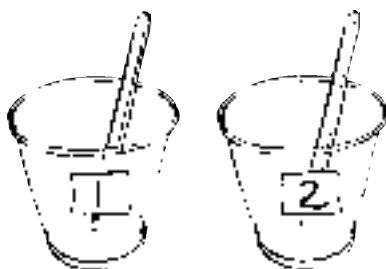


OVERVIEW

MIXTURES AND SOLUTIONS



GOALS

Chemistry is the study of the structure of matter and the changes or transformations that take place in it. Learning about the makeup of substances gives us knowledge about how things go together and how they can be taken apart. Learning about changes in substances is important for several reasons: changes can be controlled to produce new materials; changes can be used to give off energy to run machines. The **Mixtures and Solutions Module** has four investigations that introduce students to these fundamental ideas in chemistry.

FOSS EXPECTS STUDENTS TO

- Gain experience with the concepts of mixture and solution.
- Gain experience with the concepts of concentration and saturation.
- Gain experience with the concept of chemical reaction.
- Apply an operational definition to determine the relative concentrations of solutions.
- Use group problem-solving techniques to plan investigations.
- Use measurement in the context of scientific investigations.
- Apply mathematics in the context of science.
- Acquire vocabulary associated with chemistry and the periodic table.
- Be introduced to the concept that all matter is made of very small particles called atoms and that atoms combine to form molecules.
- Use scientific thinking processes to conduct investigations and build explanations: observing, communicating, comparing, organizing, and relating.

OVERVIEW CONTENTS

Goals	1
FOSS and National Science Education Standards	2
Science Background	3
Working in Collaborative Groups	8
Encouraging Discourse	9
Guiding FOSS Investigations	10
Assessing Progress	11
Integrating the Curriculum	12
FOSS for All Students	13
The FOSS Teacher Guide Organization	14
The FOSS Investigation Folio Organization	15
Scheduling the Mixtures and Solutions Module	16
Safety in the Classroom	17
Mixtures and Solutions Module Matrix	18
FOSS Staff	20

MIXTURES AND SOLUTIONS MODULE MATRIX

SYNOPSIS

SCIENCE CONTENT

THINKING PROCESSES

1. SEPARATING MIXTURES

Students make mixtures of water and solid materials (salt, gravel, and diatomaceous earth) and separate the mixtures with screens and filters. They find that water and salt make a special kind of mixture, a solution, that cannot be separated with a filter but only through evaporation.

- A mixture combines two or more materials that retain their own properties.
- A solution forms when a material dissolves in a liquid (solvent) and cannot be retrieved with a filter.
- Evaporation can separate a liquid from a solid in a solution.
- The solid material separated by evaporation from a solution forms distinctive patterns.

- Measure solids and liquids to make mixtures and solutions.
- Observe the behavior of solid materials in water.
- Compare the weight of a mixture to the weight of its parts.
- Organize observations on a student sheet.
- Communicate observations.

2. REACHING SATURATION

Students make a saturated solution by adding salt to water until no more salt will dissolve. They also make a saturated citric-acid solution. Using a balance, they compare the solubility of the two solid materials by comparing the mass of the salt and citric acid dissolved in the saturated solutions. They use the property of solubility to identify an unknown material.

- Solubility is the property that substances have of dissolving in solvents. Solubility is different for different materials and can change with temperature and different solvents.
- A solution is saturated when as much solid material as possible has dissolved in the liquid.
- When equal volumes of two solutions made from the same ingredients are compared, the heavier one is the more concentrated solution.

- Observe the behavior of a saturated solution.
- Compare the quantities of two solid materials required to saturate a volume of water.
- Relate the added weight of the solution to the dissolved material in the saturated solution.
- Compare the solubility of materials in water.
- Communicate observations.

3. CONCENTRATION

Students observe and compare soft-drink solutions that differ in the amount of powder (water held constant) and that differ in the amount of water (powder held constant) to develop the concept of concentration. They make salt solutions of different concentrations and compare them, using a balance. They determine the relative concentrations of three mystery solutions made from the same solid material.

- Concentration expresses a relationship between the amount of dissolved material and the volume of solvent.
- The more material dissolved in a liquid, the more concentrated the solution.
- A concentrated solution can be made more dilute by adding solvent to the solution.

- Measure volumes of solids and liquids to make solutions that differ either in amount of solid material or in amount of water.
- Relate the concentrations of a solution to the amount of solid material dissolved in a volume of water.
- Determine the relative concentrations of solutions.

