Human Battery (Zn\(^{2+}/\text{Zn}\) with Cu\(^{2+}/\text{Cu}\))

**Description:** A galvanic cell is constructed using Zn\(^{2+}/\text{Zn}\) and Cu\(^{2+}/\text{Cu}\) couples with a “human” salt bridge.

**Materials:**
- 1 M CuSO\(_4\)
- 1 M ZnSO\(_4\)
- Voltmeter
- Connecting wires
- Zn and Cu strips

**Procedure:**

For large lecture halls, perform demonstration on base of document camera.

1. Pour 1 M CuSO\(_4\) and 1 M ZnSO\(_4\) solutions in separate containers (or use setup in Dabney 114). Set the Zn electrode in the ZnSO\(_4\) and the Cu electrode in the CuSO\(_4\) solution.

2. Connect the black wire (anode) to the Zn electrode and the red wire (cathode) to the Cu electrode. The voltmeter will not show any reading until the circuit is completed by touching each electrode with bare hands. The human body is used as the salt bridge.

**Discussion:**

Due to their respective reduction potentials, a spontaneous redox process occurs when the zinc electrode is connected to the negative terminal and the copper electrode is connected to the positive terminal of the voltmeter. The spontaneous flow of electrons from anode to cathode generates a current with a voltage lower than the theoretical \(E^\text{o}_{\text{cell}}\) for these couples (1.10 V). This demonstration should be performed in conjunction with the same experiment utilizing a NaCl salt bridge. Have students hypothesize why the two different types salt bridges give different results. Compare dry versus “sweaty” hands by wiping a NaCl solution on the student’s hands.

\[
\begin{align*}
\text{Anode} & : \text{Zn} \rightarrow \text{Zn}^{2+} + 2 \text{e}^{-} & E^\text{o}_{\text{red}} (V) & = -0.76 \\
\text{Cathode} & : \text{Cu}^{2+} + 2 \text{e}^{-} \rightarrow \text{Cu} & & +0.34
\end{align*}
\]

**Safety:** Wear proper protective equipment including gloves and safety glasses when preparing and performing this demonstration.
**Disposal:** Copper and zinc solutions can be reused as long as no contamination occurred. Electrodes should be rinsed, dried and cleaned by scrubbing with steel wool.

**References:**