

Get in Line

Exploring Linear (and Nonlinear) Situations

K20 Center

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Grade Level	7th – 8th Grade	**Time Frame**	70–90 minutes
Subject	Mathematics	**Duration**	2 class periods
Course	Middle School Mathematics		

Essential Question

How do we know when a relation is linear?

Summary

In this lesson, students use graphs with linear and nonlinear relationships to connect the idea of a constant rate of change with a graph being linear. Then, students identify or calculate the rate of change from a given scenario and use it—along with the y-intercept—to write a linear equation in slope-intercept form.

Snapshot

Engage

Students compare graphs and consider what must be true about graphs with straight lines.

Explore

Students graph given scenarios then describe the graph.

Explain

Students connect academic language to their exploration of linear and nonlinear relations.

Extend

Students construct their own scenarios with corresponding graphs, tables, and equations.

Evaluate

Students match peers' scenarios through a Card Matching activity.

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 (8th Grade)

PA.A.1.2: Use linear functions to represent and model mathematical situations.
PA.A.1.3: Identify a function as linear if it can be expressed in the form y=mx + b or if its graph is a non-vertical straight line.

Attachments

- Create Your Own—Get in Line - Spanish.docx
- Create Your Own—Get in Line - Spanish.pdf
- Create Your Own—Get in Line.docx
- Create Your Own—Get in Line.pdf
- Lesson Slides—Get in Line.pptx
- Reading the Situation (Sample Responses)—Get in Line.docx
- Reading the Situation (Sample Responses)—Get in Line.pdf
- Reading the Situation—Get in Line - Spanish.docx
- Reading the Situation—Get in Line - Spanish.pdf
- Reading the Situation—Get in Line.docx
- Reading the Situation—Get in Line.pdf

Materials

- Lesson Slides (attached)
- Reading the Situation handout (attached; one per student; print two-sided)
- Reading the Situation (Sample Responses) document (attached)
- Create Your Own handout (attached; one per student; print one-sided)
- Scissors (one per student)

5 minutes

Engage

Display **slide 3** from the attached **Lesson Slides**. As they walk into class, ask students to think about what the graph on the slide tells them. Here students are shown a graph of how delicious different foods are depending on their temperature.

If it is a classroom norm, have students get out their math notebooks once class begins. If not, have them get out a piece of paper. Direct students to write everything they think the graph is telling them.

After a couple of minutes, facilitate a brief discussion, asking for volunteers to each share one thing they wrote.

Move to **slide 4** and introduce the Think-Pair-Share strategy. Ask students what the straight lines mean compared to the curved lines. Instruct students to write what they think on their paper. Have students find a partner and share what they wrote. As time allows, ask for volunteers to share what they or their partner wrote.

Teacher's Note: Purpose

Use this activity to identify misconceptions. However, ask more questions than you provide answers. For example, ask students to explain the reasoning behind their claim about the graph can give clarity on what students know.

Share the lesson's essential question on **slide 5** and the learning objectives on **slide 6**. Review each of these with your class to the extent you feel necessary.

20 minutes

Explore

Teacher's Note: Individual or Small Group Work

This activity can be completed individually or in pairs. Decide whether you would prefer students to work on their own or with a partner to design a graph for the given scenario.

Display **slide 7** and give each student a copy of the attached **Reading the Situation** handout. Explain to students that they are to read each scenario (situation), graph the scenario, and then determine if the graph is a line (or not) and identify the *y*-intercept.

As students work, circulate the room to monitor progress and answer questions.

Teacher's Note: Guiding the Activity

There are no units provided on the blank coordinate planes on the handout. This means that students' graphs will vary quite a bit. Use the attached **Reading the Situation (Sample Responses)** document as needed. Students may be uncertain when determining how to graph their scenario and what units to use. Promote a healthy struggle but do not let students get to the point of frustration and quitting.

If needed, bring the class together to share some strategies for determining scale from reading a scenario. If you notice a majority of students having the same struggle, consider working through the first example as a class.

15 minutes

Explain

Once students complete their Reading the Situation handouts, display **slide 8** and walk students through the first two scenarios, asking if each could be graphed as a straight line or not. Facilitate a discussion on each situation, have students "vote" either way, and have them share their processes on how they graphed that scenario.

Teacher's Note: Situation Discussion

Have students talk through the first few situations because, hopefully, the same logic was used for each scenario. However, continue to Situation 3 if needed. Once you notice the sharing has become repetitive, naturally end the discussion. Transition to telling students which of the remaining situations should or should not be represented with a straight line.

- Situations 1, 3, and 4 are all linear.
- Situation 2 is not linear.

After reviewing the situations, share with students that there is academic language for these graphs with straight lines and their characteristics. Transition through **slides 9–10** and have students write these vocabulary words (with definitions) in their math notebooks: *linear relationship*, *nonlinear relationship*, *rate*, *slope*, and *y-intercept*.

Teacher's Note: Taking Notes

Clearly communicate your expectations for note taking (what is versus what is not written down).

Point to the word *rate* on slide 10. Explain that this is probably how they figured out how to correctly graph the scenarios.

Display **slide 11** and introduce slope-intercept form to students. Walk students through how to calculate the rate of the first linear scenario (Situation 1) then have them go back through and find rates of the other linear scenarios (Situations 3 and 4).

Show **slide 12** and ask the class why they think they were not asked to write a rate of change for the nonlinear scenario. If students are unsure, ask guiding questions about the scenarios having a constant change or about the scenarios describing an always increasing or always decreasing situation. Before moving on, make sure that students understand that the rate of change being constant is what makes the graph linear.

15 minutes

Extend

Display **slide 13** and ask students if there is a situation in their life that could have a constant rate. Give each student a copy of the **Create Your Own** handout. This includes a section for students to represent their situation in different ways:

- **Verbally:** write their situation like a narrative
- **Numerically:** record their data points in a table
- **Visually:** graph their situation
- **Algebraically:** identify their rate of change and y-intercept then write their equation in slope-intercept form

Teacher's Note: Guiding the Activity

If students struggle to think of a linear scenario, consider sharing ideas such as walking to school or baking cookies. Have students think about shortening their scenario to only include the part that has a constant rate: running a race at a constant speed or spending money each week.

15 minutes

Evaluate

Show **slide 14** and give each student a pair of scissors. Have students cut their Create Your Own handout along the dashed lines separating all the components of their scenario, creating four cards.

Have students form groups of 4–5 or assign groups and display **slide 15**. Introduce the Card Matching instructional strategy, then have groups gently shuffle all of their cards.

Have groups trade card decks and collaborate to match cards, creating sets of four.

Teacher's Note: The Joy of Learning

Students may be inclined to match handwriting or scissor cuts but encourage them not to take this shortcut. Let students know that you understand this shortcut could be an option, but they will learn more if they try to match the cards according to the lesson content.

As students work, circulate the room and listen to conversations. Use what you hear as a formative assessment to determine if students are ready to move to the next topic or need further practice. If they do need further practice, consider creating a few additional scenarios for students to use.

Optional Differentiation

If students do need additional practice, use the scenarios you create to meet your students' needs. If they need practice distinguishing between linear and nonlinear, ask those questions about your scenarios. If they are struggling with writing a linear equation in slope-intercept form, ask that they find the slope and y-intercept, then have them practice writing their equation.

You could even set up stations, where each station has the same scenarios you created, but the task at each station is different, allowing students to practice what skill they personally need to strengthen.

Resources

- K20 Center. (n.d.) Card matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.) Think-pair-share. Strategies. https://learn.k20center.ou.edu/strategy/139