

The Annenberg/CPB Channel
Professional Development Workshop Guide

shedding light on science

An eight-part professional development workshop
series for elementary teachers of science

produced by Harvard-Smithsonian Center for Astrophysics in partnership with the
Association for the Education of Teachers in Science (AETS)

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About the Workshops

Series Overview

Science provides one way of knowing about the mysteries and splendor of our natural world. Science is a unique collaboration between human perceptions and our ability to reason and build ideas. The concept of light is an appropriate starting point for building an understanding of science because it is through the interaction of light, our eyes, and our brain that we collect most of the information we have about the world.

This series uses light as a theme through which to explore topics in physics, chemistry, biology, and Earth and space science. Unlike most science content courses that approach subject matter through one narrow discipline, these workshops show how light is a common thread that runs through many areas of science. The workshops make connections to real world phenomena as they explore the behavior of light, the transformation of energy, and the role of light in plant production of food, weather and the seasons, and more.

What will you actually see? You will visit elementary classrooms where students are investigating light. You will observe teachers in academic settings studying light and its characteristics. Interviews with experts will further illuminate the topics of energy, human vision, and the Sun's effects on ecosystems, climate, and seasons.

The series emphasizes dynamic interaction with the science content through discussion, activities, and application of the ideas to teaching. The videos and supporting materials suggest many fascinating investigations for you and your students. You will be able to respond to questions such as: What is color? Do plants eat? What causes seasons? Where do winds come from? Where do they go? How does the eye see?

Support resources for the series are available in the form of a print guide and a Web site, as well as instructional ideas contained in the video programs. These resources include activities, lesson plans, assessments, links to other content, and strategies for using community resources.

The concepts and activities in this series address the *AAAS Benchmarks* and the *NRC National Science Education Standards* with special attention to habits of mind and the history and nature of science. The series also serves as a model for teaching science to elementary teachers and, as such, may be beneficial for district inservice workshops. While the concepts and activities have been designed with the elementary teacher in mind, the materials are beneficial for any educator interested in learning science concepts and the nature of science.

About the Workshops

Workshop Descriptions

Workshop 1: SHINES and SHADOWS

Light is a form of energy that affects all facets of our lives. In this workshop we will explore how light travels and how shadows are formed.

Workshop 2: LAWS of LIGHT

Light energy has predictable properties when it interacts with matter. In this workshop we will investigate the absorption, reflection, and refraction of light.

Workshop 3: PIGMENTS, PAINTS, and PRINTING

The colors that surround us provide a rich visual experience. In this workshop we will study the effects of mixing colors of light and colors of pigment.

Workshop 4: COLOR, CONES, and CORNEAS

Humans are able to see objects when light energy enters the eye. In this workshop we will probe human vision and the perception of color.

Workshop 5: SUNLIGHT to STARCH

Green plants convert light energy into chemical energy. In this workshop we will examine green plants grown with and without light and discover how they use light energy to produce food in the process known as photosynthesis.

Workshop 6: ENERGY and ECOSYSTEMS

The food made by plants is a source of energy for other organisms living in ecosystems. In this workshop we will investigate the flow of energy from plants to animals as we construct food webs and energy pyramids.

Workshop 7: SUN and SEASONS

Light energy from the Sun is absorbed all over the Earth. In this workshop we will review how the transformed energy heats the Earth unevenly causing seasons.

Workshop 8: WIND and WEATHER

Storms, fronts, and other atmospheric phenomena derive energy from sunlight striking the Earth's surface. In this workshop we will investigate mechanisms that set the air in motion and cause weather.

About the Workshops

Video Clip Descriptions

Workshop 1

What is Light

Children express their ideas about light, where it comes from, and what it is.

Averill Elementary School, Lansing, Michigan

Professor Deborah Smith of Michigan State University and teacher Sharon Henriksen conduct an exploration of shadows in which second grade students generate, test, and share their findings.

Seeing the Light in Worcester, Massachusetts

Michele Sullivan's fourth grade class at the Midland Street Elementary School presents their reflection and light models.

Workshop 2

De Cordova Museum, Lincoln, Massachusetts

William Harby exhibits one of his sculptures and discusses using mirrors in his art.

Curved Mirrors

Kim McLeod, an astronomer at the Whiten Observatory at Wellesley College in Wellesley, Massachusetts, explains how reflecting telescopes work.

