Performance Based Learning and Assessment Task

Filling Up a Swimming Pool Task

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:
Students will be using a variety of geometrical concepts and skills dealing with volume as they work with a partner to explore 3 different possibilities for filling up a large swimming pool. This activity helps students develop and implement a plan of action to find a solution in a real world situation

II. UNIT AUTHOR:
Yolonda Shields, Benjamin Franklin Middle School, Franklin County Public Schools

III. COURSE:
Geometry

IV. CONTENT STRAND:
Measurement & Geometry

V. OBJECTIVES:
SOLs: G.9, G.13

VI. REFERENCE/RESOURCE MATERIALS:
Students will need: TI-83 Plus (or higher) Graphing Calculator, Computer, Pencil, Paper, sink (or any other water source), 25 ft. water hose, 5 gallon bucket, stopwatch, rulers, scissors, tape, Internet, GeoGebra or Geometer's Sketchpad Software (optional) / Copy of Pool Shape Template (for those who may need this accommodation), Assessment Rubric, Copy of Performance Task, Word Processing Software (i.e Microsoft Word or Google Docs), Copy of Benchmarks.

VII. PRIMARY ASSESSMENT STRATEGIES:
The rubric/listprovides both the student and teacher a reference and a checklist/rubric. The assessment list for each of the activities will contain all the essential components for this mathematics activity (includes the mathematics content, process skills, and requirements for the finished product).

VIII. EVALUATION CRITERIA:
Students will be evaluated on their completion of the activity and by their final product.

IX. INSTRUCTIONAL TIME:
Two ninety-minute class sessions

Filling-Up A Swimming Pool Task

Strand
Measurement & Geometry

Mathematical Objective(s)
Students will: 1)investigate the time it will take to fill up a swimming pool by using proportional reasoning, 2)use properties of quadrilaterals (trapezoids) to solve real-world problems, 3)use the formula for the area of two-dimensional objects (i.e trapezoids), 4)calculate the volume of the swimming pool by using the formulas for the volume of three-dimensional objects (i.e. trapezoidal prisms) or combinations of three-dimensional figures to solve real-world problems, 5)determine the disadvantages/advantages of each of the 3 given options for filling up the swimming pool (including costs, time, and other factors).

Related SOLs

- SOL G.9
- SOL G.13

NCTM Standards

- Apply and adapt a variety of appropriate strategies to solve problems
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others
- Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest.
- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Use visualization, spatial reasoning, and geometric modeling to solve problems
- Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools
- Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections
- Make decisions about units and scales that are appropriate for problem situations involving measurement
- Understand measurable attributes of objects and the units, systems, and processes of measurement
- Apply appropriate techniques, tools, and formulas to determine measurements.
- Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders
- Solve problems involving scale factors, using ratio and proportion
- Organize their mathematical tinking through discussion with peers
- Communicate their thinking clearly to teacher and peers
- Analyze and evaluate the mathematical thinking and strategies of their partners
- Use the language of mathematics to express mathematical ideas precisely

- Recognize and apply mathematics in contexts outside of mathematics
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Create and use representations to record and communicate mathematical ideas.
- Select, apply, and translate among mathematical representations.
- Use representations to model and interpret physical and mathematical phenomena.

Materials/Resources

Students will use: TI-83 Plus (or higher) Graphing Calculator, Computer, Pencil, Paper, sink (or any other water source), 25 ft. water hose, 5 gallon bucket, stopwatch, rulers, scissors, tape, Internet, GeoGebra or Geometer's Sketchpad Software (optional) / Copy of Pool Shape Template (for those who may need this accommodation), Assessment Rubric, Copy of Performance Task, Word Processing Software (i.e Microsoft Word or Google Docs), Copy of Benchmarks

Assumption of Prior Knowledge

- Knowledge of trapezoids and how to calculate their area
- Ability to recognize prisms, even though they are oriented differently
- Familiarity with the volume formulas and ability to associate filling up a swimming pool with this concept (not surface area)
- Experience with decomposing two-dimensional figures, which will help with the transition towards decomposing three-dimensional figures
- Success with proportional reasoning and doing time conversions (i.e seconds to minutes)
- Some experience with graphing calculator technology and Geometer's Sketchpad / GeoGebra Software; Experience with using Word Processing Software
- Students may be confused by the trapezoidal prism shape if they have not been exposed to different types of prisms beyond triangular, rectangular, and cylindrical prisms.
- As a result, students may have some misconceptions as to what formula to use to determine the volume.

Introduction: Setting Up the Mathematical Task

The mathematical goal of this activity is for students to use their current knowledge and to seek out additional information needed to solve this swimming pool problem. The teacher will help set the ground work by facilitating a couple of experiments dealing with the flow of water. In doing so, students will have an understanding of how the distance water flows affects the output rate, which will help them determine if they would rather have water pumped from their creek, well, or just have a more direct source like the fire department tanker truck. In addition, students will need to use their prior knowledge of three-dimensional figures to determine that the pool is shaped like a trapezoidal prism and be able to recognize the need to

determine the volume of this figure before being able to calculate how many gallons of water would be needed to fill it up. Students will need to research ways of converting cubic units to gallons. Then, students will use this information to determine how long it will take to fill the pool up using the first two options and how many trips the fire truck will have to make to fill up their swimming pool, which will help determine the cost. The goal is also to help the students use mathematics, collaboration, logical thinking, and research to gain insight into some elements involved with having a swimming pools (both the positive and negative) or having a deeper appreciation of the costs associated with pools. Students may also use word processing software to organize their ideas and answer questions that will be a part of their presentation (bonus points). Nevertheless, students will gain valuable skills as they gather information and communicate their mathematical ideas.

