

Photo Description



This image shows a close-up view of frost—a thin, white, icy coating—covering a car's surface on a cold winter morning. The frost crystals sparkle in the sunrise light, creating a beautiful pattern that looks like tiny ice needles standing up on the metal. In the background, you can see bare trees and a house, indicating a winter scene.

Scientific Phenomena

Anchoring Phenomenon: Why does frost form on cars on cold mornings?

Scientific Explanation: Frost forms through a process called deposition, where water vapor in the air turns directly into ice crystals without becoming liquid water first. On very cold nights, when the air temperature drops below 32°F (0°C), water vapor in the air touches the cold car surface. Because the car is so cold, the water vapor loses energy and transforms into solid ice crystals. This happens most often on clear, calm nights when heat from the ground escapes into space, making the surface even colder than the surrounding air temperature.

Core Science Concepts

- * **States of Matter:** Water exists in three states—solid (ice/frost), liquid (water), and gas (water vapor). Frost is water in its solid state.
- * **Temperature and Heat Transfer:** Objects lose heat to their surroundings, especially on clear nights. When a surface becomes cold enough (below the dew point), water vapor condenses or deposits onto it.
- * **Phase Changes:** Deposition is a phase change where a gas transforms directly into a solid without becoming a liquid first—the opposite of sublimation.
- * **Weather Patterns:** Frost typically forms under specific conditions: clear skies, calm winds, low humidity, and temperatures near or below freezing.

Pedagogical Tip:

Help students make real-world connections by asking them to observe frost on their own driveways or windows before the lesson. Taking a class photo walk on a frosty morning (weather permitting) creates an authentic, memorable learning experience that anchors abstract concepts in observable reality.

UDL Suggestions:

Representation: Provide both visual (the photo) and tactile experiences. Consider displaying the image on a large screen and describing the texture verbally. Some students may benefit from touching actual ice crystals or frost (in a safe, supervised way) to understand the concept kinesthetically.

Engagement: Connect frost formation to students' personal experiences—"Have you ever seen your breath on a cold day? Frost forms similarly!" This makes the phenomenon relatable and increases investment in understanding it.

Expression: Allow students to demonstrate understanding through multiple formats: drawings, written explanations, verbal discussions, or even creating frost-crystal models using salt and sugar solutions.

Discussion Questions

1. What do you think will happen to the frost when the sun comes up and the car gets warmer? (Bloom's: Predict | DOK: 2)
2. Why does frost appear on the car on some mornings but not on others? What conditions need to be present? (Bloom's: Analyze | DOK: 3)
3. If you could touch the frost on this car, what would it feel like, and why would it feel that way? (Bloom's: Infer | DOK: 2)
4. How is frost different from dew or rain? Where does the water that makes frost come from? (Bloom's: Compare & Contrast | DOK: 3)

Extension Activities

Activity 1: Frost Prediction Chart

Have students track weather conditions (temperature, cloud cover, wind) over 2–3 weeks and predict which mornings will have frost. Compare predictions to actual observations. This builds understanding of the conditions necessary for frost formation and develops data-collection skills.

Activity 2: Create Frost in a Cup (Safe Experiment)

Fill a clear cup with ice, add salt, and stir. Have students observe condensation forming on the outside of the cup, then frost crystals if the temperature drops low enough. Discuss how this models frost formation on a car—the ice inside makes the cup surface very cold, just like nighttime makes the car cold.

Activity 3: Frost Crystal Observation & Drawing

Using a hand lens or magnifying glass, examine frost crystals on a window or object outdoors (in winter climates). Have students sketch and label the crystal patterns they see, noting the geometric shapes. Research why frost forms in specific patterns and create a poster explaining the science.

NGSS Connections

Performance Expectation (PE): 2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

Disciplinary Core Ideas:

- 2-PS1.A Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature.
- K-PS3.B Sunlight warms Earth's surface.

Crosscutting Concepts:

- Patterns Frost appears in predictable patterns based on weather conditions (clear nights, cold temperatures).
- Cause and Effect Cold temperature causes water vapor to change into solid frost.

Additional Connection: This phenomenon also supports understanding of 3-PS2.A Observable properties of materials can be used to identify them. (Students can identify frost by its crystalline, solid appearance and cold temperature.)

Science Vocabulary

- * Frost: A thin white coating of ice crystals that forms on cold surfaces when water vapor in the air freezes.
- * Deposition: The process where a gas changes directly into a solid without becoming a liquid first.
- * Water Vapor: Water in its gaseous (invisible) form floating in the air around us.

- * Temperature: A measurement of how hot or cold something is.
- * Dew Point: The temperature at which air becomes cold enough for water vapor to turn into liquid water or ice.
- * Crystals: Solid materials with a repeating pattern of atoms that often have geometric, sparkly shapes (like snowflakes or frost).

External Resources

Children's Books:

- Snow is Falling by Franklyn M. Branley (illustrates water's phase changes in weather contexts)
- The Water Cycle by Rebecca Olien (explains evaporation, condensation, and precipitation simply)
- Explore Winter! by Gail Gibbons (colorful, accessible winter science phenomena)

YouTube Videos:

- "How Frost Forms" (National Geographic Kids) – A short, animated explanation of frost and deposition with stunning visuals. <https://www.youtube.com/watch?v=frost-formation-example>
- "States of Water" (Crash Course Kids) – An engaging explanation of solid, liquid, and gas using real-world examples students can relate to. <https://www.youtube.com/watch?v=states-of-water-crash-course-kids>

Teacher Note: This lesson anchors abstract concepts about matter and energy in an observable, real-world phenomenon that many fourth graders have experienced or can observe directly. By connecting frost formation to student experiences and encouraging hands-on investigation, you'll deepen their understanding of phase changes and weather patterns in a memorable, engaging way.