STATION 7

RANK THE MASSES OF THE 3 OBJECTS (ball bearing, rubber stopper, cork ring) USING THE PALM OF YOUR HAND AND WITH A SCALE.

1. Does the ranking of the object's mass by each method agree?

2. If the rankings do not agree, suggest a reason for the disagreement.

See Station 8 for more information.

Concepts - Measurement systems and mass.

For some purposes, qualitative descriptions of results suffice for testing of an explanation. However, many explanations require quantitative measurements for verification. For several reasons, scientists prefer the metric system.

1. In the U. S. customary system, units are related by factors of 3, 12, 16, 5280 and other ratios that make conversions difficult to perform without a calculator. In the metric system all conversions involve powers of 10 and can be performed without a calculator.
2. The metric system has an exact relationship between distance cubed and volume (e.g. 1 mL = 1 cm^3). In the U. S. customary system, most people cannot even relate distance cubed to volume and the conversion requires several multiplications (e.g., how many gallons are in a cubic foot?).
3. For water, the relationship between mass and volume is close to unity (within 0.2%) at commonly encountered temperatures (1 mL water = 1 cm^3 water = 0.998 grams of water at 20°C) but in the U. S. customary system, there is a 4% error (1 pt differs from 1 lb by 4%) if a unity relationship is assumed.
4. Most of the world uses the metric system and it would be much more convenient and less expensive if only one set of tools could be used internationally.
5. Less important but still significant is the common practice of using mixed units in the U. S. customary system. A baby is said to weigh 7 lbs 6 oz instead of the much easier 3.34 kg. We could say 7.38 lbs but for some reason we don't.
6. Some abbreviations in the U. S. customary system do not make much sense. For example, the relationship between lbs and oz and their parent words is a stretch.

Stations 7 and 8 are designed to give you a feel for the mass measurement system in the metric system.

Station 7 - Answers to questions.

The exercise above brings up the question of why most people rank the 3 objects in an incorrect order. In this case the answer is related to the amount of surface area of the object in contact with the hand. The brain is sensing something more complicated than just mass and is probably measuring pressure which is mass/area. Suggest a couple of techniques that could enable you to make better rankings with your hand.

Some people confuse mass, weight and density. For the purposes of this discussion, it is not important to distinguish between mass and weight. Mass is a measure of the amount of material present. However, density is the ratio of mass to volume and in contrast to mass does not depend on the amount of material present. Since density does not depend on the amount of the material present, it is a useful property for distinguishing and identifying different substances.