ChemVLab+, Contextualized Chemistry Activities

Teacher Guide

Helping students connect procedural knowledge with authentic chemistry learning

DRAFT VERSION

Spring 2020

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Contents

Using ChemVLab+ i

The OLI Platform 1

Using the ChemVLab+ Activities with Your Students 6

Virtual Lab Activities 10

PowderAde: Using colored sports drinks to explore concentration 10

IV Solutions: Using salt and glucose solutions to explore dilution 12

Bioremediation: Using bioremediation accelerators to clean oil spills 14

Gravimetric Analysis: Testing for contaminents in drinking water 16

Phase Changes: Exploring intermolecular and intracolecular Forces 18

Solar Plant: Finding the optimal material for solar plant design 20

Hot and Cold Packs: Exploring heat transfer through the design of hot and cold packs 22

Equilibirum: Using color change reactions to explore chemical equilibrium 24

Using ChemVLab+

Accessing the OLI Platform and Using the ChemVLab+ Activities with Your Students

Signing up on the OLI Platform

ChemVLab+, Contextualized Chemistry Activites are available on Carnegie Mellon's Open Learning Initiative Platform.

Where to access the activities

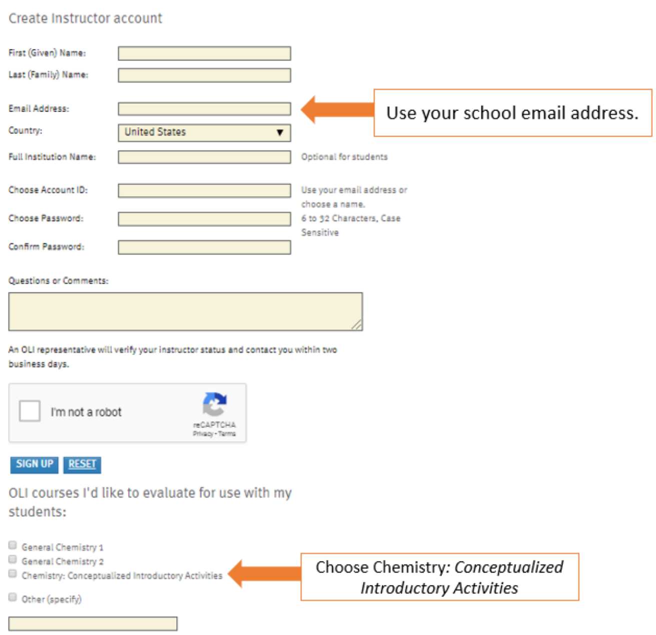
For high school classrooms go to: **k12.oli.cmu.edu**

For college classrooms go to: **oli.cmu.edu**

Creating an Instructor Account

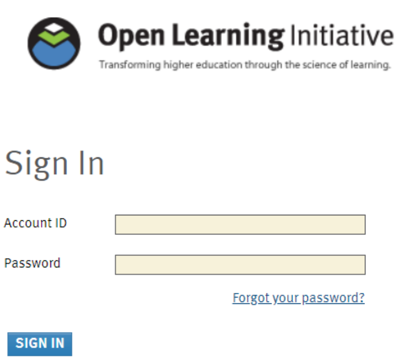
1. Click the "Educator" link in the upper right-hand corner.

2. Fill in the required information for your instructor account.
    - The OLI administrators will verify instructor accounts, so please be sure to use your school email address. If there is an issue, use the comment box to provide additional details
    - At the bottom of the form, check the box for ***Chemistry: Conceptualized Introductory Activities.***



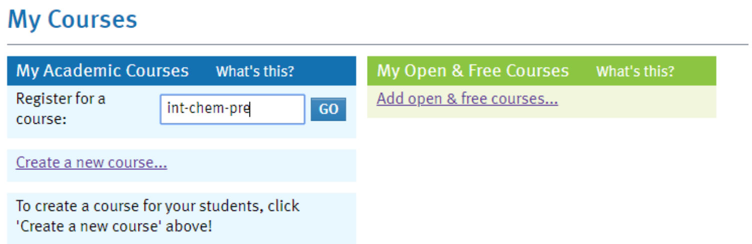
3. Once you have signed up, you will receive a welcome email within 2 business days verifying your instructor account. After you have received this email, you can preview the course by signing into your account at **k12.oli.cmu.edu** (high school) or **oli.cmu.edu** (college).

For assistance with the OLI platform or your account, please visit: https://oli-help.freshdesk.com/support/home

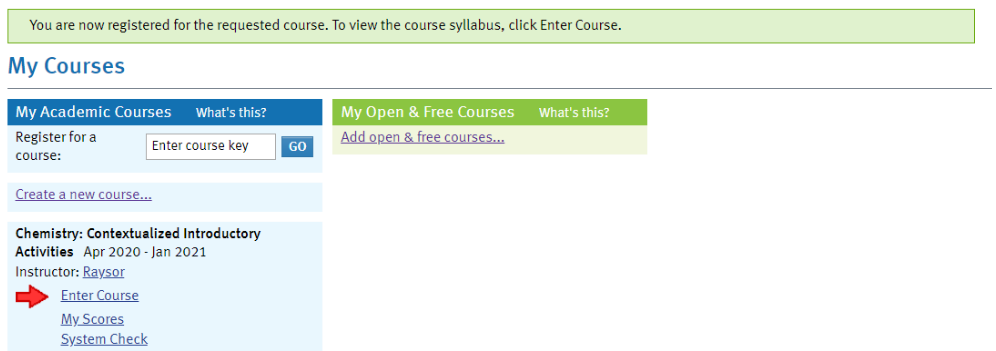


Previewing the Course

1. After signing in, you will be brought to your “My Courses” homepage. To preview the course, enter “**int-chem-pre**” in the “Register for a course” field and click “GO.”



