Mixtures and Solutions
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Teacher’s Guide

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# Mixtures and Solutions

**Teacher’s Guide**

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Mixtures and Solutions
Teacher's Guide
Grades 5-8

Introduction

This video is geared towards students in grades 5 - 8. The goal of the program is to familiarize students with the principles of physical science, by exploring the way that matter is categorized and described as well as exploring the classes of matter, mainly mixtures and solutions.

Links to Curriculum Standards

This video correlates to the following:
A. National Science Education Standards for Grades 5-8
   Physical Science (Content Standard B)
   Properties and Changes of Properties of Matter
B. Benchmark for Science Literacy (American Association for the Advancement of Science - Project 2061) - for Grades 6-8 - The Physical Setting: 4D The Structure of Matter

Summary of the Video

Categorizing and describing matter help us to shape the world in which we live. The classes of matter, mainly mixtures and solutions, make up a large part of the matter in our environment. This video closely examines the two classes of matter, mixtures and solutions, by using examples from our everyday world, local industry, and the natural environment around us.

The video is vocabulary-rich and uses key terminology such as mixture, heterogeneous mixture, homogeneous mixture, colloid, suspension, solution, solute, solvent, soluble, insoluble, solubility, saturated solution, and alloy. Numerous colorful and easy-to-understand graphics greatly enhance student understanding of the key concepts involved
with learning about categorizing and describing matter as well as learning about mixtures and solutions.

Pretest

An optional pretest is provided (Blackline Master #1). This test will help you determine the level of student comprehension prior to participating in this lesson. An Answer Key appears on pages 7-11 of this Teachers Guide.

Video Quiz

The video concludes with a ten-question Video Quiz which may be used to gage student comprehension immediately after the presentation of the video. Blackline Master #2: Video Quiz provides students with a printed copy of the questions and a list from which to choose correct answers.

Instructional Notes

Before presenting this lesson to your students we suggest that you preview the video and review this guide, and the accompanying blackline master activities in order to familiarize yourself with their content.

As you review the materials presented in this guide, you may find it necessary to make some changes, additions, or deletions to meet the specific needs of your class. We encourage you to do so, for only by tailoring this program to your class will they obtain the maximum instructional benefits afforded by the materials.

It is also suggested that the video presentation take place before the entire group under your supervision. The lesson activities grow out of the context of the video, therefore, the presentation should be a common experience for all students.
Student Preparation

You may want students to look up the vocabulary words addressed in the video, have them write down the definitions, and review their spelling and pronunciation. Terms such as matter, property, chemical properties, flammability, reactivity, physical properties, mass, weight, volume and density may be unfamiliar to students, and studying them before viewing the video will enhance student understanding.

Introducing the Video

The best way to introduce this video is through a classroom demonstration. In front of your class, set up a small table. On the table place two large beakers, one with a mixture of beans and rice, and another beaker with a mixture of water and food coloring. Show these two glass beakers to the class and ask them to make some observations about the two different types of mixtures. Ask them questions about the mixtures. Which is heterogeneous and which is homogeneous? Describe the texture of the mixtures. What is the visual appearance of the beakers?

Have the students write a two-paragraph essay about the description of the two beakers as well as comparison between them. Collect the essays and choose three to read out loud.

This demonstration will make a visual impact on the students that all mixtures are not the same and that they have different qualities.

Student Objectives

After viewing the video and completing the lessons and activities, students will be able to do the following:

- Define mixtures and provide everyday examples of heterogeneous and homogeneous mixtures.
- Describe the characteristics of a colloid.
- Describe the characteristics of a suspension.
• Define and provide everyday examples of solutions, solvents, and solutes.
• Describe the characteristics soluble and insoluble.
• Define and provide everyday examples of solubility and saturated solutions.
• Describe the characteristics of an alloy.
• Define the vocabulary words mixture, heterogeneous mixture, homogeneous mixture, colloid, suspension, solution, solute, solvent, soluble, insoluble, solubility, saturated solution, and alloy.

View the Video

This video is approximately eighteen minutes in length.

FOLLOW-UP ACTIVITIES

Discussion Questions

Following the video, students may have additional questions. Allow time for students to air their questions. Avoid answering the students’ questions directly. Ask them additional questions leading them to the answers on their own, or encourage other students in the class to answer questions.

