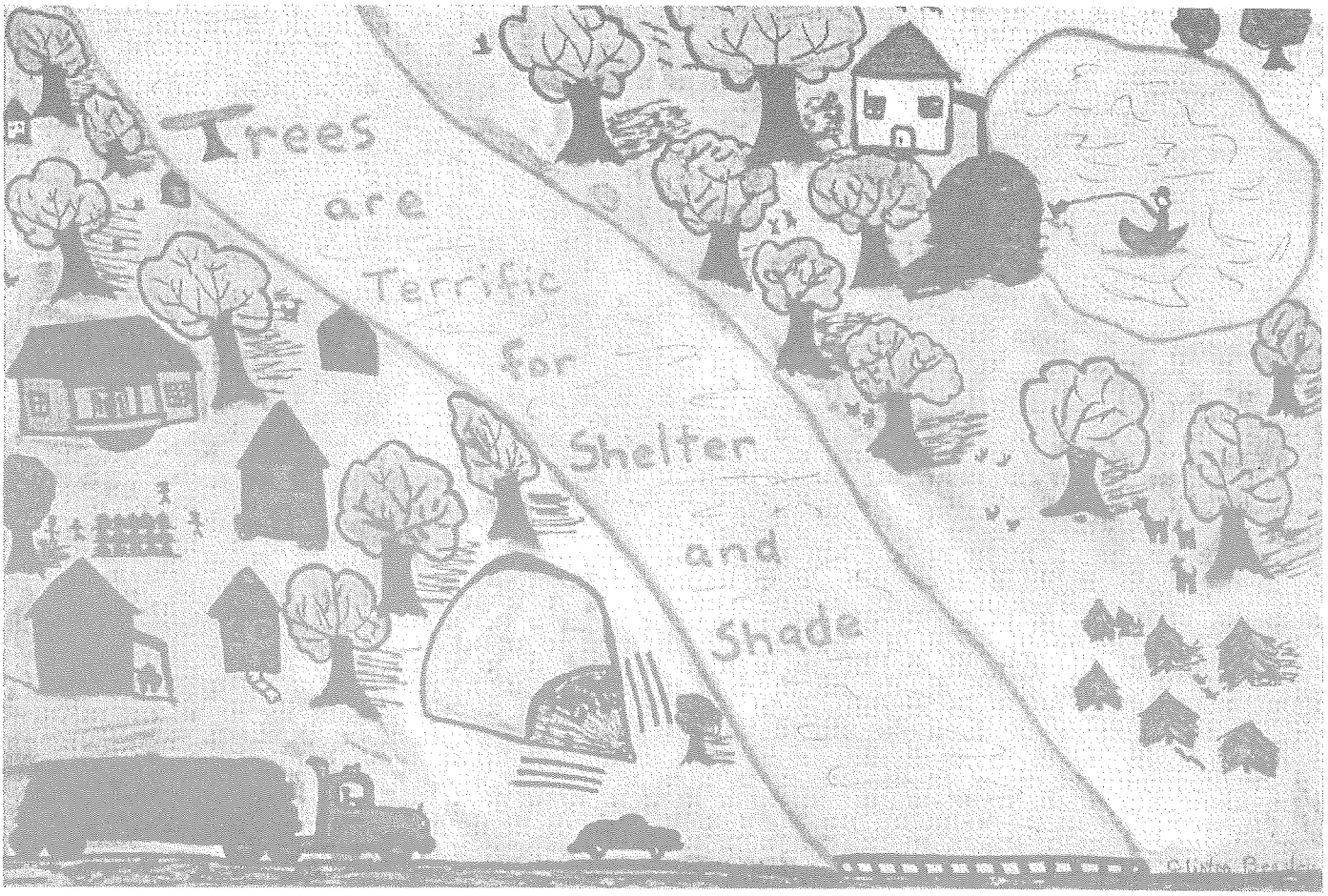
SPECTRUM

THE JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION



1999 Illinois Arbor Day Poster Contest Winner

Congratulations to Clinton Beasley 5th Grader at Dongola Unit School #66!

SPRING/SUMMER 1999

SPECTRUM

JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION
Volume 25, Number 1, 1999

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Cover: Clinton Beasley, 5th grader at Dongola Unit School #66. Teacher, Jean Lingle.

ISTA NEWS

SPRING PRESIDENT'S LETTER

THE FALSE DICHOTOMY: SCIENCE AS 'KNOWING' VS. SCIENCE AS 'DOING'

Several months ago, I received a call from Leon Lederman asking if I would be available to be part of a panel discussion on the topic of science education reform. It's hard to say, "No" to Leon and so I said, "Yes." I thought I would take Leon's invitation as an excuse to ramble on a bit about science education...what it is, what it isn't and what it could be. It seems to me that, like our friends from Indostan, we frequently fixate on the various components of the scientific enterprise, but fail to grasp the entire "beast." This is illustrated by our efforts to describe what should constitute our students' science education experience.

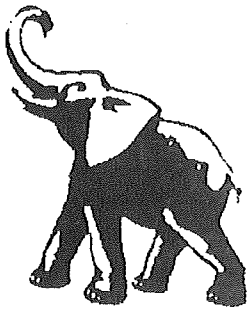
After thirty years of teaching in the schools and at the university, I'm still struck by how my students, at all levels, define science. They tend to fall into two groups; the "facts" camp and the "activities" camp. Science is either "stuff to know" or "things to do." I hear the same thing when talking with teachers of science in my staff development workshops. Elementary teachers tend to focus on the belief that "science should be fun" while their secondary colleagues point out that their students "need to know the stuff." I can't help but to feel that we, as science educators, have failed to communicate to our students, to the general public or even to each other about what science is.

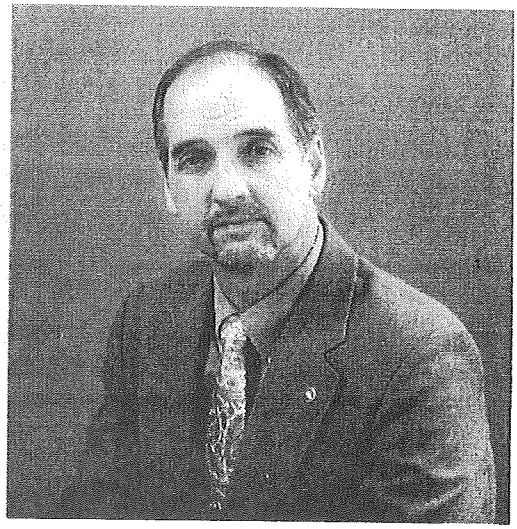
What I want to see in my students is a predisposition to apply scientific knowledge in a context of active learning. Obviously, students need to know science content. After all, what is that we expect them to process? Yet, to isolate the "stuff" from the students' world and to present it in a pre- masticated form for replication and recall, seems a disservice to science, to the learner and, ultimately, to the teacher. The third element in my outcome statement, predisposition, is often left out of our discussions. Participating in science is more than "knowing" and "doing," it is also exhibiting curiosity, enthusiasm and persistence.

The National Science Education Standards and the Illinois State Learning Standards for science encourage us to take a multifaceted view of science education. The Standards suggest that we should utilize inquiry to involve students in meaningful learning experiences that invite the application scientific knowledge. In addition, the NSES Teaching Standards and Illinois Professional Teaching Standards imply that before students will be successful and engaged science learners, teacher must resolve for ourselves what science teaching should be about. Maybe then we can help our students see that science, like the elephant in the fable, is more than its various parts.

Don Nelson

Don Nelson
President, ISTA





THE BLIND MEN AND THE ELEPHANT
A FABLE J. G. SAXE

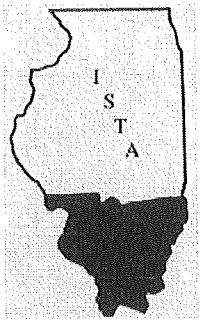
It was three men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind.

The First approached the Elephant,
And happened to fall
Against his broad and sturdy side,
At once began to bawl:
"God bless me? but the Elephant
Is very like a wall!"

The Second, feeling of the tusk,
Cried, "Ho! what have we here
So very round and smooth and sharp?
To me 'tis might clear
This wonder of an Elephant
Is very like a spear!"

The Third approached the animal,
And happening to take the squirming trunk within his hands,
Thus boldly up and spake:
"I see," quoth he, "the Elephant
Is very like a snake!"

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong.
Though each was partly in the right,
And all were in the wrong!



1999 SCIENCE IN THE SOUTH

MARCH 12, 1999

THANKS TO ALL OUR WONDERFUL VENDORS WHO DONATED THEIR TIME, ENTHUSIASM AND PRODUCTS TO HELP MAKE THIS 3RD ANNUAL REGIONAL CONFERENCE ON SCIENCE EDUCATION SUCH A HUGE SUCCESS!

BECKLEY-CARDY GROUP

CHICAGO SOCIETY FOR CLINICAL LABORATORY SCIENCE

COAL RESEARCH CENTER

FISHER SCIENTIFIC

GLOBE FEARON

ILLINOIS DEPARTMENT OF COMMERCE & COMMUNITY AFFAIRS

MICROTECH

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OFFICE FURNITURE WAREHOUSE

PRENTICE-HALL PUBLISHERS

THE SCIENCE CENTER

SCOTT FORESMAN

SOUTHERN ILLINOIS AGRICULTURE AWARENESS COMMITTEE

ST. LOUIS SCIENCE CENTER

TEXAS INSTRUMENTS

TOUCH OF NATURE

COMING SOON!

A FANTASTIC OPPORTUNITY FOR THOSE OF YOU WHO ARE NOT PROCRASTINATORS! EARLY BIRD DISCOUNT ON 1999 ISTA CONVENTION AT THE PRAIRIE CAPITOL CONVENTION CENTER. ADVANCE PROGRAM WILL BE AVAILABLE IN JUNE.

CHECK YOUR MAIL AND OUR WEBSITE

http://www.ista-il.org

1999 ELECTION RESULTS

EDEE NORMAN WIZIECKI
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MAUREEN JAMROCK
VICE PRESIDENT

DEBRA GREANEY
SECRETARY

LINDA O'CONNOR
REGION 1 DIRECTOR

STEVE CHELSTROM
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TRACY TRIMPE
REGION 3 DIRECTOR

MARYLIN LISOWSKI
REGION 4 DIRECTOR

MICHAEL SCHNEIDER
REGION 5 DIRECTOR

ANN LINENFELSER
REGION 5 DIRECTOR
(Appointed to replace Deb Greaney)

KEVIN WISE
REGION 6 DIRECTOR
(Appointed)

NANCY CAMPBELL
REGION 7 DIRECTOR

Congratulations to these newly elected officers!

(FOR A COMPLETE LIST OF YOUR 1999 OFFICERS, SEE THE INSIDE FRONT AND BACK COVERS OF THIS ISSUE)

INVITATION FOR MANUSCRIPTS

The Winter 1999 *Spectrum* is a special issue focusing on **science safety** in the laboratory, classroom, and field. The editor of the ISTA *Spectrum* invites all interested persons to submit manuscripts dealing with this topic for the journal. The deadline for submission is Friday July 2, 1999. All manuscripts on this special topic should be sent to Dr. Kevin Finson, Department of Elementary Education and Reading, Western Illinois University, 1 University Circle, Macomb, IL 61455. The manuscript should not be more than 5,000 words long. Please use APA style (author, date) for citations.

We look forward to hearing from you!

SPECIAL INTERESTS

1998 STEEL RECYCLING RATES FALL AFTER 10 YEAR GAIN

Foreign imports dramatically Impact Value of Steel Scrap

Steel recycling rates fell in 1998, due in large part to production cutbacks in the United States steel industry caused by record increases in foreign steel imports. The decline follows 20 years of growth in consumer awareness and recycling of steel cans and appliances.

As the steel industry was forced to scale back production throughout 1998 the demand for steel scrap declined, causing an inventory buildup across the country. Market value for steel scrap declined sharply throughout 1998, from $129 a ton in January to $71 at the end of the year.

Many scrap dealers and auto dismantlers are still accepting and storing larger steel products, such as cars and appliances, pending a turnaround in the market.

The Steel Recycling Institute is also working to raise awareness of the environmental impact of the current steel trade crisis. A group of 20 environmental organizations has joined SRI in petitioning the U.S. government to examine the poor environmental records of foreign steel producers in allowing unrestricted steel imports to continue to flow into the United States.

In a joint letter to President Clinton, the group stated, "Allowing this surge of inefficiently made imports to continue will cause significant and unnecessary additions to global emissions and energy consumption. It will also cause an inevitable deterioration in the steel recycling infrastructure [in the United States].

The Steel Recycling Institute, a business unit of the American Iron and Steel Institute, educates the solid waste management industry, government, business and ultimately, the consumer about the economic and environmental benefits of recycling steel. Through its seven regional offices, SRI works to ensure the continuing development of the steel recycling infrastructure.

Recycling Rates for 1998, broken out by product category

Steel Cans - 55.9% (down from 60.7% in 1997)

Appliances - 72.1% (down from 81% in 1997)

Automobiles - 92% (down from 97.6% in 1997)

Construction Plates and Beams 88% (down from 90% in 1997)

FACTS ABOUT STEEL NORTH AMERICA'S #1 RECYCLED MATERIAL

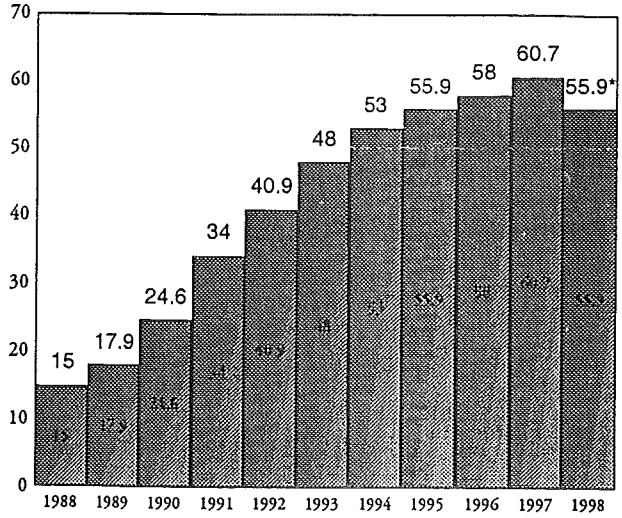
WHY IS STEEL #1?

The North American steel industry annually recycles millions of tons of steel scrap from recycled cans, appliances, automobiles and other steel products. This scrap is remelted to produce new steel. In fact, the industry's overall recycling rate is more than 65%.

There are two processes for making steel. The basic oxygen furnace (BOF) process, which is used to produce the steel needed for packaging, appliances, car bodies and steel framing, uses about 28% recycled steel. The electric arc furnace (EAF) process, which is used to produce steel shapes such as railroad ties and bridge spans, uses nearly 100% recycled steel. And, since all new steel products contain recycled steel, when you buy steel you help to close the recycling loop by buying recycled.

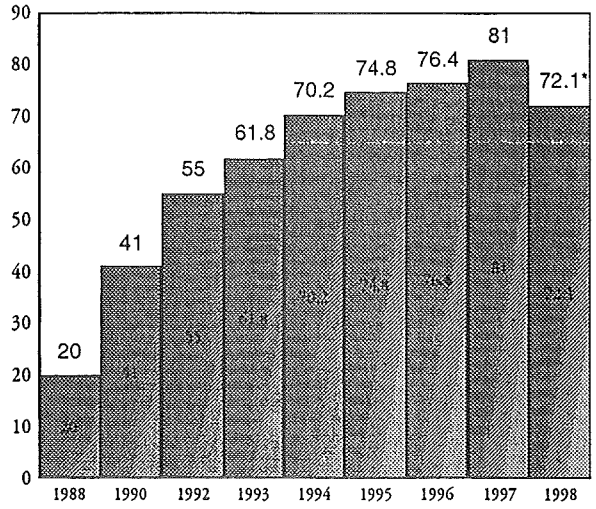
WHAT ARE CONSUMERS RECYCLING?

Many communities operate recycling programs which include steel cans. Several also provide options to recycle appliances. And while consumers are not actively involved, virtually every car taken off the road is recycled. More than 200 million Americans have convenient access to steel can recycling through curbside, drop-off and buyback programs, as well as through magnetic separation at resource recovery facilities.



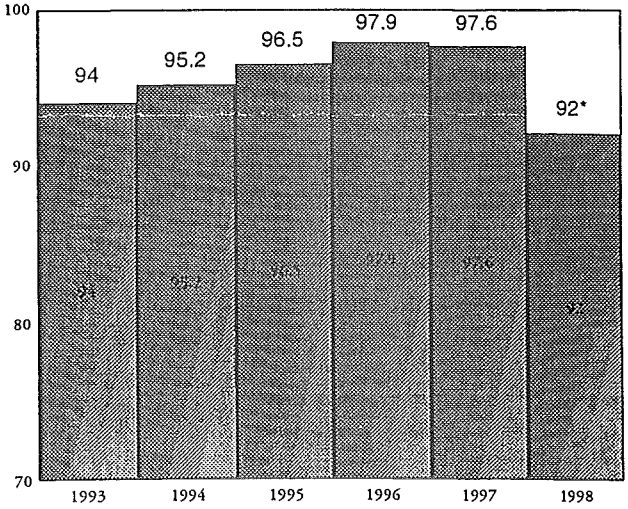
STEEL CANS

Steel cans, including food, paint and aerosol cans, were recycled at a rate of 60.7% in 1997. The industry remelted nearly 20 billion steel cans into new products for about 630 cans recycled every second. The amount of steel recovered through recycled packaging in 1997 (more than 1.7 million tons) would yield enough steel to build 200 Eiffel Towers.



APPLIANCES

Appliance recycling in the U.S. continues to grow. In 1997, more than 46 million appliances were recycled, at a rate of 81%. Appliance recycling in 1997 yielded enough steel (almost 2.3 million tons) to build 88 new baseball stadiums the size of BancOne Field in Phoenix, home of the new Arizona Diamondbacks. There are more than 12,000 appliance recycling locations throughout the United States.



AUTOMOBILES

Comparing the number of automobiles taken off the road in 1997 to the number of new cars produced shows a recycling rate of 97.6% for automobiles in 1997. Of the more than 13 million tons of steel and iron recycled from automobiles in 1997, 1.8 million tons went back to the auto industry to produce new cars. The nearly 13 million cars recycled in 1997 would circle the Earth more than one and 3/4 times.

WHAT ARE OTHER BENEFITS OF STEEL RECYCLING?

Recycling programs are established primarily to reduce the solid waste stream. Besides saving landfill space, recycling steel also saves valuable energy and natural resources. Each year, steel recycling saves the energy equivalent to electrically power about one-fifth of the households in the United States (or about 18 million homes) for one year. And every ton of steel recycled saves 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone.

