



Why Does Ice Float?

Video: 3:22 · Episode 001**Grades:** 4–8 · Chemistry**Time:** 30–45 min (video + worksheet + quiz)**Key term:** hydrogen bonds (HY-druh-jun)**Connects to NGSS:** 5-PS1-1 (matter is made of particles too small to see) · MS-PS1-4 (adding or removing thermal energy changes particle motion and state)

The big idea

Ice is just frozen water, yet it floats on water. Most solids sink in their own liquid, because their particles pack tighter when they freeze. When water freezes, **hydrogen bonds** lock each molecule to its neighbors at fixed angles, so the molecules form open rings with space in the middle. The same water takes up more room as ice, so a cup of ice weighs less than a cup of water, and it floats.

One-line recap students should be able to say: "Ice floats because freezing spreads its molecules apart."

Learning goals

- Describe a water molecule (one oxygen, two hydrogens, bent) and why neighbors attract.
- Explain that in ice, hydrogen bonds hold molecules in open rings, so ice takes more space than the same water.
- Use "more space for the same stuff" to explain why ice floats.
- Give one real-world effect: cracked bottles, split rocks, or ponds that don't freeze solid.

How to use it

1. **Before watching (3 min):** students answer the prediction on the worksheet. Don't correct them yet.
2. **Watch (4 min):** play the video once straight through. Pause at about 2:07, right after "Same box, fewer molecules," if you want a check-in.
3. **Worksheet (10 min):** fill in the blanks, then draw the molecules in water and in ice.
4. **Discuss (10 min):** pick two or three discussion questions.
5. **Quiz (5 min):** six quick questions; answer key on the last page.

What the video simplifies (so you can answer the sharp questions): molecules are drawn flat; real ice is a 3D hexagonal crystal where each molecule bonds to four neighbors. The "+" and "-" are partial charges. "25 vs 23 molecules" is an illustration of the real ~9% difference (ice $\approx 0.917 \text{ g/cm}^3$, water $\approx 1.000 \text{ g/cm}^3$). The open space in the rings is *not air*: it's just room between molecules. About 92% of ice sits under fresh water (89% in sea water).

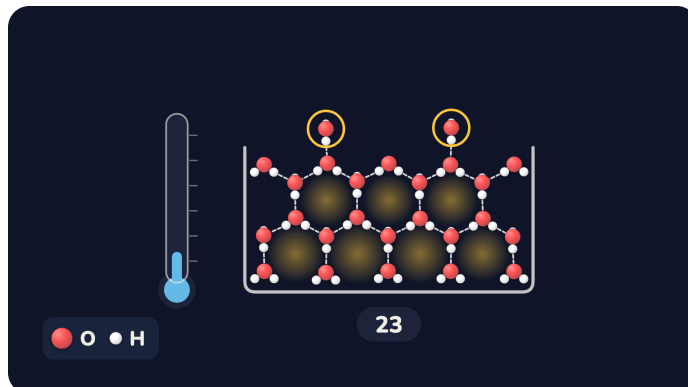


Watch Water Grow

Students measure how much space water takes before and after freezing, and see the "ten cups become almost eleven" from the video with their own eyes.



From the video: freezing locks molecules into open rings



Same box, fewer molecules: 25 → 23

You need (per group)

- A clear **plastic** cup with straight-ish sides (never glass)
- Water, a permanent marker or masking tape, a ruler
- A freezer and one overnight wait

Steps

1. Fill the cup about two-thirds full of water. Set it on a flat table.
2. Mark the water line on the outside of the cup. Measure its height from the bottom.
3. Freeze the cup overnight, standing upright.
4. Mark the new top of the ice and measure again. Compare the two heights.
5. Optional: let it melt and check that the water goes back to the first line.

What to expect: the ice stands noticeably higher than the water did, often with a small bump on top. The volume grows about 9%; in a cup with sloped sides the height change looks a little smaller than 9%. **Safety:** use plastic, not glass. As the video shows, freezing water can crack a full glass bottle.

