

## 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 ( $H_2O$ ) 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.

### 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

YouTube Videos:

- "How Do Snowflakes Form?" by SciShow Kids - Simple explanation of ice crystal formation perfect for elementary students (<https://www.youtube.com/watch?v=ao2Jfm35XeE>)
- "States of Matter for Kids" by Crash Course Kids - Engaging overview of solids, liquids, and gases with clear examples (<https://www.youtube.com/watch?v=8qtLcey0R5I>)