

## Photo Description



This image shows many old, rusty nails and metal objects scattered on weathered wooden boards. The metal pieces have different colors ranging from dark brown rust to lighter orange spots. Some nails are bent and twisted, while round metal discs are mixed throughout the collection.

## Scientific Phenomena

The anchoring phenomenon shown here is oxidation and corrosion of iron-based metals. When iron in nails and metal objects is exposed to oxygen and moisture over time, it forms iron oxide (rust). This chemical reaction changes the metal's properties, making it weaker and changing its color from silver-gray to reddish-brown. The process is accelerated by exposure to water, salt, and acidic conditions.

## Core Science Concepts

1. Chemical Changes vs. Physical Changes: Rusting is a chemical change because new substances (iron oxides) are formed that cannot be easily reversed, unlike physical changes such as melting or breaking.
2. Properties of Materials: The original properties of iron (strength, silver color, magnetic attraction) change during oxidation, demonstrating how chemical reactions alter material characteristics.
3. Environmental Factors: Temperature, moisture, and exposure to air affect the rate of chemical reactions, explaining why some nails show more rust than others.
4. Irreversible Reactions: Unlike melting ice or dissolving sugar, rust formation creates permanent changes to the metal's chemical structure.

### Pedagogical Tip:

Use before/after photos of shiny new nails versus rusty ones to help students visualize the dramatic changes that occur during oxidation. This concrete comparison makes the abstract concept of chemical change more accessible.

### UDL Suggestions:

Provide tactile experiences by letting students safely handle new nails, rusty nails (filed smooth), and iron filings to feel the different textures and weights. This multi-sensory approach supports learners who benefit from hands-on exploration.

## Zoom In / Zoom Out

1. Zoom In: At the atomic level, iron atoms are losing electrons and bonding with oxygen atoms to form completely new compounds (iron oxides). This electron transfer creates new crystal structures that are more brittle and porous than the original iron.

2. Zoom Out: This oxidation process affects entire ecosystems and human infrastructure. Rusting bridges, buildings, and vehicles require constant maintenance and replacement, costing billions of dollars annually and affecting transportation, safety, and resource management globally.

### Discussion Questions

1. What evidence do you see that tells you these nails have undergone a chemical change rather than just getting dirty? (Bloom's: Analyze | DOK: 3)
2. Why do you think some nails in the photo show more rust than others, even though they're all in the same location? (Bloom's: Evaluate | DOK: 2)
3. How might the environment where these nails were stored have affected the rusting process? (Bloom's: Apply | DOK: 2)
4. What could have been done to prevent or slow down the rusting of these metal objects? (Bloom's: Create | DOK: 3)

### Potential Student Misconceptions

1. Misconception: "Rust is just dirty metal that can be washed off."  
Clarification: Rust is a new chemical compound formed when iron combines with oxygen, creating a permanent change that cannot be reversed by washing.
2. Misconception: "All metals rust the same way."  
Clarification: Only iron and iron-containing metals (steel) rust by forming iron oxide. Other metals like aluminum or copper oxidize differently, forming different compounds and colors.
3. Misconception: "Rust only happens to old things."  
Clarification: Oxidation begins immediately when iron is exposed to oxygen and moisture, but it takes time to become visible depending on environmental conditions.

### NGSS Connections

- Performance Expectation: 5-PS1-4 - Conduct an investigation to determine whether the mixing of two or more substances results in new substances
- Disciplinary Core Ideas:
  - 5-PS1.B - Chemical Reactions
  - 2-PS1.A - Structure and Properties of Matter
- Crosscutting Concepts:
  - Cause and Effect
  - Patterns
  - Structure and Function

### Science Vocabulary

- \* Oxidation: A chemical reaction where a substance combines with oxygen to form a new compound
- \* Corrosion: The gradual destruction of materials by chemical reactions with their environment
- \* Chemical change: A process where substances combine to form new materials with different properties
- \* Iron oxide: The reddish-brown compound formed when iron reacts with oxygen, commonly called rust
- \* Irreversible: A change that cannot be easily undone or returned to its original state

## External Resources

Children's Books:

- "Chemical and Physical Changes" by David Dreier
- "What Is Rust?" by Robin Johnson
- "Material Properties" by Angela Royston

YouTube Videos:

- "Rusting of Iron - Elementary Science" - Simple explanation of oxidation process for elementary students: <https://www.youtube.com/watch?v=6wBj0tYu5cg>
- "Chemical vs Physical Changes for Kids" - Clear examples distinguishing chemical and physical changes: [https://www.youtube.com/watch?v=37pir0ej\\_SE](https://www.youtube.com/watch?v=37pir0ej_SE)