There are numerous issues which may warrant further questions. As a class you may want to discuss the questions which appear on Blackline Master #3: Discussion Questions, which may be distributed prior to class discussion. Answers to these questions appear in the Answer Key on pages 7-11 of this guide.

1. Describe how scientists classify matter.
2. Provide examples of a homogeneous mixture.
3. Provide examples of a heterogeneous mixture.
4. Provide an example of colloids.
5. Provide an example of suspensions.
6. Provide an example of solutions.
7. Provide an example of an insoluble mixtures.
8. Provide two examples of things that affect the rate of dissolving.
9. Provide an example of a saturated solution.
10. Provide an example of an alloy.
Blackline Masters

The following Blackline Master activity sheets are included with this guide. You may replicate and distribute them as needed. An Answer Key appears on pages 7-11 of this guide.

(1.) **Blackline Master #1: Pre-Test** is to be given to your students prior to viewing the video to assess their prior knowledge of the topic.

(2.) **Blackline Master #2** is the sheet corresponding to the **Video Quiz** questions found at the end of the video. You may want to stop the video before the Quiz in order to distribute this sheet. Students should select the answers from the list at the bottom of the page. Review the questions and answers as a group, or collect the Quizzes for grading; they will help you determine student comprehension immediately following the video but before executing the Follow-up Activities.

(3.) **Blackline Master #3: Discussion Questions** corresponds with the questions presented in the previous section, and may be distributed prior to class discussion.

(4.) **Blackline Master #4: Word Search** is a vocabulary exercise. Once the words have been located on the grid, students should write their own definitions of each term on the sheet. Discuss their definitions, correcting any misconceptions.

(5.) **Blackline Master #5** is an **Internet Lesson** which helps students understand how to classify matter.

(6.) **Blackline Master #6: Mixtures, Solutions, and Reactions** and **Blackline Master #7: Rock Candy** are hands-on experiments for the students to complete in class to further stress the concepts of mixtures and solutions. Please note: These experiments need adult assistance and supervision. When performing the Rock Candy experiment, explain the dangers of boiling water to students, and instruct students
that the boiling water will be handled solely by the instructor.

(7.) **Blackline Master #8: Post-Test** is to be given to your students after viewing the video and completing the accompanying exercise to assess their comprehension of the Student Objectives.

**Extended Learning Activities**

1. Observation Skills - Have each student make a list of all the things that he or she drank over a 24-hour time period. Have him or her label each liquid as a solution, colloid, or suspension. Next, have him or her label everything that he or she ate either as a homogeneous mixture or heterogeneous mixture, where applicable. Make a class list of the examples, and then categorize them as either heterogeneous or homogeneous mixtures. This will make a visual representation of mixtures.

2. Creative Writing - Have the students write a two-page short story about an alloy. Perhaps they can pretend they are observing at a steel mill. What do they see, what does the metal look like, how are people dressed which handle the molten metals, and what is the temperature in the building?

3. Career Connection - Look at the different jobs in which people in your town have, where classification of objects is very important to their careers. Have these people come into your classroom to discuss their jobs. This might include a librarian, an archeologist, a pharmacist, and a chef.
Answer Key

Blackline Master #1: Pre-Test
1. F
2. T
3. T
4. F
5. F
6. T
7. T
8. T
9. T
10. F

Blackline Master #2: Video Quiz
1. heterogeneous
2. homogeneous
3. visible
4. suspension
5. dissolved
6. solvent
7. solvent
8. solute
9. smaller
10. alloy

Blackline Master #3: Discussion Questions
1. Scientists classify matter through a classification system based on the composition of matter.
2. Examples of homogeneous mixtures include house paint, toothpaste, or milk.
3. Examples of heterogeneous mixtures include tossed salad, granola cereal, or vinegar and oil.
4. Examples of colloids include fog, smoke or gelatin.
5. Examples of suspensions include silty river water or sooty polluted air.
6. Examples of solutions include seawater, air we breathe, lemonade.
7. Examples of insoluble mixtures include oil and water.
8. Two examples of things that affect the rate of dissolving are size of particles and temperature.
9. An example of a saturated solution is a solution which has dissolved all the solute it can at a specific temperature, such as putting too much sugar into the tea — it will sit at the bottom of the cup.
10. An example of an alloy is sterling silver or steel.

Blackline Master #4: Word Search

| h | e | t | e | r | o | g | n | e | n | o | u | s | m | i | x | t | u | r | e |
| o | e | n | t | e | r | e | o | e | m | i | x | t | u | r | e | n | s | l | o | u | t | e |
| o | l | s | e | t | u | r | e | o | l | s | e | t | u | r | e | o | l | s | e | t | u | r | e |
| g | l | s | e | t | u | r | e | g | l | s | e | t | u | r | e | g | l | s | e | t | u | r | e |
| c | o | l | s | e | t | u | r | c | o | l | s | e | t | u | r | c | o | l | s | e | t | u | r |
| n | y | s | e | t | u | r | e | n | y | s | e | t | u | r | e | n | y | s | e | t | u | r | e |
| c | o | l | s | e | t | u | r | c | o | l | s | e | t | u | r | c | o | l | s | e | t | u | r |
| o | l | s | e | t | u | r | e | o | l | s | e | t | u | r | e | o | l | s | e | t | u | r | e |
| s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t |
| s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t |
| s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t |
| s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t |
| s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t | e | r | s | o | l | v | e | n | t |

Vocabulary Definitions
1. alloy - metal in which two or more solids are dissolved together
2. colloid - mixture in which particles are mixed but not dissolved
3. heterogeneous mixture - substances in which components are not evenly distributed
4. homogeneous mixture - substance that appears the same throughout
5. insoluble - substance unable to dissolve into a solvent
6. mixture - two or more substances mixed together but not chemically combined
7. saturated solution - solution that has dissolved all the solute it can at a specific temperature
8. soluble - ability of a substance to dissolve into a solvent
9. solubility - measure of how much solute can be completely dissolved in a solvent
10. solute - substance that is dissolved in another substance
11. solution - substance made of small particles in which the components are evenly mixed
12. solvent - substance in which solute is dissolved
13. suspension - heterogeneous mixture in which some particles settle out

Blackline Master #5: Internet Lesson
1. Things are organized by classification and it makes classification study easier.
2. Elements - The simplest pure substance. An element cannot be changed into simpler substances by any chemical process. Elements are made up of atoms. Even atoms are composed of smaller things.
   Compounds - Pure substances made up of more than one element. The elements in a compound are chemically bonded together to form molecules.
   Mixtures - Consists of two or more substances mixed together but not chemically combined.
   Solutions - A special mixture formed when one substance dissolves in another.
3. The three properties of mixtures are the following:
   • Each substance retains all its own chemical properties.
   • The substances can be present in any amount.
   • The substances in a mixture can be separated by simple physical means.
4. The two types of mixtures are the following:
   • Heterogeneous - not identical throughout - not mixed well.
   • Homogeneous - identical properties throughout - well mixed.
5. A solution is a substance which is dissolved in another substance.
6. The two parts of a solution are the following:
   • Solvent - the most abundant substance
   • Solute - the least abundant substance
7. All solutions are not liquids
   • Air is a solution.
   • Steel is a solution.
8. The two main solution traits are the following:
   • Particles are too small to see.
   • Particles are evenly spread out.

**Blackline Master #6: Experiment**

**Conclusion**
1. The materials which formed mixtures and combined with no reaction were oil and water; sand and sugar.
2. The materials which formed solutions, that is, one dissolved into another with no reaction were molasses and water; sugar and water; baking soda and water; vinegar and water.
3. A chemical reaction that took place when vinegar was added to the mixture of water and baking soda was that the new substance was a chemical unlike either the vinegar or baking soda. Vinegar and baking soda mixed to form bubbles that are a carbon dioxide gas. Vinegar and baking soda also formed a salt known as sodium acetate.

**Blackline Master #7: Experiment Rock Candy**

**Conclusion**
Heating the water increased the solubility of sugar in the water. The higher temperature of the water allowed a greater amount of sugar to be dissolved. The sugar-water mixture formed a supersaturated solution, where the amount of sugar dissolved exceeded the normal solubility of the solution. As the supersaturated solution cooled, the dissolved sugar began to drop out of solution, forming sugar crystals, commonly called rock candy.
Blackline Master #8: Post-Test

1. mixture
2. not
3. homogeneous
4. mixtures
5. dissolved
6. heterogeneous
7. water
8. solvent
9. insoluble
10. temperature
MIXTURES AND SOLUTIONS

Script of Narration

There are thousands of different types of matter in the world, some with remarkable properties and many different characteristics. The natural environment contains many different types of matter, including that found in plants and that found in many different types of animals. Objects made by humans also contain thousands of different types of matter.