2. You will see the course under “My Courses”. Click “Enter Course” to access and view the activities as if you were a student.

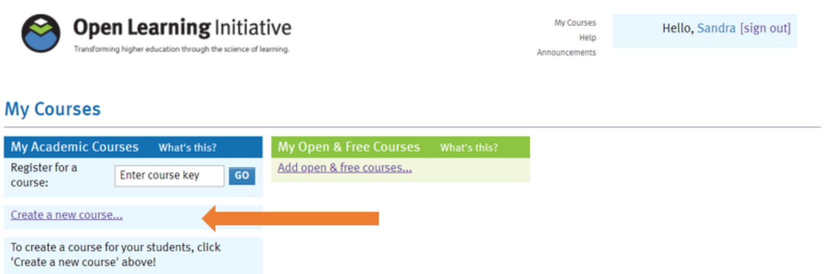


3. If you would like to use the activities with your students, you will need to set up your own sections/course(s) for your students to enroll in. Please follow the directions in the following section.

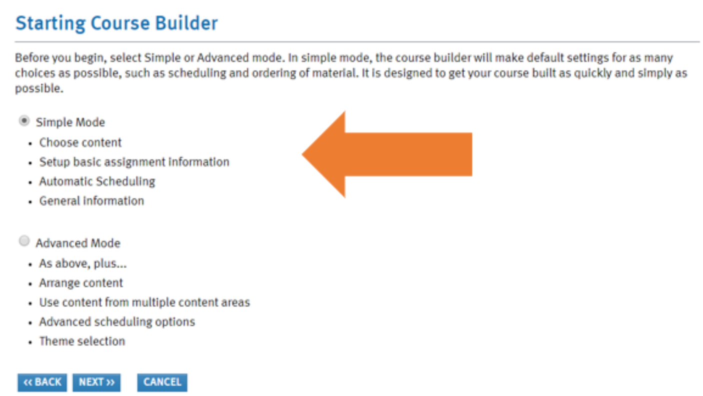
Setting up activities for your students

In the OLI system, “course” refers to a section for your students. If you would like all of your students to appear in a single gradebook, you can make a single “course” and have all of your students enroll using its course key. If you would prefer each of your classes or class periods to have a separate gradebook, you can repeat the actions below and create a unique course key for each section.

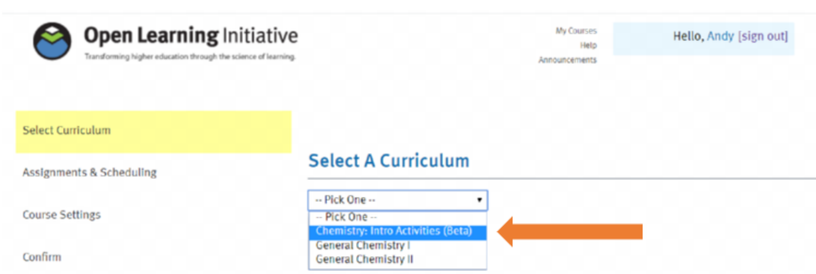
1. On your “My Courses” page, click the “Create a new course” link.



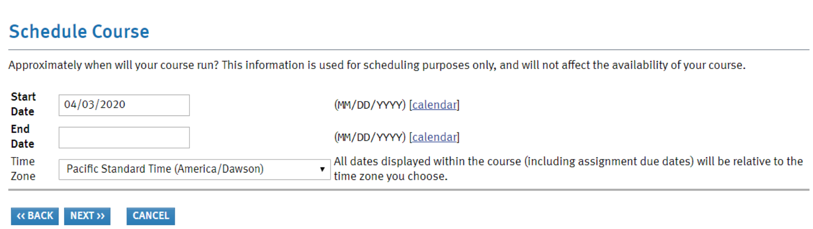
2. Choose “Simple Mode” and click the “NEXT” button.



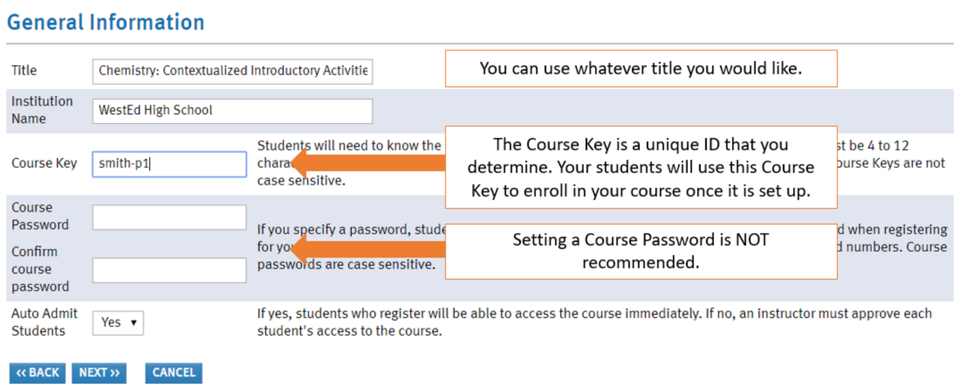
3. Choose “Chemistry: Intro Activities (Beta).” Then, click “NEXT.”



