Sparking Discovery in the Classroom

TRAVELING SCIENCE WORKSHOPS

DISCOVERY MUSEUM

Light & Color

Teacher Resource Guide

Traveling Science Workshops are generously sponsored by:

MathWorks®

Color

Color is so intimately related to light that it is hard to discuss the two separately. Color is light. Imagine yourself in your brightly colored room with the lights out at night. How do the brightly colored objects look? They are not colorful because color depends on light. Sunlight is a mixture of light that contains all the colors of the rainbow. We see rainbows when light shines through raindrops, which break up the mixture into bands of light. Prisms do the same thing.

Objects that are colorful reflect that color of light towards your eyes and absorb all other colors of light. Because reflection is so important when talking about light and color, our first activity will involve mirrors. Mirrors can help us to understand light because they reflect light clearly. Light reflects off of objects in straight lines, and when you put two mirrors close to each other, you can see reflections of reflections.

Making Kaleidoscopes

A kaleidoscope is a toy that makes reflections of reflections. It can help us learn about math as we count the reflections of different objects.

Materials

a glue stick
4 manila folders
roll of mylar
masking tape

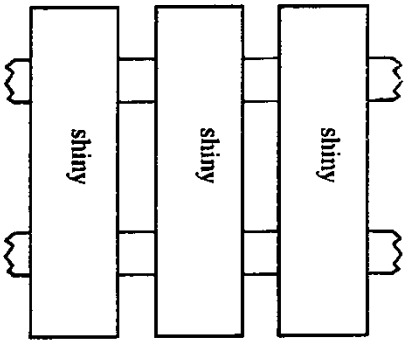
Procedure

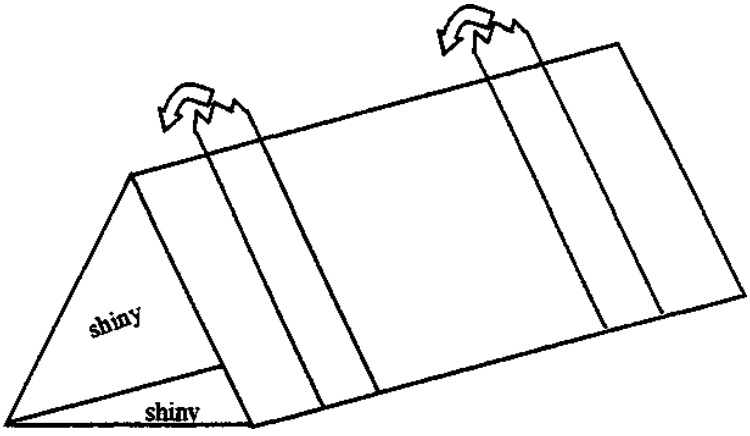
It will take about an hour to prepare enough materials for a class of 30. Cut the manila folders in half at the seam and glue-stick two sections of mylar along each sheet, silver side up. Use a paper cutter to cut 7 one-and-a-half inch strips from each of the strips on your folders. You will end up with 112 strips, enough for a class of 34.

1. Pass out 3 kaleidoscope strips to each person.
2. Put the 3 mylar strips next to each other (length to length), silver side up, on 2 pieces of masking tape (see illustration).
3. Fold the strips into a triangular tube and tape the last two pieces together.
4. You now have a kaleidoscope. You can roll it in a piece of construction paper and decorate it.

Extensions

1. Make drawings and hold the kaleidoscope just above them to look at them.
2. Make a kaleidoscope with 4 mirrors.





Separating Colors - Chromatography

The ink in pens can be made from different pigments. Even pens of the same color can be made from different pigments. As long as the pen is not waterproof, the different pigments can be separated with water.

You can use the following method, called **chromatography**, to involve your students in a detective game. Imagine a situation where you have found a note and you want to know who wrote it. It could be a Valentine, a love note, a treasure map, etc. It is in black ink and only three students have black pens. You can use water to tell the difference between the pigments in each pen and compare your results to the note. Here's how...

Materials

3 (or more) different brands of black felt-tip pens (pre-tested)
paper towels
cups
water
pencils

Procedure

1. Write a note on a piece of paper towel with one of the 3 pens. Try not to show which pen was used.
2. Cut 3 strips of paper towel and draw a large dot on the bottom of each one, using a different pen for each. Keep track of which pen drew on which strip.
3. Fold one of the strips over a pencil set across the rim of a cup.
4. Put just enough water into the cup so the bottom of the paper towel touches the water. Do not cover the dot with water.
5. Wait 5-10 minutes for the ink dot to spread up the paper towel.
6. Do this for each strip.
7. Cut a strip from the paper towel you wrote the note on so a word is at the bottom and hang it in the water.
8. Can you tell which pen wrote the note?

Extensions

Try many different pens. Find pens with interesting streaks and draw pictures with them. Then spray or splash a little water on the picture.

