Throughout the guide, teaching tips are in red.

Activity Description & Estimated Class Time

This 3-day activity has students combine materials that can be completely separated with no change to the original ingredients, and they also combine materials that interact to produce new substances. In these examples, when new substances are produced, student pairs cannot physically separate the initial ingredients. Students list characteristics of materials before they are combined, after they are mixed, and after they try to separate them again. Last year in grade 4, students had experience with properties of matter (Essential Standard 4.P.2.1). This provides a basis for determining whether combining materials creates something with new properties. These activities help students begin to distinguish between physical and chemical change.

Objectives

Students will demonstrate knowledge and understanding of the following ideas and content:

- the characteristics of a given material are consistent, and can be described;
- when materials of known characteristics are combined, then physically separated, and no changes in the characteristics of the original ingredients are observed, nothing new has been created;
- when materials of known characteristics are combined and the mixture cannot be physically separated to produce the original ingredients with their original characteristics, the interaction has produced something new;

Students demonstrate this knowledge and understanding by...

- describing characteristics of materials,
- combining those materials and describing the characteristics of the combination,
- trying to completely separate the combined materials,
- describing characteristics of the separated materials, if possible,
- applying a rule for evidence that a combination of materials has created

Correlations to NC Science Standards

5.P.2 Understand the interactions of matter and energy and the changes that occur.

5. P.2.3 Summarize properties of original materials, and the new material(s) formed, to demonstrate that a change has occurred.

Brief Science Background

Some materials can combine as a mixture, which can be separated back into original ingredients. Other materials can chemically combine to make something new, with characteristics different from the original ingredients. This activity combines some materials to produce new characteristics not present in the original materials, and it combines other materials that remain unchanged in the mixture.

Materials

Materials for the whole class for both days

- a supply of 1-oz plastic cups
- a supply of larger plastic (3 ½-oz) cups
- two 9-oz squat plastic cups
- rice
- sand
- 15 paper trays
- 15 sheets paper cut to fit inside trays
- 15 screen squares
- 15 rubber bands
- washing soda powder
- epsom salts crystals
- white beans
- black beans
- a small dropper bottle of universal indicator solution
- a small piece of steel wool
- 45 wooden coffee stirrers
- small funnels
- 30 12.5 cm diameter filter papers
- a permanent marker
- copies, 1 per pair of students, BLM 1 Mixture/Change Record Chart
- to project: BLM 2 “Mixtures and Chemical changes”

Materials for pairs of students for Day 1

- 1 paper tray
- 1 piece of paper cut to cover the flat part inside the tray
- 1 1-oz cup of rice – labeled A
- 1 1-oz cup of sand – labeled B
- 1 1-oz cup of washing soda solution – labeled C
- 1 1-oz cup of epsom salts solution – labeled D
- 3 3.5-oz plastic cups
- 2 wooden coffee stirrers
- 1 piece of screen
- 1 small funnel
- 1 rubber band
- a 12.5 cm diameter filter paper
- 1 copy of BLM 1, the Mixture/Change Record Chart

Preparation for Day 1

1. For all of the following, it is easiest to make setups by assembling the materials listed above for a pair of students on a paper tray. Before putting anything in the tray, place a piece of paper in the tray just large enough to cover the bottom (the paper keeps the tray clean when they separate materials).
2. Make stock epsom salts and washing soda solutions by placing 1 teaspoon of Epsom salts in one 9-oz squat plastic cup (label C), and 1 teaspoon of washing soda in another 9-oz plastic cup (label D). Fill both cups with water to near the top and use a coffee stirrer to mix until dissolved. Label one 1-oz cup per pair C, and one D. Pour the corresponding stock solutions into these. **Fill these 1-oz cups only half full.** Place one cup labeled C and one labeled D on each pair's tray.
3. Label one 1-oz cup per pair of students A, and one B. Pour rice into A and sand into B, half full.
4. Copy BLM 1 mixtures/change chart, one per pair of students and have these ready to give out.
5. In addition to the above cups, place a funnel, a filter paper, 3 3.5-oz plastic cups, 2 coffee stirrers, a piece of screen, a rubber band, and a copy of BLM 1 (Mixture/Change Record Chart) on each pair's tray.
6. Have BLM 2, Mixtures and Chemical Changes, ready to project.

Day 1 Procedure

1. Explain that we will work with different kinds of mixtures for the next few days. Ask the class about mixtures that they know of. If they need help, give examples: salad dressing, soft drinks, dirt, etc. Ask them what ingredients make up these mixtures.
2. Give out the supplies on the paper tray listed in "Materials for Pairs of Students Day 1" and copies of BLM 1 (Mixture/Change Record Charts).
3. Ask pairs to look at their Mixture/Change Record Charts and find the cup A and cup B boxes under "Before Combining." Ask the pairs to write as many characteristics of the stuff in cups A and B as possible in those boxes.
4. When pairs finish writing, ask them to clear the tray (except for the paper) and place a 3.5-oz plastic cup in the middle. Ask them to pour cups A and B into the cup in the middle and stir to mix. Point out the "characteristics of combined substances" column on BLM 1 and ask pairs to list characteristics of the combined materials there. **A typical response might be "like sand, only lumpier."**
5. Ask teams to clear the tray, leaving the piece of paper in it. Ask them to separate the combined ingredients, in the tray, as completely as they can, putting the separated materials back in their original cups. Ask them to record the characteristics of these separated materials on the chart. To record these characteristics, have them use the "characteristics of one separated

Procedure Cont.

substance" and "characteristics of the other separated substance" boxes in the "After Separating" column.