With all this different matter in the world, how do we go about classifying it? During the next few minutes, we are going to explore some of the ways matter is categorized and described. We are also going to explore mixtures and solutions.

Let's look at water, a substance that all living things need to survive. Water comes in different phases, depending on temperature. Here, water, at zero degrees centigrade, is a solid, as seen in the icicles that are beginning to melt.

And water above 100 degrees centigrade exists in the gas phase, or steam, seen here coming out of this beaker.

Water exists in three phases. If we were to classify it based on its phase, we would incorrectly call it three different things even though it is still water.

Next let's look at these objects. What do they have in common? Well, they are all solids, but, even though these substances are all solids, they are quite different from each other.

So as you can see, classifying matter by its phase is not a very useful method if we want to specifically know of what a substance is made. To make the task of classifying an easier one, scientists developed a classification system based on the make-up or composition of matter. The first class of matter we are going to study is mixtures. This rock called granite can be tooled to form many things such as building stones.

Granite is formed deep within the earth, and is excavated in large mines such as this one.

It is not a pure substance, but is made of many different minerals that keep their individual identity. It is made of minerals such as pink feldspar, mica, and quartz.
It is a mixture. A mixture is matter that is made of two or more substances mixed together, but not chemically combined.
There are hundreds of different mixtures, including this sand on the beach, made of different kinds of sand, rocks, and shells.
This soil, being tilled with this machine, is also a mixture.
A closer look shows it is made of different particles of dirt, stones, and plant roots.
These tomatoes, carrots, and mushrooms are being cut up to be part of a mixture.
The mixture is this salad being created.
Mixtures are classified by how well-mixed they are. As you can see, this salad does not appear to be the same throughout.
Heterogeneous mixtures are substances in which the components are not evenly distributed.
Vinegar and oil, seen here in two separate layers, is used as a salad dressing. It is a poorly-mixed heterogeneous mixture and that is why it needs to be shaken before pouring.
This cereal is another heterogeneous mixture. It is made up of oats, seeds, coconut, and raisins.
Each component, when added to the mixture, retains its individual properties, and is not chemically combined.
Homogeneous mixtures, like this paint, are different from heterogeneous mixtures in that they are well-mixed and the same throughout.
This milk is a homogeneous mixture, in that it is chemically the same throughout.
Other examples of homogeneous mixtures include toothpaste.
Perfume is also a homogeneous mixture. Having explored the differences between homogeneous and heterogeneous mixtures, let's consider the three types of mixtures: colloids, suspensions, and solutions.
Mixtures, like paint, are called colloids. A colloid is a mixture in which the particles are mixed together but not dissolved.
The particles in colloids do not settle out and are continually bombarding each other.
Shaving cream is a foam that is a colloid.
Fog and smoke are colloids, and appear quite cloudy.
The liquid on the left is a gelatin - a colloid. The liquid on the right is colored water - a non-colloid. Due to the properties of the gelatin, light can pass through it and the particles seen, but the particles in the
colored water on the right cannot be seen.
A suspension is a heterogeneous mixture in which some of the par-
ticles settle out. The particles and the water in this paper weight form
a suspension.
The water in this raging river also forms a suspension.
This flask of water was taken from the silty river. Let's see what hap-
pens if we let it stand for several hours.
After a few hours, you can see the water is clearer and the particles
have settled to the bottom.
If you look closely, you can see different sizes of particles.
When rivers rise over their banks as seen here, silt and particles often
drop out of suspension.
Seventy percent of the earth is covered with a very well-mixed liquid -
seawater.
Seawater is a solution. A solution is a very well-mixed mixture in which
particles are small and most often dissolved.
In sea water, many different chemicals, including salt, are dissolved
in water, giving seawater a homogeneous, or very well-mixed, ap-
pearance.
Another common solution consists of the gases nitrogen, oxygen, and
other gases; it is the air we breathe.
Let's make up a solution that is great to drink - lemonade. A solution
has something that is dissolved , and something that the substance is
dissolved in.
We will begin squeezing some lemons to make lemon juice. The juice
from the lemon is called the solute. A solute is a substance that is dis-
solved in another substance.
Now let's add the juice to some water. Water is the solvent. A solvent
is a substance in which the solute is dissolved.
To sweeten the lemonade, we will add another solute - sugar. Many
things dissolve in water and it is often called the universal solvent.
In our lemonade, notice that it is the same color and taste throughout
the liquid. This is a property of solutions.
Most soda drinks are injected with carbon dioxide, e a harmless gas
that you can hear when opening a soda can.
The gas gives the drink its fizz.
Many soda drinks have gases, such as carbon dioxide, that are dis-
solved in the liquid.
When a substance, like these flavored drink crystals, dissolve into another substance, like water, it is said to be soluble. When a substance is soluble, it can dissolve into a solvent. When one substance, like oil, cannot dissolve into another substance, like water, it is said to be insoluble. When a substance is insoluble, it cannot dissolve into a specific solvent.