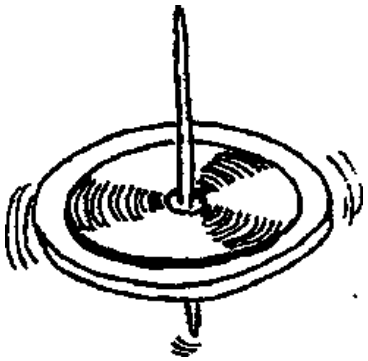
Color Mixing Tops

There are many ways to mix colors, for example, using food coloring, paints, etc. Another way to mix colors is by viewing quickly moving colored objects. Any image we see with our eyes lasts for a split second after we close our eyes or look at something else. Images that we see in rapid succession blend together. This is how films work: still photos shown very quickly in succession convey the impression of movement.

The color mixing tops do this as well. The spinning colors blur together, so red and blue usually mix to make purple. Some pigments combine well this way. Others do not. Test them out. Experiment with colors you like and effects you enjoy. You can show your class a spinning pattern on an electric mixer and challenge them to draw it and test it out on their tops.

Materials

yogurt container tops, or stiff paper
white paper
crayons
round toothpicks
scissors
push pin or thumb tack

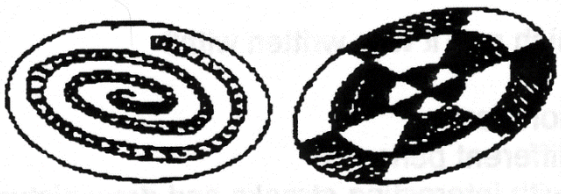


Procedure

1. On a piece of paper, trace a circle around a yogurt container top.
2. Cut out the paper and fold it into quarters.
3. Unfold it. The center is where the two fold lines cross.
4. Draw a picture with crayons or colored pencils on the paper circle.
5. Put it on the yogurt top and poke a small hole in the center with a push pin.
6. Take a round toothpick, put it in the hole so it fits firmly, and slide it about 1/3 of the way through the top.
7. Put the circle on the top and spin it.

Extensions

1. Cut out magazine pictures in circles and spin them.
2. Color a circle half red and half blue and spin it to get purple. Draw other color combinations and try to predict what you will get before spinning the top.
3. Color a large, multicolored circle. Tape it to something that spins, such as a single beater on an electric mixer. Show it to people and have them try to draw what is on your circle by experimenting with their own, smaller tops.



Secret Message Decoder

Some filters can selectively absorb certain colors of light and only allow one color to shine through. For instance, red filters absorb all light but red, so everything viewed through them will look black, white, or red.

We can use this technique to make a secret message that can only be read when seen through a red filter. Red works best at absorbing other wavelengths. It is more difficult to find optically perfect filters in other colors. Try a green filter as well and see what effect it gives. To let the whole class see the effect, make secret message decoders by cutting your filter into 1-inch squares and taping each square to an index card with a hole punched in it. Make one for each student.

Materials

red filter acetate
white card (will be used to make the secret message decoder card)
crayons or markers in red, orange, yellow, green, blue, and purple
secret message sheet

Procedure

1. Assemble the secret message decoder card by folding the card in half, using a hole punch to make a hole in the folded card, and taping the red filter acetate inside the folded card, over the hole.
2. Fill in each portion of the secret message sheet with the appropriate color.
3. Try to decipher the secret message within the design using only your eyes.
4. Now look at the design through the red filter of the secret message decoder.
5. Can you read the message now? Notice which colors stand out and which fade.
6. Try to make you own secret message.

Extensions

1. Experiment with other colored filters.
2. Can you make a filter with a soda bottle and food coloring?

Other Color Activities

Look at the Sunday comics through a magnifying glass. Can you find colors made from different colored dots? Can you draw a picture using colored dots so that the colors mix from a distance?

