Chicken Truck

Writing Algebraic Expressions

K20 Center, Kate Raymond, Kristi Adams
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Grade Level	7th – 8th Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	70 minutes
Course	Middle School Mathematics		

Essential Question

How can relationships between unknown quantities be expressed?

Summary

Chicken trucks are known to transport thousands of live chickens. Students will use mathematical reasoning to calculate the number of chickens in a truck of known dimensions, given a photograph, which was taken while travelling I-40 in Oklahoma. Students will extend their understanding by writing a mathematical expression to solve for the number of chickens for a transport vehicle of any size.

Snapshot

Engage

Students will observe a picture of a chicken truck and discuss what information they need to know in order to estimate the total number of the chickens in the truck.

Explore

Students will calculate the number of chickens in the truck from the information discussed in the "Engage" portion.

Explain

Students will toss their solutions to peers and evaluate each other's work, giving constructive criticism. When students' work is returned, they will adjust their calculations based on the feedback given from peers.

Extend

Students will develop an equation for how to calculate the number of chickens for any size transport vehicle. Students will determine the number of chickens for multiple transport vehicles of varying sizes using their equations.

Evaluate

Students will compare their equations and evaluate their answers, coming to a class consensus on the number of chickens for each vehicle.

Standards

Oklahoma Academic Standards for Mathematics (Grade 7)

7.GM.1: Develop and understand the concept of surface area and volume of rectangular prisms.
7.GM.1.1: Using a variety of tools and strategies, develop the concept that surface area of a rectangular prism with rational-valued edge lengths can be found by wrapping the figure with same-sized square units without gaps or overlap. Use appropriate measurements such as cm^2.
7.GM.1.2: Using a variety of tools and strategies, develop the concept that the volume of rectangular prisms with rational-valued edge lengths can be found by counting the total number of same-sized unit cubes that fill a shape without gaps or overlaps. Use appropriate measurements such as cm^3.

Oklahoma Academic Standards for Mathematics (Grade 7)

PA.GM.2.1: Calculate the surface area of a rectangular prism using decomposition or nets. Use appropriate measurements such as cm^2.

Attachments

- Chicken Truck Data Sheet—Chicken Truck - Spanish.docx
- Chicken Truck Data Sheet—Chicken Truck - Spanish.pdf
- Chicken Truck Data Sheet—Chicken Truck.docx
- Chicken Truck Data Sheet—Chicken Truck.pdf
- Chicken Truck Photo—Chicken Truck.docx
- Chicken Truck Photo—Chicken Truck.pdf

Materials

- Picture of chicken truck (attached)
- Calculator
- Chicken truck data sheet (optional, attached)
- Poster board
- Four different colors of Post-It notes
- Internet access

Engage

Show students the picture of a chicken truck below.

Note: A jpeg file of this photo can be found under "Attachments."

In small groups of two or three, have students discuss what they would need to know to determine the number of chickens in the truck. Their results should identify the variables to be used.

After students have a chance to discuss in small groups, call on groups to share out one variable they discussed. Have each group justify why the variable they chose is necessary to determine the number of chickens on the truck. Groups should add to the list of variables, not repeating any other group's response. Keep a list of variables on the board or chart paper. Continue to move around groups until all groups agree that all of the necessary variables are listed.

Teacher's Note

If students understand this task, they should identify the dimensions of the truck (length, width, and height), then dimensions of one chicken crate (length, width, and height), and the number of chickens per crate as the necessary variables to determine the number of chickens in the truck. Having students justify their choice of variable should help you guide them toward eliminating all other variables. If not all of the necessary variables have been identified, redirect efforts by asking what other information is needed.

Explore

Once the list of necessary variables is complete, divide the list between the groups. Assign the dimensions of the truck to half of the groups and the dimensions of the chicken crate and number of chickens per crate to the other half. Have each group research typical values for the assigned variables using the Internet.

Have the groups who researched truck dimensions share out their results. Typically, groups will have different findings. Tell students they must decide on one reasonable value for each of the dimensions. Let them discuss their findings until they reach an agreement on which values to use for each dimension, and then have groups justify their choices.

Similarly, have the groups who researched the dimensions of the chicken crates and the number of chickens per crate discuss their findings and determine one reasonable value to use for each variable. Have groups justify their choice.

Teacher's Note

Students may decide to use median values of the dimensions they found or to find the mean of the dimensions they found. Allow students to determine a reasonable value to use any way they choose, as long as they are able to justify their process.

Teacher's Note

If students are unable to find typical values or if you are short on time, a list of typical dimensions can be found in the Chicken Truck Data Sheet attached to this lesson. Use the dimensions of the semi-truck for this piece of the lesson.

