

# THE LEAK-PROOF BAG

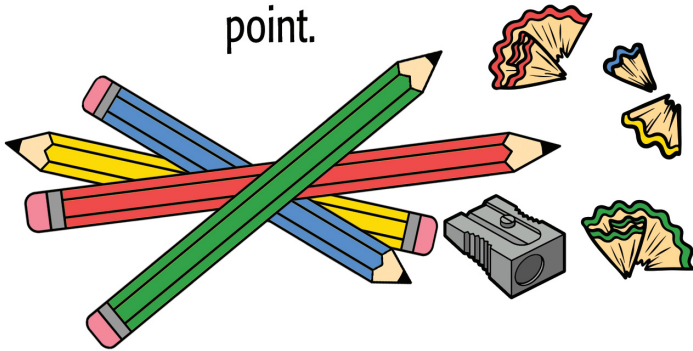
## EXPERIMENT

### SUPPLIES NEEDED:

- PLASTIC BAG
- PENCILS
- WATER

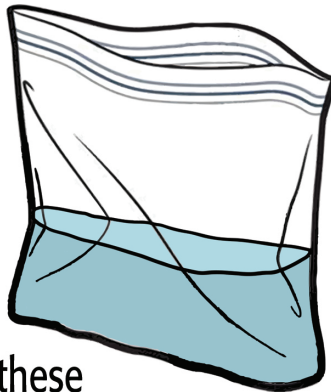
### STEP 1:

Start by sharpening the pencils. Make sure the tips are sharpened to a point.



### STEP 2:

Fill the bag one-half full with water and then seal the bag closed.



### QUESTION:

- What would happen if you tried to push one of these pencils through the bag of water?
- Would the water leak out and make a giant mess?

### KEY CONCEPTS:

- POLYMERS
- LOW-DENSITY POLYETHYLENE
- ELASTOMERS

### STEP 3:

Best to do this step outside or over a sink. Hold the pencil in one hand and the top of the bag in the other hand. Believe it or not, you can push the pencil right through one side of the bag and halfway out the other side without spilling a drop.



### HELPFUL HINTS:

- Make sure the tips of the pencils are sharpened to a point
- Be careful not to push the pencils all the way through the holes

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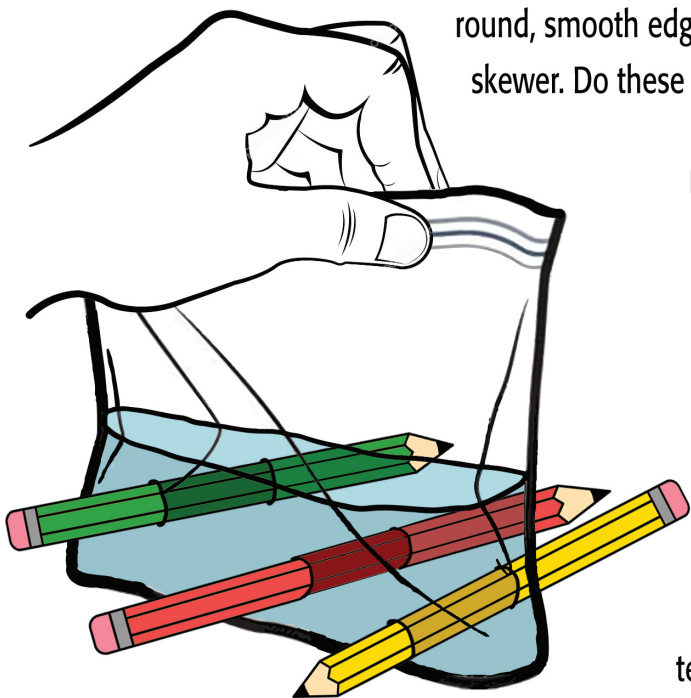
## THE SCIENCE BEHIND



### TAKE IT FURTHER

-Try experimenting with plastic bags of different sizes and thicknesses. The thicker the bag, the harder it is to get the pencil to pass through. For a really thin bag, use a plastic bag from the produce section of the grocery store.

-Experiment with different sizes and shapes of pencils. Some pencils have flat edges while others have perfectly round, smooth edges. Which type of pencil works best? Try a crayon or bamboo skewer. Do these work the same as the pencils?



### HOW DOES IT WORK?

The zipper-lock plastic bag you used was most likely made out of a **POLYMER** called **LOW-DENSITY POLYETHYLENE** (LDPE). A polymer is a chemical compound that has molecules bonded together in repeating chains. LDPE is one of the most widely used packaging materials in the world. LDPE is a very flexible material with high ductility (the amount it can deform before rupturing) but low tensile strength (the amount of stretching it can endure before breaking). LDPE is low in cost, lightweight, durable, a barrier to moisture, and very flexible.

Polyethylene molecules are flexible but weak; their flexibility is because they contain long chains of molecules that can bend and flex. Some polymers belong to a special class of substances called **ELASTOMERS**. Elastomers, like rubber and certain plastics, can stretch and bend and then return to their original shape. If plastic bags did not have polymer chains, the plastic would be hard and inflexible. Because these chains are so flexible, when you pierce the bag, the molecular chains in the plastic flex around the pencil inside the hole, creating a tight seal around the pencil and preventing the water from escaping (although you may have a few minor leaks). When you remove the pencils, the polymer chains can't move enough to fill the holes, so the water escapes leaking everywhere.