Simulation: Preparing Solutions

FOR THE TEACHER

Summary
In this simulation, students will complete a calculation in order to determine the value of an unknown variable related to a described solution and then they will observe an animation of the solution being prepared. The calculation will require the student to determine either the molarity of solution, volume of solution, or mass of solute needed. Additionally the associated particle diagram for the solution will be displayed to help students better visualize the solution at the particulate level. Finally, students will gain familiarity with the proper lab techniques for preparing a solution as they are lead through a step-by-step animated process demonstrating this procedure. The simulation is designed as a five question quiz for students to use multiple times.

Grade Level
High School

NGSS Alignment
This simulation will help prepare your students to meet the performance expectations in the following standards:
- **Scientific and Engineering Practices:**
  - Developing and Using Models
  - Using Mathematics and Computational Thinking

Objectives
By the end of this simulation, students should be able to:
- Calculate the value for an unknown variable in a solution, including the molarity of solution, the volume of solution, and the mass of solute.
- Describe the steps that should be followed in order to properly prepare a solution of known concentration and volume.
- Use a particle diagram to represent a given solution.

Chemistry Topics
This simulation supports students’ understanding of:
- Solutions
- Molarity
- Concentration
- Solute/Solvent
- Particle Diagrams

Time
Teacher Preparation: minimal
Lesson: 20–30 minutes

Materials
- Computer, tablet or phone with internet access

Safety
- No specific safety precautions need to be observed for this activity.
Teacher Notes

- This simulation could be used during a unit about solutions.
- Each quiz randomizes the order of 5 questions, and also the order in which the answer choices are presented. If students are working on the quiz at the same time, they should not have the same order of questions or answer choices as their peers.
- The quiz draws from 12 possible questions, so that a student could repeat the quiz if they are in need of additional practice, and would not be given the same 5 questions again.
- Each quiz question has two portions. Students should first complete the calculation on scratch paper, and then choose their answer from the choices provided. Next they will be presented with an animated sequence, which visually demonstrates how the particular solution is prepared in the lab.

- **Important Notes:**
  - The particle diagrams are used to show a simplified version of just a small representation of each chemical reaction.
  - The blue solution color is only used to show contrast on the screen, it is not implying that the solution formed is blue in color.
  - The water molecules are intentionally not shown in each solution.
  - The particle diagrams are intended to show the basic organization of particles. Spheres of the same size are used to represent all substances, and are not intended to indicate the relative sizes of the particles in the solution.
  - Intermolecular forces are not implied in the particle diagrams.
  - The molar mass values that were used for the calculations are as follows: 
    NaCl = 58.44 g/mol, CaBr₂ = 199.89 g/mol, MgCl₂ = 95.21g/mol, KI = 166.00 g/mol

- There is no student handout associated with this simulation. Students will be given instructions, and answer questions using the simulation interface.
- Correct answers are provided to the student during the quiz if a question is answered incorrectly. Additionally each step of the entire calculation is written for student reference.
- The simulation can be found at either of the following links (note that students can access the simulation without an AACT login):
  - teachchemistry.org/preparingsolutions

- Related classroom resources from AACT Library that may be used to further teach this topic:
  - Activity: Particle Level Molarity
  - Activity: Solubility & Solutions
  - Demonstration: What is a 1 Molar Solution?
  - Lab: Kool-Aid
  - Lab: Molarity of a Solution