



PLANET OOBLECK

You are probably already familiar with the fun substance you get when you mix of cornstarch and water. In Planet Oobleck we add art, storytelling and design to turn a classic STEM (Science Technology, Engineering, and Math) inquiry into a STEAM (STEM + ART) activity.



SOLID LIQUID GAS

In a solid, the molecules have low energy and can only vibrate in place, they are tightly bound together in a fixed shape. In a liquid, the molecules have more energy, they are more loosely connected, and are free to slip and slide past on allowing a liquid to flow. Finally, in a gas, the molecules have lots of energy and are only very weakly attracted to one another. Gas molecules fly around extremely fast bumping into things and filling any container they are placed in.

VISCOSITY

Viscosity is a measure of a fluid's ability to flow. Thick liquids such as syrup or honey flow slower and have a higher viscosity than thin liquids such as water or milk. A substance's ability to flow depends on the internal friction of the fluid, or how easily the molecules in a substance move past one another. Liquids made up of molecules that move easily past one another, such as oils, have a low fluid friction and low viscosity. Liquids made up of molecules that do not move easily past one another, such as syrups, have a high fluid friction and high viscosity.

NON-NEWTONIAN FLUID

A Non-Newtonian fluid is a substance whose viscosity changes depending on the force applied to it. A mixture of cornstarch and water, commonly called Oobleck, is an example of a Non-Newtonian fluid. Oobleck is made from a suspension of solid particles packed together and almost touching each other. These particles are floating in water and are just able to slip past one another other. When Oobleck is gently stirred or moved the suspended particles are able to slowly slip past each other allowing the mixture to act like a flowing liquid. However, if you suddenly poke the mixture and apply a force, the particles jam into one another and stick together, making the mixture act as a solid.

GAS: A state of matter where molecules are only loosely connected together and move around at high speed with a lot of energy. | **LIQUID:** A state of matter where molecules do not have a definite arrangement. They move faster than molecules in a solid, slipping and sliding over and under each other. | **MATTER:** Anything that takes up space and has mass. Everything around us is matter. Matter is made from atoms and molecules. | **SOLID:** A state of matter where molecules are bound together in a fix shape. The molecules have low energy and can only vibrate in place. | **MOLECULE:** A unit of matter; two or more atoms bound together chemically to form a substance. | **VISCOSITY:** A measure of a substance's ability to flow.

engage

With a great deal of showmanship tell your young people that out past Pluto scientist think there is an unseen planet, known only as Planet X. Recently NASA sent a space probe to the far reaches of our solar system investigate this unknown area. Excitement built when the probe detected a large object that no one had ever seen before. NASA was not sure if this new object was a planet or a large asteroid. When NASA tried to land the probe on the surface, it quickly sank before they could get any readings. Luckily as it was sinking an automatic program on the probe launched a small rocket with a sample of the surface back to earth. NASA recently retrieved this sample and is investigating it in the hopes of trying to design a probe that can successfully land on this mysterious object. Explain to everyone that you at great personal sacrifice have obtained a small amount of the sample for everyone to investigate. With a flourish show everyone the sample of Oobleck that you have prepared. Tell your group that they are going to investigate this sample and design a new probe that is capable of landing on it.

? **What do scientists do when they want to find the answer to a question?** *Scientists use careful observation to gather information they then define the questions and design experiments to test their ideas.*

? **What are conditions like out past Pluto?** *It is very dark and cold because it is so far from the Sun.*

? **What is the difference between a solid and a liquid?** *A solid is rigid and has a fixed shape. A liquid flows from place to place and can be moved around.*

? **Can something be a liquid and a solid at the same time?** *Open answers.*



what YOU WILL NEED



- ! **A space decorated Container to make Oobleck in and present to the group**
- ! **Food Coloring**
- ! **Food Extract** (*banana*)
- ! **Cornstarch** (*Approximately 2 oz per child*)
- ! **Water**
- ! **Newspaper or butcher paper to cover the tables**
- ! **Drawing Paper**
- ! **Drawing Tools**

& before YOU BEGIN

Decorate a large container to hold the Oobleck. Use tinfoil and paint to make the container look like an official NASA sample. Make the Oobleck by mixing 1-part water to 2-parts cornstarch. Before mixing add several drops of food coloring and food extract to the water (we like to use banana extract, as it smells quite alien, and young people have a hard time identifying it.). Decide how many research teams you will have and fill small containers with 4 oz. of cornstarch for each team.