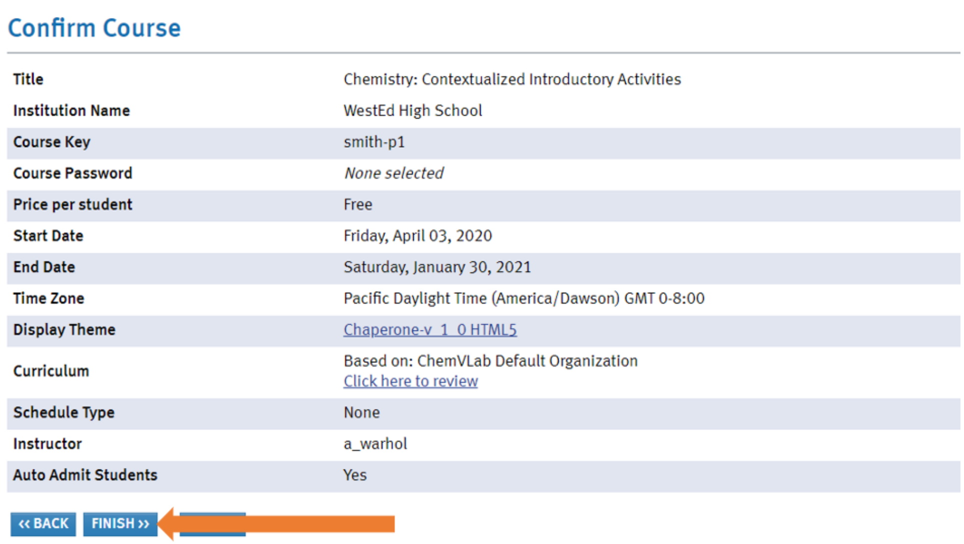
4. Set a start date and end date for your course. Then, click “NEXT.”



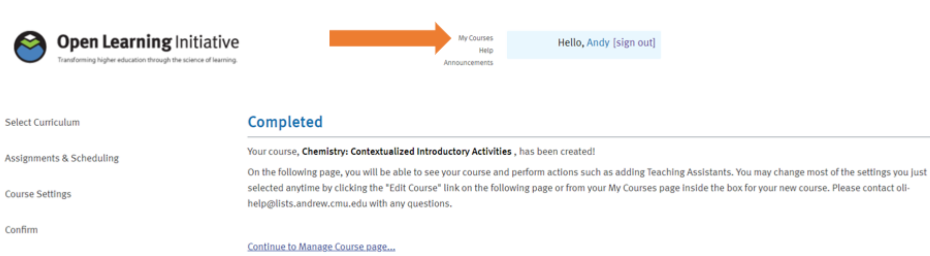
5. Fill in the general information section as indicated below. You'll be asked to create a Course Key for each section of the class that you will share with your students. We do not recommend requiring a course password, as students will have logged in using a password. When complete, click "NEXT."



6. Click "FINISH."



7. Click the "My Courses" link to return to your homepage.



Using the ChemVLab+ Activities with Your Students

How Students Create Accounts and Access the Activities

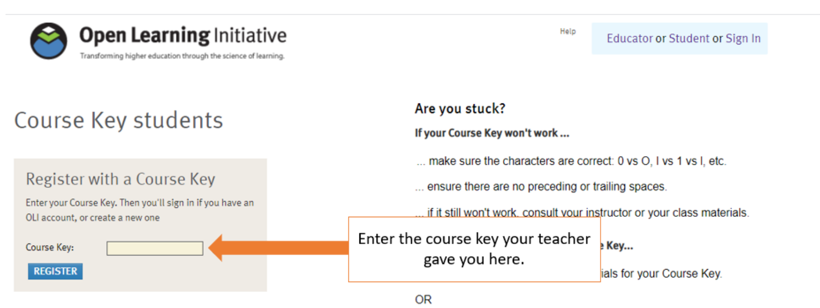
Provide your students with the course key you created for each period or section. Each student will use his or her own email address to create an OLI account and register for a course. Note that student accounts do not require verification. Once your students sign up for the course using the steps below, they will have instant access.

1. For high school students go to: **k12.oli.cmu.edu**

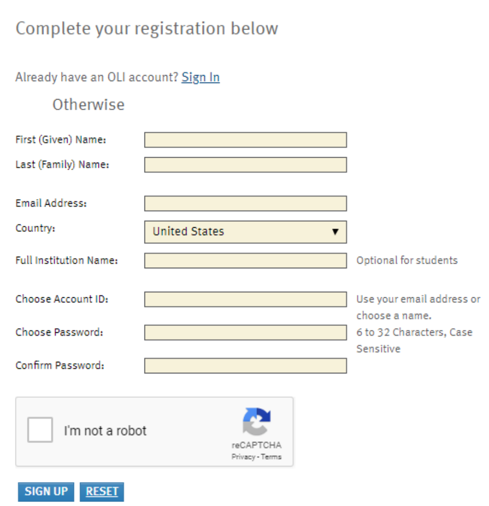
   For college classrooms go to: **oli.cmu.edu**

