**What does math have to do with dog food?**

**Video:** <https://youtu.be/E2Np5M1tGA0>

**Lesson Plan**

**Teacher Note:** Please preview the entire video and pre-work the solutions in order to anticipate students’ needs, misconceptions, and materials unique to your classroom.

You will also need to determine the background knowledge of your students regarding the following topics and decide the best method for providing that background in order to support the conceptual understanding of the mathematics shown in the video.

* + Volume
	+ Density
	+ Mass
	+ pi (π)
	+ Radius
	+ Height
	+ Order of operations
	+ Solving multi-step equations

**Common Core Mathematical Content Standards**

* 8.NS.A Know that there are numbers that are not rational and approximate them by rational numbers.
* 8.G.C Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.
* A.CED.A.4 Rearrange formulas to highlight a quantity of interest

**Common Core Mathematical Practice Standards**

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively

4. Model with mathematics

**Company Information**

Carnivore Meat Company is an award-winning manufacturer of ultra-premium raw frozen and freeze-dried pet food and treats. The Green Bay, Wisconsin company’s rapidly growing brands include Nature’s Advantage®, Vital Essentials®, VE RAW BAR and Vital Cat®, which are distributed to over 6,000 retailers nationwide, in 14 international markets and online to Chewy.com, Amazon, PetFlow.com and others. Long considered a raw pet food pioneer, the company’s freeze-dried products division supplies private label, co-packing, and ingredients to customers globally. Carnivore Meat Company is family owned and has been recognized for its growth accomplishments and manufacturing excellence with a number of awards in recent years including Wisconsin Manufacturer of the Year Award and Inc 5000 Fastest Growing Private Companies.

**Summary**

This video takes students through a real world problem solving situation regarding calculating dimensions of dog food patties that are cylindrical in shape. Students are given some, not all, the patty measurements that the customer requires, along with a manufacturing required measurement dealing with “wet weight” of the beef used in the patty.

**Pre-Activity Discussion:**

* When working with a specialized order for a customer, the “tooling” part of the machines that create dog food patty may need to be modified based on what the customer requests. Sending the correct measurements to the machinists is critical. Students will work with the customer’s requirements and the raw material requirements to calculate the necessary measurements and send a labeled drawing to the machinist.
* **Vocabulary**
	+ Density
	+ Mass
	+ Volume
	+ Wet weight
	+ Cylindrical patty

**Part 1: (0:00 – 1:07)**

BREAK 1

* Numbers to Know:
	1. Density = 0.547 oz. /cu. Inch
	2. Final wet weight (mass) = 2 ounces
	3. Thickness (height) = 0.566 inches
	4. **Final diameter < or = 3.4 inches**
* Have students use part one of student handout to label the correct measurements on the patty drawing.
* Students are given the density and mass and asked to calculate the volume. The math formula used for volume of a cylinder ( v = π \* radius2 \* height) will not work here because the specific radius (or diameter) is not given.
* Density is given and that can be used to find volume.
* Differentiation Options:
	1. Share the formula for density with students (*density = mass divided by volume*) and they solve the equation for volume.
	2. If students are unfamiliar with solving equations, sharing the formula solved for volume versus density (*volume = mass divided by density*) will allow them to access the problem by just dividing
	3. If students are ready for a challenge, do not give them the density formula above, ask them to determine what is needed and use an internet search to see if there is a relationship between density, mass and volume.
* Before showing Part 2 have students share their answers and solving methods.

**Part 2: (0:58 – 1:57)**

 **INSERT A BREAK 2**

* Have students use part 2 of the handout to find the diameter of the patty using the volume they calculated in part 1 and the formula for volume of a cylinder.
* Students are asked to correctly label a drawing of the patty with the measurements they have calculated.
* Differentiation Options:
	+ If students are unfamiliar with solving equations, sharing the volume formula solved for the radius (*radius* = $\sqrt{\frac{volume}{pi\* height}}$ ) would allow them to access the problem.
	+ If students are ready for an additional challenge, ask them to solve the volume formula for the radius and test it by substituting the values and comparing it their previous solution. Have them discuss which method they prefer (Substitute and solve for radius OR Solve for radius and then substitute) and why.
* Before showing the final solution (shown at 1:59) have students share their answers and solving methods
* Discuss any errors or misconceptions in student thinking and calculations

**Student Handout - *What does math have to do with dog food?***  Name(s):

**Pre-Video Discussion:**  *Notes on important background information.*

**Problem:** *What are the exact dimensions of the cylindrical dog food patty?*

 **Break 1:**

1. Label drawing of the patty with the correct measurements given in the video.

* 1. Density = 0.547 oz. /cu. Inch
	2. Final wet weight = 2 ounces
	3. Thickness (height) = 0.566 inches
	4. Final diameter < or = 3.4 inches

2. What is the formula for volume of a cylinder?

3. What measurement is missing?

4. You are given the density of the patty. How can you use that measurement to find the volume?

5. Calculate the volume of the patty. Show your method(s)

**Break 2:**

6. Using #2 and #3 above, Find the missing measurement.

7. You will need to send a correctly labeled drawing to the machinist in the manufacturing plant. Use the drawing below to show the measurements needed to produce the correct patty for the customer.

Answer Key - ***What does math have to do with dog food?***

2. *V* = $π\*r^{2}\*h$

3. radius r

4. *density = mass divided by volume*

5. 0.547 oz per cu in = 2 oz divided by *x* cu. inches

 x = 3.656 cubic inches

6. 3.656 cu in = pi \* r2 \* 0.566 in.

 radius = 1.434 inches

 diameter = 2.868 inches