




**How Can We Find Out
What Is in Water?**

The Science of Water:
Activity 9

Nancy Moreno, PhD.
Barbara Tharp, MS.

Center for
Educational Outreach
Baylor College of Medicine



BioEd Online

How Can We Find Out What Is in Water?

**Previously entitled, "Separating Solutions."*

This activity's objectives are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Life Science. It will guide allow students to investigate the components of a mystery liquid.

Concept

- Many different substances can be dissolved in water at the same time.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo © Freestockimages.org/. Used with permission.

Key Words

lesson, experiment, water, chromatography, substance, dissolve, dissolved,

How Can We Find Out What Is in Water? © Baylor College of Medicine.

Materials

- Prepare a “mystery liquid.”
- Each student group will need the following materials.
 - 250 mL beaker containing about 1 cm of “mystery liquid”
 - 1–2 white, round, basket-type coffee filters
 - 2 pairs of scissors
 - 2 rulers



BioEd Online

Materials

Have students conduct this activity in groups of four. Set up materials in a central area for each group’s Materials Manager to pick up.

Teacher Materials

- 250 mL beaker, or 9-oz clear cup
- Red, green, and blue food coloring (see Setup)
- Water

Materials per Student Group

- 250 mL beaker, or 9-oz clear cup containing approximately 1 cm of mystery liquid
- 1–2 white, round, basket-type coffee filters
- 2 pairs of scissors

- 2 rulers

Setup

1. Before starting the activity, prepare the “mystery liquid” by adding 10–15 drops each of red, blue and green food coloring to one cup of water.
2. Pour about 1 cm of “mystery liquid” into a 250 mL beaker for each group.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher’s Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Key Words

materials list, materials needed,

How Can We Find Out What Is in Water? © Baylor College of Medicine.

Science Safety Considerations

- Follow all instructions.
- Begin investigation only when instructed.
- Do not taste, drink or smell any substances.
- Report accidents or spills.
- Wash hands thoroughly after the investigation.
- Be careful when using food coloring. It can permanently stain clothing, surfaces, and equipment.



BioEd Online

Science Safety Considerations

Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Safety first!

- Always school district and school science laboratory safety guidelines.
- Have a clear understanding of the investigation in advance.
- Practice any investigation with which you are not familiar before conducting it with the class.
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.

Safety note: Caution students to use care when handling food coloring

as it can permanently stain clothing, surfaces, and equipment.

References

1. Dean R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. National Science Teachers Association.
 2. Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3.
- Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

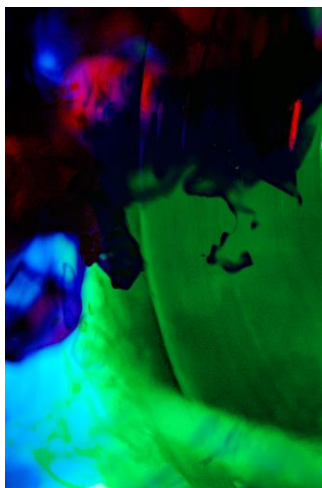
Key Words

science, classroom, safety, lab, laboratory, rules, safety signs,

How Can We Find Out What Is in Water? © Baylor College of Medicine.

Mystery Liquid

- Identify all the colors used to make the liquid in the photo.
- Describe the color of the “mystery liquid” your teacher has prepared.
- How could you determine the individual colors used to create the mystery liquid?



BioEd Online

Mystery Liquid

Small amounts of many different substances can be dissolved in water at the same time. Many of these substances are not visible or distinguishable when mixed together in water. In this activity, students will use a simple separation technique to detect the presence of several different food dyes in water.

Ask students if they are able to identify all the food colors used to create the liquid in the photo. Now, show students the mystery liquid. Ask them, “Can you tell what is in this liquid?” Explain that each student is going to become a detective and investigate the contents of the mystery liquid.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher’s Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by

grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image References

Photo montage adapted from two images © Sean McGrath, CC-BY-SA 2.0.

- “The Face Within.”

<http://www.flickr.com/photos/mcgraths/934914260/in/photostream/>

- “Fun With Food Coloring.”

<http://www.flickr.com/photos/mcgraths/934887510/in/photostream/>

Key Words

lesson, experiment, water, chromatography, substance, dissolve, dissolved, liquids,

How Can We Find Out What Is in Water? © Baylor College of Medicine.

Let's Get Started

1. Prepare test strips of filter paper from coffee filters. Cut strips about 2 cm wide and 10 cm long.
2. Fill your container about 1 cm deep with mystery liquid.
3. Place the strips in the container so only the bottom tip of each strip is touching the mystery liquid.
4. Fold the top of each strip over the side of the container.
5. Observe the strips carefully and note what occurs.