2. Click the "Student" link.

3. Provide students with the course key you want them to use. Students will enter it under "Register with a Course Key."



4. Students should fill in all information as indicated and click "SIGN UP."

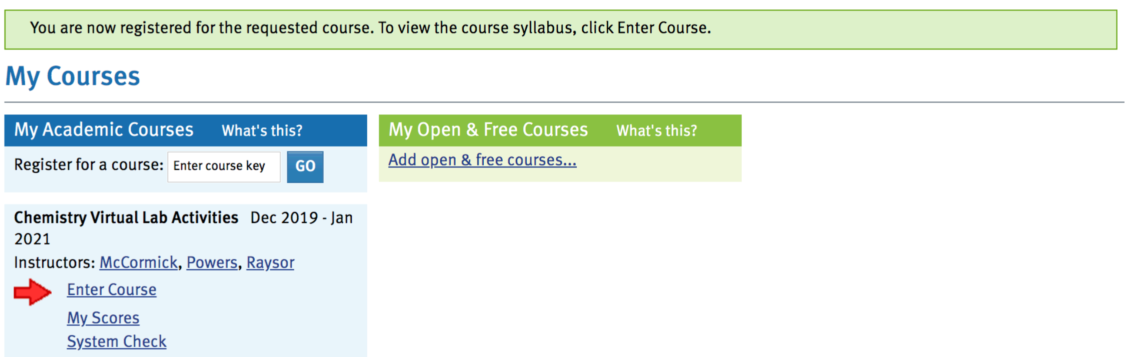


5. Click “CONFIRM ACCOUNT.”

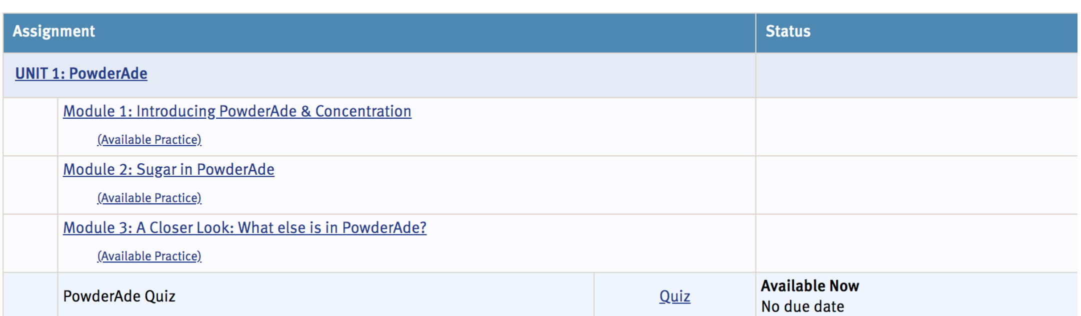
6. Click “REGISTER.”

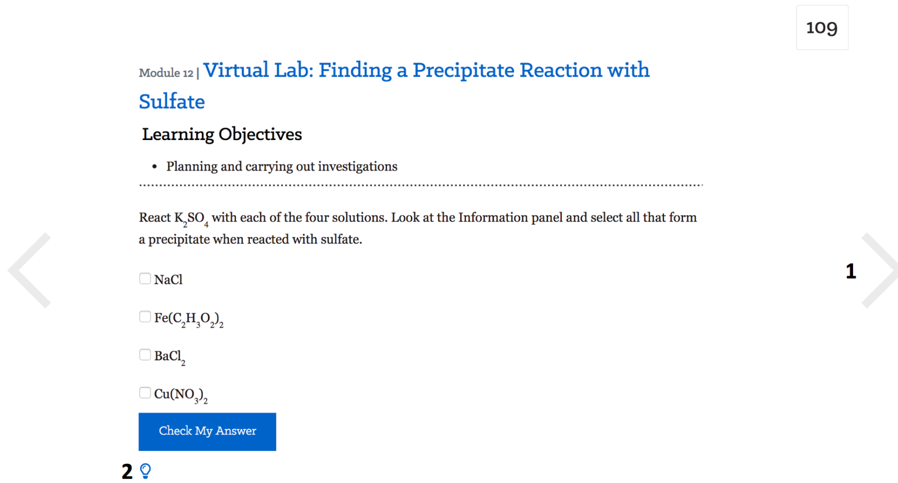
Navigating the ChemVLab+ Activities

From their homepage, students can select “Enter Course” to access the ChemVLab+ activities.



All 8 activities and their corresponding modules (sections) will be displayed on the next page. Students can select a unit to start an activity from the beginning, or jump to a module within the activity. Student progress is saved after each page is completed.





1. Students can click on the arrows on the sides of the page to continue to the next page. There is no “continue” button.
2. Student can click on the light bulb symbol to obtain hints. Most hint buttons have multiple hints, so students should click on the arrow to review additional hints.

