

## **HOW MANY PENNIES CAN GO IN?**

**A. Question:** *Can soap break forces such as tension?*

**B. Materials Needed:**

1. Two regular drinking glasses.
2. Liquid detergent.
3. About 50 pennies (or other small coins).

**C: Procedure:**

1. Make sure that the glasses are clean. Place one on the table and fill it to the brim (not too overfull, just full).
2. Now ask the students: “How many pennies can I put in the glass before it overflows?” Anticipated answer: “5, 10, 15, even 20 maybe”.
3. Start putting the pennies in the glass of water, very carefully with its edge in first (vertically), and let the students count.
4. Surprised with the result? Now place the other glass on the table, in which you should put a drop of detergent beforehand (without the students noticing it), and also fill this to the brim with water.
5. Now ask a student to put just as many pennies in this glass. What happened here?

**D: Anticipated Results:**

Students should observe a difference in the amount of pennies added to both glasses before it overflows.

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

1. How many pennies can go in the first glass? What about in the second glass?
2. What made the water overflow so easily in the second glass?
3. What kept the water from overflowing in the first glass?
4. What shape did the meniscus take form in the first glass?
5. How would the number of the coins compare if we used dimes instead of pennies? Nickels instead of pennies?

**F: Explanation:**

It is possible to put close to 50 pennies in the full glass of water, depending on how full the glass was filled. A thick-rimmed glass will look full even when the meniscus is a little below the rim. Then it is possible to put many more pennies in. A larger glass also increases the number of pennies that can be dropped. The water forms a convex meniscus due to the surface tension, which is nothing but a manifestation of cohesion of the surface molecules.

In the second glass, where the detergent was present, the surface tension of the water is broken. The cohesion between the surface water molecules is much smaller, and thus the water overflows much sooner. (Another way of secretly putting detergent in the second glass, is wetting the second bunch of pennies with a little detergent before giving it to the student.