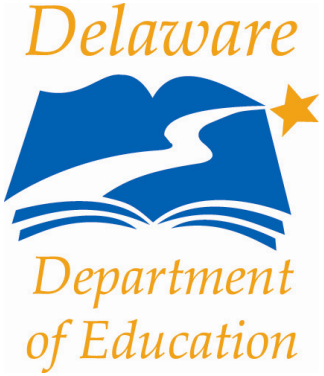
Delaware Science Coalition

Grade 5 Mixtures and Solutions Unit Template



Preface: This unit has been created as a model for teachers in their designing or redesigning of course curricula. It is by no means intended to be inclusive; rather it is meant to be a springboard for teacher thought and creativity. The information we have included represents one possibility for developing a unit based on the Delaware content standards and the Understanding by Design framework and philosophy.

Brief Summary of Unit

Students investigate properties of mixtures and solutions, dissolving a solid in a solvent, concentration and saturation of a solution, evidence of reactions, evaporation, and crystal formation. Students gain experience with laboratory tools and techniques.

Stage 1: Desired Results

Delaware Science Content Standards

Delaware Science Content Standards

This course focuses on the Delaware Science Content Standards and Grade Level Expectations in Standards 1 and 2 found on the following web site: http://www.doe.k12.de.us/programs/ci/content_areas/science.shtml

Standard 1: The Nature and Application of Science and Technology

Understandings and Abilities of Scientific Inquiry

Students should know and be able to:

1. Understand that: Scientific investigations involve asking a focused scientific question. Investigations differ depending upon the question being asked.
    - Be able to: Generate focused questions and informed predictions about the natural world.
2. Understand that: Fair test design supports the validity of the investigation. Sometimes it is not possible to know everything that will have an effect on the investigation or control all conditions.
    - Be able to: Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested.
3. Understand that: The purpose of accurate data collection is to provide evidence to compare with the prediction.
    - Be able to: Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Compare and question results with and from others.
4. Understand that: The body of scientific knowledge grows as scientists ask questions, conduct investigations, develop explanations and compare results with what is already known.
    - Be able to: Construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation.
5. Understand that: The purpose of communicating is to share and justify results. Scientists communicate their results to others,

including the details that allow others to replicate the results.

- Be able to: Communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument.

6. Understand that: The use of mathematics, reading, writing, and technology are important in conducting scientific inquiries.
   - Be able to: Use mathematics, reading, writing, and technology when conducting scientific inquiries.

Science, Technology, and Society
Students should know that:

1. Science and technology are related. Technology provides the tools needed for science to investigate questions and may provide solutions to society's problems, wants, or needs. Not all technological solutions are effective, uniformly beneficial, or equally available to everyone.

Students should be able to:

- Research and report on recycling of household materials (e.g., glass, newspaper, plastics) and how these materials are reused.
- Identify safety equipment (e.g., goggles, gloves) and procedures (e.g., washing hands, wafting, not eating) used in classroom science investigations. Explain how these promote healthy living and prevent injuries.

Standard 2: Materials and Their Properties
Properties and Structures of Materials
Students should know that:

1. Observable physical properties can be used to classify materials. These physical properties may include solubility, mass, magnetism, and electrical conductivity. Tools such as graduated cylinders, balances, rulers, magnifiers, simple circuits, and magnets are used to study the physical properties

Students should know that:

2. Heating and cooling of materials may produce changes in the state of solids, liquids and gases.

Mixtures and Solutions
Students should know that:

1. Most materials are physical mixtures. Physical mixtures can be composed of different kinds of materials, each having distinct physical properties. These physical property differences can be used to separate, sort, and group the materials of the mixture.
   - Separate the components of a mixture by using the physical properties of the components and choosing the appropriate processes (e.g., evaporation, filtering).

Students should know that:

2. Mixtures can consist of different combinations of solids and/or liquids. The characteristics of these resulting mixtures depend on the relative amounts and properties of the components.

Students should know that:

3. Physical properties can be used to separate mixtures through techniques such as filtration and evaporation.

Students should be able to:

- Make and implement a plan to separate mixtures. Revise the plan based on evidence collected. Record and communicate the results.

Students should know that:

4. When a solid is dissolved in a liquid, a solution is formed that can be separated through the process of evaporation

Students should be able to:

- Combine different amounts of solid material and water. Compare the properties of these solutions, (i.e., color, viscosity, clarity).
- Determine the quantities of two different materials (e.g., salt and sugar) required to saturate equal volumes of water and compare the results. Recognize that some materials are more soluble in water than other materials.

Conservation of Matter

Students should know that:

1. The mass of an object remains unchanged when broken into parts. The sum of the parts equals the whole

Students should be able to:

- Compare the mass of mixtures and solutions to the mass of their component parts.
- Explain why the total amount of a material remains the same even when exposed to a variety of physical treatments (e.g., flattening or balling up clay, breaking apart a candy bar, pouring liquid into a tall, slender glass vs. a short, fat glass).

