

Photo Description



This image shows frost crystals coating a surface on a cold morning, with the sun rising in the background. The frost appears as a sparkly, white, icy coating that formed overnight when water vapor in the air froze directly into ice crystals without becoming liquid water first. Trees and a building are visible in the background, also covered with frost.

Scientific Phenomena

Anchoring Phenomenon: Frost formation through deposition—the process where water vapor (an invisible gas in the air) transforms directly into solid ice crystals when temperatures drop below freezing.

Why This Happens: During cold nights, the air near the ground cools to 32°F (0°C) or below. When air gets this cold, it cannot hold as much water vapor. The water vapor in the air loses energy and changes directly into ice crystals without passing through a liquid water stage. This happens most often on clear, calm nights when the ground loses heat to space. The frost you see is millions of tiny ice crystals clumped together on surfaces.

Core Science Concepts

1. States of Matter & Phase Changes: Water exists in three states—solid (ice), liquid (water), and gas (water vapor). Frost demonstrates the solid state and the direct transformation from gas to solid.
2. Temperature & Heat Energy: Cold temperatures remove thermal energy from water vapor, causing it to freeze. The colder the air, the more likely frost will form.
3. Deposition: This is a special phase change where a gas becomes a solid without becoming a liquid first—different from melting, freezing, or condensation.
4. Atmospheric Water & Weather Patterns: The amount of water vapor in the air (humidity) affects whether frost will form. Clear nights with low humidity are ideal for frost formation.

Pedagogical Tip:

Rather than lecturing about deposition, have students observe frost forming over several cold nights if possible. Let them draw and describe what they see, then introduce the scientific term. This builds from concrete observation to abstract vocabulary—a developmentally appropriate progression for fifth graders.

UDL Suggestions:

Multiple Means of Representation: Provide labeled diagrams showing water vapor → ice crystals, alongside the actual photo. Some students may benefit from a kinesthetic demonstration where students act as water molecules (moving freely = gas; slowing down = cooling; linking arms = freezing into crystals).

Multiple Means of Action & Expression: Allow students to document frost observations through drawings, photos, or written descriptions. Some may prefer creating a stop-motion animation of frost "forming" using photos taken over time.

Discussion Questions

1. "Why do you think frost appears on this car but not inside a warm car parked next to it?" (Bloom's: Analyze | DOK: 2)
2. "What do you think would happen to the frost if the sun came out and warmed the air? Where would the water go?" (Bloom's: Predict/Hypothesize | DOK: 2)
3. "Compare frost forming to snow forming. How are they similar? How are they different?" (Bloom's: Compare & Contrast | DOK: 3)
4. "If frost only forms on clear, calm nights, what might be different about cloudy nights that prevents frost from forming as easily?" (Bloom's: Evaluate & Reason | DOK: 3)

Extension Activities

Activity 1: Frost Observation Journal

Have students check for frost on playground equipment, car windows, or grass before school for one week (if winter weather permits). They should sketch what they observe, note the air temperature, and describe what the frost looks like. After a few days, discuss patterns: When did frost form? What conditions were present each day?

Activity 2: Create Artificial Frost in a Cup

Place a metal can filled with ice and salt in the freezer or outside on a cold night. Set it on a sunny table inside the classroom. The outside of the can will develop frost crystals (deposition), while students observe it with magnifying glasses. Ask: "Where did this water come from? Why is it on the outside of the can and not the inside?" This models how frost forms on surfaces.

Activity 3: Model Deposition with Water Vapor

Boil water to create visible water vapor (steam). Hold a cold, clean mirror or glass plate above the steam. Frost-like condensation will form, showing students how gas becomes solid when cooled. Compare this to what happens on cold car windows to reinforce the phase change concept.

NGSS Connections

Performance Expectation:

5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen and are constantly moving in solids, liquids, and gases.

Disciplinary Core Ideas:

- 5-PS1.A (Structure and Properties of Matter)
- 5-PS1.B (Chemical Reactions)

Crosscutting Concepts:

- Patterns (Frost forms in patterns; water cycles in nature)
- Energy and Matter (Energy changes cause water to change states)
- Cause and Effect (Cold temperatures cause water vapor to freeze)

Science Vocabulary

* Frost: A thin layer of ice crystals that forms on surfaces when the air temperature drops below freezing.

* Deposition: The process where water vapor (a gas) changes directly into ice (a solid) without becoming liquid water first.

- * Water Vapor: Water in the form of an invisible gas floating in the air.
- * Freezing: The process where liquid water turns into solid ice when the temperature drops to 32°F (0°C).
- * Thermal Energy: The energy of heat that makes things warm; cold temperatures mean low thermal energy.
- * Humidity: The amount of water vapor present in the air.

External Resources

Children's Books:

- The Snowflake: A Water Cycle Story by Ron Fridell and illustrated by National Geographic (explores water states and phase changes)
- Come On, Rain! by Karen Hesse (explores water cycle and weather patterns)
- Water Dance by Thomas Locker (poetic exploration of water's movement and states)

YouTube Videos:

- "States of Matter: Solid, Liquid, Gas" by Crash Course Kids (4:36) — Clear, engaging explanation of the three states and phase changes. URL: <https://www.youtube.com/watch?v=kQWe7-rqOQQ>
- "How Frost Forms" by National Geographic Kids (3:45) — Visually rich explanation with real footage of frost forming on surfaces. URL: <https://www.youtube.com/watch?v=7VXh8EhF9Zo>

Teacher Tip: This lesson pairs beautifully with water cycle units and weather studies. Consider timing this lesson for late fall or early winter when frost is likely to appear locally, so students can engage in real-world observation!