[Grades 8 - IMII] Problems of the Week

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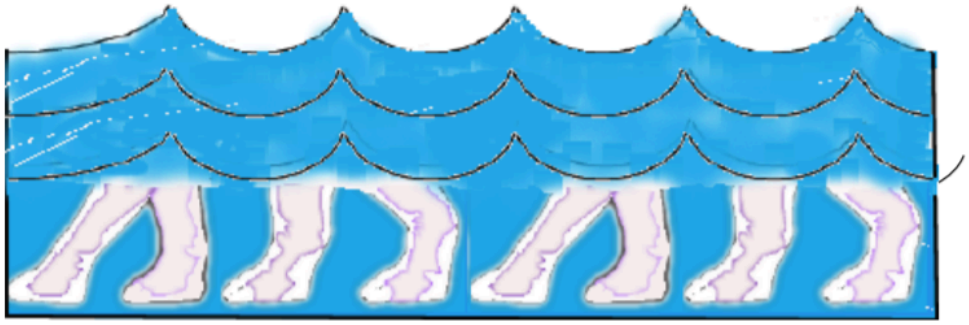
Please spend no more than 20 minutes on any given one day's assignment.

Week 1 [Day 11 - 15]

This week you will use algebraic thinking to solve problems with many multiple answers, and optimum solutions, variables, and functions. [Source: insidemathematics.org]

Day 11

You are swimming under water in a lake and you see dinosaur feet in the water. You don't want to go to the surface in case they are not friendly dinosaurs. Below is a picture of what you see.



How many dinosaurs are standing in the lake? **Explain how you know**. Use words and mathematical language to explain your solution.

Now, show this **picture** to a friend and/or family member. What's their answer? If their answer is different from yours, **can you convince them** using your explanation? Describe your **interaction** with your friend and/or family member **in your notebook.**

Day 12

You want to go with your sister to the museum to see the dinosaur exhibit. The museum has three different plans to pay for going to see dinosaurs.

You and your sister decide that you will go see the dinosaur exhibit *three times* this month. **Which plan should you buy to save money?**

Explain **your** reasoning**.** Record **your**

Museum Rate Plans

Plan A: Pay $ 3.00 per person to visit the Museum.

Plan B: Monthly membership is $8.00 for each person, but you can go as many times as you like during the month.

Plan C: A family membership for a month is $17.00. Everyone in your family can go as often as they like for a month.

Day 13

response in your notebook.

It is summer vacation and *you can go to the museum more often*. The rates change during the summer.

Museum Summer Rate Plans

Plan A: Pay $ 2.75 per person to visit the museum.

Plan B: Monthly membership is $7.50 for each person, but you can go as many times as you like during the month.

Plan C: A family membership for a month is $15.25. Everyone in your family can go as often as they like for a month.

What are some questions you could answer with this information? Make a **list of ten questions.** Try to develop a few questions that are easy and a few that are tricky or challenging. Record your **questions in your notebook.**

Now, select **one question to answer.** Then, interview a **friend and/or family member** and have them select a **question to answer**. Record the **mathematical thinking from your interview in your notebook.**

Day 14

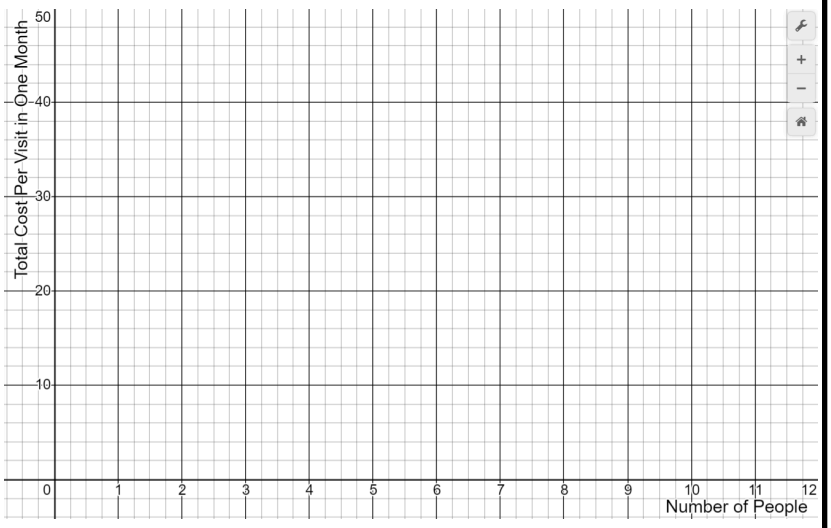
Using the information from Day 13, consider the three different plans. **Which plan is better if you only plan on visiting the museum a few times in May?** Make tables of values and graphs for each plan to help you make a decision. Record **your thinking** in your notebook and/or **use this online tool**.