Averill Elementary School, Lansing, Michigan

Deborah Smith, Sharon Henriksen, and Pat Christensen work with fifth grade students to examine the path of light through air and water.

Workshop 3

Crossover Colors

Michele Sullivan's fourth grade class at the Midland Street Elementary School in Worcester, Massachusetts investigates the colors needed to produce a television picture.

X-ray

Christine Jones, an astrophysicist at the Chandra Control Center in Cambridge, Massachusetts, explains the behavior and travel speed of photons, reflection, and absorption of light.

Workshop 4

The Eyes Have It

Dr. Camille Wainwright, a science educator at Pacific University, and Dr. Karl Citek, a professor of optometry from Forest Grove, Oregon, examine a model of the human eye, reveal how light enters the eye, and conduct an eye exam.

Pointillist Drawings

Michele Sullivan's fourth grade class draws and explains what colors they think they will see. Then the colors they ultimately see are revealed.

Workshop 5

Living Things

Pilar Fabery's first and second grade classes at the Lowell Demonstration School in Lowell, Massachusetts, classify discrete categories of living and non-living things.

Plant Food

Susan Wallace's fourth grade students at the Murkland School in Lowell, Massachusetts, discuss the phenomenon that plants make their own food versus the notion that plants' main food source comes from the soil.

The Color Green

Cheryl Lowe, a horticulturist at the New England Wildflower Society's Garden in the Woods in Framingham, Massachusetts, talks about the photosynthesis process.

Workshop 6

Ecosystems

Pilar Fabery's first and second grade classes at the Lowell Demonstration School draw ecosystems, explain which organisms they are including, and express interesting ideas about food chains.

Complex Food Webs

Susan Wallace introduces food webs to third grade students at the Murkland School in Lowell, Massachusetts and shows the interconnectedness of organisms living in an ecosystem.

Rot

At the Amherst Elementary School in Amherst, Massachusetts, Terez Waldoch conducts a guided discovery of decomposition with her fourth graders.

Workshop 7

Why Temperatures Change

Lolita Darby's fifth graders at the Martin Luther King, Jr. Elementary School in Portland, Oregon, discover that objects feel warmer if they have been in the Sun.

Workshop 8

Light Energy and Heat

At the Martin Luther King, Jr. Elementary School in Portland, Oregon, Lolita Darby's fifth graders conduct a light energy and temperature experiment and learn to measure air temperature.

Solid, Liquid, Gas

Jean Huff's third grade class at the Burr Elementary School in Newton, Massachusetts explains that molecules move differently in solids, liquids, and gases.

Workshop Components

Day of Each Workshop

Site Investigation: GETTING READY

30 minutes of discussion and activity to prepare you for the workshop video

Workshop Video

60 minutes of video with guest interviews, classroom footage, and more

Site Discussion

30 minutes of discussion and activity to wrap up the workshop video

Between Workshops

Homework Assignment

an exercise or activity that ties into the previous workshop or prepares you for the next one

Ongoing Activity: <http://www.learner.org/channel/workshops/sheddinglight/camera>

Lights, Camera, Action!: a series of Web-based light activities that will extend your general content knowledge and help you to reflect on your own learning process. Visit the Web site for the complete activity listing.

Web site: <http://www.learner.org/channel/workshops/sheddinglight>

a place to go for additional activities, resources, and discussion

Light Buddies: <http://www.learner.org/channel/workshops/sheddinglight/buddies>

We encourage you to register to be matched with a Light Buddy, a colleague from a site in a different part of the country who teaches at your grade level. Light Buddies will work together throughout the series on Web-based activities and other assignments.

Journals

A critical part of taking steps toward change is representing learning along the way. This is a deliberate process that calls for reflecting upon your own understandings before, during, and after key experiences, and documenting how these understandings change. While there are numerous ways to represent learning, we suggest using a journal. As the series progresses, pay particular attention to changes in your thinking, and the implications of these changes and record them in your journal.

Channel-Talk

an opportunity to communicate with other workshop participants via email

To subscribe to Channel-Talk (the workshop email discussion list):

Send an email message to: channel-talk-request@learner.org

The message should read: `subscribe channel-talk <Your Name>`

For example: `subscribe channel-talk Amanda Cho`

Be sure to remove any signature files before sending your message.

About the Contributors

Association for the Education of Teachers in Science

Dr. Sandra K. Abell is a professor of elementary science education at Purdue University, West Lafayette, Indiana, where she teaches undergraduate elementary science methods and graduate courses in science education. Abell's research aims to understand the process of becoming a teacher of science, from preservice education to student teaching and the induction years, and throughout the teaching career. She enjoys teaching science for understanding in collaboration with practicing elementary teachers.

Dr. Lawrence B. Flick taught elementary and middle school science for 12 years, conducting science fairs and outdoor schools for grades 3 through 9. Flick is currently on the faculty of Oregon State University, and has worked in science teacher education for 14 years teaching a variety of courses in teaching methods, curriculum, and educational research. His research focuses on teaching practices that promote concept development and higher-order thinking.

Dr. Anita Greenwood has worked in science education for 23 years, first as a teacher in the United Kingdom and now at the Graduate School of Education, University of Massachusetts Lowell. Greenwood conducts numerous science workshops for teachers at all levels K-12, and also works with preservice science teachers and doctoral students. Her background is in the biological sciences. She can be seen in *Case Studies in Science Education* working with elementary teachers as they solve problems experienced while teaching science.

Dr. Camille L. Wainwright is a professor of science education at Pacific University in Oregon. In addition to teaching science methods and educational technology classes for elementary and secondary teachers, she is also an adjunct professor in the Physics Department. Currently, Wainwright is a Co-Director of a major NSF grant and the Chair of the Oregon Science Education Council. She has published curriculum for teaching electricity and magnetism, and focuses her research on gender and achievement in science.

Harvard-Smithsonian Center for Astrophysics

Dr. Christine Jones is an Astrophysicist at the Harvard-Smithsonian Center for Astrophysics (CFA) where she carried out research in X-ray astronomy. Jones received her Ph.D. in astronomy from Harvard in 1974 for research on binary X-ray sources. She has carried out extensive studies of the hot X-ray emitting gas in galaxies and clusters of galaxies. Jones often collaborates in her research with her husband Bill Forman as well as other colleagues both from CFA and from around the world. Christine and Bill received the first Rossi prize from the American Astronomical Society for the discovery that elliptical galaxies have hot coronae. Her primary research goals are to understand the mass distribution of both dark and luminous components in clusters of galaxies and how clusters evolve over cosmological timescales, and to measure the mass distribution and the evolutionary history of elliptical galaxies.

About the Site Discussions

Helpful Hints for Successful Investigations

Included in the materials for each workshop you will find detailed instructions for the content of your **Getting Ready** and your **Going Further Site Investigations**. The following hints are intended to help you and your colleagues get the most out of these pre- and post-video discussions.

DESIGNATE A FACILITATOR.

Each week, one person should be responsible for facilitating the Site Investigations (or you might select two people—one to facilitate Getting Ready, the other to facilitate Going Further). The facilitator does not need to be the Site Leader, nor does it need to be the same person(s) each week. We recommend that participants rotate the role of facilitator on a weekly basis.

REVIEW THE SITE INVESTIGATIONS AND BRING THE NECESSARY MATERIALS.

Be sure to read over the Getting Ready and Going Further sections of your materials before arriving at each workshop. The Site Investigations will be the most productive if you and your colleagues come to the workshops prepared for the discussions. A few of the Site Investigations require special materials. The facilitator should be responsible for bringing these when necessary. **You will need these materials for Workshop 1.**

KEEP AN EYE ON THE TIME.

Thirty minutes go by very quickly, and it is easy to lose track of the time. You should keep an eye on the clock so that you are able to get through everything before the workshop video begins. You may want to set a small alarm clock or kitchen timer before you begin the Getting Ready Site Investigation to ensure that you won't miss the beginning of the video. (Sites that are watching the workshops on videotape will have more flexibility if their Site Investigations run longer than expected.)

RECORD YOUR DISCUSSIONS.

We recommend that someone take notes during each Site Discussion, or, even better, that you make an audiotape recording of the discussions each week. These notes and/or audiotape can serve as “make-up” materials in case anyone misses a workshop.

SHARE YOUR DISCUSSIONS ON THE INTERNET.

The Site Investigations are merely a starting point. We encourage you to continue your discussions with a Light Buddy and with participants from other sites on the discussion area of the Web site and on Channel-Talk, the workshop email discussion list.