When adding chocolate syrup to your milk, you usually stir it for a while. Why? Because stirring speeds up the rate of dissolving. In other words, it helps more solute - the chocolate syrup - come in contact with more solvent - the milk.

Rate of dissolving is also affected by particle size. These large particles and these small particles are both salt. When equal amounts are placed in water, you can see that the smaller particles dissolve quicker than the larger salt particles. This is because the smaller particles have more combined surface area, and come in contact with more solvent.

Temperature also has an affect on the rate of dissolving. As temperature increases, the rate of dissolving tends to increase. Here, you can see the salt easily dissolves in hot water on the right, as compared to the same amount of salt in cold water dissolved on the left.

After stirring for a couple of minutes, you can see that the salt in the hot water dissolved more than in the cold water, where there is salt left on the bottom of the beaker.

Solubility is a measure of how much solute can be completely dissolved in a solvent. There is a limit to how much solute can dissolve in a solvent.

In other words, a solvent, such as water, can only dissolve so much sugar before the sugar remains on the bottom of the beaker. Solubility is usually expressed in terms of grams of solute that can be dissolved in 100 milliliters of water at a specific temperature, usually 20 degrees centigrade.

For example, the solubility of copper sulfate is about 32 grams per 100 milliliters of water at 20 degrees centigrade.

If more copper sulfate is added at this temperature, it will not dissolve and remain as a solid. Here the solution is said to be saturated. A saturated solution is a solution that has dissolved all the solute it can at a specific temperature.
If the temperature is raised to over 90 degrees centigrade, then as much as 100 grams of copper sulfate can be dissolved. This graph shows the relationship between temperature and the solubility of copper sulfate, CuSO₄. As the temperature of the solvent increases, the solubility increases. Any solution above the line in the graph is saturated, and any solution below the line is unsaturated. But the opposite is true with gases dissolved in water. As the temperature of the solvent increases, the solubility of the gas decreases. Warm bodies of water, such as this lake, hold less dissolved oxygen than cold ones. For their survival, these trout need to live in cold water that holds more dissolved oxygen. This graph shows the relationship between temperature in degrees centigrade, on the left axis, and the concentration of dissolved oxygen in water, on the bottom axis. As the temperature increases, the solubility of dissolved oxygen decreases. Solutions can exist as solids, not just as liquids and gases. Take for example this hot piece of steel. If is a solution. Steel is made up of a solution of iron, chromium, and other metals. It is an alloy. An alloy refers to metals in which two or more solids are dissolved together. These sterling silver eating utensils are an alloy made of silver and copper.

In summary, a mixture is either well-mixed, called a homogeneous mixture, or it is not well-mixed, called a heterogeneous mixture. And there are three major types of mixtures: colloids, in which the particles are visible and not completely dissolved; suspensions, in which the particles are of different sizes, and settle out over time; and solutions, in which the particles are dissolved and are evenly mixed. You use mixtures and solutions everyday. Try to notice them and classify them. You just might be surprised at the number of mixtures and solution you use.

Fill in the correct word when you hear this tone. Good luck and let's get started.

1. A __________________ mixture is not well-mixed.
2. A __________________ mixture is the same throughout.
3. In a colloid the particles are __________________.
4. Muddy river water is an example of a __________________.
5. In a solution the particles are __________________.
6. The __________________ is the part of the solution that does the dissolving.
7. Water is often called the universal __________________.
8. The __________________ is the part of the solution that is dissolved.
9. __________________ particles tend to dissolve faster than larger ones.
10. An __________________ is a metal made of two or more solids.
Other titles in the Physical Science Series.

Properties of Matter

Phases of Matter

Elements, compounds, and the Atom

Atomic Structure and the Periodic Table

Chemical Bonding

Chemical Reactions