Unit 12: Algebraic representations of two-variable relationships

6.4A, 6.6A, 6.6B, 6.6C, 6.11A

When students plot points, identify variables, and translate between forms, they can better visualize math, understand cause and effect, and solve problems in diverse ways. These skills are key tools for mathematical literacy and problem-solving.

- **Plot points** in a coordinate plane
- **Determine** the independent and dependent variables in a situation
- **Translate** between pattern descriptions, equations, tables, and graphs

### TEKS standards

<table>
<thead>
<tr>
<th>TEKS standards</th>
<th>Common misconceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.4A:</strong> Compare two rules verbally, numerically, graphically, and symbolically in the form of $y = ax$ or $y = x + a$ in order to differentiate between additive and multiplicative relationships</td>
<td><strong>Mixing up the $x$ and $y$ coordinates</strong></td>
</tr>
<tr>
<td><strong>6.6A:</strong> Identify independent and dependent quantities from tables and graphs</td>
<td><strong>How to help:</strong> Review with students that the $x$-coordinate always comes first in an ordered pair and it tells us how far to move horizontally (right or left) on the $x$-axis (note: horizontal is like horizon to help remember). The $y$-coordinate is always second in an ordered pair and tells us how far to move vertically (up or down) on the $y$-axis. Make a poster for quick reference. Note that the points $(3, 1)$ and $(1, 3)$ are located in different places on the graph, order matters!</td>
</tr>
<tr>
<td><strong>6.6B:</strong> Write an equation that represents the relationship between independent and</td>
<td></td>
</tr>
</tbody>
</table>

---

This content is brought to you with support from ExxonMobil Foundation.
Forgetting to start at the origin | The origin, \((0, 0)\), is where the \(x\)- and \(y\)-axes intersect and is the place to start when counting to plot points.

**How to help:** When students are learning to plot points on a coordinate grid, it’s important that they start at the origin. Once they have practice and get a feel for it, they can do fewer steps.

Confusing the quadrants | The coordinate plane is divided into four quadrants that are numbered counter-clockwise, starting at the top right.

**How to help:** Review the quadrants and their labels with students often. Make a poster for quick reference.

Misunderstanding the signs | Some students might think that all numbers in the coordinate plane are positive. It’s crucial to emphasize that the \(x\) and \(y\) coordinates can both be positive and negative.

**How to help:** Practice, practice, practice! Remind students to pay attention to the negative signs, and that a negative \(x\)-coordinate means to move to the left on the \(x\)-axis and a negative \(y\)-coordinate means to move down on the \(y\)-axis.

Mixing up independent and dependent variables | Students often get confused about which variable is which — and it usually takes some thinking! The independent variable is the one we change or control and the dependent variable is the one we measure or observe. The independent variable is graphed on the horizontal axis and is also called the input. The dependent variable is graphed on the vertical axis and is also called the output.

**How to help:** Do examples together and encourage students to think about which variable in a word problem *depends* on the other. The variable that *depends* on the other is the *dependent* variable, while the variable that *does not depend* on the other is the *independent* variable. See "Best practices" for more.

### Dependent quantities from a table

**6.6C:** Represent a given situation using verbal descriptions, tables, graphs, and equations in the form \(y = kx\) or \(y = x + b\)

**6.11A:** Graph points in all four quadrants using ordered pairs of rational numbers
## Unit resources

- In Lessons 2 and 3, have students use this Equation/graph/table template as they work through the exercises or for extra practice.
- For the videos in this unit, use the Learning summary video notetaking guide.
- For the articles in this unit, use the Article notetaking guide.
- For the exercises in this unit, use the Blank workspace template.
- To record key terms and information, use the Vocabulary and notation notetaker.

