LESSON 10:
PLANET OOBLECK

SUPPLIES

MAIN BIN
- Plastic Cups - 20
- Bowls -4
- Masking Tape - 4 Rolls
- Plastic Spoons - 25

MAIN BIN ZIPLOC
- Popsicle Sticks - 40
- Straws - 16
- Paper Clips - 40

TEACHER BRINGS
- Cornstarch - 1 box
- Water - 4 cups

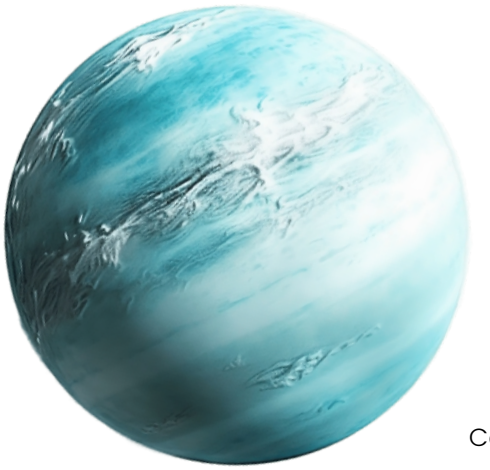
HANDOUTS FOLDER
- Paper for Brainstorming - 15

PENCIL BOX
- Pencils - 15
- Measuring Cups

OBJECTIVES
- ☑ Understand the properties of different states of matter: solids, liquids, and non-Newtonian fluids.
- ☑ Design a spacecract using selected materials to land on an oobleck surface.

HOOK
3-5 min

- What do you think it would be like to land on a planet with a surface that's neither completely solid nor liquid?
- Can you imagine walking on something that changes how it feels depending on how you touch it?



INTRODUCTION
3-5 min

Imagine you're an astronaut on a mission to explore a new planet that scientists have just discovered. This planet is unlike any other you've seen before. Instead of having a surface made of solid rock or liquid water, this planet has a unique surface material called **oobleck**.

Oobleck is special because it doesn't act like a typical solid or liquid. When you press down on it with force, it feels solid, but when you touch it gently, it flows like a liquid. Oobleck is a non-Newtonian fluid, meaning it doesn't fit into just one category. It behaves differently based on how much force is applied to it.

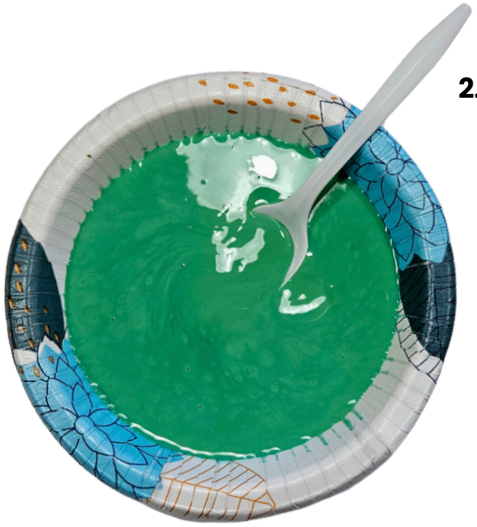
Different planets in our universe have diverse surfaces and atmospheres. When designing spacecrafts to land on these varied surfaces, scientists and engineers have to consider the unique characteristics of each environment. For instance, a spacecraft landing on a rocky surface needs strong landing gear to handle impacts, while one landing on an icy surface must prevent slipping and manage extreme cold. For gas planets, spacecraft might not land at all, but will instead need to withstand high atmospheric pressure and intense storms. Understanding these conditions is important to ensure the safety and success of space missions.

PLANET OOBLECK

ACTIVITY DIRECTIONS

30-45 min

1. Present the challenge:
Imagine you are on a mission to visit the new Planet Oobleck. Your spacecraft needs to be able to land without sinking and without getting stuck. When the spacecraft takes off again from the planet, it needs to stay intact without getting destroyed. What materials would you choose to build a spacecraft that could safely land on and navigate this strange surface?



Creating Oobleck:

2.
- We are going to begin by creating oobleck. Then, we will experiment with different materials on the surface to see which one would be best for a spacecraft that needs to land.
- Have students work in groups of 4. Assist them in mixing the oobleck.
- Begin by measuring 1 cup of cornstarch and placing it in the bowl.
- **Slowly** add 1/2 cup of water to the bowl.
- Use your hands or a spoon to mix the cornstarch and water thoroughly until you achieve a thick, gooey substance. If the mixture is too dry, add more water **VERY slowly.**
- If it's too watery, add more cornstarch.
- The oobleck will be hard to stir, and will get harder to stir the more force that is applied. Encourage students to stir very **slowly**.

