National Aeronautics and
Space Administration

Christa's Lost Lessons

Walking Rainbow

Grade: K-5

For more of Christa's lessons and accompanying videos filmed in orbit, visit www.challenger.org/christa.

www.nasa.gov

Walking Rainbow

Background Guide

Grade Level:
K-5th

Suggested Time:
60 minutes

Standards:

- Anchor Standard 1: Generate and conceptualize artistic ideas and work.
- 3-PS2-2: Motion and Stability: Forces and interactions. Make observations and/or measurements of an object's motion to pro1vide evidence that a pattern can be used to predict future motion
- CCSS.MATH.CONTENT.3.MD.A2: Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).

Background

- **Chromatography:** The separation of a mixture into its individual components.
- **Capillary Action:** When a liquid, like water, moves upward due to the cohesive and adhesive properties of the liquid.
- **Cohesion:** Particles of the same substance sticking together.
- **Adhesion:** Particles of different substances sticking together.
- **Gravity:** The force that attracts a body toward the center of the earth or toward any other physical body having mass.
- **Primary Colors:** Red, blue, and yellow.
- **Secondary Colors:** Purple, orange, and green.
- The rainbow is created by mixing colors: red + blue = purple, red + yellow = orange, blue + yellow = green.
- In order to achieve the math standard, set up the experiment so that students measure out the amount of water they add to each jar. This can be furthered by having them experiment with different amounts or types of food coloring and observing which type creates the brightest or most successful rainbow.

Essential Questions

- What is capillary action?
- Where do we see evidence of chromatography?
- What are the primary colors and when mixed together what colors do they create?
- What is cohesion and adhesion?

Objective

Following this activity, students will be able to:

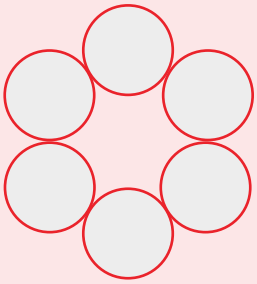
- Demonstrate how capillary action works.
- Deepen knowledge of primary colors and how they interact with one another.
- Display water's cohesive and adhesive properties.
- Watch for evidence or lack of evidence of chromatography.

Materials

- Clear jars
- Water
- Food coloring: red, yellow, blue
- Measuring cups
- Timer
- White paper towels

Teacher Preparation

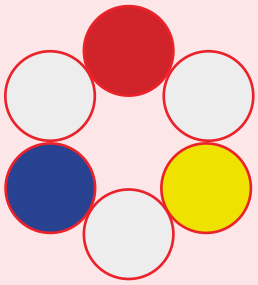
Arrange six jars in a circle so that they are touching (depicted below).



Add water to each jar. There should be enough water for the paper towel to touch one end of the water in one jar and reach over to its adjacent jar and touch the water there.

Add red food coloring to one jar, blue to another, and yellow to a third. Make sure the water is well pigmented. Light colored water will not produce a successful result.

In your circle of jars, place jars of clear water in between the colored jars. This is what will ultimately produce the rainbow effect (depicted below).



At this point, the activity is ready. The demonstration will include the use of paper towels to demonstrate capillary action.

Primary colored water will travel along the paper towel and into the clear jars in order to produce the secondary colors: orange, green, and purple.

PROCEDURE

ENGAGE (5 min)

Materials needed: Worksheet available in additional resources.

Opening Questions:

- Ask students:
  - to define **chromatography**, **cohesion**, **adhesion**, and **capillary action**.
  - if they know what primary and secondary colors are and what ones need to be mixed in order to build a rainbow.
  - what evidence of chromatography looks like.
- Explain that by using capillary action and the primary colors, you are now going to build a rainbow.

EXPLORE (5 mins)

Materials needed: pencil/pen and paper to write out predictions, worksheet available in additional resources

Initial Predictions:

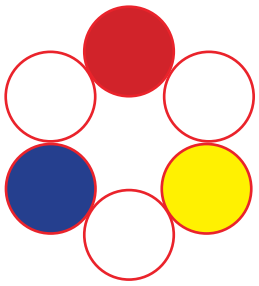
- Have students write out their initial predictions and hypothesize how they could use the given materials to make a rainbow.
- Once predictions are collected, reveal the method you will be using during the experiment.

EXPLAIN (30 mins)

Materials needed: clear jars, food coloring, water, paper towel, measuring cups, timer

Conduct Experiment:

- If materials are available for multiple tests/groups to perform this experiment, have students measure water and food coloring to put into the jars. Measurements will depend on what type of jar is being used, but it should be enough so that the paper towel can touch the water in each jar.
- Add the food coloring to the jars. Red in one, blue in another, and yellow in a third. Put a jar with clear water in between the ones with color. You can do this in a circle. In order to get a rainbow, your pattern should be red, clear, yellow, clear, blue, clear.



- Roll the paper towel into tube-like pieces. Put one end of the paper towel into the clear jar and one end into the colored jar. Repeat this process for each set of jars.
- In order to get the full rainbow, this process will take around 48 hours. At this point, you should have students set a timer to see how long it takes to make the rainbow. Students should make predictions about the colors that will be made, what will happen to the paper towel, and how long it will take.

