Color and Light

TABLE OF CONTENTS

About **Color and Light**

DeltaScienceModules, THIRD EDITION

Students use prisms to investigate the full range of colors in white light, called the visible spectrum. They experiment with subtractive color mixing and discover the significance of the primary pigments. Students separate pigments with paper chromatography and then combine colors by blending filtered light beams. Experiences with both subtractive and additive mixing help students understand the role of the eyes and brain in perceiving color. That understanding is extended as students identify the dot patterns in printed pictures and manipulate color filters to make colors disappear. Students also explore afterimages and phantom images, turn two-dimensional drawings into three-dimensional drawings, and demonstrate persistence of vision.

In the Delta Science Reader *Color and Light,* students read about different aspects of light and color. They discover that different surfaces and substances reflect, absorb, and refract light. They learn how we see things in general and how we see color in particular. They also read about a famous astronomer—Annie Jump Cannon—and her work with stellar spectra. Finally, students learn about color blindness.

Overview Chart for Hands-on Activities

Hands-on Activity	Student Objectives
1 **The Spectrum of Visible Light** *page 13*	• observe what happens when sunlight passes through a prism • discover the colors of the visible light spectrum • make a color wheel to see how various colors are related
2 **Mixing Pigments** *page 19*	• predict and then observe the results of mixing different colors of pigment • discover how and why certain colors, when mixed together, form certain other colors • learn the significance of the primary colors of pigments
3 **Separating Pigments** *page 29*	• use paper chromatography to separate a mixture of pigments • record and discuss their observations • apply what they know about color mixing to explain how this process works
4 **Color Filters and Light** *page 37*	• shine white light through color filters and observe how the color of the light changes • predict and then observe the effects of passing white light through different combinations of color filters • compare this process with the process of mixing pigments
5 **Mixing Light Beams** *page 45*	• use color filters and flashlights to create colored beams of light • combine different-colored beams of light on a white screen and record the results • compare additive color mixing with subtractive color mixing
6 **Primary Colors** *page 53*	• create colored light by passing it through color filters • separate colored light by directing it through a prism • discover a new set of primary colors: cyan, magenta, and yellow
7 **Colored Lighting** *page 61*	• use filters and a flashlight to make colored light • shine colored light on different-colored squares of paper • compare the results with those obtained using other methods of mixing colors
8 **Color Images** *page 69*	• discover that a pattern of small dots, when viewed from a distance, can form an image • compare color photographs with color and black-and-white printed pictures
9 **Shades of Color** *page 77*	• predict and observe the results of mixing unequal amounts of pigments • discover how diluting a mixture with water affects the shade of the mixture • attempt to explain what they observe in terms of the color-mixing processes they have already seen
10 **Color Filters and Sight** *page 85*	• record what happens when color drawings are viewed through color filters • use what they know about color and filters to explain what they observe • create drawings that change when viewed through color filters
11 **Seeing in 3-D** *page 93*	• use color filters to make a set of glasses that can be used to view three-dimensional images • draw a picture that will appear three-dimensional when viewed through the glasses • learn how people see things in three dimensions
12 **Sight and Afterimages** *page 101*	• discover what causes an afterimage to form • learn how an object's color and the color of its afterimage are related • use this information to create an oddly colored picture that looks normal as an afterimage • gain insight into how our eyes perceive color
13 **Color Wheels** *page 109*	• observe the effect of spinning a wheel with different-colored halves • predict what will happen when other color wheels are spun • compare this process to other color-mixing processes
Assessment *page 117*	• See page 117.

Process Skills	Vocabulary	Delta Science Reader
observe, experiment, use variables	**prism, refract, spectrum**	pages 2–3, 5, 8–9
predict, observe, hypothesize	**absorb, pigment, primary colors of pigment, reflect, subtractive color mixing**	pages 4, 11
collect, record, display, or interpret data; hypothesize	**chromatogram, chromatography**	
predict, observe, compare, infer	**filter**	pages 11–12
predict, observe, compare, use variables	**additive color mixing, primary colors of light**	page 13
predict, experiment, observe, define based on observations		pages 11–12, 13
predict, observe, experiment		pages 11–12, 13
compare, classify	**continuous-tone, halftone**	page 13
predict, observe, experiment, hypothesize	**concentration, proportion**	
predict; collect, record, display, or interpret data; infer		pages 4, 7, 10, 11–12
experiment, make and use models	**binocular vision, monocular vision, three-dimensional (3-D)**	pages 5–6, 10, 11–12, 15
infer, compare, observe	**afterimage, complementary color**	pages 7, 10, 11–12, 15
observe, predict, compare	**persistence of vision**	pages 10, 11–12

See the following page for the Delta Science Reader Overview Chart.