6. Briefly discuss:

   - How were characteristics in the combined sand and rice different from and like just sand and rice by themselves?
   - How did you separate the sand and rice?
   - Describe some evidence that the sand and rice were or were not changed after being combined and separated. Explain how your evidence supports your claim.

7. Give each pair 1-oz cups C and D, half full of liquids. Ask teams to record characteristics of the two liquids in the cup C and cup D boxes under "Before Combining." **Caution everyone not to taste the liquids. Neither liquid is poisonous in small amounts, but don't say so. Student s should never taste chemicals. Both liquids look like water, so pairs will not likely see differences.** When teams have recorded observations, ask them to combine the liquids in the 3.5-oz plastic cup. Challenge them to list characteristics of the combined materials on the chart. When teams finish, ask them to **keep their copy of the chart to use during the next class period.**

8. Ask pairs to use the filter paper and funnel to separate the two liquids. Ask them to place the funnel in a 3.5-oz plastic cup. Guide them to fold the filter paper (project BLM 3 if necessary) and place it in the funnel. When the setup is complete, ask them to pour the milky colored liquid through the filter paper. **Filtering may take as long as 5 minutes. During that time, hold a class discussion about the first two bullets below.**

   - What characteristics did you observe in the two liquids combined that were different from the two liquids by themselves before they were combined?
   - Before you mixed the two liquids, what evidence did you have that they were different or the same? After mixing, what evidence did you have that they were different or the same?

   After filtering, give this notebook prompt.

   Notebook Prompt:

   - Describe how you separated the mixture.
   - Describe your evidence that the two liquids were or were not changed and explain how that evidence supports your claim.

   Ask pairs to set the filter paper aside to dry overnight. Examine it during the next class period and discuss whether it represents "something new." **It is something new because neither of the two liquids that were combined contained white stuff.**

9. Discuss the differences between sand and rice and the two liquids when it comes to combining and separating them. **Comparing these two combinations provides a rich opportunity for students to think, speculate, and explain their thoughts. Try to get as many ideas as possible from them, but do not use this time to teach about mixtures and chemical compounds.**

Procedure for Day 1 cont.

10. Project BLM 2 and ask students to copy it into their notebooks. BLM 2 says:

- *Some ingredients can combine and separate again without changing. These don't make anything new. This kind of combination is called a mixture.*
- *Some ingredients combine but don't easily separate again. These make something new. This kind of combination is called a chemical change.*

Ask

- which kind of combination was the sand and rice, and why?
- which kind of combination was the two clear liquids, and why?

Day 2

Materials

Materials for the whole class for day 2

-
- a steel wool pad
- a 9-oz plastic cup of water

Materials for pairs of students for day 2

- a paper tray with a piece of paper cut to cover the flat part inside
- two 3.5-oz plastic cups
- 1-oz cup half full of white beans – labeled E
- 1-oz cup half full of black beans – labeled F
- 1-oz cup half full of washing soda solution – labeled G
- 1-oz cup half full of indicator – labeled H
- BLM 1 Mixture/Change Record Chart partially filled out on previous day
- a coffee stirrer
- a small funnel
- a 12.5 cm diameter filter paper
- 2 copies BLM 1, Mixtures/Change Record Chart from part 1 of the activity

Preparation for Day 2

1. Per pair, make two 1-oz cups, one labeled E, and one F. Fill the cups labeled E half full of white beans and the cups labeled F half full of black beans.
2. To make washing soda stock solution, label a 9-oz plastic cup G and fill it with water. Stir in 1 teaspoon of washing soda with a coffee stirrer. The solution will be clear with a little foam on top.
3. Per pair, label one 1-oz cup G and fill it half full with solution from cup G.
4. To make indicator stock solution, label a 9-oz plastic cup H and fill it with water. Drip 50 drops of universal indicator from the dropper bottle into the water and stir it with a clean coffee stirrer. The solution should be green.
5. Per pair, label one 1-oz cup per pair H and half fill these cups with solution

Preparation cont.

from cup H.

6. Be sure teams have their copy of BLM 1, Mixtures/Change Record Chart from part 1 of the activity.
7. Per pair, place two 3.5-oz plastic cups, cups E and F, and 2 coffee stirrers on a paper tray. Have these trays ready for teams. Set aside cups G and H to give out later on (in step 6 of the procedure).
8. Set aside a steel wool pad and two 9-oz plastic cups, one empty and one full of water. You will use these in the last step in the activity.

