

Slope Matters

Slope-Intercept Form

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Grade Level	7th – 9th Grade	**Time Frame**	1–2 class periods
Subject	Mathematics	**Duration**	90 minutes
Course	Algebra 1, Pre-Algebra		

Essential Question

What components are necessary for a function to create a line?

Summary

In this lesson, students use the Desmos Studio graphing calculator to explore how changing the y-intercept or slope of a line affects the graph. They will find real items to serve as examples of lines with defined slopes and use Desmos Studio to find the linear functions that represent those items. This lesson works well as an introduction to slope-intercept form or as a review before teaching systems of equations.

Snapshot

Engage

Students make notes and observations of photos that have strong lines with positive or negative slopes during an I Notice, I Wonder learning activity.

Explore

Students use the online Desmos Studio graphing calculator to explore how changing the number in front of x (slope) or the number after the plus sign (the y-intercept) influences the graph of a line.

Explain

Students generate a "rule" for the relationship between the linear equation and the graph and justify their decision, then complete a foldable to identifying the components of slope-intercept form.

Extend

Students find real-world examples of lines with defined slopes and then use digital photos and the Desmos Studio graphing calculator to generate a linear function that represents their pictures.

Evaluate

Students demonstrate their ability to predict the effect on a linear function when the slope changes and use a Muddiest Point prompt to reflect on their learning.

Standards

ACT College and Career Readiness Standards - Mathematics (6-12)

A406: Exhibit knowledge of slope
A514: Determine the slope of a line from an equation

Oklahoma Academic Standards Mathematics (8th Grade)

PA.A.2.4: Predict the effect on the graph of a linear function when the slope or y-intercept changes. Use appropriate tools to examine these effects.

Attachments

- Commit and Toss—Slope Matters - Spanish.docx
- Commit and Toss—Slope Matters - Spanish.pdf
- Commit and Toss—Slope Matters.docx
- Commit and Toss—Slope Matters.pdf
- Examine and Reflect—Slope Matters - Spanish.docx
- Examine and Reflect—Slope Matters - Spanish.pdf
- Examine and Reflect—Slope Matters.docx
- Examine and Reflect—Slope Matters.pdf
- Foldable Definitions—Slope Matters - Spanish.docx
- Foldable Definitions—Slope Matters - Spanish.pdf
- Foldable Definitions—Slope Matters.docx
- Foldable Definitions—Slope Matters.pdf
- Foldable—Slope Matters.pdf
- Lesson Slides—Slope Matters.pptx
- Predicting Changes—Slope Matters - Spanish.docx
- Predicting Changes—Slope Matters - Spanish.pdf
- Predicting Changes—Slope Matters.docx
- Predicting Changes—Slope Matters.pdf
- Slope Pictures—Slope Matters.pptx

Materials

- Lesson Slides (attached)
- Slope Pictures slide deck (attached; print one-sided)
- Predicting Changes handout (attached; one per student; print two-sided)
- Commit and Toss handout (attached; one half per student; print one-sided)
- Foldable handout (attached; one per student; print one-sided)
- Examine and Reflect handout (attached; one per student; print one-sided)
- Paper
- Pencils
- Colored pencils
- Playing cards (one deck per student pair)
- Digital cameras or phones with cameras
- Student devices with Internet access
- Foldable Definitions handout (optional; attached; one half per student; print one-sided)
- Scissors (optional)
- Glue sticks (optional)

Preparation

During the Explain phase of the lesson students are going to create a foldable for slope-intercept form of a line. For students who need more scaffolding, the attached **Foldable Definitions** handout may be copied, cut out, and glued under the appropriate flaps. This handout contains two sets of definitions for the four variables. In other words, the handout has enough definitions for two students. Cut out the definitions before the lesson, then pass them out to students who need this resource at the same time you pass out the **Foldable** handout. Students will still need to write the vocabulary words: *dependent variable*, *slope*, *independent variable*, and *y-intercept*. Also give these students a glue stick to glue these definitions into their foldable.

15 minutes

Engage

Teacher's Note: Activity Preparation

Print the attached **Slope Pictures** slide deck (or choose other photos of real-world situations that illustrate a line with a positive or negative slope). Hang the pictures around the room, so that small groups of students may view them easily. The photographs are numbered to facilitate note taking and discussion later in the lesson. If it is not possible to print the photos, display them one at a time. If using printed pictures, consider laminating them so they will be more durable.

