

Airplanes and Airstrips, Part 2

Writing Linear Equations: Tables

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Grade Level	8th – 9th Grade	**Time Frame**	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 given a table of values. Students will use their knowledge of slope and y-intercept to analyze linear data tables and represent the linear relationship in the data as an equation. Students also will watch a video of a former air traffic controller speaking about his career. Prerequisites for this lesson include identifying slope and y-intercept given a linear equation, graphing linear equations, writing linear equations given a graph, and calculating the slope of a line given two points. This lesson places emphasis on linear relationships being represented and modeled in multiple ways.

Snapshot

Engage

Students watch a video of a former air traffic controller speaking about his career and use prior knowledge to represent linear relationships as graphs, equations, and tables.

Explore

Students explore writing linear equations from tables while acting as a flight crew and create a poster illustrating the steps.

Explain

Students reflect on their peers' posters and find the similarities and differences and eliminate earlier misconceptions of how to represent a table of values as a linear equation.

Extend

Students create their own problem by creating a table of data with a linear relationship.

Evaluate

Students demonstrate their understanding by writing a linear equation from their peers' table.

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.F.3.1: Identify and generate equivalent representations of linear functions, graphs, tables, and real-world situations.

Attachments

- Flight Data—Airplanes and Airstrips, Part 2 - Spanish.docx
- Flight Data—Airplanes and Airstrips, Part 2 - Spanish.pdf
- Flight Data—Airplanes and Airstrips, Part 2.docx
- Flight Data—Airplanes and Airstrips, Part 2.pdf
- Landing Changes—Airplanes and Airstrips, Part 2 - Spanish.docx
- Landing Changes—Airplanes and Airstrips, Part 2 - Spanish.pdf
- Landing Changes—Airplanes and Airstrips, Part 2.docx
- Landing Changes—Airplanes and Airstrips, Part 2.pdf
- Lesson Slides—Airplanes & Airstrips, Part 2.pptx
- Note Catcher—Airplanes and Airstrips, Part 2 - Spanish.docx
- Note Catcher—Airplanes and Airstrips, Part 2 - Spanish.pdf
- Note Catcher—Airplanes and Airstrips, Part 2.docx
- Note Catcher—Airplanes and Airstrips, Part 2.pdf
- Poster Planning—Airplanes and Airstrips, Part 2 - Spanish.docx
- Poster Planning—Airplanes and Airstrips, Part 2 - Spanish.pdf
- Poster Planning—Airplanes and Airstrips, Part 2.docx
- Poster Planning—Airplanes and Airstrips, Part 2.pdf

Materials

- Lesson Slides (attached)
- Flight Data handout (attached; one page per group of three; print one-sided)
- Landing Changes handout (attached; one per class; print one-sided)
- Poster Planning handout (optional; attached; one per group; print one-sided)
- Note Catcher handout (attached; one per student; print one-sided)
- Paper
- Pencils
- Poster paper
- Markers (three colors per group)
- Sticky notes (optional)

Preparation

During the Engage portion of the lesson, students will be given a graph, equation, or table and asked to create the other two. Each student will be given a strip of paper with one given representation and space to create the other two representations of linear functions.

Prior to the lesson, print the number of pages needed from the attached **Flight Data** handout. Each page contains one set of three strips of paper. For example, if you have a class of 12 students, print pages 1–4. If you have a class of 30 students, print all 10 pages.

Cut out and shuffle the strips. Students will use these strips to match up with their other crew members during the Engage portion of this lesson.

Optional Group Size Modifications

If you have one student short of a multiple of three (i.e., 29 students), have the two extra students form a group with you as the third member. Participate enough to allow the two students to check their work against your strip of paper, but be sure to devote your attention to monitoring the whole class.

If you have one student over a multiple of three (i.e., 25 students), consider making an extra copy of page 1 and giving out one duplicate strip (discarding the extra two strips) such that one group will have four members.

During the Explore portion of the lesson, students will be given a "new airstrip to land on" due to inclement weather. Before the lesson, print the **Landing Changes** handout and cut out the Flight Crew strips, labeled *Flight Crew A*, *Flight Crew B*, etc. This handout has new landing data for ten flight crews, five per page. Each group needs one Flight Crew strip; cut out as many as you need for your class.