Procedure for Day 2

1. Explain that we will look at more examples of combinations. Project BLM 2 again and say we will decide which kind of combination we make: a mixture or a chemical change.
2. Give out trays of materials. Be sure teams have their copy of BLM 1 partially filled in from the previous day.
3. Ask pairs to record characteristics of the contents of cups E and F in the appropriate places on the chart.
4. When teams finish, ask them to combine cups E and F in a 3.5-oz plastic cup and thoroughly mix. Ask them to describe characteristics of the combined material in the "combined" column of the cup E and F row.
5. Ask pairs to separate the combined beans back into the original cups and describe characteristics of the separated beans in the 2 columns under "After Separating." After everyone does this, share results and discuss. Ask what kind of combination this was, and why. Ask pairs to clean out the small cup and re-use it for the next steps.
6. Give out cups G and H to each pair. Ask them to use cups G and H to repeat what they just did, including recording characteristics of cups G and H in the chart.
7. Ask teams to use the funnel and filter paper as before, pour the combined liquids through it, and record results in the "After Separating" column. **They will not be able to separate it. The liquid will remain blue and look the same as it did before going through the filter.**
8. Ask: "What kind of combination is this, and how do you know?" and discuss differences in combining and separating the two liquids and the bean mixture.
9. Show the steel wool around the class and ask for descriptions of characteristics. Put it in the 9-oz plastic cup and pour the cup of water into it. Ask what kind of combination this is, and ask for reasons. Explain that the cup of water and steel wool will sit until next class period, when we will write down characteristics of the combination. Ask for predictions about what we will see in the cup.

Day 3

Wrap-Up

1. Review:
   - Things that can be combined and separated again, and still have their original characteristics are called mixtures.
   - Things that combine and make something with new characteristics, and can't easily be separated again, are called a chemical change.
2. Ask everyone to go through their Mixture/Change Record Chart and identify each combination as either a mixture or a chemical change.
3. Ask everyone to look at the steel wool and water from the previous class period. Ask them to describe the characteristics of the combined materials. Ask them if they think they can separate the combination back into steel wool and water. Ask if the class thinks this is a mixture or a chemical change. Ask for reasons.
4. Give an example of a mixture such as salad. Explain that the fact that the ingredients are combined doesn't change them, and you can pick through the salad and separate the ingredients unchanged. Ask the class to give examples of mixtures.
5. Explain that an example of chemical change is pancakes. Combining the ingredients in pancake batter and cooking it changes the ingredients into something new, and you can't easily separate the ingredients back into their original form. Ask the class to give other examples of chemical changes.

Guided Practice

Guided Practices are similar to typical tests, but require students to reveal their thinking about content. They serve as a practice before a test and should not be graded. They are intended to expose misconceptions *before* an assessment and to provide opportunities for discussion, re-teaching, and for students to justify answers. They are best given as individual assignments without the manipulatives used in the activity. In that context, pose the following "test items" to the class. Ask them to write responses in notebooks.

Choose the response that best completes the sentence.

1. Someone combines a teaspoon of white crystals with a cup of water. It is probably a mixture if:
   A. the water foams, and a gas with a strange smell comes out.
   B. the crystals disappear in the water, but after the combination sits out for a few days, the water evaporates to leave behind the same crystals.
   C. the water changes color and is filtered, but nothing comes out into the filter paper.
   D. the crystals change color.

Day 3

2. Oil and water are poured together in a jar, then shaken up. At first, the jar looks cloudy, but after a few minutes, the oil is all on the top and the water is all on the bottom. This combination is a:

    A. chemical change because the water sinks to the bottom and that is new.

    B. chemical change because the oil turns into small droplets for awhile.

    C. a mixture because the oil and water separate and nothing new is made.

    D. a mixture because the water changes to get cloudy for awhile.

3. A log burns until only smoke and ash are left. This is a:

    A. chemical change because the log changes into things with new characteristics.

    B. a mixture because the smoke is made of tiny pieces of log floating in the air.

    C. a mixture because the ashes can be separated back into log and air.

    D. a chemical change because the smoke can be filtered out of the air.

Answer Key

1. **B**
2. **C**
3. **A**

BLM 1 Mixture/Change Record Chart

NAMES_____Date_____

BEFORE COMBINING (enter cup label letter in each box)		COMBINED	AFTER SEPARATING (if it could be separated)	
Characteristics of substance	**Characteristics of substance**	**Characteristics of combined substances**	**Characteristics of one separated substance**	**Characteristics of the other separated substance**
Cup A	**Cup B**			
Cup C	**Cup D**			
Cup E	**Cup F**			
Cup G	**Cup H**			

Mixtures and Chemical Changes

Some ingredients can combine and separate again without changing. These don't make anything new. This kind of combination is called a mixture.

Some ingredients combine but don't easily separate again. These make something new. This kind of combination is called a chemical change.

BLM 3 Folding Filter Paper