Talk about it

- Did any water get added in the freezer? So why is it taller?
- How does this match the molecule box in the video (same box, fewer molecules)?
- If ice takes more space for the same water, what does that mean for how heavy a cupful is?



Why Does Ice Float?

Name: _____

Date: _____

Before you watch

Ice is just frozen water. So why do you think it floats on water instead of sinking?

While you watch: fill in the blanks

1. Melt some candle wax and drop in a solid chunk. The solid chunk _____.
2. A water molecule has one _____ atom and two _____ atoms.
3. The tugs between water molecules are called _____.
4. When water freezes, the molecules lock into _____ with open space in the middle.
5. Ten cups of water freeze into almost _____ cups of ice.
6. About _____ of an iceberg is under the water.

Draw it

Draw the water molecules in liquid water and in ice. Show how they are arranged.

LIQUID WATER (warm)**ICE (cold)**

Explain it

Explain to a friend why a pond in winter freezes on top instead of from the bottom up.



Talk It Over, Then Check Yourself

Discussion questions

1. Before the video, what did you expect to happen to a solid dropped into its own melted liquid? Why?
2. The rings in ice have "open space" in the middle. Is that space filled with air? How could you find out?
3. Water pipes can burst on very cold nights. Use the video to explain why.
4. If ice sank, what would happen to a lake over a long, cold winter? What would fish do?
5. The video says "speed of motion = temperature." What happens to the molecules as water warms back up?

Quiz

Name: _____

1. Why does ice float on water? (Circle one.)
A. Ice is colder than water
B. Ice has air bubbles inside
C. The same water takes more space as ice
D. Ice is heavier than water
2. What is a water molecule made of?
A. Two oxygens, one hydrogen
B. One oxygen, two hydrogens
C. One carbon, two oxygens
D. Only hydrogen
3. What happens to water molecules as water freezes?
A. They speed up
B. They crowd closer together
C. They lock into open rings
D. They split apart into atoms
4. True or false: in most substances, the solid sinks in its own liquid. _____
5. Why can a full glass bottle of water crack in the freezer?
A. Water expands when it freezes
B. Glass shrinks in the cold
C. Ice is sharp
D. The bottle gets too heavy
6. How does floating ice help fish survive the winter?



Worksheet: fill in the blanks

1. sinks · 2. oxygen, hydrogen · 3. hydrogen bonds · 4. rings · 5. eleven · 6. nine-tenths

Draw it: liquid shows molecules close together in a jumble, tumbling (motion lines are a plus); ice shows molecules in an orderly pattern of rings with gaps in the middle.

Explain it: ice is less dense than water, so it forms on top and floats there like a lid. The lid keeps cold air off the water below, so the pond doesn't freeze solid.

Quiz

1. **C.** The same water takes more space as ice, so a cupful of ice weighs less than a cupful of water. (B is a common guess: the gaps are not air.)
2. **B.** One oxygen, two hydrogens.
3. **C.** They slow down, hydrogen bonds hold, and they lock into open rings.
4. **True.** Solid wax sinks in melted wax; most solid metals sink in their melted metal.
5. **A.** Water expands about 9% when it freezes, and the full bottle has nowhere for it to go.
6. Ice floats on top like a lid. It keeps the cold air away from the water below, so the water underneath stays liquid and fish can keep swimming.

Discussion: points to listen for

1. Most students expect the solid to sink (or float) based on everyday experience; ask what "packed tighter" means.
2. No: the gaps are space between molecules, not air. If it were air, it would bubble out when ice melts (some bubbles come from dissolved air, not the rings).
3. Water in the pipe freezes and expands, pushing on the pipe until it splits.
4. Ice would sink and pile up from the bottom; the lake could freeze solid, leaving fish nowhere to go.
5. They speed up, hydrogen bonds snap and re-form, the rings fall apart, and the molecules crowd back in.