Learning goals for pH scale

Students will be able to use *pH Scale* to

- Write descriptions that demonstrate the use of pH and/or relative hydronium and hydroxide ions as shown in the simulation to:
    A. Determine if a liquid is acidic or basic
    B. Place liquids in relative order of acidity or basicity

- Write descriptions or draw molecular-level representations that demonstrate the logarithmic relationship of pH—in particular, what a change in 1 pH unit means in terms of hydronium ion concentration. Investigate the usefulness of such a scale, versus using a linear scale, to describe the acidity or basicity of liquids.

- Describe *qualitative* relationships between pH and concentration of hydroxide and hydronium ions using the values and graphical / pictorial representations shown in the simulation. For example, the relationships between:
    A. pH and hydronium ion concentration
    B. hydronium ion concentration and hydroxide ion concentration
    C. pH and hydroxide ion concentration

- Propose *quantitative* relationships using the values and graphical / pictorial representations shown in the simulation. For example, the relationships between:
    A. pH and hydronium ion concentration
    B. hydronium ion concentration and hydroxide ion concentration
    C. pH and hydroxide ion concentration
    D. numbers of ions and moles of ions
    E. moles of ions and molar concentration of ions

- Calculate concentrations of hydroxide and hydronium ions at a given pH.

- Predict (qualitatively and quantitatively) how increasing or decreasing the volume of a particular liquid affects its pH, concentrations of hydroxide and hydronium ions, and moles of hydroxide and hydronium ions.

- Predict how diluting a particular liquid with water will affect its pH, concentration of hydroxide and hydronium ions, and moles of hydroxide and hydronium ions.

- Predict and test whether an acid—if diluted with enough water—can have a pH greater than 7.00. Predict and test whether a base—if diluted with enough water—can have a pH less than 7.00.

- Use the reported number, moles, and concentration values of water, hydronium, and hydroxide to describe the main components of a liquid at a given pH value.

Advanced goals:

- Test quantitative predictions about the effects of diluting a particular liquid with water on pH.

- Use concentrations of hydroxide and hydronium ions in particular liquids and in water to explain why dilution of acids and bases with water levels out at pH 7.00.

- Evaluate the strengths and weaknesses of the "H_3O^+ / OH^- ratio dot view" in terms of representing relative H_3O^+ and OH^- concentrations. Describe why water molecules are not included in the "dot view."

- Identify the pH range in which a linear scale may be useful in depicting concentrations of hydroxide and hydronium ions. Identify the pH range in which a logarithmic scale is more useful than a linear scale in depicting concentrations of hydroxide and hydronium ions.