Lesson 19

Tables, Equations, and Graphs, Oh My!

Goals

- Create a verbal description and a graph to represent the relationship shown in an equation and table.
- Identify tables and equations that represent the same relationship and justify (orally) the match.
- Interpret and critique (orally) different representations of the same relationship, i.e. table, equation, graph, and verbal description.

Learning Targets

- I can create a table and a graph that represent the relationship in a given equation.
- I can explain what an equation tells us about the situation.

Lesson Narrative

In this culminating lesson, students look at several examples of equations that represent important relationships from real-world situations. In the first activity, students briefly examine eight relationships, matching an equation and a table that represent the same relationship. To make the matches, students need to reason abstractly and quantitatively.

In the following activities, each student works more closely with one of the relationships: interpreting the equation, continuing the table, and creating a graph. This gives students an opportunity to become an expert on one of these relationships and then use multiple representations to explain their understanding to others.

Student Learning Goal

Let's explore some equations from real-world situations.

Access for Students with Diverse Abilities

- Action and Expression (Activity 1)

Access for Multilingual Learners

- MLR8: Discussion Supports (Activity 2)

Instructional Routines

- Card Sort
- Take Turns

Required Materials

Materials to Gather

- Graph paper: Activity 1
- Straightedges: Activity 1
- Sticky notes: Activity 2
- Tools for creating a visual display: Activity 2

Materials to Copy

- Card Sort Equations and Tables Cards (1 copy for every 1 student): Warm-up

Lesson Timeline

10 min	15 min	15 min
Warm-up	Activity 1	Activity 2

Instructional Routines

Card Sort

ilclass.com/r/10783726

Please log in to the site before using the QR code or URL

Instructional Routines

Take Turns

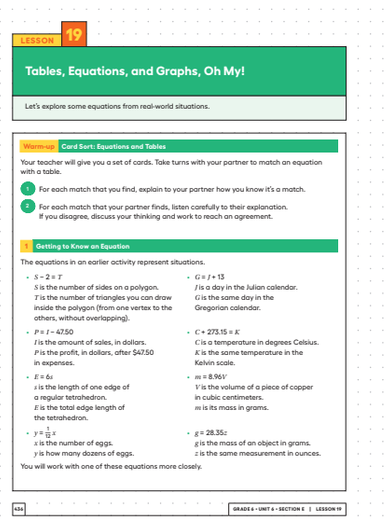
ilclass.com/r/10573524

Please log in to the site before using the QR code or URL

Building on Student Thinking

Some students may struggle to relate the variables in the equation to the columns of the table. Remind students that when we have one variable expressed in terms of the other variable, we call the former the "dependent variable" and the latter the "independent variable". For example, in the equation $a = b + 6$ we say that b is the independent variable and a is the dependent variable, because a is expressed in terms of b.

Student Workbook



LESSON 19

Tables, Equations, and Graphs, Oh My!

Let's explore some equations from real-world situations.

Warm-up Card Sort: Equations and Tables

Your teacher will give you a set of cards. Take turns with your partner to match an equation with a table.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

1 Getting to Know an Equation

The equations in an earlier activity represent situations.

- $S = 2 \cdot T$
  S is the number of sides on a polygon.
  T is the number of triangles you can draw inside the polygon (from one vertex to the others, without overlapping).
- $P = I - 47.50$
  I is the amount of sales, in dollars.
  P is the profit, in dollars, after $47.50 in expenses.
- $E = 6s$
  s is the length of one edge of a regular tetrahedron.
  E is the total edge length of the tetrahedron.
- $y = \frac{1}{12}x$
  x is the number of eggs.
  y is how many dozens of eggs.
- $G = J + 13$
  J is a day in the Julian calendar.
  G is the same day in the Gregorian calendar.
- $C + 273.15 = K$
  C is a temperature in degrees Celsius.
  K is the same temperature in the Kelvin scale.
- $m = 8.96V$
  V is the volume of a piece of copper in cubic centimeters.
  m is its mass in grams.
- $g = 28.35z$
  g is the mass of an object in grams.
  z is the same measurement in ounces.

You will work with one of these equations more closely.