Teachers will use the following guidelines:

- Discuss the activities for the day (refer to displayed Agenda)
- Motivating activity to introduce the goal of the task/activity (Experiment: Using a stopwatch, determine the time it takes to fill up a 5-gallon water bucket straight from the faucet vs. using a 25 ft. water hose) Please Note: Creating and showing a video of these 2 experiments to the students could be a possible alternative to doing these tasks in the classroom.
- Student discussion about why these differences occurred and what they think would happen if an additional 25 ft. water hose were connected, etc. Students would be able to see that as the distance increases, the amount of time it takes to fill the bucket up increases. Then, discussion would follow with why this concept is important or relevant. Hopefully, the students will discuss filling up a swimming pool, which will be a great transition to the task discussion.
- Distribute the task and assessment rubrics to the students; Teacher will give an outline of the performance assessment task and the timeframe for completion as students look at the typed version that is passed out to them.
- Students can pick a partner or the teacher can create the groups
- In their groups of 2, students will begin brainstorming steps for addressing this real-world task
- Teacher will act as facilitator and will ask questions or give prompts to the students, such as things they should consider. The teacher will reinforce the idea that he or she is going to be in this role and that the students will be responsible for developing a plan and implementing that plan to come up with a solution.
- Students will be asked to draw upon their prior knowledge to come up with solutions
- Teacher will help students understand the task by effectively answering their questions if they arise.

- Students will have to use Mathematics to solve the problem, but will be given access to a computer and the Internet to help them.
- To make the students' mathematical thinking and understanding public, students will collaborate with their partners, come up with a solution or solutions, and share their ideas through a culminating activity that involves the presentation of their information.

Student Exploration

Student/Teacher Actions

- Students will be collaborating with their partner to come up with multiple ways for finding the volume of the swimming pool that is shaped like a trapezoidal prism. The students will be actively using Mathematics, research, and exploration to do a variety of calculations. Students will have access to the computer for research, typing their results, and using GeoGebra/Geometer's Sketchpad Software if desired. They will also have access to the Internet and a graphing calculator to help them with these calculations.
- Students will analyze and describe the potential advantages/disadvantages, costs, and factors to be considered for filling up the large swimming pool using each of the 3 methods: creek, well, or fire truck (Students in urban areas may be interested in researching more about wells).
- The teacher will be a facilitator who helps the kids stay on task. He or she will help guide the students and use a variety of questions to help guide the students as they participate in their exploration.
- There are many different variables to consider, such as the water output rate (i.e gallons per minute/hour), the amount of water available for the fill up (i.e the fire truck tank can only hold a certain amount of water, the creek's flow could be low, or the well can only have a certain amount of water safely pumped in a certain timeframe without risk of it running dry – how long it takes before a well water's supply can be replenished), the distance the water is being pump/potential strain on the pump, how often the pool needs to be filled up, potential costs associated with filling up the pool, ways to determine the output rate if this information was not given to you (i.e using a 5-gallon bucket, a stopwatch, and proportional reasoning)
- Possible misconceptions or errors could involve students not recognizing that the pool is a prism with trapezoid sides. They may falsely think it is a rectangular prism since the other sides have this shape. In addition, students may attempt to find the surface area of this three-dimensional figure instead of making the appropriate connection between filling up a swimming pool and volume
- If students struggle with identifying that the pool is a trapezoidal prism, a review of the definitions of prisms and bases may help. In addition, visual students may be able to decompose the trapezoidal prism into a rectangular prism and a triangular prism. Or, they

may could copy the image and "attach" it to the original image thereby making it into a rectangular prism, find the volume of this rectangular prism (l x w x h), and take half of it to get the volume of the pool. These possible solutions are included in the benchmarks that are attached to this performance based assessment task.

- Students can experiment with reconstructing the image using GeoGebra or Geometer's Sketchpad software. Then, they can use it to visualize the decompositions, recompositions, and transformations listed above. This could also be used in their typed material if desired. Students with accommodations may be given a copy of the Pool Shape Template to use (see attached resource at the end of this task).
- Higher-order questioning will be used, such as: If the pump from the creek fills the pool up at a rate of 5 gallons every 1 minute and 40 seconds and the well fills it up a gallon every 15 seconds (both use the same size pipe and same horse power pump), which one (the creek or the well) is located closer to the pool? How do you know?
    - This goes back to the motivating activity at the beginning of the lesson.
- The teacher also has the option of making this task even more challenging by providing or having students research some form of costs for the well water and the creek water. Even though the water is free, there are still costs for the pump, hoses, etc.

Monitoring Student Responses

- I expect students to work together as they communicate their thinking and their new knowledge with each other and with the teacher.
- The teacher will help students with any clarification needs and assist students who are having difficulties by helping them connect their previous experiences to these new ones.
- If there are students who are ready to move forward, differentiation will be used and the students can explore additional ways to solve the problem, additional topics (listed earlier in the student exploration section, etc.). This information could also be included in the final product.
- Students who are ready to prepare their class presentation (demonstrating what feedback they would give their parents), can go ahead and move to the computer to begin typing out key ideas/information (they will earn bonus points).
- Closure will involve the students sharing their results through a culminating activity, such as a presentation to the class. This will be followed by a group discussion and with the teacher providing feedback.

