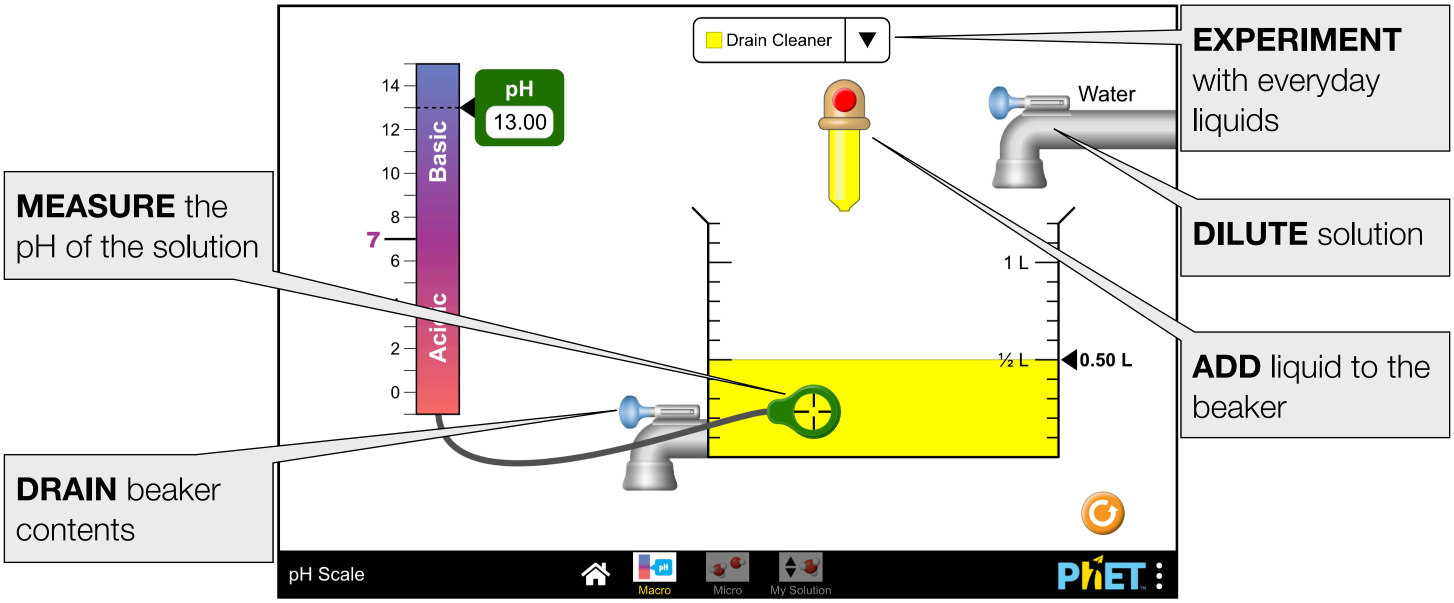
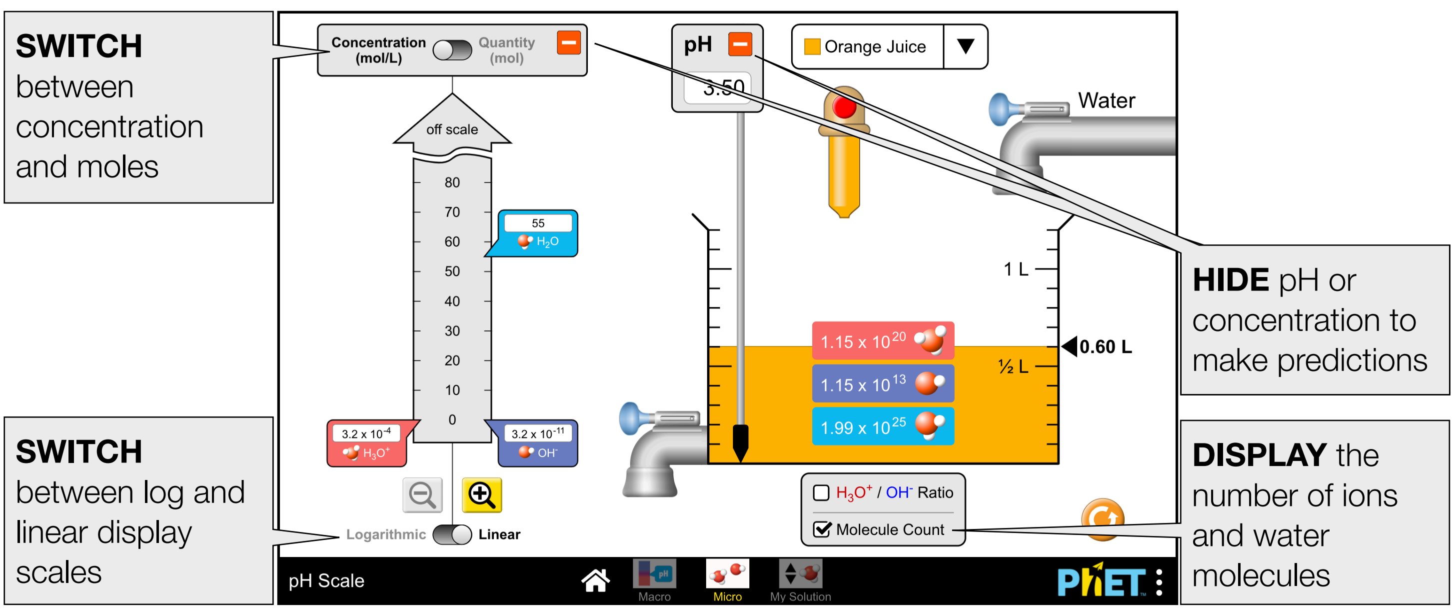
Macro Screen

Test the pH of everyday liquids to determine whether each is acidic, basic, or neutral.