BioEd Online

Let's Get Started

1. Give each student group 1 or 2 basket-type coffee filters, from which they will prepare test strips. Have students smooth and flatten the filters. Then, each student should cut a filter strip about 2 cm wide and 10 cm long.

2. Give each group a 250-mL beaker with about 1 cm of mystery liquid in the bottom. Tell students that they will put the tips of their filter strips into the mystery liquid. Ask, *What do you think might happen when you this?*

3. Have each student write his or her initials at the top of his or her filter paper strip. Then, have students place the bottom tips of their strips into the liquid and fold the strips over the side of the beaker so that they stay upright. Student's also may tape the strips onto a pencil, and rest the pencil across the top of the cup.

Note: The activity will work better if the strips are not pressed against the sides of the beakers.

1. Have students observe the beakers and strips for 5–10 minutes. As color begins to rise up the strips, ask, *What is happening?*

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

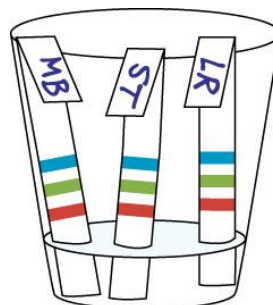
Key Words

lesson, experiment, water, chromatography, substance, dissolve, dissolved, solutions,

How Can We Find Out What Is in Water? © Baylor College of Medicine.

Let's Talk About It

- Remove your filter strip when the liquid has risen up the filter paper to about 2 cm from the top of the container.
- Lay the strip on paper towel to dry.
- How many colors are on your strip?
- What does this tell you about the mystery liquid?



BioEd Online

Let's Talk About It

Once the liquid in the strips has risen up the filter paper to about 2 cm from the top of the beaker or container, have students carefully remove their strips and lay them on a paper towel to dry. Ask students, *What colors do you see on your strips?* Usually, three color bands will form: blue at the top, followed by yellow or green, followed by red at the base. Ask students, *What do these findings tell us about the mystery liquid? How many substances were mixed together to make the liquid?*

The strips may be preserved in a notebook or displayed in class after they are dry. Encourage students to extend their discoveries to other situations. For example, ask, *Since several different things were mixed together in the mystery liquid, do you think other types of liquids also might be mixtures of different substances?*

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's*

Guide. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Illustration by M.S. Young © Baylor College of Medicine.

Key Words

lesson, experiment, water, chromatography, substance, dissolve, dissolved, solutions,

How Can We Find Out What Is in Water? © Baylor College of Medicine.

The Science of Chromatography

- Chromatography comes from the Greek words, *chrōma* (color) and *graphein* (to write).
- It is a simple technique commonly used to separate different substances in a liquid.
- Chromatography takes advantage of water's "stickiness."
- Different molecules travel up the filter paper at different rates, based on their size and attraction to water molecules.
- Differential movement of kinds of molecules results in a banding or spotting pattern on the filter paper.



BioEd Online

The Science of Chromatography

The technique known as chromatography takes advantage of water's "sticky" qualities, which enable it to travel up a piece of filter paper. When this happens, water molecules are attracted to charged regions on the cellulose molecules in the paper. As water moves up, it carries other molecules with it (such as the food coloring dyes used in this activity). Molecules found in different colors of food dye will move up the paper at different rates, based on their sizes and their level of attraction to the molecules of water. As a result, each food coloring dye will form a separate band or spot on the filter paper, ultimately creating a pattern.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Key Words

lesson, experiment, water, chromatography, substance, dissolve, dissolved, solutions, liquid, molecule,

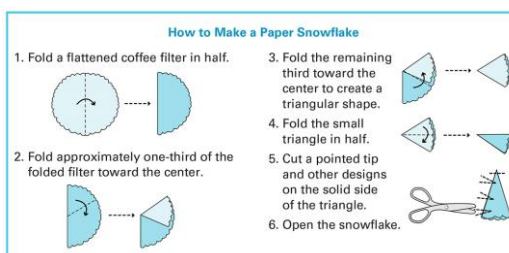
How Can We Find Out What Is in Water? © Baylor College of Medicine.

Extensions

- Have students cut snowflakes out of coffee filters.

- Create rainbow snowflakes with coffee filters.

- Set folded snowflakes in beakers or containers, with the tip or outer edges placed in the mystery liquid to color the snowflakes.



BioEd Online

Extensions

After conducting the activity with filter paper strips, let the students fold and cut snowflakes out of coffee filters. Place the folded snowflakes in the beakers or containers, with the tips or outer edges in the mystery liquid. This process will color the snowflakes in rainbow patterns.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Illustrations by M.S. Young © Baylor College of Medicine.

Key Words

Lesson, experiment, water, chromatography, substance, dissolve, dissolved, liquids,

How Can We Find Out What Is in Water? © Baylor College of Medicine.