Big Ideas

- **Materials** have **observable** and measurable properties that can be **changed**.
- **Materials** have uses based on their **structure and properties**.
- Solutions are defined through **observation** and **evidence.**

Unit Enduring Understandings

Students will understand that…

1. The structures of materials determine their properties.

2. The properties of a mixture are based on the properties of its components.

3. Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation.

4. The properties of a solution are based on the properties of its components.

5. A solution is a mixture, but a mixture is not always a solution.

Unit Essential Question(s)

- What makes a question scientific?
- What constitutes evidence?
- When do you know you have enough evidence?
- Why is it necessary to justify and communicate an explanation?
- How do the properties of materials determine their use?
- How can the properties of the components of a mixture be used to separate the mixture?
- How do the components determine the properties of mixtures?

Knowledge & Skills

Students will know:

- A mixture is composed of two or more materials. The materials each have their own physical properties.
- There are two kinds of mixtures- a suspension and a solution.
- In a solution, the substances that have been mixed seem to disappear. Individual parts of the substances are not identifiable.
- A suspension is a mixture in which parts of the individual substances can be seen.
- Evaporation is the process of water changing into water vapor in the air.
- Evaporation, filtration and/or screens can be used to separate some mixtures.
- Simple tools can be used to separate mixtures.
- Crystals can be identified by their properties.
- A saturated solution is a mixture in which the solvent has dissolved as much materials as possible.
- Solubility is the ability to dissolve a material in a solvent.
- The mass of the mixture is equal to the mass of the parts.
- The amount of material dissolved in a liquid is the concentration.
- Liquids take the shape of their containers and are measured by volume.

- Chemical changes occur when the original substances results in new substances.
- A precipitate is a solid material that forms as a result of a chemical reaction.
- During chemical reactions, a gas may result.

Students will be able to….

- Identify safety rules and equipment to be used when working with chemicals.
- Work in cooperative groups.
- Observe materials and accurately record the observations.
- Investigate what happens when water is added to gravel, salt, and a powder. Make and record observations.
- Discuss investigation results with others.
- Justify explanations using evidence.
- Use a screen, filter, and the process of evaporation to separate substances.
- Find the mass of materials.
- Use tools to accurately measure (syringe in mL, mass in grams).
- Make and follow a plan to separate a mixture of dry materials.
- Investigate the saturation of salt in water.
- Weigh individual substances, combine the substances, and determine the total weight.
- Investigate the solubility of citric acid in water.
- Separate citric acid from water.
- Make and follow a plan to saturate water with a mystery powder (Epsom salts).
- Make concentrated solutions.
- Investigate the results of reactions involving calcium chloride and baking soda, calcium chloride and citric acid, and baking soda with citric acid.

Stage 2: Assessment Evidence
(Design Assessments To Guide Instruction)

Suggested Performance Task(s)

This Mixtures and Solutions unit is assessed through the use of an end-of-unit summative assessment. This assessment is intended

to uncover student misconceptions which will then direct instruction. Both the student guide and teacher directions and rubrics are included. To access the end-of-unit summative assessment, go to the website listed below. Click on the Delaware Science Comprehensive Assessment Program.

http://www.doe.k12.de.us/programs/ci/content_areas/science.shtml

Key Transfer Ideas:

1. Understand the nature of mixtures and their properties. Mixtures can be made up of solids, liquids, or gases or any combination thereof.
2. Measure the mass and volume of solids and liquids.
3. Understand that solutions are special forms of mixtures that have varying concentrations with different properties.

Student Expectations:

- Predict the components of a mixture.
- Weigh a mixture to determine its mass and correctly record the mass with its units (grams).
- Make a plan to separate the mixture using three different tools. Describe how the tools will separate the mixture.
- Describe how evaporation can be used to determine if any substances are dissolved in the liquid.
- Identify that the mass of the total mixture would be equal to the sum of the mass of the individual parts.
- Observe and record two physical properties for each of three liquids.
- Conduct a coating test on each liquid.
- Conduct the smear test on each of three liquids.
- Observe and record changes to the physical properties of liquids when water is added.
- Organize data in a bar graph.
- Recognize that dilution decreases the mass of a substance.
- Analyze data, recognize a trend, and make a prediction.
- Use data to identify a solvent that dissolves the most solvent.
- Understand that a clear liquid may contain dissolved substances that cannot be seen.

