



## Water Water Everywhere: Designing Water Filters

### Lesson 3

---

### Title: Calculating Rate

Grade Level: 3, 4, 5, 6

Written by: Carolyn Townsend  
Witchcraft Heights Elementary, Salem, MA

Prep Time: 15 Minutes  
Lesson Time (1): 30 Minutes  
Lesson Time (2): 30 Minutes

---

#### Lesson Description:

Students will apply their science experiment data on the water flow through water filters and be challenged to determine the time it would take to fill a gallon jug (advanced) or just a cup (beginner) with water. Students graph the results.

#### Strands:

- Operations and Algebraic Thinking
- Measurement and Data
- Mathematical Practices

#### Standards:

- 
- Identify and explain patterns in arithmetic
- Write and interpret numerical expressions
- Use the four operations with whole numbers to solve problems
- Represent and interpret data
- Model with mathematics
- Analyze patterns and relationships

#### Objective:

Students practice calculating and graphing rate data.

#### Materials:

- Advanced:
  - Each student:
    - Worksheet: Filtering Water and Calculating Rates
    - Paper
    - Pencil
- Beginner:
  - Each student:
    - Worksheet: How long will it take to fill a cup with filtered water?
    - Paper
    - Pencil

**Lesson Plan:**

1. This lesson is designed to be completed after the Lesson 3, Exploring Water Filters lab.
2. Students will be presented with an open response challenge based on the rate data collected during the water filter lab.
  - a. The Advanced worksheet challenges students to calculate how long it would take to fill a gallon jug of water based on the rate the water flowed through their water filter. Once calculated, students will graph the results. The
  - b. Beginner worksheet includes graphics for students to color to determine the time it would take to fill a cup based on the quarter cup measurement. Students utilizing this worksheet may continue to calculate the time to fill a gallon jug once a relationship is determined between time and volume. Again, a graph is created.
3. For both the Advanced and Basic lessons, the graph will depict a constant rate based on the water filter flow. The graph should show a straight line for changes to the quantity of water over time.
4. This may lead to additional questions or discussion in class about what constant rate means and other examples of constant rate. Here is a link to some additional problems with constant and variable rate of change:  
[http://www.figurethis.org/challenges/math\\_index.htm](http://www.figurethis.org/challenges/math_index.htm)

**Reflections:**

- By calculating rates in this way, questions about rate and increasing rates can be discussed.
- Discuss the practicality of using students' water filters for filtering water for an entire village, or a small or large community.
- Students could continue to extrapolate on this data to determine the time it would take to clean enough water for people to consume in a day, week, or month.

**Assessment:**

There is no assessment for this extension lesson.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

A

## Filtering Water and Calculating Rates

After completing the *Exploring Water Filters* and the *Designing a Water Filter* experiments in the **Engineering is Elementary** unit, Salila determined that the time it took to filter the water differed by the type of water filter that was used.

Salila's teacher asked the class to calculate how long it would take to fill a one gallon jug using the filter she designed. If the water took 45 seconds to filter through the filter design, you could say that the rate the water filtered through the paper filter was 0.25 cups/45 seconds, or one quarter cup every 45 seconds.

Look at the rate your water filtered during the ***Designing a Water Filter*** experiment. How long do you think it would take to fill a gallon jug at this rate? What information do you need to know before continuing with this challenge? Make a plan and then complete your plan below. Make sure to include the instructions on how you calculated your answer.

Graph the results: Create a line graph on the grid below showing the rate of the water flowing through the filter over time. Where does the line graph cross the one hour mark?

Title: \_\_\_\_\_







Was there an increase or decrease in the amount of water over time? Explain your answer.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## How long will it take to fill a cup with filtered water?

During science class, Salia filled a cup to the  $\frac{1}{4}$  cup mark with filter water in 15 seconds. She wants to calculate how long it would take to fill a cup of water to 1 full cup. Can you help her by shading in the pictures below?

Color $\frac{1}{4}$ of the cup	Color $\frac{2}{4}$ of the cup	Color $\frac{3}{4}$ of the cup	Color $\frac{4}{4}$ of the cup
			

It took 15 seconds to fill  $\frac{1}{4}$  of a cup. Complete the pie piece on the stopwatch to show 15 seconds. Color in the pie.



I calculated that it would take \_\_\_\_\_ seconds.

