Concentrated Solutions – Grade 5, Level 3

Lesson Overview

In this lesson, students will construct explanations, ask questions, plan and carry out investigations, analyze and interpret data and develop models in order to understand how the amount of solute and solvent determine the concentration of a solution.

Alignment

Science Standard/Indicator Addressed

5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.

Performance Indicator

5.P.2B.4 Construct explanations for how the amount of solute and the solvent determine the concentration of a solution.

Science and Engineering Practices (as appropriate)

5.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

5.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

5.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

5.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.

5.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

5.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4)

support hypotheses, explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.

ELA Inquiry Standards (as appropriate)

1.1 Formulate questions to focus thinking on an idea to narrow and direct further inquiry.

3.1 Develop a plan of action for collecting relevant information from primary and secondary sources.

3.2 Organize and categorize important information; collaborate to validate or revise thinking; report relevant findings.

4.1 Draw logical conclusions from relationships and patterns discovered during the inquiry process.

4.2 Reflect on findings to build deeper understanding and determine next steps.

Connections

Disciplinary Literacy Strategies (for Purposeful Reading, Meaningful Writing, and Productive Dialogue)

- Highlighting
- Stem Completion Notes
- Notebooking or Journal entry
- Proof Paragraph
- Give me Five
- Think-Ink-Pair-Share
- Think-Pair-Share

Computational Thinking

*Computational thinking (CT) is a problem-solving process that includes (but is not limited to) the following **characteristics**:*

- Formulating problems in a way that enables us to use a computer and other tools to help solve them.
- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources

- Generalizing and transferring this problem solving process to a wide variety of problems

These skills are supported and enhanced by a number of dispositions or attitudes that are essential dimensions of CT. These ***dispositions or attitudes*** *include:*

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- The ability to deal with open ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Lesson Plan

Time Required – Three 60-minute class periods

Disciplinary Vocabulary – mixture, solution, solute, solvent, concentration

Materials Needed:

Day 1

Each group needs:

- Two - 500 mL containers (plastic or glass)
- Six– 15-50mL clear vials (plastic or glass)
- 10 mL Pipette or medicine dropper
- graduated cylinder
- water

For the entire class to share:

- food coloring

Day 2

Each group needs:

- One- 500mL plastic container
- Styrofoam cup for each group member (Taste Test)
- 5mL scoop
- Drinking water (1 liter will make 4 rounds)

Formative Assessment Strategies: Students record individual answers in notebook, record group answer in notebook, data collection

Computational Thinking:

Students will:

- collect and ***logically organize and analyze data*** in order to answer the question relating to the concentration of a solution.
- ***Identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources*** while they select the best concentration ratio given the problem.
- ***communicate and work with others*** to achieve the best recipe for their drink mix.
- ***Generalizing and transferring this problem solving process to a wide variety of problems***

Misconceptions:

Students often do not distinguish between the processes of melting and dissolving. Students know they add solids to liquids but cannot explain where they go.

Safety Note(s):

- Students should wear safety glasses or goggles during the investigations.
- On Day 2, students will be allowed to taste their solutions. They should be reminded they do not typically taste things in the science lab and NEVER do so without being instructed!

Engage

- Daily items in our homes are bought in "concentrate."
- Ask the class to think of examples and record on the board.
- Ask Students to record in their science notebooks what it means if something is concentrated.

- Share their answers with their partner.
- Square to make a group of 4. Each person should share what their partner said.
- Develop a definition that demonstrates the understanding of all members of the group.
- Record the group answer in your notebook.

