Unit 5, Lesson 4

Introduction to Linear Relationships

Let’s explore some relationships between two variables.

4.1 Stacks of Cups

4.2 Stacking Cups

Here is information about the two stacks of styrofoam cups in the photo.

- One stack has 6 cups, and its height is 15 cm.
- The other stack has 12 cups, and its height is 23 cm.

How many cups are needed for a stack with a height of 50 cm?

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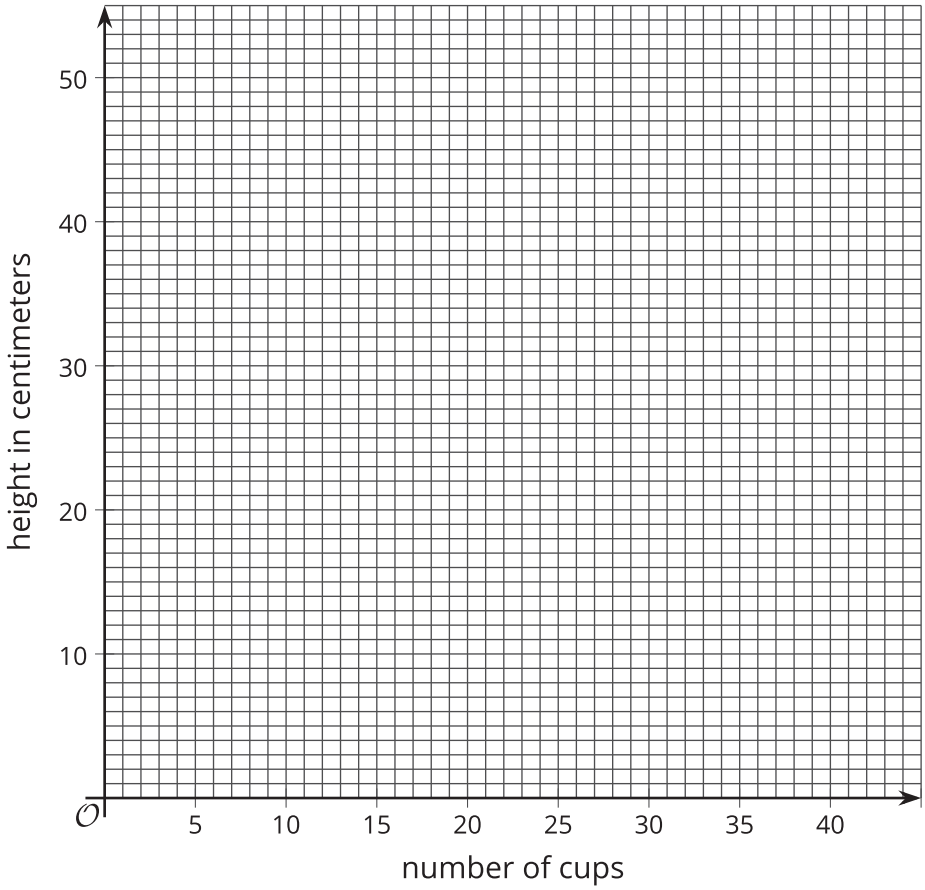
4.3 Connecting Slope to Rate of Change

1. If you didn't create your own graph of the situation before, do so now.



2. What are some ways to tell that the number of cups is not proportional to the height of the stack?

3. What is the **slope** of the line in your graph? What does the slope mean in this situation?

4. At what point does your line intersect the vertical axis? What do the coordinates of this point tell you about the cups?

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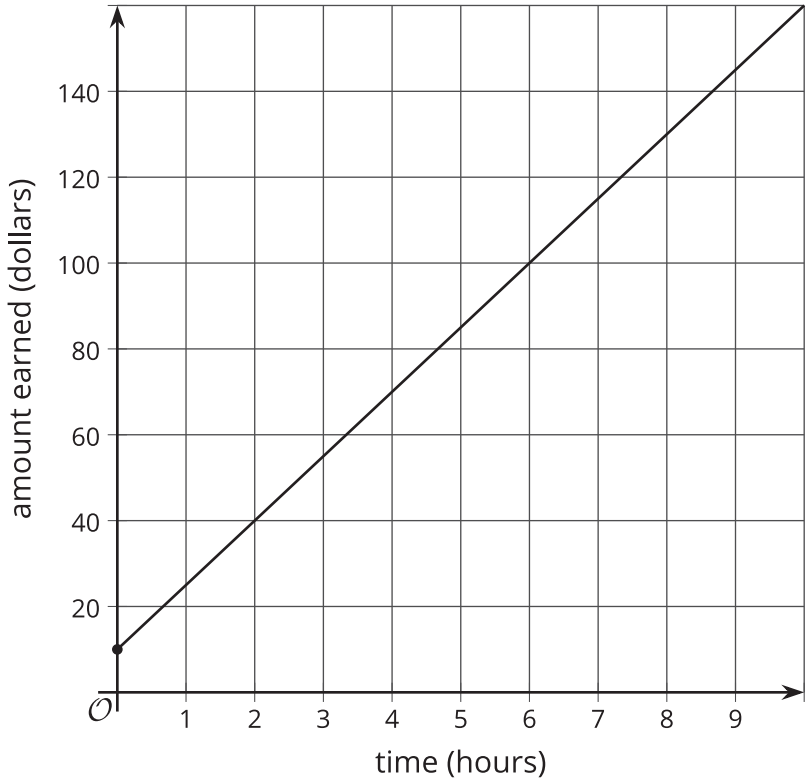
Lesson 4 Summary

A **linear relationship** is any relationship between two quantities where one quantity has a constant rate of change with respect to the other. For example, Andre babysits and charges a fee for traveling to and from the job, and then a set amount for every additional hour he works. Since the total amount he charges with respect to the number of hours he works changes at a constant rate, this is a linear relationship. But since Andre charges a fee for traveling, and the graph does not go through the point $(0, 0)$, this is not a proportional relationship. Here is a graph of how much Andre charges based on how many hours he works.



The rate of change can be calculated using the graph. Since the rate of change is constant, we can take any two points on the graph and divide the amount of vertical change by the amount of horizontal change. For example, the points $(2, 40)$ and $(6, 100)$ mean that Andre earns 40 dollars for working 2 hours and 100 dollars for working 6 hours. The rate of change is $\frac{100-40}{6-2} = 15$ dollars per hour. Andre's earnings go up 15 dollars for each hour of babysitting.

Notice that this is the same way we calculate the slope of the line. That's why the graph is a line and why we call this a “linear relationship.” The **rate of change** of a linear relationship is the same as the slope of its graph.

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