Plan ___

Table of values:

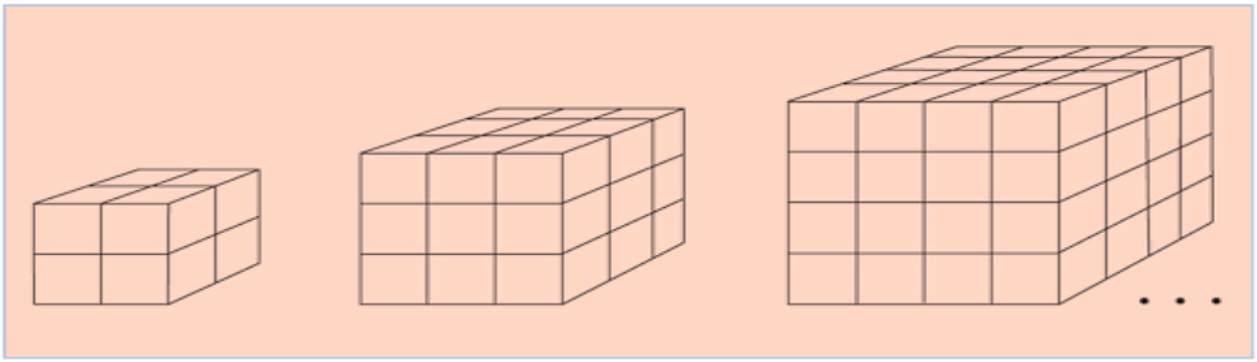
Number of People	Total Cost Per Visit in One Month
1	
2	
3	
4	
5	
6	
...	

Graph:



Day 15	--- Using the information from **Day 13** and **Day 14**, **which is the best plan for the entire summer?** It depends! Who would you bring to the museum? Make **a list of your friends and/or family who you would invite.** Record the **list in your notebook.** Suppose you and your guests visit the museum on May: 12, 23, 24, June: 23, 24, and July: 5. **What plan would you select?** Explain **your reasoning.** Use strategies and information from previous days to help develop your explanation. Record your response **in your notebook.**
Want some more? Practice examining 'Equations and Relationships' on graphs (from Illustrative Math), Representing a Context on a Graph (from Khan Academy), or check out the Problem of the Week for 6th - 8th grade for Week 1. **Still want more?** Check out the Problem of the Week for IMI - Pre-Calculus for Week 1.	

Week 2 [Day 16 - 20]	
Day 16	**The Biggest Box** Your main task in this activity is to build the biggest box you can from a single sheet of paper. In this activity,"biggest" means "holds the most," and "box" means a container with four rectangular sides, a rectangular bottom, and no top. You can cut your paper and tape pieces together in any way you want as long as your final product is a box. If your first attempt doesn't satisfy you, try again. Keep working at it until you think you have built the biggest box possible. To measure how much the box holds, use something you have an abundance of at home (rice, salt, beans, flour, etc.). Questions to consider as you're doing this: **Will every box you make hold the same amount because it's all from one sheet of paper? Why might that be true or untrue?**
Day 17	All sorts of containers are used for everyday goods. Containers are made out of different materials, have different sizes and shapes, and are used for different purposes. Look around your home for different kinds of containers. 1. What shapes did you find? Make sketches of the different containers you saw. 2. What kinds of materials were used? 3. What units of measurement were used to indicate how much a container holds?

