ICE: phone: 888/220-9822; 608/262-3033; fax: 608/265-8094; email: ice@chem.wisc.edu; Internet: http://ice.chem.wisc.edu

What does ICE have to offer you?
Kits, Guidebooks, Activities, and More...

Communicating Science—that's what ICE is all about. We are a national center for science educators to develop and disseminate ideas. These efforts are evident in kits and publications, in programs for students and for teachers, and in research in chemical education. ICE develops demonstrations and hands-on activities; sponsors workshops for teachers; carries out research in chemical education; disseminates exemplary ideas via publications and kits. Here's how to find out more about what we do:

Outreach. Programs range from summer camps for middle schoolers to Science Fusion Theater to informal exhibits at science museums. See http://ice.chem.wisc.edu/Outreach.html.

Education. Activities include summer REU and RET programs, nanoscience Webquests, an online nanoscience course, and more. Go to http://ice.chem.wisc.edu/Education.html.

Research. Efforts range from the development and evaluation of chemistry outreach projects to the use of new pedagogies for teaching chemistry to the adaptation of latest science and technology to classroom materials. Find out more at http://ice.chem.wisc.edu/Education.html.

Nanoscience. Nanoscale structure is a familiar ICE theme, cutting through everything we do. Our efforts in this direction are summarized at http://ice.chem.wisc.edu/Nanoscience.html. Our Nanoworld materials are summarized on page 7.

Many of our activities end up as kits, hands-on activities, or books—tools you need to help you communicate the relevance, excitement, and fun of chemistry. The table below lists our publications, their level, and their type of use. Brief descriptions and order numbers of each are on the following pages. (Our Order Form has been inserted; check our Web site for the most up-to-date price information.) So, if you want to • teach about modern materials • introduce nanoscience • do relevant hands-on activities or • run a summer chemistry camp, you have come to the right place!

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| Hands-On Activity Manuals and How-To Guides |       |      |      |
| Chem Camp Handbook | MS | M | 6 |
| Chemistry Companion for Middle School Teachers | MS | M | 6 |
| Fun with Chemistry: A Guidebook of K–12 Activities, Volume 1 | All Levels | M | 6 |
| Fun with Chemistry: A Guidebook of K–12 Activities, Volume 2 | All Levels | M | 6 |
| ICE DevICEs: How to Construct Inexpensive Classroom & Lab Tools | MS, HS, GP | M | 7 |
| SPICE: Guidebook for a Traveling Outreach Program | All Levels | M | 6 |
| Super Science Connections | Elem | M | 6 |

| Books |       |      |      |
| Experiences in Cooperative Learning | MS, HS, AP, Coll | Reference | 5 |
| Scientific Ethics for High School Students | HS | CP | 5 |

**Key: Level of Use**

- Elem Elementary K–5
- MS Middle School 6–8
- HS High School 9–12
- AP Advanced Placement
- Coll College (undergraduate)
- GP General Public

**Key: Type of Use**

- M Manual (How to guide)
- D Demo (Demonstrate to a group or class)
- I Group work (Activity carried out by a group of 2–3)
- L Lab exercise (Hands-on activity)
- CP Class Participation (Students or groups can participate along with a Demo—purchase additional pieces)

**NOTE**

As with all science materials for children, it is expected that ICE hands-on resources will be used with appropriate adult supervision. Some kits contain small parts that might pose a choking hazard for small children.

The Polyhedral Model Kit showing the layered structure of kaolinite
**Solid-State Model Kit—It’s now a classic**

It’s hard to describe the structure of a crystal with a two-dimensional drawing. No need to anymore! We’ve got the answer! The **Solid-State Model Kit** allows you and your students to easily build and study structural models of metals, ionic compounds, and even superconductors. See instantly how atomic packings determine physical properties—density, cleavage planes, conductivity directions.

Our kit is an excellent tool to present sphere packing, unit cells, coordination number, layering, radius ratios, and interpenetrating polyhedra. Radii of the spheres correspond with the radius ratios for cubic, octahedral, and tetrahedral coordination. The kit is designed for individual use, laboratory exercise, tutorials, and lectures. Using the detailed illustrated manual that comes with each kit, students can build structures one atom at a time by placing spheres on the appropriate rods as shown by a template. Completed structures are approximately 4” × 4” × 6”. Replacement parts are available.