Explore

Setup

- Tell students we are going to make a solution with food coloring and water. Identify the solute and the solvent. Record in their notebooks.
- Give each group two large containers to hold water, one for pure water and one to rinse pipette, and 4-8 smaller containers (the vials) for their solutions.
- Have each group obtain several 5 drops of food coloring dye, placing it in one of the clear vials. (any color)

Investigate

- Use the graduated cylinder to measure 10 mL of water to place in the container with the food coloring. Gently swirl the vial to help the dye dissolve in the liquid.
  (Make sure you rinse both pipette and graduated cylinder each time they are used.)
- Record the concentration as 5 drops/10 mL
- Record observations *color
- Remove 1 mL of solution from vial #1 and place it in vial #2
- Add 9 mL of water to vial #2. Gently swirl the solution.
- Record observations *color compare to vial #1 (They may or may not notice a slight decrease in color intensity in the vial #2)
- Have students continue with the dilution process. Each time they make a new solution, have them take 1 mL from the vial immediately preceding the current vial (for instance, vial #3 will have 1 mL of solution from vial #2, not from vial #1). Then add 9 mL of water. Have them record color comparisons for each solution.
- Record answers to the following questions in your notebook:
    - When the solution appears colorless, does this mean the dye is no longer present in the water? (No, it did not disappear, just because you can't see it does not mean it is not there.)

    - What happened to the concentration of the food coloring? (The solution became less concentrated)
    - Can we control the concentration of a solution? (Yes, more solute and/or less solvent is more concentrated. Less solute and/or more solvent is less concentrated.)
- Draw a model that explains concentration in your notebook. Use only one color of marker of pencil.

Day 2

We will continue our lesson on concentration. Today, we need to help a friend solve a problem. Susie works at Kool Aid plant and she has lost the directions that are supposed to be printed on the label. How will consumers know how to mix their Kool Aid?

This will be a tasty investigation. Remember we do not typically taste things in the science lab and NEVER do so without being instructed!

- Each group has been given supplies to help Susie figure out the directions that should be printed on the label.
- Start with 250mL of water each test. Record the solute in increments of 5mL.
- Design a Data Chart to collect your data.
- Notes: Extension Knowledge would require students to identify the quantitative relationships (ratio) of solute and solvents in specific percent concentrations for solutions.
- Record your results
- Answer these questions in your notebook:
    - What happened to the concentration of the Kool Aid solution? Answer in a cause and effect statement. If I did …. Then this …
    - Can we control the concentration of a solution? (Yes, more solute and/or less solvent is more concentrated. Less solute and/or more solvent is less concentrated.)
    - What were the directions you sent to Susie to print on the label?
    - Did everyone in your group have the same directions? Why or Why not?
- Revise your model to explain concentration. Use a different color from yesterday.

Explain

Day 3

- Complete Stem notes with your group based on your inquiry experiences. The words that will go in the blanks are your vocabulary words such as solute, solvent, concentration and words like more or greater, and decrease and less.
  - Student Stem notes (fill in the blank note sheet) to be given
  - Teacher will project notes, complete and highlight modeling for the students.
- Students will highlight key words and phrases to reinforce causal relationship between solute, solvent and concentration.
- Student groups will receive their original explanation of concentration. They will decide individually if their current definition is the same or has it changed. They will discuss with their partner why their definition has changed or has not changed.
- Invite 5 to share their answers
- Students will write a Proof Paragraph to answer the question:
  Can you change the concentration of a solution?

Other information on this indicator(s) can be found in the support documents/resources on the SC State Department website.

www.ed.sc.gov (Instruction → Standards and Learning → Mathematics or Science → Support Documents and Resources)

Content Area (Disciplinary) Literacy strategies and descriptions can be found on the S2TEM Centers SC website:

s2temsc.org (Resources → Disciplinary Literacy Virtual Library → Strategy Warehouse)

Computational Thinking Reference:

https://csta.acm.org/Curriculum/sub/CurrFiles/CompThinkingFlyer.pdf
https://csta.acm.org/Curriculum/sub/CompThinking.html

Additional Information

Level 1 lessons contain a realignment to the 2014 Science and/or the 2015 Mathematics Standards.

Level 2 lessons contain Level 1 information and Content Area Literacy and Disciplinary Literacy Strategies.

Level 3 lessons contain Level 1 and 2 information and Computational Thinking Connections.

Level 4 lessons contain Level 1, 2, and 3 and integration of at least 2 content areas.