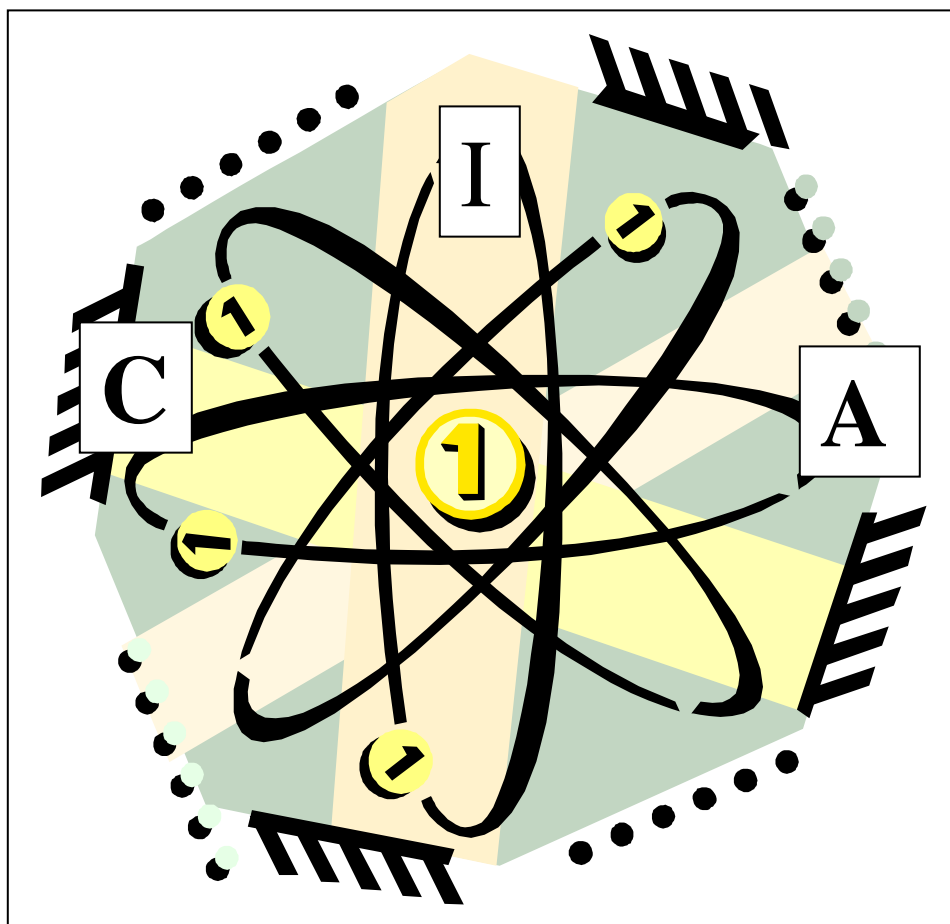


# Curriculum, Instruction, Assessment (CIA) Alignment

Science, Grade 4

Unit 3: Physical and Chemical Changes

Task Analysis and Hands-on Investigations



Ronald Blocker, Superintendent  
Orange County Public Schools  
Orlando, Florida

2003-2004



**Subject Area:** Science  
**Strand A:** The Nature of Matter  
**Grade:** 4

**Benchmarks**

SC.A.1.2.1: The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

SC.A.1.2.2: The student knows that common materials (e.g., water) can be changed from one state to another by heating and cooling.

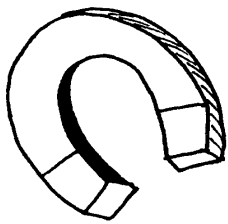
SC.A.1.2.3: The student knows that the weight of an object always equals the sum of its parts.

SC.A.1.2.4: The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

SC.A.1.2.5: The student knows that materials made by chemically combining two or more substances may have properties that differ from the original materials.

<b>TASK ANALYSIS</b>	
<b>The student...</b>	
<b>PHYSICAL AND CHEMICAL CHANGES</b>	
•	determines the properties of an object using qualitative observations and metric measurements that incorporate tools such as rulers, thermometers, balances, and graduated cylinders.
•	compares the mass of an object to the sum of its parts.
•	physically combines different materials to create mixtures.
•	separates a mixture by sorting, sifting, filtering, and evaporating.
•	demonstrates that physical changes in the states of matter can be produced by heating and cooling.
•	observes the original materials and compares their properties to the properties of the new material produced in a chemical reaction.





# WHAT'S THE MATTER?

## BENCHMARK and TASKS

**SC.A.1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

- The student physically combines different materials to create mixtures.
- The student separates a mixture by sorting, sifting, filtering, and evaporating.

## KEY QUESTION

What is a mixture and how can it be separated?

## BACKGROUND INFORMATION

An **element** is the simplest form of matter. All matter is made up of **atoms**. Each **element** is made of atoms of the same type. Two or more elements that have combined chemically are called a **compound**. A compound can be separated only by chemical means. Table salt is an example of a compound.

A **mixture** is a combination of two or more substances that have not combined chemically. A mixture can contain elements, compounds, or both, and in any amounts. Because the substances in a mixture are not combined chemically, they keep their unique properties and can be separated by physical means. Mixtures can be separated using processes that depend on their different properties:

Sorting: To separate by arranging according to class, kind, or size

Evaporation: To convert or change into a vapor, usually leaving only the dry, solid portion of the mixture

Sifting: To separate fine particles from coarse particles

Filtering: To separate suspended matter in a liquid or gas

A mixture can be made up of ingredients in any amount. Some mixtures are coarse (cement, trail mix, rock); some contain tiny particles (jelly, milk, ink). There are no symbols or formulas for mixtures. Mixtures may be made of **solids** only, **liquids** only, or **gases** only, or they may be made of different combinations of solids, liquids and gases.

## MATERIALS

### Teacher

assortment of mixtures, such  
as a box of crayons, deck of cards,  
trail mix, shells, rocks, etc.

### Per pair of students

2 plastic cups labeled A and B  
container with 6 marbles  
container of popcorn kernels  
container of small paper clips or iron nuggets  
container of sand  
1 tray  
1 magnet  
*What's the Matter?* record sheet

## **TEACHING TIPS**

1. Ideally, the iron part of the mixture should be small enough so that it is difficult for students to remove the iron from the mixture without using a magnet. Iron filings would be perfect but they are messy, hard to get off the magnets after the activity and pose a danger to students' eyes. Iron nuggets or small steel paper clips can be used as a substitute. If using paper clips, choose the smaller type and make sure that the paper clips are attracted to a magnet. Iron nuggets can be ordered from a science supply company.
2. Although the teacher could assemble the mixtures before class, there is value in allowing students to make their own mixtures for this activity. If time allows, you might even consider requiring the students to follow a recipe such as the one below in order to practice mass measurement.

### **Sample Recipe for cup A**

Mix together in cup A:

6 marbles

15 grams of popcorn kernels

10 grams of paper clips

## **ENGAGE**

Display an assortment of mixtures, such as shells, crayons, or rocks. Ask:

*How are these materials alike?*

*Can these materials be sorted and separated? How?*

*Which materials would be easy to separate? Hard to separate?*

Tell students that all of these assortments are mixtures.

## **EXPLORE**

1. Give each pair of students a tray with containers of marbles, popcorn kernels, and paper clips along with the cup labeled A and a magnet. Tell students to combine the marbles, popcorn kernels and paper clips to make a mixture.
2. Ask students to find a way to separate the three materials and to write a sentence about how they did it on their record sheet. After separating the mixture, have students place the marbles, popcorn, and paper clips back into their original containers and move them on the tray back to the materials table.
3. Distribute a tray with cup B along with the container of sand and the container of paper clips (or iron nuggets) to each pair of students. Make sure that students still have their magnet to use. Tell students to first combine the sand and paper clips to make a mixture and then once again separate the two materials, writing a sentence about the method used on their record sheet.
4. Have students place the sand and paper clips back into their original containers and return them and the magnet to the materials table.