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** and share the lesson's essential question: "How can we predict what the graph of a linear function will look like?" Move to **slide 4** and share the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Instruct students to find a partner or assign students partners. Display **slide 5** and share the I Notice, I Wonder instructional strategy.

On a piece of paper, have students make a table like the one on slide 5. Tell students that they will be walking around the classroom and reflecting on different pictures. Explain that they will write down everything they notice from a picture in the left column and anything they wonder or have a question about in the right column. If necessary, give students an example of what they might write, "I noticed ___ about picture #1." Do not mention lines or slopes at this time. Have students walk around to the pictures hanging around the room and, using the strategy, reflect on the pictures. Give students some time to reflect and talk with their partner about their discoveries.

Have the class come together to share their notices and wonders. Ask if anyone noticed anything that all of the pictures had in common.

20 minutes

Explore

Teacher's Note: Activity Preparation

Try to become familiar ahead of time with the Desmos Studio graphing calculator to better help students navigate through the Explore and Extend phases of this lesson. It is not necessary for students to have Desmos accounts to use the Desmos Studio graphing calculator. For more information, go to the Graphing Calculator portion of the K20 Center's Desmos resources.

Deck of Cards: Preparation Options

Students will be using a deck of cards to change the slope or *y*-intercept of each graph. Face cards will be "draw again" cards. Since a deck of cards has Ace–10 representing the numbers 1–10, students may have trouble fitting a slope or *y*-intercept of 10, for example, on their **Predicting Changes** handout. Depending on your group of students, this may or may not be of any concern. Consider some of the following options for handling this:

1. Have a plan for how you would like your students to number their *x*- and *y*-axes. Remind students that if along their *x*-axis they count by 2s then they should also count by 2s along the *y*-axis. If they change the value of each increment to something other than one, remind them that they will need to label their scale to indicate that change.
2. To reduce the likelihood of needing students to adjust the scale of their graph, consider preparing the decks of cards so that they contain only the lower numbers and have all four suits represented. Either you can prepare the cards before the lesson or after giving each pair of students a deck of cards, instructing students to remove the cards greater than 6 (or whatever number you choose), including the face cards. Tell students that the Ace represents the number one.
3. Consider using CPM Probability Generator for a digital card deck. You or your students can also adjust the available cards within the digital card deck.

Pass out the attached **Predicting Changes** handout to each student and give each pair of students a deck of cards.

Display **slide 6** and review how to use the Desmos Studio graphing calculator with your students.

Teacher's Note: Encouraging Exploration

Try to not introduce this as slope-intercept form or discuss anything other than how to navigate the task in Desmos Studio. Student discovery is the key here.

Instruct each pair to type the equation $y = 2x + 3$ into the entry box on the left column of the page. Then model to students how to graph the line shown on the computer onto the first coordinate plane on the Predicting Changes handout.

Display **slide 7** and explain the activity to your students. They are to draw a card. The card determines what the student needs to change about the previous equation, following the card rules on the following slide (slide 8). Using the deck of cards and the instructions, have pairs complete the front side of the handout (or three manipulations). Here students are focusing on the procedure of the activity. Move to **slide 8** and review the card rules with the class. A summary of the card rules (the table on slide 8) is also on the Predicting Changes handout for students to quickly reference. Display **slide 9** and ensure students understand what they are expected to do by reviewing this example with the class.

As students are completing the front side of the handout, direct students to get a colored pencil or pass out colored pencils. Each student needs one colored pencil.

Instruct students to now look at the back side of the Predicting Changes handout. Display **slide 10** and review the new process with the class. The card drawing and equation changing process is the same as before, but now students are to predict what will happen to the graph after the new equation is written, *before* they use the Desmos Studio graphing calculator. Students should draw their predicted line using a colored pencil and the actual line with a regular pencil. Display **slide 11** to use as an example as needed.

25 minutes

Explain

Display **slide 12** and have your students reflect on the previous activity by answering the following question:

- Were your predictions correct? If not, do you know why?

If time allows, ask for volunteers to share their thoughts with the class.