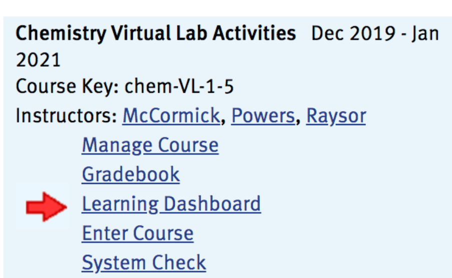
Helpful Tips

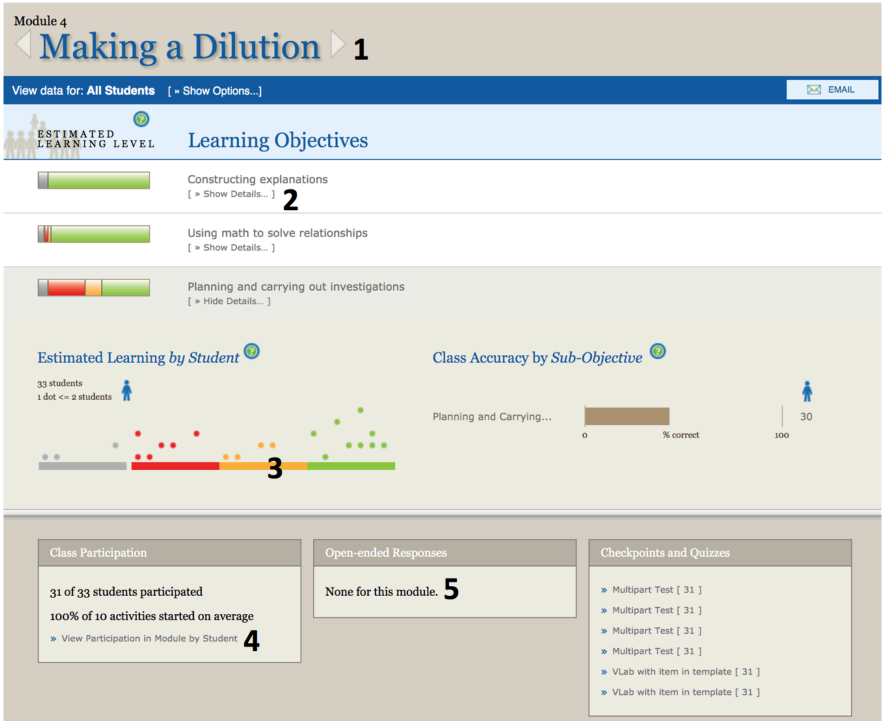
- Recommended browser: Chrome
- Be sure the browser window is maximized.
- If the page freezes or an item does not appear, try refreshing the page.

Using the Learning Dashboard to Monitor Student Progress

As an instructor, you can access the Learning Dashboard. The Learning Dashboard allows you to monitor student progess through each activity module. You can also use the estimated learning level to check for understanding and identify learning gaps.

From your hompage, select “Learning Dashboard” for the class period you would like to view.





1. Use the left and right arrows to toggle between reports for each activity module.
2. Select "Show Details" to expand a Learning Objective.
3. Select a color on the bar to view individual students who fall into that estimated learning range.
4. Under Class Participation, select "View Participation in Module by Student" to view how far individual students have progressed through the activity.
5. If a module has items with open-ended responses, you can select an item under "Open-ended Repsonses" to see individual student responses.

Activity Feedback

ChemVLab+ is an active research project that is still in development.

The following pages include individual activity descriptions which provide NGSS practice alignment, useful prior content knowledge, suggested framing, and any known technical issues students may encounter.

If you would like to provide feedback on the activities or let us know of any errors or bugs, we'd really appreciate it!

Please fill out following form: **https://tinyurl.com/ChemVTeacherFeedback**

PowderAde

Using colored sports drinks to explore concentration

Students explore concentration through colored sports drinks. In the virtual lab, they prepare drinks with differing concentrations and use a spectrometer, which measures color, to determine the concentration of colored particles. They explore conversions and think proportionally and molecularly about the ingredients within PowderAde.

NGSS Practices

Developing and Using Models	Planning and Carrying Out Investigations	Using Math and Computational Thinking	Constructing Explanations
Students connect chemical formulas with molecular representations and use the periodic table to predict whether PowderAde ingredients are ionic compounds or molecules.	Students use the virtual lab to combine PowderAde and water to create different volumes and concentrations of drinks. Students infer that the concentration of two drinks is the same by comparing the amount of absorbed light, as measured by the spectrometer.	Students use mathematical reasoning to determine the amount of grams needed to obtain a desired volume and concentration of a drink. They explore conversions and think proportionally about the ingredients within PowderAde.	Students explain the relationship between number of particles, light absorption, and concentration. They explore what makes a substance a mixture and how, when comparing drinks, some proportions are held constant while others change.

Useful Prior Content Knowledge

- Concentration as a measure of grams per liter
- Mathematical proportions and conversions

Structuring a Lesson Around the Activity

Pre-activity Questions

- Compare and contrast water and a sport drink like Gatorade.
- If you add 2 grams of a powered sport drink mix to 10ml of water, what is the concentration in g/ml? What is the concentration in g/L?

Post-activity Questions

- Two other students in the class make PowderAde drinks. One student adds 10 grams to 40ml of water and another adds 20 grams to 80ml of water. Compare the two drinks, considering grams of PowderAde, volume, and concentration. Would you expect the two drinks to have the same color intensity? Why or why not?
- A new product, PowderAde Flex, comes with two packages. One contains just sugar, and the other contains the rest of the ingredients in PowderAde. This new product allows you to add only as much sugar as you want to your drink. Can you use light absorbance to determine the concentration of sugar in a PowderAde Flex drink? Can you use light absorbance to determine the concentration of the other ingredients in PowerAde Flex?

Issues Students May Encounter

Page 9; Virtual Lab: Diego's Drink

- Students may need need assistance finding the light absorbance in the virtual lab. Demonstrate the use of the function or show a screen capture of the light absorbance graph/table.
- Anwer Key: 0.55

Page 10; Virtual Lab: Diego's Drink Concentration

- The virtual lab does not keep track of the amount of PowderAde added. Students will need to keep track themselves. They can toggle between the flask and the spectrometer graph to monitor the absorbance as it increases when PowderAde is added.
- Anwer Key: Students need to add 1 gram of PowderAde to 100mL flask of water 6 times, for a total of 6 grams to match Diego's absorbance of 0.55. They need to convert 100mL of water to 0.1 L, and then divide 6g/0.1L for a concentration of 60 g/L.

Making IV Solutions

Using salt and glucose solutions to explore dilution

Students explore dilution and concentration by making patient IVs. They learn about the molecular structure of salt and glucose and connect the microscopic to what is measurable. Students use proportional reasoning to obtain the desired volume and molarity of solutions in the virtual lab.

