Ice Ball

Physical Science | Lesson Guide

5th Grade

Photo Description

A large, clear ice sphere sits in a blue plastic tray, showing beautiful crystal patterns that look like frozen fireworks or tree branches spreading from the center. The ice ball appears to be melting slightly, with some water visible in the tray beneath it. The crystal formations inside the ice create stunning white, feathery designs that radiate outward in all directions.

Scientific Phenomena

This image represents the Anchoring Phenomenon of crystallization patterns in freezing water. The spectacular branching patterns visible inside the ice sphere are called dendrites, which form when water molecules arrange themselves in orderly, repeating patterns as they freeze. The feathery, tree-like structures occur because ice crystals naturally grow in hexagonal (six-sided) patterns, and impurities or temperature variations in the water cause the crystals to branch outward as they compete for space during the freezing process.

Core Science Concepts

1. States of Matter: Water exists as liquid, solid (ice), and gas, and can change between these states when energy (heat) is added or removed.

2. Crystal Formation: When liquids freeze, their molecules arrange in organized, repeating patterns called crystals, which create the beautiful branching structures we see.

3. Heat Transfer: The ice sphere is melting because heat energy from the warmer air is transferring into the colder ice, causing the solid to change back to liquid.

4. Molecular Arrangement: In ice, water molecules are locked in place in an orderly pattern, while in liquid water, the molecules move freely and randomly.

Pedagogical Tip:

Have students draw what they observe before explaining the science. Their initial sketches and descriptions reveal their thinking and help you address misconceptions more effectively.

UDL Suggestions:

Provide multiple ways for students to explore this concept: visual observation, hands-on ice experiments, digital simulations of molecular movement, and kinesthetic activities where students model molecular behavior with their bodies.

Zoom In / Zoom Out

1. Zoom In: At the molecular level, water molecules (H ,O) are slowing down and forming hexagonal rings as they lose energy during freezing. Each molecule connects to four others in a rigid, three-dimensional lattice structure that creates the crystal patterns we observe.

2. Zoom Out: This same crystallization process happens throughout Earth's water cycle - in snowflakes forming in clouds, ice sheets in polar regions, and frost on windows. These crystal formation patterns affect weather systems, climate, and the availability of fresh water for all living things on our planet.

Discussion Questions

1. What do you notice about the patterns inside this ice ball, and how do you think they formed? (Bloom's: Analyze | DOK: 2)

2. If you made ice balls using different liquids like salt water or sugar water, how might the crystal patterns change and why? (Bloom's: Evaluate | DOK: 3)

3. How is the formation of these ice crystals similar to other patterns you see in nature? (Bloom's: Apply | DOK: 2)

4. What evidence do you see that this ice ball is changing states of matter? (Bloom's: Analyze | DOK: 2)

Potential Student Misconceptions

1. Misconception: "Ice is colder than water" or "Ice makes things cold"
   Clarification: Ice and water can be the same temperature (32°F/0°C). Ice absorbs heat energy from warmer objects, which is why it feels cold to touch.

2. Misconception: "The patterns were painted or put inside the ice ball"
   Clarification: These crystal patterns form naturally as water freezes, created by the way water molecules arrange themselves during the freezing process.

3. Misconception: "All ice looks the same inside"
   Clarification: Ice crystal patterns vary based on freezing speed, water purity, and temperature conditions, creating unique designs each time.

Cross-Curricular Ideas

1. Mathematics - Geometry & Patterns: Have students measure the ice sphere and trace the crystal patterns on graph paper. They can count the branches radiating from the center, identify hexagonal (6-sided) shapes within the patterns, and create symmetry drawings based on what they observe. This connects to 5.G standards on 2D shapes and 5.MD on measurement.

2. English Language Arts - Descriptive Writing: Ask students to write detailed descriptions of the ice sphere using sensory words and figurative language (similes and metaphors). They might write "The ice crystals look like frozen lightning bolts" or "The patterns spread out like a snowflake's arms reaching into space." This builds vocabulary and descriptive writing skills while deepening their scientific observations.

3. Art - Nature-Inspired Design: Have students create artwork inspired by the crystal patterns using materials like watercolor, salt painting, or paper cut designs. They can research how artists and architects use crystal patterns and symmetry in their work, then design their own repeating patterns based on what they see in the ice sphere.

4. Social Studies - Water Resources & Climate: Connect ice crystallization to how Earth's water cycle affects different regions. Students can research how ice formation in polar regions, glaciers, and mountain snowpack impacts water availability for communities around the world, and how climate change is affecting these frozen water sources.

STEM Career Connection

1. Glaciologist - A glaciologist studies ice sheets, glaciers, and how they form and change over time. They travel to frozen places like Antarctica and the Arctic to observe ice crystal formations and understand how climate affects Earth's frozen water. They use tools and cameras to measure ice and collect samples for study. Average Salary: $65,000 - $85,000 per year

2. Materials Scientist - Materials scientists study how different substances form crystals and structures, which helps them create new materials for technology, sports equipment, and buildings. Understanding ice crystal formation helps them design better materials that can handle extreme cold or heat. Average Salary: $68,000 - $95,000 per year

3. Meteorologist - Meteorologists study weather and atmosphere, including how water freezes in clouds to form snow and ice crystals that create snowflakes and precipitation. They use crystal formation patterns to predict weather and understand storms. Average Salary: $62,000 - $92,000 per year

NGSS Connections

- Performance Expectation: 5-PS1-3 - Make observations and measurements to identify materials based on their properties
- Disciplinary Core Ideas:
  - 5-PS1.A - Matter of any type can be subdivided into particles that are too small to see
  - 2-PS1.A - Different kinds of matter exist and many of them can be either solid or liquid
- Crosscutting Concepts:
  - Patterns - Students observe patterns in crystal formation
  - Structure and Function - The molecular structure determines the crystal patterns we observe

Science Vocabulary

* Crystal: A solid material whose molecules are arranged in a repeating, orderly pattern.
* Dendrite: A branching, tree-like crystal formation that grows outward from a central point.
* Crystallization: The process when molecules in a liquid arrange themselves into an organized, solid structure.
* State of matter: The form that matter takes, such as solid, liquid, or gas.
* Heat transfer: The movement of thermal energy from a warmer object to a cooler object.
* Molecule: The smallest unit of a substance that still has all the properties of that substance.

External Resources

Children's Books:
- The Story of Snow: The Science of Winter's Wonder by Mark Cassino
- Ice is Nice!: All About the North and South Poles by Bonnie Worth
- States of Matter by David Dreier