For more information on the recycling location nearest you for steel cans, appliances and other materials, call the Steel Recycling Institute's consumer hotline, 1-800-YES-1-CAN (937-1226) or visit our website at **http://www.recycle-steel.org**

COMPUTER SPECTRUM

The mission of the **National Environmental Education and Training Foundation (NEETF)** is to help America meet critical national challenges through environmental learning. It addresses issues such as health, clean water, educational excellence, and global competitiveness through environmental learning. http://www/neetf.org

A new website focuses solely on the issues of rural schools. It is sponsored by the **Organizations Concerned About Rural Education**, a coalition of more than two dozen education, farm, rural, technology, and other groups interested in rural education.
http://www.ruralschools.org

Rand McNally Educational Publishing has launched k12online, a website offering free outline maps, lesson plans, classroom activities, and consulting services, in addition to an online store for teachers.
http://www.k12online.com

WebTeacher is a comprehensive, self-paced Internet tutorial that provides both basic and in-depth information about the World Wide Web. The site includes materials on how to use the Internet and information on Internet safety, broadband cable technology, the Universal Service Fund, other funding sources for schools, education websites, lesson plans, and a guide to the cable television industry's educational resources. The site is maintained by the cable television industry in conjunction with TECH CORPS, a nonprofit group that assists schools with technology plans.
http://www.webteacher.com

AT&T's online resources for teachers includes AskLN℠, an online mentoring program on using technology effectively in the classroom; the Community Guide to the Information Superhighway, which helps schools understand and plan for the use of the Internet; and an online Internet tutorial for teachers.
http://www.att.com/edresources

The Department of Education has released *An Educator's Guide to Evaluating the Use of Technology in Schools & Classrooms*. Designed for individuals with little or no formal training in research or evaluation, the 100-page guide provides examples of technology surveys and needs assessments that can be used by administrators, teachers, and students.
http://www.ed.gov/pubs/EdTechGuide/

World Chemistry includes resources such as interactive tutorials with animations, a reference guide to chemical terms, FAQs, interactive molecular models, VRML periodic tables, and a chat room. It is designed for advanced chemistry students ages 16-19.
http://www.intschool-leipzig.com/bailey/home/index.htm

Science Net Physics, a project from the Toronto Public Library's Science Net, has more than 650 links to physics resources, arranged by the Dewey system and grouped by target audiences: teachers; K-6; and
7-12. http://sciencenet.tpl.toronto.on.ca

The **Planetary Geology Teachers Guide** from NASA's Education Division features exercises grouped into five classroom units for grades five and up: introduction to geologic processes, impact of cratering activities, planetary atmosphere, planetary surfaces, and geologic mapping.
http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Planetary.Geology

The **Science Fair Project Resource Guide** is sponsored by the Internet Public Library for K-12 science students. The site offers information on how to do a project, actual samples of some projects grouped by age level, ideas for projects your students could try, and resources for completing the project.
http://www.ipl.org/youth/projectguide/

At **Lesson Stop**, you can access links to thousands of lesson plans and sign up for the *Lesson Stop Newsletter*, a free weekly listserv that highlights online lesson plans.
http://www.lessonstop.org

A group of "professionals with wide-ranging expertise in academia and industry" has launched **Room 103**, which can answer your (or your students') science questions, provide an archive of old questions, and describe new trends in various science fields.
http://www.room103.com

At the **Little Scientists** site, you'll find information on a "hands-on" approach to teaching science and computing to young children.
http://www.little-scientists.com

2001 Colleges, Universities, and Scholarships lists the admissions office e-mail addresses, telephone numbers, and financial aid e-mail addresses for thousands of colleges and universities nationwide. **101 Top College, University, and Scholarship Pages** features links to free scholarship search services; single college applications accepted by hundreds of colleges; college "matching" databases; SAT practice tests; and more. Access both at the URL below.
http://www.college-scholarships.com

At the **Science Junction**, you'll find online simulations, lesson plans, data set activities, and science web resources.
http://www.ncsu.edu/sciencejunction

Be sure to drop by the **Franklin Institute Online** for its monthly list of Things To Do, a number of classroom activities for all grades.
http://www.fi.edu

Lesson Plans/Homework:
http://www.studyweb.com/index2.htm

Assessment:
http://www.middleweb.com/linksweek.html
http://www.coe.missouri.edu/~arcwww/pa/

Hurricanes:
http://www.clark.net/pub/cosmic/93th.html
http://www.miamisci.org/hurricane/hurricane0.html

Earthquakes:
http://www.teleport.com/~jstar/earthq.html
http://quake.wr.usgs.gov/recenteqs

Volcanos:
http://volcano.und.nodak.edu/vw.html
http://www.volcanoes.com

Weather:
http://www.itdc.sbcss.k12.ca.us/curriculum/weather.html
http://www.weatheronline.com
http://www.scholastic.com/magicschoolbus/index.htm
http://www.whnt19.com/kidwx
http://faldo.atmos.uiuc.edu/WEATHER/weather.html
http://groundhog.sprl.umich.edu

Wetlands:
http://www.miamisciorg/ecolinks/everglades
http:www.ospi.wednet.edu:8001/curric/land/wetland/index.html

Listserves

The **Middlescience** mailing list is designed for middle school teachers teaching general, life, and earth science. The purpose of the list is to share and generate ideas and to make teaching and learning more effective. To join the list, visit this website: http://www.onelist.com/subscribe.cgi/middlescience

The **EDRESOURCE** listserv is a group of educators, students, teachers, and administrators interested in online education, Internet-based education, and integrating the Internet into education. For more information, visit:
http://www.eGroups.com/list/edresource

K12 Newsletters is a service of the Internet Scout Project in the Computer Sciences Department at the University of Wisconsin-Madison. The goal of K12 Newsletters is to combine in one place the best of the Internet's K-12 newsletters. Current newsletters being posted include *Algebra Times, ASCD Bulletin, Blue Web'n Update, Bonus Points for 7-12 Educators, Online Class, Education World Newsletter, Geography Newsletter, Innovative Teaching, Kids Klicks, Lesson Stop, MacsUNITE, Net-Mom News, PBS Teacher Previews, Surfing the Net with Kids, ThinkQuest*, and *This Week's Top Academic Internet Research Sites.*
For more information, visit the website listed below.
http://scout.cs.wisc.edu/scout/

Free Internet Services for Educators

Three million people have joined GeoCities, the "largest and fastest-growing community on the Internet." As a GeoCities homesteader, you receive limited space where you can build a homepage in one of its "Neighborhoods"; free e-mail; help with designing your homepage; chat rooms; contests; and more. The free e-mail account includes attachment and mail forwarding features, and it can adapt to Netscape, Internet Explorer, Eudora, and other mail reader programs. In return, GeoCities asks members to support advertisers by allowing its pop-up ads to appear on homepages and requests that members acknowledge GeoCities as the host with a link to its homepage. For a small fee ($4.95), you can purchase an expanded membership package that offers expanded server space, a personal URL, and more. For more information on GeoCities, go to
http://www.geocities.com/main/help/geotour

You can also involve your school in the Family Education Network (FEN), which currently has school websites in 37 states. FEN works with a school directly to bring it free e-mail and web services. FEN is the exclusive partner in providing local web services to 27,000 PTA units nationwide. It also has partnerships with the American Association of School Administrators; Communities in Schools, Inc.; and the National School Boards Association. For more information, visit the website
http://familyeducation.com

SchoolNotes.com, a community service from Data Sense, Inc., provides web pages for teachers, parents, and students to communicate school-related information. This service allows individuals to place the school information on the web at any time they need to without first programming the information in HTML; school websites can then link directly to the individual's information via SchoolNotes. Advertising is also involved, and users are encouraged to submit names of potential advertisers to Data Sense. For more information on SchoolNotes.com, visit
http://schoolnotes.com/schoolnotes/about.html

The **American Forest Foundation**'s award-winning environmental education program, **Project Learning Tree (PLT)**, enters cyberspace with a new Web site (www.plt.org) designed to help educators and students share information easily on the World Wide Web. The new Web site is designed to help the more than 500,000 educators trained in PLT's PreK-12 curriculum in all 50 states and several other countries. It also encourages educators with up-to-the-minute information on PLT sponsored events, conferences, workshops and environmental education news.

HISTORY OF CHEMISTRY WEB SITES

This Week in Chemical History

This page in ChemCenter, the Web site of the ACS, features "This Week in Chemical History," a day-by-day list of milestones and anniversaries from recent to alchemical history.
http://www.chemcenter.org/history.html

The Catalyst

The Catalyst lists Web resources on the history of chemistry for high school teachers, including lesson plans written by teachers.
http://home.fuse.net/thecatalyst/m04histr.html

The Mining Company

The Historical Aspects section of the Mining Company's Web site has information on Arnold Beckman, the history of chemical engineering, Nobel Prize winners in chemistry, historical figures in radioactivity, and more.
http://chemistry.tqn.com/msub13.html

Angelfire, a web-based service, gives you a free, permanent, private e-mail account. With Angelfire, you can access your e-mail from any location, or check your mail from more than one computer. With this service, you don't need to own a computer; all you need is a web connection, and Angelfire will store all of your e-mail for future reference. You can also send web pages or gifs, block unwanted e-mail, and configure your account to access several e-mail addresses. For more information about Angelfire, visit
http://email.angelfire.com/freemail/About.html

With KOZ, Inc.'s SchoolLife program, you can put your school on the Internet. KOZ has prepared a complete guide for using its system and provides planning materials on how to implement an interactive website for your school. For more information, visit http://www.schoollife.net

KOZ is also a corporate sponsor of the highly successful Global Schoolhouse Network (GSN). For more than 15 years, the Global Schoolhouse has offered programs for teachers that showcase emerging technologies. GSN's Internet-based learning activities include projects for beginners and advanced users; the use of e-mail, the web, online multimedia, and video-conferencing projects that start and end at different times throughout the school year; and activities for all ages and grade levels. For more information on the Global Schoolhouse Network, visit http://www.gsn.org

GIVE STUDENTS ACCESS TO SCIENTISTS & ENGINEERS VIA THE INTERNET

A new web site, entitled "Write to a Scientist or Engineer," is available for use by students from kindergarten through graduate school. It is intended to generate new interest in science and the technologies and provide students personal access to working and teaching professionals. Triangle Coalition member, Georgia Youth Science & Technology Centers, Inc. (GYSTC), host of the site, has set up a network of participating scientists and engineers to answer student questions, including professionals from Lockheed Martin Aeronautical Systems Company, NASA, Southern Polytechnic State University and a regional Georgia Youth Science & Technology Center.

For more information contact Jim Thompson, President & CEO, Georgia Youth Science & Technology Centers, Inc. at 770-528-4978 or via e-mail to jthompso@spsu.edu. Or visit www.spsu.edu/gystc

VIRTUALLY VOLCANIC...

The World Wide Web offers a mountain of information about volcanoes, natural disasters and measures that can be taken in meeting them. In most cases, links throughout the site will guide you back to the site's main screen. You'll want to be sure your students find some or all of the following resources:

• Smithsonian Institution's site on Popocatépetl has extensive reports about the volcano's activity. www.nmnh.si.edu/gvp/volcano/region14/mexico/popo/gvnb.htm#top

• The U.S. Geological Survey Cascades Volcano Observatory site covers Popocatépetl <vulcan.wr.usgs.gov/Volcanoes/Mexico/Popocatepetl/framework.html> and other volcanoes. The overall site includes a glossary of volcanic terms; suggestions for responding to hazards and FAQs on related topics most easily accessed from the main screen, at vulcan.wr.usgs.gov; and extensive links to resources on volcanoes and other Earth science subjects.

• The University of North Dakota's extensive volcano site (volcano.und.edu) includes a glossary; scientists' answers to questions about volcanoes and the opportunity for students to ask volcanologists additional questions; and links to other resources. See the screen on El Popo and summaries of recent volcanic activity with links to news reports: volcano.und.edu/vwdocs/volc_images/north_america/mexico/popocatepetl.html volcano.und.nodak.edu/vwdocs/current_volcs/popo/mar5popo.html

• Michigan Technological University's volcano site includes information on Popocatépetl and other volcanoes, a list of active volcanoes by geographic region, and other topics and links.
www.geo.mtu.edu/volcanoes

• The following areas describe different types of volcanoes:
pubs.usgs.gov/gip/volc/types.html
volcano.und.edu/vwdocs/vwlessons/volcano_types
windows.ivv.nasa.gov/earth/interior/volcanos_general.html

RBS OFFERS NSF CURRICULUM PROGRAMS

The homepage of Research for Better Schools (RBS), a division of the Mid-Atlantic Eisenhower Consortium, now features a number of NSF K-12 science and math programs that were highlighted in a July 1998 showcase conference. The new online directory features a summary description of each of the curriculum programs presented at the conference, along with information on the NSF implementation program.

The following science curriculum programs appear on the site: Active Physics, grades 9-12; Biology: A Community Context, grades 9-10; BSCS Biology: A Human Approach, grades 9-12; BSCS Biology: An Ecological Approach, grades 9-12; Chemistry in the Community, grades 9-12; ChemQuest, high school; Comprehensive Conceptual Curriculum for Physics (C3P), grades 9-12; and Developmental Approaches in Science, Health, and Technology (DASH), grades K-6.

Also featured on the site are Event-Based Science, grades 6-8; Foundational Approaches in Science Teaching (FAST), grades 6-8; Foundations and Challenges to Encourage Technology-based Science (FACETS), grades 6-8; Full Option Science System (FOSS), grades K-6; Genetics: Fundamentals and Frontiers and Bioethics Forums, high school/college; Geoscience Education Through Interactive Technology (GETIT), grades 7-10; Insights, grades K-6; Insights in Biology, grades 9-10; Issues, Evidence, and You (IEY), grades 8-9; Life Lab Science, grades K-5; Middle School Science and Technology, grades 6-8; Minds On Physics (MOP), grades 11-12; Prime Science, grades 9-10; Science 2000, grades 5-8; Science and Technology for Children, grades 1-6; and Science for Life and Living: Integrating Science, Technology, and Health, grades K-6. For more information, see the RBS site at http://www.rbs.org.

American Society of Plant Physiologists

This valuable resource for educators, students, scientists includes a list of volunteer scientists available to work with educators around the country!
http://aspp.org

GETTING GLOBAL WITH TECHNOLOGY

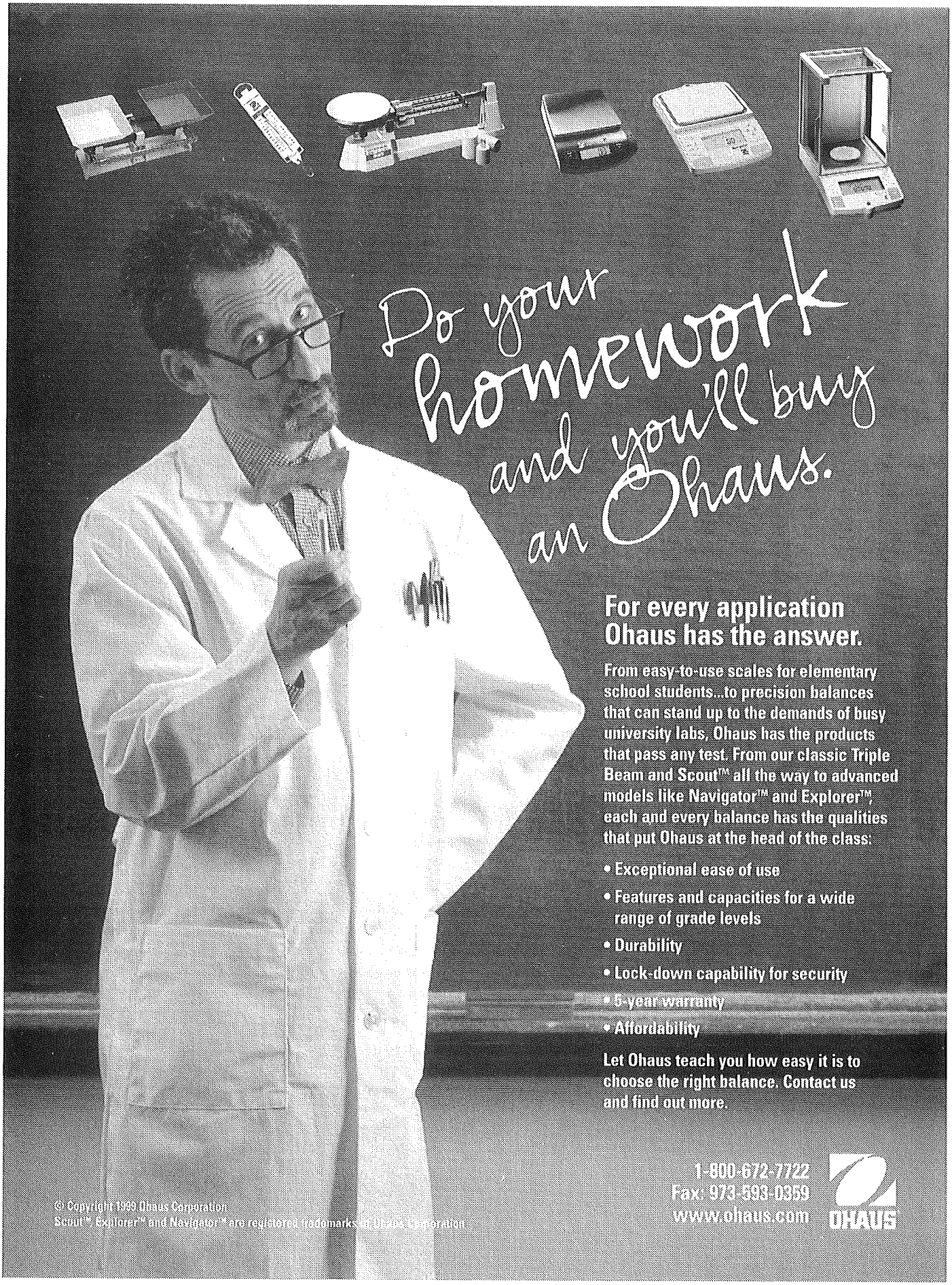
As more classrooms gain access to the World Wide Web, teachers and students are discovering approaches to global education that are almost as dynamic as exploring the world in person. Among Web options for global studies, one especially appealing site is *GlobaLearn*. In this ongoing and free project, students interact with live remote expedition teams around the world in activities that develop the skills, awareness, and determination to become responsible stewards of Earth.
GlobaLearn founder Murat Armbruster conceived the idea for this site while teaching history to juvenile offenders at a lock-up facility outside Detroit, Mich. No sooner had Murat begun working with the children, than he found that they had little understanding of the world beyond their own neighborhoods, and therefore had little reason to be interested in history.
With the determination to make the world relevant to children, Murat chose the Web as a vehicle for transporting children around the globe. In this interactive, multimedia platform, *GlobaLearn* enables students to make dynamic comparisons between their lives and the lives of others in different countries. As children exchange ideas with individuals in faraway places, they gain a sense of global citizenship.
GlobaLearn can be viewed by anyone with access to the Web. The address is
http://www.globalearn.org/

EPA OFFERS WEB SITES FOR TEACHERS AND STUDENTS

The U.S. Environmental Protection Agency (EPA) has unveiled the following new on-line resources for educators and students:

The Environmental Education Center Teachers' Web site — www.epa.gov/teachers — features guidance for writing government grants, offers links to community-service project ideas, provides plans for classroom curricula, and highlights scholarship and award opportunities, among many other paperless tools for schools. The teachers' site also provides direct links to the EPA Library and other environmental Web sites.

The Students' Web site — www.epa.gov/students — allows student to interactively: board EPA's research vessel Lake Guardian, test the fresh water of the Great Lakes; step into the shoes of "Inspector EPA," find sources of pollution in your own neighborhood; or get the latest information on environmental fellowships, internships and mentoring programs.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ARTICLES

Museum Partners Science Program
A unique collaboration among

Aurora University
Chicago Cultural Institutions
Chicago Public Schools
Illinois State Board of Education

Background

In 1994, the Chicago USI, hereafter called the Chicago Systemic Initiative (CSI), was the catalyst for the formation of the Chicago Museum Partners, a collective of cultural institutions in the greater metropolitan area of Chicago. The Museum Partners welcome all agencies of informal instruction to join in a unique relationship which is not limited to the City of Chicago nor to what is typically thought of as a museum. Included in the partnership are agencies as far away from Chicago as 50 miles - such as SciTech in Aurora, JFK Health World, and the Stillman Nature Center in Barrington.

The partnership has as members a nature center, a botanic garden, zoos, conservatories, and an exhibit in a college of podiatry, in addition to the nationally well-known powerhouses such as the Adler Planetarium, Shedd Aquarium, Field Museum, and Museum of Science and Industry. The Art Institute of Chicago and the Chicago Historical Society have also joined in this unique enterprise of training science teachers.

Each of these institutions has the expressed desire to work with Chicago teachers and their students to broaden their cultural heritage while increasing their knowledge base in science, mathematics, and technology.