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Warm-up

Card Sort: Equations and Tables

10 min

Activity Narrative

The purpose of this activity is to familiarize students with the eight relationships they will continue to work with for the rest of this lesson. In this partner activity, students take turns matching equations and tables that represent the same relationship without knowing what real-world situations the relationships represent. As students trade roles explaining their thinking and listening, they have opportunities to explain their reasoning and critique the reasoning of others.

Students can make use of structure as they narrow down which tables could possibly match each equation. For example, they may recognize whether the values for the dependent variable should be greater or less than the corresponding values for the independent variable, based on the operation and numbers in the equation.

Launch

Tell students that the cards contain either an equation or a table and that they will take turns matching the cards. Explain how to set up and do the activity. If time allows, demonstrate the steps with a student as a partner. Consider demonstrating productive ways to agree or disagree, for example, by explaining mathematical thinking or asking clarifying questions.

Arrange students in groups of 2. Give each group a set of 18 cards cut from the blackline master.

Consider allowing students to use calculators to ensure inclusive participation in the activity.

Student Task Statement

Your teacher will give you a set of cards. Take turns with your partner to match an equation with a table.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

Table I: $G = J + 13$

Table J: $m = 8.96V$

Table K: $y = \frac{1}{12}x$

Table L: $P = I - 47.50$

Table M: $C + 273.15 = K$

Table N: $S - 2 = T$

Table O: $g = 28.35z$

Table P: $E = 6s$

Activity Synthesis

The purpose of this discussion is to elicit the different characteristics of the equations and tables that students used to make their matches. Select 2–3 groups to share one of their sets of cards and explain how they matched an equation with a table. Discuss as many different sets of cards as the time allows, highlighting the ways students connect the variables and operations in each representation and use the terms "dependent variable" and "independent variable."

Activity 1

Getting to Know an Equation

15 min

Activity Narrative

In the previous activity, students looked at eight different equations. In this activity, each student focuses on just one of those equations to learn about the real-world situation it represents. As they interpret the variables and values in terms of the situation, they reason abstractly and quantitatively. Extending a table they saw earlier gives students an opportunity to practice both evaluating expressions and solving equations.

This activity also asks students to create a graph of their assigned relationship on graph paper. In previous activities, students were given a grid with the axes already labeled and numbered whenever they were asked to create a graph of a relationship. Here, they must decide for themselves how to scale each axis, which is an opportunity to practice attending to precision.

Launch

Decide whether to assign the equations or allow students to select an equation. Make sure there is at least one student working with each equation.

Use this example equation to help students understand what each step of the task is asking them to do.

$$2.54i = c$$

i is a measurement in inches.
c is the same measurement in centimeters.

1. The number of centimeters is the product of the number of inches and 2.54.

2.

independent variable: length (inches)	dependent variable: length (centimeters)
5	12.7
36	91.44
75	190.5
60	
	300

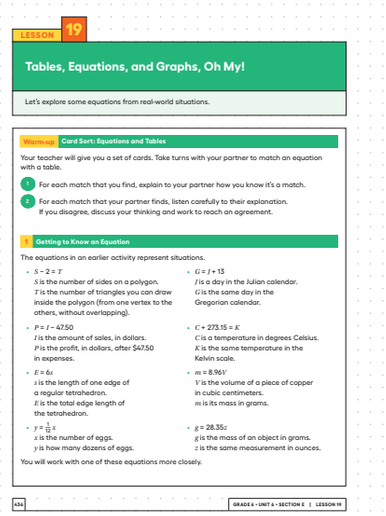
Access for Students with Diverse Abilities (Activity 1, Student Task)

Action and Expression: Internalize Executive Functions.
Chunk this task into more manageable parts. Check in with students within the first 2–3 minutes of work time. Look for students who need additional support deciding how to label and scale each axis of their graph. Invite students to share strategies they have used so far, as well as any questions they have before continuing.
Supports accessibility for: Memory, Organization

Building on Student Thinking

If students show they may be unsure how to set up their graph from scratch on graph paper, prompt them to think about the maximum value they want to represent on each axis and what number they could count by to get to that maximum value in the amount of space they have.

Student Workbook



LESSON 19

Tables, Equations, and Graphs, Oh My!

Let's explore some equations from real-world situations.

Warm-up Card Sort: Equations and Tables

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1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

1 Getting to Know an Equation

The equations in an earlier activity represent situations.

