

Mind Stretch



End of Vegas

An average shower uses 5 gallons of water per minute.

1. About how many minutes do you spend showering each day?

The student answer could be anything but you may want to question unreasonable answers given that they will affect subsequent results. Generally the students will answer between 5 and 15 minutes.

2. **Show how** you would estimate the number of gallons of water you use showering for this many minutes each day.

This answer should be 5 times the answer given in question 1 (e.g., $5 \times 10 = 50$)

3. **Show how** you would estimate the number of gallons of water you use showering in one week (7 days)?

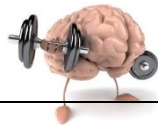
This answer should be 7 times the answer given in question 2 (e.g., $50 \times 7 = 350$)

4. Write **an equation** showing how many gallons of water you use showering in x days. Use the variable y to represent the gallons of water used.

This answer should: 1) be an equation; 2) the coefficient of x should be the student's answer in problem 2; and 3) be equal to y in order for students to connect to subsequent problems. [Note: the equation can be written in standard, point-slope, or $x =$ form but these are unusual and may make graphing the equation difficult for students who use these forms.]

¹ **Inspiration for Task:** Inspiration for the End of Vegas task came primarily from the Lines and Linear Equations lesson developed by the Math Assessment Resource Services (MARS, 2012); see [link](#).

Workout



End of Vegas

Nevada and California are in the middle of a drought. Unless something changes, Las Vegas may soon run out of water. The lake that supplies 90% of the water for Las Vegas, Lake Mead, will be at a level so low by 2021 that it will not provide any water.

Facts:

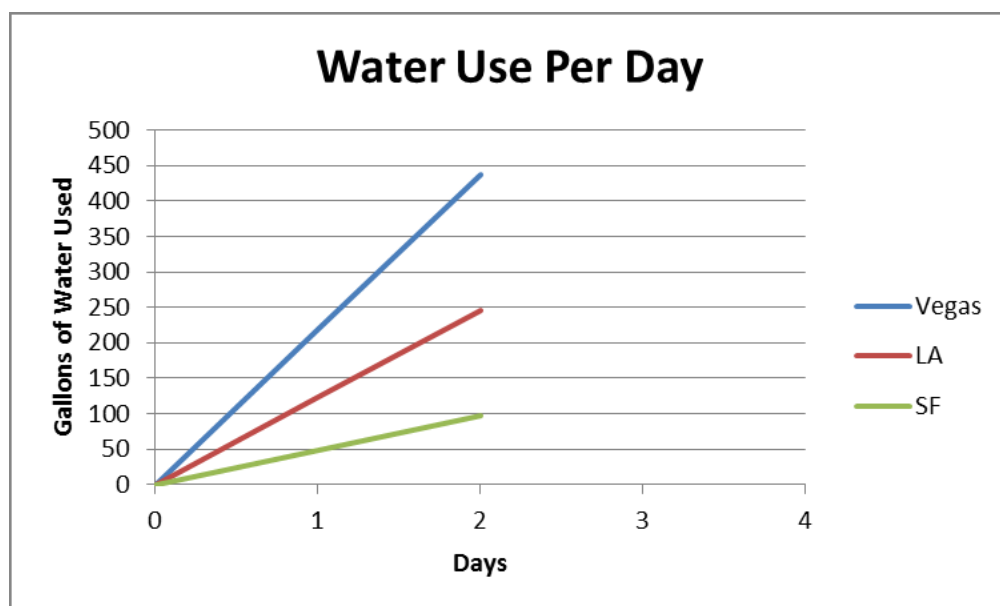
- Las Vegas uses water at a rate of 219 gallons per person per day.
- Los Angeles uses water at a rate of 123 gallons per person per day.
- San Francisco uses water at a rate of 49 gallons per person per day

[TEACHER NOTE: You may want to read these facts a second time with your students or ask for a volunteer to put these facts into her/his own words:

For instance: "219 gallons per person per day means each person in Las Vegas uses 219 gallons each day (on average)."

It is **important** to emphasize/remind students that this problem is not examining the rate of water use by the **total population** of a city but **per person each day**.]