	4. What criteria do you think manufacturers use to decide what kind of container to use for their products? 5. Choose a specific container and write about one of these two topics: • How the container could have been designed better • Why the manufacturer designed the container that way
Day 18	**Comparing Area and Perimeter** Hey, students! Go to student.desmos.com and type in: **XYM 7ZR**
Day 19	**Painted Cubes Problem** The outside faces of the following cubes are painted. These cubes are built from smaller 1-centimeter cubes.  Figure Two Figure Three Figure Four A)How many smaller cubes will have three faces painted? B) How many smaller cubes will have two faces painted? C) How many smaller cubes will have one face painted? D) For Figure 100, how many cubes will have three, two, and one face(s) painted?
Day 20	**Beyond Boxes** Now that you've explored the concepts of area and volume more, try to build a bigger container of a different shape (still from a single sheet of paper). This time, your shape does not need to have rectangular sides.

	Can you build a container that could hold more than the box you built before. What shapes did you use?

Want some more? Check out the Problem of the Week for 6th - 8th grade for Week 2 and/or the Problem of the Week for IMI - Pre-Calculus for Week 2.

Week 3 [Day 21 - 25]

Day 21

This week you will use math that uses geometric properties of circles and triangles to optimize a situation. *Adapted from Robert Kaplinsky's "How Much Shorter Are Staggered Pipe Stacks?"*

Stacking Pipes

As an engineering designer for Home Depot stores, you are asked to display 1000 pipes in the yard of a Home Depot store.

For this task, you will have one week to create a proposal that describes how to stack the pipes, either staggered or non-staggered. Your proposal will include justification for why your proposed plan is best. You will need to identify the required width and height for the space to display 1000 pipes for the store.

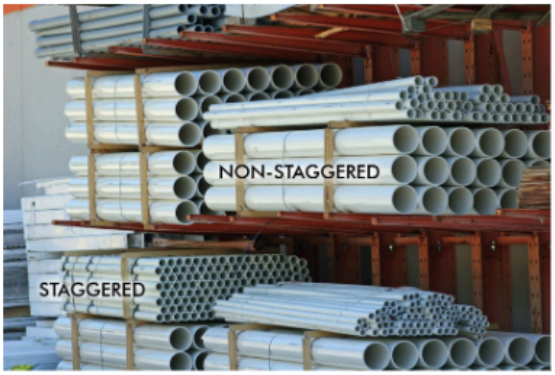


Figure A

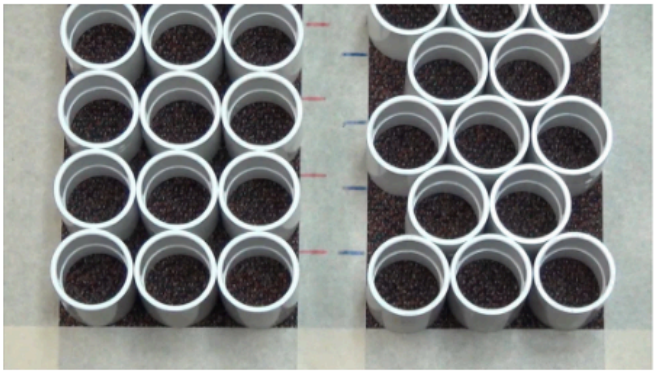


Figure B

Figure C

The diameter of each pipe is approximately 5.6 cm.

Explore a smaller related problem and make predictions

To get started on this proposal, let's take some time to get to know this situation. Examine the images carefully. Read the questions below. Then, record your thinking in your notebook.

1. How much is the difference in height for 20 layers of **staggered** pipes compared to 20 layers of **non-staggered** pipes? Estimate how the stagger affects the height.

2. If the bottom layer has 10 pipes and follows the pattern shown in **Figure B** above, what would be the difference in the number of pipes stacked in 20 layers staggered compared to 20 layers non-staggered?

Day 22

Explore the math of heights for staggered vs. non-staggered

Here is a close up image of what the pipes might look like if they were staggered. Use this new image and information from Day 21 to continue exploring the heights for different displays.

1. Complete the table on the next page for stacking layers of pipes with a **5.6 cm diameter.**

2. Use the "*Illustration of 3 layers' height*" to help with determining the **heights of staggered stacks**, establishing and then applying a pattern. [If you get stuck, here is a hint.]