Program Goals

- Enable teachers to improve instructional practices through the provision of enriching tools and resources that actively engage their students and increase learning in the areas of mathematics, science, and technology while crossing traditional academic lines and incorporating interdisciplinary concepts.
- Increase content knowledge and pedagogical skills of teachers.
- Improve abilities to use accepted practices of science, and promote logical thinking, effective communication and teamwork.
- Provide activities and methods for classroom instruction that have real-world connections and applications.
- Promote an understanding of science and technology and their relation to societal issues.
- Provide academic credit and opportunities for professional development and possible certification and/or endorsement.
- Demonstrate how science, mathematics, and technology can be learned effectively in a non-threatening environment that can be translated into effective and creative classroom practice.
- Make real the vision of Chicago Public Schools Curriculum and Instruction Department that science is taught to every student in every school every day.

Strategies for Implementation

Teachers may earn a total of 9 semester hours of graduate credit from Aurora University in the following courses: Life Science for Teachers, Physical Science for Teachers, and Earth and Space Science for Teachers. Each course requires participation in 6 program sessions lasting 6.5 hours each and held on Saturdays. All classes are held at one of the agencies in the Museum Partners consortium. The program participants rarely, if ever, meet in a regular university classroom setting.

While the courses have traditional titles, the development of course work is around the "big ideas" of science - form and function; change and constancy; systems; and models and explanations. Aurora University has accepted the course syllabus, which was developed for these courses and wholeheartedly endorses the content and process delivered in the course.

The creativity of the museum staff in offering non-traditional lessons is evident by some of the titles: The Art Institute of Chicago offered a class in light and color and used art to illustrate the science of optics. The Chicago Historical Society did a session on the physics and geology of the Illinois and Michigan Canal (one of the significant engineering feats that allowed for growth of Chicago). At the Lincoln Park Zoo teachers not only talked about endangered species, but also they observed their behaviors and habitats. At the Field Museum of Natural History geologic time, dinosaurs, fossils, and paleontology were made real by working with curators and fossil hunters.

The courses are coordinated and supervised by an adjunct instructor from Aurora University whose role is to monitor for high-quality instruction which is aligned to the National Science Education Standards, the Illinois Academic Standards, and most of all the Chicago Academic Standards and Curriculum Frameworks. Museum educators, docents, curators, scientists, and program coordinators at the various institutions conduct all sessions under the supervision of the Aurora University adjunct instructor. Under the supervision of the adjunct instructor and the Manager of Science for the Chicago Public Schools, each of the representatives of the agencies plans the program for the year, deciding collaboratively when and where to schedule the three classes in life, physical, and earth and space sciences. Using course syllabi approved by Aurora University, content is covered in unique ways using the strengths of the program staff of each of the institutions and the exhibits that are unique to their institution. The course syllabi are reviewed and approved by the university Science Department which screens proposals for 1) academic rigor commensurate with graduate level work; 2) emphasis on content; 3) course evaluation is tied to content; and 4) appropriate classroom applications.

Aurora University plays an important role in this collaborative because it has provided to the Chicago Public Schools, through its extension program, the opportunity for teachers to earn graduate credit at a very reasonable cost. The university provides adjunct instructor status to the Program Coordinator who is on staff at the Chicago Botanic Garden, from where the grant from the Illinois State Board of Education is administered.

The University charges $50 per credit hour. Thus, a teacher taking all three courses would be able to earn nine credit hours for $450. Nine hours of university credit (on campus) would cost $3,672. That is 8 times the off-campus tuition. The Chicago Systemic Initiative has provided a tuition reimbursement of 50% and encourages the teachers to seek further support from local school Eisenhower and staff development funds at their school.

Cost share of the program for Cohort 4 (1998-99 School Year) breaks down as follows:

- The ISBE is supplying approximately $88,000 for administrative and museum staff costs; Web site development and maintenance; travel; program evaluation, supplies and printing.
- Teachers contribute $5,625 for 50% of the cost of tuition.
- Chicago Systemic Initiative is providing $20,000 in tuition reimbursements, materials, and in-kind support.
- Museum Partners are providing approximately $28,000 in in-kind support for the program. This includes staff, use of facilities, and instructional and other print materials.
- CPS provides in-kind staff support, curriculum publications, and other instructional materials to program participants.
- Aurora University provides tuition reductions equivalent to $80,550 from their regular tuition, which is $408 per credit hour.

The table on page 14 lists partners in the project that have contributed to this staff development effort and/or have contributed support in this collaboration.

Lessons Learned

Participants saw the Museum Partners Program as an opportunity for personal growth, and as a way of learning better methods for teaching science. Teachers became much more comfortable in working with mathematics and science concepts, and in helping children to participate in high-quality math and science activities which they gathered in great quantity at every class session that they attended. The experience also offered a way for teachers to overcome their fear of teaching science. They were exposed to a number of different ways of approaching a problem, and were comfortable in helping students participate in critical thinking and problem solving activities.

The teachers appreciated the fact that they were learning through using actual materials that they could eventually use with their students. They felt that the museums' materials were of high quality and easily adaptable to a number of teaching conditions and grades. They felt that the hands-on experience at the museums demystified the content found in more traditional resources such as textbooks. Those who were not content savvy gained confidence in their ability to wade through difficult material once they had the hands-on experience. They were able to experience the Aah! and the Eureka! that we want students to have. Further, they got to know the museum educators and scientists whose names and phone numbers have now become entries in their personal resource bank.

The Museum Partners Program taught teachers about the vast resources that exist in the museums in the Chicagoland area and how these resources might be employed in classroom instruction in addition to the logistics of taking a field trip. Teachers felt that they need to be able to take more field trips and that the program should expand in both scope and depth. Our graduates are constantly calling for "Part IV' They know that we have not exhausted all of the resources of the museums and want to come back for more.

CSI Museum Partners

Participating Institutions	Institutions Providing Training and/or Support to the Museum Partners Science Program			
	Cohort 1 1995/96	Cohort 2 1996/97	Cohort 3 1997/98	Cohort 4 1998/99
Adler Planetarium	x	x	x	x
Argonne National Laboratory	x	x	x	x
Art Institute			x	x
Barat College		x		
Brookfield Zoo	x	x	x	x
Chicago Academy of Sciences	x	x	x	x
Chicago Botanic Garden	x	x	x	x
Chicago Children's Museum	x	x	x	x
Chicago Historical Society			x	x
Cook County Forest Preserve District				
DuSable Museum of African American History				
Fermilab		x	x	x
Field Museum	x	x	x	x
Garfield Park Conservatory		x	x	x
International Museum of Surgical Science		x		
JFK Health World			x	x
Kohl Children's Museum				
Lincoln Park Zoo	x	x	x	x
Museum of Science & Industry	x	x	x	x
Scholl College "Feet First" Exhibit			x	x
SciTech	x	x	x	x
Shedd Aquarium		x	x	x
Stillman Nature Center			x	x
Teachers Academy for Math & Science			x	x
Total Participating Institutions in MPSP	10	15	19	19

Because of the enthusiasm generated by this program, many teachers have decided to return to school not only to finish their endorsement requirements, but also to complete a master's degree program in science education. Many have become staff developers at their respective schools, taking on the role of teacher/leader in science in their local school community.

The program was highly rated in all formative and summative evaluations, on paper as well as in focus groups conducted by the CSI external evaluator. The external evaluator for the CSI undertook a detailed study of the first two cohorts and conducted a focus group of past participants to gather evidence for the ISBE to fund this program. The opportunity for personal, professional, and intellectual development was valued and held long-term interest for most participants. It was apparent that the participants made tremendous strides in improving their approaches to teaching science and were very vocal advocates for the program at the focus group and at other occasions. Networking among the participants has always been advocated and we have found them having "reunions" of their cohort. We have found them buying whole tables at the annual science dinner so that they can see one another and share experiences. This program has truly caused these teachers to "bond' and form a "community of learners."

The program was originally delivered under the auspices of National-Louis University. While feeling very strong about maintaining the program there, they were unable to bring the cost of tuition down to a level that the CSI could afford. Thus, the change was made to Aurora University where the relationship has been a strong one. So strong in fact, that the Chicago Public Schools are now a Collaborating Academic Partner with Aurora University. Two staff members, one in science and one in mathematics now have adjunct instructor status and are able to offer coursework, for credit through the university for the Chicago Public Schools teachers.

Enrollment in CSI/MPSP Programs by Year

	Cohort 1 1995 – 1996			Cohort 2 1996 - 1997			Cohort 3 1997 - 1998			Cohort 4 1998/99		
	Phys	Earth	Life	Phys	Earth	Life	Phys	Earth	Life	Phys	Earth	Life
	27	27	27	13	13	13	26	25	25	25	25	25
Schools	25			12			35			53		
Teachers	27			13			43			75		

Implications for Change

Because of the high demand for these courses, it appears obvious that we have to expand the capability of the museums to handle requests for staff development from external agencies such as CSI. This of course requires additional resources. It is the intention of the Museum Partners to continue to seek funding from the ISBE and to investigate potential resources from the National Science Foundation.

Additionally, we have received many inquiries from teachers in the lower grades, K-4, who would like a program developed after this model for them. High school teachers have also made such a request. It is highly likely that the CSI/Museum Partners Program will continue to grow, add new partners, and expand the program so that it has impact on K-12 teachers in the CPS.

With current funding from the ISBE, three other cities in Illinois, Rockford, Peoria, and Springfield, will be contacted. They will determine whether they wish to see how the Museum Partners Science Program model can be used effectively by them, and how the institutions of informal science education in their geographical area of the state can be more effectively utilized for teacher training.

This year a field trip component is offered to the teachers who respond to a brief RFP. Their proposal will have to align with the Chicago Academic Standards and incorporate some of the activities that the teachers received as part of the program.

For the first time this year, a technology component will be available. This was established in response to program evaluations. The teachers want to learn how to use the Internet and have access to its vast resources. A Web site will be constructed, and teachers will be able to post lessons and notices to their colleagues. The museum program participants currently have their own bulletin board under the auspices of CSI. Every teacher will receive a copy of DOE publication *Internet Activities Using Scientific Data* and will be encouraged to help their students do data analysis for authentic research of real scientists.

Another new component this year is 'Job-shadowing." The teachers will be required to work closely -with a museum scientist to learn how he/she goes about the work that they do. Not only does this provide an opportunity for the teachers to see the science enterprise first hand; it will allow them to get a sense of what a science career is all about.

Our sense is that we have developed a valuable model for teacher training which can be modified in a number of ways to adapt to the local condition, is non-threatening, and is enjoying high praise from the participants and positive feedback from participating museums and funding agencies. The demand for this coursework is so high that we maintain quite an extensive "waiting list," and we even have teachers from parochial and private schools calling for admission into the training program.

Initially, the MPSP was exclusively funded by the CSI. As we have progressed through three cohorts, we have been able to reduce the cost to CSI and transfer costs to a substantial grant from the Illinois Scientific Literacy Fund. Our proposal was rated 94 out of 100 points and was funded during its first submission. It is the intention of the CS1 Museum Partners to wean the program from CSI funding and to seek support from other agencies that traditionally contribute to teacher training and museum programs.

In order to let the public know of this wonderful program, we are planning to do videotaping of some of the sessions and to broadcast a feature on Chicago Cable Access Television. We hope to capture some classroom instruction to show the enthusiasm that has passed from museum educator to teacher to student.

Our work with teachers in elementary school has confirmed our suspicions that most pre-service teachers seeking general education certificates are under-prepared to teach science. As an aside to this program, CSI has begun to work with the universities within a 100-mile radius that supply novice teachers to our system. All have agreed to work on informing their pre-service teaching candidates in elementary and high school methods of the Chicago Academic Standards and have invited our staff to visit their classes. After a first meeting, it was evident that they wholeheartedly support such collaboration and had been waiting for someone to invite them to the table.

Audrey Champagne once said at an ISTA meeting that "we have the socially reprehensible practice of testing children on material they have not had an opportunity to learn." It is our goal to correct that practice by giving every student high-quality science instruction daily that is delivered by well-trained teachers who have a strong grasp of content and who have developed the pedagogical skills necessary to make our vision real. One teacher remarked that "MSPS is the best educational program that I have ever experienced. It provides teachers with a wealth of current information that is presented by highly qualified and enthusiastic instructors, who instill confidence in the teachers participating in the program."

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WHY YOU SHOULD KEEP ON TEACHING HANDS-ON SCIENCE

It could be that I'm preaching to the choir by extolling the virtues of hands-on science in *Spectrum*, but I've observed a rather disheartening trend the past few years among certain of our colleagues. I hear teachers saying: "I know that a discovery approach works, but it takes too much time and I have to get these kids ready for the state test." Years of research concerning developmentally appropriate and best practices are being ignored for the sake of test scores.

This attitude is especially dismaying since we live in a time when science and technology have never been more important. It is estimated that 80% of the problems our students will face come directly from humanity's use and abuse of science. A 1980 Federal Government report predicted that by the year 2000: overpopulation in the third world, starvation in certain areas, depletion of certain natural resources, desertification, global warming, and extinction of certain flora and fauna (The Global 2000 Report to the President, 1980). Well, it's almost the millennium; how correct were the predictions?

Unfortunately, above predictions aside, there is evidence that many in our society are turning away from science and consequently lack the skills needed to be intelligent users of science. If we are to solve the problems that our society faces, we must educate in ways which establish not only scientific literacy, but also in ways that allow people to enjoy science, believe in it, and value it in their lives. Cramming for a criterion reference test will not bring about the above attributes.

The Illinois assessment program is being used as yet another excuse for teachers, especially elementary teachers, not to teach hands-on science. The lack of time for science in the elementary school has been a concern for many years. Manning et al. (1981) reported that 25% of teachers polled spent no time at all teaching science, and the remaining 75% spent less than two hours a week on science.

Since young children formulate their attitudes at an early age, elementary science education is vital in developing positive feelings toward science (Estes, 1990). Stuffing discrete bits of knowledge into young minds, I feel, will not develop positive attitudes.

Science taught in an active, discovery approach will develop in children: inquiry and problem solving skills, critical and creative thinking skills, a body of knowledge, an ability to make more intelligent decisions about society, a better understanding and appreciation of the planet, knowledge for future careers, and a set of values and ethics based of the scientific method. All of these attributes must be experienced if they are to be attained. They can not be read about. And, I don't think most of them can be assessed by filling in the bubbles on an answer sheet.

Assessment is vital. It tells us if boys and girls have attained a certain level of mastery. The type of assessment must match the type of skills imparted by the curriculum. The curriculum shc .ve the assessment, not the reverse. The present Illinois ment instrument, in the minds of certain teachers, is determining not only curricular content but also instructional methodology.

Paper and pencil instruments, such as the state test, assess content very well but not processes or usage. It is no wonder, then, why teachers who are concerned about scores, are shunning hands-on, discovery teaching even though an extensive body of research has determined that it is the optimal way to teach science. Optimal, not only for acquisition of processes and application but also for product, the factual content that is so worrisome to Illinois teachers. Preoperational and concrete children must experience, must do, if they are to understand and remember.

Research aside, the main reasons why we should teach hands-on is that it provides motivation and is fun. Science is no longer the daunting memorization of facts but something to be enjoyed and appreciated. Also, it fits the way young children think. It answers their questions, the ones the kids think are important. Evelyn Smith said it most eloquently this way:

When you ask...
Why are babies born so small?
Where are their teeth, and hair and all?
What makes them want to suck their thumb?
Why can't they walk, and jump and run?
That's Science.
When you say...
How come John's the oldest brother,
And do I always have to be the other?
Will he always be the tallest?
Will I grow up as the smallest?
That's Science.
When you wonder...
Why are robin's eggs so blue?
Do people lay eggs as they do?
If birds can fly and people can't
Why can't a dog, or cat, or ant?
That's Science.
When you want to know...
Can apples grow on maple trees?
Are you sure milk is good for me?
Are two and two always four?
Does every room have a door?
That's Science.
When you see...
That flowers don't grow when it snows.
That all kites need a wind that blows.
Some birds are red, some blue, some brown.
And, a wheel, to roll, must be round.
That's Science.
All the things you want to know,
About yourself and how you grow,
About the world in which you live,
What you think, and find, and give.
THAT'S SCIENCE

REFERENCES

Estes, Yvonne Baron, (May, 1990). Breakout--Catch A Wave In Science. *Phi Delta Kappan*, 686-691.

Manning, P.C., Esler, W.K., & Baird, J.R. (1981). How Much Science Is Really Being Taught? *Science and Children*, 19, 40-41.

Smith, Evelyn. (Date Unknown). *An Operational Definition of Science.*

Major Findings and Conclusions. *The Global 2000 Report to the President: Entering the 21st Century*, vol. I, Washington, D.C. G.P.O., 1980.

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THE IDEAS WE LEAVE BEHIND

This past summer, my family and I vacationed at Niagara Falls and Toronto. Part of our sightseeing included visits to two authentic forts from the past. Fort Erie and Fort York. Both of these forts experienced battles during the War of 1812.

As a result of visiting the forts, I learned that prior to the outbreak of that war, a British officer came up with a very novel and lethal idea, the effects of which are still being felt today. His thought was to pack an artillery shell with musket balls and when the shell would burst, the balls would scatter with deadly force in all directions.

The creative British artillery officer, I discovered, was a certain Lieutenant Henry Shrapnel. Thus began the shrapnel bomb.

This story intrigued me because I had always thought of shrapnel as merely the word in the dictionary referring to antipersonnel shell fragments. Now I discovered that Shrapnel was also the name of the man who invented the idea and gave that idea "life". It seemed as though time had forgotten Shrapnel the man, and chosen only to remember the lethal "shrapnel-idea" he left behind.

As I thought about what amounted to my new discovery (perhaps others are aware of it), I began to think about the journey of an idea. *I began to think about the responsibility we all have for the ideas we leave behind.*

The journey of the shrapnel-idea, or shrapnel bomb, is worth noting. Designed originally for the love of country, the shrapnel-idea, unfortunately, has snowballed and been used by various people in ways that Henry Shrapnel could never have imagined. Employed in numerous wars and conflicts for almost two hundred years, a present-day shrapnel bomb list might include the typical fragmentation bomb (designed for destroying enemy troops and light equipment), the cluster bomb (containing hundreds of small bombs designed for the same purpose), and the terrorist bomb (packed with nails and intended for civilians).

Regardless of his intentions, Henry Shrapnel must bear much of the responsibility for those victims who have died as a result of his shrapnel-idea. We are responsible for the ideas we leave behind.

The fact that over the course of time, the Shrapnel name has managed to transform itself into the dictionary word, shrapnel, provides a revealing model. Over the last two centuries, it has often been reported that an unlucky victim was killed by shrapnel. To my way of thinking, the victim was not only killed by shrapnel, but by the shrapnel-idea, and therefore, at least indirectly, by Shrapnel himself. One could say that *to be killed by shrapnel is to be killed by Shrapnel.*

It might be asked: How is this relevant for those individuals who are seeking to better the world? The answer is that we should think about those ideas that we are most attached to as having a life and an energy of their own. The good news is that what holds true for destructive thinking also holds true for the creative unified thinking that moves humanity forwards rather than backwards. The ideas that we give life to are our seeds. It is up to us to direct our creativity in a positive direction, so that long after we have left this world, the ideas we leave behind can still be working for the good.

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ENGINEERING CHANGE IN THE EDUCATION SYSTEM

Blueprints for Reform

Since its publication in May 1998, *Blueprints for Reform* has received high praise from educators nation-wide, and indications are that the book is becoming a "must have" for anyone interested in improving science, mathematics, and technology education.

Blueprints presents summaries of a dozen papers prepared by experts on aspects of the education system that must change to make Project 2061's vision of science literacy for all students a reality. *Blueprints* also poses questions that are designed to stimulate dialogue about the issues raised in those papers.

