Dripping Faucet

I went away for a 2 week vacation in December. When I arrived home I realized I had left the faucet dripping by accident. About how much water did I waste in the 2 weeks?

Your answer should be in a form that will give me a clear idea or picture of how much water I wasted. Please use the chart of equivalent weights and measures.

Since I did not tell you how fast my faucet was dripping, be sure to include the information about your dripping faucet that will help me to compare it to my dripping faucet.

Grade Levels 6 - 8

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Context

I teach sixth grade math and science and I wanted a problem that would link the two subjects. We just finished a unit on density where we did a fair amount of measuring volume of regular and irregular shaped objects. We were working with cubic measure and I wanted to assess how many students could use their understanding of volume to give me a solution that really gave me a feel for how much water I wasted.

What This Task Accomplishes

This problem has students experimenting to collect data to use in their solution. This relates to the *NCTM Curriculum and Evaluation Standard 1: Mathematics as Problem Solving* - students can use problem-solving approaches to investigate and understand mathematical content; and develop and apply a variety of strategies to solve problems, with emphasis on multi-step and non-routine problems.

The students will also need to communicate their solution in writing which covers *Standard 2 - Mathematics as Communication* - discuss mathematical ideas and make conjectures and convincing arguments.

The problem also has students using *Standard 5: Number and Number Relationships* - students can understand, represent and use numbers in a variety of equivalent forms in real-world situations.

Hopefully it has students thinking more about volume and different ways of expressing their solution, which is in *Standard 12: Geometry* - develop an appreciation of geometry as a means of describing the physical world.

Finally, the problem also has students thinking of how to use a chart of equivalent measures to change from one unit of measure to another. This skill is described in *Standard 13: Measurement* - students can make and use measurements to describe and compare

phenomena and understand the structure and use of systems of measurement.

What the Student Will Do

All the students went home and collected their water. Some did not record enough information about their drip rate to allow me to compare it to my drip. Almost all students could work the computation (amount of water in one minute, to one hour, to one day, to two weeks) using calculators. The most difficult part was getting them to express their solution in a meaningful way. Some found the equivalent measures chart confusing and difficult to work with.

Time Required for Task

The students were given the problem at the end of a class period and some discussion was necessary. They brought in their individual water dripping information the next day and worked the whole period. Some kids still needed more time because at the end of the period we talked more about making their solution meaningful to themselves and to me.

Interdisciplinary Links

This problem could be used in science or an environmental education unit.

Teaching Tips

I made sure everyone understood the problem. We talked about fast drips and slow drips and that I would be able to compare their results to my drip if they could describe how fast their drip was. I told them to collect their information by experimenting with a drip at home (we talked about how to get your faucet to drip). I told them if they wanted to, they could bring in their water and use some of the measuring tools we had in school, or they could use any measuring tools they had at home. We looked over the equivalent tables and discussed some of the equivalents so they would be familiar with the chart. I found it necessary to repeat many times and give specific examples as I tried to get my students to understand what "a meaningful solution" was. I asked them if a student said that I wasted 143,859 drips in the two weeks - would that have any meaning to them? Did that solution (although maybe correct) give them a clear and meaningful idea or picture of how much water I wasted? I would then refer them to the chart to see if they could find a better equivalent.

Suggested Materials

- Chart of equivalents (see page 5)
- Graduated cylinders
- Measuring cups
- Teaspoons
- Tablespoons
- Calculators

Possible Solutions

Answers vary, but the best solutions were students who related the amount of water to the sink at home or at school, gallon milk cartons or some kind of cube or rectangular solid that they drew.

Benchmark Descriptors

Novice
The student attempts to find the number of cubic centimeters wasted in two days not two weeks. The student multiplies 48 (hours) by 14,400 (cc in 24 hours) and thinks s/he is finding the number of cc in two days, so the student is applying inappropriate concepts. Their strategy is not helping to solve the problem.

Apprentice
This solution is not complete. The student tells me how many drips s/he got in two weeks, but failed to work with any standard measure in order for me to get a feel for how much water I wasted. Since this was part of the problem, the student's strategy was only partially useful, leading toward a partial solution. There was some evidence of mathematical reasoning when the student successfully found the number of drips for two weeks, but there is also some confusion. The student records that 1 drip = 1 cc + 1 ml. Since a cubic centimeter equals a milliliter, does that equation mean that a drip is the same as 2 cc? Or is the student confused. The student never uses that information, so it is hard to tell. The solution is not clearly presented.

Practitioner
This student shows a clear understanding of the problem. S/he works the problem successfully although not very directly. S/he gives the solution in three different ways; first the number of gallons that was wasted; then s/he uses the chart to change that to cubic feet; and then goes back to the gallons and uses milk cartoons to give me a better picture of how much water was wasted. S/he has a clear explanation (especially by his/her use of labels), detailing how the problem was solved. All the steps are included.

Expert
This student has a deep understanding of the problem and also uses his/her knowledge of volume and proportions to express his/her solution in a more meaningful way. His/her explanation is very clearly shown and explained by labeling all the computational steps. S/he uses a very efficient strategy. S/he also adds at the end, the cost of the wasted water by finding the cost/gallon of town water.

