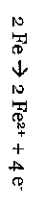


Buried in garages, basements, and storage spaces all around the world are forgotten tools, motorbikes, and bits of scrap metal rusting away. Rusted metal is a familiar site to many but is misunderstood by most. Can rust be removed? Can metal be "unrusted"? What exactly is rust anyway?

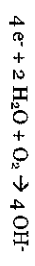
Motorbikes are often referred to as "iron horses" because of the metal that makes up many of their parts. Iron (Fe) is a strong, inexpensive metal with magnetic properties. In addition to motorbikes, it is often used in building materials, cars, ships, tools, and machines. The downside of using pure iron is that it is quite reactive. Iron quickly corrodes when exposed to water and oxygen. The result of this corrosion is rust.

Many metals undergo corrosion when they are exposed to oxygen, which is why the process is also called "oxidation." For example, copper corrodes when it is exposed to oxygen in the air. However, it doesn't form orange, flaky rust. Copper changes from its normal shiny brown color to a dull green known as patina. Old pennies and statues often develop a patina coating due to oxidation. Unfortunately, for motorbike owners, iron oxidizes fairly quickly when it is left out among the elements.

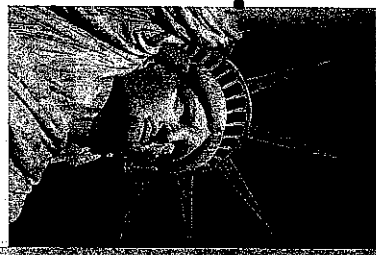
What we call "rust" is actually a compound known as iron oxide (Fe₂O₃) that results from the oxidation of iron. There are a couple of reactions that work together to produce rust. When oxygen, water, and iron combine, such as when a motorbike is left outside during a rainstorm, the iron readily gives up its two valence electrons:



Atoms in the water and oxygen in the atmosphere quickly take up the electrons:



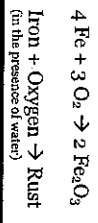
The remaining Fe²⁺ and OH⁻ ions attract each other because of their opposite charges. They combine, forming the red flaky substance we call rust.



The Statue of Liberty is actually a copper statue that has been oxidized with a greenish patina due to the salty air surrounding it.

3

The overall chemical reaction that changes the shiny bright iron of a vintage motorbike into weak brittle rust is:



Rusting is a chemical reaction between oxygen and iron. Like all chemical reactions, it produces a new substance: rust.

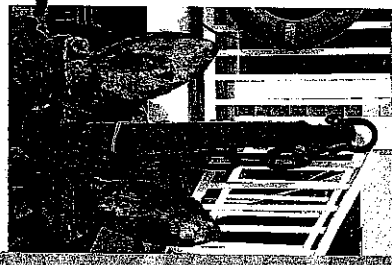
Unfortunately, chemical reactions are irreversible. There is no way to "unrust" a piece of iron. Once corrosion weakens the metal, it will have to be replaced. This isn't so bad for forgotten motorbikes, but it poses serious questions about the effect of corrosion on other structures.

When an iron bridge rusts, it loses strength to support passing cars. That loss of strength can quickly become a major safety hazard. The same is true for buildings, machinery, and other heavy objects that rely on iron's strength. If even one cog in a machine rusted, the entire mechanism could break down or fall apart. Iron oxidation can be both a nuisance and a danger. Never underestimate the damage that rust can cause.

We can easily prevent rust from forming. Keeping iron objects clean and dry prevents oxidation. By removing dirt and other debris, moisture can't collect easily.

Avoiding substances that increase rusting helps iron last. Salt, which is used to de-ice roads in the winter, increases rusting. Cars that drive along salted roads often show signs of rusting. Rust weakens the car's body and takes away from its appearance. For these reasons, any vehicles, including motorbikes, should be carefully cleaned and covered, and kept away from salty roads during the winter.

Rust prevention coatings exist that combat the oxidation process. Often, these coatings are mixed into the paint on cars and other vehicles.



The anchors of ships are prone to rusting because of their constant exposure to salt and water.

4

Iron oxidation reactions can happen to any iron or iron alloy metal. It can happen slowly over many years, or it can happen rapidly overnight. Either way, rusting is a common chemical reaction that occurs whenever conditions are right for iron, water, and oxygen to come together.

Discover Education Literacy Activity

"The Secrets of Rust"

Directions: Complete the following sections in order to receive 100%. All sections must be complete to receive full credit.

- Close Reading:** Read each chunked section 1-4 of the text prior to completing the literacy activity below. For each chunked section, include 2 annotations to the side of the section.
 - Annotations include but are not limited to vocabulary and definitions, questions you would like answered by other groups, opinions about the article, new information that you have learned, and more.
- Summarize:** After reading each chunked text (1-4), write a brief main idea expressed in the text. You should have a main idea written for each chunked text.
- Context Clue:** Highlight the context clues in each chunked text that helped you develop your summaries.
- KWHL Chart:** Access prior knowledge by creating one KWHL chart like the one below for the article, "The Secrets of Rust."

K: What do I already know about this?	W: What else do I want to know about this?	H: How will I learn about this?	L: What have I learned after reading the article?
-	-	-	-
-	-	-	-