How long do you think it will take to fill  $\frac{2}{4}$  or  $\frac{1}{2}$  of the cup? Complete the pie piece on the stopwatch to show  $\frac{1}{2}$ . Color in the pie.



I calculated that it would take \_\_\_\_\_ seconds.

Do you see a pattern? Again, color the stopwatch below with your prediction about how long it would take to fill the cup  $\frac{3}{4}$ .



I calculated that it would take \_\_\_\_\_ seconds.

At this point your cup will be filled,  $\frac{4}{4}$  is the same as 1 cup. Color the stopwatch with your prediction to fill the cup, 1 cup.

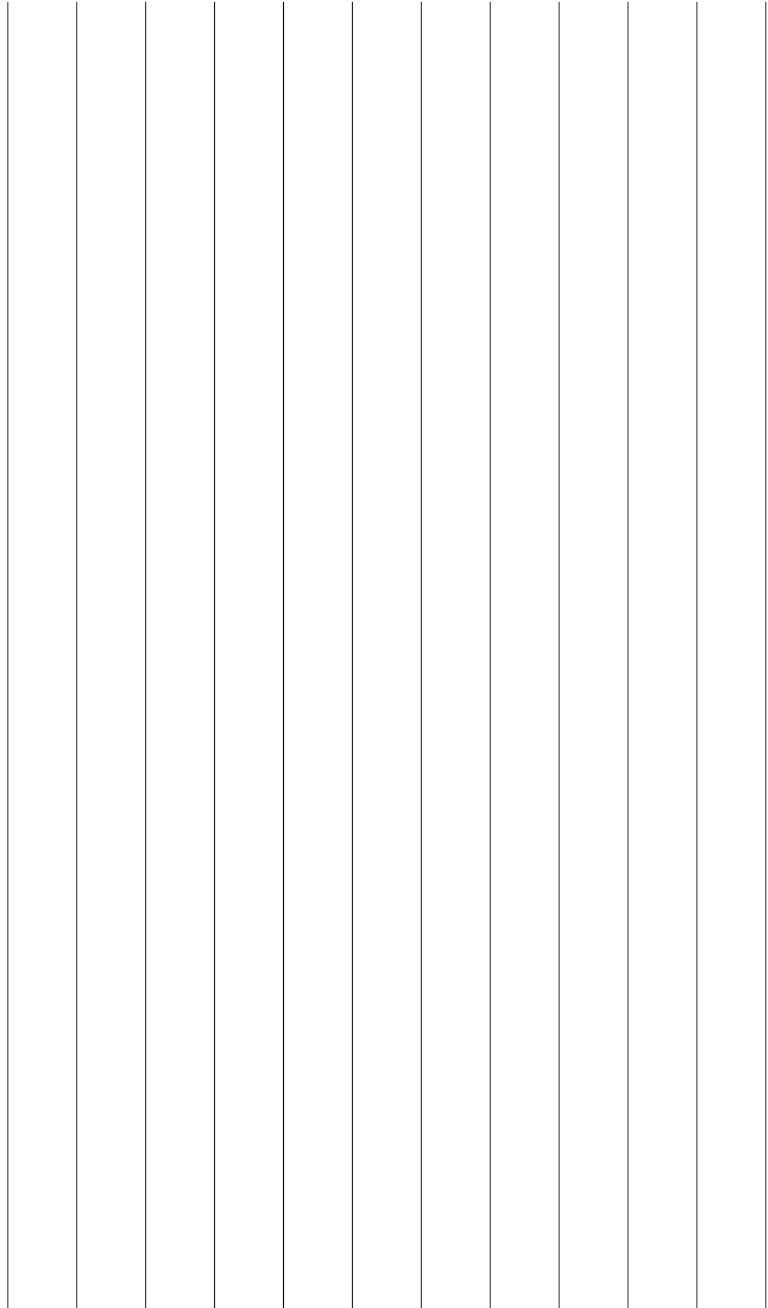


I calculated that it would take \_\_\_\_\_ seconds.

Look at the table you have created above. Explain any patterns that you see. Use the back of this paper to write your answer.

Graph your results from the table you made on page 1. Counting by 5s, label the "Seconds" axis.

Graph Title: \_\_\_\_\_



$\frac{1}{4}$  Cup

$\frac{1}{2}$  Cups

$\frac{3}{4}$  Cups

1 Cup