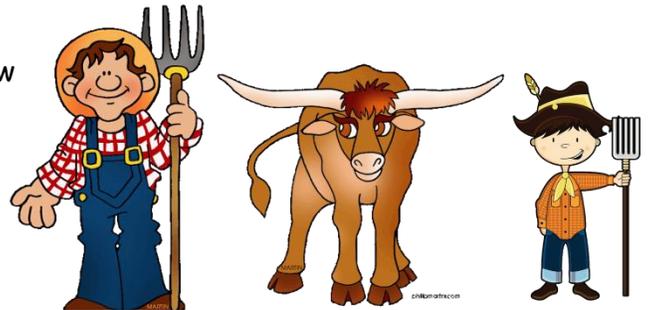




How to Weigh a Fair Steer

Old MacDonald has been helping his son Jimmy MacDonald prepare for the local County Fair. Jimmy has been working hard all year to get his steer Bruno ready to show in the market steer class. Market animal classes are split up into weight ranges. Old MacDonald knows that a steer ranging in the 1200-1300lb weight range will most likely win the show. BUT there is a problem! The fair is 1 week away and Old MacDonald's beef scale just broke! How can Old MacDonald and Jimmy figure out a different way to get Bruno weighed before the fair begins????

Jimmy suddenly calls out "Whoopi! I figured it out! I know how we can weigh Bruno!" He walks Bruno to the edge of the farm pond and says, "and I only need the pond, a boat, 50lb bags of grain, and a marker to do it!" What has Jimmy MacDonald got up his sleeve?



Let's see if YOU can figure out and use the same scientific principles Jimmy is planning on using to weigh Bruno!

What you will need!

- ✓ A large bowl filled with water
- ✓ A small plastic tub (like Tupperware) that fits inside your large bowl without touching the sides or bottom. (This will be your BOAT)
- ✓ Modeling clay
- ✓ Small rocks or pebbles
- ✓ A kitchen scale
- ✓ A marker
- ✓ Optional book "Weighing the Elephant" by Ting-xing

Terms you should know!

Buoyancy: The upward force exerted by a fluid that opposes the weight of an immersed object.



Float: The ability of an object to remain on the surface of a fluid.

Before you begin: Build your own clay version of a steer (male cattle) like Bruno! The model should fit inside of the container that you are going to use as a boat.

- Roll a large ball to be the body. If more weight is needed to sink the boat, roll the clay that forms the body of the steer around some metal washers or a weight (metal nuts work well!)
- Form four cones to make the legs. Attach the two smaller legs to the front of the body and the two larger legs to the sides.
- Roll a ball slightly smaller than the body to form the head.
- Roll 4 smaller lengths to make your steer's horns and ears.
- Add eyes, hooves, and a tail to complete your steer!





Challenge!

Now it's YOUR turn! Using only the materials listed above, see if you can figure out a way to find the weight of YOUR Bruno figure. Don't cheat, take at least 10-15mins experimenting before your read Jimmy MacDonald's solution!

Remember the scientific principles mentioned above? How can those help you solve this challenge?

Jimmy's Solution! Jimmy led his steer Bruno down to the pond and right into farmer MacDonald's rowboat. Then he slowly let the rowboat out into the lake. This is what he saw. (figure 1)

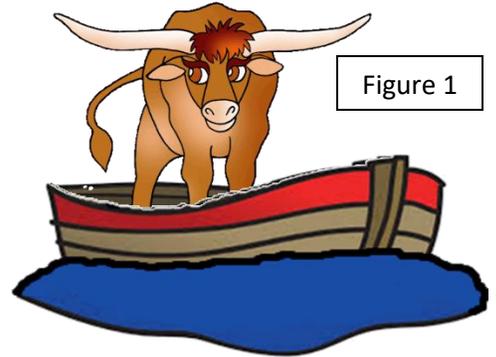


Figure 1

He took a marker and marked the spot on the boat where the water line had been with Bruno in the boat (figure 2). Then he started putting 50lb feed bags into the rowboat. He did this until the boat sank back into the water to the line he had marked with Bruno in the boat.

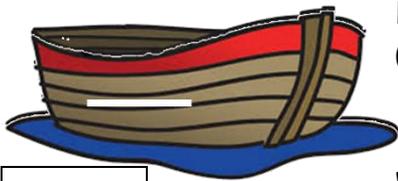


Figure 2

Once the water level reached the line on the boat (figure 3), Jimmy knew he had the same amount of weight in the boat as Bruno was, because the **Buoyancy** now matched from when Bruno was in the boat.

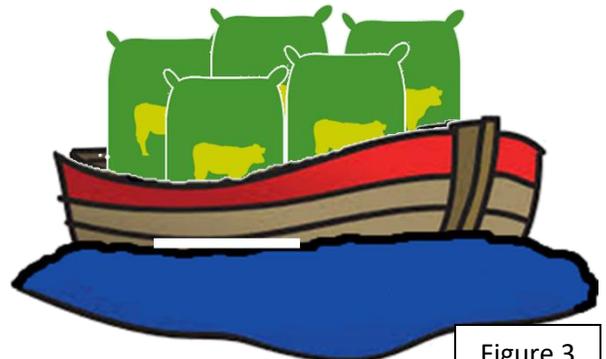


Figure 3

Jimmy had put 25 50lb bags of feed in the rowboat before the water level had reached the line.

This meant that Bruno was _____ pounds heavy!
The perfect weight for next week's County Fair!

How did this work? Were you able to do the same this with your Clay Bruno? Test Jimmy's solution on your experiment to see how much your Bruno Weighs!

My Bruno figure weighs _____ (Ounces, Grams, Pounds) {Circle One}

Follow the Science on the next page!



Answer to Bruno's Weight: 1250lbs

Show me the science!

Archimedes Principle: We can explain why objects float in water thanks to the Greek philosopher Archimedes, who one day sat down in a very full bath and noticed water spilling over the sides. This sight of the water being pushed out of the bath gave him an idea that helped him understand floating. According to legend, he was so excited by his discovery that he leapt out of the bath and went running naked down the street yelling "Eureka! Eureka!" The overflow of water had prompted the discovery of **buoyancy** and the key to **floating**. Archimedes' principal states: An immersed object is buoyed up by a force equal to the weight of the fluid it displaces.



When an object is lowered into water, its weight pushes down on the water and some of the water is pushed aside. The weight of the water pushed aside pushes back with an upward force. An object will **float** when it pushes aside enough water to equal its weight. A boat will sink in the water till it displaces enough water to equal its own weight.

Take it Further!

What type of scales do we have available to help us weigh things? Use the internet to collect photos of different scales. From trucks to trains, look up what large modern day items might need weighing. How are big, heavy items weighed today? What does the local County Fair use to weigh steers?

References:

- This activity was adapted from the National Afterschool Association STEM Gems curriculum titled "How to Weigh an Elephant". You can find the original lesson by going to: <https://naaweb.org/resources/stem-gems>