20 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to share the lesson's essential question: "How can linear relationships be represented in multiple ways?" Show **slide 4** to share the lesson's learning objective. Review each of these with your class to the extent you feel necessary.

Move to **slide 5** and distribute one strip of paper from the attached **Flight Data** handout to each student.

Students with a given graph are also given the job title of flight captains. Instruct the flight captains to individually work to write an equation and create a table of values, containing five ordered pairs, for their given graph.

Students with a given equation are also given the job title of first officers. Instruct the first officers to individually work to create a graph and a table of values, containing five ordered pairs, for their given equation.

Students with a given table of values are also given the job title of flight engineer. Instruct the flight engineers to individually work to write an equation and create a graph for their given table.

Once their individual exercises are complete, display **slide 6** and instruct students to find and sit with their flight crew—the two other people in the room that have the same equation, graph, and table of values as them. Once students are in their groups of three, direct students to discuss with their flight crew how they found the missing information from their given flight data strip.

Teacher's Note: Timing

Because this activity is part of the Engage section of the lesson, it should not last more than 10–15 minutes. Allow approximately 5–7 minutes for the students to complete their exercises, 1–2 minute to find their group members, and 2 minutes to compare and share their work.

Teacher's Note: Things to Look For

As you walk around the room to monitor student progress during this activity, look for and/or suggest that students find: the slopes and *y*-intercepts of the graphs, equations, and tables and how those different representations model the same relationship.

Also use this time to listen for misunderstandings. Use what you observe to determine if students are ready to continue the lesson or need to review the concepts covered in Airplanes and Airstrips, Part 1.

Consider bringing the class together for a conversation about table values. Ask if students' tables were all exactly the same or not. If they were not the same, ask how they determined if they were in the correct flight crew.

Move to **slide 7**. Introduce the *Airplanes and Airstrips, Part 2* video, which features a former air traffic controller talking about his career and how he uses linear equations. Play the video for students.

Embedded video
https://youtube.com/watch?v=0oPjZk1HxwQ

Have each group discuss the following question: “When he mentioned *rate of change* and *speed*, how does that relate to what we know about linear equations?”

After giving groups a couple of minutes to discuss, ask for a few volunteers to share out. If needed, facilitate a discussion that pushes the class to see that *speed* is a *rate of change* and that the rate of change is also the *slope*.

30 minutes

Explore

Display **slide 8** and give students the following scenario:

“Sometimes pilots need to make in-flight decisions when landing a plane. Luckily, they do not have to make those decisions alone. Due to inclement weather, the air traffic controller sent each flight crew alternate landing data. Using the new data, each crew must write an equation for the airstrip they now need to land their aircraft on.”

Transition to **slide 9** and distribute one Flight Crew strip from the attached **Landing Changes** handout to each flight crew (group of three students). Explain to students that they have each been given new data and need to complete the challenge of writing a linear equation without graphing or plotting any of the given points. Ask the questions on the slide and give them approximately 5 minutes to discuss as a group:

- What information would you need?
- How do you get that information?
- What steps would you take?

As students discuss, transition to **slide 10**. Before giving out poster paper, provide each group with a copy of the **Poster Planning** handout or ask them to create a plan on notebook paper.

After 5–8 minutes, students should be finished with planning their poster. Display **slide 11**. When students show you their poster plan, give them (or indicate the location of supplies) a poster and two markers. Direct their attention to the slide and explain that they should use one color to make their tables, show their work, and write their equations. Their second color is for numbering and labeling steps. For example, “Step 1: Make a Table” should be a different color than the table of values on their poster.

Teacher's Note: Guiding the Activity

Students are exploring the process of representing linear functions in multiple ways. It will be tempting to tell students the steps or how many steps, but resist the temptation and let them create their own steps in their own words. Push them to use academic language when creating their steps and feel free to help them rephrase their steps into shorter phrases rather than long sentences. That help is ideal when students are planning their poster.

