Alternate Redox Lab

This is the on-line version of the redox lab. It follows the same procedure, except you cn't actually build the cells.

PART A: BUILDING AND TESTING VOLTAIC CELLS

PURPOSES:

Firstly, to predict which chemicals will produce the most powerful voltaic cell. And secondly, to build and test different voltaic cells.

BACKGROUND RESEARCH:

Look up definitions for the following terms in your textbook *(hint: look for the definition boxes starting on p. 86 and/or the glossary).* Write them down in the table below.

Term	Definition
Voltaic cell:	
Battery:	
Electrode:	
Electrolyte:	
Anode:	
Cathode:	
Electrolytic cell:	
Electroplating:	

PROCEDURE AND OBSERVATIONS

1) Use the Reactivity Series' below to **predict** which chemicals in each cell will participate in a spontaneous reaction. Do this by circling the chemicals involved on the Reactivity Series and drawing a line between them. "Downhill" lines indicate a spontaneous reaction. The first one is done for you. Also include arrow labeled as "oxidation" or "reduction" and fill in the blanks below.

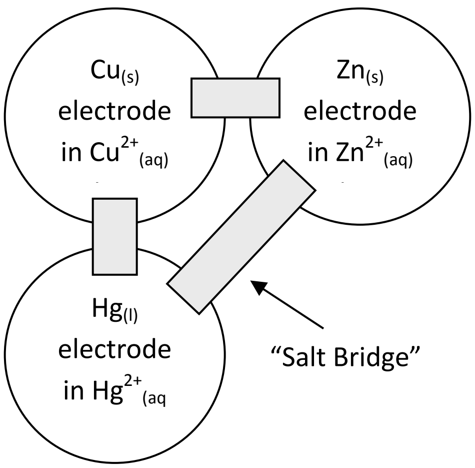
Cell #1	***Cell #2***	***Cell #3***
Reduction Half-Reaction	**Reduction Half-Reaction**	**Reduction Half-Reaction**
$Au^{3+}(aq) + 3e^- \rightarrow Au(s)$	$Au^{3+}(aq) + 3e^- \rightarrow Au(s)$	$Au^{3+}(aq) + 3e^- \rightarrow Au(s)$
$Hg^{2+}(aq) + 2e^- \rightarrow Hg(l)$	$Hg^{2+}(aq) + 2e^- \rightarrow Hg(l)$	$Hg^{2+}(aq) + 2e^- \rightarrow Hg(l)$
$Ag^{+}(aq) + e^- \rightarrow Ag(s)$	$Ag^{+}(aq) + e^- \rightarrow Ag(s)$	$Ag^{+}(aq) + e^- \rightarrow Ag(s)$
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
$2H^{+}(aq) + 2e^- \rightarrow H_2(g)$	$2H^{+}(aq) + 2e^- \rightarrow H_2(g)$	$2H^{+}(aq) + 2e^- \rightarrow H_2(g)$
$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$
$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$	$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$	$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$
$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$
$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$	$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$	$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$
$Cr^{2+}(aq) + 2e^- \rightarrow Cr(s)$	$Cr^{2+}(aq) + 2e^- \rightarrow Cr(s)$	$Cr^{2+}(aq) + 2e^- \rightarrow Cr(s)$
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$

Cu^{2+} will undergo reduction _____ will undergo reduction _____ will undergo reduction

$Zn_{(s)}$_ will undergo oxidation _____ will undergo oxidation _____ will undergo oxidation

2) In the table below, rank the cells in terms of the relative amount of power you **predict** that they will produce.