## **EXPLAIN**

*What is a mixture? (A mixture consists of two or more substances, each retaining its own properties.)*

*How did you separate the mixtures? (by using a magnet and by sorting)*

*Were there any other ways to separate them?*

*Were there any mixtures you could not separate?*

### **EXTEND/APPLY**

1. Ask students to bring in a small sample of their favorite cereal in a baggie. Have them determine if the cereals are mixtures. Let students decide how they would separate any of the cereals that are mixtures.
2. Let students play a “Mixture or Not” game. List ten items on the board, such as the following:  
trail mix                      fog                              salad  
Kool-Aid                      salt                              roll of Life Savers  
smoke                          sugar                              closet full of clothes  
pumice

Ask students to decide if the items are mixtures or not and explain their decisions. Mixtures include trail mix, Kool Aid, smoke, fog, salad, Life Savers, closet full of clothes, and pumice. Fog is a mixture of water and air. Pumice is a mixture of rock and air. Smoke is a mixture of ash and air. Both sugar and salt are compounds. The elements making up these compounds are chemically combined and cannot be separated by ordinary means.

### **ASSESSMENT**

1. Ask students to write their own definition of a mixture and give examples.
2. Ask students to write about how they would separate a mixture of paper clips, marbles, and rice.

# WHAT'S THE MATTER?

## CUP A

**Explain how you separated the contents of Cup A.**

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## CUP B

**Explain how you separated the contents of Cup B.**

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# A MATTER OF MIXING

## **BENCHMARK and TASK**

**SC.A.1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

- The student separates a mixture by sorting, sifting, filtering, and evaporating.

## **KEY QUESTION**

How can mixtures be separated? (sifting)

## **BACKGROUND INFORMATION**

### **BACKGROUND INFORMATION**

An **element** is the simplest form of matter. All matter is made up of **atoms**. Each **element** is made of atoms of the same type. Two or more elements that have combined chemically are called a **compound**. A compound can be separated only by chemical means. Table salt is an example of a compound.

A **mixture** is a combination of two or more substances that have not combined chemically. A mixture can contain elements, compounds, or both, and in any amounts. Because the substances in a mixture are not combined chemically, they keep their unique properties and can be separated by physical means. Mixtures can be separated using processes that depend on their different properties:

**Sorting**: To separate by arranging according to class, kind, or size

**Evaporation**: To convert or change into a vapor, usually leaving only the dry, solid portion of the mixture

**Sifting**: To separate fine particles from coarse particles

**Filtering**: To separate suspended matter in a liquid or gas

## **MATERIALS**

### **Teacher**

1 tray  
1 vial (see Teaching Tips)  
1 vial rim cap (see Teaching Tips)  
1 fine mesh screen (see Teaching Tips)  
1 coarse mesh screen (see Teaching Tips)  
sand and paper clips or iron nuggets mixture (from the *What's the Matter?* activity)  
1 magnet

### **Per student**

hand lens

### **Per group**

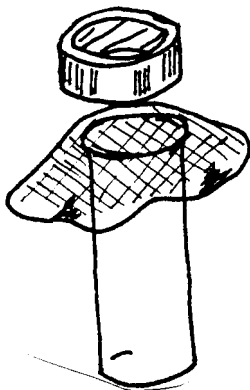
1 sheet of 8 1/2 x 11 inch dark construction paper cut into four pieces  
1 tray  
one 25 mm plastic vial of sifting mixture (see Teaching Tips)  
1 vial cap rim (or rubber band)  
1 fine mesh screen  
1 coarse mesh screen  
*Sifting Mixtures* worksheet  
1 microscope and blank slides (optional)

## TEACHING TIPS

1. Order the Sifting Mix or prepare your own: 1 cup of coarse sand, 1 cup of salt, 1 cup baking soda. Mix well and pour into small vials for each group. Set up trays with group materials.
2. You can purchase the following items from Delta Education (1-800-258-1302):  
Coarse Mesh Screen (**package of 40**) #90-190-0821; Fine Mesh Screen (**package of 40**) #90-190-0953; Sifting Mix #90-130-2223; Vials (**package of 10**) # 90-220-0439; and Vial Cap Rims (**package of 10**) # 90-180-0369

## ENGAGE

1. Display the sand and iron nuggets mixture. Ask: *How did you separate this mixture in the last activity?*  
Demonstrate separating the mixture with the magnet.
2. Ask: *Is there another way we could separate the mixture?*
3. Show students the jar of sifting mixture but do not identify its contents by name. Tell students that each group will be given a vial of the mixture and tools with which to separate it into parts that have different properties.
4. The technique of using a vial, vial cap rim and mesh screen as a “saltshaker” can be demonstrated by placing the mesh screen over the vial of mixture and securing the mesh with the vial cap rim. When turned upside down, the vial can be used as a “salt shaker”.



## EXPLORE

1. Distribute a tray with all materials to each group.
2. Tell students that they will separate the contents of the mixture into parts by sifting. The mixture should be sifted onto the dark construction paper pieces. Point out that there are two different screens to use in the process. Encourage students to think carefully about how to use the screens. (Note: Students may discover that the order in which they use the screens is important; that they can use both screens together; or that they can fold a screen to create different thicknesses. Encourage groups to share their discoveries.)
3. Have students use a hand lens or a microscope to examine each substance after sifting and record properties of each on the *Sifting Mixture* worksheet.

### **EXPLAIN**

*How many substances were in the mixture?*

*How could you tell that there were that many substances?*

*How did you separate them?*

*What happened when you used the coarse screen first?*

*What happened when you used the fine screen first?*

*How were the individual substances alike?*

*How were the individual substances different?*

### **EXTEND/APPLY**

Ask the following questions:

*Have you ever sifted anything?*

*What is the purpose of sifting? (to separate fine particles from coarse particles)*

*Why would a baker need to sift flour?*

### **EXTENSION**

Read about the California gold rush. Find out how people separated mixtures of water, sand, and rock to find gold.

### **ASSESSMENT**

Show students a mixture containing coarse sand, baking soda, salt, and paper clips. Ask them to write about how they would separate the mixture. Encourage them to think about what they did in the last two activities: *What's the Matter?* and *A Matter of Mixing*.

## SIFTING MIXTURES

Assign a number to each of the substances that you sifted from the mixture. Use a hand lens and/or microscope to observe each substance. Record your observations about the color and texture of each substance.

<b>Substance Number</b>	<b>1</b>	<b>2</b>	<b>3</b>
<p><b><u>Color</u></b>                      Is the substance very light, medium colored, or very dark?</p>			
<p><b><u>Texture</u></b>                      Is the substance very fine, medium-textured, or very coarse?</p>			

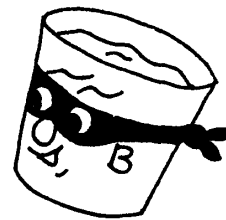
Making Inferences:

What do you think substance #1 is? \_\_\_\_\_

What do you think substance #2 is? \_\_\_\_\_

What do you think substance #3 is? \_\_\_\_\_





## POOF! IT'S GONE

### **BENCHMARK and TASK**

**SC.A.1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

- The student separates a mixture by sorting, sifting, filtering, and evaporating.

### **KEY QUESTION**

How can mixtures be separated? (evaporation)

### **BACKGROUND INFORMATION**

An **element** is the simplest form of matter. All matter is made up of **atoms**. Each **element** is made of atoms of the same type. Two or more elements that have combined chemically are called a **compound**. A compound can be separated only by chemical means. Table salt is an example of a compound.

