Damage Control

What would happen if you parked your bicycle outdoors all summer, or left a tool sitting in a puddle for too long? Most likely, they would end up covered in flaky, orange rust. Complete this experiment to test it out.

SCIENCE IN ACTION

Using the materials and instructions you've been given, record your observations below.

1. How long did the steel wool take to rust in the bowl of hydrogen peroxide? _____

In the bowl of hydrogen peroxide with salt added? _____

2. Why was the steel wool you used first cleaned of all surface oils? _____

_____

3. What role does the added salt play? _____

Did something happen when you added the salt? _____

4. Were there places where the steel wool rusted first or rusted more? _____

_____

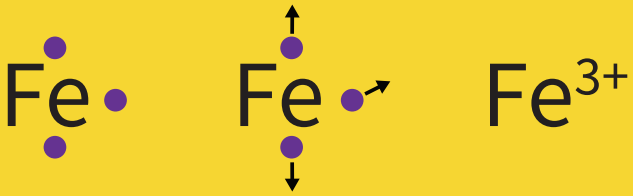
5. What factors do you think affected the rate at which the steel wool rusted? How does that compare to other objects, such as tools or steel structures? _____

What's Happening Here?

Rust is an example of electrochemical corrosion, a very common event that causes metals to break down and form compounds known as oxides. It involves a series of chemical reactions. The main activity is called an oxidation-reduction reaction, or *redox reaction*, which is the transfer of electrons from one atom or molecule to another.

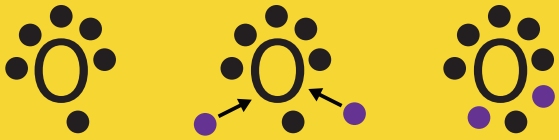
The result is hydrated iron oxide, or rust. All it takes is a thin film of moisture for rust to occur, especially at a place where metal is bent or weakened in some way. Acids and electrolytes, like salt in ocean water, can increase the speed of rusting and the size of the rusted area.

Iron releases electrons and becomes positively charged. This is **oxidation**, and it looks like this: **$Fe \rightarrow Fe^{3+} + 3e^-$**



Source: http://study.com/academy/lesson/what-is-oxidation-definition-process-examples.html

Oxygen on the iron's surface, dissolved in water or just from the air, gains the electrons. This is **reduction**, and it looks like this: **$O_2 + 4e^- + 2H_2O \rightarrow 4OH^-$**



Source: http://study.com/academy/lesson/reduction-in-chemistry-definition-lesson-quiz.html

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Redox reactions can be beneficial — this is the reaction behind batteries, photosynthesis, and the human body's conversion of food into energy. But electrochemical corrosion of metals costs billions of dollars in infrastructure damage each year. Given enough time, any amount of iron, exposed to oxygen and water, will convert entirely to rust, losing all structural integrity and crumbling. In addition, rust takes up more space than the original metal; this expansion can destroy the integrity of concrete and other materials.

American Coatings Association℠