Cell	Spot-wells Connected to Make the Cell		Prediction of Power Output: (Rank from least powerful-1 to most powerful-3)
# 1	$Cu_{(s)}$ in $Cu^{2+}_{(aq)}$	$Zn_{(s)}$ in $Zn^{2+}_{(aq)}$	
# 2	$Cu_{(s)}$ in $Cu^{2+}_{(aq)}$	$Hg_{(l)}$ in $Hg^{2+}_{(aq)}$	
# 3	$Zn_{(s)}$ in $Zn^{2+}_{(aq)}$	$Hg_{(l)}$ in $Hg^{2+}_{(aq)}$	



If you were to build the three voltaic cells:

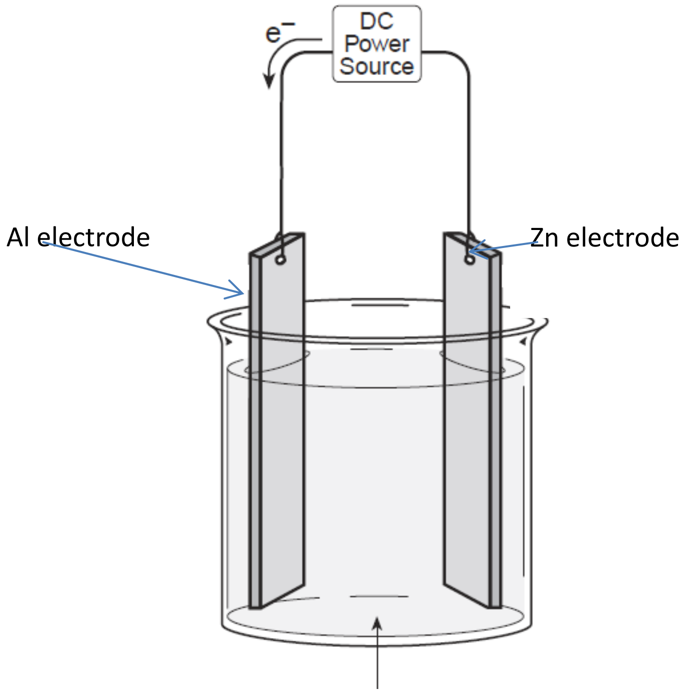
- Fill the spot-wells about two-thirds full with electrolyte solutions as shown below:
- Place the appropriate electrode in each well (make sure you polish it with steel wool first).
- Connect each well with a strip of paper towel "salt bridge".
- Use the voltmeter to measure the voltage of each cell.

ANALYSIS AND EVALUATION QUESTIONS:

3) What ions move through the salt bridge? Explain your answer.

4) Which electrode in Cell 2 will get smaller in size as the cell operates? Explain why.

PART B: ELECTROLYTIC CELLS AND ELECTROPLATING



$Zn(NO_3)_{2(aq)}$

PURPOSE:

To observe the operation of an electrolytic cell as it electroplates an object.

PROCEDURE:

You teacher will show you a demo of an electrolytic cells similar to the on shown to the left.

ANALYSIS AND EVALUATION QUESTIONS:

5) The battery uses energy to strip electrons away from $Zn_{(s)}$ atoms in the Zn electrode. This causes the atoms to become $Zn^{2+}_{(aq)}$ ions.

a) Is the zinc metal undergoing oxidation or reduction when it becomes zinc ions?

b) Write the half reaction.

6) After striping the electrons away from the zinc metal electrode, the battery forces them into the item being electroplated.

a) Why does the electrolyte solution have to contain Zn^{2+} ions initially?

b) Explain why the zinc ions move through the solution toward the item being electroplated.

7) When the silver ions ($Ag^{+}_{(aq)}$) attach to the item being electroplated, they become solid silver ($Ag_{(s)}$) because each of the them receives one of the electrons that were originally stripped away from the silver electrode and pumped into the item being electroplated.

a) Are the zinc ions being oxidized or reduced?

b) Write the half reaction.

8) In the electrolytic cell, zinc is being forced to essentially react with itself. Is this a spontaneous reaction? Provide evidence for your answer.

9) Describe the main difference between voltaic cells and electrolytic cells. *(Hint: think about energy.)*

10) Describe a technological application of

a) Voltaic cells

b) Electrolytic cells