A **mixture** is a combination of two or more substances that have not combined chemically. A mixture can contain elements, compounds, or both, and in any amounts. Because the substances in a mixture are not combined chemically, they keep their unique properties and can be separated by physical means. Mixtures can be separated using processes that depend on their different properties:

**Sorting:** To separate by arranging according to class, kind, or size

**Evaporation:** To convert or change into a vapor, usually leaving only the dry, solid portion of the mixture

**Sifting:** To separate fine particles from coarse particles

**Filtering:** To separate suspended matter in a liquid or gas

A **solution** is a type of mixture that looks like a single substance and has the same properties throughout. Within a solution, one substance is dissolved in another substance. The substance that dissolves is called a solute. The substance into which a solute dissolves is called a solvent. In the example of salt water, the salt is the solute and the water is the solvent.

### **MATERIALS**

#### **Teacher**

1 jar Mystery Mixture labeled A (1 cup Kosher salt mixed with 1 quart hot water)

1 jar Mystery Mixture labeled B (plain water)

#### **Per group**

2 clear, plastic cups labeled A and B

hand lenses (1 per student)

2 medicine cups labeled A and B

2 droppers

1 tray

cotton swabs (2 per student)

1 paper bag taped to the desk for disposal of used cotton swabs

### **TEACHING TIPS**

1. Prepare a solution of hot water and 1 cup of Kosher salt. Stir to dissolve. Cool the solution and pour into the jar labeled A. (The use of Kosher salt will ensure a clear solution.) Fill the jar labeled B with plain water.
2. This lesson may need to take place over a two-day period to provide time for evaporation to occur.

### **ENGAGE**

1. Show the class the jars labeled A and B. Create a Double Bubble Map as students observe how the substances are alike and how they are different.
2. Review students' learning about mixtures.
3. Ask students if they think the jars contain mixtures. Ask, *How can you be sure if these are mixtures?* Tell students they will find out during the activity.

### **EXPLORE**

1. Distribute materials to each group, withholding the cotton swab until it is needed.
2. Ask one student from each group to take the tray with 2 medicine cups and 2 droppers to a designated station to pick up the mixtures.
3. Show students how to use the droppers to place 5 mL of mixture A into medicine cup A and 5 mL of mixture B into medicine cup B. Be sure students use a clean dropper for each solution.
4. After the tray is taken back to the group, students should observe and discuss the properties of each mixture. (The mixtures should look the same.) There should be no tasting at this time!
5. Have students turn the plastic cups labeled A and B upside down on the tray.
6. Have students carefully pour the measured solution A out of the medicine cup onto the inverted bottom of cup A. Have students pour measured solution B onto the inverted bottom of cup B. Ask students to make predictions about what will happen to the solutions over the next 24 hours.
7. Students should check the cups periodically until evaporation has occurred. Caution them not to turn the glasses upright even if the water is gone.
8. After evaporation has occurred, students should use hand lenses to observe the bottoms of the drinking glasses.

### **EXPLAIN**

1. Ask:  
*What do you see on the bottom of Cup A and Cup B?*  
*What has happened to the liquid?*  
*Do both cups look the same?*
2. Ask students to draw what they see on the bottom of each cup and to label the drawings- Cup A and Cup B.
3. Have students tape a paper bag to the desk for the disposal of used cotton swabs. Give each student two, clean cotton swabs. Let each student dip a clean cotton swab in water, touch the

bottom of Cup A, and taste the residue. Throw the swab away! Use a clean swab to taste the residue on the bottom of Cup B. Throw the swab away! Ask: *What did you taste?*

*Can you guess what was in each jar?*

*Were there mixtures in both jars?*

4. Discuss evaporation as a means of separating a mixture. Ask: *When might this method of separating mixtures be used?*

### **EXTEND/APPLY**

Discuss:

*With fresh water becoming scarce in Florida, scientists must find ways to get more fresh water.*

*What is the main source of water on earth?*

*Based on our experiment, can you think of a way to get fresh water from salt-water oceans?*

*Suppose you have a mixture of water and salt, and you use evaporation to separate the water from the salt. Where does the water go?*

### **ASSESSMENT**

Ask students what method they would use to separate a mixture of:

- A. iron and sand (sorting with a magnet)
- B. sand, salt and baking soda (sifting)
- C. salt and water (evaporation)
- D. marbles and golf balls (sorting by hand)

# FINELY FILTERED

## **BENCHMARK and TASK**

**SC.A. 1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

- The student separates a mixture by sorting, sifting, filtering, and evaporating.

## **KEY QUESTION**

How can a mixture be separated? (filtering)

## **BACKGROUND INFORMATION**

An **element** is the simplest form of matter. All matter is made up of **atoms**. Each **element** is made of atoms of the same type. Two or more elements that have combined chemically are called a **compound**. A compound can be separated only by chemical means. Table salt is an example of a compound.

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**Evaporation:** To convert or change into a vapor, usually leaving only the dry, solid portion of the mixture

**Sifting:** To separate fine particles from coarse particles

**Filtering:** To separate suspended matter in a liquid or gas.

## **MATERIALS**

### **Teacher**

125 mL water mixed with 1 Tbsp. of cornstarch (in plastic jar)

### **Per group**

paper towels

1 tray

2 plastic cups

1 funnel

5 coffee filters (cone filters would work and reduce the need for folding)

hand lenses

small container of cornstarch

small container of water

1 graduated cylinder

1 tablespoon

## **TEACHING TIP**

Remind students NOT to taste any substance.

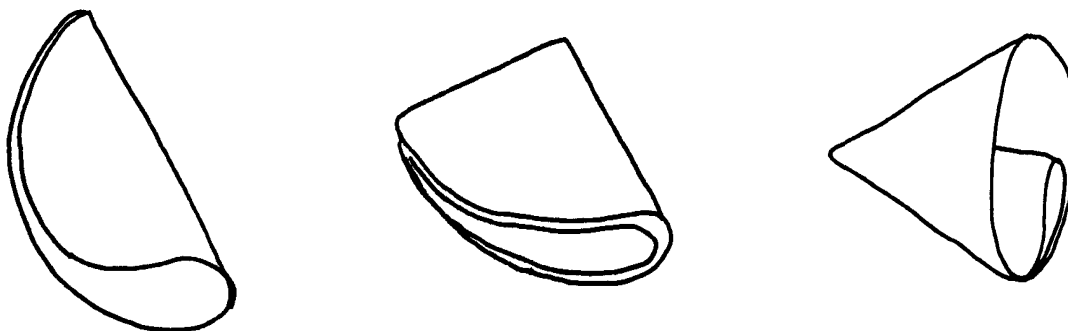
## **ENGAGE**

1. Display the jar of corn starch/water mixture. (Make sure it is thoroughly mixed.)

- Ask: *What does this solution look like?* (It should resemble milk.)
2. Let the mixture set for a few minutes and ask students what they observe. (Students should start to see the substances in the mixture separate.)
  3. Explain that the mixture contains two substances, water and corn starch. The cornstarch is in suspension. (That means the cornstarch is distributed throughout the water.)
  4. Ask: *Can we separate this mixture another way?*

### **EXPLORE**

1. Give each group a set of materials. Ask students to mix 1 Tbsp. of cornstarch with 125 mL water in one of the plastic cups.
2. Show students how to fold a coffee filter in half, in half again, and then pull it out to form a cone as shown in the illustration. (If using a cone coffee filter, this step can be skipped.)



3. Have students place the cone filter in the funnel, and then place the funnel in one of the plastic cups. One group member should pour the cornstarch/water mixture into the funnel.
4. After the mixture has been filtered, tell students to unfold the filter, place it on a paper towel and label the paper towel #1. Ask students to observe the residue on the filter. Have students rinse and dry the first cup which held the mixture.
5. Students should prepare another filter and place it in the funnel. The liquid should now be filtered a second time. Remind students to unfold the filter afterwards, place it on a paper towel labeled #2, and observe the residue. Again, students must rinse and dry the cup.
6. Have students repeat the filtering process until they have filtered the liquid five times.