The kit comes in two versions: **Deluxe** and **Student** (described below); the primary difference between the versions is the number of spheres and rods. **Note**: two Student Kits may be combined to build all (> 80) crystal structures in the instruction manual. The **Polyhedral Model Kit**, below, uses an alternate approach to seeing molecular structure.

**Deluxe Version Kit**: use it to build more than 80 different solid state structures—all of the crystal structures in the instruction manual

Deluxe Kit parts include: an instruction manual, 2 bases, 15 templates that fit over bases, 39 metal rods that insert into holes in the bases, 56 colorless spheres, 17 yellow spheres, 39 green spheres, 44 blue spheres, and 39 pink spheres.

➤ **Order No. 92-004: Deluxe Version Model Kit**

**Student Version Kit**: build more than 60 structures with one kit; combine two Student Kits to build all of the crystal structures in the instruction manual.

Student Kit parts include: an instruction manual, 2 bases, 15 templates that fit over bases, 27 metal rods that insert into holes in the bases, 27 colorless spheres, 19 green spheres, 22 blue spheres, and 32 pink spheres.

➤ **Order No. 94-006: Student Version Model Kit**

**Polyhedral Model Kit**

The **Polyhedral Model Kit** simplifies visualization of many complex chemical structures that involve polyhedral shapes. It can be used to make many structures that are commonly discussed in science and engineering courses such as inorganic and solid-state chemistry, chemical engineering, geology, industrial chemistry, environmental science, materials science, soil science, and physics. Structures are built by linking polyhedral units rather than individual atoms, which provides an alternate view of how structural components fit together. The kit also allows users to make complex, non-symmetrical structures, thus students can more readily visualize and comprehend the spatial arrangement of complicated structures that cannot be represented by ball-and-stick or space-filling models.

The Polyhedral Model Kit nicely complements the ICE Solid State Model Kit (see above). Each kit gives different insights into molecular structures, an important pedagogical objective; together they can induce real comprehension into structure–property relationships. More information about the Polyhedral Model Kit and directions for assembling the **more than 40 structures** that can be built with it—such as NaCl, ZnS, H₂O(s), rutile, perovskites, gibbsite, talc, muscovite, and quartz—can be found at http://mrsec.wisc.edu/Edetc/pmk/index.html. The Polyhedral Model Kit was produced by University of Wisconsin–Madison Materials Research Science and Engineering Center (MRSEC) and is distributed by ICE.

➤ **Order No. 06-002: Polyhedral Model Kit**

**Help your students understand why ice floats.**

Solid water has an open nanoscale structure, making it less dense than liquid water. Its structure is illustrated at the left using the Solid State Model Kit, at the right using the Polyhedral Model Kit.
**Nanocrystalline Solar Cell Kit** — our most popular kit! (MS), HS, AP, Coll; G, I, L

When students build their own Nanocrystalline Solar Cell they recreate the process of photosynthesis: they generate electricity from light using natural dyes from berries. The solar cell has enough electrical output to power a small motor (not included). The kit provides an interdisciplinary context for students learning basic principles in chemistry, biology, physics, as well as environmental science. The instruction manual has comprehensive background information for the instructor as well as user reproducible laboratory instructions and prepared materials for data collection and assessment. The Solar Cell Kit contains the materials below (enough to make 5 reusable solar cells). Additional kit components are available.

- conductive (tin dioxide coated) transparent glass (10 pieces)
- colloidal titanium dioxide powder, Degussa P25 (20 grams)
- iodide electrolyte solution in dropper bottle (15 mL)
- woodless graphite pencil (HB) (1)
- 83-page manual with background info and student handouts
- 500 ohm potentiometer (1)
- glassine envelopes (5)
- dropper bottle (1)
- binder clips (10 clips)
- 12 cm copper tape

➤ **Order No. 98-001: Nanocrystalline Solar Cell Kit**

**Exploring the Nanoworld Kit** (MS), HS, AP, Coll; G, I

Nanoworld adventures await inside this kit! Use it to explore how we can accomplish the feats of “seeing” atoms, assembling them into a variety of novel structures, and customizing their properties to develop new technologies. The kit is available in both English and Spanish language versions.