4. FIZZ QUIZ

Students systematically mix combinations of solid materials (calcium chloride, baking soda, and citric acid) with water and observe changes that occur. The changes (formation of a gas and a white precipitate) are identified as chemical reactions. Students investigate these reactions and the materials that are produced.

- When a change results from mixing two or more materials, that change is a chemical reaction. A reaction results in new materials.
- Formation of a gas is one change that occurs in some reactions.
- Formation of a precipitate occurs in some chemical reactions.
- Not all chemicals react when they are mixed.

- Measure solids and liquids while conducting chemical reactions.
- Compare properties of precipitates to determine their identities.
- Determine all possible pairs of reactants involving a set of three chemicals.

Language Extension

- Invent a gorp recipe.

Math Extension

- Problem of the week.

Science Extensions

- Find out if something dissolves.
- Research diatomaceous earth.
- Research sodium chloride.

See the Science Stories folio.

- *Mixtures and Solutions*
- *A Salty Story*
- *Earth Elements*

www.fossweb.com

Check the FOSS website for interactive simulations, to write questions to a scientist, for teaching tips, and to talk with other classes using FOSS.

Home/School Connection: Students make oobleck, a mixture of cornstarch and water, and explore its properties.

Language Extensions

- Define saturation.
- Make it crystal clear.
- Find citric acid.
- Research citrus fruits.

Math Extensions

- Problem of the week.
- Graph the saturation relationship.

Science Extensions

- Make concentration rainbows.
- Make other saturated solutions.
- Change the temperature.
- Find out if time affects saturation.
- Compare crystals of several chemicals.
- Dissolve two materials in one solution.
- Grow really big crystals.

See the Science Stories folio.

- *Decompression Sickness*
- *Sour Power*

Home/School Connection: Students make a mixture resulting in a homemade version of Silly Putty. They modify the recipe to change the properties of the product.

Language Extensions

- List descriptive words.
- Play a game of Concentration.

Math Extensions

- Problem of the week.
- Calculate drink cost.

Science Extensions

- Make concentration rainbows.
- Compare the crystals.
- Investigate drinks.
- Investigate dilution.
- Make unknown concentrations.

See the Science Stories folio.

- *Grow Your Own Crystals*
- *The Air You Breathe*

Home/School Connection: Students broaden their understanding of crystal formation to include crystals that form in a solution, and crystals that form in air above a solution through wicking on a substrate. Two tried-and-true techniques for making crystals are suggested for students to try with friends and families at home.

Language Extensions

- Describe the reaction.
- List descriptive words.
- Apply the reaction.

Math Extension

- Problem of the week.

Science Extensions

- Compare the crystals.
- Compare the reactions.
- Investigate limiting chemicals.
- Investigate baking powder and baking soda.

See the Science Stories folio.

- *What a Reaction!*
- *What Is Matter Made Of?*
- *Ask a Chemist*
- *The Periodic Table*
- *The Metals*
- *The History of Rubber*

Home/School Connection: Students work on their chosen projects at home.



FOSS AND NATIONAL STANDARDS

The **Mixtures and Solutions Module** encourages students to develop the skills of investigation in order to build explanations based on knowledge and evidence. This module supports the following National Science Education Standards.

SCIENCE AS INQUIRY

Develop students' abilities to do and understand scientific inquiry.

- Generate questions; design and conduct scientific investigations to answer those questions.
- Employ tools to gather, analyze, and interpret data.
- Use data to construct reasonable explanations.
- Develop and communicate explanations using evidence.
- Analyze alternative explanations and predictions.
- Understand that scientists use different kinds of investigations and tools to develop explanations using evidence and knowledge.

CONTENT: PHYSICAL SCIENCE

Develop students' understanding of properties of matter and changes in properties of matter.

- Substances have characteristic properties, such as solubility. A mixture of substances often can be separated into the original substances using one or more of the properties.
- Substances react chemically in characteristic ways with other substances to form new substances.
- More than 100 known elements (92 of them naturally occurring) combine in a multitude of ways to produce compounds, which account for the living and nonliving substances in our world.

SCIENCE AND TECHNOLOGY

Develop students' understandings about science and technology.

- Scientists work collaboratively in teams and use tools and scientific techniques to make better observations.

HISTORY OF SCIENCE

Develop an understanding of science as a human endeavor.

- Science and technology have been practiced by people for a long time.