### **EXPLAIN**

*Do all of the filters look the same?*

*What is the residue on the filter?* (cornstarch that was suspended in the water)

*Which filtering trial took the longest?* (trial #1)

*Why did the first trial take so long?*

*How would you describe the mixture after five trials?*

*How does filter #1 compare with filter #5?*

*How does the liquid look now compared to the way it looked before you started filtering?* (Use some of the mixture from the Engage activity for this comparison.)

### **EXTEND/APPLY**

1. Ask students to think of some things that are filtered. Make a list as they respond.

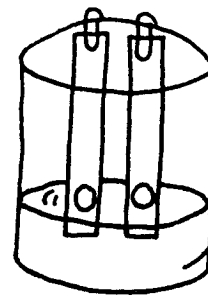
(coffee, tea, drinking water, pool water, and air are a few examples that students may suggest.)

2. Discuss how water is filtered for drinking.
3. Take two samples of pond water. Save one sample for comparison purposes and perform the filtering process on the other sample. Have students compare the filtered water with the original pond water sample.

### **ASSESSMENT**

Ask students to compare four ways of separating mixtures: sorting, evaporation, sifting, and filtering

# MOBILE MIXTURES



## **BENCHMARK and TASK**

**SC.A.1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

- The student separates a mixture by sorting, sifting, filtering, and evaporating.

## **KEY QUESTION**

How can a mixture be separated? (chromatography)

## **BACKGROUND INFORMATION**

An **element** is the simplest form of matter. All matter is made up of **atoms**. Each **element** is made of atoms of the same type. Two or more elements that have combined chemically are called a **compound**. A compound can be separated only by chemical means. Table salt is an example of a compound.

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**Sorting**: To separate by arranging according to class, kind, or size

**Evaporation**: To convert or change into a vapor, usually leaving only the dry, solid portion of the mixture

**Sifting**: To separate fine particles from coarse particles

**Filtering**: To separate suspended matter in a liquid or gas.

Different types of matter can be combined; colors can be mixed to get new colors. Inks and dyes consist of molecules of coloring substances that are dissolved in a liquid base. When color is applied to a filter and placed in contact with water, the color molecules dissolve and are carried up the strip. Different colors get carried along faster and farther than others because some color molecules are bigger and/or heavier than others. This color separation process is called *chromatography*.

## **MATERIALS**

### **Teacher**

1 black, water soluble marker  
1 sheet of paper

### **Per group**

1 coffee filter  
1 saucer or Styrofoam plate  
paper clips  
1 black, water-soluble marker  
1 green, water-soluble marker  
1 orange, water-soluble marker  
water

## **TEACHING TIP**

Have other colors of water-soluble markers and coffee filters available. (Brown markers usually show an amazing array of colors when filtered!)

## **ENGAGE**

Review by asking:

*What is an example of a mixture?*

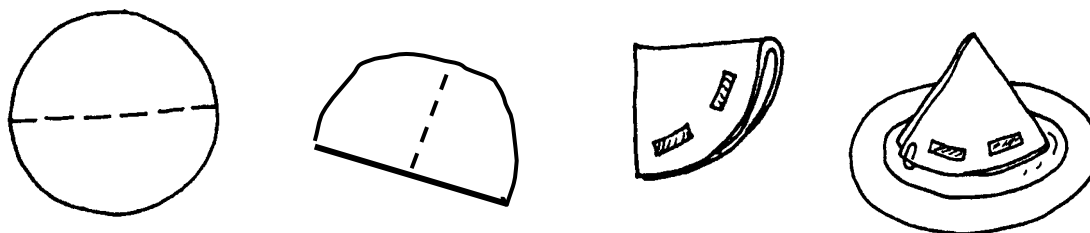
*What are some ways that you have learned to separate mixtures?*

With a water-soluble marker draw a black line on a paper. Ask: *Is this a mixture?*

Tell students they will have a chance to find out.

## **EXPLORE**

1. Distribute the materials to each group.
2. Show students how to fold the coffee filter in half, and in half again.



3. One student in the group should use the dark green marker to make a mark about one inch from the rounded edge of the folded filter.
4. Have another student use the black marker to make a mark about one inch from the rounded edge. (This is the edge that will be set in water.) The two marks should not touch each other, but need to be on the same side.
5. Tell students to secure the edge of the filter with the paper clip so that a cone is formed, as shown in the illustration.
6. Fill the plate with water and place the rounded edge of the cone in the water. Be sure the water does not touch the colored marks.
7. Allow the paper to stand undisturbed while students observe for 10 minutes.

## **EXPLAIN**

*What happened to the two marks made on the filter?*

*What caused the marks to separate into different colors?* (The molecular attraction of the liquid tends to pull the surface molecules back into the liquid. This surface tension causes the liquid to act like a stretched membrane. When this liquid comes into contact with a solid, as in the filter paper, it moves up the solid. Different colors get carried along faster and farther than others because some color molecules are bigger and/or heavier than others.)

*How does this show that colors are mixtures?* (Marking pens are combinations of several basic colors, and we can see them separate.)

*What colors were contained in the black mark?*

*What colors were contained in the green mark?*

*Do you think the black mark I made on the sheet of paper at the beginning of the activity is a mixture? Why or why not? (Yes, because black ink is a mixture of all colors.) Place the strip in a cup of water and find out whether or not it really is a mixture.*

*If we were to place an orange mark and a brown mark on the filter, what colors do you think might appear on the filter? (Try it and find out!)*

### **EXTEND/APPLY**

Show a color wheel and have the students discuss how the arrangements of colors are related to the chromatography experiment.

### **ASSESSMENT**

1. Make several different mixtures:
  - salt water
  - sand, popcorn kernels, and paper clips
  - corn starch and water
  - brown marker
  - sand, salt, and baking soda
  - box containing different kinds of seashells or rocks
2. Have a materials table which contains magnets, coffee filters, sifters, water, plastic cups, dark construction paper, saucers, etc.
3. Give each group a different mixture to separate. Tell students to decide as a group how to separate their mixture, gather the appropriate materials, and perform the separation. After successfully separating the mixture, each group needs to describe the method used. Encourage students to use the vocabulary they learned during their study of mixtures in their discussions.

# A CLOSER LOOK

## BENCHMARKS AND TASKS

**SC.A.1.2.1** The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

**SC.A.1.2.3** The student knows that the weight of an object always equals the sum of its parts.

**SC.A.1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

- The student determines the properties of an object using qualitative observations and metric measurements that incorporate tools such as rulers, thermometers, balances, and graduated cylinders.
- The student compares the mass of an object to the sum of its parts.

## KEY QUESTION

What are the properties of a seltzer tablet?

## BACKGROUND INFORMATION

**Physical changes** in a substance or material result only in changes in the appearance of the material. While the size, shape, texture, etc., may be changed, the substance is still the same substance. **Chemical changes** result in a new substance being formed.

A crystal is a solid form of a substance in which the **atoms** are arranged in repeating patterns. A powder is a substance that has been ground or pulverized into finely dispersed, loose, solid particles.

## MATERIALS

### Per student

science journal  
*A Closer Look* activity sheet  
hand lens

### Per group

1 or more seltzer tablets  
1 snack-size plastic bag  
1 tape measure  
1 sheet of black construction paper  
2-3 toothpicks  
1 microscope  
1 triple-beam balance or electronic balance  
(The balance used must be sensitive enough to measure small amounts.)  
chart paper  
rock salt crystals

## TEACHING TIPS

1. Do not open the seltzer tablets in advance as they absorb moisture.
2. Caution students against tasting substances.
3. If only one electronic or triple-beam balance is available, groups can rotate to a station to use it.

## **ENGAGE**

1. Distribute several rock salt crystals to each student group. (Rock salt works well because of its size.)
2. After allowing sufficient time for students to observe the properties of the crystals, have them a sketch what they observed in their science journals.
3. Ask the students to describe the properties of the crystals. List these properties on the board. If students have difficulty describing properties, ask how they would tell another person about these crystals if that person had never seen them before.

