PhET Tips for Teachers

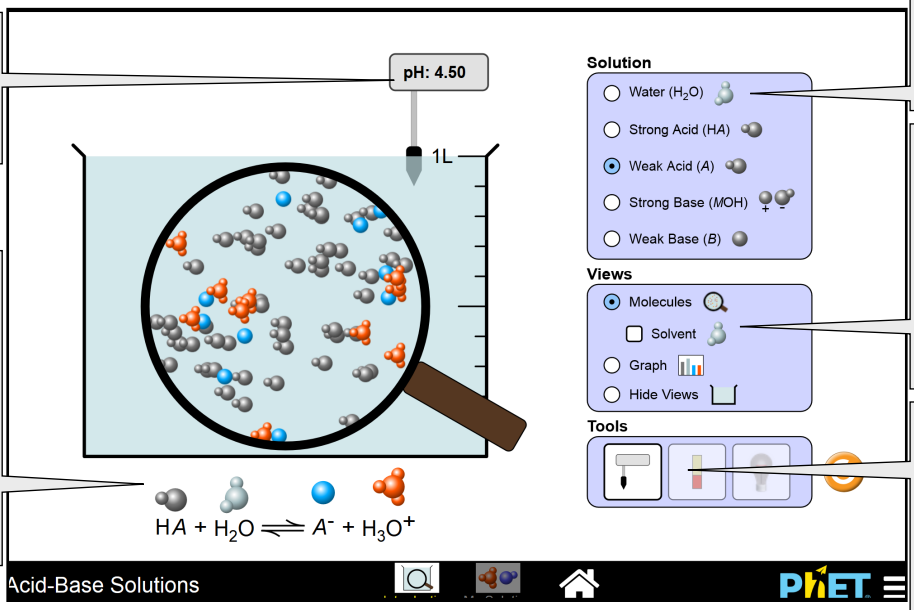
Acid Base Solutions

Introductions Screen

In this screen, students explore the properties of acids and bases using particulate level diagrams, graphs and tools such as a pH meter, pH paper, and a conductivity tester.

MEASURE the pH of the solution.

USE the balanced equation to compare what happens when acids and bases dissolve in water.



CHOOSE solution to investigate.

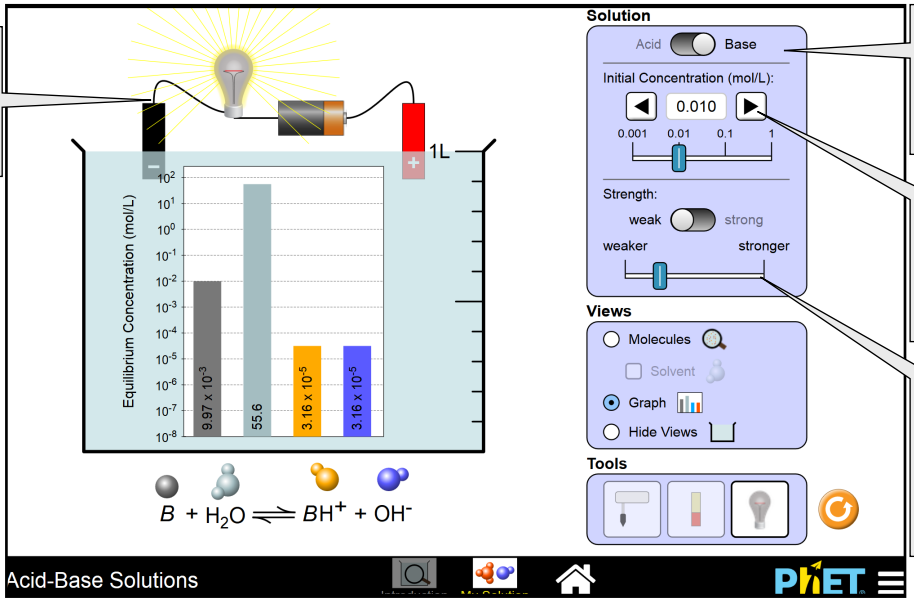
DISPLAY molecules or a graph in beaker to identify solution components.

SELECT pH meter, pH paper or conductivity meter to determine solution properties.

My Solution Screen

Students create solutions to explore the differences between strong versus weak and concentrated versus dilute acidic or basic solutions.

MEASURE solution conductivity.



CREATE an acidic or basic solution.

VARY the initial concentration of the solution.

CHANGE the relative strength of the acid or base.

Hanson, November 2015

Insights into Student Use

- Students often confuse acid/base strength and concentration. For example, students often think that a stronger acid means the acid is more concentrated.
- In a classroom study, we found that students tend to think that pH measures the strength of an acid or base.
- Interviews revealed that students who had not received instruction on acids and bases found the generic representations of acids (HA) and bases (B) confusing at first. You may wish to introduce the idea of generic representations by first giving examples of real compounds (e.g.. HCl and HF) and then introducing the generic representation before students interact with the simulation.
- Many students are not aware that the initial concentration of an acid or base can be different than the equilibrium concentration. The graph is labeled to show it measures the concentrations of all species at equilibrium.

Model Simplification

- The number of particles in the magnifying glass is related to the equilibrium concentration. We chose to ignore the auto-ionization of water for acid and base solutions.
- Because the actual values are hidden in the Introduction screen, students can use the equilibrium concentrations to calculate the initial concentration of acid/base and K_a/K_b. The initial concentration is 0.01 M for all solutions and the equilibrium constant is $1x10^{-7}$ for the weak acid/base.
- We chose to hide the K values in the My Solution screen, enabling students to focus on the concept of strength. The K values for the weak/strong slider range in value from $1x10^{-10}$ to $1x10^{2}$ on a log scale.
- The pH meter and pH paper must be dipped into the solution to measure pH. Students can use this feature to predict the pH for different solutions.
- When using the conductivity probe, both electrodes must be placed into the solution to measure conductivity. The luminance of the bulb is modeled as linear with pH, and water is given a small conductivity. Note that the conductivity of distilled water is not measurable with equipment typically available to students.

Suggestions for Use

Sample Challenge Prompts

- List the properties of acidic and basic solutions using what you have observed in the simulation.
- What ions are present in an acidic solution? What ions are present in a basic solution?
- Describe the difference between a strong and weak acid or base.
- Describe the difference between a acid strength (strong versus weak) and acid concentration (concentrated versus dilute).
- A student claims, “Strong acids always have a lower pH than weak acids.” Do you agree or disagree with this claim? Use evidence from the simulation to support your reasoning.
- What happens to the pH of an acidic solution as the initial concentration is increased? Why do you think this happens?

See all published activities for Acid Base Solutions here.
For more tips on using PhET sims with your students, see Tips for Using PhET.

Hanson, November 2015