all problems you should check your answers by hand calculations in order to make any necessary small adjustments. Technology is a marvelous tool, but always know the limitations of the technology you are working with. You will be dragging on the points along the sliders that are labeled *m* and *b*. This will change the values of these parameters and thus change the red line in the sketch.

1. Click and drag on the slider labeled *m*. Describe below what happens to the red line when *m* becomes increasingly positive.

2. What happens to the line if *m* equals zero?

3. Describe below what happens to the red line when *m* becomes increasingly negative.

4. Summarize the role *m* plays in the equation $y = mx + b$.

5. Drag the slider *m* so that its value is back to 1.0. Now drag slider point *b* and observe. Describe below what happens to the red line as *b* changes. Focus your attention on the *y*-intercept.

6. Drag slider point *b* so that its value is 3.0. Now move slider point *m* back and forth. Move the slider point *b* so that its value is -2.0. Move slider point *m* back and forth again. Describe below what behavior in the red line you observe.

7. Summarize the role *b* plays in the equation $y = mx + b$.

8. Write the equation in slope-intercept form for each of the lines described below. As a check, drag the *m* and *b* slider points to the appropriate values so that the line described is drawn on the screen. Remember, the accuracy of the slider values is only to one decimal place. On some problems you will need to do some paper and pencil calculations as a check to make sure you have the correct equation of the line.

a) Slope is 2.0, and the y-intercept is (0, -3).

b) Slope is -1.5 and the y-intercept is (0, 4).

c) Slope is 3.0 and the *x*-intercept is (-2, 0).

d) Slope is -0.4 and contains the point (-2, 4).

e) Contains the points (3, 5) and (-1, 3).

Activity 4: Point-Slope Form

- *Objectives*
  1. *Use a slider to explore the affects of certain parameters on the point-slope form of a line.*
  2. *Explore the file to answer the questions in the Exeter Lab.*

Preparing the Window

- Open a new GeoGebra file.
- Keep the algebra window open and the axes on. Turn the grid on. Set labeling to new points only.

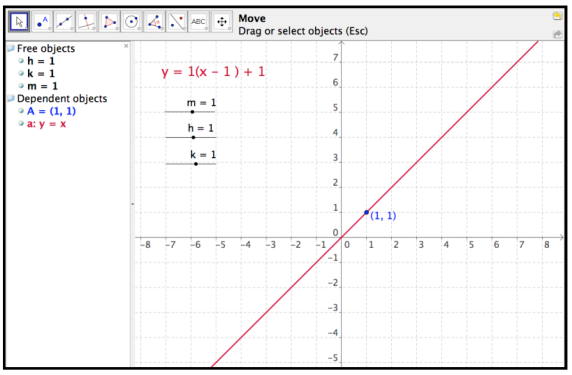
Construction Steps

1		Create sliders m, h, and k. Set the minimum at -10 and the maximum at 10. Set the increment to 0.1.
2		Into the input field, enter the formula: f(x) = m*(x-h)+k
3		Create a text box and type "f(x)="+m+"(x-"+h+")+"+k (the red text will be static text)
5		Into the input field, enter the formula: (h,k).

Format the file as you like lock down the text box and the sliders. Next save the file as **Linear44.ggb.** Use this file to complete the following Exeter Lab

Exeter Computer Lab – Point-Slope Form Sliders

1. Once you have opened the program GeoGebra, click on menu **File/Open**, and choose file entitled **Linear44**. When the file on the screen opens up, you should see the one on the right. There is a coordinate axis with three "*sliders*" you will use to change the value of the parameters *m*, *h*, and *k*. These three parameters control the line in red that is displayed on the screen. Also displayed in the upper left hand portion of the screen is the equation in point-slope form.



General Instructions: The initial values for *m*, *h*, and *k* are all initially set to 1.0. For the purpose of this worksheet, the accuracy for these parameters has been purposefully chosen to be one decimal place. It is important for you to realize this limitation on the accuracy, so that for certain problems you will check your answers by hand calculations in order to make any necessary small adjustments. Technology is a marvelous tool, but always know the limitations of the technology you are working with. You will be dragging on the points along the sliders that are labeled *m*, *h*, and *k*. This will change the values of these parameters and thus change the red line in the sketch whose equation is determined by these parameters in the form $y = m(x - h) + k$.

2. Click and drag on the slider labeled *m*.

a) Describe below what happens to the red line when *m* becomes increasingly positive.

b) What happens to the line if *m* equals zero?

c) Describe below what happens to the red line when *m* becomes increasingly negative.

d) Summarize the role *m* plays in the equation $y = m(x - h) + k$.

3. Drag slider point *m* so that it's value is equal to 1.0. Now drag slider point *h* and observe.

a) Describe below what happens to the red line as *h* changes. Focus your attention on the point (*h, k*) that is on the line.

b) Drag slider point *h* so that its value is 3. Now move slider point *m* back and forth. Move slider point *h* so that its value is -2. Move slider point *m* back and forth again. Describe below what behavior in the red line you observe.

c) Summarize the role *h* plays in the equation $y = m(x - h) + k$.

4. Drag slider points *m* and *h* so their values are one. Now drag slider point *k* and observe.

a) Describe below what happens to the red line as *k* changes. Focus your attention on the point (*h,k*) that is on the line.

b) Drag slider point *k* so that its value is 3. Now move slider point *m* back and forth. Move slider point *k* so that its value is -2. Move

slider point *m* back and forth again. Describe below what behavior in the red line you observe.

c) Summarize the role *k* plays in the equation $y = m(x - h) + k$.

5. Write the equation of the line in *point-slope form* for each of the lines described below. As a check, drag the *m*, *h*, and *k* slider points to the appropriate values so that the line described is drawn on the screen. Remember, the accuracy of the slider values is only to one decimal place. On some problems you will need to do some paper and pencil calculations as a check to make sure you have the correct equation of the line.

a) Slope is 2 and contains the point (1,3).

b) Slope is 2 and contains the point (-2,1).

c) Slope is -1 and contains the point (-2,1).

d) Parallel to the line $y = 3(x - 2) + 4$, and goes through the origin.

e) Slope is 4/5 and the x-intercept is (2, 0).

f) Contains the two points (2,3) and (-1,4).

g) Contains the two points (-3,5) and (4,5)

6. Explain below why the line through the points (2, 3) and (2, -2) cannot be constructed using this slider program, implying that its equation cannot be written in *point-slope form.*