Other Evidence

Formative Assessments from FOSS Manual Mixtures and Solutions Assessment

- Response Sheet – Separating Mixtures, Investigation 1: Separating Mixtures , Part 2: Separating a Salt Solution
- Teacher Observation – Procedures Student Sheet – Separating a Dry Mixture – Investigation 1: Separating Mixtures – Part 4: Separating a Dry Mixture
- Response Sheet – Reaching Saturation – Investigation 2: Reaching Saturation – Part 2: Citric-Acid Saturation
- Response Sheet – Concentration – Investigation 3: Concentration – Part 2: Salt Concentration
- Response Sheet – Fizz Quiz – Investigation 4: Fizz Quiz – Part 2: Reaction Products
- End-of-Module Assessment – use pages as formative assessment pieces
- Teacher Observation -Assessment Chart for Investigation 1
- Teacher Observation - Assessment Chart for Investigation 2
- Teacher Observation - Assessment Chart for Investigation 3
- Teacher Observation - Assessment Chart for Investigation 4
- FOSS Science Stories Mixtures and Solutions Comprehension Questions

Student Self-Assessment and Reflection

- Teacher Observation – Procedures Student Sheet – Mixtures and Solutions Journal – Investigation 2: Reaching Saturation – Part 3: The Saturation Puzzle

- Teacher Observation – Procedures Student Sheet – Mixtures and Solutions Journal – Investigation 3: Concentration – Part 3: Mystery Solutions

Stage 3: Learning Plan
(Design Learning Activities To Align with Goals and Assessments)

Key learning events needed to achieve unit goals

The Regents of the University of California. FOSS *MIXTURES AND SOLUTIONS.* Delta Education. 2000.

Investigation 1 Separating Mixtures

Part 1 -Making and Separating Mixtures
Students will make mixtures and solutions with different solid materials and water and use filters and screens to separate the mixtures. Students discover special kinds of mixtures and solutions that can only be separated by evaporation.
Part 2 – Separating a Salt solution
Students investigate the conservation of mass by comparing mass of solutions to mass of their parts.
Part 3 – Observing Crystals
Students identify the pattern of salt crystals left behind following the separation in Part 2.
Part 4 – Separating a Dry Mixture
Students separate and mixture of gravel, powder, and salt by using filtering and evaporation.

Investigation 2 Reaching Saturation
Part 1 – Salt Saturation
Students add salt to water until the solution becomes saturated. Students use a balance to determine the amount of salt that went into solution.
Part 2 – Citric Acid Saturation
Students add citric acid to water until the solution becomes saturated. Students use a balance to determine the amount of citric acid that went into solution. Students compare the solubility of citric acid and salt in water.
Part 3 – The Saturation Puzzle
Students identify an unknown material by determining the mass it takes to saturate fifty milliliters of water.
Part 4 – Comparing the Crystals
Students identify and compare citric acid and Epson salt crystals and compare them to salt crystals.

Investigation 3 – Concentration
Part 1 – Soft-Drink Recipes
Students make and compare Kool-Aid solutions that vary in the amount of water to learn the concept of concentration.
Part 2 – Salt concentration
Students use a balance to determine the relative concentration of salt solutions.
Part 3 – Mystery Solutions
Students determine the relative concentration of three mystery solutions to determine which is the most concentrated and which is the most dilute.

Investigation 4 – Fizz Quiz
Part 1 – Chemical Reactions

Students look for evidence of chemical reactions by mixing combinations of calcium chloride, baking soda, and citric acid with water and observe changes that occur.
Part 2 – Reaction Products
Students use filtering and evaporating techniques to separate and study the products of the reactions.
Part 3 – Reaction in a Zip Bag
Students place combinations of materials from Part 1 and 2 in a Zip Lock bags and observe products of chemical reactions.
Part 4 – Choosing Your Own Investigation
Students review the investigations they have completed in the past several weeks and identify a subject they would like to investigate in greater detail.

Resources & Teaching Tips

FOSS Science Stories

- Mixtures and Solutions
- A Salty Story
- Decompression Sickness
- Sour Power
- Grow Your Own Crystals
- The Air You Breathe
- What a Reaction!
- Ask a Chemist
- The Periodic Table
- The History of Rubber

Student Reading- Non-Fiction

- Chemical Chaos by Nick Arnold
- Chemistry by Chris Oxlade
- Investigating Solids, Liquids, and Gases with Toys by Jerry Sarquis
- Louis Pasteur, Young Scientist by Francene Sabin
- Marie Curie, Brave Scientist by Keith Brandt
- Science Experiments You can Eat by Vicki Cobb
- Oobleck – Bartholomew and the Oobleck by Dr. Seuss

FOSS Video Mixtures and Solutions

Foss Mixtures and Solutions Website (www.fossweb.com)

What tips to teachers of the unit can you offer about likely rough spots/student misunderstandings and performance weaknesses, and how to troubleshoot those issues?

Conservation of Mass – use better scales than what comes in the kit or do as a teacher demo.

Challenge the students to bring in products/labels/boxes, etc. that contain Citric Acid

Make ice-cream in a zip lock bag.

Accommodation/Differentiation ideas and tips