Exploring the Nanoworld Kit is a general-audience activity kit that contains everything you need (except a standard 9V battery):

- color booklet
- diffraction slide
- fiber optic
- light emitting diode and circuit
- magnifying glass
- memory metal
- LED flashlight

➤ **Order No. 04-001: Presenter’s Guide (includes one Try This! packet)**

**Two Ways to Introduce the Nanoworld** All Levels; D

1. **Demo Mode: Nanoworld Presenter’s Guide with Try This! Packet**

Audiences of all ages enjoy learning about the Nanoworld! The Nanoworld Presenter’s Guide provides presenters and teachers with background information and instructions and materials to demonstrate four simple nanotechnology-related experiments:

- Light-Emitting Diodes (LED) and Fiber-Optic Activity
- Diffraction Activity: Optical-Transform Structure Determination
- Memory-Metal Activity
- “Seeing Atoms” Activity: Scanning-Probe Microscopy

The Guide includes talking points (with multiple variations for different audiences), supplemental information, applications, and Web links to enhance the presenter’s own knowledge of the nanoworld. The Nanoworld Presenter’s Guide comes with a single “Try This!” packet that contains the materials to demonstrate the four activities described in the Guide (for multiple packets for hands-on use, see below).

➤ **Order No. 04-002: Try This! Packets with Booklets (10 packets)**

2. **Hands-On Mode: Try This! Activity: Extra Packets Available**

Your students can join in if you purchase individual Try This! packets. They can carry out the activities on their own or in groups. The Try This! packets, with an accompanying mini activity booklet, can be purchased in sets of 10 or 30. (The Try This! booklet is a product of the Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces (MRSEC) at the University of Wisconsin–Madison, was funded by the National Science Foundation, and is distributed by the Institute for Chemical Education.)

➤ **Order No. 04-002A: Try This! Packets with Booklets (30 packets)**

ICE: phone: 888/220-9822; 608/262-3033; fax: 608/265-8094; email: ice@chem.wisc.edu; Internet: http://ice.chem.wisc.edu
Hands-On Nanoscience with ICE Kits

LED Color Strip Kit: Nanotechnology in Action!

The LED Color Strip Kit illustrates the properties of LEDs and semiconductor materials with a series of hands-on, minds-on activities that are aligned with both NSES Science Content Standards 9–12 and ITEEA Content Standards for Science Technological Literacy. Because semiconducting materials found in LEDs are grown virtually an atomic layer at a time, light-emitting diodes (LEDs) represent an exciting application of nanotechnology. This kit can be used as a demonstration or (if you obtain additional color strips) as an activity in which multiple groups of students can participate. We recommend a group of 2–3 students. The instructions and activities in the manual may be photocopied and distributed to the class. Replacement parts are available. A 9V battery is required but not included.

The LED Color Strip Kit contains:
- strip of light-emitting diodes (including an infrared LED) with a capacitor
- diffraction grating slide
- luminescent cap
- 50-page manual has background info and LED experiments for teachers, LED activities for students

➤ Order No. 02-001: LED Color Strip Kit
➤ Order No. 02-001S: Set of 10 additional color strips only

Explorations in Materials Science Kit

High school students can actively explore and compare properties of different materials with the Explorations in Materials Science Kit. The core of the module is hands-on laboratory work, using elements of chemistry, physics, mathematics, and engineering. Students prepare working samples of the major classes of materials (metal, plastic, and ceramic) from molds included with the kit. Then they investigate the mechanical behavior, the electrical, magnetic, optical, and thermal characteristics, the chemical stability, and other physical properties of each material, including density and grain structure. The 70-page manual includes user reproducible student directions for sample preparation and testing as well as a teacher’s guide. The Classroom Kit transforms this from a demo to a hands-on experience for students; we recommend groups of 2–3 students. Explorations in Materials Science (a joint offering from ICE and General Atomics) contains the specialized materials below; replacement parts are available. Other parts are easily obtainable.