"It's a valuable resource for anyone working in science education reform," says Dr. Carlo Parravano, director of the Merck Institute for Science Education in Rahway, New Jersey.

The Merck Institute is working on systemic reform in four school districts by providing professional development for K-8 teachers and seeking to improve curriculum implementation and assessment. Dr. Parravano says he is frequently approached for background information on a specific area of science education reform, and he enthusiastically recommends *Blueprints*. "There are very few places to go for this kind of information," he reports. *Blueprints* is "up to date and has an extensive bibliography," he adds.

William McDiarmid, director of the Institute for Social and Economic Research at the University of Alaska, feels the book embodies the fundamentals of education reform.

"As I work with various groups around the country, I find that *Blueprints for Reform* provides the basic principles that state departments of education, foundations, and others can build on," McDiarmid said. "It lays out a reasonable set of goals and gives strategies for reaching those goals."

Cary Sneider, vice president for programs at the Museum of Science in Boston, is especially impressed with the graphics in *Blueprints*. "I like the data," Sneider declares. "Throughout the book the graphs are full of useful information, and they are nicely organized and displayed."

Information in Demand

Educators across the country are evidently eager for the kinds of information *Blueprints* provides. Oxford University Press reports that 2,300 pre-publication copies were sold, and sales to date have topped 3,200 and are steadily climbing. *Blueprints* has also generated considerable interest at recent educators' meetings, such as the National Science Teachers Association regional conferences.

Exactly what is it about *Blueprints* that has created this demand? Part of the answer is that *Blueprints* brings a great deal of clarity to the complexity that often characterizes the education system. Many science teachers are especially pleased that so many important topics have been addressed so thoroughly and in one document. *Blueprints* sheds light on individual parts of the system and shows how those parts fit together. Each chapter serves as a primer on a key component of the K-12 education system but also deals with more advanced topics that are routinely overlooked.

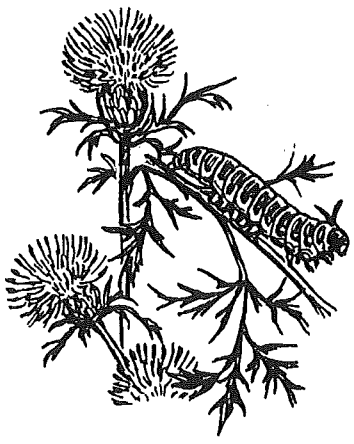
Another reason *Blueprints* is being so well received may be the manner in which the book was put together. Only after extensive consultation with educators, scientists, and policymakers did Project 2061 choose the twelve key components of the education system that are addressed in *Blueprints*. It then consulted still more experts to describe these components as well as how they interact with one another. During an extensive review process, additional educators and specialists participated in three focus groups where they provided feedback on each *Blueprints* chapter. The combined knowledge of hundreds of experts in education, science, mathematics, and technology went into the creation of the publication.

Continuing the Dialogue

Project 2061 encourages educators not simply to read *Blueprints* but to become active participants in the work it promotes. To spark thoughtful debate that will further education reform, readers are encouraged to respond to survey questions about *Blueprints* topics on Project 2061's Web site at: **http://project2061.aaas.org**

Readers are also invited to help expand *Blueprint's* resources and bibliographies by emailing information on relevant programs, projects, reports, and research studies to: ***blueprints*@aaas.org**

Blueprints for Reform: Science, Mathematics, and Technology Education is available on-line at:
http://project2061.aaas.org
or from Oxford University Press.
For ordering information call 1-800-451-7556.



Tom Thompson
Philomath High School
Adapted from *TOST*

TEACHING SCIENTIFIC INQUIRY: A NINE WEEK UNIT

Introduction

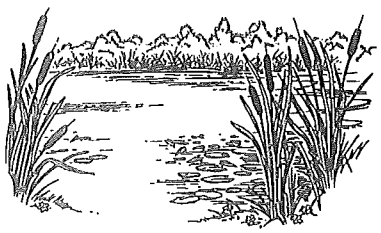
Instruction in scientific inquiry should be an important part of any science program. The importance of scientific inquiry is recognized in national and state standards documents. The National Science Education Standards even states that "inquiry is the foundation for the development of understandings and abilities of the other content standards."[1] Unfortunately, this important content is often relegated to a few simple lessons on "The Scientific Method" or an occasional open-ended inquiry lab. Science teachers at Philomath High School have recognized this deficiency and have developed a nine week instructional unit on scientific inquiry. The unit has been in development for the last three years. The purpose of this article is to share our method of teaching inquiry from my own perspective since each of us actually puts our own twist on the unit.

Early on in the development of this unit we decided that a topic as important as scientific inquiry needed concentrated and thorough treatment. We loosely adopted a method of teaching inquiry described in a book called *Students and Research: Practical Strategies for Science Classrooms and Competitions*.[2] The basic principles behind the unit are to provide a series of investigations that stimulate student interest, reflect different methods of investigation and provide opportunities to integrate basic skills of inquiry.

Activities

The unit begins with an ecological study. Freshmen grab insect nets and head out to a nearby field. Half of the field has been mown and half is left unmown. Students are instructed to collect insects and record observations in both areas for further study in class. When we return to class they practice careful observation by describing and grouping the insects using the observations.

The next step is to develop questions. How does the size of insects differ in the tall and short grass? How does the diversity of insects differ? There are numerous questions that they can choose from. Each class chooses a question and then begins the task of designing an investigation that might answer that question. Groups of students then head back to the field, collect more insects, analyze the data, draw conclusions and report on the findings in writing.



I find that this investigation is an excellent beginning. Usually the weather cooperates and my students want to be outside anyway. Most of my students have some familiarity with insects so they can propose reasonable questions and hypotheses. They are able to identify numerous variables that may affect the results of their investigation. Finally, the investigation provides plenty of data to manipulate and graph.

Each of the investigations that follow the ecological study are chosen to expose students to different methods of scientific inquiry and different data gathering tools. A simple bacterial study using agar plates and sterile swabs allows students to manipulate variables a little and to produce an actual control. It also produces data that is somewhat difficult to quantify. An investigation of the temperature of the reaction between zinc and copper sulfate or the period of a pendulum allow much tighter control of constants and a chance to use line graphs with the concept of best fit. Comparing brands of paper towels gives them a chance to come up with their own question and to have students in another class replicate their data. A behavioral study has students observing others while trying to find ways to effectively record and report data that may be difficult to quantify. Finally I have students develop and conduct surveys that give data that can be correlated.

Similarities

Although each activity mentioned was chosen for its unique issues, there are similarities that occur throughout.

Each investigation starts with a question. From the beginning I emphasize the importance of questions in science. In the beginning of the unit I narrow the scope of the questions so one student group isn't doing something completely different from another. This also gives an opportunity for me to model asking good quality questions. Later in the unit I encourage students to take a little more latitude in their questions.

Students have to identify variables that are important. I introduce the idea of independent variables, dependent variables and constants from the beginning. Once students have identified variables it seems to be easier to plan the investigation. One tool that I have used often is an experimental design diagram described in the book by Cothron, Giese and Rezba. The diagram helps my students organize their thoughts.

Investigations begin with a written plan. The experimental design diagram helps students create a plan. Their plans must be in writing and must include the variables they have identified and how much data they plan to collect. I usually don't require a detailed procedure since these often change as an investigation progresses.

Data gathering must always be organized. Some type of data table is essential to organized data. Before any data gathering begins, my students have to show me a well constructed data table. Early in the unit I provide them with a general format that works for most data gathering. Some of the investigations have different requirements for organizing data and we deal with those as they come up.

Data must be displayed in a way that emphasizes patterns. Most of my students have had extensive background in constructing graphs thanks to their middle school teachers. I usually focus on how to choose the right type of graph and how to produce that graph so that it demonstrates a pattern in the data. Not all the investigations have data that can be graphed. There are times with we have to talk about displaying data in other ways that still can emphasize patterns.

A written report that includes the question, method, data, analysis and conclusion is submitted by every student. I provide a standard lab report format starting with the first investigation. On each lab report I focus instruction on one part of the report. For example, during the paper towel investigation I focus on the materials and methods section so they can exchange methods with another class for replication.

I work with students to help them recognize the commonalities between each investigation. I also ask students to propose additional questions they have following each investigation. These additional questions are important. They help students recognize that science evolves. As we try to answer one question, more questions come up that lead to further investigation. The student questions also serve as a pool of ideas for their own independent investigations.

Scientific inquiry is a complex process. Students need to learn how to quantify data, organize data, graph data, identify variables, ask questions, make observations and draw conclusions. They also need to know how to communicate their findings. The skills are endless. One way to teach these is to teach each in isolation. I have chosen not to do this. Each activity is a complete inquiry. In each inquiry I may emphasize a particular skill such as how to create a proper data table, but I include all skills that are important to the investigation. I also provide separate practice such as writing a well organized conclusion or identifying variables. By the end of the unit students have been able to practice important inquiry skills in the context of complete investigations.

Assessment

The most difficult part of this unit is the assessment. Individual inquiry skills are not difficult to test. Given data on a test, students can demonstrate their ability to graph. Given a description of an investigation they can identify variables. However, inquiry is not just the ability to create graphs or identify variables. I do use tests to check skills, but the most important assessment is a final science project. Every student develops a question of personal interest and carries out their own investigation to help them answer that question. This can create major headaches for the teacher. However, the challenge is worth it since I can finally see what they can do on their own. I try to provide minimal assistance, but many students need help narrowing their question or identifying a valid method.

Conclusion

The most important thing I learned from teaching this unit is that high school freshmen are quite capable of conducting scientific inquiry: that a large number of my students could produce a work sample that would meet state standards. I have also found that developing a question is perhaps the hardest part of conducting an investigation. I have tried several strategies to help students develop questions that include modeling questions, brainstorming, and a systematic method suggested by Cothron, Giese and Rezba. It is clear to me that no single strategy works for all students or for all types of investigation.

Each year I find things that need to be modified. The report writing format I used this year helped students create better quality lab reports, but their conclusions seemed to be too shallow. Next year I will model writing conclusions using student work that I have saved this year. I have also realized that I need to provide more content background for each investigation so that my students can develop hypotheses when appropriate. This summer I will be searching for reading materials that provide that background.

I am convinced that the unit we have developed at our high school is a very successful way of teaching inquiry. By focusing on complete investigations in a nine week period we help students move from independent inquiry skills to a synthesis of those skills. The drawback to this way of teaching inquiry is that it takes a large block of time that many teachers may feel is not available to them. The advantage is that our students seem to retain their ability to conduct inquiry. A biology teacher at our school, who does not teach freshmen, commented that his sophomores are much more sophisticated in their understanding of scientific inquiry now that we teach this unit.

1. National Research Council (1996), 104. *National Science Education Standards.* Washington, DC: National Academy Press.

2. Cothron, Giese & Rezba (1993). *Students and Research: Practical Strategies for Science Classrooms and Competitions.* Dubuque, Iowa: Kendall/Hunt Publishing Company.

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INTRODUCING THE CONCEPTS OF LIGHT AND LASER THROUGH A GUIDED INQUIRY APPROACH FOR CONCEPTUAL CHANGE

Part III* Background Information

Visible Light:

Light is the portion of the electromagnetic spectrum that is visible to the human eye. It comes from tiny particles of matter called atoms— specifically, from tiny subatomic particles of the atom called electrons. Thus, basic understanding of the atom's structure and behavior is essential for understanding light and how it is made, and in turn for understanding the concept of laser light beams.

Most of the world around us is made up of matter, a substance that has mass and occupies space. In its common form (solid, liquid, or gas), matter is made of atoms. An atom is made of a central part called the nucleus, and tiny particles called electrons. The nucleus is made up of two subatomic particles, positively charged protons and uncharged neutrons, both of which always stay in the center of the atom, and make up by far most of the mass of an atom. Orbiting in three dimensions around the outside of the nucleus are the electrons, in orbits called "shells" or energy levels. These electrons are negatively charged and many times smaller in mass than either the proton or neutron. Furthermore, the negatively charged electrons which constantly spin around the nucleus are held in space by an electrical attraction to the positively charged protons. In a given atom however, the number of positively charged protons and negatively charged electrons is the same, and therefore, the overall charge of any single atom is zero or neutral.

Different atoms have different numbers of orbits or shells of energy (energy levels) around the nucleus. Each shell of energy can only hold up to a specific number of electrons. For example, using the formula $2(n)^2$, the first shell of energy (n=1) can hold up to two electrons, the second (n=2) up to eight electrons, the third (n=3) up to eighteen electrons, the fourth (n=4) up to thirty two electrons, and so on. The closest energy level to the atom's nucleus which contains the lowest number of electrons (up to two electrons), is the lowest energy level. Electrons that orbit the nucleus in the same energy levels contain the same amounts of energy, and the farther a shell of energy is from the nucleus, the more energy it contains, and more energy its electrons contain.

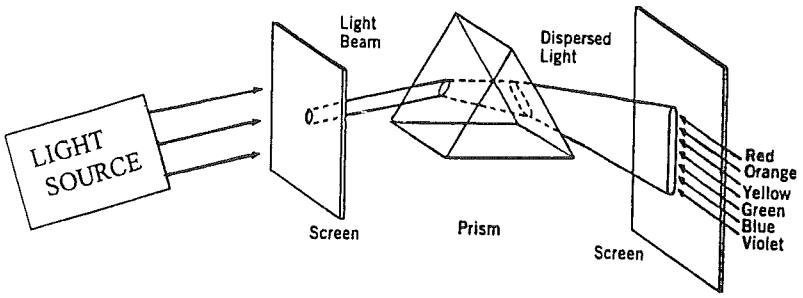


Fig. 2. White light beams which are made up of different wavelengths, travel through a prism of glass at different speeds, and emerge from the prism at different angles, thereby causing the white light beams to separate into a spectrum of seven colors (ranging from red to violet), each with a specific wavelength, frequency, and range of amplitude (intensity).

When electrons that are orbiting the nucleus of an atom are exposed to a form of radiation (heat or light), they absorb energy and become excited by this gained energy. These excited electrons can use the energy to jump from lower to higher shells of energy which are farther from the nucleus. For example, an excited electron may jump from the second to the fifth shell. When it uses up most of its extra energy in the jump, then it falls back to its original lower shell (the second energy level). It is important to know here that this atom is considered unstable when its electrons have been boosted from lower to higher energy shells. So, eventually, boosted electrons return to their low energy shells releasing the stored energy (energy they have absorbed), in a form of photons (packets of light energy). Light is made up of streams of photons. In other words, light is created from the jump, and subsequent fall, of electrons upon excitation and the concomitant energy release that coincides. This energy they release assumes the form of photons, which combine into beams of light *electromagnetic radiation* or waves (often visible light).

Since the atoms of different elements contain different amounts of energy, each kind of atom releases energy at a characteristic wavelength. Thus, when atoms of different elements are exposed to a form of radiation (heat or light), they emit different colors or wavelengths of light. This is simply because "each element is as individualistic as a fingerprint; it burns with a distinctive spectrum — lines of bright bands superimposed by dark lines, rather like a colorful bar code." (Shroyer, 1993, p. 13).

White light is made up of various colors of light, each with a specific wavelength and frequency, but all the electromagnetic waves travel from the sources of the light in straight lines and in all directions. In a vacuum, the speed of all electromagnetic waves is the same and is about 300 million meters per second, or what we call the speed of light. However, different electromagnetic waves of light travel at different speeds in different mediums, such as glass, water and air. For example, the white light beams which are made up of different wavelengths, travel through a prism of glass at different speeds, and emerge from the prism at different angles, thereby causing the white light beams to separate into various rainbow colors, each with a specific wavelength, frequency, and range of amplitude (intensity). Specifically, when a beam of light enters a glass prism, it is dispersed into a spectrum of colors (red, orange, yellow, green, blue, indigo, and violet). The component colors of the white light corresponding to different wavelength are refracted at slightly different angles, and thus they spread out into a spectrum of colors. Red light has the largest wavelength and the smallest index of refraction, and thus bends the least. Violet light, with the shortest wavelength, has the largest index of refraction and is bent the most. These wavelengths are expressed in units of nanometers.

In summary, ordinary white light consists of many different colors (each with a specific wavelength and frequency) mixed together, each going in various directions and interfering randomly with each other. Because light varies in wavelength, it appears as different colors to the human eye, from the larger wavelengths of red (at 0.7 microns, that is 0.7 millionth of a meter) to the shorter wavelengths of violet (at 0.4 microns). Red light's larger wavelength is met with a low frequency, whereas violet light, with its short wavelength, is known to have a high frequency. As a final note, ultraviolet energy is just outside the range of visibility, and has an even higher frequency (See Fig. 2).

Facing The Challenge:

Now, think of this scenario: ***What do you think will happen if an excited electron of a given atom is exposed to, or hit by, additional energy (heat or light) before the electron completely falls back down to its original orbit ?***

So far, we know that when an electron of a normal atom is exposed to a form of radiation (i.e., heat or light), this electron absorbs the energy and becomes excited. If this excited electron is not exposed to additional radiation (heat or light), then it falls back down to its original shell and emits the excess energy it has left as a photon of visible light. However, as Einstein proposed in 1919, if this excited electron is exposed to additional identical radiation (heat or light), then the excited electron will not gain additional energy. Instead, this electron may make a transition to a lower energy level and emit its extra energy as another photon. Thus two identical photons with the same frequency leave the atom in the same direction traveling in step with each other (in phase). If these two identical photons hit two more excited atoms, the process will be repeated, ending with four identical photons with the same frequency and phase that go off the atom in the same direction. The four identical photons will hit four more excited atoms, and eight identical photons (or packets of light energy) with the same frequency and phase will leave the atom in the same direction, traveling in step with each other. Then, the eight identical photons will hit eight more excited atoms and sixteen photons will be produced, and so on.

This process of accumulating the number of produced identical photons is called amplification by stimulated emission and is defined below:

> Notice that stimulated emission is an amplification process -one photon in, two out. Of course, this is not a case of getting something for nothing, since the atom must be initially excited, and energy is needed to boost an electron to a higher state. This excitation process is somewhat analogous to pumping water to a roof-top reservoir for later use. However, stimulated emission does provide a way to amplify light. (Wilson, 1994, p. 817)

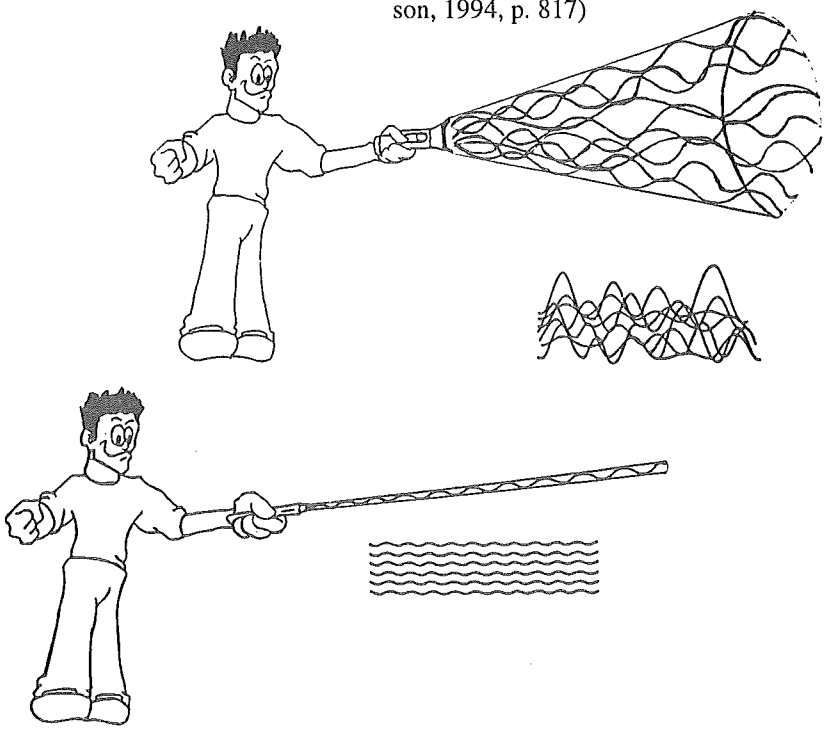


Fig. 3. Ordinary light, whether from the sun, a candle, or flashlight, is incoherent. It travels in many different directions and spreads to invisibility after going a short distance. This is simply because white light consists of a combination of wavelengths all traveling randomly. On the other hand, laser light consists of light of only one kind of wavelength and where all the crests and troughs of the waves of light travel together. So, a laser sends out a beam of coherent light in a straighter, turner line than any ordinary source of light.

