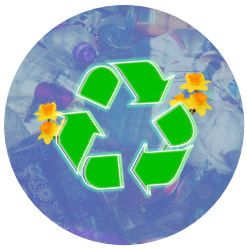

Reduce, Reuse, Represent

Multiple Representations of Linear Functions

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Grade Level	7th – 8th Grade	**Time Frame**	3 class periods
Subject	Mathematics	**Duration**	110–135 minutes
Course	Pre-Algebra		

Essential Question

How can we represent a linear function in different ways?

Summary

In this lesson, students explore the relationship between different linear representations: algebraic, numerical, graphical, and verbal. Students will translate between graphs, tables, equations, and written descriptions. Students also learn how to create an equation from a table using the TI-30XS MultiView calculator.

Snapshot

Engage

Students choose between two different job offers that have different pay rates and starting bonuses then justify their reasoning.

Explore

Students recall their prior knowledge of linear functions and use a given story to create a table, a graph, and an equation through a scaffolded activity.

Explain

Students deepen their understanding of translating between equivalent linear representations and learn how to use a calculator to generate an equation from a table.

Extend

Students visit stations and practice translating between representations, developing their flexibility.

Evaluate

Students demonstrate their understanding by independently creating a table, graph, and equation from a story.

Standards

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

AF403: Relate a graph to a situation described in terms of a starting value and an additional amount per unit (e.g., unit cost, weekly growth)
AF502: Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)
AF503: Match linear equations with their graphs in the coordinate plane

Oklahoma Academic Standards Mathematics (8th Grade)

PA.A.2.1: Represent linear functions with tables, verbal descriptions, symbols, and graphs; translate from one representation to another.
PA.A.2.2: Identify, describe, and analyze linear relationships between two variables.
PA.A.2.3: Identify graphical properties of linear functions, including slope and intercepts. Know that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional relationship.

Attachments

- Algebra Mad Libs—Reduce, Reuse, Represent - Spanish.docx
- Algebra Mad Libs—Reduce, Reuse, Represent - Spanish.pdf
- Algebra Mad Libs—Reduce, Reuse, Represent.docx
- Algebra Mad Libs—Reduce, Reuse, Represent.pdf
- Calculator Guide—Reduce, Reuse, Represent - Spanish.pdf
- Calculator Guide—Reduce, Reuse, Represent.pdf
- Exploring Linear Relationships—Reduce, Reuse, Represent - Spanish.docx
- Exploring Linear Relationships—Reduce, Reuse, Represent - Spanish.pdf
- Exploring Linear Relationships—Reduce, Reuse, Represent.docx
- Exploring Linear Relationships—Reduce, Reuse, Represent.pdf
- Function Fieldwork (Sample Responses)—Reduce, Reuse, Represent.pdf
- Function Fieldwork Stations—Reduce, Reuse, Represent.docx
- Function Fieldwork Stations—Reduce, Reuse, Represent.pdf
- Function Fieldwork—Reduce, Reuse, Represent - Spanish.pdf
- Function Fieldwork—Reduce, Reuse, Represent.pdf
- Graph—Reduce, Reuse, Represent.pdf
- Guided Notes (Model Notes)—Reduce, Reuse, Represent.docx
- Guided Notes (Model Notes)—Reduce, Reuse, Represent.pdf
- Guided Notes—Reduce, Reuse, Represent - Spanish.docx
- Guided Notes—Reduce, Reuse, Represent - Spanish.pdf
- Guided Notes—Reduce, Reuse, Represent.docx
- Guided Notes—Reduce, Reuse, Represent.pdf
- Lesson Slides—Reduce, Reuse, Represent.pptx

Materials

- Lesson Slides (attached)
- Exploring Linear Relationships handout (attached; one page per group; print one-sided)
- Graph handout (attached; one per student; print one-sided)
- Guided Notes handout (attached; one per student; print two-sided)
- Guided Notes (Model Notes) document (attached)
- Calculator Guide handout (attached; one per student; print one-sided)
- Function Fieldwork Stations document (attached; one set per class)

- Function Fieldwork handout (attached; one per student; print two-sided)
- Function Fieldwork (Sample Responses) document (attached)
- Algebra Mad Libs handout (attached; one set per group; print one-sided)
- Chart paper (one per group)
- Highlighters (variety of colors; one per student)
- Pencils
- Paper
- TI-30XS MultiView calculators (one per student)

Preparation

During the Explore phase, students work in groups of 2–3 to create a poster. Dedicate space in your classroom for students to hang their posters and ensure that there is enough space to comfortably walk around to read each poster. If space is limited, consider using the hallway.