Overview Chart for Delta Science Reader
Color and Light

Selections	Vocabulary	Related Activity
Think About...		
What Is Light? *page 2*	**electromagnetic wave, energy, light, ray, wave**	Activity 1
• Reflection of Light *page 4*	**image, reflect**	Activities 2, 10
• Absorption of Light *page 4*	**absorb**	Activities 2, 10
• Refraction of Light *page 5*	**concave lens, convex lens, focal point, lens, mirage, refraction**	Activities 1, 11
What Happens When Light Hits Different Materials? *page 7*	**illuminated, luminous, opaque, shadow, translucent, transparent**	Activities 10, 12
Electromagnetic Spectrum *page 8*	**electromagnetic spectrum, gamma rays, infrared rays, microwaves, prism, radio waves, ultraviolet rays, visible spectrum, wavelength, white light, x-rays**	Activity 1
How Do We See Objects? *page 10*	**cornea, iris, optic nerve, pupil, retina**	Activity 10, 11, 12, 13
How Do We See Colors? *page 11*	**color filter**	Activities 2, 4, 6, 7, 10, 11, 12, 13
What Are the Primary Colors of Light? *page 13*	**primary colors of light**	Activities 5, 6, 7, 8
People in Science		
• **Annie Jump Cannon, Astronomer** *page 14*		
Did You Know?		
• **About Color Blindness** *page 15*		Activities 11, 12

See pages 125–133 for teaching suggestions for the Delta Science Reader.

MATERIALS LIST

Color and Light

Quantity	Description
1	acetate sheet, frosted
1	acetate sheet, green*
1	acetate sheet, red*
3	acetate sheets, blue
4	acetate sheets, cyan
3	acetate sheets, green
4	acetate sheets, magenta
4	acetate sheets, orange
3	acetate sheets, red
4	acetate sheets, violet
3	acetate sheets, yellow
10	bags, plastic, reclosable
32	batteries, D-cell*
11	cardboard, 10 cm × 30 cm*
16	crayons, p/8
32	cups, plastic
33	dropper bottles
16	flashlights
1	food coloring, blue, 1 oz*
1	food coloring, green, 1 oz*
1	food coloring, red, 1 oz
1	food coloring, yellow, 1 oz*
1	index cards, p/100*
16	magnifiers
5	paper, blotter, 30 cm × 48 cm*
1	paper squares, black, p/16
1	paper squares, blue, p/16
1	paper squares, green, p/16
1	paper squares, red, p/16
1	paper squares, white, p/16
1	paper squares, yellow, p/16
300	paper, white, sheets*
16	prisms
1	string, 250 ft
1	tape, masking*
1	toothpicks, p/750*
16	trays, mixing
1	video, *Color and Light*
1	**Teacher's Guide**
8	**Delta Science Readers**

Quantity	Description
TEACHER-PROVIDED ITEMS	
–	paper towels, white
32	pencils
32	photographs, color
32	pictures, printed, black-and-white
32	pictures, printed, color
32	rulers, metric
16	scissors
1	stapler
1	tape, transparent
1	VCR and monitor
–	water, tap

* = consumable item

† = in separate box

To order consumable items or refill kits, please call 1-800-442-5444.

ACTIVITY SUMMARY

In this Delta Science Module, students investigate the relationships between pigments, color filters, and the light that strikes them.

ACTIVITY 1 Students begin their exploration of color and light by observing the properties of light. They use prisms to discover that sunlight (and other light that appears to be white) is actually a combination of many different colors of light, and they learn that this observable range of colors is known as the visible spectrum of light.

ACTIVITY 2 Students mix different colors of pigments and observe the new colors that are produced. This procedure introduces students to the concept of subtractive color mixing. They discover how and why certain colors combine to form certain other colors and learn the significance of the primary colors of pigment.

ACTIVITY 3 Students use paper chromatography to determine which color pigments make up the color that they're investigating.

ACTIVITY 4 Students examine what happens to white light when it passes through one or more color filters. They enhance their understanding of subtractive color mixing by investigating various combinations of filters and the colors of light produced when white light is shown through them.

ACTIVITY 5 Students are introduced to additive color mixing. They observe the effects of mixing colored light additively and compare the process with that of subtractive color mixing. In doing so, students begin to understand the role that the eyes and brain play in the perception of color.

ACTIVITY 6 Students return to the prism to investigate the composition of colors that are made as a result of subtractive mixing. By directing colored light through a prism, they prove that colored light produced as a result of subtractive color mixing may still consist of a range of different colors.

ACTIVITY 7 Students discover that the apparent color of an object is affected by the color of light that shines on it. They observe what happens when colored objects are lit by colored light.

ACTIVITY 8 Students' careful scrutiny reveals the secret behind printed pictures—they are actually made up of patterns of tiny dots!

ACTIVITY 9 Students investigate the effects of varying the concentrations of pigments. They learn that they can create almost any color by combining the three primary colors in varying amounts.

ACTIVITY 10 Students observe the effects of color filters on what we are able to see. They examine how crayon marks seem to disappear when viewed through same-color filters.

ACTIVITY 11 Students discuss monocular and binocular vision and their relationship to distance and depth perception. They apply their knowledge of how color filters affect our sight to create the illusion of a three-dimensional object from a two-dimensional drawing they make.

ACTIVITY 12 Students observe both the characteristics and the causes of these color-inverted phantom images, known as afterimages. Then they create an oddly colored picture that looks normal when viewed as an afterimage.

ACTIVITY 13 Students make multicolored wheels and tape them to spinners. They then watch as colors appear to blend together or to turn a different color when the wheels are spun—a phenomenon known as persistence of vision.