Assessment List and Benchmarks

Class handouts, rubric/list, and benchmarks are attached.

Performance Based Assessment Task

Name(s): _____

_____

Date: _____

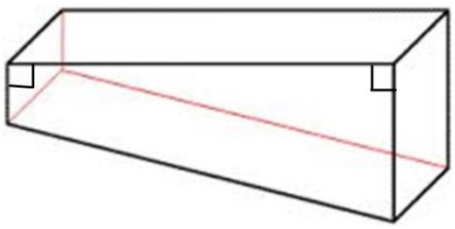
Geometry Teacher: _____

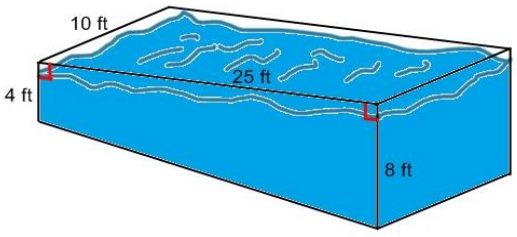
Filling Up a Swimming Pool

Pool Filling Options & Other Important Information

Summer is almost here and you are looking forward to a vacation filled with lots of fun, especially swimming! Your parents have just had a pool installed at your home and are planning to fill it up with water. However, since the pool is so large, they are considering their options: pumping water from a nearby creek, using water from their well, or calling the local volunteer fire department to see if they would bring their tanker truck to fill it up for a fee of $175 per 3,000 gallons of water and a travel fee of $50 for each trip made to the pool. The fire truck's water tank is 15.2 feet long, 7.8 feet wide, and 6.35 feet high. You also know from previous experiences with getting water (to the place where the pool will be located) that it takes 1 minute and 40 seconds to fill up a 5-gallon bucket with water from the creek and that it takes 15 seconds to fill up a gallon jug from the well. You talk this over with your friend who is also in your Math class and you both decide to use Mathematics to come up with the best solution.

Here is an outline of the pool's shape and dimensions:





Determining the Best Option

Before you and your partner are able to determine the best option for filling up your pool, you must first correctly identify the type of two-or-three dimensional figure the pool represents or what figures could be used to construct the pool's shape. You both must be able to explain your mathematical reasoning behind your shape selection. Only then can you use Mathematics to determine how much water would be needed to fill the pool.

You and your partner will analyze all three options. You will be expected to show your work and provide written explanations for how you analyzed each option. In doing so, you will create a list of benefits and disadvantages for each of the 3 options as you factor in the potential costs and determine which option is most beneficial for the family in terms of time, available resources, and risks. Your mathematical input is valuable in helping your parents make the best decision. As you work with your partner, you are expected to participate in discussions by speaking or asking a question at least three times. As math scholars, you will use your knowledge of Geometry and other math concepts/skills to come up with a solution to this real-world problem, as well as research. Possible research may include conversions for determining how many gallons of water would be needed to fill the pool based on its dimensions.

Class Presentation

You will present and share you and your partner's conclusions to the math class in any format you choose (letter, conversation, etc.) If you type the key concepts / information you used for your 2-3 minute presentation, you will earn bonus points! Be prepared for your teacher and your classmates to ask questions and/or give you feedback after the presentation. You want to make sure you create a quality and neat product that you can share with your parents.

***REFER TO THE ATTACHED ASSESSMENT LISTS & RUBRICS FOR A CHECKLIST/INFORMATION ON HOW YOU & YOUR PARTNER WILL BE GRADED!**

			Earned Assessment	
#	**Element**	**Point Value**	**Self**	**Teacher**
1	Student participated in discussions with his/her partner and the class by speaking or asking a question at least three times (recorded with an observation checklist by instructor).	2		
2	Student developed a plan for analyzing all 3 options for filling up a swimming pool with water.	2		
3	Student documented any research done and the information gathered to address this real-world problem.	2		
4	Student recorded measurement findings while completing the activity and used proper mathematics to verify solutions.	2		
5	Student correctly identified the type of two-or three-dimensional figure the pool represents or what figures could be used to construct the pool's shape.	2		
6	Student explained their mathematical reasoning behind their shape selection (name of the figure that the pool is shaped like).	2		
7	Student correctly determined which formulas to use related to filling up a swimming pool	2		
8	Student used the dimensions of the pool appropriately when being substituted into these formulas	2		
9	Student can show why their formulas work for any pool that is similarly shaped (i.e. sketches)	2		
10	Student estimates and compares the time needed to fill up the pool using a nearby creek versus using well water by using problem solving such as proportional reasoning.	2		
#	**Element**	**Point Value**	**Self**	**Teacher**
11	Student calculates how many trips the fire	2		

	truck would need to make in order to fill up the swimming pool			
12	Student determines the total cost associated with using the volunteer fire department to fill the swimming pool	2		
13	Student lists a minimum of 3 advantages/disadvantages associated with each of the 3 options based on mathematics, knowledge, and research	2		
14	Student selects the best option for filling up the swimming pool and gives at least 3 reasons why he or she made that choice	2		
15	Student actively participates in a 2-3 minute class presentation	2		
16	Student answered all of the higher-order questions posed to him or her by the teacher and the classmates after the presentation	2		
17	Student demonstrates use of technology in their solution or final product	2		
18	Student's work and presentation is well-organized	2		
19	Student's work is neat	2		
20	Student can explain their reasoning for their ideas, formulas, and work shown from activity.	2		
21	Student uses Word Processing Software to type presentation key ideas / information (**Bonus Points!)**	2		
	Total (Out of 40)			

