

Airplanes and Airstrips, Part 1

Writing Linear Equations: Graphs

K20 Center, Michell Eike, Sherry Franklin, Dy'Nelle Todman
Published by *K20 Center*

This work is licensed under a Creative Commons CC BY-SA 4.0 License

Grade Level	8th – 9th Grade	**Time Frame**	70-90 minutes
Subject	Mathematics	**Duration**	2 class periods
Course	Algebra 1		

Essential Question

How can linear relationships be represented in multiple ways?

Summary

This lesson addresses writing linear equations when given a graph. Students will use their knowledge of slope and y-intercept to analyze linear graphs and represent what they see graphically as an equation. This lesson also offers an opportunity to reiterate the meaning of slope and y-intercept, while placing emphasis on linear relationships being represented and modeled in multiple ways. Prerequisites for this lesson include identifying slope and y-intercept when given an equation or graph, graphing linear equations, and being familiar with the different forms of a linear function.

Snapshot

Engage

Students activate prior knowledge and show what they know about identifying slope and *y*-intercepts from graphs and equations.

Explore

Students are introduced to writing linear equations through a Desmos Classroom activity by acting as pilots and attempting to safely land airplanes on airstrips.

Explain

Students formalize their understanding of how to write a linear equation and reassess the equations they wrote during the Explore activity.

Extend

Students create their own airplane challenge questions, demonstrating their understanding of the relationship between the equation and the graph of a linear function.

Evaluate

Students write linear equations for other students' airplane challenges.

Standards

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

AF503: Match linear equations with their graphs in the coordinate plane

Oklahoma Academic Standards Mathematics (Algebra 1)

A1.A.4.1: Analyze, use and apply mathematical models and other data sets (e.g., graphs, equations, two points, a set of data points) to calculate and interpret slope and the x- and y-intercepts of a line.
A1.A.4.3: Write the equation of the line given its slope and y-intercept, slope and one point, two points, x- and y-intercepts, or a set of data points.
A1.A.4.4: Express linear equations in slope-intercept, point-slope, and standard forms. Convert between these forms.

Attachments

- Card Matching—Airplanes and Airstrips, Part 1 - Spanish.docx
- Card Matching—Airplanes and Airstrips, Part 1 - Spanish.pdf
- Card Matching—Airplanes and Airstrips, Part 1.docx
- Card Matching—Airplanes and Airstrips, Part 1.pdf
- Guided Notes (Model Notes)—Airplanes and Airstrips, Part 1.docx
- Guided Notes (Model Notes)—Airplanes and Airstrips, Part 1.pdf
- Guided Notes—Airplanes and Airstrips, Part 1 - Spanish.docx
- Guided Notes—Airplanes and Airstrips, Part 1 - Spanish.pdf
- Guided Notes—Airplanes and Airstrips, Part 1.docx
- Guided Notes—Airplanes and Airstrips, Part 1.pdf
- Note Catcher—Airplanes and Airstrips, Part 1 - Spanish.docx
- Note Catcher—Airplanes and Airstrips, Part 1 - Spanish.pdf
- Note Catcher—Airplanes and Airstrips, Part 1.docx
- Note Catcher—Airplanes and Airstrips, Part 1.pdf

Materials

- Note Catcher handout (attached; one per student; print two-sided)
- Guided Notes handout (attached; one per student; print two-sided)
- Guided Notes (Model Notes) document (attached)
- Card Matching handout (optional; attached; one per pair; print one-sided)
- Pencils
- Coloring utensils (4 colors per student; markers, colored pencils, pens, etc.)
- Student devices with internet access

Preparation

To prepare for the Amplify Classroom activity in this lesson, go to *Amplify Classroom: Airplanes and Airstrips, Part 1*. Sign up to create an account or log in. Select the “Assign” dropdown button, and then select “Create single session code.” Adjust the settings as desired, then select “Create Invite Code.” Prepare this session invitation code to distribute to students during the lesson. For help assigning an Amplify Classroom activity, see k20.ou.edu/AssignActivity.

For more information about getting started with Amplify Classroom, go to k20.ou.edu/StartAmplify.

