



TOPIC 2

Math Modeling in 3 Acts:
How Tall Is Tall?

Lesson Overview

KEY CONCEPTS

Mathematics Objectives

- ✓ Use mathematical modeling to represent a problem situation and to propose a solution.
- ✓ Test and verify the appropriateness of their math models.
- ✓ Explain why the results from their mathematical models might not align exactly with the problem situation.

Language Objective

- ✓ Explain why the results from their mathematical models may differ from the exact answer.

Essential Understanding

Many real-world problem situations can be represented with a mathematical model, but that model might not represent the real-world situation exactly.

COHERENCE

Earlier in this topic, students:

- Interpreted equations.

In this lesson, students:

- Develop a mathematical model to represent and propose a solution to a problem situation involving linear equations and functions.

Later in this course, students will:

- Identify parallel and perpendicular lines.
- Refine their mathematical modeling skills.

BALANCE

This mathematical modeling lesson focuses on application of both math content and math processes.

- Students draw on their understanding of concepts related to linear equations to develop a representative model.
- Students apply their mathematical model to test and validate its applicability to similar problem situations.

MATH
MODELING
IN 3 ACTS

CCO

Mathematical Process
Standards A.1A
Apply mathematics to
problems arising in everyday
life, society, and the workplace.
TEKS
A.5B



How Tall Is Tall?

The world's tallest person in recorded history was Robert Wadlow. He was 8 feet 11.1 inches tall! Only 5% of the world's population is 6 feet 3 inches or taller. What percent of the population would you guess is 7 feet or taller?

We usually use standard units, such as feet and inches or centimeters, to measure length or height. Did you ever wonder why? In the Math Modeling in 3 Acts lesson you'll consider some interesting alternatives.



ACT 1

ACT 1 Identify the Problem

1. What is the first question that comes to mind after watching the video?
2. Write down the main question you will answer about what you saw in the video.
3. Make an initial conjecture that answers this main question.
4. Explain how you arrived at your conjecture.
5. Write a number that you know is too small.
6. Write a number that you know is too large.
7. What information will be useful to know to answer the main question? How can you get it? How will you use that information?

ACT 2 Develop a Model

8. Use the math that you have learned in this Topic to refine your conjecture.

ACT 3 Interpret the Results

9. Is your refined conjecture between the highs and lows you set up earlier?
10. Did your refined conjecture match the actual answer exactly? If not, what might explain the difference?

BUILD G.R.I.T. Grow Confidence
Develop confidence. As you work on your conjecture and reason with your peers, continue to think positively about your ability to come up with responses that make sense.

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Student Companion

Students can do their work for the task on their *Student Companion* which you can print from **SavvasRealize.com**.

 Texas Essential Knowledge and Skills (TEKS)

Mathematical Process Standards

The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

A.1A apply mathematics to problems arising in everyday life, society, and the workplace.

Linear functions, equations, and inequalities: The student applies the mathematical process standards to solve, with and without technology, linear equations and evaluate the reasonableness of their solutions. The student is expected to:

A.5B solve linear inequalities in one variable, including those for which the application of the distributive property is necessary and for which variables are included on both sides.



How Tall Is Tall?

In this mathematical modeling task, students explore and apply linear functions. Students will be presented with a situation in which height is measured in unconventional ways. They will be tasked with creating and using a linear model to measure height in terms of foam cups. To do so, they apply concepts that they study in Topic 2.

ACT 1
The Hook

Play the video. The video shows the height of a basketball player in terms of other objects. A stack of cups starts to build next to him.

After the question brainstorming, present to students the Main Question they will be tasked with answering. Remind students to write down their questions and conjectures.

MAIN QUESTION

What is the basketball player’s height in foam cups?



ACT 2
Modeling With Math

Think about the task. Ask students to speculate how they could figure out how tall the player is in cups. Then let them think about what information they would need to find the answer.

Reveal the information. Use the video to provide data about smaller stacks of cups. Suggest that students record this information, possibly in a table. Then ask them to look for patterns and think about ways they can use the data to answer the Main Question. How could they represent the relationship between the number of cups and the height of the stack? How could they use that representation to generate more data?

What’s the connection? Give students time to struggle as they think about how their ideas are connected to what they learned in this topic about using a linear function to represent a situation.

INTERESTING MOMENTS WITH STUDENTS

Students may recognize a pattern and then struggle. Students may see that you add 0.6 inches for each additional cup in the stack, but the prospect of adding until they reach 80 inches sounds miserable! Help them turn a sequence into a linear function.

Students may divide the height of the person by the height of one cup. This assumes that two cups will be twice the height of one cup. You can physically demonstrate what their model means (the cups would hover over each other), or you can replay Act Two to show how the cups are stacked inside one another.

Necessary Information

Player height
 80 in. (including shoes)

Foam cups
 height of the lip: 0.6 inches
 height of the base: 4 inches
 All cups are the same size.



ACT 3 The Solution

Play the video. The final video shows all of the cups falling into place. The player’s height, in foam cups, is revealed. Offer praise to the students who had the closest mathematical answer and closest guess.

MAIN QUESTION ANSWER

The player’s height is 130 cups.

Do the “post-game” analysis. It turns out that the more cups you stack on top of each other, the more the weight of all the cups on top compresses the cups near the bottom of the stack. While the calculated solution is approximately 127 cups, the actual answer is greater—130 cups.

Now that the solution has been revealed and discussed, ask students to analyze and evaluate the efficiency of the approach they chose to solve the problem.

ONE POSSIBLE SOLUTION

There is a linear relationship between the number of foam cups in the stack and the height of the stack. The equation $h = 4 + 0.6n$, where h is the height of the stack and n is the number of cups, can represent the situation.

Since the player’s height is 80 inches, solve the equation $80 = 4 + 0.6n$.

$$80 = 4 + 0.6n$$

$$76 = 0.6n$$

$$127 \approx n$$

There are approximately 127 cups in the stack.

INTERESTING MOMENTS WITH STUDENTS

Students may ask about 0 cups. Our function says that 0 cups have a height of 4 inches. This is where you can talk about domain. 0 is not in the domain of our function, nor are some rational numbers like $3\frac{1}{2}$, because they do not make real-world sense. Therefore, the domain is limited to the natural numbers.

CREATE A PROBLEM

As students finish the original task, ask them to construct their own problem to find the height of an object that is a certain number of foam cups tall. Challenge students to use the linear relationship they defined in the task to determine the height in feet and then choose an appropriate object.