Each group needs one page from the attached **Exploring Linear Relationships** handout. This handout contains 10 pages, each with similar scenarios with different values. The goal is for each group to have a unique scenario. Print enough copies of the handout so that each group has one page.

10 minutes

Engage

As students enter the classroom, display **slide 3** from the attached **Lesson Slides**. To begin the lesson, ask students to read the given scenarios and decide which job option they would prefer.

Direct students to think independently about the reason for their choice, then indicate their choice by moving to the side of the room that corresponds to their choice. As students move, remind them to not discuss the answer with their friends or neighbors yet.

Display **slide 4** and introduce the Philosophical Chairs strategy. Have students discuss their choices with peers on the same side of the room for 1–2 minutes. Then, ask a volunteer from Option A to share their reasoning with the class, followed by a volunteer from Option B. Repeat with new volunteers from each side. Review each of these with students to the extent you feel necessary.

Teacher's Note: Guiding the Activity

Some students may base their decision on non-monetary factors, such as company values or job preferences. Allow these perspectives, but steer the conversation toward pay differences by asking guiding questions as needed.

Use student responses as a formative assessment to gauge their understanding of starting values and rates of change. Address any misconceptions before proceeding.

Show **slide 5** to share the lesson's essential question with students. Transition to **slide 6** to identify the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

30 minutes

Explore

Have students get into small groups of 2–3 students or assign groups so that there are ten groups. Display **slide 7** and give each group one page of the attached **Exploring Linear Relationships** handout. Instruct groups to use the given story to create a table, then generate a graph, and finally write an equation.

As students work, circulate the room to monitor progress. When most groups are nearly finished, transition to **slide 8**. Distribute a piece of chart paper and a copy of the attached **Graph** handout to each group. Explain that they should transfer their answers from the handout onto the poster. For the graph, students should draw on the Graph handout and attach it to their posters. If desired, they may also color or decorate their posters.

Differentiation

For students needing language or reading support, consider having them include the original story problem on their poster. Then, when comparing different representations later in the lesson, ask them to highlight key portions of the story, including both words and numerical values.

This is a good stopping point. Collect student posters and save them for the next class period. Begin the next class by displaying the posters around the room.

35 minutes

Explain

Teacher's Note: Materials

During this phase of the lesson, groups will use a highlighter to mark observations on other groups' posters. Each group needs one highlighter, but be sure to distribute at least two different colors throughout the classroom. Colored pencils or markers can be used as alternatives.

Display **slide 9** and have students hang their posters. Conduct a modified Gallery Walk and explain that students should visit a peer's poster, identify patterns, and highlight one observed pattern. They will repeat this process for a second round.

Distribute one highlighter per group and have them analyze another group's poster. Instruct students to highlight a pattern or similarity among the table, graph, and equation. Use hidden **slide 10** as an example but do not show it to students, as it reveals what they should discover independently. Give students about 5 minutes for this task.

After they have highlighted one poster, transition to **slide 11**. Instruct students to analyze a different poster that has a highlight color different from their own. They should identify and highlight another pattern or similarity. This second pattern may be more challenging to find, so allow another 5 minutes.

Teacher's Note: Purpose and Guiding the Activity

The goal of this activity is for students to recognize the presence of the *y-intercept* and *slope* across representations. As students analyze posters, circulate and listen to discussions. Use this time to make corrections by asking guiding questions. For example, if students are observing a pattern that seems coincidental, ask them if their pattern applies to the graph, table, and equation.

Transition through **slides 12–13** and facilitate a whole-class discussion about what they discovered through this activity. Use this time to introduce the terms *initial value* and *rate of change*.

Display **slide 14** and distribute the **Guided Notes** handout. At this stage, students are only focusing on the connections between the representations that have lines connecting them. These include:

- Story and table
- Table and graph
- Graph and equation
- Equation and story
- (Other connections will be discussed later.)

Transition through **slides 15–18** and complete the front side of the handout as a class. Instead of directly explaining the connections, ask guiding questions to prompt students to articulate their observations. Encourage the use of academic language as they describe connections between the different representations. Have students write their connections on the provided lines between the different representations. Use the **Guided Notes (Model Notes)** document as needed.

Display **slide 19** and pose the question: "Is it necessary to transition between representations in the same order (from story → table → graph → equation) every time?" Could they translate from a form in one corner of their notes to the form in another corner? Facilitate a brief discussion, then transition through **slides 20–21**. Have students draw diagonal lines between the opposite corners to indicate the flexibility of being able to translate to and from any given form.