## **EXPLORE**

1. Tell students that they are going to investigate the properties of a seltzer tablet. Distribute materials to each group.
2. Give students time to observe the whole tablet using only the unaided eye. Have students draw what they see.
3. Have students again observe the whole tablet using a hand lens and then a microscope, each time drawing the details they are able to observe.
4. Encourage each group to observe as many properties as they can, observing such characteristics as color, size, shape, smell, texture, hardness, and flexibility.
5. Students should use the measuring tape to find the diameter of the tablet.
6. Have students place the tablet in a snack bag before placing it on the balance to find the mass. Students should record the mass of the whole tablet in the snack bag.
7. Next, tell students to keep the tablet in the sealed snack bag and crush it. Have students find the mass of the crushed tablet in the snack bag and compare it to the mass of the whole tablet in the snack bag. Students should record this measurement and compare it with that of the whole tablet. (The mass before and after crushing should be approximately the same. If it is not the same, encourage students to try to explain why. Perhaps they did not have the tablet in the snack bag when they found the mass before crushing, or they spilled some of the tablet from the bag after crushing.)
8. Tell students to empty the crushed tablet onto a piece of black construction paper and repeat their observations for the crushed tablet, using first the unaided eye, then the hand lens and finally the microscope to observe and describe what they see. (They should be observing a combination of powder and crystals. From the engage activity, they should be able to identify crystal shapes. Using the sense of touch is a good way to determine the texture of powders and crystals.)

## **EXPLAIN**

*After crushing the tablet, what properties were changed? (size, shape, and texture)*

*Was this a physical change or a chemical change? (Matter may be changed chemically or physically. Chemical changes cause new substances to form, while physical changes do not. Crushing the tablet is just a physical change because no new substance is formed.)*

*What two substances were found in the mixture? (The tablet is composed of powder and crystals.)*

*How did the mass of the crushed tablet and the mass of the whole tablet compare? (The tablets should have had approximately the same mass because the mass of an object always equals the sum of its parts.)*

### **EXTEND/APPLY**

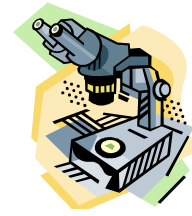
Have students think of other examples of physical changes, such as freezing, breaking glass, hammering wood together to build a playhouse, dipping bananas in chocolate, water evaporating from a pond, etc. List these on a Physical Changes/Chemical Changes Tree Map.

### **ASSESSMENT**

Ask students to give an example of a physical change and tell why it is a physical change.



## A CLOSER LOOK



Unaided Eye	Hand lens	Microscope

Record some of the properties of the seltzer tablet. \_\_\_\_\_

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What is the diameter of the whole seltzer tablet? \_\_\_\_\_

What is the mass of the whole seltzer tablet? \_\_\_\_\_

What is the mass of the crushed seltzer tablet? \_\_\_\_\_

Unaided eye	Hand Lens	Microscope

# IT'S IN THE BAG

## **BENCHMARK and TASK**

**SC.A. 1.2.5** The student knows that materials made by chemically combining two or more substances may have properties that differ from the original materials.

- The student observes the original materials and compares their properties to the properties of the new material produced in a chemical reaction.

## **KEY QUESTION**

What are the properties of matter after a chemical change?

## **BACKGROUND INFORMATION**

**Chemical changes** take place all the time. In a chemical reaction, changes occur that produce new substances with new properties. Chemical reactions, such as those that take place when baking cookies, using some cleaning products, or digesting the food we eat, change the composition of substances. Baking cookies is a chemical reaction because the ingredients lose their identifying properties and the combined ingredients change to cookies, which have new properties. This is an endothermic reaction because the cookie absorbs **heat**.

## **MATERIALS**

### **Teacher**

1 sheet of paper  
1 pair of safety goggles  
1 candle  
matches  
1 cup of water for safety  
2 balloons  
1 nail  
1 ice cube in a cup  
vinegar  
baking soda  
1 glass soda bottle

### **Per pair of students**

1 labeled container of vinegar  
1 labeled container of baking soda  
1 zipper-type plastic sandwich bag  
1 spring clothespin  
1 graduated cylinder  
1 tablespoon  
2 pairs of safety goggles  
1 small piece of wood

## **TEACHING TIPS**

1. Any type of plastic bag that can be sealed can be used for this activity; the sandwich size works well.
2. All students and the teacher should wear safety goggles during this activity.
3. The gas that forms in the bag is carbon dioxide, which is harmless so it is okay if the bags pop open during the reaction or if students open their bags at the end of the reaction to see if there is any odor. Encourage students who wish to smell the contents of the bag to use a wafting motion to bring the odor to their nose rather than sticking their nose into the plastic bag.
4. Try to save at least one reaction bag that has not been opened to use during the Explain portion of the lesson.

## **ENGAGE**

1. Show students a piece of paper, crumple it in your hand, and ask the students how you have changed the paper. Guide students to see that you have not chemically changed the paper; you have only physically altered it. It looks different but is still the same material.
2. Tear the paper in half and again ask students about the change. Help students recognize that only a physical change has occurred. The paper is still paper, only in smaller pieces.
3. Put on your safety goggles. Hold the paper over a metal trashcan or other metal container. Then strike a match and burn the paper. (Caution! Have water handy when you do this.) Remind students that they should not try this at home. Ask students if the paper is still paper after it burns. The paper is permanently altered into a new substance. Explain that they are going to perform some chemical changes. Remind students that in the previous lesson, they created a physical change with a seltzer tablet by crushing it; they did not alter the chemical nature of the tablet itself.

## **EXPLORE**

1. Place a labeled container of vinegar and a labeled container of baking soda on tables so all students can see the chemicals in the containers. Ask students to describe the characteristics of each chemical. Record their descriptions in a chart on the board. Encourage students to use terms such as solid and liquid when describing the chemicals.
2. Tell students to place 50 mL of vinegar in the plastic bag and carefully seal the bag just above the vinegar level with a spring clothespin.
3. Have students place 1 Tbsp. of baking soda in the bag. The baking soda should not go past the clothespin. Students should close the opening of the bag making sure it is completely sealed.
4. After closing their bags, students should observe carefully as they remove the clothespin that separates the substances. Encourage them to feel their bags. (They will become inflated and will feel very cold.)
5. Ask students to describe the changes in the bag. Write their descriptions on the board.
6. Save any of the unopened bags to use in the Explain portion of the activity. Have students throw their bags away and clean up the work area before discussing the results.

## **EXPLAIN**

*What changes occurred after the vinegar and the baking soda mixed together? (The bag inflated and got cold.)*

*What do you think caused the bag to inflate? (A gas was formed inside the bag that could not escape.)*

*In a chemical reaction, changes occur that produce new substances with new properties. Was this a chemical reaction? (yes) How do you know? (A new substance was formed - a gas that was not present before the reaction took place. The acid and soda are getting heat energy from the water to produce carbon dioxide.)*

## **EXTEND/APPLY**

The gas produced in this chemical reaction is carbon dioxide. Discuss the use of carbon dioxide in extinguishing fires. Light a candle. Use a bag in which the chemical reaction has occurred but has

not been opened to allow the gas to escape. Open the bag and quickly stick the candle in the gas inside the bag. The candle flame will be extinguished immediately.

### **ASSESSMENT**

Perform the following demonstrations for the class and have students record whether a physical or chemical change has taken place and why they think so.

#1: Use a nail and scratch a piece of wood. (physical change)

#2: Open a book of matches and tear one out. (physical change)

#3: Strike a match. (chemical change)

#4: Blow up a balloon. (physical change)

#5: Blow up a balloon using vinegar and baking soda. (chemical change)

Place a small amount of vinegar in an empty soda bottle (glass works best). Fill a balloon with a small amount of baking soda. Twist the balloon so the baking soda will not escape while placing the mouth of the balloon on the top of the soda bottle. Make sure the balloon is tightly covering the mouth of the bottle before untwisting it and releasing the baking soda into the vinegar.