Cubic Measure

1 cubic foot (ft^3) = 1.728 cubic inches (in^3)
27 cubic feet = 1 cubic yard (yd^3)

Liquid Measure

When necessary to distinguish the liquid pint or quart from the dry pint or quart, the word "liquid" or the abbreviation "liq" should be used in combination with the name or abbreviation of the liquid unit.

4 gills = 1 pint (pt) = 28.875 cubic inches
2 pints = 1 quart (qt) = 57.75 cubic inches
4 quarts = 1 gallon (gal) = 231 cubic inches = 8 pints = 32 gills

1 cord (cd) firewood	128 cubic feet (exactly)
1 cubic centimeter (cm^3)	0.061 cubic inch
1 cubic decimeter (dm^3)	61.024 cubic inches
1 cubic inch (in^3)	0.554 fluid ounce 4.433 fluid drams 16.387 cubic centimeters
1 cubic foot (ft^3)	7.481 gallons 28.317 cubic decimeters
1 cubic meter (m^3)	1.308 cubic yards
1 cubic yard (yd^3)	0.765 cubic meter
1 cup measuring	8 fluid ounces (exactly) 1/2 liquid pint (exactly)
1 dram fluid (fl dr) (British)	0.961 U.S. fluid dram 0.217 cubic inch 3.552 milliliters
1 dekaliter (daL)	2.642 gallons 1.135 pecks
1 gallon (gal) (U.S.)	231 cubic inches (exactly) 3.785 liters 0.833 British gallon 128 U.S. fluid ounces (exactly)

Novice

Although incorrect, the student clearly explains how the task was solved.

① I got 10 cc. in 1 minute
1 x 10 = 10 cc.

② That would be 600 cc. in 1 hour
60 x 10 = 600cc

③ There are 24 hours in a day
24 x 600 = 14,400 cc

④ 14,400 cc. in 24 hours

⑤ In 48 hrs. there would be 691,200 cc
(2 days) 48 x 14,400 = 691,200 cc.

The student shows some math language and notation.

Apprentice

how many drip in 2 weeks

1 drip = 1cc + 1ml, 13 drips in 1 minute 60 x 13 = 780

780 drips in 1 hour.

The student uses accurate and appropriate math terms and notation.

24 hour x 780 drips = 3,120 din pg in 24 hours

10 dogs x 3120 drips = 43680 drips in 2 weeds

Solution is incomplete and not clearly presented.

Practitioner

The student explains his/her process for solving the task.

The teacher's faucet was dripping for 2 weeks. On my faucet there was 80 drips in a minute. There are 60 minutes in an hour so 80x60= 4,800 drips in an hour. There are 24 hours in a day so 4,00 X 24 = 115,200 drips in a day. There are 7 days in a week so 7X 115,200 = 806,400 drips in a week. There were 2 weeks so 806,400 x2 = 1,612,800 drips in 2 weeks.

I know there's 20 drips in a teaspoon. There are 48 teaspoons in ¼ cup so 48 x 20 = 960 drips in a ¼ cup. There are 64 ¼ cups in a gallon so, 960 x 64 = 61,440 drips in a gallon. So, 1,612,800 ÷ 61,440 = 26.25 gallons of water wasted. Which is about 35 cu. ft.

Thats the same as 26 of those gallon milk cartons and one 1 quart carton.

I think that its neat that just by knowing how many drips were in a minute and how many drips were in a teaspoon you can find out how many drips were wasted in 2 weeks.

The student uses accurate and appropriate math terms and notation.

The student puts his/her conclusion in relative terms to demonstrate a concept of how much water was wasted.

Expert

How Much water was waisted in 2 weeks?

7cc a minute

60 minutes
x 7cc
420 cc were waisted in 1 hour
x 24 hours
1680
+ 8,400
10,080 cc waisted in 1 day
x 7 days a week
70,560 cc waisted in a week
2 weeks
141,120 cc were waisted in 2 weeks.

The student clearly labels accurate and appropriate mathematical notation.

The paint is, all you do is start with 1cc and work your way up till 2 weeks.

The student explains his/her reasoning.

Dripping Faucet

Expert

141,120 cc waisted in 2 weeks is related to, or can fill ~~to is a~~ 5 sinks

Sink = 13 in
x 21 in
13
+260
2473
x 6 in
1,638 cubic inches in sink

The student shows a command of creating equivalences.

1 cubic inch / 16.387 cc = 1,638 / X

X = 26,842 cc of water that fills the sink 5 times

Expert

$\frac{1 \text{ cubic inch}}{16.387 \text{ cc}} = \frac{x}{141.120 \text{ cc}}$

$x = 8611.7043 \text{ cubic in}$

$\frac{1 \text{ gallon}}{231 \text{ cubic in}} = \frac{x}{8611.7043 \text{ cin}}$

$x = 37.28 \text{ gallons}$

$+ \quad x \quad .003 \text{ dollars/gallon}$

$.111840 3$

The student clearly communicates his/her conclusion.

WOW! you only waisted about $.11!

*waste it costs about $.003/gallon