## Lesson overview

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Objective</th>
<th>Teaching tips</th>
</tr>
</thead>
</table>
| **Lesson 1: Coordinate plane**
TEKS standard: 6.11A | Students will be able to plot points on a coordinate plane and identify in which quadrant (or axes or origin) the point is located. | - **Warm up activity:** Ask students to plot positive and negative numbers on a number line. To make it more challenging, include fractions and decimals. You may want to use this Number line template.
- Students graphed points in a coordinate grid in 5th grade, but only in Quadrant I. They may need support with graphing negative numbers.
- Review important vocabulary (coordinate plane, axes, $x$-axis, $y$-axis, origin, quadrant) with students and review how to graph points on a coordinate plane after watching the videos. Have students record words and diagrams in the Vocabulary and notation notetaker. |
| Video | Article | Exercise |
| 5      | 3       | 2        |
| **Lesson 2: Dependent and independent variables**
TEKS standard: 6.6A, 6.6C | Students will be able to determine independent and dependent variables in a situation. Students will be able to complete a table from an equation. Students will be able to match graphs and equations. | - Discuss independent and dependent variables and talk through examples together. The article provides definitions, examples, and additional practice.
  The dependent variable is the value that is affected when we change the independent variable—it depends on the independent variable. See “Best practices” for more.
- Students will translate linear patterns between descriptions, equations, tables, and graphs. Use this Equation/graph/table template for students to show their work, especially for the third exercise. |
<p>| Video | Article | Exercise |
| 2      | 1       | 3        |</p>
<table>
<thead>
<tr>
<th>Lesson 3: Number patterns</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TEKS standard: 6.4A, 6.6B</td>
<td></td>
</tr>
<tr>
<td>Students will be able to write an equation when given a rule in words.</td>
<td>Students will be able to write tables from graphs and graphs from tables.</td>
</tr>
<tr>
<td>Students will be able to identify relationships in tables.</td>
<td></td>
</tr>
</tbody>
</table>

- Continue to offer this [Equation/graph/table template](#) to students for the exercises. For extra practice, you can complete one section and have students finish the other sections. Or, have students fill in one section and trade with a partner to complete!
- It’s important for students to get comfortable translating patterns between descriptions, equations, graphs, and tables. These multiple representations are different ways to describe the same relationships.

**TRY THIS WITH YOUR STUDENTS**
Best practices

**Independent and dependent variables**

It can be tricky to determine which variable is dependent and which is independent in a problem situation. Sometimes, it might not be clear which is which, but in this unit, the given situations are generally straightforward.

The dependent variable is the value that is affected when we change the independent variable—it depends on the independent variable.

Another way to think about it is, which variable is impacted by the other? For example, if we collect data on how many cookies someone can eat in a given period of time, the number of cookies eaten depends on the amount of time they are given, so the number of cookies is the dependent variable and the time given is the independent variable. It wouldn’t make sense in this situation to say that the amount of time given depends on the number of cookies eaten. Let’s look at a few more examples where we identify the independent and dependent variables.

Marty is running a lemonade stand. He notices that the more cups of lemonade he sells, the more money he makes.

It makes sense that the more lemonade he sells, the more money he makes. Alternatively, it would not make sense to say that the more money he makes, the more lemonade he sells (this is true because they are related, but the money comes from the amount of lemonade he sells, not the other way around). The independent variable is the number of cups of lemonade he sells and the dependent variable is the amount of money he makes.

Jimmy is doing a science experiment where she waters different plants with varying amounts of water to see how much they grow.

Does the amount of water depend on how much the plants grow? Or does how much the plants grow depend on the amount of water? The first question doesn't make sense because we are not measuring the growth of the plants and using that to determine how much water they get. The thing that is changing in the experiment (that Jimmy is controlling) is the amount of water, and we are observing the plant growth. Thus, the independent variable is the amount of water and the dependent variable is their growth.
CLASSROOM ACTIVITIES

Battleship!
Battleship is a great game to play to help students get practice with a two dimensional coordinate grid. It uses numbers on one axis and letters on the other, but the idea is the same. This is particularly helpful for students who are having a hard time working with a coordinate grid. Note that the game only uses Quadrant I.

If you don't have access to the game or don't want to do an activity with that theme, you can create your own with graph paper and colored pencils. Have students sit back-to-back with their partner or stand up folders between the students to block their view. Give each student a piece of graph paper with axes labeled up to 15 in each direction (or however many will fit; don't forget negative numbers!). Designate one student to place the objects and one student to guess. You'll need to give students “objects” to be placed on the grid and the guessing student will also need to know what the “objects” are. The “objects” can be as simple as 5-6 different rectangles for students to color in on their grid. When the guesser gets a “hit,” that coordinate can be crossed off of the picture.

Connect the dots
Have students make their own connect the dots activity! Give each student a piece of graph paper with the axes as large as possible. Have each student plot and connect points to make a picture. They will write out the ordered pair for each dot in the order they want them to be connected. Trade lists of ordered pairs to see if they get the correct pictures back.

GENERAL CLASSROOM IMPLEMENTATION RESOURCES:

- Weekly Khan Academy quick planning guide: Use this template to plan your week using Khan Academy.
- Using Khan Academy in the classroom: Learn teaching techniques and strategies to support your students and save time with Khan Academy.
- Differentiation strategies for the classroom: Discover strategies to support the learning of all students.