#6: Melt an ice cube. (physical change)



## COLOR CLUES

### **BENCHMARK and TASK**

**SC.A.1.2.5** The student knows that materials made by chemically combining two or more substances may have properties that differ from the original materials.

- The student observes the original materials and compares their properties to the properties of the new material produced in a chemical reaction.

### **KEY QUESTION**

How can you determine if common household items are acids or bases?

### **BACKGROUND INFORMATION**

Chemicals are grouped together because of common properties. Acids are a group of chemicals that have a sour taste, can neutralize bases, and turn purple cabbage juice red. Foods like lemons, oranges, and tomatoes contain acids. Bases are chemical opposites of acids; they feel slippery or soapy, can neutralize acids, and turn purple cabbage juice green or blue. Foods that contain bases have a bitter taste. (Baking soda dissolved in water is one example.) Acids and bases can neutralize each other, resulting in a **solution** that is neither acidic nor basic and will not change the color of purple cabbage juice.

Purple cabbage juice will turn a wide range of colors, from yellow-green for strong bases to bright red or pink for acids. Cabbage juice is an acid-base indicator. Litmus paper is also an acid-base indicator.

### **MATERIALS**

#### **Per group**

½ cup of cabbage juice (see Teaching Tips)

9 droppers

*Color Clue Data Table*

egg cartons or ice cube trays (White egg cartons or ice cube trays work best. Sometimes plastic ice cube trays can be found at a dollar store. Another option is to purchase chemical plates from a science supply company.)

crayons

safety goggles (1 pair per student)

solutions to be tested:

medicine cup of vinegar (equal parts vinegar and water)

medicine cup of baking soda (1 tsp. dissolved in water)

medicine cup of rubbing alcohol (full strength)  
medicine cup of aspirin (1 aspirin dissolved in water)  
medicine cup of salt water (1/2 tsp. in water)  
medicine cup of ammonia (1-2 drops of ammonia dissolved in water)  
medicine cup of lemon juice (full strength)  
medicine cup of water (plain tap water)  
medicine cup of shampoo (1 tsp. dissolved in water)

### **TEACHING TIPS**

1. Cabbage juice can be made by the teacher before the activity or you can have students make the cabbage juice themselves. The best way to prepare cabbage juice before the activity is to use a large non-aluminum pan. Place about 1 gallon of water in the pan along with a purple cabbage that you have cut into large pieces. Bring the water to a boil and turn off the heat. Let the cabbage just sit in the water over night. Pour off the cabbage juice into a large container and throw away the cabbage pieces. The cabbage juice will keep in the refrigerator for several weeks or can be frozen for months.  
Optional method: Students can prepare the juice at the beginning of the activity. Have them place torn pieces of purple cabbage leaves into a zipper-type plastic bag. Add  $\frac{3}{4}$  cup of very warm water and close the bag securely. Students should gently squeeze the bag of cabbage and water until it turns dark blue (about 3 minutes).
2. Caution students not to taste any of the items during the lab.
3. Make sure to only use 1 or 2 drops of ammonia to prepare the ammonia solution.
4. Safety goggles should be worn when working with chemicals.
5. You may want to prepare students before they encounter the strong odor of cabbage juice.
6. Labeling both cups of solutions to be tested and the egg carton sections 1-9 to match the data sheet will help students keep track of which solution is being used during the testing.

### **ENGAGE**

1. Ask:  
*When someone sneezes, what might that indicate?*  
*When you walk into your house and smell chocolate chip cookies, what does that indicate?*  
*When you have your temperature taken and it is 101 degrees, what does that indicate?*
2. Discuss the fact that we are surrounded by clues to what is happening in the world around us. These are called “indicators”. Ask students if they can think of other indicators (e.g., crying, thunder, frost, telephone rings).
3. Tell students that many items in our homes are either acids or bases. Sometimes we can tell by tasting that a substance is acidic. However, since tasting isn’t always a safe way to tell, sometimes we need to use an indicator. The indicator we are going to use in this activity is cabbage juice.

### **EXPLORE**

1. Distribute materials to the groups. In the egg carton, have students put  $\frac{1}{2}$  medicine dropper of cabbage juice in each of the 9 compartments. (If chemical plates are purchased, they will be smaller than egg cartons so students will only need about 3-4 drops of cabbage juice in each of the chemical plate wells.)

2. Ask students to add a few drops of the first household test solution to the first compartment and gently jiggle the egg carton to mix the cabbage juice and solution.
3. Tell students to select the crayon that most closely matches the color of the mixture and record on the *Color Clue* data sheet. Students may need to blend two colors together to get the correct shade to match.
4. Tell students to continue testing the household solutions in order, using a new dropper each time to avoid contamination of the solutions being tested.

### **EXPLAIN**

1. Ask:
 

*Which solutions were the most acidic? How can you tell?* (Acidic solutions tend to be pinker.)

*Which solutions were the most basic? How can you tell?* (Basic solutions tend to be greener.)

*Which solutions do you think are neutral - neither an acid nor a base? How can you tell?* (Purple indicator is unchanged.)
2. Display the following chart. Ask students to order the solutions from strongest acid to strongest base according to the chart.

Acid-Base Color Chart	
Strong Acid	Pink
Weak Acid	Lavender
Neutral	Purple
Weak Base	Blue
Strong Base	Green

### **EXTEND/APPLY**

1. Ask students if they can think of a way to neutralize one of the acidic solutions. Discuss their ideas and test them, if possible. (Adding a base to an acid can neutralize the acid.)
2. Ask students if they can think of a way to neutralize one of the base solutions. Try their ideas, if possible. (Adding an acid to a base can neutralize the base.)
3. Acid rain is a serious problem in many urban areas. Fumes from cars and industry rise into the air and dissolve in the droplets of water that form clouds. In the droplets these substances form an acid and fall to earth as acid rain. Acid rain may have a pH value as low as 2.8. Use a weak solution of vinegar/water to water a plant for one month. Chart the condition of the plant.
4. It is important to maintain the correct pH balance in a swimming pool. In order to do this, pool water needs to be tested periodically. Ask students if any of them have experienced testing swimming pool water at home. If so, ask them to find out what is used to adjust the pH of their pools if they are too acidic. (Some form of soda ash is added to neutralize the water.)

### **EXTENSIONS**

1. Let students test solutions again with new indicator paper:
  - Dissolve 1 tsp. turmeric (spice) in  $\frac{1}{4}$  cup rubbing alcohol.

- Dip coffee filters in the solution, let the excess solution drip off, and then spread the filters on foil to dry. (Turmeric stains hands, clothes, and counter tops, so handle carefully.)
  - Cut dried filters into 1 x 2 inch strips.
  - Give indicator strips to students. Explain that they will change to bright red in basic solutions. Let them test several solutions. Ask students to think about how they could use the strips to indicate the presence of acids. (Dip the strip in a base first, turning it red. Dip it in acid afterwards. The acid will neutralize the base, returning the strip to its original color.)
2. Purchase some litmus paper from a science supply catalog and let students test the same solutions that were used with the cabbage juice. Have them compare their results with the results from the cabbage juice activity.

### ASSESSMENT

Maria added cabbage juice to 3 different liquids. Here is her data table:

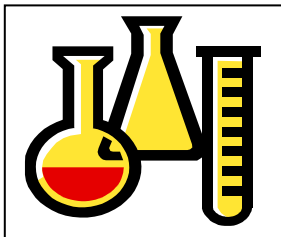
Liquid Number	Color of the Liquid After Adding Purple Cabbage Juice
1	Pink
2	Green
3	Purple

What do you know about the three liquids just from looking at Maria's data table?