Resources

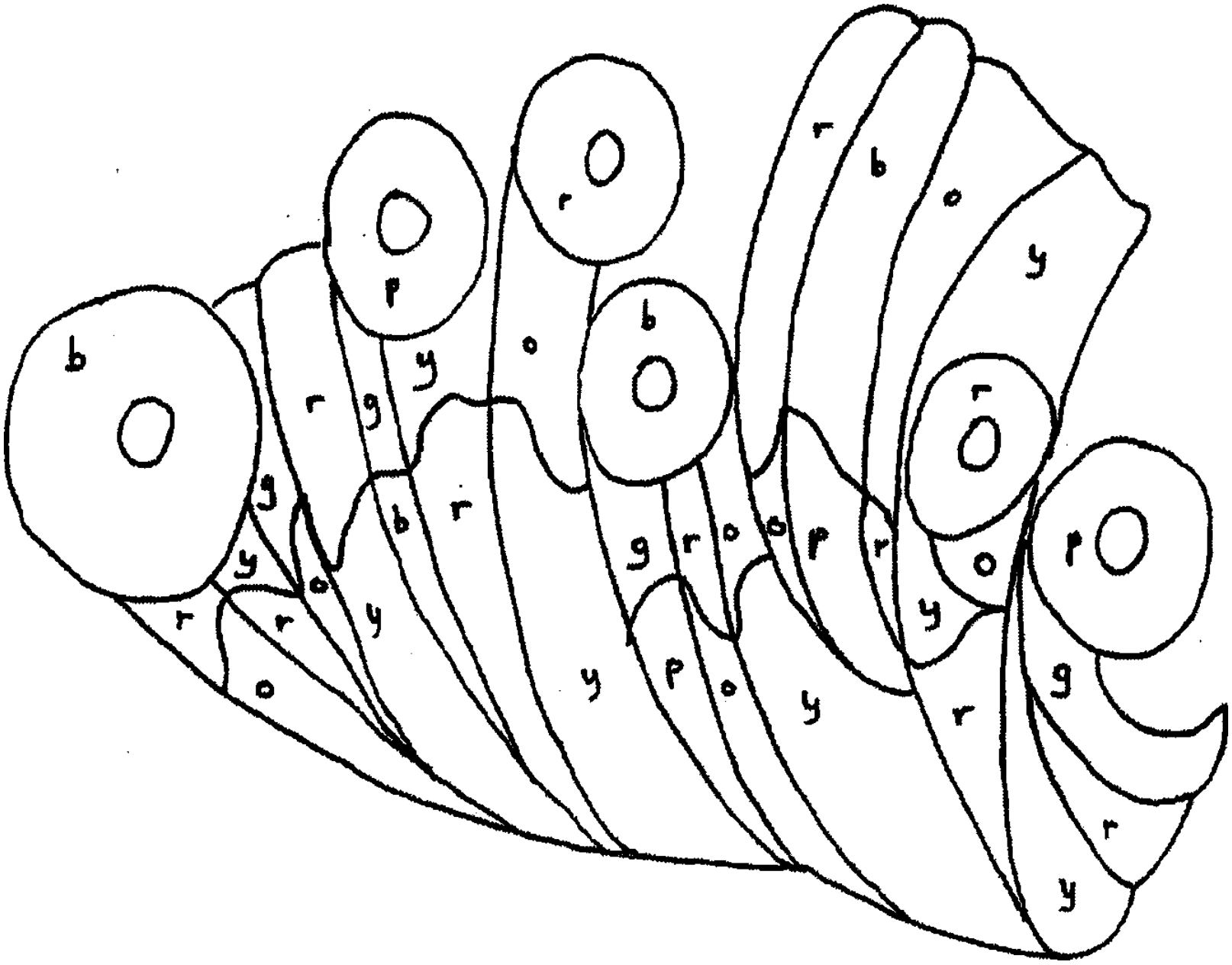
Print Resources

- *Light: Shadows, Mirrors, and Rainbows*, Natalie Rosinsky, Picture Window Books, 2002
- *Light is All Around Us*, Wendy Pfeffer, HarperCollins, 2015
- *Super Simple Experiments with Light and Color,* Paige Polinsky, Abdo Publishing, 2016
- *Light and Color,* Gerry Bailey and Steve Way, Gareth Stevens, 2008
- *The Science of Color: Investigating Light,* Karen Kenney, Abdo Publishing, 2015
- *A Book About Color: A Clear and Simple Guide for Young Artists,* Mark Gonyea, Henry Holt and Co., 2010
- *Fun Experiments with Light: Periscopes, Kaleidoscopes, and More*, Rob Ives, Hungry Tomato, 2017

Online Resources

- Online color mixing interactive with option to add your own images.
    - https://www.physicsclassroom.com/Physics-Interactives/Light-and-Color/RGB-Color-Addition/RGB-Color-Addition-Interactive
- Light and Color Science Snacks via the Exploratorium, experiments that are slightly more in-depth and require a few supplies.
    - Colored Shadows: https://www.exploratorium.edu/snacks/colored-shadows
    - Three Little Pigments: https://www.exploratorium.edu/snacks/three-little-pigments
    - Truly Primary Pigments: https://www.exploratorium.edu/snacks/truly-primary-pigments
    - CD Spectroscope: https://www.exploratorium.edu/snacks/cd-spectroscope
    - Diffraction: https://www.exploratorium.edu/snacks/diffraction
    - Color Contrast: https://www.exploratorium.edu/snacks/color-contrast
    - Color Table: https://www.exploratorium.edu/snacks/color-table
    - Poking Fun at Color Mixing: https://www.exploratorium.edu/snacks/poking-fun-at-color-mixing

SECRET MESSAGE SHEET



Coloring Code

1=orange	4=violet
2=green	5=red
3=yellow	6=blue