NGSS Practices

Planning and Carrying Out Investigations	Using Math and Computational Thinking	Constructing Explanations
Students use the virtual lab to dilute iodine, saline, and glucose solutions in order to obtain a desired concentration or molarity.	Students think about the ratios between concentrations as well as the chemicals within ionic compounds and molecules. Students consider the relationship between the number of moles, mass, molar mass of a substance, and the molarity of a desired solution, performing calculations when needed.	Students explain what happens to the volume and concentration of solutions when substances, like water, are added.

Useful Prior Content Knowledge

- Concentration as a measure of grams per liter
- Dilution, including using proportional reasoning to find the correct amount of solution and water needed for a dilution
- Calculating molar mass
- Relationship between molarity, moles, and grams

Structuring a Lesson Around the Activity

Pre-activity Questions

- Determine the molar mass of Potassium Chloride (KCl). How many moles of Potassium Chloride are needed to make 100 mL of a 1.0 M solution? What mass of Potassium Chloride is needed?
- You have a 1.0 M solution of KCl. Explain how to create a 0.5 M solution of KCl using dilution. How many parts water and KCl solution are needed? What's the ratio between the concentration of KCl in the original solution and the new concentration?
- A chemist makes two KCl solutions with different concentrations. Solution A is made by dissolving 50.0 g of KCl in 400 mL of water. Solution B is made by dissolving 50.0 g of KCl in 200 mL of water. What can be said about the solutions' concentrations?

Post-activity Questions

- What quantity remains constant when you dilute a solution? What changes? Explain your answer.
- In the virtual lab, you were asked to create a 1.052 M glucose solution by adding solid glucose to water or by diluting the 0.526 M solution. Write out the steps for each of these processes.

Bioremediation

Using bioremediation accelerators to clean oil spills

Getting bacteria to eat oil is a powerful approach to cleaning up oil spills, and the first step is adding a bioremediation accelerator to form clumps that the bacteria will eat. Students perform experiments to determine the stoichiometric relationship between the accelerator molecules and the oil molecules so they can recommend the correct amount of accelerator. The reaction between the remediator and the oil provides a context for understanding stoichiometric proportions and limiting reagents.

NGSS Practices

Developing and Using Models	Planning and Carrying Out Investigations	Analyzing and Interpreting Data	Using Math and Computational Thinking	Constructing Explanations
Students obtain information from molecular representations to balance chemical equations.	Students use the virtual lab to mix solutions and create different amounts of a product, thinking about the ratio of the reactants.	Students interpret the results of the virtual lab to ascertain which substances are the reactants and which are the products when solutions are combined. They figure out which chemicals participate in a chemical reaction and which chemical is the limiting reagent.	Students balance chemical equations, determine the ratio between reactants, and calculate the number of moles of a solution needed to react with octane.	Students construct explanations around limiting reagents and spectator ions. They discuss what chemical equations and stoichiometric coefficients tell you about a reaction. Students also consider the importance of concentration rather than just the number of moles to determine how much of a substance is needed.

Useful Prior Content Knowledge

- Identifying reactants and products of chemical reactions
- Balancing chemical equations
- Limiting reagents
- Spectator ions

- Relationship between moles, grams, volume, and concentration
- Conversions

Structuring a Lesson Around the Activity

Pre-activity Questions

- Balance the chemical equation: __ Na + __Cl_2, → __ NaCl. If an equal amount of 10 grams of Na and Cl_2 are combined, which would be the limiting reactant?
- Place these salt solutions [NaCl(aq)] in order of increasing molarity:
  - 4.0 mol per 8.0 L
  - 6.0 mol per 6.0 L
  - 1.0 mol per 10.0 L

Post-activity Questions

- In the chemical equation below, label the reactants and products. Are there any substances that do not participate in the chemical reaction?
  - $2Na^{+}_{(aq)} + CO_3{}^{2-}_{(aq)} + Cu^{2+}_{(aq)} + SO_4{}^{2-}_{(aq)} \rightarrow 2Na^{+}_{(aq)} + SO_4{}^{2-}_{(aq)} + CuCO_{3\,(s)}$
- Define a limiting reactant. How can you tell if there is a limiting reactant in an experiment? How do you know which reactant is limiting?
- Why do chemical equations need to be balanced? Think about the virtual lab activities and reactions between octane and bioremediation accelerators to reason through your answer.
- Draw particle views for 1.0 M NaCl, 2.0 M NaCl, and 1.0 M Na_2S. Use different symbols for each element. Which solution(s) has the least ions present in the particle view?

Issues Students May Encounter

Page 59; Virtual Lab: AC Reaction

- ZC is the name of the solution and contrains two ions: C ions and Z ions. Be sure students look at the particulate viewer before they combine the solutions. Some students incorrectly assume ZC is a compound.
- Answer key: Only A and C are reactants. Z is not a reactant because it does not participate in the reaction.

Page 65; Virtual Lab: Balanced Equation of Octane and S-200 (and other virtual lab pages)

- Students must keep track of the amount of solution added. There is no mechanism in the virtual lab to figure this out after solutions have been combined.

Gravimetric Analysis

Testing for contaminents in drinking water

Through a combination of particulate-level representations and virtual lab activities, students learn how gravimetric analysis can be used to determine the concentration of various species in water. Students review precipitation reactions and use the virtual lab to find out which chemicals react to form precipitates. Using stoichiometry to connect mass to concentration, students determine if the water is safe to drink based on EPA guidelines.

