Metal Trees

**Description:** This experiment demonstrates two spontaneous redox processes. Silver crystals “grow” on a copper surface or lead crystals “grow” from a zinc surface.

**Materials:**
- 2% AgNO₃ (2g/100mL)  
- 2 Petri dishes  
- Copper (wire or strips)  
- 5% Pb(OAc)₂ (5g/100mL)  
- Zinc strips

**Procedure:**

For large lecture halls, project demonstration using a document camera.

1. Add solid strips or wires (in preformed shapes if desired) to separate Petri dishes.

2. Cover the copper in 2% AgNO₃ solution and let stand. Silver will begin to form on the surface and will become more crystalline within 15 minutes. The AgNO₃ solution will also take on a pale blue color as Cu²⁺ ions enter into solution.

3. Cover the zinc in 5% Pb(OAc)₂ solution and let stand. Lead will begin to form on the surface and will become more crystalline within 20-30 minutes.

**Discussion:**

Due to their respective reduction potentials, copper (\(E_{\text{red}}^{0} = +0.34\) V) is oxidized in the presence of Ag⁺ (\(E_{\text{red}}^{0} = +0.80\) V) and zinc (\(E_{\text{red}}^{0} = -0.76\) V) is oxidized in the presence of Pb²⁺ (\(E_{\text{red}}^{0} = -0.13\) V). The following equations describe the redox chemistry observed in this demonstration:

\[
2 \text{Ag}^{1+} (aq) + \text{Cu} (s) \rightarrow 2 \text{Ag} (s) + \text{Cu}^{2+} (aq)
\]

\[
\text{Pb}^{2+} (aq) + \text{Zn} (s) \rightarrow \text{Pb} (s) + \text{Zn}^{2+} (aq)
\]
Safety: Wear proper protective equipment including gloves and safety glasses when preparing and performing this demonstration. Lead acetate is toxic and should be handled with care.

Disposal: Solutions can be collected together and disposed of in an appropriate waste container.

References:

Summerlin, L. R.; Ealy, J. L. In Chemical Demonstrations: A Sourcebook for Teachers; American Chemical Society: 1985; Vol. 1, p 151.