

LessonTitle: Proportion Activities (One Foot Tale, Space Mission Needs) Alg 3.6

Utah State Core Algebra Standard 2 -4 Process Standards 1-5

Summary

In this lesson, students apply proportions to examine real life questions. In One Foot Tale, they pretend to be shrunk to one foot tall. They measure items in the classroom and use ratio and proportion to find out the size of these items if they are shrunk proportionately. Then they write a story like Gulliver’s Travels using their numbers.

In Pre Space Mission Needs, they use proportions to find the amount of oxygen, water, and fuel they need to travel in space for an extended time.

Enduring Understanding

Shrinking and stretching proportions have many applications in the real world.

Essential Questions

- What would the world be like if you were only one foot tall?
- How much oxygen, water and fuel would you need to travel for an extended time in space?

Skill Focus

- Application of Ratio and Proportion

Vocabulary Focus

Proportion

Materials A literature book such as Gulliver’s Travels or If You Hopped Like a Frog, Catalogues, Measuring tools

Assess

Launch ideas

“We decided that we would read “If I Could Hop Like a Frog” and do a few of the conversion in the back of the book to get the students thinking about how the world would be different if they had attributes in proportion to animals or other stages of life.” You could also read a bit of Gulliver’s Travels.”

“We talked a little about Gullivers Travels, but many of the students were not familiar with the book. The students could relate more to model airplanes and model cars. We talked about what must happen for two student’s worlds to shrink the same and when they would shrink differently. Students needed a review on how to solve proportions by cross-multiplying.”

Explore ideas

“We decided that there should be a little modeling on the worksheet part of the activity. We decided that we would try to model one conversion and choose to model the length of the room conversion. We thought that we would have a couple students measure the length of the room and then we could model the conversion using our own height, or the height of 60 inches. After modeling one of the conversions we would turn the students loose with tape measures and rulers and make sure that they had taken all their measurements before they left class. With regards to the worksheet, there was some debate whether we wanted the students to use decimal conversions or if they should have to simplify improper fractions. We left this question up to individual teachers to decide based on the capacity of their students. We also decided to make a few changes to the worksheet. We wanted to give them more room in the table to set up and calculate their proportions. We also rewrote some the instructions (I’ll send an attachment of what we did). We also decided on a grading scale that we would use.”

“The students worked alone or in pairs. Most students enjoyed this activity and worked well with a lot of monitoring. Jeanene edited the worksheet and spread out the chart so students had room to show work. I have a new blind student that has a Braille meter stick to measure with. She is a great example to my class of overcoming obstacles to succeed in math.

Most of the stories mirrored the math abilities of the students. Students who struggle in math also struggle in English. Jayna had a Russian student who wrote a two page typed story and made-up a test using his measurements at the end of the story. We also had students draw pictures to illustrate their stories. Students presented their stories to the class voluntarily or for extra credit.”

Summarize ideas:

“We found that especially high school students at algebra level have very poor writing skills. They don’t know that sentences start with a capitol letter, end with a period or even what a sentence is. I had one story that was 3/4 of a page and was one continuous run-on sentence. Before starting the story, we should have reviewed how to write a paragraph.”

“We decided that we would probably have students share their stories with their groups and then have a few students share their stories with the class.”

Application ideas

“This was an activity that most of us used after our students were already comfortable with proportions. We really didn’t give any guided practice. The whole project is a good application of proportions that should give them a more personal view and a better understanding of proportions.”

Information

Because proportional reasoning is so important, we have included several lessons to help students expand and reinforce their learning of this concept. You may wish to choose one or the other but not both of the following activities.

If you choose to use One Foot Tale, read or talk about the book Gulliver’s Travels and scale models. Or read the book If You Hopped Like a Frog. Have students do Alg 2.4b, the One Foot Tale activity below or have them figure out the answers to the questions posed in If You Hopped Like a Frog.