- $S - 2 = T$
  S is the number of sides on a polygon.
  T is the number of triangles you can draw inside the polygon (from one vertex to the others, without overlapping).
- $G = J + 13$
  J is a day in the Julian calendar.
  G is the same day in the Gregorian calendar.
- $P = I - 47.50$
  I is the amount of sales, in dollars.
  P is the profit, in dollars, after $47.50 in expenses.
- $C + 273.15 = K$
  C is a temperature in degrees Celsius.
  K is the same temperature in the Kelvin scale.
- $E = 6s$
  s is the length of one edge of a regular tetrahedron.
  E is the total edge length of the tetrahedron.
- $m = 8.96V$
  V is the volume of a piece of copper in cubic centimeters.
  m is its mass in grams.
- $y = \frac{1}{12}x$
  x is the number of eggs.
  y is how many dozens of eggs.
- $g = 28.35z$
  g is the mass of an object in grams.
  z is the same measurement in ounces.

You will work with one of these equations more closely.

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3. The values in the second row of the table mean that if something is 36 inches long, it is 91.44 centimeters long.
4. Substitute 60 for i in the equation and solve for c: $(2.54)60 = 152.4$. Then write 152.4 for centimeters in the table. Substitute 300 for c in the equation and solve for i: $2.54i = c$,300 ÷ 2.54 is approximately equal to 118.11. (Point out that students should round values to the nearest hundredth, tenth, or whole number.) Write 118.11 for inches in the last row of the table.
5. Show a graph with "length (inches)" on the horizontal axis, "length (centimeters)" on the vertical axis with the scales and intervals of both axes already labeled. Demonstrate plotting points at (5, 12.7), (36, 91.44), (75, 190.5), (60, 152.4), and (118.11, 300). Make sure students know they may have to estimate the locations for some points.

Give students 5–10 minutes of quiet work time followed by partner and whole-class discussion. If there is more than one student working with the same equation, consider letting them share their answers and reasoning with each other, after they have had some time to work on their own.

Student Task Statement

The equations in an earlier activity represent situations.

- $S - 2 = T$
  S is the number of sides on a polygon.
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You will work with one of these equations more closely.

1. Rewrite your equation using words from the context. Also use words like "product," "sum," "difference," "quotient," and "term."

   Sample response for the equation $S - 2 = T$:

   The number of triangles in a polygon is the difference of the number of sides of the polygon and 2.

2. In an earlier activity, you matched equations and tables.

   Copy the values from the table that matched your assigned equation into the first three rows of this table. Make sure to label what each column represents.

   Sample response for the equation $S - 2 = T$:

   The first three rows of this table:

independent variable: number of sides of the polygon	dependent variable: number of triangles inside
5	3
20	18
36	34
60	58
302	300

3. Select one of the first three rows of the table and explain what those values mean in this situation.

   Sample response for the equation $S - 2 = T$:

   In a polygon with 5 sides, you can draw 3 triangles from one vertex that do not overlap.

4. Use your equation to find the values that complete the last two rows of the table. Explain your reasoning.

   Sample response for the equation $S - 2 = T$:

   See last two rows of the table.

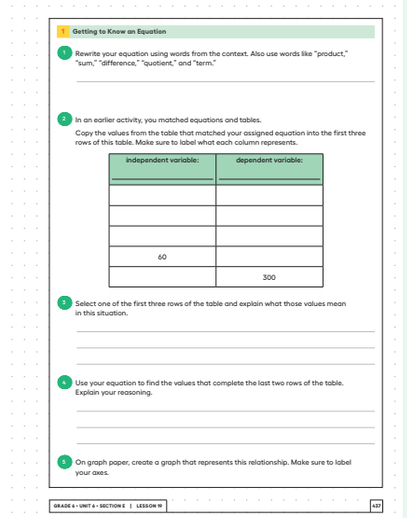
   Sample reasoning: $60 - 2 = 58$ and $300 + 2 = 302$.

5. On graph paper, create a graph that represents this relationship. Make sure to label your axes.

   Sample response for the equation $S - 2 = T$:

   A graph with "number of sides of the polygon" on the horizontal axis, "number of triangles inside" on the vertical axis, and points at (5, 3), (20, 18),(36, 34),(60, 58), and (302, 300).

Student Workbook


1 Getting to Know an Equation

1. Rewrite your equation using words from the context. Also use words like "product," "sum," "difference," "quotient," and "term."