1. Sketch a line to represent each city's water use **per person per day** over time on the same graph below. You should have 3 lines when you are done.

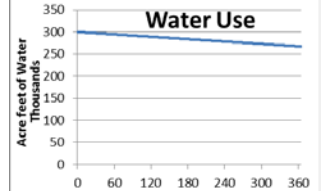
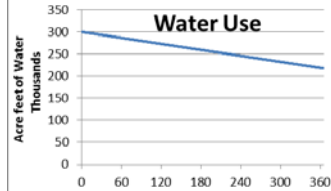
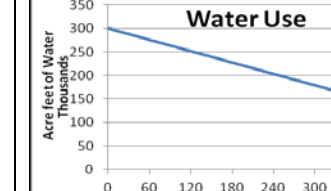


2. Explain how use of water per person in Las Vegas, Los Angeles, and San Francisco compare over time.

Las Vegas is using the most water per person each day. Their rate, 219 gallons per person per day is the highest. SF is using the least water per person per day at 49 gallons per person. Las Vegas is using over 4 times as much water for each person each day than SF and almost twice as much as LA.

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3. Take out your End of Vegas cards to complete the workout. Match the graph, equation and picture cards for each city. **Attach** the graph, equation and picture card for **Los Angeles** to this worksheet.

$-90x + 300,000 = y$ <p>San Francisco, CA</p>	$-226x + 300,000 = y$ <p>Los Angeles, CA</p>	$-417x + 300,000 = y$ <p>Las Vegas, NV</p>
		

4. How can you **prove** that these are the correct representations for the water use in Los Angeles? In your answer, please explain what **specific information** from each representation connects it to the water use in Los Angeles.




The picture shows that LA uses water at a rate in between Vegas and SF. The equation shows that the slope for how much water LA uses is -226 (in thousands of acre feet). This rate shown in the graph is less steep than the rate for Vegas, but steeper than the rate for SF, and the slope for LA in the equation is also in between the slopes for Vegas and SF. $-226 \text{ acre feet per day} \times 360 \text{ days} = -81,360 \text{ acre feet}$, the amount used in a year, which is about the amount of water shown as being used up in the graph ($300,000 - 81,360 = 218,640$). The graph also shows that the city begins with an allowance of $300,000$ acre feet of water because that is the y -intercept, the amount of water at time 0 .

Check Your Pulse

Compare your answers with a partner. Discuss where you agree or disagree.

1. In a few words, explain what part(s) were difficult for you?

Circle the thumb that best describes how you are feeling:

?	I have lots of questions, I need help. 	Almost got it, but need practice. 	Got it. I can explain this to a classmate. 
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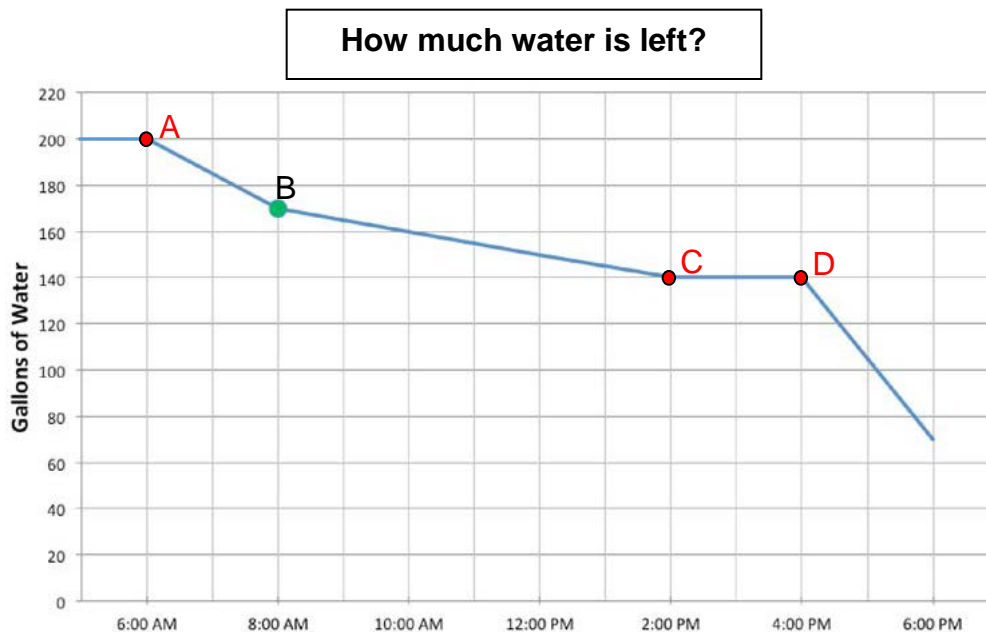
Final Lift



