Archimedes – Volume and Displacement

The story handed down through the generations is that Hiero, a king of the Greek city of Syracuse, gave a goldsmith a lump of gold and told him to make a royal crown. When the goldsmith brought the crown to the king, it weighed the same as the lump of gold Hiero had given to him. King Hiero began to ponder on the honesty of this craftsman. He was not certain, but he suspected that the goldsmith had kept some of the gold for himself and had mixed silver with the rest of it to make the crown heavy. That is when Hiero called Archimedes and asked him to discover the truth, but without melting the crown down.

Archimedes knew this would be a difficult problem to solve and wondered how to go about it. The answer came suddenly! One day as Archimedes was lowering himself into one of the public baths in the city, he noticed that some water flowed over the sides of the tub. It is said that he became so excited that he ran out of the bath house through the streets of Syracuse, yelling, "Eureka! Eureka!" In Greek it meant, "I found it! I found it!"

Archimedes then needed to make an experiment to prove this idea of his. First, he weighed the crown. Then, he took a lump of gold and of silver, each weighing the same as the crown. The silver lump was larger because silver is lighter than gold. It takes much more silver to weigh as much as the lump of gold.

He put each lump in a vessel. The vessels were filled to the rim with water. The larger amount of silver caused more water to overflow than the lump of gold did, although both weighed the same. Archimedes knew then that any solid material will push away an amount of water equal to its own bulkiness, or *volume*. If the crown were pure gold, it would have to push away, or *displace* the same amount of water as the lump of pure gold that weighed the same.

But the crown made **more** water overflow than the lump of gold had. Was the goldsmith honest or dishonest? He was dishonest. He had added silver to the crown to make it bulkier. The king found him guilty of stealing.

Archimedes continued experimenting and found that what he learned could be used as a rule. This rule could be used for things that could float as well as for things that sink. Any object that floats will displace its own *weight* of water. Any object that sinks will displace an amount of water equal to its own *volume*. *Volume is the amount of* ***space*** *an object takes up.*

What is weight? Weight tells how *heavy* something is. What is volume? Volume tells us how much *space* it takes up. Do a pound of butter and pound of marshmallows both weigh the same? Yes! But, if you make a pile from a pound of marshmallows, you discover that it takes up much more space, or *volume*.

Can you think of other things that float and sink? What do you think would be a good example for testing Archimedes discovery?