NGSS Practices

Developing and Using Models	Planning and Carrying Out Investigations	Using Math and Computational Thinking	Constructing Explanations	Obtaining, Evaluating, and Communicating
Students use models to show the particulate view of a solution and precipitate during and after a precipitation reaction.	Students consider different laboratory techniques and determine what is appropriate, thinking about specificity, filtering, and weighing. They carry out investigations within the virtual lab, combining aqueous solutions to see if a solid forms and being sure that the chemical in question has completely precipitated out of the solution.	Students balance chemical equations, calculate molar mass, and think proportionally about the relationship between the number of moles and the mass of a substance.	Students construct explanations for why particular processes are necessary, how each chemical interacts when solutions are combined, and the importance of thinking about concentration and not just mass or number of moles.	Students compare the found concentrations of dissolved solids to EPA guidelines and decide whether the water is safe to drink.

Useful Prior Content Knowledge

- Soluble and insoluble solids; properties of solid and aqueous molecules
- Balancing chemical equations
- Relationship between grams, moles, volume, and concentration
- Calculating molar mass
- Conversions

- Precipitation reactions

Structuring a Lesson Around the Activity

Pre-activity Questions

- Describe the difference between soluble and insoluble solids? What happens to a soluble solid when it is mixed with water? How do you know if substance is insoluble?
- Balance the following chemical equations:
  - $H_2 + O_2 \rightarrow H_2O$
  - $N_2 + H_2 \rightarrow NH_3$
  - $Ca + H_2O \rightarrow Ca(OH)_2 + H_2$

Post-activity Questions

- Describe what needs to be true of the reactants and products in order to form a precipitation reaction that can be used in gravimetric analysis.
- For each chemical equation below, determine if gravimetric analysis could be used. Explain why or why not.
  - $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$
  - $2KOH(aq) + CaCl_2(aq) \rightarrow Ca(OH)_2(s) + 2KCl(aq)$
  - $CaI_2(s) + Cl_2(g) \rightarrow CaCl_2(s) + I_2(s)$
  - $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$
  - $2HCl(aq) + Zn(s) \rightarrow ZnCl_2(aq) + H_2(g)$
  - $SiO_2(s) + H_2O(l) \rightarrow H_2O(l) + SiO_2(s)$
- In the virtual lab, why was it necessary to add excess silver nitrate ($AgNO_3$) to the unknown chloride solution?
- Review the calculation below. Describe the purpose of each component of the equation.

$$0.215 \text{ g AgCl} \times \frac{1 \text{ mol AgCl}}{143.322 \text{ g AgCl}} \times \frac{1 \text{ mol Cl-}}{1 \text{ mol AgCl}} \times \frac{35.453 \text{ g Cl-}}{1 \text{ mol Cl-}} = 0.0532 \text{ g Cl}^-$$

Issues Students May Encounter

Page 85; Virtual Lab: Observing Precipitation Reactions (and other virtual lab pages)

- Sometimes the precipitate does not appear when it should. If this occurs, try:
  - Refreshing the page. Keep in mind that all work will be lost on virtual lab pages if refreshed.
  - Separating the vessels by clicking elsewhere on the page to observe the reaction.
  - Pouring one solution directly into the vessel that contains the other solution or use a 250 mL flask to combined both solutions.

Phase Changes

Exploring intermolecular and intramolecular forces

In the context of phase changes, students infer the strength of electrical forces within and between particles. Students conduct an investigation of vapor pressure, comparing the macroscopic, earth's water cycle, to the microscopic, the intermolecular forces of water and other gases in the atmosphere. Students learn about the heating curve model and the relationship between temperature and kinetic energy.

NGSS Practices

Developing and Using Models	Analyzing and Interpreting Data	Constructing Explanations
Students use the heating curve of water to understand temperature changes and phase transitions.	Students consider experiments in which heat is added to water. They analyze changes in the average kinetic energy of particles, the state of water, and the attractive forces between water molecules.	Students explore what is happening at the molecular level during phase changes and interpret differences in melting point/boiling point as it relates to strong or week attractive forces.

Useful Prior Content Knowledge

- Temperature
- Kinetic energy
- Heating curve diagram; relationship between heat added and temperature
- Solid, liquid, or gaseous states
- Attractive forces: Inter- and intramolecular forces
- Melting and boiling point

Structuring a Lesson Around the Activity

Pre-activity Questions

- Recall what you have learned about phase changes in your previous science classes. Write down what you know (or have questions about) regarding states of water, phase changes, or Earth's water cycle.
- You put a kettle of water on the stove. Describe and make predictions about what will happen to the water as it is heated.
- Is heat the same as temperature? Why or why not? Provide an example to support your argument.

Post-activity Questions

- When heating a solution, you detect an increase in temperature. What is happening at the molecular level? You continue to add heat, but the temperature is no longer increasing. What is happening then?
- Consider substances other than water, and make predictions about their relative attractive forces. Provide your reasoning for each substance.

Solar Plant

Finding the optimal material for solar plant design

This activity covers temperature, heat transfer, and heat capacity in the context of renewable and sustainable energy. The setting is a solar plant that uses thousands of mirrors to reflect sunlight onto the top of a tower, where the thermal energy from the sun is transferred to a liquid. The liquid then flows into an electric plant where the stored thermal energy is converted to electrical power. By designing and testing experiments, students consider heat capacity and boiling point as they establish the best substance for storing and transferring thermal energy.

NGSS Practices

Developing and Using Models	Planning and Carrying Out Investigations	Using Math and Computational Thinking	Constructing Explanations
Students explore the relationship between temperature, heat flow, and the speed of particles through animated molecular models.	Students design tests, selecting independent variables, dependent variables, and constants. Using the virtual lab, students experiment with mass and heat to compare changes in temperature of three salt blends.	Students calculate change in temperature based on initial and final temperatures and consider the relationship between energy released and time (kJ).	Students evaluate the specific heats of substances to find the material that would require the most heat to raise the temperature and the material that would store the most heat.