To set up the activity’s pacing for students, select the “Teach" button in the same row as the corresponding session code. In the resulting pop-up window, copy the session code if needed. Close the pop up. In the upper-left corner of your screen, select the “Pace” icon. Follow Amplify’s prompts to select the first and last screens that you want students to see. Here, select screens 1 and 3. Select "Restrict to Screens 1–3" to confirm your selection. This allows students to access only screens 1–3 at this time. For more information about other tools on the teacher dashboard, go to k20.ou.edu/Facilitation.

10 minutes

Engage

Provide students with your session code. Then have them go to student.amplify.com/join and enter the session code.

Teacher's Note: Sign-in Options

If students sign in with their Google or other account, then their progress automatically saves, and they can resume the activity or view their work later. If students continue without signing in, they can complete the activity, but they must do so in one sitting. It is strongly recommended that students sign in; otherwise, they risk losing their work.

Introduce the lesson using **screens 1–2** of the Amplify Classroom activity. **Screen 1** displays the lesson's essential question. **Screen 2** identifies the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Assign student pairs or ask students to find their own partners. Direct students' attention to **screen 3** and inform students they are going to complete a Card Matching activity.

Teacher's Note: Amplify Classroom Card Sort

This card matching activity may be overwhelming on small screens. Share with students the following tips to avoid frustration:

- **Enter full screen:** To increase the size of your workspace, select the expanding arrows in the center of the top pane of the window.
- **Organize your workspace:** In the same way you would arrange cards on a physical surface, organize the cards on your screen.
- **Condense a stack of cards:** Once you have matched a set of cards together, select the arrow.
- **Enlarge the card:** Select the card to magnify the image.

Alternative Card Matching Activity

If students need physical cards for the Card Matching activity, you may print the attached **Card Matching** handout and cut out one set of cards for each pair of students. Students are expected to match each linear equation with its corresponding graph.

After students start the card matching activity, select the orange plus sign on the Amplify Classroom dashboard to allow students to progress to **screen 4**. Inform students that this screen gives students feedback and shows how many cards out of 16 are correctly matched. If the screen seems empty, it is because there are not yet any correct matches, whether that is from a lack of attempt, guessing, or misunderstanding.

Teacher's Note: Guiding the Lesson

Usually, students find the slopes and the *y*-intercepts of the equations and graphs and use those details to find matches. If you see students really struggling—remember that there is value to a healthy struggle—consider having students graph the equations and then match the graphs they drew with the ones they were given.

As you walk around the room monitoring students' progress, listen for key terms that students are using. Make note of misconceptions that need to be addressed during the Explain portion of the lesson.

Keep in mind that students should not spend more than 10 minutes on this Card Matching activity. If the majority of students are not at or near completion after 8–10 minutes, bring the class together to complete the Card Matching activity together. Use this time to correct misunderstandings. The purpose of this lesson is to develop flexibility in notation, not to introduce different forms of a linear equation. So, use this activity as a formative assessment to determine if students are ready for the remainder of this lesson.

Bring the class back together and have pairs share with the whole group how they matched their graphs and equations.

To guide the class discussion, consider asking some of the following questions:

- What methods did you use to match the graphs and equations?
- How did you know which graph went with each equation?
- What characteristics did you look for in the graph that helped you pick its matching equation?
- What characteristics did you look for in the equation that helped you pick its matching graph?
- Were all the equations in slope-intercept form? If not, how did you find the matching graph for that equation?
- What is slope-intercept form?
- What is slope?
- What is a *y*-intercept?

Use student responses to determine if students need a quick refresh on slope and *y*-intercept or need a more in-depth review of graphing linear equations.

20 minutes

Explore

On the Amplify Classroom dashboard, select the orange plus sign to allow students to progress to **screen 5**. Have students watch the video, *Funny Plane Landings*, by selecting the link on the screen. The video gives students an idea of what an airplane landing on an airstrip looks like before using the idea to work with linear functions in the Amplify Classroom activity.