ELABORATE (10 mins)

Materials needed: N/A

Defining Terms and Explaining:

- **Capillary Action**: When a liquid, like water, moves upward due to the cohesive and adhesive properties of the liquid. This is how the water and food coloring was able to move up the paper towel and mix in the clear jar.
- **Cohesion**: Particles of the same substance sticking together. Cohesion is what allowed the water to stick to itself.
- **Adhesion**: Particles of different substances sticking together. Adhesion allows the water to stick to the paper towel and the inside of the jar.
- **Gravity**: The force that attracts a body toward the center of the earth, or toward any other physical body having mass. Gravity is what kept the water in the jar, along with all other objects that have mass.
- **Chromatography**: The separation of a mixture into its individual components. Did your students see the effects of chromatography in this experiment?

EVALUATE (5 mins)

Materials needed: pen and paper to record observations

Record Observations:

- Students should periodically record observations of the experiment.

Questions to Consider:

- What is happening to the papertowel?
- What is happening to the clear water?
- How long is the process taking?

Extension and Enrichment

You can have students test different types or colors of food coloring. They can see what brands work best or what other colors can be made when mixing them together. This can either be physically tested or theoretically predicted as an additional step.

Additional Resources: Printable worksheets included.

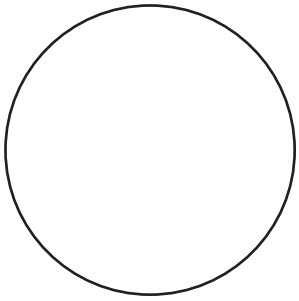
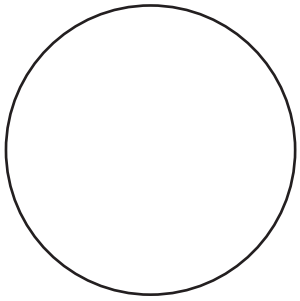
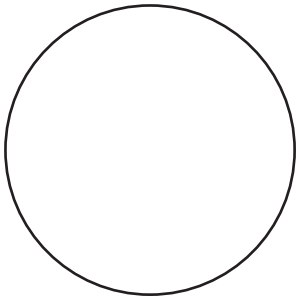
WALKING RAINBOW

THINK!

Recall your knowledge of capillary action and chromatography. How do the concepts of cohesion and adhesion apply to capillary action? What is chromatography and where have you seen examples of it before? In order to create this "Walking Rainbow", you will need to apply these concepts while furthering your knowledge of the color wheel and primary colors.

PRIMARY COLORS

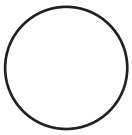
What are the primary colors? Color them in the circles and write their names on the lines below.

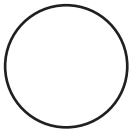
_____ _____ _____

SECONDARY COLORS

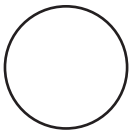
You can create a rainbow from these colors! Below, list the two primary colors that combine to make a secondary color. Color in the circle with the secondary color they make. Write its name on the line next to the circle.

_____ + _____ = _____ 

primary color primary color secondary color

_____ + _____ = _____ 

primary color primary color secondary color

_____ + _____ = _____ 

primary color primary color secondary color

WALKING RAINBOW

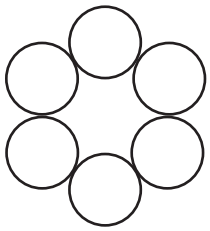
GATHER YOUR MATERIALS!

Here's what you'll need:

1. 6 Clear Jars
2. Red, Yellow, and Blue Food Coloring
3. Paper Towels
4. Water
5. Measuring Cup

DIRECTIONS

1. Arrange the clear jars in a circle so that they touch, but leave an empty space in the middle. Try to make it look exactly like the diagram below.



2. Next, add water to each jar. Make sure there is enough to fill the jar about 3/4 of the way up. Be sure to measure how much water you put in the jar!

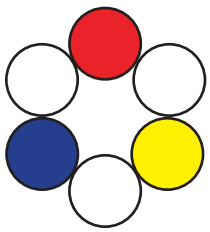
   How much water did you add to each jar? _____

3. Predict: Your goal is to be able to create the secondary colors of the rainbow by using food coloring, paper towels, and capillary action. Write your prediction and explain how you will be able to achieve this goal below.

   _____

   _____

4. Next, add the food coloring to the jars. The jars should have a pattern of color, clear, color, clear. See the diagram below for help! Be sure to add enough food coloring so the water is brightly colored. Count how many drops you use.



# of red drops:	_____
# of yellow drops:	_____
# of blue drops:	_____

WALKING RAINBOW

5. Finally, roll a piece of paper towel into tube-like pieces. Dip one end of a paper towel into a colored jar and then fold it over so that the other end is dipped in the clear jar. Repeat this process for each set of jars. You should use a total of three paper towels.

DATA

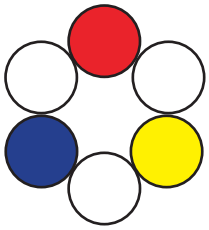
Let the jars sit for 48 hours. Observe what happens to the paper towels and water as time passes. Be sure to set a timer. Describe and record your observations in the table below.

Time Passed	Paper Towel	Water

WALKING RAINBOW

CONCLUSION!

What happened to the clear jars? Color in the diagram with what you see now after 48 hours.



Explain how capillary action, gravity, cohesion, and adhesion played a role in making the rainbow.

Recall your knowledge of chromatography. Did you see any evidence of the effects of chromatography in this experiment? Explain your reasoning.

How would this experiment have been different if you started with food coloring on the paper towel instead of the water? Would you have gotten the same result?

How would this experiment work in space? What do you think would be different? Do you think you would have gotten the same results? Why or why not?

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