

## IS THE CROWN MADE OF PURE CLAY?

**A. Question:** *Can the formula  $D = M/V$  help us solve object identity problems?*

### **B. Materials Needed:**

1. Molding clay
2. Some sawdust or woodchips
3. A graduated cylinder or beaker
4. An equal arm or technical balance

### **C: Procedure:**

1. Make “impure” clay by mixing some sawdust or wood chips in the clay.
2. Now make an intricate shape (like a crown) out of the “impure” clay, and ask: “How can I find out whether the crown is made of pure clay or not?” You may also tell the story of the King, his crown, and Archimedes).
3. Weigh pure clay on the balance of the same mass as that of the crown. Form the clay into a ball.
4. Determine the volume of the crown and the pure clay by immersing them one by one in the graduated beaker. Read off the water level before and after immersion and calculate the difference.

### **D: Anticipated Results:**

The impure clay crown will displace more water than the ball of pure clay.

### **E: Thought Questions for Class Discussion:**

1. If the crown and the clay ball were to displace the same amount of water, what may we conclude about the crown?
2. If the crown is made of impure clay, how would the two volumes differ?
3. Why does the ball need to be of the same mass as the crown?
4. What property are we actually determining of the crown?
5. What property is determined by immersing the object in water.
6. How did Archimedes determine the density of the King’s crown?
7. Is density a specific characteristic of a substance?

### **F: Explanation:**

The King suspected that his crown maker had cheated him (by mixing in copper with gold to make his crown). Therefore, he summoned Archimedes to check whether his crown was made of pure gold or not. To do this, Archimedes made use of the definition of density ( $D = M/V$ ). He weighed out pure gold so that its mass would be the same as that of the crown. Then he determined the volume of the crown and the mass of the pure gold by immersing each in water. If the crown were made of pure gold, the density of both objects should be the same, thus also the volume of the displaced water. If the volume of the crown came to be larger than that of the pure gold mass, then the crown would have been made of impure gold.