Embedded video
https://youtube.com/watch?v=mlK1SebcXOg

Ask students to imagine they are pilots. Do they think they could do a better job than the pilots in the video? Is anyone interested in becoming a pilot?

Share with students that pilots are tasked with landing airplanes in the center of a landing strip to ensure the safest landing possible. However, as they saw in the video, it does not always happen that way. Explain to students that they all have a pretty good knowledge of linear functions, and they will explore, as pilots, how this knowledge can help them land some airplanes.

Give each student a copy of the attached **Note Catcher** handout, then select the orange plus sign on the Amplify Classroom dashboard six times to allow students to progress to **screens 6–11**. Direct pairs of students to use the Stop and Jot strategy and pause at the end of each screen to make notes on their handout. Encourage students to also use this space to write down any questions they have as they work through the screens.

Teacher's Note: Guiding the Activity

Use the Amplify Classroom dashboard to monitor student-progress; students should not spend more than 5 minutes per screen.

If students seem unsure of what type of notes to jot down on their Note Catcher handout, use the following guiding questions:

- What on the screen did you find important?
- What did you know or notice about the graph you were given?
- How did you use what you noticed to make decisions?
- If you were to teach someone else how to complete this activity, what would you make sure to share with them?

15 minutes

Explain

On the Amplify Classroom dashboard, select the orange plus sign to allow students to progress to **screen 12**. This screen indicates that students are to set aside their Amplify Classroom activity to complete their Guided Notes with the class. Give each student a copy of the attached **Guided Notes** handout. Use the attached **Guided Notes (Model Notes)** document to help guide students in completing their notes.

Give each student four coloring utensils. Students could share four markers or colored pencils/pens. Have students use one color for everything on the page that involves slope. Have students help create an exhaustive list of what "m" equals in the cloud bubble. Using that same color, draw the decreasing rise over run stair-steps below the first line (under slope-intercept form), labeling the rise and run.

Now, have students use a second color for everything that involves the y-intercept. Have students write "y-intercept" and its definition next to the "b =" in the second cloud bubble. Use this same color to label the point (0, b) on the y-axis of the first graph.

Using a third color, have students label any point on the second graph that is on the line with the ordered pair: (x_1, y_1). Have students avoid labeling the x- or y-intercepts, as that could cause confusion later. Let students know that point-slope form can still be used if the point is the x- or y-intercept but that their notes should be clear that the point is not required to be an intercept. Use this same color to fill in x_1 and y_1 in the point-slope equation. Then have students use the first color to show the decreasing rise over run stair-steps like they did for the first graph but on a smaller scale. Lastly, have students write that the point (x_1, y_1) is any point on the line in the third cloud bubble.

Using a fourth color, have students color the word "Standard" and label the x- and y-intercepts: (a, 0) and (0, b), respectively. If the y-intercept is already labeled with the second color, that is perfectly okay. Now, have students make a note in the last cloud bubble that this form is the most user-friendly when looking for x- and y-intercepts.

Teacher's Note: Guiding the Activity

Help students see the relationship between the name of slope-intercept form (and point-slope form) and its algebraic representation. In the same way, help students see that what they are given helps them determine which form to use at the beginning, even if slope-intercept form is the goal at the end. For example, if students are given the y-intercept and the slope, then slope-intercept form is the one to start with. If they are given a point, other than the y-intercept, and a slope, then point-slope form is the better choice. Standard form is usually given or used when asked to find x- and y-intercepts.

Students may also ask about labeling the x-intercept with (a, 0). When working with linear equations, traditionally the equation $x = a$ represents a vertical line, so this is why the letter "a" is used for that point. (Similarly, $y = b$ is traditionally used to represent a horizontal line.)

Direct students' attention to the back of the Guided Notes and model how to land the plane safely (how to write the correct equation of a line).

Teacher's Note: Guiding the Lesson

The first example has the plane on the *y*-axis, so using slope-intercept form is the best choice. Example 2 does not show the plane to encourage students to practice using point-slope form. If students ask if it "matters" which point on the line they use, consider having half of the class try one point, while the other half tries a different point.