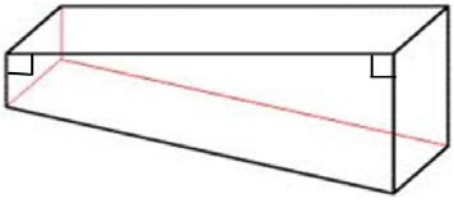
	RUBRIC FOR ACTIVITY 1			
#	**Element**	**0**	**1**	**2**
1	Student participated in discussions with partner by speaking or asking a question at least three times (recorded with an observation checklist by instructor).	Student did not speak or ask any questions	Student contributed 1 or 2 times	Student contributed 3 or more times
2	Student developed a plan for analyzing all 3 options for filling up a swimming pool with water.	No evidence of a plan provided	Evidence of plans for 1-2 of the 3 options	Evidence of plans for all 3 options
3	Student documented any research done and the information gathered to address this real-world problem	No documentation	Minimal documentation	Sufficient documentation
4	Student recorded measurement findings while completing the activity and used proper mathematics to verify solutions.	Measurements are not provided	Some measurements are provided.	All measurements are provided
5	Student correctly identified the type of two-or three-dimensional figure the pool represents or what figures could be used to construct the pool's shape.	Student does not correctly identify the two- or three-dimensional figure the pool represents or what figures could be used to construct the pool's shape	Student attempts to identify the name or the components of the pool's shape, but does so incorrectly	Student correctly identifies the name and/or components of the pool's shape
6	Student explained their mathematical reasoning behind their shape selection (name of the figure that the pool is shaped like).	Does not explain	Attempts to explain, but does not do so correctly	Clearly explains their reasoning
7	Student correctly determined which formulas to use related to filling up a swimming pool	No formulas developed	Formulas developed, but not all formulas are correct	Correct and logical formulas developed

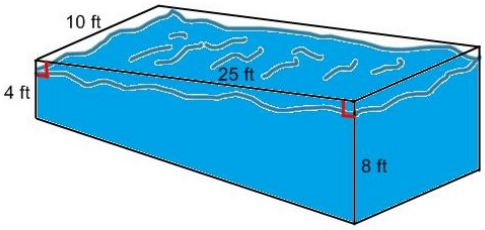
#	**Element**	**0**	**1**	**2**
8	Student used the dimensions of the pool appropriately when being substituted into these formulas	No indication of appropriate use of substitution into these formulas	Some dimensions are substituted correctly into these formulas	All dimensions are substituted correctly into these formulas
9	Student can show why their formulas work for any pool that is similarly shaped (i.e. sketches)	Cannot show how the formulas work	Partially shows why the formulas work	Correctly and completely shows how the formulas work
10	Student estimates and compares the time needed to fill up the pool using a nearby creek versus using well water by using problem solving such as proportional reasoning.	Student does not correctly use problem solving and mathematical reasoning to estimate and compare the 2 fill-up times	Student either estimates the times correctly using problem solving and proportional reasoning, but fails to compare the 2 fill-up times	Student correctly and effectively uses problem solving and proportional reasoning to estimate and compare the 2 fill-up times
11	Student calculates how many trips the fire truck would need to make in order to fill up the swimming pool	Student is unable to calculate the number of trips needed to be made because he or she fails to determine how much water each fire truck can hold	Student follows the appropriate steps for calculating the number of trips, but makes a minor mathematical error	Student correctly calculates the number of trips
12	Student determines the total cost associated with using the volunteer fire department to fill the swimming pool	Student has no plan or does not implement a plan to find the total cost for the volunteer fire department filling up the pool	Student attempts to determine the total cost, but does not factor in the travel fee and the number of trips needed	Student correctly determines the total cost of having the volunteer fire department fill the swimming pool

#	**Element**	**0**	**1**	**2**
13	Student lists a minimum of 3 advantages/disadvantages associated with each of the 3 options based on mathematics, knowledge, and research	Student does not lists any advantages/ disadvantages for each of the 3 options	Student lists an average of 1-2 advantages / disadvantages for each of the 3 options	Student lists 3 or more advantages / disadvantages for each of the 3 options
14	Student selects the best option for filling up the swimming pool and gives at least 3 reasons why he or she made that choice	Does not defend	Partially defends and explains	Fully defends and explains reasoning with at least 3 reasons why
15	Student actively participates in a 2-3 minute class presentation	Student does not participate	Student passively participates	Student actively participates
16	Student answered all of the higher-order questions posed to him or her by the teacher and the classmates after the presentation	No follow-up questions answered	Follow-up questions answered, but are not correct or clear	Follow-up questions answered logically and correctly (or close to correct)
17	Student demonstrates use of technology in their solution or final product	No evidence of technology use	Technology use is present, but is not effectively used	Technology use is evident in the solution or final product and is effectively used
18	Student's work and presentation is well-organized	No evidence of organization	Not fully organized	Well-organized work and presentation
19	Student's work is neat.	Lacks neatness	Needs improvement	Neat and legible
20	Student can explain their reasoning for their ideas, formulas, and work shown from activity.	Student provides no explanation	Explanation provided with logical flow, but is mostly incorrect	Explanation provided with logical flow and is mostly correct
21	Student uses Word Processing Software to type presentation key ideas / information (Bonus Points!)	Did not use this software	Did not use this software	Used this software