Teacher Kit
- 3 3-bar molds
- ⅓ lb. tin shot

Classroom Kit
- 15 3-bar molds
- 2 lb. tin shot

➤ Order No. 97-005: Explorations in Materials Science, Teacher Kit
➤ Order No. 97-005X: Explorations in Materials Science, Classroom Kit for 5 lab groups

NEW—Buy one, give one! ICE Gift Certificates

Looking for a gift for someone who teaches chemistry and who could use good, tried and true classroom materials? Or maybe you would like to present an award or a certificate of appreciation to a local teacher. A send-off present to a someone just beginning a teaching career can provide a special boost.

An ICE Gift Certificate may be your answer. They are available in increments of $25; although $100 is the top amount listed, we can easily go higher. Certificates may be used to purchase any of the materials listed and described online on the ICE Web site (http://www.ice.chem.wisc.edu) and in print on our Brochure and Order Form. Certificates may not be converted to cash.

➤ Order No. 11-002: Gift Certificate (available for $25, $50, $75, or $100) or contact ICE.


# Hands-On Science with ICE Kits

## The Line of Resistance Kit

The **Line of Resistance Kit** will help you teach your students to measure resistance using only a piece of paper and a graphite pencil!

A Teacher’s Guide with background information as well as 10 easy-to-do experiments that students will enjoy are in the 44-page manual included with this kit. Some topics covered are: electrical resistivity of graphite and wire; resistance of serial and parallel circuits; and open and short circuits. The kit contains a piezoelectric igniter (replacement igniters available), which allows your students to demonstrate how lightning rods work (the path of least resistance). The kit comes in two forms: Teacher Demonstration Kit or a hands-on Classroom Kit (materials for 20 students). A multimeter is required but not provided. The Line of Resistance Kit is the first in a joint effort by ICE and General Atomic Sciences Education Foundation to bring hands-on materials and physical science to teachers and students.

- Order No. 97-002: Line of Resistance, Teacher Demo Kit, with manual and materials for one person
- Order No. 97-002X: Line of Resistance, Classroom Kit, with manual and materials for 20 students

### Optical Transform Kit

Model X-ray diffraction using a visible laser and two-dimensional patterns on a 35-mm slide—the Optical Transform Kit. The kit includes: directions, patterns on slides, and overhead transparency masters. Additional slides available for student hands-on use. A source of visible laser light is not included, but any laser pointer will work.

- Order No. 90-002: Optical Transform Kit (booklet and 1 set of 4 slides)
- Additional 35-mm slides of the four different patterns, in lots of 10, for hands on:
  - Order No. 90-002S (10 Unit Cell Slides)
  - Order No. 93-003S (10 Discovery Slides)
  - Order No. 93-004S (10 VSEPR Slides)
  - Order No. 93-005S (10 Plane Groups Slides)

### DNA Optical Transform Kit

You can simulate Rosalind Franklin’s famous X-ray diffraction experiments that led to the discovery of the DNA double helix. All you need is a visible laser and two-dimensional diffraction pattern slides from the DNA Optical Transform Kit.

The kit includes: a manual with background information and directions, a diffraction pattern slide, and overhead transparency masters. A source of visible laser light is not included, but any red laser pointer will work.

- Order No. 99-001: DNA Optical Transform Kit (booklet and slide)
- Additional slides for hands on:
  - Order No. 11-005 (5 additional slides)
  - Order No. 11-010 (10 additional slides)

## DNA Structure

Measuring the Resistivity of a Graphite Line

Using the Line of Resistance Kit you can explore the electrical properties of materials and circuits using a graphite pencil, a piece of paper, and a multimeter.

## Books

### Scientific Ethics

**Scientific Ethics for High School Students** uses case studies to stimulate classroom discussion about various topics, such as obtaining data, laboratory safety, computing ethics, and working with others. Ethics contains instructions for teachers on how and when to use these case studies, along with commentaries that discuss each topic. Ethics has been used by high school teachers since 1994 to provide a useful and enjoyable means to introduce students to ethical issues in scientific investigation. Though this publication does not deal explicitly with moral issues such as plagiarism and cheating, such issues could easily be made extensions of the discussions of ethics.