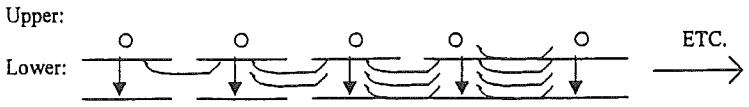
Here Comes The Laser Beam:

If, in a given element, there are more atoms in the excited state than in the ground state, then what occurs is a stimulated emission of photons rather than an absorption of photons; with this we have amplification. A laser uses this process to produce a huge number of identical photons. A laser is a device that uses a standard light source to excite electrons of the atoms of a given element to produce intense, narrow, monochromatic, and coherent beams of light by the process of stimulated emission. This means that laser beams are light waves that have identical wavelengths, frequency, amplitude (brightness or intensity), and a very small angle of divergence in comparison with the beam of ordinarily white light. See fi :gure -3.

The term "laser," stands for light amplification by stimulated emission of radiation— and much of what comprises a laser is suggested in the acronym itself. In fact, what can be said here is that laser action depends on emission by a stimulated process. To produce laser beams, we need a device that has a source of light and enables us to generate a condition in which we can have more atoms in the excited state than in the ground state, and more stimulated emission than absorption of photons. One kind of laser device consists of a tube containing gases, liquids or solids, and two mirrors, each placed at an end of the tube. One of these mirrors however, is only half-reflective of radiation. The element used in the tube "is chosen by the properties of laser light it produces. Different elements produce different wavelengths of light, [and different maximum powers or brightness.]" (Maton, 1993, p. 117).

The light source within the device produces energy that excites a great amount of electrons into an upper state. The photons that are released as the electrons fall to a lower state are reflected backwards and forwards with the two mirrors. As they move back and forth between the two mirrors, some photons will strike more and more atoms and keep producing millions of identical photons. Since one of these two mirrors is half-reflective (a partial mirror) not all the photons being emitted will be reflected and thus some will be trapped and a tiny bit of them will go through. As the beam becomes strong enough, a small percentage of the coherent light escapes in step with each other (phase) through this mirror, producing a laser beam of one kind of light (or monochromatic light). It is coherent because all of its light waves have the same wavelength and phase. It is monochromatic because it is one kind of colored light. It has the same frequency because the number of the waves passing a given point (say the partial mirror) per unit time is the same. The representation below shows how a laser beam is generated.

Figure -4-



As electrons fall to a lower state after being excited, the photons released cause other electrons to fall as the pattern continues and a coherent light beam is generated. Note that the circles represent photons and the downward arrows signify the fall of electrons to a lower state.

Where lasers differ from other light however, is in their ability to generate all that energy into a dense concentration of monochromatic and coherent light within one space (see figure -3-). When all electromagnetic waves of the same wavelength travel in the same direction and meet in one point of space, there lies the rationale for a beam of light— the laser beam. However, like any light, the laser beam follows the rules of noncoherent light — that being its angle of incidence equals the angle of reflection and that it can refract and diffract — but in a more exact manner. This is the where the greatest difference lies. A laser beam is exact and is less subject to dispersion of its energy to the outward world than the noncoherent light beams. This is the beauty of lasers, and why they have been mastered as much as the technology of this day will allow.

Types of Laser:

Laser beams differ from each other in the state of matter that comprise them and the mechanism through which the beams are generated. See table -2- for the structure and the nature of various types of lasers.

Type of Laser	Matter Utilized	Mechanism
Solid State Laser.	Sold materials such as rubies.	Heating
Gas Laser.	Gas such as helium	Heating
Gas Dynamic Laser.	Gas	Heating and Cooling
Semi-conductor Laser.	Crystal	Heating
Liquid Laser.	Liquid such as organic days	Heating

Table 2. Types of laser and the state of matter that comprises each.

Some kinds of laser beams are very intense and much brighter than even the light given off by the sun. This is simply because a laser puts out more energy per square centimeter than the sun does. According to Bova (1975), "the sun emits about 7 Kilowatts of light energy from each square centimeter of its surface. A laser, on the other hand can produce more than a billion watts of energy in a beam about one square centimeter in cross section" (p. 18).

Laser beams can be focused down to tiny spots without spreading out widely, and thus can emit very narrow, thin beams of light. Furthermore, while laser beams can be produced in any of the seven colors of the rainbow, only one color is present in a given laser beam. All laser beams are pure because only photons of the same wavelength can be emitted. Lasers can also "produce forms of light that the human eye can't see — infrared (IR) and ultraviolet (UV) radiation" (Bova, 1975, p.19). In addition, lasers emit wavelengths that are all lined up together precisely to match peaks and troughs in one coherent beam, concentrating and optimizing their energy (Maure 1992, Laurence 1986, Kallard 1977).

Sense of History:

It is interesting to note that the birthplace of lasers can be found with the advent of the "maser." Charles H. Townes and his colleagues were the first to discover microwave amplification by stimulated emission of radiation (i.e. "maser"). In 1954, Townes's team was able to excite ammonia molecules that emitted microwaves at a specific, identical frequency upon relaxation. Later, Townes and his brother-in law, Arthur L. Schawlow collaborated to generate an "optical maser;" a device that would amplify light, not microwaves, thereby producing a very narrow beam of light at a single frequency. In 1958, they published a scientific paper explaining their ideas and what was needed to make an optical maser. Built upon these great discoveries, two years later, in 1960, Theodore Maiman built the first successful laser, and the dawn of the "laser" had arrived (Bova 1975, Kallard 1977, Laurence 1986).

The Application of Laser Beams:

At this time in our history, lasers are being utilized in the medical arena as an exacting force. In times of surgery, lasers can offer the benefits of the ultimate, perfect scalpel— able to cut and cauterize as it moves through any type of biological medium. And with the advent of high-tech mirrors and significant increases in the power of computers, we are now able to go places with a laser even without the benefit of the naked eye. All that is necessary to turn the laser is a skilled user, the right equipment, and a high memory-based computer.

In addition to the medical field, one finds lasers in all aspects of life. Industry utilizes the great technology of lasers in all its assembly line productions. From the manufacturing of cars to beverage containers, lasers have etched, molded, formed, and dyed various starting materials into their finished forms. There is no limit to the bounds of the laser— and it is certain that as our understanding of this powerful tool increases, so will its many applications.

What is more, is the new use of lasers to produce holograms. Hologram means "complete picture"— a picture that appears to have volume. This is because of the three dimensional quality given to the representation. The picture/representation is given the aura of having depth, length, and width.

To do a hologram, the idea of laser theory comes into play. In fact, all a hologram requires is two laser beams. One of the laser beams shines onto the object and then onto a special photographic film. Therefore, an image of the object has been recorded onto the special film. The other laser beam is directed to a mirror, and then is reflected off the mirror onto the film. This film records the data as well, and thereby gives a three dimensional facet to the original object's picture — i.e. a hologram has been made from the combination of one film and two laser beams. Below is a pictorial representation of how this wondrous situation occurs:

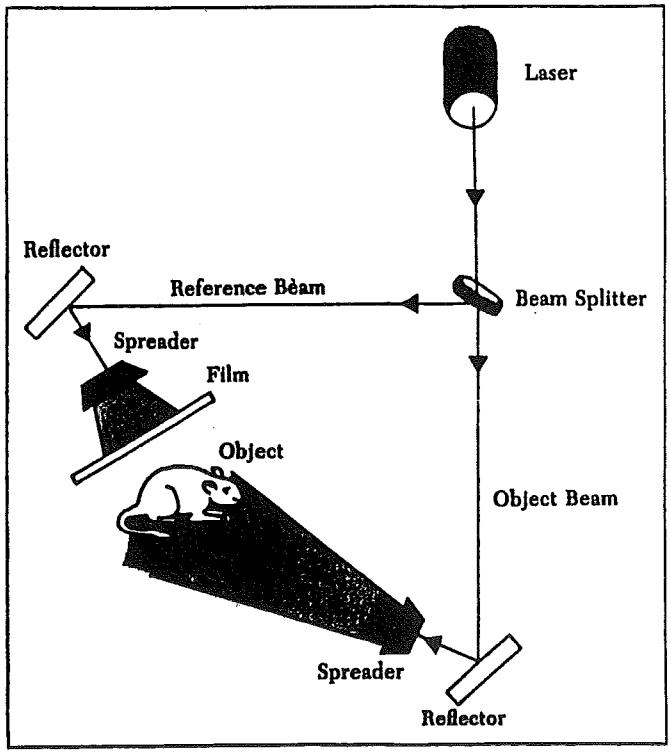


Fig. 5. As illustrated in Brennan (1992)"The light from a laser is split into two beams: one beam lights up the object being photographed and the other beam goes to a photographic plate. When developed, the plate or film becomes a hologram; three-dimensional image that appears to have depth like a real object." (p. 143) (Figure credit: Richard P. Brennan, 1992).

Finally, it is interesting to see that as our advancements in technology take us from the standard light bulb to the complexity of the hologram, also too will our new-found uses for this technology. As they say, technology leads the way.....

Part IV: Relevant Laboratory Situations

The following are a few suggestive activities to reinforce the students' understandings of the concepts of light and laser. In no way does this suggest that these are the only laboratory situations that can be utilized to introduce and/or foster these concepts.

Activity # 1: Breaking Down The White Light:

The needed equipment for this lab activity is a prism and a piece of cardboard with a one inch horizontal or vertical slit in the middle. The aim of the activity is to reduce white light into its corresponding rainbow colors using a prism. White light is composed of different wavelengths of light that travel through glass at different speeds and emerge from a prism at different angles, thereby causing light to separate into various rainbow colors. As a variation, one can use the "slitted" cardboard juxtaposed with the prism to pull out just one particular color of the rainbow. See below for expected results and a pictorial representation of the breakdown of light into its comprised colors. For students who need further challenge teachers could ask the following question: *What do you think will happen if we put another prism between the beam with a particular color (e.g. green) and the cardboard?*

	Prism	Prism With Slitted Cardboard	Extra Prism Between Beam & Cardboard
Standard Incandescent Light Bulb	See the Colors of the Rainbow	See a Particular Color of The Rainbow	? ?
Fluorescent Light Bulb	See the Colors of the Rainbow.	See a Particular Color of The Rainbow.	? ?
Laser	Direction Change of Beam.	Direction Change of Beam or Annihilation of Beam Due to Cardboard Acting as a Blockade.	?

Table 3. Effects of prism, with or without cardboard upon use of various light sources.

Activity # 2: Directional Change of Light Beams:

A fluorescent light bulb apparatus, an incandescent light bulb apparatus, a laser, two or more mirrors, and a piece of cardboard with a 1/4 hole in the middle are needed for this lab activity. The purpose of this laboratory situation is to show just how mirrors can change the direction of light in either a focused manner or in a diffused manner. Below is expected results with the use of one mirror. For sake of understanding and excitement for the student(s), it is suggested to use multiple mirrors to change the path of the light many times once the basic concepts of dispersion forces and angles of incidence and reflection are understood.

In this laboratory activity students will discover how exact a laser beam can be routed to a new location with the use of one or more mirrors. This laboratory can also be used as an introduction to laser holography, and the production of three-dimensional pictures (i.e. holograms), as explained in Part # 3 "Background Information."

	Mirror Usage
Standard Incandescent Light Bulb.	?
Fluorescent Light Bulb.	?
Laser.	Focused, Mathematically Determinable Direction Change.

Table 4. How mirrors change the direction of light from different light sources.

Activity # 3: The Inherited Nature and Characteristics of Various Types of Light (Intensity, Directionality, Monochromaticity, and Coherence):

In this activity, students will compare the intensity, directionality, monochromaticity, and coherence of laser beams to other light sources. Usually, we give each student a copy of Table 5 and we discuss together in class the intensity, directionality, monochromaticity, and coherence of laser beams. Then, each student does library research and fills in the rest of the table on his or her own. The class is divided into groups of two students, and each group is asked to write three pages explaining the inherited nature and characteristics of various types of light (Table 5).

	Intensity	Directionality	Monochromaticity	Coherence
Standard Incandescent Light Bulb	?	?	Different colors all mixed together to produce white light.	Incoherent wavelengths.
Fluorescent Light Bulb	?	?	?	Incoherent wavelengths.
Halogen Light	?	?	?	Incoherent wavelengths.
Laser beam	Light beams of very high intensity	Highly directional	Monochromatic (one color)	Coherent wavelengths.

Table 5.The four main differences between laser and all other sources of light.

Activity # 4: The Application of Lasers In Modern Society:

This activity can be used as an internet homework assignment. Each student is given a copy of Table 6 and is asked to use the internet to find examples of the use of lasers in the ten listed categories in Table 5. The students are also asked to define all the words listed in the ten categories in Table 6. Then, each student is asked to prepare two-to-three written pages about the application of lasers in modern society based on Table 6. These written pages must accompany Table 6.

Students can find the needed information in, for example, any new college physics textbook, any multimedia Encyclopedia (such as the 1995-1998 *Grolier Multimedia Encyclopedia* published by Grolier Incorporated, Grolier Electronic Publishing, Inc.), or in various books such as those written by Bova (1975), Mauler (1982), Laurence (1986) or Eslow (1988). Also, *The Handy Science Answer Book* (1994,1998) is a good choice for information, as to is the Internet.

No.	The Field of Application	The Use of Lasers
1	Laser-Induced Controlled Thermonuclear Fusion.	
2	Communications.	
3	Materials Working.	
4	Medical Applications.	
5	Surveying and Ranging.	
6	Holography.	
7	Isotope Separation and Spectrograph.	
8	Military Applications.	
9	Information Application.	
10	Arts Application.	

Table 6. The application of laser in modern society

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Bibliography

Bova, Ben (1975). *The Amazing Laser.* Philadelphia: The Westminster Press.

Cherif, A., Gialamas, S., and Simos, E. (1997). Science and Mathematics: Integrating the teaching of science, math, and social studies in relevant context. *Spectrum Journal*, 23(3): 20-28.

Cherif, Abour H. (1988). *Inquiry: An Easy Approach In Teaching Science. Lectures* and workshops the author has been giving for the last few years to a number of teachers and students - taught under various titles including *Inquiry: A Rewarding Approach in Teaching Science, Inquiry: A Rewarding Approach for Conceptual Change,* and *Giving Science Back to Children.* Faculty of Education, Simon Fraser University.

Cherif, Abour H. (1993a). *Relevant Inquiry.* The Science Teacher, 60(9): 26-28.

Cherif, Abour H. (1993b). Science Education: What's It All About?. *Illinois School Research and Development,* 29(3): 12-17.

Cherif, Abour H. (1998). Making Sense of Density Around You Through Guided Inquiry. *Washington Science Teacher's Journal,* 38(1): 14-19.

Dewey, John. (1910). *How We Think* . Boston: Heath and Co.

Eskow, Dennis (1988). *Laser Careers. New* York: High-Tech Careers Books.

Gialamas, Stefanos (1991). Mathematics for Artists. *Proceeding National Conference on the Education of Artists.* New York School of Visual Arts. October 1991.

Gialamas, Stefanos (1993 Spring). Knots every where. *Consortium of Mathematics and Application,* No. 45., pp.

Harper, A. E. (1990). Critical evaluation-the only reliable road to knowledge. BioScience, 40(1):46-47.

Hurd, Paul DeHart . (1969).*New Directions in Teaching Secondary School Science.* Chicago: Rand McNally & Company.

Jacobson, W. J. and Bergman, A. B. (1987). *Science For Children: A book for teachers.* New Jersey: Prentice-Hall, Inc.

Kallard, T. (1977). *Exploring Laser Light: Laboratory Exercises and Lecture Demonstrations Performed With Low-Power Helium-Neon Gas Laser.* Stony Brook, Nre York: American Association of Pgyscis Teachers.

Laurence. Clifford L. (1986). *The Laser Book: A New Technology of Light.* New York: Prentice Hall Press.

Maton, Anthea, et al. (1993). *Prentice Hall Science: Sound and Light.* Englewood Cliffs, New Jersey: Prentice Hall.

Maurer, Allan (1982). *Laser: Light Wave of The Future.* New York: ARCO Publishing, Inc.

Moore, Randy (1989). What vs. how we teach (Editorial). *The American Biology Teacher*, 51(2):68.

Murphy, James T, J.M. Hollon, and P. W. Zitzewitz (1986). *Physics: Principles & Problems*. Columbus, Ohio: Charles E. Merrill Publishing Company.

Popp, Jerome A. (1981). Teaching science scientifically. *Journal of Education*, 7 (2):12-15.

Schwab, J. J. (1962). The Teaching of Science as Enquiry. In J.J. Schwab and P. F. Brandwein (Eds). *The Teaching of Science.* Cambridge: Harvard University Press.

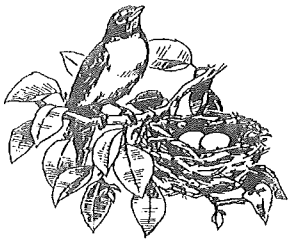
Shroyer, Ja Ann (1993). *Quarks, Critter And Choos.* New York: Prentice Hall.

Suchman, J. Richard (1966). *Developing Inquiry.* Inquiry Development Program. Chicago, Illinois: Science Research Associates.

Wilson, Jerry D. (1994). *College Physics*. Englewood Cliffs, NewJersy: Prentice Hall.

Yager, Robert E. (1988). Differences between most and least effective science teachers," *School Science and Mathematics*, 88 (4): 301-307.

The 1995-1998 Grolier Multimedia Encyclopedia . Published by Grolier Incorporated, Grolier Electronic Publishing, Inc.



Karen Newell
www.minnetonka.k12.mn.us/support/science/tools/ooey.html

OOEY, GOOEY RECIPES FOR THE CLASSROOM

Condensed Milk Paint

Use 1/4 cup of condensed milk with a few drops of food coloring for pastel paint that will dry with a glossy finish. Us the paint sparingly or it will take forever to dry!

Sparkly Paint

Premix liquid starch with powdered tempera or Pour liquid starch on the paper. I have kids spread it around and then sprinkle on powdered tempera from a big holes salt shaker. Spread it around some more. This works well on slick, or "finger paint" paper or the slick side of freezer paper, but special paper isn't required. Add salt for more sparkles. Coarse salt works best.

Finger Paint

In a saucepan, mix cornstarch with 3/4 cup cold water to a smooth paste. Soak gelatin in 1/4 cup cold water. Set aside. Pour boiling water slowly over cornstarch mixture, stirring. Cook over medium heat, stirring constantly, until the mixture boils and clears. Remove. Stir in gelatin. Cool and divide into separate small screw top jars. Add color. Refrigerate to store. The paint is transparent, strong, and durable with high gloss finish. It may be used on dry or wet paper.

Play Dough

1 cup flour, 1 cup warm water, 2 teaspoons cream of tartar, 1 teaspoon oil, 1/4 cup salt, food coloring

Mix all ingredients, adding food coloring last. Stir over medium heat until smooth. Remove from pan and knead until blended smooth. Place in plastic bag or airtight container when cooled. This will last for a long time.