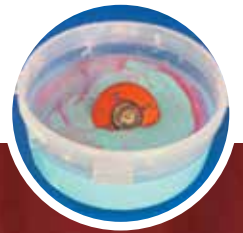
Split your group into small investigative teams. Have each team gather the following:

- ! **1 Small Container** (*a bowl or cup for mixing an Oobleck sample*)
- ! **1 Spoon**
- ! **1 Popsicle Stick**
- ! **A Model Probe** (*Anything that is heavy for its size such as a nut and bolt or a toy space craft*)
- ! **2 Cups of Water** (*one to mix into the Oobleck and the other for rinsing fingers and probes*)
- ! **Paper Towels**

EXPLORE & EXPERIMENT

- 1 Have kids form into small research teams.**
- 2 Have a member of each team gather the supplies for their team:** a small container containing 4 oz. of cornstarch, 2 cups of water, a spoon, a popsicle stick, and the model probe.
- 3 Have each team pour 4 ounces of water** (half a cup) into their container of corn starch and slowly mix to combine.
- 4 Invite each team to describe their mixture?** What does it feel like? What are its properties? Is it runny? Is it hard to stir? What sinks to the bottom the water or the cornstarch?
- 5 Have each team continue to slowly stir in water a small amount at a time** till the cornstarch mixture is smooth with a heavy syrup like consistency.
- 6 Walk around the group and add a drop of food coloring and extract to each team's Oobleck.** After the smell and color has been added have each of the teams stir their mixtures. Ask how is it easiest to stir?

- 7** **Guide the research teams through an investigation of the sample.** What does the sample look like? What does it sound like? Using just the tip of a finger how does it feel? How does it smell? Is it hot or cold, sticky, wet or dry, powdery or rough? Encourage the kids to use good descriptive words. Allow the group ample time to think of questions and describe their observations. How would they describe the sample to someone on the telephone who could not see it?
- 8** **After exploring the Oobleck have each team land their probes on the surface and observe what happens.** The probe should slowly sink.
- 9** **Have each research team try to retrieve their probes using the spoons and popsicle sticks.** Given the nature of the Oobleck this can be a challenge.
- 10** **Have everyone slowly sink their fingers into the Oobleck.** Then have everyone quickly drum their fingers on the surface. When moving slowly the Oobleck acts like a liquid, but when force is applied it acts as a solid. Is it a liquid a solid or both?
- 11** **Have each research team put their probes back on the surface of the Oobleck** and this time use their fingers to try and push it in. What happens?
- 12** **Distribute the drawing tools and challenge everyone to design a space probe capable of landing on and moving around Planet Oobleck.** Encourage kids to discuss their ideas and plans with a partner prior to starting their drawings.
- 13** **Invite everyone share their designs with the rest of the group.**





NEWTONIAN LIQUIDS SUCH AS WATER, VINEGAR AND MOST OILS FLOW AT THE SAME RATE REGARDLESS OF THE FORCE THAT IS APPLIED TO THEM. Non-Newtonian fluids flow at different rates depending on how much force is being applied to them. Explain that Oobleck is not really all the way from the outer reaches of our solar system, it just a great example of a Non-Newtonian fluid made from cornstarch and water. Oobleck's ability to flow slows down when a force is applied to it. Squeeze it hard enough and it will turn from a liquid to a solid. Let it go and it turns instantly back into a liquid.

Ask your young people if they know of any other Non-Newtonian fluids? Ask if anyone has ever tried to get ketchup out of a glass bottle? What do you have to do to get the ketchup out? You have to hit the bottle. Just like Oobleck, ketchup is a Non-Newtonian liquid. With Oobleck, the harder you squeeze it the more solid it gets. With ketchup the opposite is true. The harder you squeeze the more liquid it gets. That's way you have to hit a ketchup bottle to get any to run out. The shock from the pounding causes the ketchup inside to loosen up and flow. Today, to overcome this problem most ketchup is sold in a squeeze bottle. Does ketchup flow out of an inverted squeeze bottle with an open cap? No, the ketchup is too thick, there are no drips. The bottle has to be squeezed to get the ketchup out. When the bottle is squeezed a force is applied that makes the ketchup more liquid, allowing it to flow out of the bottle.

The logo consists of the words "EXTEND" and "EVALUATE" in a white, uppercase, sans-serif font, separated by an orange ampersand. Above the ampersand is a stylized orange graphic of a house or bridge outline.

EXTEND & EVALUATE

For a stronger art connection, provide drawing supplies and challenge groups to invent alien race that lives on the cold dark Planet Oobleck. Invite young people to draw what the aliens look like and write short stories about a day in the life of the aliens.

For a stronger engineering connection provide craft materials such as craft sticks, cardstock cups, and plates and challenge kids to make a probe capable of landing on the surface of Planet Oobleck. Fill a large aluminum pan with Oobleck so the group can test their probes by dropping them into the pan from a fixed height.