Investigation Five – Mixing Colors (Physical Change)

Standard I Students will understand that chemical and physical changes occur in matter.
Objective 2 Evaluate evidence that indicates a physical change has occurred.
Intended Learning Outcomes 1. Use science process and thinking skills 2. Manifest scientific attitudes and interests 3. Understand science concepts and principles 4. Communicate effectively using science language and reasoning

Standard I

Objective 2

Background Information

Not all color changes indicate a chemical reaction. Merely mixing colors is a physical change. No new substance is formed. This can be confusing to students when trying to understand the difference between the color change in a chemical reaction and color change when two colors are mixed together (physical change: blue and yellow food coloring mixed together creates green; chemical reaction: colorless vinegar added to purple cabbage juice turns pink).

This activity will help students understand the differences between color mixing and color change due to a chemical reaction as they "get back" the colors they mixed together using chromatography. Chromatography is a method used to separate the different ingredients of a mixture. It was first used by Russian botanist Mikhail Tsvet to separate the pigments that make up plant dyes. It is now used to determine the ingredients that make up flavors or scents, to analyze the components of pollutants, to find traces of drugs in urine, and to separate blood proteins to identify various species of animals. Chromatography is also commonly used in police labs to determine unknown substances found at crime scenes.

There are many different types of chromatography, but all of them involve a gas or a liquid (the water in this activity) flowing through a stationary substance (the paper towel). Because the physical and chemical make-up of the pigments used to make colors vary, the rate and distance at which they travel along the paper towel varies, causing the colors to separate out.

This activity is written as a hands-on activity for cooperative teams. However, the color mixing (steps 1-5) could be done as a teacher demonstration using petri dishes on an overhead projector. Teams should complete the color separation (chromatography).

Pre-Assessment/Invitation to Learn

Materials
- 6 clear plastic cups
- Water
- Red food coloring
- Blue food coloring
- Yellow food coloring

Teacher demonstration:
- Have the 3 primary colors in 3 clear plastic cups.
- Ask students what will happen when two colors are mixed together.
- Mix them in new cups to make the secondary colors.
- Ask the students if this is a physical or chemical change.
- This is a physical change and we will prove this with chromatography.

Instructional Procedure

Materials
For each team of 3-5 students:
- 4 clear plastic cups
- 1 – 1ml plastic pipette (eye dropper)
- Red, yellow, blue food coloring
- One sheet of absorbent paper towel
- Glass plate or china saucer
- Student journal page "Mixing and Un-mixing Colors"
- Student Sheet for Color Chromatography
- Water

Cooperative teams of 3-5 should complete the following procedures:
Part 1 Color Mixing:
1. Using the pipette, place about 5 ml of water in each of the 3 cups.
2. Add 3-5 drops of red food coloring to one cup. Repeat for yellow and blue. (If using the pipette to drop colors be sure to rinse it between colors.) Swirl Each cup to mix the food coloring and the water.
3. Using the pipette, drop about ½ ml of one of the food color water mixtures on the glass plate. Mix the colors together using the tip of the pipette. Observe what happens. Record your observations.
4. Repeat procedure 3, mixing different colors. Carefully record observations. To avoid test spots from running together, rinse your plate at the sink and dry it before continuing.

After the teams have completed the above procedures, lead a discussion about the color mixing activity. Have students share what colors each mixture made. Record their responses on the board. Ask:

"Is color mixing a physical change or a chemical reaction?
What evidence supports your answer?" You may have students supporting both choices. Some students may feel, since there was a color change, that there was a chemical reaction. Accept all answers and record the responses on the board. Tell the students that the next part of the activity will help answer the question. Ask: "Can the substances in a chemical reaction be returned to their original states?" *(No)* "Can the substances combined in a physical change (mixture) be separated out?" *(Yes)*

Have the teams complete the following procedures:
Part 2 Chromatography:
1. Carefully drop one drop of red, one drop of yellow, and one drop of blue food coloring together on the glass plate.)If you are using the pipette to drop the colors, be sure to rinse it between colors) Mix the three drops together with the tip of the pipette. Observe the mixture. What color is it? Record your observation.