- Order No. 97-003: Scientific Ethics

### Experiences in Cooperative Learning

**Experiences in Cooperative Learning** is a compilation of laboratory and classroom exercises, seeds for discussion, and assessment tools and strategies gathered from teachers. It contains more than 150 pages of working, practical examples ranging from middle school science to college chemistry. The publication provides basic information about the cooperative learning technique and encourages creative thinking about the learning process.

- Order No. 95-001: Experiences in Cooperative Learning
Hands-On Science—How to Do It

Super Science Connections (SSC) was designed to help elementary school teachers who have little science background integrate hands-on science activities into a typical K–3 curriculum. It was written by K–3 teachers, for K–3 teachers.

Super Science Connections integrates children’s literature, writing, mathematics, art projects, social studies, and health instruction with hands-on science—observing, devising experiments, hypothesizing, and drawing conclusions. It models ways in which your classroom can become a place where students learn and enjoy science in context. SSC contains 39 activities centered on a science concept or process skill connected to the AAAS Benchmarks for Science Literacy. The activities are divided into these topics: Color and Light, Insulation, Pressure, Surface Tension, and Water and Changing Its State.

➤ Order No. 94-009X: Super Science Connections (3-hole punched, notebook not included)

The Chemistry Companion for Middle School Science Teachers is a companion to the Fun With Chemistry Guidebooks. It incorporates hands-on activities and chemistry topics that will help revitalize the middle school curriculum. It features a variety of topics including: the scientific method, matter, the periodic table, atoms, acids and bases, energy, chemical reactions, chemical bonding and environmental chemistry. It offers analogies, real-world applications, and several hands-on activities to complement the topics above and your curriculum.

➤ Order No. 97-001: The Chemistry Companion for Middle School Teachers

The SPICE (Students Participating In Chemical Education) traveling demonstration program is an enormous success, having reached 70,000 people in the last 20 years. In the SPICE Guidebook we have assembled our experience on how to organize and put on a program of demonstrations in schools or public places. Includes “scripts” of demonstrations, advice on gearing an activity to different audiences, notes on safety, a bibliography of demonstration source-books, and suggestions for hands-on activity events.

➤ Order No. 92-001: SPICE Handbook
Hands-On Science—How to Do It

ICE DevlCEs: Make your own equipment  MS, HS, GP; M

Need more hands-on tools for your classroom? Don’t have a lot of money or time to spend? Make your own with ICE DevlCEs. The ICE DevlCEs booklet shows how, in less than an hour per DevlCE and for very little money, you can have 11 different tools including:

- magnetic stirrer
- BB board
- electrolysis apparatus
- two miniature explosion devices
- balance
- mass spectrometer simulator
- chromatography column simulator

With ICE DevlCEs you learn first from making the device, then learn even more by using it to demonstrate a chemical principle—for example, use the BB board to demonstrate annealing, hardening, and tempering of metals; the neon lamp cord demonstrates the chemistry of vision; the chromatography simulator illustrates column chromatography.

Devices use materials readily available at hardware stores. All devices are stand-alone—no computer required.

➤ Order No. 94-010: ICE DevlCEs booklet

Replacement Parts

Yes, We Have Replacement Parts!

Has the manual for one of your ICE kits gone missing?
Are some of the spheres from your Solid-State Model Kit AWOL? Are the templates all dog eared and the rods bent?
Do you need a replacement diffraction slide? Could you use additional diffraction slides for hands-on classroom use?
How about parts for the Nanocrystalline Solar Cell Kit?

Wire with shape-memory retention is a hot item. ICE has pieces of untreated Nitinol™ wire (short or cut to size), and at a reasonable price.

If any of the above questions apply to you, or if you are in a similar predicament, just check our Web site or contact ICE at the address below. We handle such requests all the time and will be glad to “top up” your ICE materials.

Journey to the Nanoworld—Let ICE Lead the Way

Nanoscale structure is a theme that has been with ICE since its early days. If you are interested in bringing the nanoworld to your students, ICE can help. We have lots of materials available, all tried and tested, from introductory demos through those that take a close up look at molecular structure. Here are some leads. Get more information in this brochure (page numbers are noted) or go to our Web site at www.ice.chem.wisc.edu.

Get Started!