End of Vegas

During the drought each household gets a water “allowance” of 200 gallons per day. Below is a graph of how a family used water from 6AM to 6PM on a Saturday.

1. Label the graph at points **where the slope changes**. One point (B) is labeled for you as an example. Label the other points (A, C, and D) where slope changes.



2. Based on the graph, describe how the slope changes **at each point** and what might be happening. An example is provided.

Example: The family starts w/ 200 gallons before 6 am. Between Points A and B, the amount of water decreases. The slope is pretty steep. Perhaps the family is taking showers one after another between 6 & 8 am.

At 8 am (Point B), the slope changes. The family keeps using water, but at a slower rate. Maybe someone left the faucet dripping in the shower. Dad gets home at 2 pm (Point C) and turns off the dripping shower faucet. He goes out again and no one is home until 4 pm, so no water is getting used. The line segment between 2 and 4 pm is horizontal – 0 gallons of water are used over this 2 hour time period, the slope is 0. Mom, Sam, and Jimmy get home at 4 pm (Point D). Sam puts in a dirty load of laundry, Mom starts the dishwasher, and Jimmy turns on the sprinkler to water the lawn. Water is used at a fast rate for the next 2 hours, until 6 pm, so the slope of the line is the steepest all day.

3. Which of the equations below fits segment drawn between 6:00 AM and 8:00 AM? (Circle one answer) Note: x is the number of hours after 6:00 AM.

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a. $y = 15x$

c. $y = 200 - 15x$

b. $y = 15x + 200$

d. $y = -1$

4. Does the answer you circled above suggest a proportional relationship between x and y ? Explain.

No, x and y are not in a proportional relationship. Although the graph of this equation is a line, the line does not go through $(0,0)$. So the equation cannot be rewritten as a proportion.

5. Does the slope of the line on the graph change, or is it constant, between 6:00 AM and 6:00 PM? Explain your thinking.

The graph shows that the rate of water use changes over time. This is not a constant relationship.

6. If the family cut their water use in half between 6 AM and 8 AM, how would the **line on the graph** change? As part of your answer, explain why you think this.

Instead of using 30 gallons of water in 2 hours (15 gallons per hour), the family would only use 15 gallons of water in 2 hours (7.5 gallons per hour). So the slope of the line would be much less steep $(-7.5 : 1)$.

7. If the family cut their water use in half between 6 AM and 8 AM, how would the **equation you selected** change? As part of your answer, explain why you think this.

The equation would now be $y = 200 - 7.5x$ since the slope is $\frac{-7.5}{1}$.

The mayor of LA challenges the mayor of Las Vegas, saying, "We will reduce our water use more than you." Las Vegas' mayor accepts the challenge. During the next year, LA cuts water use from **123 gallons to 61 gallons per person per day**. Las Vegas cuts water use from **219 to 139 gallons per person per day**. Los Angeles has about 15 million residents; Las Vegas has about 2 million residents. Who cut their water use more? Explain your reasoning.

LA's water use drops to a rate that is just less than half of what it used to be – a 62 gallon reduction; $\frac{62}{123} = 50.4\%$, a reduction of over 50%. Las Vegas cuts its water use

by more gallons per person (80), but this rate is a reduction of only about $\frac{80}{219} = 36\%$.

Also, because LA has many more residents, their total water reduction will be more.

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