Benchmark

Given the following diagrams representing the swimming pool, we came up with the following observations:





Observations:

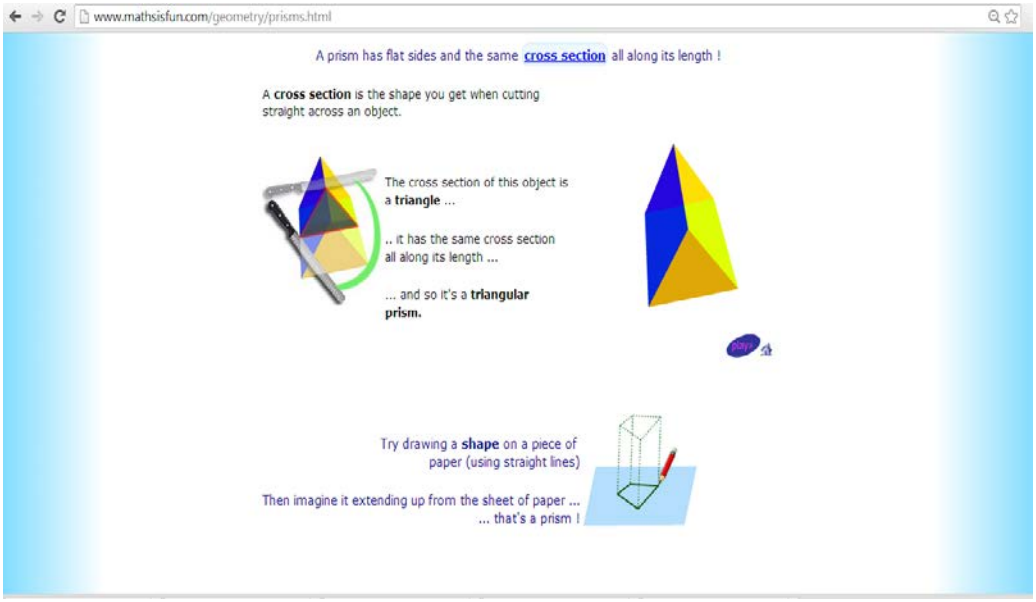
- The swimming pool is not like the typical cylindrical shaped or rectangular prism shaped pool.
- The top of the swimming pool is a rectangle and 3 other sides are also rectangles. The walls of the pool are trapezoids.
- This pool is similar to the pools we swim in at the YMCA – there is a deep end and a shallow end. According to the diagram above, the deep end is 8 feet deep and the shallow end is 4 feet deep.

Initial Questions:

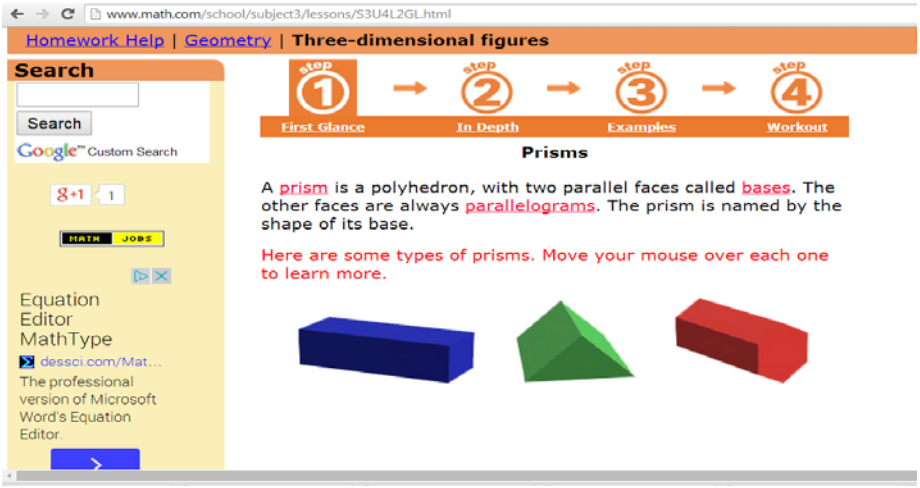
- In order for us to have a better understanding about what it takes to fill up this swimming pool, we need to be able to figure out how much water it will take to fill up the pool. When the pool was built, they didn't tell my parents how much water it would hold. But how?
- We know that the pool's shape is three-dimensional instead of two-dimensional and we know that we have to find the volume of the pool instead of its surface area because volume deals with how much it takes to fill an object, but which formula should we use?
- How can we convert this volume, which will be in cubic feet, into gallons?
- How can we determine how much time it will take to fill the pool up by using the creek and by using the well?
- What can be some advantages or disadvantages for using the creek, well, or having our local volunteer fire department deliver the water?
- How much will it cost to have the fire department deliver the water?

Solutions and Research:

- Through collaboration, we concluded that the pool's shape was not pyramid or cone, but was some type of prism. We agreed that it was not a rectangular prism since all of the sides were not rectangles.
    - Types of prisms we knew about: rectangular and triangular
        - We did a Google Search and we found the following information:
            - http://www.mathsisfun.com/geometry/prisms.html



- http://www.math.com/school/subject3/lessons/S3U4L2GL.html



- We used the information to refresh our memory on key definitions, like bases. We also experimented with trying to "cut" the pool's shape into cross-sections that were alike – eventually we realized that

these cross-sections were the shape of trapezoids, so we thought the name of the pool's shape was trapezoid prism. Out of curiosity, we did another Internet search (Google) for this phrase and we immediately saw that it was called a trapezoidal prism!