3. Exploring Oobleck:
- Encourage students to touch the oobleck. Have them press on it quickly and then slowly, observing how it behaves differently.
- Discuss their observations.
  - What did you notice about how the oobleck reacted when you pressed on it quickly with your finger?
  - How did the oobleck behave when you slowly dipped an object into it?
  - What happened to the oobleck when you tried to roll it into a ball in your hands?

4. Experimenting with Materials:
- Provide students with small samples of the available materials: plastic cups, spoons, paper clips, popsicle sticks, and straws.
- Have students test how each material interacts with the oobleck by pressing and placing them on the surface. Ask them to observe and record which materials float, sink, or support weight.
- Discuss their findings and help them decide which materials might be best for building their spacecraft landers.

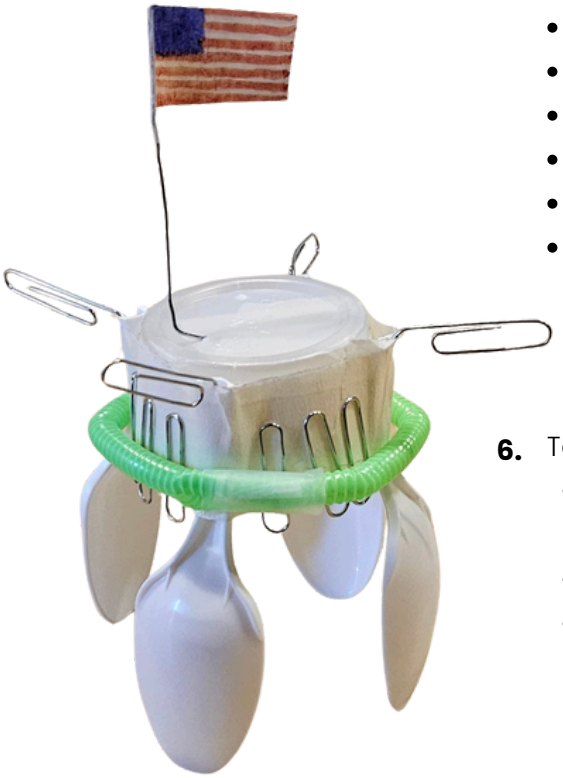
PLANET OOBLECK

ACTIVITY DIRECTIONS

30-45 min

5. Designing the spacecraft:

- Have students work in groups of three to design their spacecraft.
- Allow them to draw their design ideas.
- Encourage them to label the design with the materials they will need.
- Provide each group of 4 with the following materials:



- 4 plastic cups
- 4 plastic straws
- 8 popsicle sticks
- 8 plastic spoons
- Masking Tape
- 8 paper clips

TEACHER TIP

- When students are designing their spacecrafts, assist them by asking guiding questions
- "How will this part of your design help your spacecraft land safely on the oobleck?"
- "What might happen if the oobleck hardens under your spacecraft, and how can you design to handle that?"
- Move around the classroom to offer suggestions and help troubleshoot any issues they encounter.

6. Testing the spacecraft:

- Once the spacecrafts are built, each group will test their spacecraft by landing it on the oobleck surface.
- Does it sink? Can it be easily lifted?
- Observe which designs are most successful.

EVALUATE AND REDESIGN

- Ask students to observe their spacecraft on the oobleck and note any issues such as tipping, sinking, or instability.
- Have students discuss within their groups why these issues occurred. What aspects of their design contributed to these problems?
- Encourage students to brainstorm possible changes to their designs that could address the issues they observed. Remind them to consider the properties of the materials and the behavior of the oobleck.
- Allow students to make adjustments to their spacecraft using the available materials. They might want to add support structures, change the shape of the landing legs, or redistribute the weight.
- Once modifications are made, have students retest their spacecraft on the oobleck. Observe the new performance and discuss any improvements or remaining issues.