Pre-Space Mission Needs could be used as an assessment

Suggestion

To help students get started writing their One Foot Tale stories, you may wish to read the following student sample beginning:

“The Incredible Shrinking Woman” or “Things Are Way Out of Proportion”

“One day after the final school bell rang at 2:50, I was outside my classroom doing hall duty. When I returned to my room I discovered a surprise on my desk, a small bag of tasty looking chocolates. There was no note, but I was hungry so I took my first bite. Immediately, the room began to expand until it seemed the ceiling was miles away. Suddenly I realized I had shrunk. I ran around in circles calling for help until I stumbled over a large wooden plank a ruler. I laid down next to the ruler and discovered that instead of being 5’3” tall, I was now exactly one foot in height.

I decided I had nothing to lose so I pulled out another chocolate—that one inch square chocolate had shrunk with me. (Do #1) I ate the shrunken chocolate and leaned against a desk to think. But suddenly the desk shrunk proportionally with me (Do #2)

Alg 3.6a

One Foot Tale

What would the world be like if you were only one foot tall?

The following project will help you answer this question.

- 1) Find the actual measurements of the items in the table. (Make certain you label.)
- 2) Write a ratio using your height in inches. 12 “/ actual _____
- 3) Set up a proportion for each item and write it in the appropriate space.
- 4) Solve the proportion, round your answers to the hundredths place. Write your answer in the converted column. (Make certain you label.)

	Actual	Proportion set-up	New Size
Your Height		XXXXXXXXXXXX	
Pencil			
Desk length			
Desk width			
Door height			
Foot length			
Chair height			
Little finger length			
Room length			
Room width			
Length of a mile			
Your choice			
Your choice			
Your choice			

Write a story using at least 10 of the measurements above (actual and converted).

Sample beginning: One night...I was one foot tall. My pencil, which usually measures 6 inches, was now 1.14 inches long. To my mom it looked like a straight pin....

Turn your project and story in by _____

Grading Scale

1. Correct table _____ points
2. Story with measurements in it. _____ points
3. Presentation (neatness) _____ points

Oxygen Needs

Oxygen is a required need to support life in space. One 20 kg tank will support an average sized person for 16 hours. From this data please make the following calculations.

1. How many oxygen tanks will *each* person need for the journey?
2. How many total oxygen tanks will the crew need for the journey?

Oxygen is also required to generate electricity. The space vehicle requires 30 kg of oxygen every 24 hours to generate power. From this data please make these additional calculations.

3. How many additional 20 kg tanks will you need to complete your space journey?
4. CAUTION: Experience has shown that you should plan on taking an addition 20% supply of oxygen for emergency us. How much additional oxygen will be required?
5. What is the total oxygen need for your crew? Remember to include oxygen for breathing, power, and emergency use.
6. How many 20 kg oxygen tanks should we load on your space vehicle?

Water needs

Each day on your journey your minimum water requirements per individual are 2 liters of water. From this data make the following calculations.

1. How much water will each person need on their journey?
2. How much total water will the crew need on their journey?
3. Question 1 and 2 gives you the minimum amount of water you need. You need to take an additional 15% for emergency needs. How much total water will you need to take with this additional amount added on?

4. Water comes in 50 liter tanks. How many tanks will need to be loaded on your space vehicle.

Velocity Requirements and Fuel Needs

In order to escape the earth's gravity your space craft needs to be traveling at a certain velocity called the escape velocity. To find the escape velocity you need to use the following formula, $v = \sqrt{2GM/d}$, where G is the universal gravitational constant, M is the mass of the attracting body, and d is the distance from its center.

$$G = 6.67 \times 10^{-11} \text{ nt}\cdot\text{m}^2/\text{kg}^2, \text{ where a nt} = \text{kg}\cdot\text{m}/\text{s}^2$$

$$M = 5.983 \times 10^{24} \text{ kg}$$

$$d = 6.357 \times 10^6 \text{ m}$$

1. Use the formula above and given information to find the velocity your space craft should go to escape the earth's gravity? (Units should be in m/s^2)

Most of the work done in launching a rocket occurs near the earth's surface. So to put a payload infinitely far from the earth's surface it requires at least 60 million joules of energy per kilogram of load.

2. Your rocket has a load of 80,000 kg. How much energy (fuel) would you need to escape the earth's gravity? (Units should be in joules)
3. One fuel cell contains one million joules. How many fuel cells will be needed for your launch so you can escape earth's gravity?