Pass out the attached **Commit and Toss** handout to each student and show **slide 13**. Direct students to independently answer the following questions:

- What does changing the number in front of the *x* do to the graph?
- What does changing the number after the plus sign do to the graph?
- What do these numbers represent?

Using the Commit and Toss strategy, have students crumple their papers and toss them into a pile. After each student picks up a classmate's paper, have your students write whether they agree or disagree with what is on other students' papers and give the reasons why. Once they are done, have students share their statements and any agreements or disagreements.

Teacher's Note: Lesson Pacing

This is a good place to pause. Let students know that in a later part of the lesson, they will apply their learning to a real example of slope found around the school.

Depending on your students' ability to take photos around the school (see more details under the Extend portion below), consider asking students to take photos for the Extend activity as homework. They could take pictures at home, at a park, etc.

Optional Preparation

Students are now going to create a foldable for slope-intercept form of a line. If you prepared the attached **Foldable Definitions** handout to support students, pass out the definitions to students who need this resource at the same time you pass out the **Foldable** handout. Students will still need to write the vocabulary words: *dependent variable*, *slope*, *independent variable*, and *y-intercept*. Also give these students a glue stick to glue these definitions into their foldable.

Display **slide 14** and have students talk about what they think the words *slope* and *y-intercept* mean. While students are discussing, pass out the attached **Foldable** handout and a pair of scissors to each student.

Show **slide 15** and demonstrate to students how to fold and cut the foldable.

Once students complete the folding and cutting of the foldable, ask for volunteers to share their definition of slope. Ask which letter on the foldable they think they should label as the slope, then display **slide 16**.

Repeat this again with the *y*-intercept and use **slide 17**.

Show **slide 18** and ensure that students wrote the definitions of slope and *y*-intercept under the correct flaps.

Display **slide 19** and explain to students that *x* is the independent variable and *y* is the dependent variable. Tell students that these two variables will remain variables, while the variables *m* and *b* will be specific numbers.

Show **slide 20** and tell students that they are adding reminders instead of definitions under the equals sign and plus sign.

20 minutes

Extend

Teacher's Note: Activity Preparation

It is helpful to become familiar in advance with how to upload the photos into the Desmos Studio graphing calculator. For more information, go to the Extra Resources portion of the K20 Center's Desmos resources.

Have a plan for how you expect students to get their pictures to the Desmos graphing calculator. Do you want them to use their smartphone for the whole activity? Do you want them to primarily use their school device?

Have students continue working with their partner from early or have them find a new partner. Display **slide 21** and instruct pairs to use a digital camera or a cell phone to photograph two examples of slope in the school building. Allow approximately ten minutes for students to take the photographs.

Alternative Approaches

If students using devices to take pictures in the school is not an option, consider allowing students to browse the internet for a photo instead; or, you could take pictures of different places around the school and share them with your students.

Instruct students to add their picture to their Desmos Studio graph by clicking the "Add Item" button (+) in the top-left corner of the screen and selecting "image." This can be accomplished several ways. Students could access the Desmos Studio graphing calculator from their device and allow Desmos Studio to access their photo folder, or they could get the image to their school device via email, etc. and access the Desmos Studio graphing calculator from there.

Now direct students to determine the slope-intercept equations for their images.

Instruct students to explain, either in writing or in a class discussion, why they know their equations are correct, and what helped them decide their answers are correct.

10 minutes

Evaluate

Display **slide 22** and pass out the attached **Examine and Reflect** handout to each student. Have students demonstrate their understanding of the relationship between slope-intercept form of a linear equation and its graph by answering the questions in the *Making Changes* section of their handout.

Have students reflect on the lesson and their overall understanding of the content using the Muddiest Point strategy. Have students answer the following questions on their handout.

- **Crystal Clear:** What do you think is the easiest (clearest) part of what you learned today?
- **Muddiest Point:** What do you think is the most confusing (muddiest) part of what you learned today?

Collect completed handouts to assess student learning.

Resources

- K20 Center. (n.d.). Commit and toss. Strategies. https://learn.k20center.ou.edu/strategy/119
- K20 Center. (n.d.). CPM probability generators. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2317
- K20 Center. (n.d.). Desmos studio. Tech tools. https://learn.k20center.ou.edu/tech-tool/2356
- K20 Center. (n.d.). I notice, I wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.). Muddiest point. Strategies. https://learn.k20center.ou.edu/strategy/109