

What is the Worth of Gold? An Activity Series of Metals

Questions:

How can you rank metals, including hydrogen, in terms of their reactivity? Is the reactivity of an alloy very different from the reactivity of its major component? Why are certain metals chosen to make jewellery?

Pre-lab:

- Using periodic trends, rank Cu, Fe, Mg and Zn in order from **least to most reactive**. **Explain**.
- What is an alloy? Will steel be more or less reactive than iron, its main component?
- Make an appropriate observation table for this lab.

Materials:

Goggles	Well plate (s): 6x 6 matrix	Dropper Bottles	Tweezers	Scissors
Toothpicks	1 M HCl(aq)	Distilled water	1M CuSO ₄ (aq)	1M MgSO ₄ (aq)
1M FeSO ₄ (aq)	1M ZnSO ₄ (aq)	Pieces of copper	Pieces of magnesium	Pieces of zinc
Pieces of iron	Pieces of steel	Pieces of galvanized steel		

Safety Precautions

Hydrochloric acid is extremely corrosive to eyes and skin. **Always wear eye protection.** Steel wool is sharp. Do not pull it apart with bare hands and take extra precaution when cutting it with scissors.



Procedure:

- Place well plate on a sheet of paper and label it according to the diagram shown below:

Figure 1: Experimental Setup

	HCl	H ₂ O	CuSO ₄	FeSO ₄	MgSO ₄	ZnSO ₄
Cu						
Mg						
Zn						
Fe						
Steel						
Galvanized steel						

- Use tweezers or a scoopula to place a small amount of each metal into the designated well. Record the appearance of each metal in the observation table.
- As shown in Figure 2, put enough drops of the appropriate solution to completely cover the metal.

Figure 2: Amount of Metal and Solution in Well

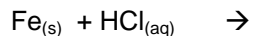
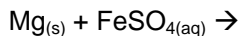
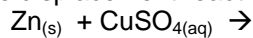
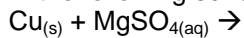


- Record any evidence of reaction, in words, for each test in the observation table. If there was no reaction, write "NR" in the matrix. Wait at least 2 minutes to see if a reaction occurs. If you are unsure of any observation, repeat the experiment in a small test tube to observe the reaction more carefully.
- Dispose of the solutions in the waste beaker labelled "metal waste". Do not pour anything down the drain. Return any of the unused metals and solutions to the teacher.

Lab Questions (Answer neatly on a separate piece of paper)

Analysis

1. In the following series, write the corresponding single displacement reactions if they occur.



2. What evidence do you have that hydrogen in hydrochloric acid is different from hydrogen in water?
3. How does the reactivity of the metals predicted in your pre-lab compare with your observations? Create a list of most reactive to least reactive. Include hydrogen in the form of water and also as an ion (H⁺). Do not include the alloys.
4. a) Compare the reactivity of the following pairs and explain your observations:
i) reactivity of zinc and galvanized steel
ii) reactivity of iron and steel
b) From your observations, what generalizations can be made about the properties of alloys versus the properties of their major component?
5. Think about your lab scoopula, why is it made of stainless steel?

Application

6. Let's take a look at jewellery. Add the following metals to your activity series: gold, platinum and silver. From your series, why are these elements used in jewellery and how can you explain the cost (or worth) associated with them?
7. You want to displace silver from a solution of silver nitrate. From your activity series generated in question 6, what would you use and why?
8. Magnesium is very shiny, why is it not used to make jewellery?
9. List some reasons for alloying metals.
10. Discuss the particular reasons for alloying gold with other metals.
11. Gold will alloy with many other metals. Investigate how you would get the following colours of gold: yellow, pink/red, white, green, and purple.