Matter

Physical Science | Lesson Guide

2nd Grade

Photo Description

This picture shows many old, rusty nails and screws scattered on a wooden deck. The metal pieces have turned brown and orange colors because they have been outside for a long time. Some of the nails look very old and crusty while others still show some shiny metal parts.

Scientific Phenomena

The anchoring phenomenon represented here is rusting - a chemical change that occurs when iron or steel reacts with oxygen and water over time. This is a slow chemical reaction called oxidation where the metal combines with oxygen from the air to form iron oxide (rust). The process is accelerated by moisture, which is why outdoor metal objects rust faster than indoor ones. This demonstrates that materials can change their properties when they interact with their environment.

Core Science Concepts

1. Chemical vs. Physical Changes: Rusting is a chemical change because the metal becomes a completely different substance (iron oxide) that cannot be easily changed back to its original form.

2. Material Properties: Different materials respond differently to environmental conditions - wood weathers but doesn't rust, while metals containing iron will rust when exposed to air and moisture.

3. Environmental Interactions: Materials interact with their surroundings (air, water, temperature) which can cause them to change over time.

4. Observable Changes: Scientists can observe and document how materials change by looking at color, texture, and other properties.

> **Pedagogical Tip:**
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> Have students compare brand new nails with rusty ones side-by-side. This concrete visual comparison helps second graders better understand the concept of change over time.

> **UDL Suggestions:**
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> Provide multiple ways for students to explore this concept: visual comparison charts, hands-on material sorting activities, and simple drawings to document observations. This supports different learning preferences and abilities.

Zoom In / Zoom Out

Zoom In: At the microscopic level, individual iron atoms are combining with oxygen atoms to create new molecules of iron oxide. This happens very slowly as oxygen molecules from the air bump into and stick to the metal surface.

Zoom Out: This rusting process is part of the larger materials cycle on Earth. Metals are mined from the ground, processed into useful objects, and eventually break down and return to the environment. Understanding how materials change helps engineers design better buildings, bridges, and tools.

Discussion Questions

1. What do you notice is the same and different about these metal pieces? (Bloom's: Analyze | DOK: 2)
2. Why do you think some nails look more rusty than others? (Bloom's: Evaluate | DOK: 3)
3. What would happen if we left a shiny new nail outside for a whole year? (Bloom's: Apply | DOK: 2)
4. How could we protect metal objects from rusting? (Bloom's: Create | DOK: 3)

Potential Student Misconceptions

1. "Rust is just dirt on metal" - Students may think rust can be washed off like dirt. Clarification: Rust is actually a new substance formed when metal changes chemically.

2. "Only old things rust" - Students might believe only very old metal rusts. Clarification: Rusting can begin immediately when iron is exposed to air and moisture, but it takes time to become visible.

3. "All metals rust the same way" - Students may think all metals turn brown and flaky. Clarification: Only metals containing iron rust this way; other metals like aluminum or copper change differently.

Cross-Curricular Ideas

1. Math - Measurement & Sorting: Have students measure and sort rusty nails by size (shortest to longest) or by how rusty they are (least rusty to most rusty). Create a simple bar graph showing how many nails fall into each category. This connects to 2.MD.A.1 (measuring length) and 2.MD.B.5 (creating picture graphs).

2. ELA - Descriptive Writing: Ask students to write or dictate sentences describing what they observe in the photo using sensory words. Example: "The nails are bumpy, orange, and rough." Create a class word wall of descriptive words (rusty, crusty, shiny, bumpy, smooth) to support vocabulary development and writing skills.

3. Social Studies - Community Helpers: Connect to builders, construction workers, and engineers who use nails and metal in their jobs. Discuss how these professionals must protect metal tools from rusting to keep them working well. This relates to understanding how people in the community use science and materials.

4. Art - Mixed Media Exploration: Have students create artwork using safe, clean rusty nails, screws, and wire arranged on paper or cardboard to make designs or pictures. This hands-on experience deepens their understanding of metal properties while developing fine motor skills and creativity.

STEM Career Connection

1. Materials Engineer: A materials engineer studies how different substances like metals, plastics, and wood work and change. They figure out which materials work best for making things like cars, buildings, and tools. They might work to invent new metal coatings that stop nails and tools from rusting! Average Salary: $100,000 USD

2. Construction Worker: Construction workers use nails, screws, and metal tools every day to build houses, buildings, and bridges. They need to know how to protect their metal tools from rust and choose the right materials that will last a long time outdoors. Average Salary: $48,000 USD

3. Chemist: A chemist is a scientist who studies how materials and substances work and change. Some chemists work on stopping rust and creating special paints and coatings that protect metal from water and air. They help design better products that last longer! Average Salary: $82,000 USD

NGSS Connections

- Performance Expectation: 2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- Disciplinary Core Idea: 2-PS1.A - Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature.
- Crosscutting Concept: Patterns - Patterns in the natural and human designed world can be observed and used as evidence.

Science Vocabulary

* Rust: The brown, flaky coating that forms on iron when it mixes with air and water over time.
* Metal: A hard, shiny material that can be shaped and is often used to make tools and nails.
* Chemical change: When a material becomes something completely new and different.
* Properties: The special qualities that describe how something looks, feels, or acts.
* Observe: To look carefully and notice details about something.

External Resources

Children's Books:
- "What Is the World Made Of? All About Solids, Liquids, and Gases" by Kathleen Weidner Zoehfeld
- "Materials" by Chris Oxlade
- "Rust and Corrosion" by David Dreier