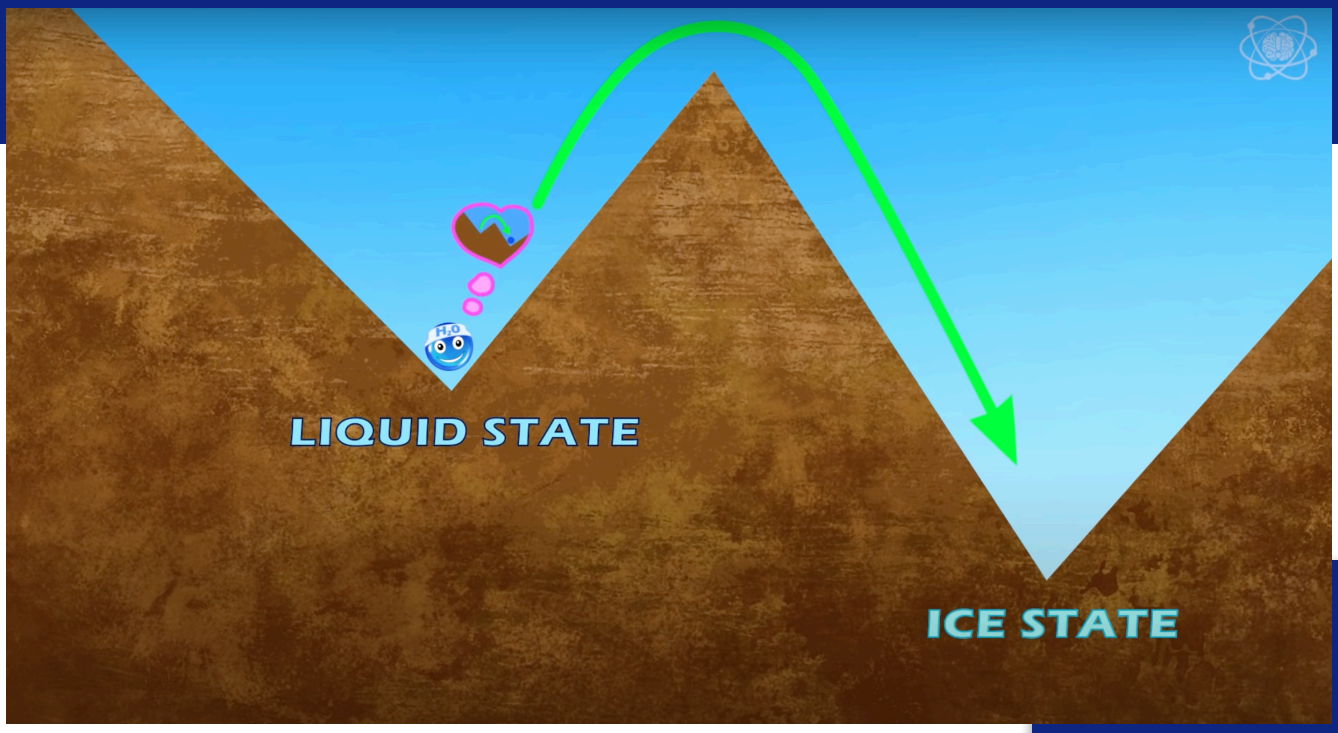
Super Cooling Water

Goal: Students will be able to explain why purified water can fall below freezing temperatures while remaining in a liquid state.

Objective: Students will demonstrate how to freeze supercooled water instantly, and they will be able to explain why it freezes upon impact.



Procedure

1. **Prep:** Create two large rectangles in painters tape on the floor (large enough for 6-12 students to move around in each rectangle).
2. **Hook:** Remove a supercooled water bottle from the freezer, and show students how you can freeze it instantly by banging it on the table. Ask students to brainstorm how and why this might be happening. Share a few responses.
3. Have students **write** down three "I wonder if?" questions with guesses about how and why the water might have frozen so quickly on impact.
4. **Explain and pause for note taking**: *There are three*

Materials:

-Purified water
-2 water bottles per student (one filled with purified water, one empty to be filled with tap water at home)
-Tap water
-Painters tape
-12 sheets of blue construction paper
-6 sheets of brown construction paper

ways to increase freezing speed: Lower temperature more, add an impurity such as dust, or add a seed crystal to start the crystallization process. Water is normally liquid at room temperature because the molecules are flowing all around each other allowing the water to flow in a liquid state. When something becomes solid, the molecules lock into place.

When water is supercooled, its temperature falls below freezing (32 F/0 C) where it could become ice, yet it remains liquid. This is possible with purified water because there are no impurities for molecules to latch onto. Impurities in water act as sites where crystals can begin to form, speeding up the freezing process.

5. **Ask:** What can you guess about the type of water in this water bottle? Why?
6. **Explain:** *In purified water, the impact of banging the water bottle can cause some of the molecules to line up starting the freezing process*. *Some students should guess that it is purified water because it was supercooled to below freezing.

Demonstrate

7. **Choose** six students to stand in each taped rectangle. Give each student a piece of blue construction paper to hold to show that they are representing water molecules.
8. **Tell** students in one rectangle to move freely around the rectangle, representing flowing water.
9. **Distribute** brown sheets of construction paper to represent dust/impurities to six new students. Before they enter the other rectangle, ask the class to tell the water molecules what they should do when the impurities enter (the water molecules should stick to the impurities and stop moving or freeze). Guide them as needed.
10. **Tell** the students representing the dust to enter the second rectangle, and tell the water molecules in that rectangle to stick to them and freeze.
11. **Ask** students to imagine that the water in the pure rectangle (no dust) is below freezing temperature. How could it freeze instantly without adding

impurities? *Some students should remember that impact can cause the water molecules to line up and freeze.

12. **Tell** the water molecules/students in the pure water bottle to line up next to one another when you hit the tape with a yardstick. Hit the tape border of the water bottle with a yardstick, and have the students line up to represent freezing.
13. Have students **draw** a diagram of the demonstration with the pure and impure water bottles in their notebooks.
14. **Show** Impossible Science Video and pause to reinforce information and allow for note taking.

Assessment:

Students will **recreate the experiment** at home (alone or with a partner/small group), **film it,** and **submit their video**. Teacher will provide water bottles- one empty to be filled with tap water and one filled with purified water.

1. Fill two water bottles- one with purified water and one with tap water and put in the freezer. Check after 45 min- should take 2-3 hrs.
2. The bottle with the tap water will freeze first. Once it is frozen, the purified water will be super cool. Remove it from the freezer.
3. Gently move the bottle to observe the air pocket moving, proving that it is still liquid.
4. Bang the bottom of the water bottle against the counter and observe what happens.
5. The shock of the impact should make enough molecules align to begin the freezing process, and it should spread to all of the water.

Safety Note:

Adult Supervision Recommended

Watch the companion video here:

YouTube