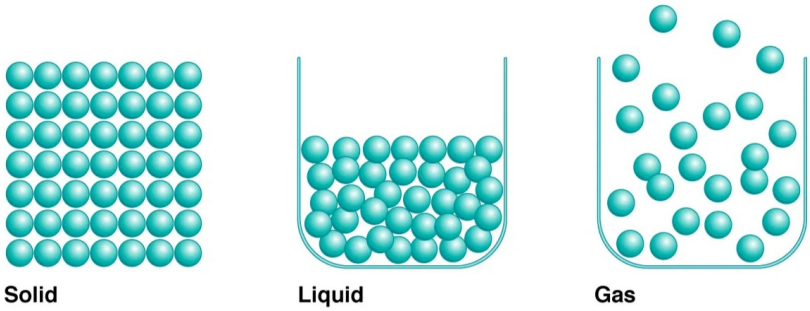
# States of Matter: Solid, Liquid, and in Between

- Everything is made of **matter**
- All matter has **mass** and takes up space (**volume**)
- Matter can be in different phases: solid, liquid, gas, and some in between.




## Part 1: Solids

1. Gently press down on the jello with your finger. The jello will **deform** (change shape).
What does it do when you let go?

springs back  stays deformed  fractures

Fill in the blanks with 'more' or 'less":
The _____ you push, the _____ the jello deforms.

2. Push a toothpick down into the jello so that it sticks out vertically.
What happens if you push the tip of the toothpick gently sideways and let it go?
Deformation then springing back  permanent deformation  fracture

Now push the toothpick sideways further (until it is almost horizontal). What happens?
Deformation then springing back  permanent deformation  fracture

3. On a different part of the jello, press down with your finger and with the sharp tip of a chopstick, pressing roughly the same amount.

Discuss: is it easier to **fracture** the jello with your finger or with a chopstick? Why?
What is different between the two?

- A **solid** object has a preferred **shape**
- Applying force will make the solid change shape (deform).
  - Small pressure → **elastic deformation**. Object springs back when force removed.
  - Larger pressure → **fracture** (object breaks)
  - The same force concentrated on a smaller area causes more **pressure**

## Part 2: Liquids

**Volume** (space taken up) is measured in "milliliters" (mL)


1. Pour 40 mL of water into the graduated cylinder.
2. Pour the water into a bowl.

Did the liquid change its shape? Yes / No

3. Pour it back into the cylinder.

Did the liquid change its volume? Yes / No

4. Pour the water back into a bowl again. Sprinkle some pepper on the surface (to help see what the water is doing). Try making a 'rip' in the water.


Discuss: what does the water do when you push or pull on it? Is it possible to rip or fracture the water? When you stop pushing, do all parts of the water spring back to their original place? (look at where the pepper goes)

- Applying a force makes the liquid flow. When the force is removed the liquid (eventually) stops moving but does not spring back.

Fill the blanks using the words **liquid**, **solid**, **shape**, and **volume**.

A _____ maintains its _____ and its _____ when you push on it.
A _____ maintains its _____ but not its _____ when you push on it.

## Part 3: Viscoelastic Materials

1. Make "Oobleck" by mixing the following in a bowl:

- 6 tablespoons cornstarch
- 50 mL water (measure with the graduated cylinder)

If needed add a little more water or a little more cornstarch

2. Push on the oobleck with your finger.
Discuss: How does the oobleck behave if you push on it slowly? What if you push hard and fast?

3. Pull through the oobleck with a chopstick.

What happens when you pull slowly? oobleck fractures or oobleck flows
What happens when you pull fast? oobleck fractures or oobleck flows

4. Can you roll a marble rapidly over its surface? Yes or No
What happens to the marble on oobleck if it stops rolling? Sits on surface or Sinks

Is it possible to roll a marble over the surface of water? Yes or No
What about over a surface of jello? Yes or No

Discuss: In what ways is the oobleck like a solid? Like a liquid?

5. Can you form the oobleck into a ball by rolling it between your hands?
What happens to the oobleck in your hand when you stop rolling?

A **viscoelastic material** has properties of both solids and liquids. It will flow and change shape when pushed slowly, but will bounce back and rip when pushed quickly.

What other viscoelastic materials have you seen or touched?