Name _____ Date _____ Period _____

ZornScience
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Solutions Virtual Lab

Chemistry

Open activities.zornscience.org/solutions-lab/ and follow each step. Record values exactly as the lab shows them, with their units.

Objective

Use the Solutions Lab to make solutions of a known molarity with a volumetric flask, dilute a stock solution and check $M_1V_1 = M_2V_2$, and use solubility curves to predict when crystals form.

NGSS alignment

HS-PS1-3 (structure of substances and electrical forces between particles) and HS-PS1-7 (using mathematical representations of moles and mass). Practices: planning and carrying out investigations, analyzing and interpreting data, using mathematics. Crosscutting concept: scale, proportion, and quantity.

Meet the simulation

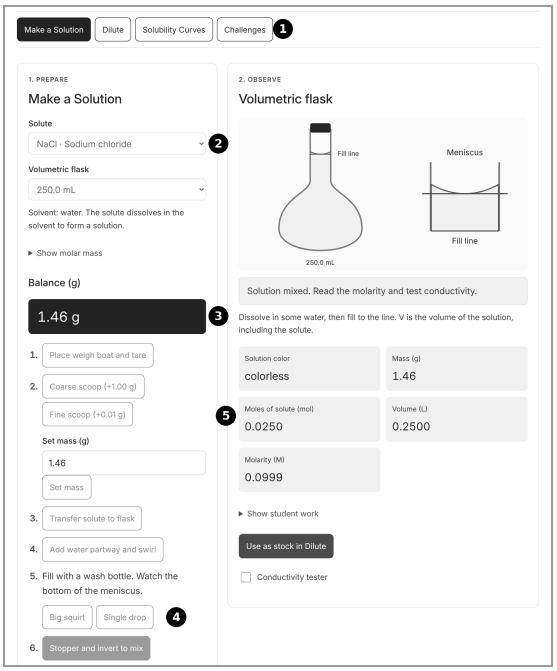


Figure 1. Make a Solution. (1) Mode tabs: Make a Solution, Dilute, Solubility Curves, Challenges. (2) Solute and volumetric flask. (3) The balance and the numbered steps: tare, weigh, transfer, and dissolve. (4) The wash bottle. Use Big squirt, then Single drop until the bottom of the meniscus sits on the fill line, then stopper and invert. (5) The readouts: mass, moles, volume, and molarity.

Pre-lab

1. Name the solute and the solvent in salt water. Write the formula for molarity, with units.

2. How many grams of NaCl (58.44 g/mol) do you need to make 250.0 mL of 0.100 M NaCl?

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Part A. Make a Solution

3. Choose Make a Solution and check Conductivity tester. For each row, pick the solute and flask, then follow steps 1 to 6 (type the mass and press Set mass). Record the moles, the molarity, and the bulb. Why does the NaCl solution read 0.0999 M and not exactly 0.100 M?

Solute	Mass (g)	Flask (mL)	Moles of solute (mol)	Molarity (M)	Bulb
NaCl	1.46	250.0			
KNO_3	5.06	100.0			
$CuSO_4 \cdot 5H_2O$	6.24	250.0			
$C_{12}H_{22}O_{11}$ (sucrose)	8.56	250.0			

4. The $CuSO_4$ and sucrose solutions are both 0.100 M. Why does only one of them light the bulb? Classify each as a strong electrolyte or a nonelectrolyte.

5. Choose NaCl and the 1000. mL flask. Check Measure 1.00 L of water instead, weigh 58.44 g, and follow the steps. Record the volume and molarity. Then press Start over, uncheck the box, and make it again by filling to the line. Explain the difference.

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Part B. Dilute

6. Choose Dilute and the 1.00 M $CuSO_4$ stock. For each row, pick the pipet (V_1) and flask (V_2), transfer, fill to the line, and mix. Record M_2 and the water added. Which two rows give the same M_2, and why?

V_1 (mL)	V_2 (mL)	M_2 (M)	Water added (mL)
10.00	100.0		
25.00	250.0		
5.00	100.0		
25.00	100.0		

7. Choose the 2.00 M NaCl stock. Dilute 10.00 mL to 100.0 mL, press Use as the new stock, and repeat. Record M_2 after each step. How many times more dilute is the final solution?

8. Check Particle view. Compare the stock aliquot and the diluted solution. What stays the same? What changes?

Part C. Solubility Curves

9. Choose Solubility Curves and KNO_3. Leave Cool gently unchecked. Set the temperature to 70 °C, press Start over, and add 100 g (Add 10 g ten times). Lower the temperature to each value and record the results.

Temperature (°C)	Solubility (g per 100 g H_2O)	Dissolved (g)	Crystals formed (g)	Solution state
70				
50				
30				
10				

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10. Press Start over at 70 °C and add 100 g KNO_3 again. Check Cool gently and cool to 30 °C. Record the dissolved mass and the solution state. Then press Drop in a seed crystal and record what happens. How does this explain a hand warmer?

11. Choose NH_3 (a gas). At 0 °C, add 80 g, then warm to 30 °C. Record the dissolved mass and gas escaped. Cool back to 0 °C. Why doesn't the gas come back, and why does warm soda go flat?

Analysis

12. Calculate the mass of NaCl needed for 500.0 mL of 0.250 M NaCl. Then make it in the lab and record the molarity it shows.

13. Plan how to make 250.0 mL of 0.100 M $CuSO_4$ from the 1.00 M stock. Which pipet and flask do you use, and how much water is added? Test your plan in the lab.

14. Name two sources of error if you made these solutions in a real school lab.

Conclusion

15. Write a claim, evidence, and reasoning: what does molarity measure, and how do dilution and temperature change how much solute is in a solution?

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