2. Cut a 9 cm strip of paper towel.
3. Using the tip of the pipette place a small drop of the food color mixture in the center of the paper towel strip about 3 cm from one end. (See illustration p. 8.2.17.
4. Fill a clear plastic cup to about 2 cm deep with water.
5. Place the end of the paper towel strip with the food coloring dot into the water. (Make sure the water does not touch the food coloring.)
6. Observe for 5-10 minutes. What happened? *(The colors separated)* Why? Record your observations.

At this point lead a discussion about what the students have observed. Share the information from the "Background" section. Make sure students understand that mixing colors just changes the physical property of color and that usually the colors can be separated out. This shows that only a physical change has occurred. When there is a color change during a chemical reaction, there is a change at the molecular level and new substances are formed.

Curriculum Extensions

Science –

- Chromatography can be used to separate the colors from the inks in felt-tipped markers. Have students use the procedures in Part 2 using a variety of water color markers. (ILO 1)

Assessment Suggestions

- Ask the following questions for student understanding:
  - ✓ Was the mixing of the colors a physical or chemical change? (physical)
  - ✓ Why? (Because the colors could be separated out.)
  - ✓ How can we tell when a chemical change has occurred? (There is a new product and the ingredients can't be brought back to their original states.)

- ✓ Check for understanding by looking at the students' journal pages.

Reference to Assessment Section

Unit Test	Multiple Choice	Constructed Response	Performance Test
1	5, 6, 7, 8, 10, 11, 12	1, 4	Chemical Change Log
2	3, 7, 8, 9, 10, 11	3, 4	Chemical or Physical

Student Sheet for Color Chromatography

Your team will need:

- ✓ 4 clear plastic cups
- ✓ 1 – 1ml plastic pipette (eye dropper)
- ✓ Red, yellow, blue food coloring
- ✓ One sheet of absorbent paper towel
- ✓ Glass plate or china saucer
- ✓ Water

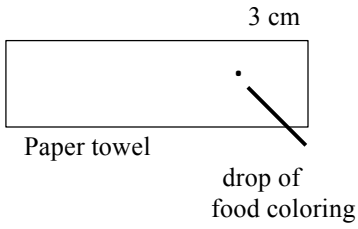
Working with your team complete the following procedures:

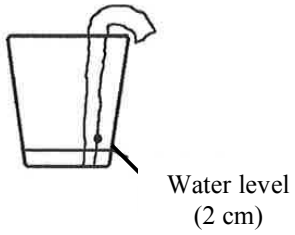
Part 1 Color Mixing:

1. Using the pipette, place about 5 ml of water in each of the 3 cups.
2. Add 3-5 drops of red food coloring to one cup. Repeat for yellow and blue. (If using the pipette to drop colors be sure to rinse it between colors.) Swirl each cup to mix the food coloring and the water.
3. Using the pipette, drop about ½ ml of one of the food color water mixtures on the glass plate. Rinse pipette. Drop ½ ml of another color into the first color on the plate. Mix the colors together using the tip of the pipette. Observe what happens. Record your observations.
4. Repeat procedure 3, mixing 2 different colors. Carefully record observations. To avoid Test spots from running together, rinse your plate at the sink and dry it before continuing.

Part 2 Chromatography:

1. Carefully drop one drop of red, one drop of yellow, and one drop of blue food coloring together on the glass plate. (If you are using the pipette to drop the colors be sure to rinse it between colors). Mix the three drops together with the tip of the pipette. Observe the mixture. What color is it? Record your observation.
2. Cut a 3 cm strip of paper towel.
3. Using the tip of the pipette, place a small drop of the food color mixture in the center of the paper towel strip about 3 cm from one end.





4. Fill a clear plastic cup to about 2 cm deep with water.
5. Place the end of the paper towel strip with the food coloring dot into the water. (Make sure the water does not touch the food coloring.)
6. Observe for 5-10 minutes. What happened? Why? Record your observations.

Mixing and Un-mixing Colors Journal Page

Name _____ Team _____

Date _____

Observations Part 1:

Observations Part 2: