Module Title: Reactivity of Iron		
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Time to complete module: 10 minutes plus the corresponding discussion

Note: The specimens used for demonstrating the corrosion of iron/steel in water will need to be left at least overnight to ensure the corrosion is visible

Description of module, lab or demonstration:

Students will be introduced to the oxidation/ corrosion of iron from two different sources (flame and water). From the examination of corrosion from multiple sources, students will be able to compare and contrast the effects each has on the iron samples. Students will also be able to observe the effect of various material processing techniques has on the corrosive properties of iron.

Pre-requisite knowledge and skills:

A general knowledge of the corrosion of iron/steel materials would be beneficial, but not required for the successful implementation of the demonstration.

Materials Category:	Structure of Materials	❒
	Metals	☑
	Ceramics	❒
	Polymers	❒
	Composites	❒
	Other	❒
Target Grade Level(s)	Middle School 6-8	❒
	High School 9-12	☑
	Two-year College 13-14	☑
	Four-year College 15-16	☑

MatEd core competencies that the training meets:

- 7.001 Describe the General Nature of Ferrous Metals
- 16.007 Describe how changes in manufacturing processes effect material properties

List of equipment and supplies needed:

- One or Two Objects made from iron or steel
- 2 Pads of Steel Wool
- Bunsen Burner or propane torch
- Tongs (hold the objects in the flame)
- Beaker of water
- 30- safety glasses (PPE)

Curriculum overview and notes to instructor:	Steel wool is made from iron or steel wires or turnings. Steel wool pads also contain some oil from the production process. The combination of the fine wires and the oil

	makes steel wool quite flammable, as seen in this demonstration. The demonstration is best used with older students because younger ones may try it at home. The steel wool burns at a high temperature (actually vaporizes in part) that would cause serious burns if used carelessly. The burning process is oxidation and the oxidation product is a vapor, although drops of molten iron are also visible. The corrosion process is also oxidation, and the standard corrosion products are rust (i.e. FeO, Fe2O3, etc). The corrosion process is not as colorful, but the result is similar. In the discussion, the instructor can note the standard reactivity series, in which iron is more-or-less in the middle of more reactive and less reactive metals. Standard chemistry experiments make use of this reactivity series.
Mode of presentation: Demonstration	
Module	**Abstract:** Our experience tells us that iron is a material used in construction for its strength. However, we also know that iron reacts with its environment, usually in the form of corrosion. This demonstration shows that iron is actually quite reactive when present in small sections (with a high surface-to-volume ratio), both in a flame and in water. **Experimental Process:** 1. Beforehand (Up to 24 hours), place half of the pad of steel wool in the beaker of water. You will use it at the end of the activities below. 2. Discuss metals reactivity. Ask the students if they have experience with metals reacting. 3. Using the flame, place one or two solid steel or iron objects in the flame. Do they react? How? Have the students discuss. 4. Now put the other half of the pad of steel wool into the flame. Discuss why it reacts so much more readily than the solid objects. 5. Take out the steel wool that was in the beaker of water- did it react? How is that different than the steel wool in the flame? 6. Help the students understand that both in the flame and in the water, the iron reacted to oxidize into an iron oxide product (one molten or vapor, one as rust). **Further Study:**

	1. Research the products of the high temperature reaction that was demonstrated. 2. Investigate the process of corrosion. What are the corrosion products? 3. Change the composition of the water by adding salt. What changes? 4. Change the water in other ways you can think of. What is the result? 5. Investigate how steel wool was developed and how it is made. 6. How does this demonstration apply to machining steel-consider the turnings.
References:	Bryk, N.E. (2007). *Steel wool*. Retrieved August 20. 2007 from http://www.madehow.com/Volume-6/Steel-Wool.html. Experiments on the Web. (2007 February). *Oxidation of iron*. Retrieved August 20, 2007 from http://www.cci.ethz.ch/experiments/verbr_Fe/en/stat.html. Terrific Scientific. *Corrosion*. Retrieved August 20, 2007 from http://www.terrific-scientific.co.uk/Topics/Corrosion/0-introduction.htm.
Briefly describe how the effectiveness of the module was evaluated:	"10 Simple and Effective In-class Experiments and Demonstration for Materials Education, An Overview" by Ryan A. Webster, Intern-Edmonds Community College
Author Bio:	Dr. Tom Stoebe works with the National Resource Center for Materials Technology Education (MatEd) housed at Edmonds Community College. Dr. Stoebe is a Professor Emeritus in Materials Science and Engineering at the University of Washington and has been at the forefront of materials education in the United States.