Micro Screen

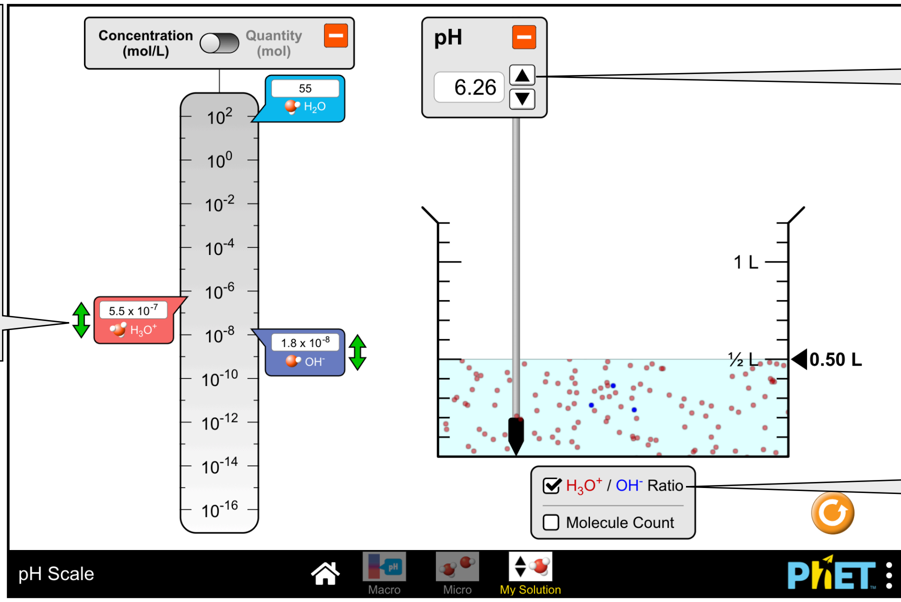
Experiment with everyday liquids and relate the pH to hydronium ion and hydroxide ion concentrations.



My Solution Screen

Create your own liquid by directly manipulating pH or ion concentration. Visualize the relative number of hydroxide ions and hydronium ions in solution.

DRAG H_3O^+ or OH^- sliders to customize pH. Changing one slider automatically changes the other.



ADJUST the pH directly; press and hold to adjust quickly

CHOOSE ratio view to see the major ion in the solution

Customization Options

The following query parameters allow for customization of the simulation, and can added by appending a '`?`' to the sim URL, and separating each query parameter with a '`&`'.

Query Parameter and Description	Examples
`autofill` - when true, the dropper will autofill the beaker to 0.50 L when switching solutes. Default is true.	`autofill=false`
`supportsPanAndZoom` - when true, enables panning and zooming of the simulation using pinch-to-zoom or browser zoom controls. Default is true.	`supportsPanAndZoom=false`
`screens` - launches the screens listed after the '`=`'. Each screen should be separated by a comma. For more information, visit the Help Center.	`screens=1` `screens=2,3`

Insights into Student Use

- A sliding scale is used to show concentration and quantity values instead of a traditional bar **graph**, since the bar graph tended to cue students to compare the volumes of the bars. When shown a bar graph students tended to describe one concentration as twice as large as another, when the values were actually many orders of magnitude different.
- From having used indicators like litmus paper or pH paper, some students may think that the **color of the substance** is related to pH; to address this idea, the My Solution screen shows a solution that does not vary in color. Also, battery acid and drain cleaner have purposefully identical colors.

- Because the **H_3O^+/OH^- ion ratio** is shown with dots, many students initially assume the dots represent the actual number of ions in the beaker. Asking students to display and discuss the molecule count at the same time can help. Also, since the ion ratio is approximated to a linear relationship at most pH values, the differences upon dilution or small changes in pH are difficult to see. Asking students to compare the ratio view across larger differences in pH elicits more interesting discussion and helps students interpret this view.

Model Simplifications

- For liquids with a range of measured pH values, an average value from the literature was used.
- The simulation does not account for the different acid dissociation constants (Ka) for each liquid when calculating the ion concentrations or the pH after dilution. We make the simplification that any increase in the concentration of the major ion is due to the ions already present in the added water. For example, if students add 100 mL of water to an acidic solution, then the number of moles of H3O+ increases by 1×10^{-8} mol. The concentration of the minor ion is then calculated using the self-ionization constant for water (Kw). These calculations account for the leveling effect of water.
- The ratios of ions have been simplified; the ion ratio varies logarithmically between pH 6-8, but is approximated as a linear relationship outside of this range.
- The values displayed in the pH meter and graph indicators are rounded, so it may be possible for a solution to display a pH of 7.00 without being neutral. (The displayed concentrations/quantities of H_3O^+ and OH^- ions may not be equal.)

Suggestions for Use

Sample Challenge Prompts

- Predict if the pH of your solution will increase or decrease after you add water. What about the concentration of H_3O^+ ions?
- Describe two different ways you could fill the beaker with a solution with pH 6.00. Is it possible to use hand soap to do this? Explain.
- Given only the solution pH, how would you estimate the concentration of H_3O^+ ions in a solution? What about the concentration of OH^- ions?

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