Kool-Aid Play Dough

1 cup flour, 1/4 cup salt, 2 tablespoons cream of tartar, 1 package of unsweetened Kool-Aid, 1 tablespoon vegetable oil, 1 cup water

Mix flour, salt, cream of tartar, and Kool-Aid in a medium pot. Add water and oil. Stir over medium heat for 3 to 5 minutes. When the mixture forms a ball in the pot, remove. Knead until smooth. Put in a plastic bag and refrigerate.

Monster Bubbles

6 cups water, 3/'4 cup corn syrup, 2 cups Joy dish washing liquid

Mix together. Let it sit for 4 hours (to let bubbles settle), then enjoy.

Singing Cake

1 cup butter, 2 cups brown sugar, 3 eggs separated, 2 squares bitter chocolate melted, 1 cup raisins, 2 teaspoons cinnamon, 1 teaspoon cloves, 4 cups sifted flour, 1 cup strawberry jam, 1 cup chopped nuts, 2 teaspoons baking powder mixed in 1 cup buttermilk

Cream butter and sugar. Add egg yolks and stir. Add melted chocolate and stir. Add raisins. Add cinnamon, cloves, and flour, stir. Stir in nuts and jam. Now add the baking powder to the buttermilk and quickly stir into the cake mixture. Fold in the stiffly beaten egg whites. Quickly pour the mixture into a greased and floured angel cake pan. Bake at 350 degrees until cake stops singing which is about 45 minutes. Make sure you time this so your guests are present during the baking. Once the cake is baked, the effect is over.

Edible Fun Dough

1 cup peanut butter, 1 cup honey, 2 cups powdered milk (Use just the powder)

Mix all the ingredients in a bowl. Add more powdered milk to make a more workable dough if needed. This dough is great for little ones who put everything into their mouths. Form the dough into shapes and eat for a snack.

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OUTDOOR SENSORY EXPERIENCES

The most important resources students possess to learn with are their senses. The traditional classroom relies on just a few of the senses. Most instruction is through sight and sound. This reduction of stimuli, in the classroom, results in many children not learning in their modality preference. Not all children learn best auditorially or visually, and the traditional classroom setting provides little interaction with, touching, smelling, and feeling (emotion).

If students are to maximize their potential to learn they should practice receiving and interpreting stimuli from all the senses. The outdoor classroom provides a unique setting for students to gain experiences in utilizing all their senses and expressing their perceptions.

Some children are uncomfortable with learning a different way and environment, and need some practice and structure in the outdoor classroom. Following are a few sensory activities that I have found successful.

Beginning Sensory Exercise

Objective

To set the correct tone for a hike or on entering the outdoor area.

Procedure

A. Before entering an area have the students sit quietly.
   1. Listen for about one minute. What did you hear?
   2. Breath deeply a few times. What types of smells did you experience?
   3. Look around. What do you see, in the air, the trees, on the ground?
   4. Pick up a small amount of soil. What is its texture? What makes up the soil?--humus, clay, pebbles, etc.
   5. Taste the soil by putting a small bit to the tip of your tongue. What does it taste like?

B. Form a circle sitting on the ground to contemplate the following:
   1. The evidence of man.
   2. The evidence of erosion.
   3. The evidence of change.
   4. What might happen to this area in the future.

C. Observe the surrounding area to create an attitude of awareness.
   1. Look at your clothes. Are they cotton, wool, leather, etc?
   2. Where did they come from?
   3. Discuss the fact that all parts of the environment are interrelated and that each part depends directly or indirectly on other parts.

Hand Washing

Objective

To allow students to get warmed up to using their senses.

Procedure

1. Have students "wash" their hands in snow or leaves.
2. "Wash" the face lightly for several seconds.
3. Discuss with students what they did and how it felt, smelled, etc.

Sensory Hike

Objective

To identify using the five senses, the sounds, smells, textures, and sights along a prearranged trail.

Procedure

A. Mark off a trail in a four leaf clover design.
B. Divide students into groups of three.
C. Have students walk each leaf of the trail four times looking for the following:

1. Sight: Identify what is seen and record it in a notebook.
2. Smell: Identify the odors and record.
3. Sound: Blind fold a group member and have the other two lead her/him around the course and then record what is heard.
4. Touch: Blindfold a group member and have her/him led around the trail feeling different objects and then record what is felt.

D. Discuss with students their observations.

Seton Watching

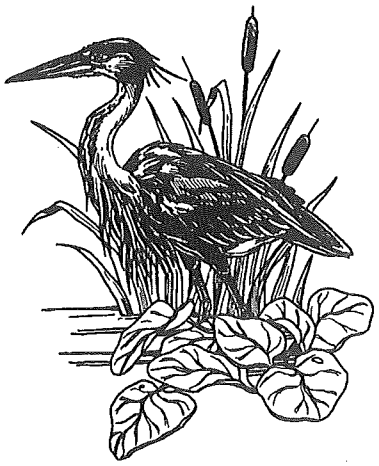
Objective

To let students totally involve and commune with nature.

Procedure

1. Explain what Seton Watching is: sitting or standing in one place unmoving; not rigidly, but in a relaxed way; totally stilling the body and opening yourself to the environment.
2. Put yourself in a relaxed position, become part of the surroundings, and allow your mind to wander.
3. Seton Watch as a group:

A. Interlock arms.
B. Put group in the right frame of mind.
C. Relax the body and mind.
D. Remain mentally alert.
E. Use all five senses.
F. Look for unusual objects, odors, sounds, and movements.
G. Relate your observations and feelings to the group and/or record them in a log book.



Group Sensitivity Experience

Objective

To become aware of the senses through group activity.

Procedure

1. Have the students lie on their backs with their heads toward the center of the circle and hold hands.
2. Pick out five of the more vocal students in the group and assign each of them to become one of the five senses. Ask the other students to try and feel what the other students are feeling.
3. Try the same procedure but have the students with their feet toward the center or sitting back to back.

Haiku Poetry and Scrolls

Objective

To unite the sensory experiences using the arts of poetry and drawing.

Materials

1. A 15 cm by 45 cm piece of white tissue paper for each student.
2. Two slender, straight twigs about 25 cm long per student.
3. White glue.
4. Drawing materials such as colored pencils, magic markers, or black ink pens.

Procedure

1. Students should have been exposed to haiku before doing any of any of the sensory experiences, but review the process with them.
2. After a sensory exercise, have the students compose a haiku about what they observed and felt.
3. After the students compose their poems, they make a scroll (oriental style) from their twigs and tissue paper by gluing the top and bottom of the 15 cm sides of the paper to the twigs.
4. Students should reproduce their poem on the tissue paper with pencil, marker, or an ink pen.
5. There should be enough space at the bottom or top of the tissue paper for illustrating the poem.
6. Ask students to share their poem, if they wish, to the class.

Lori Lancaster
Centennial High School
Gresham, Oregon
Reprinted from *TOST*

WRITING A CONCLUSION TO EVALUATE LABORATORY EXPERIENCES

When I was teaching at the Inter-American Academy in Guayaquil, Ecuador, I was responsible for their International Baccalaureate (IB) chemistry course. In this capacity, I was introduced to "rubrics," or what we now know as "scoring guides," even though I did not know", this until I returned to the states. Students taking this course were responsible for keeping a laboratory notebook. I was to score them according to a set of descriptors that fell into three categories: Communication, Observation and Interpretation.

The original descriptors were almost incomprehensible to students. Even though I would explain and demonstrate, they really would not understand what it was they were supposed to do. Over the years, I have attempted to make these descriptors more "student friendly." And since I have gone from having fewer than 20 student notebooks to grade in Ecuador to close to 150 at Centennial High School, I have also tried to find the most efficient way to use my time. The idea is to evaluate a student's understanding of the laboratory activities, while keeping current with the concepts being taught in class.

While I still have students keep a laboratory notebook and do check them on occasion, I have found that having the students synthesize conclusions from the information in the lab notebook is about as efficient as I can be at this time. Please note that this process is still evolving.

As a reference I give the students an outline of what a laboratory conclusion should contain, and the elements of the scoring guide. The outline follows the Communication, Observation and Interpretation categories that I originally used as an IB Chemistry teacher. But the essential idea is to show the student that all of the information they need is in their laboratory notebooks. The outline also follows a scientific inquiry format: there is a problem, a procedure is conveyed, the data is presented, and the results explained using the concepts being learned in class.

As you can imagine, trying to get the students to do this at the beginning of the year is like pulling teeth. I've kept examples of conclusions written by past students in order to show the different scores and the reasoning behind them. This seems to help as the students learn the process. By the end of the year, many of the students start producing conclusions that convince me that they genuinely understand what they did in the lab and how it relates to the concepts I'm teaching them.

I hope that you find this helpful. If you have some changes that you think would improve this, please don't hesitate to contact me at llancast@teleport.com. Have a great school year!

The Outline

DIRECTIONS: There will be three (3) paragraphs for the conclusion. Each paragraph should address those questions under each heading. Use complete sentences and use a passive voice (do not use I, we, my, etc.)

PARAGRAPH 1:

Give a clear and accurate account of the work carried out and the success in accomplishing the purpose of the activity.

A. What was the purpose of the activity?

B. Was it accomplished?

C. What did you do to accomplish the purpose? Summarize the procedure.

PARAGRAPH 2:

Show a good appreciation of the technique errors and their affects on the calculations and/or conclusions drawn.

A. What are the results or conclusions drawn for this activity? (What did you do with the data you collected?)

B. What are the technique errors (possible and/or actual)?

C. How would the technique errors affect the results or conclusions drawn?

PARAGRAPH 3:

Show a good understanding of how the activity relates to the concepts being developed in class.

A. What are the concepts being developed in class?

B. Explain the concepts.

C. Briefly describe how the lab relates to the concepts.

D. Why is it important? How does it apply to the real world?

The Scoring Guide

SIX (6) POINTS

On the evidence of the written conclusion, the student has:

- given a clear and accurate account of the work carried out and his/her success in accomplishing the purpose of the activity.
- shown a good appreciation of technique errors and their effects on the calculations or conclusions drawn.
- shown a good understanding of how the activity relates to the concepts being developed in class.
- processed the data effectively and produced accurate and thorough explanations for the results obtained.
- used complete sentences with proper spelling and *grammar.*
- written a coherent essay with a logical flow of ideas and appropriate conclusion.

FOUR (4) POINTS

On the evidence of the written conclusion, the student has:

- given an accounting of the work carried out and his/her success in accomplishing the purpose of the activity.
- mentions errors, but does not specify how they affect the calculations and/or conclusions drawn.
- limited understanding of how the activity relates to the concepts being developed in class.
- made an attempt to process the data and to explain the results obtained.
- made a few minor grammar and spelling errors.
- written an essay in which the organization makes it difficult to understand.

TWO (2) POINTS

On the evidence of the written conclusion, the student has:

- only alluded to the work carried out and his/her success in accomplishing the purpose of the activity.
- made little or no attempt to mention errors and their effect on the calculations and/or conclusions drawn.
- struggled to relate the activity to the concepts being developed in class.
- made many grammar and/or spelling errors.
- written an essay which is disorganized and difficult to read.

Jean Delfiner
Chem Club News
Chemistry Teachers' Club of New York
October, 1993

THE UNKNOWN PICKLE

The glowing pickle demonstration (1) never fails to arouse student interest. The problem is where to use it. Since Appling (2) demonstrated that the glow is the sodium D Line, I am using it as an unknown in the atomic emission unit.

Materials:

1. Spectra charts.
2. Incandescent light source.
3. Spectra tubes with known gases, tube holder and power supply.
4. Dill pickle.
5. Insulated holder for electrodes with wiring to connect to 120 Volt/60 Hz/1 phase alternating current.
6. Holographic diffraction gratings. (See article at right for instructions for making a class set).

Procedure:

7. Darken the room (semidarkness is fine.)
8. View the light from incandescent bulb through a diffraction grating.
9. View the light from the various gas spectra tubes through a diffraction grating.
10. Insert the electrodes into opposite ends of the pickle and connect to 120/60/1 AC.

In a few seconds, the pickle will heat up and start to steam and then an electric arc will form within the pickle. The arc will glow with a light that is visible through the translucent body of the pickle.

11. View the glowing pickle through a diffraction grating.

Observation:

12. The spectrum of the incandescent light is continuous.
13. The spectrum of the gas tubes have discrete color lines.
14. The spectrum of the glowing pickle viewed through the diffraction grating is yellow, not the familiar "RoyGBiv" rainbow spectrum of an incandescent object.

Notes:

15. Compare the known gas spectra to the charts.
16. Compare the unknown pickle spectrum to the charts and determine that it is the yellow sodium D line.

Literature cited:

1. Delfiner, J.; Delfiner, A.; "Making My Pickle Glow Is Serious Science," Chem Club News, May, 1992, p. 1.
2. Appling, J. R.; Yonke, F. J.; Edington, R. A.; Jacobs, S.; "Sodium D Line Emission from Pickles," Journal of Chemical Education, Vol. 70, No. 3, March 1993, p. 250.

Al Delfiner

Reprinted from the *Masthead*

HOLOGRAPHIC DIFFRACTION GRATINGS FOR THE WHOLE CLASS

Holographic diffraction gratings are several orders of magnitude more efficient than the usual student acetate gratings; and they are very inexpensive, less than a nickel each if you make them yourself. Here's how you do it.

Materials:

1. Holographic diffraction grating material. Purchase 9"x5" sheet or 6'x5" roll from: Learning Technologies, Inc. 59 Walden Street Cambridge, MA 02140 (800) 537-8703
2. 3"x5" white index cards, unlined on at least one side.
3. 1/4" wide mylar or acetate tape.(Scotch tape)
4. Hand held, one hole paper punch to punch 1/4" hole.
5. Paper cutter.

Manufacture:

6. Cut the grating material into 5/16"x5" strips.
7. Cut the strips into 5/16"x3/8" pieces.
8. Fold index card in half (2-1/2"x3") with the blank side out.
9. Punch a 1/4" hole through both leaves of the folded index card. Try to center the hole.
10. Open the card. On the inside, place the small piece of grating over one of the holes with the 3/8" edge parallel to the fold and slightly offset.
11. Secure in place with a 1/2" length of tape. Make sure the tape does not cover the hole.
12. Fold the card closed. The grating is now between the leaves of the folded card and can be seen between the holes.

Use:

13. Hold the folded card against your nose for support and look through the hole at the light source. Rotate your head approximately 23° left or right to see the spectrum.

Notes:

14. Learning Technologies, Inc. says that "The shape of the grating surface produces a dispersion angle of 23.5° and a groove separation of 1375 [micrometers] (750 lines per nm) for a wave length of 550 nm. The sinusoidal shape of the grating surface places most of the light in the first order image. This shape is embossed in a lowcost clear polyester plastic."
15. Give these inexpensive gratings to your students to take home. Let them observe that although all automobile stop lights appear to be the same color red, their spectra are not the same. "Neon signs" are especially interesting.
16. After assembling all the materials, I manufactured gratings at a rate of more than 200 per hour.

OPPORTUNITIES

7TH ANNUAL NEISON AND BETTE HARRIS INSTITUTE FOR INTRODUCTION TO PROBLEM-BASED LEARNING
August 1-5, 1999

The goal of the Institute is to provide educators hands-on experience as PBL learners and designers. Participants receive instruction and mentoring in designing PBL curriculum and developing implementation strategies from experienced PBL educators while engaging in guided practice and dialogue with fellow participants. Because innovations in teaching practice are strengthened through collegial support, we encourage teams of educators to register.
The Harris Institute is held at the Hickory Ridge Conference Center in Lisle, Illinois. Space is limited to 60 participants. Reserve your space for the Harris Institute, an introduction to Problem-Based Learning, now!
For reservations or more information, please contact:

Sina Fritz
630-907-5956
email: sina@imsa.edu

Michelle L. Adams - Production Manager
the Center@IMSA
630-907-5073

Schedule:
Tuesdays, Wednesdays, & Thursdays
7:30 am - 4:00 pm

Astronomical Society of the Pacific
BE A
"PARTNER IN ASTRONOMY"
AT THE 1999 ASP ANNUAL MEETING

As President of the ASP and organizer of the 1999 Annual Meeting, it is my pleasure to invite you to attend that meeting in Toronto, Canada. But there is more! This will be a joint meeting with the American Association of Variable Star Observers (AAVSO), and the Royal Astronomical Society of Canada (RASC). "Partners in Astronomy" signifies the three partner organizations; the two neighbor countries Canada and the US; the partnerships between amateurs and professionals, and between scientists and educators; and the many facets of astronomy which are on the program.

Highlights include: tours of the David Dunlap Observatory, the University of Toronto Campus Observatory, and the famous Ontario Science Centre; Universe '99—two days of exhibits and non-technical lectures on Frontiers of Astronomy; two days of invited and contributed papers on History of Astronomy; a day of RASC contributed papers; the AAVSO Business Meeting and Papers Session (believe it or not, Director Janet Mattei's report will be a highlight of the meeting!), a two-day ASP workshop for school teachers; a Family Fair for the kids; a Project ASTRO workshop on creating partnerships between astronomers and teachers; and a gala AAVSO+ASP+RASC Awards Banquet. For those of you who are deeply engaged in astronomy research or education, there is a special three-day symposium on "Amateur-Professional Partnership in Astronomical Research and Education." This symposium, and its proceedings, wills et the agenda for amateur-professional partnership for years to come.

Our host for the meeting is the University of Toronto, a leader in astronomy research and education for almost a century. The meeting will be held on the main campus of the University, in the heart of the city, close to restaurants, shops, museums, galleries, theaters, parks and other cultural and recreational facilities. For those of you from the US, your dollar goes 50% further here!

So don't miss Toronto in 1999 for the most varied, interesting and affordable meeting of the decade. You will be able to meet old friends, and new ones, too. The bulk of the meeting events are on the holiday weekend of Thursday, July 1 to Monday, July 5. The symposium is July 5-7. Stay an extra week and enjoy one of the great cities of the world.

For advance information, contact **John R. Percy**, Erindale Campus, University of Toronto, Mississauga, Ontario Canada L5L 1C6. E-mail: jpercy@erin.utoronto.ca.

Information on registration and accommodation will be provided later. As the arrangements for the meeting become finalized, you can find them on the ASP website (**www.aspsky.org**), as well as on the AAVSO (**www.aavso.org**) and the RASC (**www.rasc.ca**) sites. Those interested in participating in the symposium should contact John Percy directly.

EXPLORE LIFE SCIENCE AT THE BRONX ZOO THIS SUMMER

Pablo Python Looks At Animals
Grades K-3
- Early childhood curriculum
- Introduces science concepts

Workshop Date: July 19-23, 1999

Habitat Ecology Learning Program
Grades 4-6
- Explores How Nature Works, Grasslands, and Rain Forests
- Investigates environmental issues & human cultures

Workshop Date: July 5-9, 1999

Voyage From The Sun
Grades 4-9
- Links ecology, biology, and the physical sciences
- Examines the origin of energy and how it is used by plants and animals

Workshop Date: July 26-30, 1999

W.I.Z.E.: Diversity of Lifestyles
Grades 6-8
- Focuses on how animals of the air, land, and water are adapted to their environments
- Integrates geography, math, and language arts

Workshop Date: July 12-16, 1999

$295 registration and materials fee includes:
- Cost of instructional program
- Extensive classroom materials
- Cost of lodging & two meals per day
- Partial airfare reimbursement
- Behind the scenes visits at zoo exhibits & live animal demonstrations

For an application and more information about our programs across the nation, call **Ann Robinson, Manager of National Programs at (800) 937-5131.**

LIVE AT THE EDGE THIS SUMMER!