Display **slide 22** and direct students' attention to the bottom of their handout. Ask for volunteers to share the different ways to represent slope and *y*-intercept. The goal for this portion of the handout is to create an exhaustive list summarizing key concepts in the graphic organizer.

Have students retrieve their calculators following regular classroom procedures. Direct their attention to the example on the back of their Guided Notes handout. Display **slide 23** and guide the class through creating a table from a given story. Move to **slide 24** to reveal the completed example.

Display **slide 25** and distribute a copy of the attached **Calculator Guide** handout to each student. Explain that students will now use their calculator to generate an equation from the table. Have them follow along with their handout as you walk them through the steps.

To conclude the example, instruct students to independently graph the linear function. As they work, transition to **slide 26** so they can check their results.

25 minutes

Extend

Teacher's Note: Activity Preparation

During this portion of the lesson, students work in groups of four at each station. Each station provides one linear representation, and students must create the other three. The activity consists of four rounds, requiring a minimum of four stations.

The attached **Function Fieldwork Stations** document contains eight pages; print enough so that each station has one page. Set up each station with one handout page and a calculator. Arrange enough stations for your class size. For example:

- If you have 16 or fewer students, use Stations 1–4.
- If you have 16–20 students, use Stations 1–5.

Students will now apply their knowledge by translating between different linear representations. Display **slide 27** and assign students into groups of 4. Have each student choose from one of the following job titles:

- Ecologist
- Wildlife Biologist
- Solar Technician
- Climatologist

Teacher's Note: Guiding the Activity

For this activity, a student's job title does not impact the quantity or type of work. The job titles are used to help communicate when students are to create a certain linear representation. If students are curious about those roles in the real world, briefly share with them what that job might look like.

- **Ecologist:** Studies the relationship between organisms and their natural ecosystems
- **Wildlife Biologist:** Studies animals and their habitats
- **Solar Technician:** Installs, maintains, and assembles solar panels
- **Climatologist:** Studies how climate changes over time and how it affects the environment

Assign each group to a different station, then display **slide 28** to introduce the activity. Explain that:

- Each station provides one representation (e.g., a table, graph, equation, or story).
- Each group must create the other three representations based on the given one.
- During each round, one student will have no assigned task—this student is responsible for helping the team complete the task on time and for leading the group discussion.

Give each student a copy of the attached **Function Fieldwork** handout and transition to **slide 29**. Instruct students to locate the first table (Round 1) and write the number of the station (from the page at the station) on their handout. Remind students that the handout at the station has a task listed for each person based on their job title. Give students three minutes to translate their given representation into their assigned representation.

Once students finish writing their representation, move to **slide 30**. Give students two minutes to discuss and compare their work.

Repeat these steps for rounds two, three, and four.

Sample Student Discussions

At Station 1, the Ecologist may have no assigned task in the first round because the group is given a story. In this case, the Ecologist should read the problem along with the group, offering help when needed. This may involve moments of silent observation before asking questions such as:

- "Is anyone stuck?"
- "Has everyone started?"
- "How did you create the table/graph/equation?"

When one minute remains, the Ecologist may check in:

- "Is everyone done?"
- "Does anyone need help?"

Once the group has completed their linear representations, the Ecologist leads the discussion by asking:

- "What was the initial value in the story?"
- "Where is that number in the graph, table, and equation?"
- "Do all of our slopes match?"

As students work at stations, circulate the room and provide support as needed. Use the attached **Function Fieldwork (Sample Responses)** document as a reference.

10 minutes

Evaluate

Have students find a partner or assign partners. Display **slide 31** and distribute the attached **Algebra Mad Libs** handout, giving one page to each student.

Explain that students will ask their partner for the indicated parts of speech to fill in the blanks in their story. For example, a student with the Student A handout would ask their partner, Student B, for a name to complete the first blank. Use **slide 32** as needed to model the activity. Give students 3–4 minutes to complete both stories.

Move to **slide 33** and have students trade papers. Then, instruct them to:

- Read their completed Algebra Mad Libs story.
- Create a graph with appropriate labels.
- Construct a table with at least five data points.
- Write an equation representing their story.

Alternative Pacing

If there is not enough time for this activity to be completed in class, assign this activity as independent work for students to complete and return the next day.

Collect student work and review for accuracy and common misconceptions.

Resources

- K20 Center. (n.d.). Gallery walk / carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- K20 Center. (n.d.). Philosophical chairs. Strategies. https://learn.k20center.ou.edu/strategy/71