

## Photo Description



Long, pointed icicles hang down from the edge of a roof or overhang. The icicles are different sizes and shapes, with some being thick and others thin. They formed when water dripped and froze repeatedly during cold weather.

## Scientific Phenomena

This image shows the Anchoring Phenomenon of ice formation and phase changes. Icicles form when liquid water from melting snow or ice drips from a surface and freezes before hitting the ground. This happens because the air temperature is below 32°F (0°C), causing the water molecules to slow down and arrange themselves into a solid crystal structure. The repeated cycle of dripping and freezing creates the characteristic pointed shape as each new drop adds another layer of ice.

## Core Science Concepts

1. States of Matter and Phase Changes: Water exists in three states (solid, liquid, gas) and can change between them when energy is added or removed through heating or cooling.
2. Freezing Point: Water freezes at 32°F (0°C) when thermal energy is removed, causing water molecules to move slower and form organized crystal structures.
3. Heat Transfer: Heat moves from warmer objects to cooler objects, which explains why liquid water loses heat to the cold air and freezes into solid ice.
4. Particle Behavior: In solids like ice, particles are tightly packed and vibrate in place, while in liquids like water, particles move more freely and can flow.

### Pedagogical Tip:

Use hands-on demonstrations with ice cubes melting and refreezing to help students visualize molecular movement during phase changes. This concrete experience helps bridge abstract concepts.

### UDL Suggestions:

Provide multiple ways to represent particle movement through drawings, physical movements, and digital simulations to support different learning styles and abilities.

## Zoom In / Zoom Out

1. Zoom In: At the molecular level, water molecules ( $H_2O$ ) slow down and form hexagonal crystal structures when they freeze. The molecules arrange in an organized pattern that makes ice less dense than liquid water.

2. Zoom Out: This connects to Earth's water cycle, where water constantly changes states as it moves between oceans, atmosphere, and land. Icicles represent one small part of this massive global system of water movement and energy transfer.

### Discussion Questions

1. What conditions are necessary for icicles to form, and why don't they form in summer? (Bloom's: Analyze | DOK: 3)
2. How would the shape of icicles change if the temperature was much colder or warmer? (Bloom's: Evaluate | DOK: 3)
3. What evidence can you observe in the photo that shows water changed from liquid to solid? (Bloom's: Apply | DOK: 2)
4. Why do you think some icicles in the photo are thicker than others? (Bloom's: Analyze | DOK: 2)

### Potential Student Misconceptions

1. Misconception: "Ice is colder than water." Reality: Ice and water can be the same temperature (32°F) during the freezing process; the difference is in the arrangement of molecules, not temperature.
2. Misconception: "Icicles form because it's snowing." Reality: Icicles form from liquid water that drips and freezes, often during sunny winter days when snow melts but air temperature stays below freezing.
3. Misconception: "All water freezes the same way." Reality: Pure water freezes differently than water with dissolved substances (like salt), which lowers the freezing point.

### Cross-Curricular Ideas

1. Mathematics - Measurement and Data: Have students measure the length and width of different icicles in the photo (or actual icicles if available) and create a bar graph comparing their sizes. They can calculate the average length and discuss why icicles vary in size. This connects to measurement standards and data representation.
2. ELA - Descriptive Writing: Ask students to write a detailed paragraph describing what they observe in the icicle photo using sensory language and scientific vocabulary. They could also write a "day in the life" narrative from the perspective of a water droplet that becomes an icicle, incorporating the phase change process into creative storytelling.
3. Social Studies - Geography and Climate: Explore regions around the world where icicles commonly form (northern climates, mountain areas) and discuss how weather patterns and geography affect where people live. Students can research winter conditions in different countries and compare them to their own local climate.
4. Art - Sculpture and Design: Inspire students to create icicle sculptures using materials like clear plastic straws, salt-water solutions, or even ice itself. This hands-on art experience helps them understand the formation process while developing fine motor skills and artistic expression.

### STEM Career Connection

1. Meteorologist - A meteorologist is a scientist who studies weather and climate patterns. They predict when it will snow, rain, or freeze, and they help communities prepare for dangerous winter weather that could create icicles and ice storms. Meteorologists use special instruments and computers to track weather changes. Average Annual Salary: \$97,000 USD
2. Civil Engineer - Civil engineers design and build structures like buildings, bridges, and roads that need to withstand winter weather conditions. They must understand how ice and freezing temperatures affect materials so that roofs don't collapse under heavy icicles and roads stay safe. Average Annual Salary: \$88,000 USD

3. Climate Scientist - A climate scientist studies long-term weather patterns and how Earth's climate is changing over time. They investigate how freezing temperatures and ice formation are affected by human activities, which helps us understand our planet's future. Average Annual Salary: \$102,000 USD

### 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 - Patterns can be used as evidence to support an explanation
  - Energy and Matter - Matter is transported into, out of, and within systems

### Science Vocabulary

- \* Freezing Point: The temperature at which a liquid changes into a solid.
- \* Phase Change: When matter changes from one state (solid, liquid, gas) to another state.
- \* Crystal Structure: The organized, repeating pattern that particles form in a solid.
- \* Thermal Energy: The energy that comes from heat and causes particles to move.
- \* Molecule: The smallest unit of a substance that still has all the properties of that substance.

### External Resources

Children's Books:

- The Magic School Bus: Wet All Over by Joanna Cole
- Water Is Water by Miranda Paul
- Ice Is Nice! by Robin Nelson