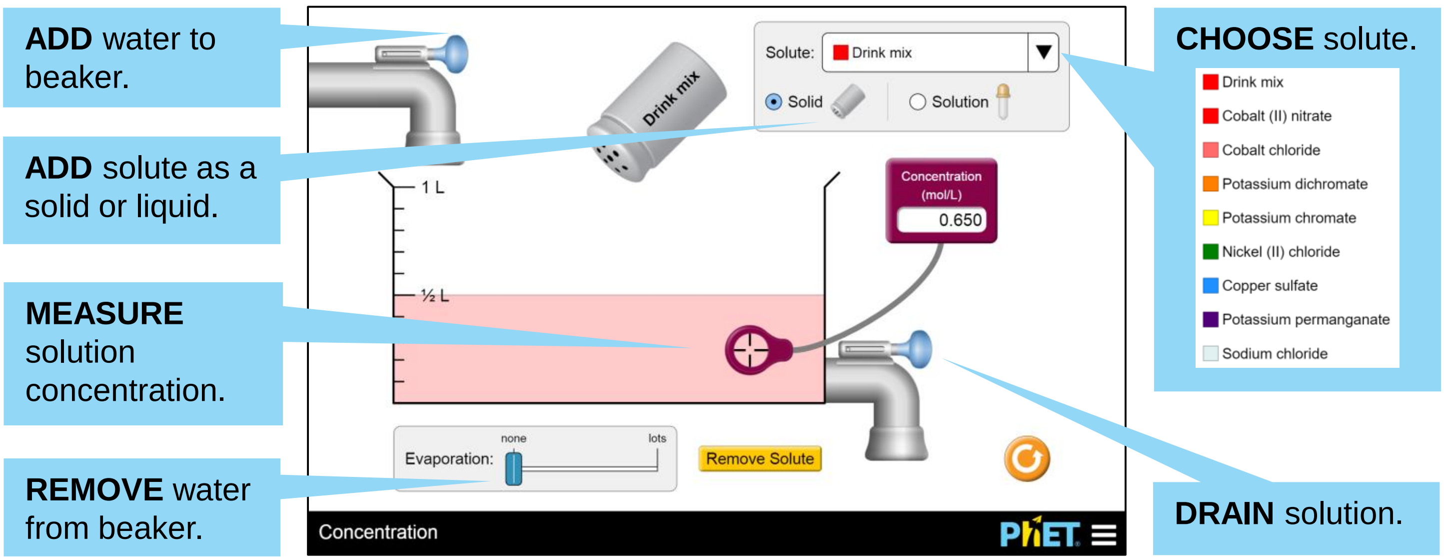
Concentration

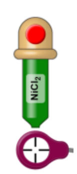
Students build an understanding of solution concentration by varying amounts of solute, solvent, and solution. Experimenting with several different chemicals in solid and concentrated solution form, students can discover qualitative and quantitative relationships between solution components.



Complex Controls

- The maximum amount of solute that can be added to the beaker is 7 moles; the shaker or dropper will not dispense any more solute. You can remove some solute with the drain faucet or you can remove all of the solute by clicking: 

- The dropper will add a concentrated solution of the solute. The concentration of the solution in the dropper can be measured by putting the probe below the dropper and pressing the red button to release solution.



Model Simplifications

- A simplified equation was used to calculate molarity: Moles of solute/Volume of solvent. This simplification was used because the effect of solute volume is relatively small and variations in solution volume due to addition of different solutes could lead to student confusion.
- The solute is always water.
- When the moles of solute per liter of water is above the saturation point, small crystals will form at the bottom of the beaker and the solution will be marked as saturated.
- The values used to calculate the solubility for each solute were taken from the CRC Handbook of Chemistry and Physics 91st edition (http://www.hbcpnetbase.com). Drink mix was assumed to have the same solubility as sucrose.

Solute	Formula	Molar Mass (g/mol)	Color	Solubility in water (mol/L)	Dropper Solution (mol/L)
Drink mix (sucrose)	$C_{12}H_{22}O_{11}$	342.296	red	5.96 @ 20^0C	5.50
Cobalt (II) nitrate	$Co(NO_3)_2$	182.942	red	5.64 @ 25^0C	5.00
Cobalt chloride	$CoCl_2$	129.839	pink	4.33 @ 25^0C	4.00
Potassium dichromate	$K_2Cr_2O_7$	294.185	orange	0.51 @ 25^0C	0.50
Potassium chromate	K_2CrO_4	194.191	yellow	3.35 @ 25^0C	3.00
Nickel (II) chloride	$NiCl_2$	129.599	green	5.21 @ 25^0C	5.00
Copper sulfate	$CuSO_4$	159.609	blue	1.38 @ 25^0C	1.00
Potassium permanganate	$KMNO_4$	158.034	purple	0.48 @ 25^0C	0.40
Sodium chloride	NaCl	58.443	no color	6.15 @ 25^0C	5.50

Suggestions for Use

Sample Challenge Prompts

- Describe the relationship between the amount of solute, volume of solution, solution color, and solution concentration.
- Predict what happens to the concentration of a solution if:
  - water is evaporated from beaker.
  - water is added to the beaker.
  - water is drained from the beaker.
- Explain what is meant by the term “saturated”. Use evidence from the simulation to support your answer.
- Are all solutes equally soluble? Support your answer with examples from the simulation.
- Do all solutes form saturated solutions? Why or why not?

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