

## Photo Description



This image shows a bright yellow daffodil flower covered in frost and snow, with green leaves also frosted over, against a wooden fence background. The white frost crystals coating the plant demonstrate how water vapor in the air can freeze directly into ice without melting into liquid water first.

## Scientific Phenomena

Anchoring Phenomenon: Frost formation on plants during cold weather.

Why This Happens: When temperatures drop below freezing ( $32^{\circ}\text{F}/0^{\circ}\text{C}$ ), water vapor in the air can skip the liquid stage and transform directly into ice crystals through a process called deposition. The cold plant surfaces provide a place for these water molecules to freeze and accumulate. This is a key part of the water cycle that students often overlook—water doesn't always melt; it can also freeze directly from a gas to a solid. The daffodil's warmth (slightly above air temperature) and the moisture in early morning air create perfect conditions for this beautiful frost layer to form.

## Core Science Concepts

\* The Water Cycle & Phase Changes: Water exists in three states—solid (ice/frost), liquid (water), and gas (water vapor). This image shows the direct transition from gas to solid (deposition), which is less commonly observed than evaporation or condensation.

\* Temperature's Role in Matter: All substances, including water, change their state depending on temperature. Below  $32^{\circ}\text{F}$ , water freezes; above that, it can melt or evaporate depending on conditions.

\* Energy Transfer: The water molecules in the air lose thermal energy, which causes them to slow down and bond together as solid ice crystals on the plant's surface.

\* Plant & Environmental Interactions: Plants don't "die" from frost coating; hardy plants like daffodils have evolved strategies to survive freezing temperatures. The frost itself can insulate tender new growth.

### Pedagogical Tip:

This image is an excellent "teachable moment" for deposition—the least familiar phase change for elementary students. Rather than jumping to explanation, show students this photo and ask, "Where did this ice come from? The plant didn't pour water on it. Did it rain?" Allow them to theorize before explaining that invisible water vapor in the air froze directly into these crystals. This builds conceptual understanding rather than rote memorization.

### UDL Suggestions:

Multiple Means of Representation: Provide a simple water cycle diagram showing all four phase changes (evaporation, condensation, precipitation, deposition) side-by-side with photos of each. Some students are visual learners and benefit from seeing deposition illustrated alongside the other, more familiar processes. Consider creating a comparative anchor chart: "Where does water go?" with branches for each phase change.

Multiple Means of Action/Expression: Allow students to demonstrate understanding in different ways: some might draw and label the water cycle with deposition highlighted, others might create a short skit showing water molecules "freezing onto a leaf," and others might write frost observations in a nature journal.

## Discussion Questions

1. Where do you think the frost and ice on this plant came from, and why didn't it fall as snow instead? (Bloom's: Analyze | DOK: 2)
  - This question probes students' understanding of deposition vs. precipitation.
2. If the temperature rises above 32°F tomorrow, what will happen to the frost? Explain the process using the word "evaporation" or "melting." (Bloom's: Explain | DOK: 2)
  - This connects backward and forward in the water cycle.
3. Why do you think the daffodil flower is still yellow and colorful even though it's covered in frost? Is it dead? (Bloom's: Evaluate | DOK: 3)
  - This bridges water cycle science with plant biology and encourages systems thinking.
4. In which season(s) or times of day do you think frost is most likely to form? Why? (Bloom's: Analyze | DOK: 3)
  - This encourages students to think about patterns and real-world conditions.

## Extension Activities

1. Frost Crystal Observation Lab: On a cold morning, take students outside with hand lenses to observe frost crystals on various surfaces (grass, metal, leaves, wood). Have them sketch what they see and compare crystal shapes. Discuss why some surfaces have more frost than others. (Safe if students dress warmly and stay supervised.)
2. Build a Water Cycle Model in a Bag: Students create a closed-system water cycle by drawing the four phase changes on the outside of a ziplock bag, filling it partially with water, sealing it, and taping it to a sunny window. Over several days, they observe condensation forming at the top (like frost forming), water droplets forming, and the cycle continuing. This makes deposition visible in a controlled way.
3. Temperature & Phase Change Investigation: Use ice cubes, water, and thermometers to demonstrate that water changes state at specific temperatures (0°C/32°F for freezing). Challenge students to predict what will happen to frost if you bring a frosted leaf indoors and measure its temperature over time, connecting their observations to the thermometer readings.

## NGSS Connections

Performance Expectation: 5-PS1-1 - Develop a model to describe that matter is made of particles too small to be seen and that these particles are in constant motion.

Disciplinary Core Ideas:

- 5-PS1.A - Structure and Properties of Matter (phase changes and particle behavior)
- 5-ESS2.B - Weather and Climate (water cycle processes)

Crosscutting Concepts:

- Patterns - Frost formation follows predictable patterns based on temperature and moisture
- Cause and Effect - Cold temperature causes water vapor to freeze directly onto surfaces

## Science Vocabulary

- \* Frost: A thin layer of ice crystals that forms on surfaces when water vapor in the air freezes during very cold nights.
- \* Deposition: The process where water vapor (a gas) turns directly into ice (a solid) without becoming liquid water first.

- \* Water Vapor: Water in the form of an invisible gas floating in the air around us.
- \* Phase Change: When matter transforms from one state (solid, liquid, or gas) to another, usually because of a change in temperature.
- \* Condensation: The process where water vapor (gas) cools down and turns into liquid water droplets.

### External Resources

Children's Books:

- The Water Cycle\* by Rebecca Olien (simple, grade-appropriate explanation of all phase changes)
- Come Back, Sun\* by Dan Yaccarino (explores seasonal changes and frost/ice formation)
- Snowflake: A Water Cycle Story\* by Jane Burton (traces a water molecule through deposition and precipitation)

YouTube Videos:

- \* "The Water Cycle for Kids" by National Geographic Kids (3:45 min) - Covers all phase changes including deposition with clear animations. <https://www.youtube.com/watch?v=ajV7KMZkF1c>
- \* "Frost Formation Explained" by Crash Course Kids (4:30 min) - Specifically focuses on how frost forms at night and why it appears on grass and plants. [https://www.youtube.com/watch?v=xDJ\\_k6FTCTA](https://www.youtube.com/watch?v=xDJ_k6FTCTA)

---

Teacher Note: This image is a wonderful real-world anchor for teaching deposition—a phase change that students encounter but rarely name or understand deeply. The daffodil's resilience also opens conversations about how plants adapt to winter conditions, bridging earth science and life science in meaningful ways.