## COLOR CLUES

<b>Solutions</b>	<b>Color</b>
<b>1. Vinegar in water</b>	
<b>2. Baking Soda in Water</b>	
<b>3. Rubbing Alcohol</b>	
<b>4. Aspirin in Water</b>	
<b>5. Salt in Water</b>	
<b>6. Ammonia in Water</b>	
<b>7. Lemon Juice</b>	
<b>8. Water</b>	
<b>9. Shampoo in Water</b>	



# POWDER PUZZLE

## **BENCHMARK and TASKS**

**SC.A.1.2.5** The student knows that materials made by chemically combining two or more substances may have properties that differ from the original materials.

- The student determines the properties of an object using qualitative observations and metric measurements that incorporate tools such as rulers, thermometers, balances, and graduated cylinders.
- The student observes the original materials and compares their properties to the properties of the new material produced in a chemical reaction.

## **KEY QUESTION**

Can you identify a mystery powder by any chemical changes that take place when it is tested with different indicators?

## **BACKGROUND INFORMATION**

Chemical properties of materials are demonstrated in reactions with other materials. When liquids are added to powders, students can observe bubbles and fizzing that indicate that a gas has been formed by the reaction. Color changes can indicate the presence of particular substances. Many chemicals react differently when heated. Heating can cause both **physical and chemical changes**. Vinegar indicates the presence of carbonates by fizzing and bubbling. Carbon dioxide gas is produced in such reactions. (Baking soda and vinegar will produce this gas.) Iodine can be used to indicate the presence of a starch by turning purple. Cornstarch mixed with iodine solution shows this reaction. Heating sugar causes it to form a liquid and then turn black. This type of change does not occur when heating the other powders in this activity. Salt does not react with vinegar, and iodine does not form a liquid nor turn black when heated.

## **MATERIALS**

### **Per group**

1 tray to hold the cups labeled  
5 medicine cups labeled A-E  
    5 mL cornstarch labeled A  
    5 mL sugar labeled B  
    5 mL baking soda labeled C  
    5 mL salt labeled D  
    5 mL Mystery Substance E  
wax paper  
2 copies of *Powder Puzzle* grid  
paper towels  
1 clothespin  
newspaper

### **Per group (continued)**

5 squares of aluminum foil  
5 spoons labeled A-E  
1 microscope and blank slides  
2 droppers  
2 dropper bottles of testing solutions:  
    vinegar  
    water  
15 toothpicks  
4 small squares of dark construction paper  
Mystery Substance E (baking soda and sugar)

### Per student

safety goggles  
gloves  
science journal  
hand lens

### Per teacher

matches  
candle anchored with clay and foil  
iodine, diluted 75 % water/25% iodine  
vial of mystery powder (baking soda)

### TEACHING TIPS

1. **Check student health records and ask parents if students have any allergies to iodine. Iodine is a mild poison.**
2. Buy 2-5 % strength iodine and then dilute it further by mixing it with water to create a weak solution – 75% water to 25% iodine – the color of weak tea.
3. The teacher should place the drops of iodine on the groups’ testing sheets so the students do not have to handle it.
4. Caution students not to taste anything during this activity.
5. A safe way to manage the heating of the chemicals is for the teacher to supervise a table with several candles and have students take turns heating a substance and then carrying the substance back to the group to observe. The teacher can also heat the substances, and when cool, the heated substances can be passed from group to group so students can record the results.
6. Have students wear gloves and safety goggles when handling the materials.
7. These tests should be conducted during several class periods.

### ENGAGE

Show students a vial of Mystery Powder. Tell the class that you have been given this powder, and you need to determine what it is. You don’t want to taste it because you don’t know if it is safe to taste. Ask students for ideas on how to determine what is in the vial in a safe manner.

### EXPLORE

1. Cover desks with newspaper. Distribute trays containing 4 medicine cups of mystery powders A-D and these materials: 2 copies of the grid, wax paper, 2 droppers, hand lenses, 1 bottle of vinegar, 1 bottle of water, spoons labeled A-D, a microscope, and toothpicks.
2. Tell students they are to work as a group on this activity, following these directions:
  - Have students label each dark square of paper A, B, C, and D. Then carefully place about ¼ teaspoon of each substance on the paper with the matching label. Using hand lenses and the microscope, students should observe each powder, noting color, consistency and texture. *Is this substance powdery or does it have a structure of crystals?* This information should be recorded on the grid under the “substances/observations” column.
  - Place one copy of the grid on your table and cover it with the wax paper. (Use the second copy of the grid to record the group’s observations.)
  - Place a bit of each powder down the first vertical column under *Water Test*. Drop approximately 2 drops of water on each substance and observe. Use a different toothpick to stir each substance. (Throw the toothpick away after each use.) Record your observations on the grid. If no reaction occurs, write “no reaction.”

- Place a bit of each powder down the second vertical column under *Vinegar Test*. Drop approximately 2 drops of vinegar on each substance and observe. Use a different toothpick to stir each substance. (Throw the toothpick away after each use.) Record your observations on the grid.
  - Place a bit of each powder down the third vertical column under *Iodine Test*. The teacher will walk by and drop approximately 2 drops of iodine on each substance while you observe. Use a different toothpick to stir each substance. (Throw the toothpick away after each use.) Record observations on the grid.
  - Have one student from each group shape a piece of aluminum foil into a bowl and attach a clothespin handle to create a spoon. Place some of the powder from cup A into the bowl of the spoon. The spoon should be taken to the candle station and heated under the teacher’s guidance. The student who is heating the substance needs to have safety goggles and no loose clothing or hair that may accidentally get into the flame. After heating, the powder can be carried back to the group so observations can be added to the group’s grid under “Reaction to Heat”. (If the aluminum spoon containing the substance is placed right above the flame, heating occurs rapidly. A minute or less of heating is all that is required.) Have students continue this process for substances in cups B, C, and D.
3. Have students put the grids aside and then observe the powders again after a short time to see if any additional changes have occurred.

### **EXPLAIN**

1. On the board write the following clues to the identity of the mystery powders.
  - Iodine will indicate the presence of cornstarch by turning purple or blue/black.
  - Vinegar will indicate the presence of baking soda by fizzing, which shows that a gas is being produced.
  - Water will dissolve substances such as sugar and salt at different rates.
  - Heat causes sugar to melt (change to a liquid) and then turn brown or black.
2. Ask students to use their grids to help them respond to these questions:
 

*Which mystery substance reacted most dramatically with the iodine?*  
(Mystery Substance A)  
*What is the name of that substance?* (cornstarch)  
*Which mystery substance reacted by producing bubbles when mixed with vinegar?*  
(substance C)  
*What is the name of that substance?* (baking soda)  
*Which mystery substance turned black when heated?* (substance B)  
*What is the name of that substance?* (sugar)  
*Which of the mystery substances showed no reaction with vinegar, iodine, or heating?* (salt)
3. Distribute samples of Mystery Substance E shown during the Engage activity. Students should place this sample on the grid in the spaces for Substance E, so they can compare it with the other powders. Have students observe the powder and then perform the water, vinegar, iodine, and heat tests. Using the results from the activity, students should be able to identify Mystery Substance E as baking soda due to its reaction with vinegar and the fact that it does not react with iodine or turn black or brown when heated.

### **EXTEND/APPLY**

Make a mystery powder mixture by mixing baking soda and sugar. Students should perform tests on the mystery powder mixture and try to identify the substances it contains. In their science journals have students write the names of the two ingredients that make up the mystery powder mixture and a paragraph explaining how they identified those ingredients.

### **EXTENSION**

Test each of the substances used in this activity by dropping a few drops of cabbage juice indicator on each one. Cabbage juice indicator can be made by placing several leaves of red cabbage in a sealed baggie of hot water and kneading until the liquid is dark in color. This will determine whether the substances are acids or bases. (Baking soda is basic, cornstarch is acidic, and salt and sugar are neutral.)

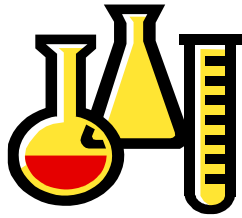
### **ASSESSMENT**

Give students this scenario:

Last night a cherry pie disappeared from the school cafeteria. Several clues were left behind and discovered by the principal this morning. The first clue is a mysterious white powder found on the floor. One set of footprints was left in the powder. In addition, witnesses reported that four people were seen in the area: Salty Sammy, Sugar Susie, Baking Soda Billy and Corn Starch Clara.