- Also, through our investigations with making these cuts, we discovered that a trapezoidal prism can be split into a rectangular prism and a triangular prism.

- Now, that we knew the shape, we moved on to our next task – finding the volume of the swimming pool.

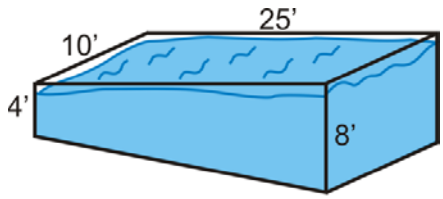
Formulas Used for Finding the Volume of the Swimming Pool & the Calculations:

- We came up several ways to find the volume of the swimming pool. These methods are described below, along with sketches:

Method #1:

V = Bh (B represents the area of the trapezoidal base; h represents the height of the prism)

B = A = ½ (b_1 + b_2)h (used to find B the area of the trapezoidal base, where h represents the the height of the trapezoid)



Calculations:

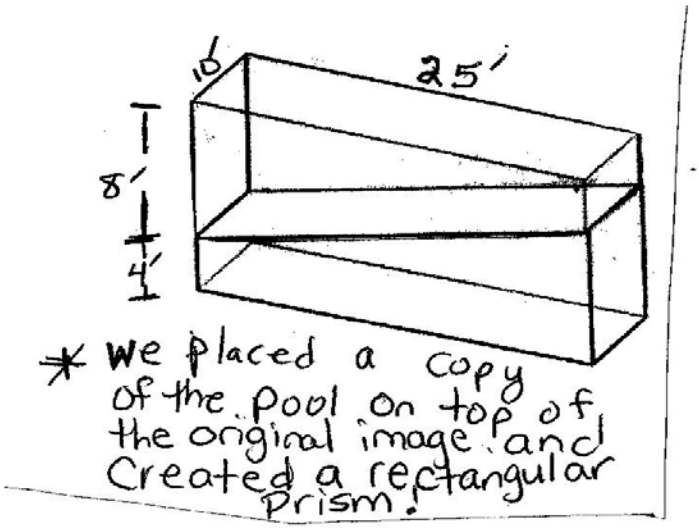
B = A = ½ (b_1 + b_2)h
B = ½ (4 + 8) 25
B = ½ (12) 25
B = 6 (25)
B = 150 ft^2

V = Bh

V = 150 (10)

V= 1500 ft^3 or 1500 cubic feet

Method #2:



- The rectangular prism that we created is 25 ft. x 10 ft. x 12ft. Once we found the volume of this rectangular prism, we could split it in half to find the volume of the swimming pool.

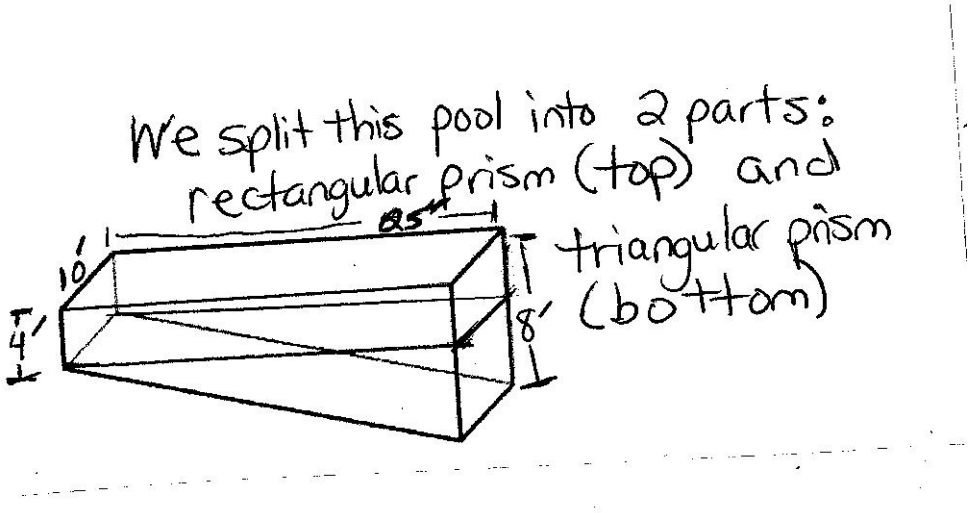
Calculations:

$V_{\text{rectangular prism}}$ = Bh = lwh (l represents the length, w represents the width, and h represents the height of this rectangular prism)

V = 25(10)(12)
V = 250(12)
$V_{\text{rectangular prism}} = 3000\ ft^3$ or 3000 cubic feet

V_{pool} = ½ (3000)
$V_{pool} = 1500\ ft^3$ or 1500 cubic feet

Method #3:



- We remembered the formula for finding the volume of rectangular prisms (V = lwh), but did not quite remember the formula that was used on our Geometry Formula Sheet for the volume of a triangular prism. But, then we recalled that the formula for the volume of any prism is V = Bh and since the base of the triangular prism is a triangle, B = 1/2bh (b represents the base of the triangle and h represents its height). After finding the volume of each three-dimensional figure, we added the volumes together to find the volume of the swimming pool.