(THE CUTTING EDGE OF RESEARCH AND INNOVATIVE TEACHING)
NSF-TRUE Program
at the
University of Florida

America's middle and high school science, math, and technology teachers *NOW* is the time to apply for this summer's hottest research participation program, NSF-TRUE. TRUE begins June 13 to July 31, 1999, on the campus of the University of Florida (UF). Participants will spend seven weeks working in labs and in the field with eminent scientists and scholars from various academic programs at one of America's leading research universities. If you are among those selected to "live at the leading edge of research," you will:
- do mentored research in funded laboratories,
- participate in biotechnology, physics, forestry, and other workshops,
- enrich content and pedagogical skills,
- develop linkages between doing and teaching current research, and
- build professional networks with leading scientists and teachers from throughout America.

Teachers selected will receive:
- on-campus apartment at no cost,
- $2,600 stipend,
- $300 toward travel expenses,
- $200 mini-grant to develop classroom action plans,
- an option to earn graduate credits or teaching certification, and
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To request a brochure/application, please call, E-mail, or write:
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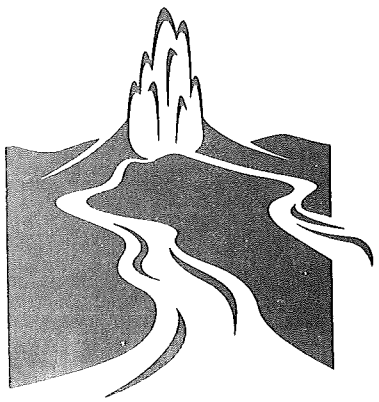
Gainesville, FL 32611-2010
(352) 392-2310 phone
(352) 846-1921 fax
E-mail: true@cpet.ufl.edu



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Volcano, HI 96785
Tel/Fax: (808) 985-9901
E-mail: jbabb@aloha.net

ALOHA! PROJECT LAVA

Spend a week in Hawaii exploring Kilauea, one of the most active volcanoes on Earth, in **Project LAVA (Learning About Volcanic Activity)**, a summer course for K-12 science teachers conducted in Hawaii Volcanoes National Park on the Big Island. The session is scheduled for **July 28-August 3.** Classroom sessions consisting of demonstrations, hands-on activities, and lectures are followed by field excursions and hikes that provide "real-life" experience on an active volcano. The cost of the course is $795, which includes seven nights housing in comfortable cabins near the summit of Kilauea Volcano, ground transportation to and form the Hilo airport and during all field trips, two catered dinners, instructional materials, and Project LAVA t-shirt. Optional academic credit (graduate and undergraduate) is offered for an additional fee. Airfare and meals (except for the two catered dinners) are not included.

Registration is limited to 20 teachers and is on a first-come, first-served basis. The deadline to register is May 28 for the July/Aug. session. For registration materials or more information, contact Janet Babb at the above address.

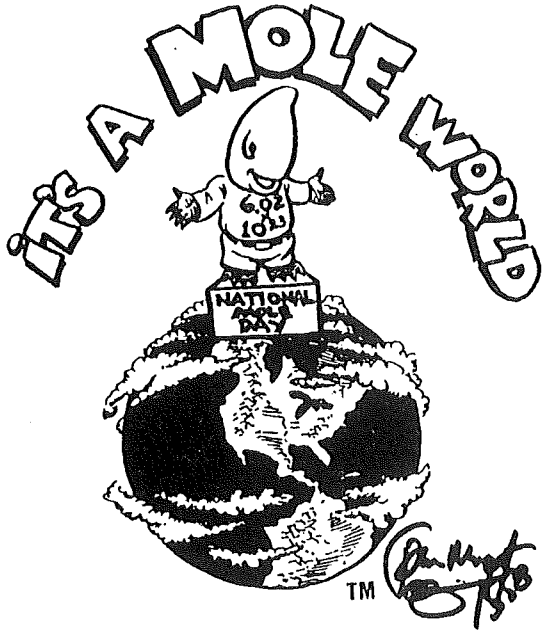
THE ILLINOIS EE LEADERSHIP CLINIC PROFESSIONAL DEVELOPMENT FOR TODAY'S LEADERS

For three years, the National Environmental Education Advancement Project (NEEAP) has sponsored national training for state leaders in order to build state capacity for environmental education. This program has served to build new state visions for EE, while providing the professional tools needed to attain reformed organizational goals. Illinois has participated in this program and other NEEAP offerings for the past five years. The knowledge and skills gained by participating EE leaders is passed on, ultimately benefiting the participating organizations and institutions involved.

In November, 1999, the Environmental Education Association of Illinois (EEAI) and the Illinois Environmental Education Advancement Consortium (IEEAC) are proud to cosponsor the first Illinois EE Leadership Clinic. The Clinic will help serve as a national model for other states interested in building state EE leadership through the development of participant skills in areas such as partnership building, program assessment, grant writing, and resource use. The Clinic also will help participants overcome barriers to program implementation. Participants also will be introduced to current in-state partnerships, opportunities to connect with state organizations and other leaders in the field, and avenues for involvement within the state plan for EE in Illinois.

The EEAI/IEEAC Leadership Clinic Committee is searching for today's EE leaders in Illinois. Applicants for this first year must be involved in either the development, management, coordination, design and evaluation of EE programs, or be affiliated and involved with national, state, regional or local partnerships. Participants must he capable of sharing knowledge and expertise gained through Clinic experiences within their partnerships and institutions. Participants also must have gained nomination Or Sought sponsorship from either an EE organization or partnership.

Although many of the participants will be invited from various in-state, environmental education based organizations, there is opportunity for grass-roots involvement. If you feel that your participations meet the criteria for involvement, and you wish to become more involved in building state capacity for EE in Illinois, contact Mary Rice, IEEAC Chair, at (847) 985-2100 (Phone) or (847) 985-9692 (Fax) to be placed on a mailing list for application and needs assessment materials. We will continue to update you as the development of the Clinic progresses.



Thousands of people around the world, mostly high school chemistry teachers, celebrated National Mole Day in a big way last October 23rd. And again in 1999 even more people are making plans for a celebration that will help several million persons become enthused about chemistry, which is the central science.

The National Mole Day Foundation coordinates National Mole Day activities worldwide and has selected **IT'S A MOLE WORLD** as the theme/slogan for National Mole Day 1999. Chemists, especially chemistry teachers, are encouraged to celebrate National Mole Day as a way to show how chemistry is a vital, positive force in everybody's lives. The Day is celebrated from 6:02 a.m. to 6:02 p.m. on October 23rd to commemorate Amedeo Avogadro. The Avogadro number, 6.02×10^{23}, is the basic unit of counting chemical quantities. Sometimes October 23rd is written "10/23."

Idea kits and newsletters published by the NMDF serve as the basis for innovative ways to celebrate the Day. America's chemsinger, Mike Offutt, will again prepare an audio cassette tape of several chemistry songs written especially for the NMDF. The NMDF also makes available other Mole Day memorabilia.

First-time molesdues of US $15 (renewals are US $10 for continuous membership) can be sent to the National Mole Day Foundation, Inc., 1220 S. 5th St., Prairie du Chien, WI 53821. Personal checks, purchase orders, and VISA/MasterCard are welcome. Members receive the official starter Idea Kit, Mike Offutt's audio cassette tape, and periodic newsletters. The NMDF is a not-for-profit corporation funded in 1991 for the purpose of getting all persons, especially kids, enthused about chemistry. Contact can be made at the address above or phone/fax **608/326-6036** or email **mole@icsbbs.com** or via website **http://gamstcweb.gisd.k12.mi.us/~nmdf**. Since annual molesdues are the major source for NMDF funding, support of many individuals and organizations is appreciated.

AWARDS AND RECOGNITION

1999 ISTA AWARDS

Nominations Open
Deadline: June 15, 1999

- Outstanding Pre-service Science Educator Award
- Distinguished Life-long Science Teacher
- Outstanding Elementary Science Teacher Award, and
- Outstanding High School Science Teacher Award

Contact Deb Greaney or Diana Dummitt for applications.
See inside front cover for addresses, e-mails.

GOLDEN APPLE FOUNDATION
8 South Michigan Avenue, Suite 700
Chicago, IL 60603-3318

HIGH SCHOOL TEACHERS SELECTED AS 1999 GOLDEN APPLE AWARDEES

Some of Chicagoland's best 6th-8th grade teachers were recognized as Golden Apple Award Finalists. The finalists honored by the Golden Apple Foundation at the **Celebration of Excellence in Teaching** Saturday, February 13 from 10:00 a.m. - 1:30 p.m. at The House of Blues, 333 North Dearborn Street in Chicago. This year's Celebration featured Keith Anderson, a 1990 Golden Apple Fellow, and the award-winning Hillcrest High School Jazz Ensemble.

The Finalists were selected from over 900 nominations of outstanding middle school teachers from Cook, Lake and DuPage counties. The Foundation's Selection Committee is made up of 70 volunteer Chicago-area educators and education administrators. Two committee members observed each Finalist in the classroom and interviewed the Finalist's principal and selected colleagues, parents and students. The 10 Golden Apple winners were selected in March and will honored in May in a one-hour prime time special produced by WTTW/Channel 11.

Each of the 10 Golden Apple Award winners will receive a tuition-free fall term sabbatical at Northwestern University; $2,500; a personal computer from IBM; and induction into the Golden Apple Academy, made up of past Golden Apple winners.

1999 GOLDEN APPLE AWARD WINNERS

Barbara Marie Figlewicz
Sanborn Elementary School, Palatine

Dorothy Franklin
Dewitt Clinton Elementary School, Chicago

Ranada Lynn Johnson
Mann Elementary School, Chicago

Elizabeth Ann Lightfoot
Pulaski Community Academy, Chicago

Jacqueline McGrew
Winston Campus Jr. H.S., Palatine

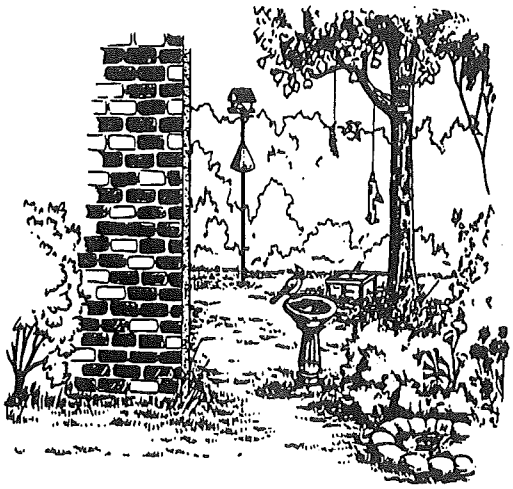
Sandra A. Pye
Adam C. Powell Jr. Paideia Comm. Acad., Chicago

Carlos Rodriguez
Inter-American Magnet School, Chicago

Craig Segal
Inter-American Magnet School, Chicago

James R. Sorenson
Chippewa Middle School, DesPlaines

Steven Tabisz
Hinsdale Middle School, Hinsdale



SCHOOLYARD HABITAT ACTION GRANTS

Sixteen Illinois educational organizations, from an early childhood center to various schools to a local college, received environmental action grant funding for projects including a shoreline restoration project, a ravine woodland improvement program, prairie plots and butterfly gardens.

Projects WILD, Learning Tree and WET are environmental education programs for use with students from kindergarten through high school. The Projects are interdisciplinary in nature and encourage hands-on learning. The Schoolyard Habitat Action Grant program funds the development of local habitat areas that can be used to teach math, science, agriculture, botany and other subjects.

Forty-nine applicants requested a share of $6,000 in available grant funding. grants were awarded based on student and community involvement, incorporation of a project into school curriculum and benefits to wildlife. Partnerships are strongly encouraged and enable project organizers to maintain a positive momentum throughout the year.

Since 1994, the Schoolyard Habitat Action Grant Program has been funded by a donation from the Jadel Family Foundation and is administered through the Illinois Conservation Foundation. The maximum award is $500. In addition to the monetary award, recipients will receive related classroom materials, a certificate and a sign to post at the habitat site. Free tree and shrub seedlings and prairie forbs are available from IDNR's nursery stock. Technical assistance from IDNR's wildlife biologists is also available.

Representatives from the Illinois Department of Natural Resources and the Environmental Education Association of Illinois judged applications. Businesses, corporations and other contributors wishing to help fund the grant program in the future can contact IDNR's Educational Services Section at 217/524-4126, TDD 217/782-9175. To receive a copy of the new 1999 Schoolyard Habitat Action Grant application, please contact Paula Driver, 217/524-4126,
email: teachkids@dnrmail.state.il.us
www.dnr.state.il.us/nredu/nredpage.htm

1998 SCHOOLYARD HABITAT ACTION GRANT RECIPIENTS

Bureau County
Bureau Valley High School in Manlius: Wetland viewing Station (grades 9-12) — $365

Cook County
Cesar E. Chavez School in Chicago: A Prairie in Your Yard (grades K-5) — $500
Wilma Rudolph Learning Center in Chicago: A butterfly Urban Paradise at Rudolph Center (grades preK-3) — $400

Fayette County
Shobonier Elementary School in Vandalia: Outdoor Laboratory Facility (grades K-5) — $300

Kane County
Sleepy Hollow School in Sleepy Hollow: Lake Sharon Shoreline Restoration and Beautification Project (grades 4-5) — $500

Lake County
Barat College in Lake Forest, Illinois Campus Ravine Woodland Restoration (college pre-service students) — $280
North Barrington Elementary School: Interactive Habitat (grades K-5) — $500

Madison County
Roxana High School and Roxana Central Elementary School in Roxana: A Walk on the Wild Side (grades K-12) — $300

Marshall County
Sparland Elementary in Sparland: Project GROW (Gardens Reflect Opportunities of Wonder) (grades K-6) — $500

McDonough County
MacArthur Early Childhood Center in Macomb: Creating a Natural Children's Place (grades preK and kindergarten)— $200

Moultrie County
Bethany Junior-Senior High School in Bethany, Illinois prairie Plot Pilot Project (grades 6-12) — $200

Sangamon County
Riverton Middle School in Riverton: Expanding the Prairie (grade 7) — $375

Stark County
Stark County Soil and Water Conservation District Schoolyard Prairie Plot (grades 6-8) — $100

Vermilion County
Judith Giacoma Elementary in Westville: Project Prairie Garden (grade 3) — $460

Warren County
Immaculate Conception School in Monmouth: Wildlife Habitat (grades K-8) — $220

Interstate Mining Compact Commission
459-B Carlisle Drive, Herndon, VA 20170-4819
Phone: 703/709-8654
Fax: 703/709-8655
Web Address: www.imcc.isa.us
ail: gconrad@imcc.isa.us or bbotsis@imcc.isa.us

IMCC NATIONAL MINERALS EDUCATION AWARDS

The Interstate Mining Compact Commission (IMCC) is sponsoring two national minerals education awards to recognize the efforts of those who educate others about the use of minerals and the issues associated with mining, particularly from an environmental perspective, and those who have undertaken special outreach programs to inform the public about mining. There are two awards that will be presented:

Mining Awareness Educator Award
This award will be presented to a teacher or school from an IMCC member state that has achieved excellence in one or more of the following categories:

- provided educational outreach in an innovative manner that increases the level of understanding in the classroom and/ or community about mining and its impacts
- promoted environmental stewardship while enhancing the understanding of issues associated with mining and natural resource development
- created unique educational materials or curriculum demonstrating the production and/or use of minerals and associated environmental protection.

These criteria may be met through classroom and/or out-of-classroom (i.e. field trips, mine tours, etc.) activities. This award will consist of a framed award certificate and a $250 gift certificate for classroom resource materials.

Public Outreach Award
This award will be presented to an industry, environmental, citizen or other group, or to a state government body, that has achieved excellence in one or more of the following categories:

- provided educational outreach in an innovative manner that increases the level of understanding in the community about mining and its impacts
- promoted awareness of environmental stewardship associated with mining through active involvement of citizens
- fostered cooperation and partnerships with diverse groups to achieve understanding
- enhanced the understanding of issues associated with mining and natural resource development
- fostered public education through mine tours, visitor centers, community awareness days, career days, personnel volunteerism in the schools, maintaining adopt-a-school programs or education partnerships, or any other innovative initiative deemed deserving by the awards committee.

This award will consist of an engraved plaque recognizing the winner.

A person or organization can self-nominate or can be nominated by someone else using the attached format. The winners of the two awards will be selected by the IMCC Awards Committee from among those nominated using the above criteria and the information provided. Awards will be presented at the awards banquet held in conjunction with IMCC's annual meeting. The deadline for submissions is February 1 of each year. For further information contact Beth Botsis at IMCC (703) 709-8654 or E-mail: bbotsis@imcc.isa.us.

NATIONAL WILDLIFE FEDERATION CERTIFIES LOCAL SCHOOL CAMPUS AS OFFICIAL "SCHOOLYARD HABITAT"

The National Wildlife Federation announces that Wheaton Warrenville South High School in Wheaton, Illinois has put out the welcome mat for all kinds of birds, squirrels, and other wildlife while offering its students an alternative, outdoor classroom. A designated portion of the Wheaton Warrenvillle South campus is now recognized as a National Wildlife Federation (NWF) Schoolyard Habitat®.

Launched in 1995, the Schoolyard Habitats program provides materials and expertise to encourage the creation of wildlife habitat areas as learning centers in schoolyards nationwide. It follows in the tracks of NWF's successful Backyard Wildlife Habitat™ Program, now in its 24th year.

The portion of the Wheaton Warrenville South campus that has been certified a Schoolyard Habitat is a model of ecological stewardship and common-sense conservation for the community. Even more importantly, it functions as a living classroom that offers students and teachers enhanced learning experiences across the curriculum. For students, the learning is creative, practical, and hands-on, whether they're tracing how the land has been used over time for history class, using nature as the subject of an art project, keeping a journal of the habitat's development for English, or collecting and observing organisms for science class. The habitat is a "classroom" students will remember.

The Schoolyard Habitats program has developed an information kit that will aid you through the process of creating a schoolyard habitat. The kit consists of an instructional Planning Guide and a pre-paid Application for Certification. It may be ordered with Visa or MasterCard by calling (410) 516-6583 or by sending a check (payable to the National Wildlife Federation) to NWF—Backyard Wildlife Habitat program, 8925 Leesburg Pike, Vienna, VA 22184. The cost of the packet is $18.45 (including shipping and handling) plus any applicable state and local taxes. For general information on the program, please call (703) 790-4434, Fax: 703-790-4075, Website: http://www.nwf.org/

Hector Ibarra
MLSTA Past President,
Iowa City, IA

DON'T KEEP YOUR PROGRAM AND SUCCESS A SECRET

There are many outstanding teachers that are keeping all the exciting things that are happening in their classroom a secret. Awards allow the public to know about the wonderful things you are doing with your students. Most importantly, awards give you and your program creditability. Many awards provide monetary funds for your classroom and some provide trips for the teacher and student. I encourage you to apply for the teacher awards. One in particular is the Catalyst Award. One portion of the CMA Catalyst award honors middle level educators. Look over the programs and begin generating ideas for next year's awards. Please consider entering your program in one of the following award categories. Call and ask for application forms or ask to be put on their mailing lists.

Marteka Award for Creative Science Teaching
$2,500 + $1,000 travel
1940 Rohret Ct SW, Iowa City, IA 52240
Due date: Nov. 15
http:www.NSTA.org/nmlsta

Hurd Award
$1,000
Sndrosene@scholastic.com
Due Date: Nov.15
http:www.NSTA.org/nmlsta

Environmental Science Awards
$2,500-12,500/trip to FL
Ed. Dept., Sea World, Elizabeth Chick, 7007 Sea World Drive,
Orlando, FL 32821
407-363-2389
Due date: Feb. 28

Chevron-Times Mirror Magazines Conservation Awards
$2,000 cash/trip
PO Box 7753, San Francisco, CA 94120
415-894-2457 or 202-624-1113
Due date: Dec. 15

Keep America Beautiful Awards
Plaque/trip
9 West Broad St., Stanford, CT 06902
203-323-8987 Kit Martinsen
Due Date: Aug.