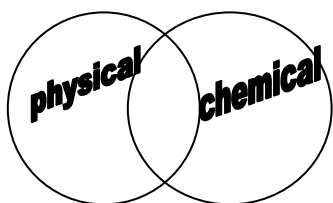
Describe the test you could perform to find out what the mystery powder is and how you would decide who is guilty.

Student Scientists: \_\_\_\_\_



## POWDER PUZZLE

<b>Substance/ Observations</b>	<b>Water Test</b>	<b>Vinegar Test</b>	<b>Iodine Test</b>	<b>Reaction to Heat</b>
<b>Substance A</b>				
<b>Substance B</b>				
<b>Substance C</b>				
<b>Substance D</b>				
<b>Mystery Substance E</b>				



# NAME THAT CHANGE!

## BENCHMARKS and TASKS

**SC.A.1.2.2** The student knows that common materials (e.g., water) can be changed from one state to another by heating and cooling.

**SC.A.1.2.4** The student knows that different materials are made by physically combining substances and that different objects can be made by combining different materials.

**SC.A. 1.2.5** The student knows that materials made by chemically combining two substances may have properties that differ from the original materials.

- The student physically combines materials to create mixtures.
- The student demonstrates that physical changes in the states of matter can be produced by heating and cooling.
- The student observes the original materials and compares their properties to the properties of the new material produced in a chemical reaction.

## KEY QUESTION

How do you know whether various changes in matter are chemical or physical?

## BACKGROUND INFORMATION

**Matter** goes through **chemical and physical changes**. During physical changes, the state of the matter may change but not the chemical composition. Melting ice is a physical change since the matter (ice) changes form but the chemical composition remains the same (water). During a chemical change, the chemical composition of the matter changes. Burning a match and rusting iron are both chemical changes. In each case the bonds holding the molecules are broken and the **atoms** reform into different molecules.

## MATERIALS

### Per class (materials for all stations)

5 transparent plastic cups

strands of steel wool

tongs

2 containers of vinegar

paper towels

2 plastic spoons

1 empty 35 mm film canister

cubes in ice bucket or some other container that will keep them from melting

baking soda

1 plastic knife

small apples

safety goggles

matches

1 balance and mass set

salt

1 graduated cylinder

2 containers of water

1 candle anchored in clay on aluminum foil

### Per student

*Name That Change* activity sheet

## **TEACHING TIPS**

1. **Ask an adult volunteer to facilitate Station #5.** Make sure all safety precautions are strictly followed when using an open flame. All loose clothing and hair should be secured. Students should wear safety goggles. Water should be available at the station.
2. Make a sign for each station as follows:

Station #1 Procedure: Observe an ice cube in a plastic cup for a few minutes. Clean up before leaving the station.

Station #2 Procedure: Label a paper towel with the names of the students in your group. Use tongs to dip a small piece of steel wool into a cup of vinegar. Place the steel wool on a paper towel and observe. Since this change takes several hours to occur, you will leave the paper towel containing the steel wool to view later today.

**Note:** Steel wool can be purchased in a hardware store. It is used in refinishing furniture. Do not use the soap pads you find for sale in the grocery store. (This change takes several hours to occur. You may want to prepare a sample the night before to have at this station for students to view.)

Station #3 Procedure: Place a spoonful of baking soda into a plastic cup. Fill the film canister with vinegar and pour it into the cup with the baking soda. Observe what happens. Clean up the materials before leaving the station.

Station #4 Procedure: Cut a wedge from the apple and place it in the plastic cup. Observe it for a few minutes. Clean up before leaving.

Station #5 Procedure: Caution! Be very careful with the open flame. Observe all safety precautions!! Use clay to secure the candle to the aluminum foil. Light the candle. Observe for a few minutes. Blow out the candle.

Station #6 Procedure: Place 2 grams of salt in a plastic cup. Add 10 mL of water and stir. Observe. Empty and rinse the cup before leaving the station.

3. The materials to be placed at each station are as follows:

Station 1: ice cubes in ice bucket, plastic cup

Station 2: steel wool pieces, plastic cup with vinegar, tongs, paper towels

Station 3: plastic spoon, plastic cup, empty film canister, baking soda, vinegar, paper towels

Station 4: apple, plastic knife, plastic cup

Station 5: matches, candle, clay, aluminum foil, container of water, safety goggles

Station 6: salt, container of water, plastic cup, spoon or stirrer

## **ENGAGE**

Ask: *What is the difference between a chemical and a physical change?* (A chemical change produces a new product that has different chemical properties from the original substances while a physical change does not produce a new product. In a physical change the chemical properties of the original substance remain unchanged.)

*Give some examples of physical changes.* (freezing water to form ice, tearing paper)

*Give some examples of chemical changes.* (baking a cake, burning a match)

*Can you think of a situation where a substance might change both physically and chemically?*  
(Students may not have any ideas to discuss. This is a good place to tell them to think about this question as they move through the stations.)

### **EXPLORE**

1. Divide students into six groups and give each student a data sheet.
2. Explain to students that they will be moving through six different stations. At each station they should follow the procedure on the station card, observe any changes that occur and record on their data sheet if the change was physical, chemical, or both. Tell students to make sure they also write a reason for their choice.
3. Tell each group where to start and explain how students are to move as a group through the stations when you give the signal to move. Make sure students know that they will be given a three-minute warning before rotating so they should immediately begin to clean up when they hear the warning.
4. Watch students as they work at the stations and decide how to time the station rotations. After students have moved through all of the stations, you may want to clean up before going on to the Explain part of the lesson.

### **EXPLAIN**

1. Draw a Venn diagram on the board. Label one circle physical and the other chemical.
2. Give each group a large piece of chart paper or a white board. Tell students to copy the Venn diagram onto their chart.
3. Instruct students to decide as a group where each change (Station 1-6) should be placed on the Venn diagram. Give students several minutes to do this.
4. Conduct a class discussion having each group share where they placed the changes on the Venn diagram and why.
  - Physical changes include ice melting and mixing salt and water.
  - Chemical changes include the steel wool reacting with the vinegar to form rust and the production of a gas when vinegar and baking soda are combined.
  - The slicing of an apple is both physical and chemical. When the apple is sliced, a physical change occurs and when it is exposed to air and turns brown, a chemical change occurs.
  - The burning candle is also both physical and chemical. The melted wax is a physical change. The burning wick and wax is a chemical change.
5. If students have a problem coming up with the same results, have them describe the problems they had in determining whether changes at the stations were physical or chemical. Make sure you discuss how both a physical and a chemical change can occur.

### **EXTEND/APPLY**

Ask students where these changes would be placed on their Venn diagrams:

Cutting hair (physical)

Toasting a piece of bread (chemical, new substance is formed)

Dissolving a seltzer table in water (chemical, gas bubbles are produced)

Breaking rocks with a hammer (physical)

Melting ice cream (physical)

## **ASSESSMENT**

*If you were to crack an egg and stir it, would this be a physical or chemical change? Explain.*

*If you were to cook that egg, would that be a chemical or physical change? Explain.*

The choices that students make as to physical or chemical change are not as important as the explanation that goes along with those choices. If students call a change physical, they should explain that the substance changes shape, size, or state but is still the same stuff. Students should explain that chemical changes form new substances and evidence that physical changes have occurred might be gas bubbles, a change in color, or a change in temperature.

Student Scientist: \_\_\_\_\_

## NAME THAT CHANGE!

Station	Physical	Chemical	Both	Why?
#1 Ice Cube				
#2 Steel Wool in Vinegar				
#3 Baking Soda and Vinegar				
#4 Apple Slice				
#5 Burning Candle				
#6 Salt and Water				