Remember, this is a guided discussion; prompt students and solicit responses from a variety of students. Guide students by asking the following questions:

- What is slope-intercept form?
- What do we need to know to write an equation in slope-intercept form?
- How do we find the slope of a line? (Remember, there are many right answers to this.)
- Where is the *y*-intercept?
- If the *y*-intercept is hard to find, what form of a linear equation should we use?

After walking through an example, ask students to look at the questions they may have written on their Note Catcher and ask any questions they still have. Use student feedback to determine if you need to model 1–2 more examples.

10 minutes

Extend

Teacher's Note: Activity Preparation

Students are going to create their own problem for their peers to answer. Depending on your class, you may not want students to know who created the question that they are answering. If that is the case, use the anonymize feature which will replace students' names with the names of random mathematicians. In the upper-left corner of your teacher dashboard, select the icon above the word "Anonymize" to enable this feature.

From the Amplify Classroom dashboard, you can see which student is which mathematician by selecting the three vertical dots to the immediate right of the mathematician's name.

On the Amplify Classroom dashboard, select the orange "Stop" button; now students can complete the Amplify Classroom activity at their own pace. Direct their attention to **screen 13** and preview the task.

On **screen 14**, students are to create their own airplane challenge for their classmates to answer. First, students select the "Make My Challenge" button. The activity prompts students to move the airplane and airstrip and then write the equation for a successful landing.

Direct students' attention to the back of their Note Catcher handout: "Plane Landing." Instruct students to use the first row to write their name in the first column and their work in the second column as they create their own airplane challenge. Remind students that this is a challenge problem, so think of something that will challenge their classmates.

After submitting their airplane challenge, students will see their classmates' airplane challenges.

Teacher's Note: Managing the Amplify Classroom Activity

Screen 14 is designed for students to create a problem by moving two points (the airplane and airstrip) and using their two points to write the equation of a line (that successfully lands the plane). Once students correctly write the equation of their line, in any form, they select the "Submit Challenge" button to submit their problem to their peers to answer. This button is not enabled unless the student has the correct equation for their two points.

If they are really struggling to write an equation, encourage them to press the back arrow to navigate to the previous screen and adjust their points (airplane and airstrip).

15 minutes

Evaluate

Teacher's Note: Troubleshooting

It may take a moment for students to see the other students' questions for a number of reasons. If you are sure that more than one student has submitted their question, and a student is not seeing others' questions, then encourage students to refresh the page.

Direct students to select any of their classmates' challenges and safely land the plane by writing the correct linear equation and entering it into the Amplify Classroom activity. Instruct students to use their handout to write the name of their classmate (or mathematician's name) in the first column and use the corresponding second column to show their work.

Have students complete their handout by answering five challenges from their classmates. Use the student responses to determine if students need additional practice or are ready for the next topic.

Teacher's Note: Managing the Amplify Classroom Activity

Once students successfully submit their airplane challenge question, they will see other students' challenges. Above each challenge is their classmate's name (or the name of a mathematician if using the anonymize feature). Once they select the challenge question, they type in their linear equation, in any form, and select the "Submit" button. If the airplane has a successful landing, then the "Submit Response" button is enabled. This button is not enabled unless the student has the correct equation for their peer's question.

On the Amplify Classroom dashboard, select the "Summary" tab. Use this view to see how many challenges students completed. Under **screen 14**, you will see a large check mark indicating that the student successfully created a challenge-question. For each question the student answered correctly, you will notice smaller check marks.

Resources

- Armijo, S.R. (2012, February 27). *Funny plane landings* [Video]. YouTube. https://www.youtube.com/watch?v=mlK1SebcXOg
- Eike, M. (n.d.). *Airplanes and airstrips, part 1* [Interactive activity]. Amplify Classroom. https://classroom.amplify.com/activity/62b48f6b291b690529cb6f77?collections=6058d39e867dd93b9a98d722
- K20 Center. (n.d.). Amplify classroom. Tech Tools. https://learn.k20center.ou.edu/tech-tool/1081
- K20 Center. (n.d.). Card matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Stop and jot. Strategies. https://learn.k20center.ou.edu/strategy/168