NAME____________________________

Activity One: Faucet Flow Rates

For the following questions, brainstorm with your team. Write down lots of answers, let everyone on your team participate, and then summarize your answers in the spaces provided below.

What is flow rate? How does it relate to your life?

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After discussing with your class, summarize your understanding of flow rate and provide an example:

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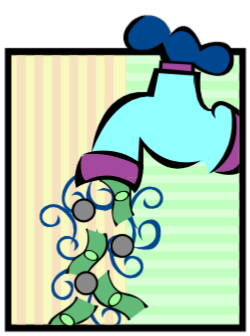
To help you learn about flow rate, you and a partner will be determining the flow rate of a faucet when it is on three different levels – full blast, half blast, and quarter blast.



Materials needed to complete this experiment:

1. A typical water faucet (the kitchen sink or a sink in your science lab at school will work)
2. An empty gallon jug (an empty gallon milk jug will work well)
3. A stopwatch (a wrist watch or classroom clock with second hand will also work)
4. A teammate (another student in your class or a parent will work great!)
5. A computer with Internet access

Procedure

1. Select one person to be the timer and one to hold the gallon jug.

2. Turn the faucet on full blast. Estimate the time you think it will take to fill up the gallon jug. Record your answer in Table 1 below.

3. Start the timer at the same time as the jug is placed under the faucet.

4. Determine how much time (in seconds) it takes to fill the jug all the way to the top. Record the time in Table 1 on Data Sheet 1 in the line called Full-Blast Trial #1.

5. Empty out the jug.

6. Repeat steps 3-6 two more times, and fill in the lines called Full-Blast Trial #2 and Full-Blast Trial #3 in Table 1.

7. Now turn the faucet on half-blast. Repeat steps 2-6 and record your data in Table 2. ***Make sure to open the faucet to the same place for each trial!***

8. After you have done three tests at half-blast, turn the faucet to quarter-blast, and repeat steps 2-6. ***Make sure to open the faucet to the same place for each trial!*** Record your data in Table 3.

9. Use your data to determine the flow rate for each of your trials; record the answers in each table.

HINT: You know how many seconds it took to fill up one gallon, so if it took 17 seconds to fill up the gallon jug your calculation might look like this:

$$\frac{1gal}{17\sec} = 0.059 gallons / second$$

Table 1 – FULL-BLAST DATA

Faucet Level: **Full Blast**	Prediction Time needed to fill the jug (seconds)	Actual Time to fill the jug (seconds)	Flow Rate (gallons per second)
Trial #1			
Trial #2			
Trial #3			
Average of Trials			

Table 2 – HALF-BLAST DATA

Faucet Level: **Half-Blast**	Prediction Time needed to fill the jug (seconds)	Actual Time to fill the jug (seconds)	Flow Rate (gallons per second)
Trial #1			
Trial #2			
Trial #3			
Average of Trials			

Table 3 – QUARTER-BLAST DATA

Faucet Level: **Quarter-Blast**	Prediction Time needed to fill the jug (seconds)	Actual Time to fill the jug (seconds)	Flow Rate (gallons per second)
Trial #1			
Trial #2			
Trial #3			
Average of Trials			

10. Create a graph of your average flow rate (on y-axis) versus average time to fill the jug (on x-axis). Your graph should have three data points. Include a title and labels on each axis.

11. Draw a “best fit” straight line through the data points.

12. What percent does the flow rate increase as you go from half blast to full blast?

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13. Using the graph, what would the flow rate be at ¾ blast?

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14. Based on your data, estimate the flow rates of the following:

Bath tub faucet (full blast) ____________ Garden hose: _____________

Fire Hydrant: _____________ Shower: _______________

15. For the above estimates, consider the constraints on water flow rate and how these affect flow rate from the various sources. What determines the flow rate of each? What can be done to alter the flow rate from these sources?

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16. The bathtub faucet, garden hose, and shower are all examples of standard water uses in a household. Many municipalities charge more for water during the day than the night, since the demand for water is greater during the day. If you were to design a schedule of water usage in the household to minimize the cost to residents, what are some of the criteria / constraints that you should consider? For instance, should a resident have to shower at 3am in order to save money?

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17. Now that you have your flow rates in gallons per second, you need to convert them to cubic feet per second. Cubic feet per second are very common units for flow rate. The data you get tomorrow from the Internet will be in cubic feet per second.

Fill in Table 4 using the following conversion:

$$1 gallon = 0.134\ ft^3 \text{ or } 0.134 \text{ cubic feet}$$

HINT: If your flow rate was 0.059 gal/sec you would divide by 0.134 ft^3/gal (given above), and your calculation would look like this:

$$\frac{0.059}{0.134} = 0.44\ ft^3/sec, \text{ or } 0.44 \text{ cfs}$$

Table 4: Converting Gallons/Second to Cubic Feet/Second

Faucet Level	Flow Rate (gal/sec) ***FROM DATA SHEET 1***	Flow rate (cubic feet per second)
Quarter-blast		
Half-blast		
Full-blast		

Activity Two: River Flow Rates

You will now compare the flow rates from your faucet to the flow rate of a local river. Think of a river near to where you live. Based on your observations from the faucet experiment, write a hypothesis statement about a river close to where you live. ***Your hypothesis should be an estimate of the flow rate in that river***:

I estimate that the flow rate in the ___________________________

River is ________________cubic feet per second (cfs).

Procedure:

1. On a computer with Internet access, go to http://waterdata.usgs.gov/nwis/rt. The title on the top of the webpage should read "USGS Current Water Data for the Nation".

2. Click on the state that you live in on the map to the left of the page.

3. On the right of the page, you should have a list of options of real-time data. Choose the option that reads "Statewide Streamflow Real-Time Table" or "Statewide Streamflow Current Conditions Table" for your state.

4. You should find a list of rivers and streams labeled with a station number and a station name. Looking through the station name, find the river that you chose on the previous page. If you cannot find it, choose another local river and repeat the estimation on the previous page. Once you have located a local river on the website that matches the river you chose on the previous page, look through the data. The data that you are looking for is the date and time of the most recent streamflow reading, and the discharge in ft^3/s. Discharge is the same as streamflow! Also, ft^3/s is the same as CFS = cubic feet per second.

5. Fill in the table below:

River Name	Station Location (latitude & longitude)	Flow Rate (CFS)	Date of Reading

6. Now compare your estimate with the actual value you got from the *USGS* website. How close were you? On the lines below, write what your estimate was, what the actual value is, and the difference between the two.

My hypothesis was ________________(correct/incorrect) because my was

_______________ and the actual flow rate is ________________. The

difference between my hypothesis and my actual data is________________.

7. Explain on the lines below some possible reasons for the discrepancy between your estimate and the actual flow rate.

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8. To mitigate flooding in your area, you need to determine how you might alter the flow rate. What are the design criteria that control flow rate and how would you change these?

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