Students will also have different steps from their peers—that is okay and encouraged! Some students may write that Step 1 is to make a table, while others may see that as a given and not a step. Some students may write steps using slope-intercept form, while others use point-slope form. Be sure to communicate what you expect the final resulting equation to look like (traditionally slope-intercept form: $y = mx + b$).

30 minutes

Explain

Display **slide 12** and have students hang their posters around the room. Give each student a copy of the attached **Note Catcher** handout. Explain the Expert Stay and Stray strategy: one student will stay at the poster and explain to the flight crew how to take data and write a linear equation. Those who are listening need to pay careful attention because each round a new student stays and becomes the new expert/presenter.

Continue previewing the activity by explaining that there will be three rounds, and that everyone will have a turn as the expert. There will be 5 minutes per round where learners need to visit approximately half of the other posters during that time. The expert will use a third color marker to add important information to the poster as they answer clarifying questions. Alternatively, sticky notes can be an option for adding information instead of writing directly on the poster.

Move to **slide 13** and give all flight captains a third marker color and begin round 1. Direct all flight captains to stay at their posters, ready to present. Direct all first officers and flight engineers to visit the other posters and take notes and ask questions. Remind them that they are preparing to be the next expert.

Start the 5-minute timer on the slide.

Teacher's Note: Guiding the Activity

As students are explaining and listening, circulate the room and listen to the conversations. If you hear something that is not correct, ask guiding questions to help students understand.

When the timer expires, direct students to “freeze,” and show **slide 14**. Direct all flight engineers to move to the nearest poster. If there are multiple flight engineers at a poster, direct them to move to a different poster without a flight engineer such that all flight engineers are at a poster that they have visited, ready to be the new expert for that poster.

Show **slide 15** and begin Round 2 by starting the 5-minute timer on the slide.

When the timer expires, use **slides 16–17** to repeat the activity once more, now with first officers as the new experts.

When the timer expires the final time, direct students to find their original flight crews (original groups).

Display **slide 18** and have the students answer the questions on the slide and write their responses on the back of their Note Catcher handout:

- What did you notice that all the posters had in common?
- Why were all the posters not the same?

Once you discuss the questions above as a whole class, consider the misunderstandings that you heard and take time to correct students. Ask the class if there are any questions. Use this time to make sure students understand how to write a linear equation from a table of data.

Teacher's Note: Reminders

It is important to highlight to students that they can find the slope of a line by (1) identifying a pattern in the table by looking at the change in *y*-values and the change in *x*-values or (2) selecting two sets of ordered pairs and using the slope formula. It is also important to highlight to students that there will be instances that they can identify the *y*-intercept in the table and instances where they cannot and must use an ordered pair and the slope they previously calculated to write the equation of a line, likely starting with point-slope form.

5 minutes

Extend

Move to **slide 19** and prompt students to create a table of values with five ordered pairs that model a linear relationship on a piece of notebook paper. Once they have completed their table and believe they have modeled a linear relationship, have the students fold their paper into a paper airplane.

Preview the activity by explaining to students that they are going to gently throw their paper airplane across the room. Then they are going to pick up one paper airplane.

Instruct the class to throw their paper airplanes. Then direct them to pick up one paper airplane.

10 minutes

Evaluate

Display **slide 20** and instruct students to unfold the paper airplane they picked up. Ask students to trade if they picked up their own original paper airplane.

Now direct students to write the linear equation represented by the table. Remind students to use their steps from their poster. Allow students time to reflect on the process. Prompt them by asking if the steps they used gave them the correct answer. If students respond that they did not, prompt them further by asking how they could edit their steps.

Collect the paper airplanes to assess student understanding of the lesson.

Resources

- K20 Center. (2021, September 21). *K20 Center 5 minute timer* [Video]. YouTube. https://www.youtube.com/watch?v=EVS_yYQoLJg
- K20 Center. (2023, January 5). *Air Traffic Controller - Airplanes and Airstrips, Part 2*. [Video]. YouTube. https://www.youtube.com/watch?v=0oPjZk1HxwQ
- K20 Center. (n.d.). Expert stay and stray. Strategies. https://learn.k20center.ou.edu/strategy/2650