Useful Prior Content Knowledge

- Experimental design: constants, dependent variables, independent variables
- Temperature and kinetic energy of particles
- Thermal energy
- Heat transfer
- Specific heat and heat capacity
- Boiling point

Structuring a Lesson Around the Activity

Pre-activity Questions

- If I have a substance that is 20°C and you add heat so that the final temperature is 42°C. What is the change in temperature?
- A researcher is interested in studying how the amount of time spent studying influences test scores. Define dependent variable, independent variable, and constant. Then, indicate what variables in the study might be the DV, IV, and constant.

Post-activity Questions

- Equal amounts of heat are absorbed by 100g samples of two solid metals with differing specific heat. First, define specific heat. Then, compare the metal with the lesser and greater specific heat. Which undergoes the smallest change in temperature?
- When you bite into a freshly baked pizza, you are more likely to burn yourself on the sauce than on the crust, even though the whole pizza (crust and sauce), were in the same oven and based at the same temperature. Why is this the case?
- Consider the use of a thermometer, which uses mercury in the interior. Use your knowledge of chemistry, including concepts such as heat transfer and specific heat, to think about how thermometers work. Would the thermometer still work effectively if there was water instead of mercury inside?

Hot and Cold Packs

Exploring heat transfer through the design of hot and cold packs

In this activity, students explore heat transfer and temperature by considering the design of hot and cold packs used to treat minor injuries. In the virtual lab, students evaluate substances by comparing their change in temperature when added to water. Students investigate kinetic energy at the molecular level and connect heat transfer to transfer of kinetic energy between systems. Throughout, students learn that endothermic and exothermic reactions are linked to the design of hot and cold packs.

NGSS Practices

Developing and Using Models	Planning and Carrying Out Investigations	Analyzing and Interpreting Data	Constructing Explanations	Obtaining, Evaluating, and Communicating
Students complete chemical equations by placing of heat on either the reactant or product side to represent endothermic or exothermic reactions.	Students design and carry out experiments by adding various chemicals to water samples. They record the temperature or change in temperature after a reaction is complete.	After testing substances in the virtual lab, students determine whether a reaction is endothermic or exothermic and, given these properties, if the substance would be best used for a hot pack or cold pack.	In thinking about heat transfer, students determine the source, drain, and flow of heat. Students consider bond breaking and making and whether energy is released or absorbed. They label reactions as endothermic or exothermic based on evidence.	Students compare the results from all the experiments to evaluate the best substance for a hot pack and cold pack.

Useful Prior Content Knowledge

- Temperature
- Heat transfer
- Kinetic energy and potential energy
- Endothermic and exothermic processes

- Bond breaking and making

Structuring a Lesson Around the Activity

Pre-activity Questions

- Suppose that you mix two water samples: 300g of water at 20°C and 200g of water at 50°C. What do you expect the final temperature of the water to be?

Post-activity Questions

- A hot object is placed next to a cold object so that they are touching. Describe what happens to both objects. Be sure to describe the speed of particles and heat flow.
- Determine whether the following processes are endothermic or exothermic. Explain your thinking.
  - boiling ethanol
  - freezing liquid mercury
  - subliming carbon dioxide
- In the virtual lab, you added 10g of KCl to a cup of water at 25°C. The final temperature was 19.64°C. Compare the average kinetic energy of the particles before and after KCl was added. Describe what you would expect to see if you had a molecular view of the water in the cup.
- What is the relationship between temperature, heat, and kinetic energy?

Equilibrium

Using color change reactions to explore chemical equilibrium

This activity uses color change reactions to cover topics in chemical equilibrium, including the nature of reversible reactions and the use of LeChatlier's principle. Students investigate the concentration of reactants and products and connect this balancing forward and reverse reaction rates at equilibrium.

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Students arrange solutions and molecular views to match the relative concentrations of reactants and products. They evaluate forward and reverse chemical reaction equations and consider the different ways particles can be represented.	Students make predictions then test what happens to solutions when heat or other substances are added.	Students interpret the virtual lab results and select what happens to the rate of the forward reaction and the overall system. They also determine whether a reaction is endothermic or exothermic.	Students define the state of equilibrium and provide plausible explanations for system shifts and reaction rate changes when chemicals or heat are added.

Useful Prior Content Knowledge

- Concentration and color change
- Equilibrium
- Forward and reverse reactions
- Endothermic and exothermic reactions
- Le Chatelier's principle

Structuring a Lesson Around the Activity

Pre-activity Questions

- Describe the relationship between color and concentration. What might a change in color indicate?
- What are signs of a chemical reaction?
- Brainstorm some ways you can speed up a reaction.

Post-activity Questions

- A student obtained a test tube with white, slightly soluble calcium hydroxide in water. This system was at equilibrium as represented by the following equation: $Ca(OH)_2(s) \rightleftharpoons Ca_2^+(aq) + 2OH^-(aq)$
  - What macroscopic observation would you expect regarding the amount of solid precipitate in the system at equilibrium if hydrochloric acid, HCl(aq), were added? Explain your answer using Le Chatelier's principle.
  - What macroscopic observation would you expect regarding the amount of solid precipitate in the system at equilibrium if calcium nitrate solution were added? Explain your answer using Le Chatelier's principle.
  - When the solution was placed in an ice bath and cooled, it was observed that the solid calcium hydroxide precipitate was produced. Based on this observation would you expect the reaction to be exothermic or endothermic?
  - If the solution were placed in a hot water bath and heated, would you expect the amount of solid calcium hydroxide precipitate to increase, decrease, or stay the same?