4. Using the alligator clips, connect one wire to one end of the zinc strip and the second wire to the copper strip. Take the free end of the wire attached to the zinc strip, and connect it to one terminal on the voltmeter. Take the free end of the wire attached to the copper strip, and connect it to the other terminal on the voltmeter. The needle on the voltmeter should move to the right. If your voltmeter's needle points to the left, reverse the way the wires are connected to the terminals of the voltmeter. Immediately record the voltage reading in your data table, and disconnect the circuit.
5. Record the concentration of the solutions and sketch a diagram of your electrochemical cell.
6. Rinse the copper and zinc strips with a *very small* amount of distilled water. Collect the rinse from the copper strip in the $CuSO_4$ beaker and the rinse from the zinc strip in the $ZnSO_4$ beaker. Rinse each end of the salt bridge into the corresponding beaker.
7. Use the table of standard reduction potentials in the textbook to calculate the standard voltages for the other cells you can build using copper, zinc, or aluminum. Build these cells and measure their potentials following steps 1–6.

CLEANUP AND DISPOSAL

8. Clean all apparatus and your lab station. Wash your hands. Place the pieces of metal in the containers designated by your teacher. Each solution should be poured in its own separate disposal container. Do not mix the contents of the beakers.

ANALYSIS AND INTERPRETATION

1. **Organizing Ideas:** For each cell that you constructed, write the equations for the two half-cell reactions. Obtain the standard half-cell potentials for the half-reactions from **Table 1,** and write these E^0 values after the equations.
2. **Organizing Ideas:** For each cell you tested, combine the two half-reactions to obtain the equation for the net reaction.
3. **Organizing Ideas:** Use the E^0 values for the half-reactions to determine the E^0 for each cell.
4. **Resolving Discrepancies:** Compare the actual cell voltages you measured with the standard cell voltages in item 3. Explain why you would expect a difference.

CONCLUSIONS

1. **Inferring Conclusions:** Based on the voltages that you measured, which cell produces the most energy?
2. **Applying Ideas:** On the basis of your data, which metal is the strongest reducing agent? Which metal ion is the strongest oxidizing agent?
3. **Applying Ideas:** Indicate the direction of electron flow in each of your cell diagrams.

EXTENSIONS

1. **Predicting Outcomes:** Describe how and why the reactions would stop if the cells had been left connected.
2. **Designing Experiments:** Design a method that could use several of the electrochemical cells you constructed to generate more voltage than any individual cell provided. (Hint: consider what would happen if you linked an Al-Zn cell and a Zn-Cu cell. If your teacher approves your plan, test your idea.)