# Exploring Materials—Oobleck

*When is a liquid like a solid?*

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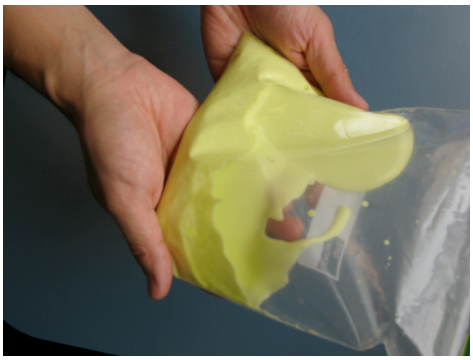
# Exploring Materials—Oobleck

## Try this!

1. Move the Oobleck around in the plastic bag.
2. Now, try tapping or squeezing the Oobleck. What do you think, is it a solid or a liquid?



**Oobleck**

## What's going on?

When you quickly apply a lot of pressure to Oobleck, like tapping or squeezing, it firms up like a solid. When no pressure is applied, it flows like a liquid. Oobleck is actually a simple mixture made of corn starch and water that has some very surprising properties.

Oobleck is one of many materials called non-Newtonian fluids. Non-Newtonian fluids are fluids that do not follow Newton's 3rd law of motion, "every action has an equal and opposite reaction". For example, most fluids move faster when they are pushed harder. Oobleck moves slower when more force or pressure is applied. Some other non-Newtonian fluids are ketchup, toothpaste, and paint. In a regular Newtonian fluid, **viscosity** (resistance to motion) is a constant and only changes if the temperature is changed. Oobleck responds to how fast and how hard a force is applied. Pressure affects Oobleck's viscosity because it changes the way the cornstarch and water interact. When you slowly stir the Oobleck it behaves like a liquid. The same force applied quickly makes it act more like a solid.

## Now try this!

1. Place a plastic egg into a small bag, and then put that bag into one of the large bags of Oobleck.
2. Hold the large bag and an unprotected plastic egg about 2.5 feet (or roughly chest height) off the ground.
3. At the same time, drop the bag and the egg. What happens?

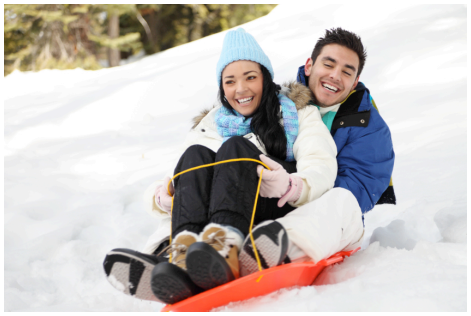
**Oobleck experiment**

## What's going on?

The Oobleck protects the egg. When it hits the ground, a quick direct force is applied to the Oobleck.

The cornstarch clumps together and hardens like a solid, absorbing the impact and protecting the plastic egg. The Oobleck quickly goes back to acting like a liquid. Researchers are using sheer-thickening fluids (STFs) that behave a lot like Oobleck to make new gels and fabrics. These fabrics are flexible and comfortable when no force is applied, but when struck quickly they harden and provide solid protection.

## How is this nano?



**STFs make a winter hat more like a helmet**

**The way a material behaves on the macroscale is affected by its structure on the nanoscale.** Changes to a material's molecular structure are too small to see directly, but we can sometimes observe corresponding changes in a material's properties.

Nanotechnology takes advantage of properties at the nanoscale to create new materials. Fabrics made with sheer-thickening fluids (STFs) that contain nano-sized particles are used in a variety of technologies, from flexible body armor to protective (and fashionable) winter hats.