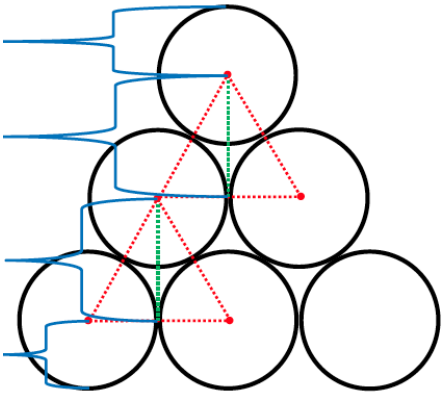


Illustration of 3 layers' height

Layers	Height without stagger	Height with stagger
1		
2		
3		
4		
5		
6		
7		
8		

9		
10		
….		
17		
18		
19		
20		
n		

Day 23

Explore height & width options for 1000 pipes

You have gathered a lot of useful information and done important mathematical thinking about your display. Now, it is time to use that information to create a strategy that best displays the 1000 pipes. Use the proposed steps and table below to organize your thinking.

Begin with base number and layer number combinations that will result in 1000 pipes. Use the diameter of each pipe (5.6 cm) and the table of heights you created in Day 21 to determine the dimensions of a display for non-staggered layers of pipes

Then, use the same base numbers suggested for non-staggered to determine the number of layers needed for comparable staggered stacks with 1000 pipes. *Note: Your pattern may have some layers with fewer pipes.*

Finally, use the pattern of heights for staggered stacks from the table you created in Day 21 to determine the dimensions of a display for staggered layers of pipes

Convert the measurements to inches and feet (1 inch = 2.54 cm)

Display for Non-Staggered Pipe Display				**Display for Staggered Pipe Display**			
	1	**2**	**3**	**1**	**2**	**3**	
Number of Pipes in the bottom layer							**Number of Pipes in the bottom layer**
Number of layers needed for 1000							**Number of layers needed for 1000**

pipes stacked <u>non-staggered</u>							**pipes stacked <u>staggered</u>**
Width of bottom layer (cm)							**Width of bottom layer (cm)**
Height of display with <u>non-staggered</u> layers (cm)							**Height of display with <u>staggered</u> layers (cm)**
Width of bottom layer (feet & inches)							**Width of bottom layer (feet & inches)**
Height of display with <u>non-staggered</u> layers (feet & inches)							**Height of display with <u>staggered</u> layers (feet & inches)**

Day 24

Create a proposal with math justification

*Create a written **<u>or</u>** video recorded proposal for designing a display for 1000 pipes. Your proposal should include all of the following:*

- Your recommendation for stacking staggered or non-staggered
- The number of pipes in the bottom layer
- The number of layers needed for 1000 pipes with your recommended stacking style
- The dimensions of the display and the math to justify your dimensions are accurate
- Why you believe the display design is best
    - Why not the other stacking style (staggered or non-staggered)
    - Why the dimensions are reasonable for a display of pipes in Home Depot stores

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Day 25

Practice with designing for pipes with different diameters

Now that you've developed some rich mathematical thinking and strategy for organizing and stacking pipes, you're ready to apply that information to different scenarios.

1. Suppose you have 3000 pipes with a diameter of 2.5 cm.
    a. What would the height be for 20 layers non-staggered?

b. What would the height be for 20 layers staggered?
c. How would your design recommendation change for a display for these pipes?
    - Staggered or non-staggered?
    - Number of pipes in the base layer?
    - Number of layers for 3000 pipes?
    - Width and height for this design in feet & inches?

2. Suppose you have 250 pipes with a diameter of 25 cm.
    a. What would the height be for 20 layers non-staggered?
    b. What would the height be for 20 layers staggered?
    c. How would your design recommendation change for a display for these pipes?
        - Staggered or non-staggered?
        - Number of pipes in the base layer?
        - Number of layers for 250 pipes?
        - Width and height for this design in feet & inches?

Want some more? Check out the Problem of the Week for 6th - 8th grade for Week 3 and/or the Problem of the Week for IMI - Pre-Calculus for Week 3.