Establishing a Table of Reduction Potentials
"Metals and Meat"

Introduction:

Oxidation is the process in which a species loses electrons, whereas reduction is a process in which a species gains electrons. Oxidation and reduction always occur together, the combination of these two processes results in a reaction that is called a redox reaction. Many reactions that occur around us are actually redox reactions. For example, when iron "rusts", iron atoms are oxidized to form Iron (III) ions while oxygen molecules in the air are reduced to form oxide ions.

In this activity you will construct six different voltaic cells and rank four metals from the highest reduction potential to the lowest reduction potential.

Materials:

4 small beakers
1.0 M solutions of $Zn(NO_3)_2$, $Cu(NO_3)_2$, $Pb(NO_3)_2$, and $Mg(NO_3)_3$
Sausage
Strips of zinc, copper, lead, and magnesium
Voltmeter
Wires with alligator clips
Steel wool
Distilled water

Procedure:

1. Clean 1 strip of each metal with the steel wool, rinse with distilled water and thoroughly dry each strip.
2. Label the beakers 1-4
3. Put 50 mL of $Zn(NO_3)_2$ and the zinc strip in beaker 1
4. Put 50 mL of $Cu(NO_3)_2$ and the copper strip in beaker 2
5. Put 50 mL of $Pb(NO_3)_2$ and the lead strip in beaker 3
6. Put 50 mL of $Mg(NO_3)_3$ and the magnesium strip in beaker 4
7. Take the sausage and form a "bridge" between beaker 1 and beaker 2 (make sure that the sausage touches the surface of both solutions)
8. Connect a wire from one metal to one lead of the voltmeter and then connect the other metal to the other lead of the voltmeter (You should always connect the metals so as to get a positive reading)
9. On the following table record which metal is connected to the positive lead, which metal is connected to the negative lead and the voltage.
10. Rinse the sausage with distilled water and dab dry
11. Repeat steps 7-10 for all metal combinations

Metal connected to left lead (anode)	Metal connected to right lead (cathode)	Voltage

The metal connected to the left lead on the voltmeter serves as the anode (the site of oxidation) and the metal connected to the right lead on the voltmeter serves as the cathode (the site of reduction).

Using this information, write the half cell reactions and the overall **balanced** redox reaction for all combinations in the table below:

Beakers connected	Oxidation half cell Reaction (anode)	Reduction half cell Reaction (cathode)	Balanced redox reaction
1 and 2			
1 and 3			
1 and 4			
2 and 3			
2 and 4			
3 and 4			

Questions:

1. Which metal served as the cathode most frequently? Which metal served as the anode most frequently?

2. Which of the metals in question 1 has the highest reduction potential? Which has the lowest? How can you tell?

3. Rank the four metals from the highest reduction potential to the lowest.

4. Compare this ranking to the placement of the four metals on the reduction potential table on page 504 in your textbook.

5. If you connected a beaker containing Manganese metal end manganese nitrite to another beaker containing cobalt and cobalt nitrate, which metal would serve as the anode? Which would serve as the cathode? (Assume positive voltage). How did you determine this?

6. Using the table on page 504, calculate the cell voltage for each combination. (There are six combinations) **SHOW YOUR WORK**

7. How does this compare to the voltage obtained in the lab? Why might there be differences?