Explain

Once the class has decided upon one value to use for each of the necessary variables, record the values on the board or chart paper so all students can see them. Tell students to calculate the number of chickens on the truck on a piece of paper. Students must clearly show and explain their work on their paper.

Teacher's Note

Students often have very different approaches to determining the number of crates on the truck. Some determine the number of crates that can be lined up and stacked in the truck, while others calculate the volume of the truck and divide by the volume of a single crate.

The following are examples common student calculations:

- Vtruck = 53’ x 8.5’ x 11’ = 4955 ft3 (This example takes into account the crate clearance from truck height)
- Vcrate = 1.92’ x 1.5’ x 0.92’ = 2.65 ft3 (Note: Dimensions were converted from inches to feet by dividing by 12.)
- Ncrates = Vtruck/Vcrate = 1870 crates 1870 crates x 6 chickens per crate = 11,220 chickens
- Nwidth = 8.5’/1.5’ = 5 crates

Have students use a Commit and Toss to peer evaluate their work. Students should evaluate their peer's work based on whether the argument is easy to follow as well as whether the calculations are correct.

Student comments might include:

- I think you miscalculated here. You have _____, and when I calculate I get ____.
- You are missing an equation that shows what you are multiplying or dividing.
- I could not follow your work. Try labeling what it is you are doing.

Teacher's Note

Because students can use varying methods to calculating the correct number of chickens in the truck, having students review each other's strategies engages them in thinking about the validity of each approach.

Have students return the work to its original author. Ask students if the person they reviewed solved the problem in the same way they had. Discuss the different strategies and their validity.

Allow students to make corrections of their work. Students may also ask their peer for clarification about any feedback they received.

Extend

Put students back into their groups and ask students to generate an equation (algebraic expression) to solve for the number of chickens for any vehicle for which the dimensions are known.

If N is the number of chickens, T is the volume of the truck, C is the volume of a crate, and l, w, and h refer to length, width and height, respectively, then some common equations written by students include

- N = 6 (T/C)
- N = 6 [(l×w×h)/(l×w×h)] (Note: students will need to differentiate between l, w, and h for truck and crate)
- N = 6 [(l/l)(w/w)(h/h)] (Note: students will need to differentiate l, w and h for truck and crate)

Have each group share their equation. Discuss why some forms may be more useful than others may.

Optional Extension: Greatest Integer Less Than

You can use this lesson to introduce the greatest integer less than function, [x], which gives the greatest integer value less than x. Using this function would allow students to account for instances when whole numbers of crates cannot be lined up or stacked along the whole dimension of a truck. For instance, if the truck is 8.5 feet tall, and crates are 1.5 feet tall, then [8.5/1.5] would result in five crates being stacked, rather than five and two thirds, since you cannot stack two thirds of a crate!

Once students have determined an equation, have students determine the number of chickens that can be transported by each of the other vehicles listed on the Chicken Truck Data Sheet attached to this lesson. Have groups record their equations, work, and result for each vehicle on a poster board and display them around the room.

Evaluate

Have one student from each group remain with their poster to explain it, while the other students complete a Gallery Walk of the posters. The students at each poster should explain their reasoning to the students on the walkabout. The students on the walkabout should ask questions and give feedback to the poster presenters.

After the gallery, use four different colors of Post-It notes to assign a color to each vehicle (e.g., yellow for the GMC Sierra, green for the Ford Ranger, etc.). Assign each student one vehicle by giving them a Post-It in the corresponding color; so, a student who receives a green Post-It in this example is assigned the Ford Ranger. Be sure there are approximately equal numbers of students assigned to each vehicle. Have students examine each poster's value for the number of chickens that can be transported by their assigned vehicle. On their Post-It notes, have students record the value they each feel is the best estimate of the actual number of chickens that vehicle would transport and a reason as to why they chose that value. Students can post their notes on the corresponding poster.

Optional Extension

Show students a jar full of marbles (or other round objects). Ask students what they would need to write an equation to calculate the number of marbles in the jar. Compare and contrast the differences between this equation and the equation for chickens in a truck. Students should recognize that they still need to divide the volume of the container, the jar (truck in the last equation), by the volume of one of the objects, the marble (crates in the last equation), but that the formulas for the volumes will change since the containers and objects are different shapes.

Resources

- Commit and Toss Instructional Strategy: K20 Center. (n.d.). Copyright 2015, Board of Regents of the University of Oklahoma. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505b3d0
- Gallery Walk Instructional Strategy: K20 Center. (n.d.). Copyright 2015, Board of Regents of the University of Oklahoma. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505a54d