2. In an earlier activity, you matched equations and tables.
Copy the values from the table that matched your assigned equation into the first three rows of this table. Make sure to label what each column represents.

independent variable:	dependent variable:
60	
	300

3. Select one of the first three rows of the table and explain what those values mean in this situation.

4. Use your equation to find the values that complete the last two rows of the table. Explain your reasoning.

5. On graph paper, create a graph that represents this relationship. Make sure to label your axes.

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Access for Multilingual Learners (Activity 2, Launch)

MLR8: Discussion Supports.
At the appropriate time, give groups 2–3 minutes to plan what they will say when explaining the relationships on their display.

"Practice what you will say when you share your display with the class. Talk about what is important to say, and decide who will speak."

Advances: Speaking, Conversing, Representing

Activity Synthesis

Use this time to elicit initial observations students may have made about the relationships between the dependent and independent variables in each representation. Students will continue to interpret and discuss these relationships as they create and describe visual displays in the next activity. They can also research to learn more about any unfamiliar contexts or terms. Before continuing, consider asking students to:

- Share how they rewrote their equation using words. Highlight the way students used words like "sum," "difference," "product," or "quotient."
- Share how they explained what the values from rows in their table meant in the context.
- Share what they noticed about the relationships after creating their graph.
- Share lingering questions they have about their relationships, including the meaning of words or background about any relationships.

Activity 2

Sharing Your Equation with Others

15 min

Activity Narrative

In this activity, students consolidate their work with equations and graphs that represent dependent and independent variables. They use multiple representations to share with each other what they have learned about their assigned relationship and the different ways each representation shows the relationship. Listen for the ways students use the vocabulary they have learned and practiced throughout the unit, in addition to how they describe relationships between variables in equations.

Launch

Distribute tools for making a visual display. Give students 5–10 minutes of quiet work time, followed by a *Gallery Walk*. If time permits, consider having students research more information about their situation to add to their displays.

Tell students that they should be prepared to share and explain their display to others during the *Gallery Walk*.

Student Task Statement

Create a visual display of your assigned relationship that includes:

- Your equation
- An explanation of each variable
- A verbal description of the relationship
- Your table
- Your graph

Be prepared to explain:

- What the variables in your equation represent.
- How the dependent variable and independent variable are related.
- What you notice about the relationship in each representation: equation, table, and graph.

If you have time, research more about your relationship and add more details or illustrations to help explain the situation.

Answers vary.

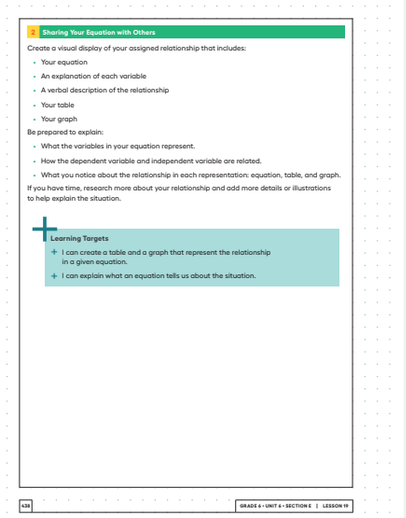
Activity Synthesis

Conduct a *Gallery Walk* so students have a chance to study and discuss each other's displays. Ask students in each group to take turns staying at their display to explain the relationship they studied or answer questions.
Ask students to reflect on the following prompts at each display they visit:

- *"What is the same about their relationship and your relationship? What is different?"*
- *"What is the independent variable in their relationship? What is the dependent variable?"*
- *"What could they add to the display to make their explanation of the relationship even clearer?"*

Provide sticky notes that students can use to leave questions or comments for the students who created each display. Give students a moment at the end to review any questions or comments left on their displays and to make any revisions, as needed.

Student Workbook



2 Sharing Your Equation with Others

Create a visual display of your assigned relationship that includes:

- Your equation
- An explanation of each variable
- A verbal description of the relationship
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Be prepared to explain:

- What the variables in your equation represent.
- How the dependent variable and independent variable are related.
- What you notice about the relationship in each representation: equation, table, and graph.

If you have time, research more about your relationship and add more details or illustrations to help explain the situation.

Learning Targets

+ I can create a table and a graph that represent the relationship in a given equation.
+ I can explain what an equation tells us about the situation.