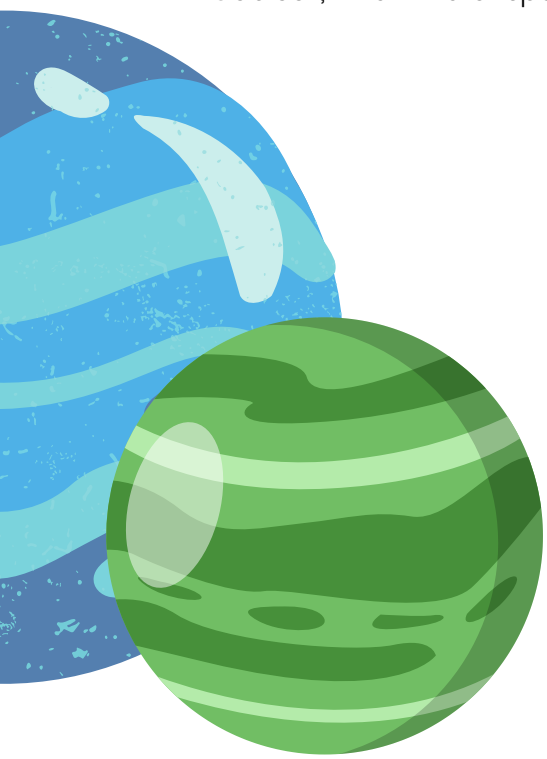
PLANET OOBLECK

DISCUSSION

3-5 min

Engage students in a discussion about their experiment:

- How did your spacecraft work on the oobleck when it was acting more like a liquid?
- What did you observe about your spacecraft when the oobleck acted more like a solid?
- Which materials did you find were best for keeping your spacecraft from sinking into the oobleck?
- Did any parts of your spacecraft sink into the oobleck?
- How did your spacecraft react when you gently placed it into the oobleck compared to when you pushed it more forcefully?
- Would you want to go to Planet Oobleck? If you were on a space mission to land on Planet Oobleck, what kind of spacecraft would be the safest to land in?

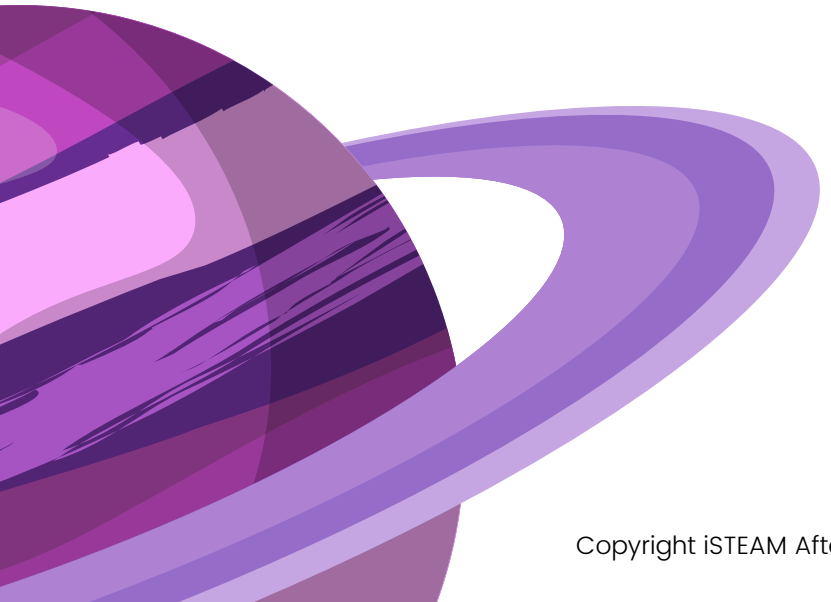


EXPLANATION

3-5 min

Oobleck is a fascinating substance known as a non-Newtonian fluid. This means that unlike most liquids, its viscosity (or thickness) changes in response to the force applied to it.

Oobleck is a suspension of cornstarch particles in water. When you apply force to oobleck, such as pressing it quickly or squeezing it, the cornstarch particles lock together. This is because the particles are pushed so close to each other that they can't move around freely, making the oobleck behave like a solid. However, when there's no force applied or the force is applied slowly, the particles have enough room to slide past one another, and the oobleck flows like a liquid.



Cosmic Contrasts

When scientists and engineers design spacecraft to explore these different planets, they must consider these unique conditions. For instance, a spacecraft landing on Mars needs to withstand dust storms and extreme temperatures, while one designed for a mission to Europa, one of Jupiter's moons, would need to deal with an icy surface and possibly subsurface oceans.