Calculations:

Rectangular Prism:

V = lwh

V = 25(10)(4)

V = 250(4)

V = 1000 ft^3 or 1000 cubic feet

Triangular Prism:

B = ½ bh (Formula used to find the area of the triangular base, where b represents the base of the triangle and h represents its height)

B = ½ (25)(8 – 4)

B = ½ (25)(4)

B = ½ (100)

B = 50 ft^2

V = Bh (h represents the height of the prism)

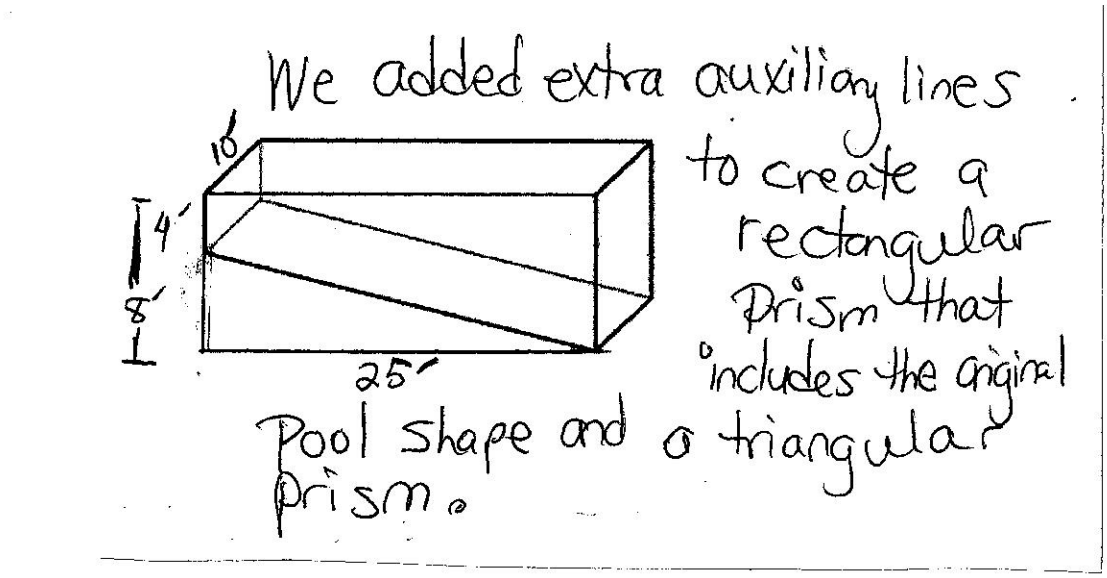
V = 50 (10)

V = 500 ft^3 or 500 cubic feet

The total volume of the pool is 1000 + 500 = 1500 cubic feet!

Method #4:

- We used a ruler and measurement to accurately extend the shallow end of the pool out to make it the same depth as the deep end. Afterwards, we connected both ends of the pool to make a rectangular prism that is shown below:



Calculations:

- Since we "built" a rectangular prism by adding a triangular prism to the pool's original shape (trapezoidal prism), it was necessary for us to find the volume of the rectangular prism and subtract the volume of the triangular prism away.

$V_{\text{rectangular prism}}$ = lwh

$V_{\text{rectangular prism}}$ = 25(10)(8)

$V_{\text{rectangular prism}}$ = 250(8)

$V_{\text{rectangular prism}}$ = 2000 ft^3 or 2000 cubic feet

$V_{\text{triangular prism}}$ = Bh = (1/2bh) h

$V_{\text{triangular prism}}$ = (1/2 *25*4) 10

$V_{\text{triangular prism}}$ = (1/2 * 100) 10

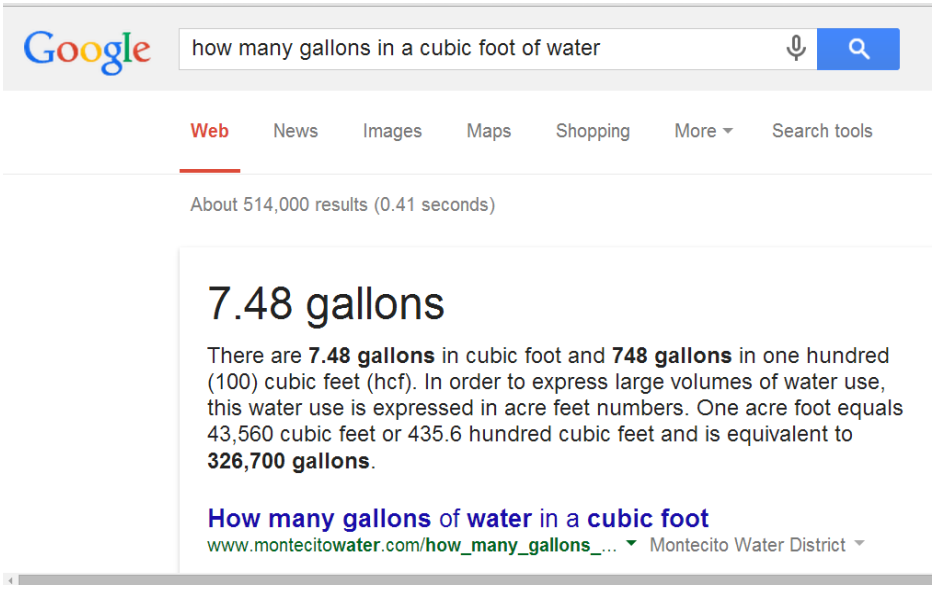
$V_{\text{triangular prism}}$ = (50)10

$V_{\text{triangular prism}}$ = 500 ft^3 or 500 cubic feet

The volume of the pool is 2000 – 500 = 1500 cubic feet!