Nanoworld Presenter’s Guide with Try This! Packet: four simple nanotechnology-related experiments; demo; general audience (p 3)
Try This! Activity: the same experiments as above but enough packets to use as individual or group hands-on activities; general audience (p 3)

Go a Bit Further...

Exploring the Nanoworld: general audience activity to “see” atoms; group work or individual project (p 3)
Explorations in Materials Science: h.s. through college students actively explore and compare properties of different materials; group or lab exercise (p 4)

Expand on the Nano Theme

Memory Metal: demo shape retention of metals, for all levels; demo or individual project (p 8)
LED Color Strip: illustrate the properties of LEDs; a kit is a demo; extra color strips make this a hands-on activity (p 4)
Nanocrystalline Solar Cell Kit: h.s. through college students recreate photosynthesis; hands-on for groups, individual projects, or lab exercise; (p 3)

Dig More Deeply: Look at Structure

Polyhedral Model Kit: students from h.s. through college can examine complex chemical structures; use as demo, group work, or lab exercise (p 2)
Solid-State Model Kit: AP and college students can build and study structural models of metals, ionic cmpds, superconductors; demo or hands-on (p 2)
Optical Transform Kit: model X-ray diffraction for AP through college students; use the kit as a demo, purchase additional slides for hands-on (p 5)
DNA Optical Transform Kit: simulate Rosalind Franklin’s X-ray diffraction experiments, as a demo; purchase additional slides for hands-on (p 5)
Watch This: Science in Action!

Memory Metal—a temperature change triggers action

Some metal alloys have shape-memory retention—thus they are said to have a memory. Our Memory Metal publication includes an eight-page description of the chemistry responsible for shape-memory retention, many diagrams (ready for overhead projection), and a sample of memory metal wire (Nitinol™) in the shape of ICE (illustrated left below). With the metal wire and a cup of water, you can demo science in action just as we’ve sketched below. Just pull both ends of the cool wire to distort its shape, then dip it in warm water. Presto! It snaps to the original shape!

Order No. 91-011: Memory Metal Kit (includes booklet plus sample of pre-shaped memory metal wire)
Replacement pieces of shaped wire available. Small pieces or cut-to-size lengths of untreated Nitinol™ wire are also available: contact ICE.

ICE Photochromic T-shirt—sunlight changes its colors

Teach photochromism with a T-shirt! This snazzy white T-shirt, made from 100% heavyweight cotton, has a black outline of the ICE structure on the front and a smiling sun on the back. Step into the sun, and the designs become bright shades of blue, purple, yellow and orange! UV active dyes in the shirt are colorless in room light, and brightly colored in sunlight.

What happens and why. Use this T-shirt to teach students how conjugated double bonds absorb light. The dyes in the T-shirts become more conjugated when exposed to sunlight resulting in a colorful, light absorbing form, and relax to a less conjugated colorless form when removed from light.

Order No. 93-002: T-shirt, adult sizes
Order No. 93-002C: T-shirt, child sizes
Indicate size on Order Form

To Order ICE Materials

Ordering. Ready to order an ICE Kit or Publication? First, get our Order Form, inserted in this Brochure or found on our Website at http://ice.chem.wisc.edu/. Orders from individuals must be prepaid. Place your order by phone, by U.S. mail, or by fax. Here is our contact information:

toll free 888-220-9822 (new toll-free number)
telephone 608/262-3033
fax 608/265-8094
e mail ice@chem.wisc.edu and iceorders@chem.wisc.edu
(sorry, we cannot accept credit card orders by email)

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University of Wisconsin—Madison
Department of Chemistry
1101 University Avenue
Madison, WI 53706-1322

Note—shipping charges. • If your order is being shipped to the Continental U.S., use the chart on the Order Form to determine your shipping charges—Standard Shipping as well as the additional charge for RUSH; include both of these in the Grand Total. • If your order is being shipped to Alaska, Hawaii, Canada, Mexico, and all other countries, contact ICE by email, fax, or phone for the amount for Standard or Rush shipping charges of your order to your specific country. Rush shipping is an additional charge: add the Rush charge to the Standard Shipping charge. Books and kits are not available for preview. Due to the nature of ICE Kits and Publications, there are no refunds, returns, or exchanges.