STEM gems

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HOW TO WEIGH AN ELEPHANT

big IDEAS

MATH

This STEM Gem presents a problem from Chinese folklore that requires critical thinking and math to solve. The age-appropriateness of the activity can be raised or lowered by changing the numbers being used to solve the problem.

STORY **THE EMPEROR WHO WANTED TO WEIGH AND ELEPHANT**

Long ago in China, there lived a powerful emperor. Every year on his birthday, the important people in the royal court attempted to outdo one another by giving the Emperor the most outrageous present. Every year the Emperor received sparkling jewelry, glistering gold, colorful cloth, and exotic animals from faraway lands. One birthday, a courtier presented the largest and most extraordinary creature anyone in the land had ever seen. An elephant all the way from India. The emperor was delighted to see the elephant, and was so amazed at its size he demanded that the elephant be weighed. This request caused a great deal of commotion among the courtiers, as there was no scale big enough to weigh the fine creature. Everyone was embarrassed and worried because no one could think of how to weigh such an enormous beast.

Finally, after much polite coughing and staring at one's slippers the emperor's youngest son, Chao Chong, came up with an idea. Everyone at the royal court turned in amazement. How could such a young person figure out a solution?

THIS WAS THE CLEVER BOY'S IDEA: He sent a boat onto the lake with the elephant on board. He told the sailors to mark the waterline on the boat, that is, the place where the edge of the boat hit the water. Then the boat was brought ashore and the elephant taken off. Next, he had the sailors put smaller stones into the boat until the water level reaches the same mark. Then, each of the stones was weighed separately with a small scale. Then when all the weights were added together you would know how heavy the elephant is. Everyone was surprised and impressed by the boy's solution.

ARCHIMEDES PRINCIPAL

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 sates: 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.

SCIENCE talk

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.

engage

Tell the story of the Emperor Who Wanted to Weigh an Elephant up to the point where the Emperor's youngest son shares his idea.

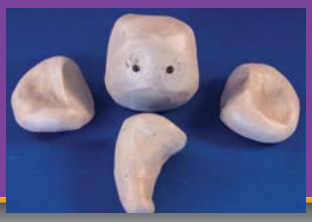
what YOU WILL NEED & before YOU BEGIN

- **Small Plastic Container to Act as a Boat**
- **A Collection of Small Pebbles/Stones** *(Enough to equal the weight of the model elephant.)*
- **Bowl for Water**
- **Modeling Clay** *(To make an elephant.)*
- **Scale** *(A digital kitchen is ideal)*
- **Optional Book *Weighing the Elephant* by Ting-xing** *(http://www.amazon.com/Weighing-Elephant-Folktale-Ting-xing-Ye/dp/1550375261)*

Fill a bowl with water and make model elephant out of clay. The model should fit inside of the container that you are going to use as a boat.

MAKING A CLAY ELEPHANT

- Roll a large ball to be the body. If more weight is needed to sink the boat roll the clay the forms the body of the elephant around some metal washers or a weight.
- 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 two smaller balls and flatten them out to form ears.
- Finally roll out a tube to form the trunk.
- Add eyes and toes to complete the effect.



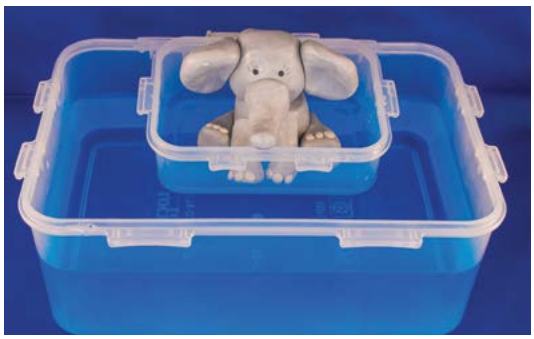
EXPLORE & EXPERIMENT

1. **Have young people form small groups** and challenge them to work as teams to come up with a solution to determining how much the elephant weighs. Give the groups 10-15 minutes to consider the possibilities and then invite each team to share its solution with the class. Discuss each group's answer.

2. **After the groups have discussed their ideas share the solution from the story.** Have groups contrast and compare their ideas with the one from the story.

3. **Tell the kids that they are going to use a model to test out the solution from the story.** Take the container that you are using for your "boat" and float it a bowl of water. Have the kids observe how far the water comes up on the side of the boat and mark it using a pen or a piece of tape.

4. **Show the group the model elephant and ask what would happen if the model elephant was placed in the boat?** Will the water level rise or sink on the side of the boat? Place the model elephant in the boat and have a child mark the new point where the water rises to on the side of the boat. Try to place the elephant as centrally as possible, so that the boat can sit level in the water.



5. **Remove the elephant** from the boat and have the group notice what happens to the water level.

6. **Find out how much the model elephant weighs.** Have the kids take turns adding small pebbles into the boat until it sinks back to the line that was marked when the elephant was in the boat.

7. **Empty all the pebbles out of the boat** and have the group use a scale to weigh each one, and record its weight in a list.

8. **Finally have everyone add up the different weights from the pebbles to determine the total weight of the elephant.** You can check the result by weighing the model elephant and making sure that the numbers are the same.

9. **Ask the group to discuss whether the Emperor's son provided a good solution to the problem?**

make THE CONNECTION

DISCUSS WHAT KINDS OF THINGS NEED WEIGHING IN OUR MODERN WORLD. What type of scales do we have available to help us? Use the internet to collect photos of different scales. From trucks to trains have the group discuss what large modern day items might need weighing. Have the young people research how big heavy items are weighed today. What does the local zoo use to weigh its elephants?

EXTEND & EVALUATE

Have the group use a map to find China. Challenge the group to research where in the world elephants are found naturally. What is the best explanation for an elephant getting to ancient China?

Have the children invent and write a story that included a math problem or riddle in it.