How Many Gallons of Water Will Fill A Pool That Is 1500 Cubic Feet?????

* We did some research and used the following sources / information:



* To the right, is a screen capture of a tool we used to quickly calculate the amount of gallons needed to fill the pool with water, based on its volume in cubic feet. It takes 11, 220 gallons of water!

* We can also calculate this by multiplying 7.48 by 1500 or by setting up and solving a proportion: 7.48 gallons / 1 cubic ft = x gallons / 1500 cubic ft. **OR** 748 gallons / 100 cubic ft = x gallons / 1500 cubic ft.

http://www.metric-conversions.org/volume/cubic-feet-to-us-liquid-gallons.htm

A Closer Look At The 3 Options (Creek, Well, Fire Truck):

Time:

- If it takes 1 minute and 40 seconds to fill up a 5-gallon bucket using water pumped from the creek and 15 seconds to fill up a gallon jug from the well, how long will it take to fill up the pool? We converted 1 minute and 40 seconds to 100 seconds and set up proportions!

Creek:

100 seconds / 5 gallons = x seconds / 11,220 gallons

5x = 100 (11,220)

5x = 1,122,000

X = 224,400 seconds

Since there are 60 seconds in a minute and 60 minutes in an hour, there are 60 x 60 seconds or 3600 seconds in an hour.

224,440 seconds / x hours = 3600 seconds / 1 hour

3600x = 224,440

X = 62.33…. or 62 1/3 hours or 62 hours and 20 minutes

We were curious about how many days this was. Since there are 24 hours in a day, 48 hours would be 2 days. So it would take 2 days, 14 hours, and 20 minutes to fill up the pool from the creek!

Well:

15 seconds / 1 gallon = x seconds / 11,220 gallons

1x = 15(11,220)

X = 168,300 seconds

There are 3600 sends in a hour.

168,300 seconds / x hours = 3600 seconds / 1 hour

3600x = 168,300

X = 46.75 hours or 46 ¾ hours or 46 hours and 45 minutes

Since there are 24 hours in a day, this is equivalent to 1 day, 22 hours, and 45 minutes to fill up the pool from the well!

- We must also consider the number of trips the fire truck will have to make to fill up the pool (using the fire truck's dimensions of 15.2 feet long, 7.8 feet wide, and 6.35 feet high and our knowledge that 7.48 gallons = 1 cubic foot).

  V = lwh
  V = 15.2(7.8)(6.35)
  V = 752.856 cubic feet

  # of gallons = 752.856 (7.48)
  # of gallons ≈ 5631.36 gallons

  11,220 /5631.36 ≈ # of trips
  1.99 or 2 ≈ # of trips

The fire truck will nearly be empty after filling up the pool during its second trip.

5631.36 (2) = 11,262.72 gallons available

11,262.72 – 11,220 = 42.72 gallons left after pool is filled up

Potential Costs of Filling Up Swimming Pool:

- Creek: pump could burn out due to the distance the water has to travel in the hose before it is able to enter the pool. Extra costs for chlorine and shock to kill algae and bacteria.
- Well: could dry out – the costs of digging another well is tremendous! If the well water supply gets low, it will take some time to replenish.
- Fire Truck: If the cost is $175 per 3,000 gallons of water and a travel fee of $50 is assessed for each trip made to the pool, the total cost would be found by setting up a proportion to determine the water cost and then adding in the travel fees:
  - $175 / 3,000 gallons = x dollars / 11,220 gallons
    3000x = 175(11,220)
    3000x = 1,963,500
    X = 654.5 or $654.50

    Since the fire truck must make 2 trips, this is equivalent to 2 ($50) or $100 for the travel fee.

    $654.50 + $100 = $754.50 to fill up the swimming pool

Our research also indicates that there could be damage to the homeowner's property or pool during these fill-ups as well as debris from the fire hoses being pumped into the pool. This increases the amount of time and cost associated with cleanup efforts. But, it will not take long at all for the pool to be filled up with this delivery service.

Advantages/Disadvantages:

Creek: Unlimited supply of water, takes a longer time to fill up the pool with this source, and requires additional chlorinating products to get the water clearer and safer to swim in, don't have to worry about it running dry (typically)

Well: Limited supply of water because it could run dry, water is cleaner, less chlorinating products will need to be used, takes 15 hours and 35 minutes less time to fill up the pool with this source versus the creek

Fire Truck: Convenient, don't have to worry about the water running over the pool's capacity while you are sleeping or having to pump the water at different stages, quick, water is cleaner and less chlorinating products will need to be used, debris could enter the pool and cost more money to clean it up, as well as to pay for possible property damages

People in rural areas have to consider how to fill their pool when purchasing pools since a well is typically the main water source and if a well runs dry, then homeowners have to pay a lot of money to get another one dug.

Best Option (Includes At Least 3 Reasons Why):

Creek: The water is free, although you will have to pay a little for the electricity used to pump the water for over 2 days; Don't have to worry about damage to your property or pool, but you will have to pay a little extra for chlorinating products, but we doubt it will add to be what it will cost for the fire truck to come fill the pool! We suggest that the pumping is done in stages, so that there is no concern about having to turn the pump off at a certain time and a decreased chance of burning up a pump. It may take longer, but as the saying goes… haste makes waste ☺!

Copy of Template to be Distributed to Students with Special Accommodations (Use if desired)