National Energy Ed. Development Project
Plaque
PO Box 2518, Reson, Virginia 20195
800-875-5029 Martha Callan
Due Date: April 15

President's Environmental Youth Awards
Plaque/Trip to DC
United States Environmental Protection Agency
401 M Street, Southwest (1707), Washington, DC 20460
202-260-8749 or 202-382-4965
Due date: July 30

Renew America
Plaque/Trip to DC
1400 16th St., NW, Suite 710, Washington, DC 20036
202-232-2252 Betsy Bird
Due Date: Sept. 15

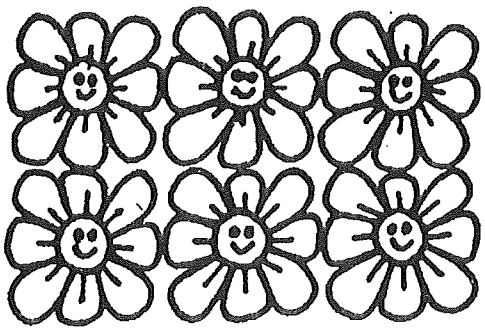
CMA Catalyst Award
$2,500 or $5,000 cash
2501 M Street, NW, Washington, DC 20037
703-741-5826 Hope Bonito
Due date: Jan. 10

PAESMT
$7,500/trip to DC
NSF, 4201 Wilson Blvd., Arlington, VA 22230
703-306-0422
Due date: Feb. 28

Walt Disney American Teachers Award
$2,500/trip to CA
PO Box 9805, Calabasas, CA 91372
818-569-3279 Kevin Trudgeon
Due Date: Feb. 15

NAGT/OEST Earth Science Award
$500 equip/trip
PO Box 5443, Bellingham, WA 98227-5443
Dr. Robert Christman
Due Date: ?

NSTA Award Programs
1840 Wilson Blvd., Arlington, VA 22201-3000
703-243-7100 Lori Pinson
Due Date: Nov. 15



EDUCATIONAL MATERIALS

FREE SCIENCE LESSONS FOR ELEMENTARY TEACHERS

ScienceSouth offers twenty (20) Free sample Science Project Instruction Plans to elementary science teachers and students, too! Send a current name/address sticker or label along with $3.00 for postage and handling to: ScienceSouth, PO Box 50182, Knoxville, TN 37950-0182. Titles furnished include: volcano model, collecting leaves, plant maze, biodegradables, holding ice, heat and color, bridges, stopping sound, color mixing, testing detergents, microwave effect on seeds, chemical garden, recycling, heads and tails, killing a potato, chromatography, popcorn, synthetic cola, egg drop, and celery split.

WIND ENERGY INFORMATION GUIDE for middle school through college educators from the U.S. Department of Energy. The guide describes wind energy and how it works, its uses, the environmental and economic aspects of wind energy, wind turbine design, and the U.S. wind resource. Photographs and illustrations are included, and each chapter provides annotated references for further research. The guide can serve as a resource for science reports, projects, and fairs. Contact Document Distribution Service, National Renewable Energy Laboratory, 1617 Cole Blvd., Golden, CO 80401-3393; 303-275-4363; fax 303-275-3619; e-mail sally_evans@nrel.gov

Educational packets on natural gas from the National Energy Foundation. Choose from four packets covering levels K-12 (one packet per educator may be requested). Place orders online at http://www.xmission.com/~nef/gas.html

Cleaner Cars Module, which instructs young drivers about the importance of proper car maintenance in reducing air pollution. The module also describes other actions responsible drivers can take to reduce air pollution, such as avoiding high speeds and combining errands in one trip. Included in the package are Cleaner Car Trivia, an interactive computer program on CD-ROM; *Exhausted: Clearing the Air About Auto Emissions,* a video; "What Pollutants Come from Mobile Sources," a slide-chart wheel with details about mobile source emissions and related car-care issues; a slide presentation with accompanying script; *Cleaner Cars Student Manual*; background information on air pollution, the Clean Air Act, and emissions from cars; checklists for buying a cleaner car, maintaining a car, and maintaining vehicle air conditioning systems; and information on the health effects of car emissions, determining fuel efficiency, electric vehicles, and recycling auto fluids. For more information and to request a copy of the module, call 1-800-557-2366.

Materials on creating and maintaining a healthy environment at school and at home, including a teachers guide, lessons, a poster, and classroom activities. See the Georgia-Pacific Health Smart Institute website at: http://www.gphealthsmart.com

A set of up to 30 copies of *Our Changing Climate*, a publication designed to raise the level of public awareness on issues dealing with global climate change. Released by the National Oceanic and Atmospheric Administration, the publication discusses historical events attributed to climate and socio-economic impacts of climate patterns. Request publications on school letterhead. Contact UCAR, Joint Office for Science Support, Attn.: Leilani Pena, PO Box 3000, Boulder, CO 80307-3000; 303-497-8666; fax 303-497-8633; e-mail rtn@joss.ucar.edu

Subscriptions to *Principled Practice in Mathematics and Science Education*, a newsletter published by the National Center for Improving Student Learning and Achievement in Mathematics and Science. Contact Sue MacKerr, Wisconsin Center for Education Research, School of Education, University of Wisconsin-Madison, 1025 W. Johnson St., Madison, WI 53706; 608-265-6240; e-mail ncisla@mail.soemadison.wisc.edu. The newsletter is available online at: http://www.wcer.wisc.edu/ncisla/

***Inside the Cell*, newly revised booklet** for high school and college science students and teachers that describes the critical functions of the organelles found in the cell. The booklet aims to help readers better understand today's basic biomedical research. Write to *Inside the Cell*, NIGMS Public Information Office, Bldg. 45, Rm. 1AS.25, Bethesda, MD 20892.

***Indoor Air Hazards Every Homeowner Should Know About*, publication** from the Environmental Protection Agency and the USDA's Cooperative State Research, Education, and Extension Service. Request item 636E from the Consumer Information Center, Dept. 636E, Pueblo CO 81009; 1-888-878-3256; http://www.pueblo.gsa.gov

Subscriptions to WRRI News, the newsletter of the Water Resources Research Institute at North Carolina State University. A back issue (July/August 1998) contains an article called "When Is Scientific Knowledge Sufficient for Environmental Decision making?" that can serve as a point of discussion for students. The newsletter is available online at http://www2.ncsu.edu/ncsu/CIL/WRRI, or you can write to WRRI, Box 7912, NC State University, Raleigh, NC 27695-7912 or send e-mail to: listserv@ncsu.edu (in the message, type "subscribe WRRI-NEWS <your full name>").

The College Board's new multimedia program GRO/Going Right On, which can be downloaded from http://www.collegeboard.org/press/html9899/html/981027.html. Free to middle and junior high schools, the software is designed for early teens who may be uncertain about their future prospects for college or unsure about how to get on the college-bound track. The program emphasizes early academic preparation and uses a mix of words, music, and animation to hold students' attention.

Sample issue of *Faces*, a publication for middle level social studies teachers that includes maps, feature stories, activities, photographs, and illustrations. Contact Cobblestone, a division of Simon and Schuster, at 609-924-7209, ext. 25; e-mail Elizabeth_Crooker@prenhall.com; or visit: http://www.cobblestonepub.com

REPORT PROVIDES DATA ON SCIENCE EDUCATION

Students Learning Science: A Report on Policies and Practices in U.S. Schools is now available on the Internet and in report form from the Government Printing Office. The report uses the science information collected during the 1996 National Assessment of Educational Progress (NAEP), which for 27 years has examined what students in grades 4, 8, and 12 know and can do in various subject areas. The report presents results relating to teachers' academic preparation and professional development, the amount of emphasis science instruction receives in schools, student course-taking, and the availability of school resources that support science learning. To view the report online, visit the National Center for Education Statistics homepage at: http://nces.ed.gov/pubsearch. Copies of the report cost $13. Send your payment to New Orders, Superintendent of Documents, PO Box 371954, Pittsburgh, PA 15250-7954. The stock number is 065-000-01190-5.

Materials from the Ecological Society of America. "Careers in Ecology" is a brochure for high school and college students with information on paths to becoming an ecologist and the many options available. Two- to four-page fact sheets cover such topics as invasive species, biodiversity, coral reefs, and global climate change. "Issues in Ecology," a series of four-page brochures on environmental issues, were prepared by panels of distinguished scientists with the help of a science writer and are suitable for the general public. The brochure "What Does Ecology Have To Do with Me? introduces the science of ecology and its role in human society. Contact ESA, 2010 Massachusetts Ave. NW, Suite 400, Washington, DC 20036-1023; 202-833-8773; e-mail esahq@esa.org

ChemSketch chemical drawing software, available for downloading from the Advanced Chemistry Development website at http://www.acdlabs.com/download/index.html#ChemSketch35. The software is full-featured and offers a 3D viewer/optimization tool; stored structure templates that allow very fast structure drawing, as well as pre-drawn lab apparatus and molecular orbital diagrams; and estimates of density, refractive index, and molar volume. (The company also has an Educator's Page, located at http:///www.acdlabs.com/educators/

Mad Cow U.S.A.: Could the Nightmare Happen Here?
Sheldon Rampton and John Stauber offer a chilling look at the history of bovine spongiform encephalopathy (BSE or mad cow disease) and related diseases, the fiasco created by the government and scientists in handling the disease in Britain, and the fear that regulators and industry are underestimating the possibility that a similar disease is already in the United States. Contact Common Courage Press, Box 702, Monroe, ME 04951, ph. 207-525-0900, fax 207-525-3068.

Altered Genes: Reconstructing Nature: the Debate
Editors R. Hindmarsh, G. Lawrence, and J. Norton assemble fourteen essays by Australian, Canadian, and New Zealand authors on the implications of genetic engineering on evolution, biodiversity, ethics, agriculture, and health. Contact Allen and Unwin, 9 Atchison Street, St. Leonards, NSW 1590, Australia, ph 61-2-8425-0100, fax 61-2-9906-2218, e-mail: frontdesk@allen-unwin.com.au.

DejaShoe produces shoes and boots made of recycled tires, newspapers, Styrofoam, metal and cloth. The bottoms of the soles say: Reduce, Reuse, Recycle. For additional information, call 503/682-8814.

Soapstone is dust free and can be used instead of chalk for writing on classroom chalkboards. Schulhof Company in Woodstock, Illinois carries soapstone and can be reached at 815/338/1500.

EarthWrite pencils, made of recycled newspapers and cardboard boxes, cost $2.39 per dozen. You can buy this product at office supply or drug stores. They are produced by Sanford, 2711 Washington Blvd., Bellwood, IL 60104. See also: http://www.sanfordcorp.com.

Leapfrogging Through Wetlands presents lively, hands-on learning with imaginative activities and realistic stickers in a book that allows children ages 9-12 to investigate the world of sedges, rushes, ducks and frogs by becoming "wetland detectives." This book is available from Dog-Eared Publications for $10.95 and can be ordered by calling 888/DOG-EARS or email: www.dog-eared.com.

Nature Smart: A Family Guide to Nature by Stan Tequila and Karen Shanberg is written in a friendly style. Each chapter introduces a different component of nature: "Hike Smart," "Woodland Smart," "Bug Smart," "Mushroom Smart," and "Weather Smart." The appendix has lists of environmental organizations and an extensive bibliography. The book is predominately for the Midwest and Eastern regions of the United States. Adventure Publications, Inc., $17.95. 292 pages.

NEW ENVIRONMENTAL EDUCATION MATERIALS

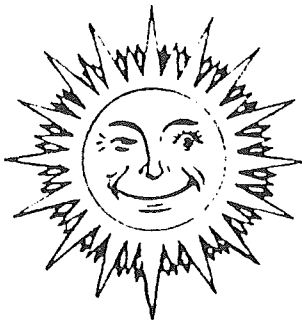
The Illinois State Geological Survey has stocking stuffers available for those interested in the following: *Guide for Beginning Fossil Hunters* ($2.00), *Guide to Rocks and Minerals of Illinois* ($2.00), *Illinois' Ice Age Legacy* ($5.25), *Guide to Pennsylvanian Fossil Plants of Illinois*, various posters and more. Write to ISGS, 615 East Peabody Drive, Champaign, IL 61820 or call 217/333-4747 for ordering information.

Give Water A Hand Action Guide is now in Spanish and on the web at: http://www.uwex.edu/erc
The guide was developed for 4-H leaders, however, it can easily be adapted for use with most youth groups. Printed copies are $5 each by calling 800-WATER 20. Or e-mail: erc@uwex.edu

Cats Indoors! The Campaign for Safer Birds & Cats has materials available on their mission to protect cats, birds and other wildlife by keeping cats indoors. For more information, contact: American Bird Conservancy, 1250 24th Street, NW, Suite 400, Washington, DC 20037. Call 202/778-9666 or e-mail: abc@abcbirds.org

One Land, One Heart is a critically acclaimed CD of 16 environmentally inspired tunes, from a group of nationally known soloists and groups. The album is a diverse brew of folk, blues, and haunting instrumentals. The CD is available from M.U.S.E. (Musicians United to Sustain the Environment). For more information, write M.U.S.E. at P.O. Box 671, South Lyon, MI 48178 or e-mail: MUSEAssociation@Juno.com

Kenaf is a plant that enables Vision Paper to produce 100% tree-free paper. Kenaf grows to maturity in 180 days, so it can be cut, harvested and a new crop planted in a short time. For more information about this alternative to the world's insatiable paper market, contact Vision Paper at 505/294-0293.



WORLD-(W)IDEAS

A free, 4'x6' laminated world map from National Geographic awaited teachers across the United States in September. The double-sided map has already helped a great many students...

- Track a pen pal's journey across Europe
- Follow the course of their "adopted" ship
- Get a better sense of the distance from their hometown—where their teacher stuck a red push-pin—to faraway places
- Celebrate the diversity of the student body. They marked the many countries from which the students have come.
- Create a three-dimensional clay version of the digital image. The model measures a full 5'x7'—11 square feet larger than the Society's original. To display both sides of the map and make it accessible to the whole school, a custodian plans to put the map in clear plastic and mount it on wheels.

You'll find K-12 lessons for the map on the Society's Web site at: www.nationalgeographic.com/education/mapskills/
The Society's map giveaway reached 113,000 schools in the United States. National Geographic, with the Royal Canadian Geographical Society, is also giving maps to more than 15,000 public, private, and aboriginal schools in Canada.
For additional maps, educators may call (800)368-2728 and ask for the double-sided world map (product #M8122001C, for $39.95).

IFIC

NEW IFIC FOUNDATION PUBLICATIONS

Publications List A complete list of publications and *Food Insight* reprints available from the International Food Information Council (IFIC) Foundation. Single copies of publications on food safety and nutrition are available free-of-charge from the International Food Information Council (IFIC) Foundation. Bulk prices are provided. To order publications, please write to Publications Department, IFIC Foundation, 1100 Connecticut Ave., N.W., Suite 430, Washington, DC 20036. All publications are now accessible on the world wide web at: http://ificinfo.health.org Inquiries and orders may be placed on our web site or via email at: foodinfo@ific.health.org

Improving Public Understanding: Guidelines for Communicating Emerging Science on Nutrition, Food Safety, and Health Based on an advisory group convened by the Harvard School of Public Health and the International Food Information Council Foundation, this publication provides "guiding principles" for general communicators as well as specific guidelines for scientists, journal editors, journalists and interest groups.

Helping Your Overweight Child. An easy-to-understand booklet to help parents and caretakers identify and assist children with weight problems. Developed by the National Institutes of Health's Weight-control Information Network and the IFIC Foundation. 20 pages.

Food Biotechnology: Health & Harvest For Our Times. A booklet providing an overview of food biotechnology from its roots in traditional agriculture to its promise for the future. 12 pages.

Understanding Food Allergy. A booklet explaining basic symptoms, diagnosis and management of food allergy, and differences between food allergy and food intolerance. Co-published with the American Academy of Allergy, Asthma and Immunology. 16 pages.

Healthy Eating During Pregnancy. An educational booklet summarizing the most current recommendations on nutrition and weight gain during pregnancy. Co-published with the March of Dimes Birth Defects Foundation. 16 pages.

Caffeine and Women's Health. A booklet providing background information on caffeine and female reproduction and other health issues. Co-published with the Association of Women's Health, Obstetric, and Neonatal Nurses. 12 pages.

Food For Thought II—Reporting of Diet, Nutrition and Food Safety What's changed in food and nutrition reporting since Food For Thought I? This new analysis compares major topics, sources, themes and opinions as reported in print and broadcast media markets nationally 1997 to 1995.

How to Understand and Interpret Food and Health Related Scientific Studies Quick! What are the definitions of placebo, statistical significance and absolute risk? This latest IFIC Review is a must-have for anyone who communicates scientific studies, but who may not have an extensive science background.

Benefits of Balance: Managing Fat in Your Diet A new consumer brochure details how lower-fat foods and foods with fat replacers can be included in the overall diet to balance food choices. It was developed in partnership with the Food and Drug Administration.

Nutrition and Oral Health: Making the Connection. A referenced white paper on the important relationship between diet and oral health, causes and prevention of cavity formation and future research opportunities.

Ingredient Series. A series of easy-to-read brochures answering the most common questions on various food ingredients. All favorably reviewed by the American Academy of Family Physicians Foundation.

Food Insight Media Guide on Food Safety and Nutrition. 1998-1999. A comprehensive manual for journalists filled with food safety and nutrition information. Includes 200 expert sources for interviews as well as backgrounders, articles and IFIC Foundation publications.

IFIC Reviews. These referenced white papers on Dietary Fats and Caffeine have been updated with the latest science, studies and information.

Everything You Need to Know About Aspartame The updated information available in this brochure addresses questions about aspartame safety and use in foods. The brochure has been favorably reviewed by the American Academy of Family Physicians Foundation.

Everything You Need to Know About Asthma and Food A patient education brochure designed to provide information about confirmed food triggers and tips for preventing food-triggered asthma. Developed in conjunction with the Division of Allergy, Asthma and Immunology, Scripps Clinic and Research Foundation.

TEACH WITH DATABASES: TOXICS RELEASE INVENTORY

Do you know where the smokestacks and outflow drains are in your community? Many people are unaware of what they emit and equally unaware that it is easy to find out. EPA's Toxics Release Inventory (TRI) records chemicals whose release is monitored by the U.S. Emergency Planning and Community Right-to-Know act. The first volume in this new NSTA series gives teachers all the tools they need to teach students about chemical releases using this important database.

The box set includes an 80-page *Teacher's Guide*, which provides students with real-world applications of science. Each activity includes teaching tips, assessment suggestions, and reproducible worksheets. Activities are based around the TRI CD-ROM (DOS), which is also included in the set. (TRI is available over the Internet for Windows or Macintosh.) As students learn how industry and government researchers monitor chemical emissions, they also learn new ways to explore their own environment. Topics include:

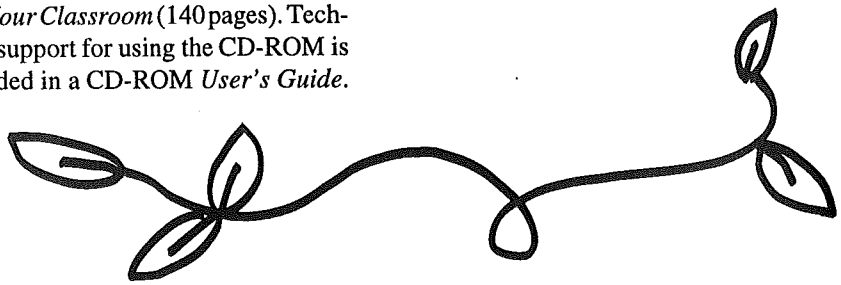
- identifying a local airshed and watershed;
- identifying toxic releases in a region;
- learning more about a toxic chemical;
- conservation of mass;
- water quality monitoring;
- bioaccumulation;
- risk analysis of air releases; and
- recycling methods.

The set also includes *Database Basics*, an activity book which leads students through the process of gathering and using data. Extensive background information suggests ways to incorporate these data skills into the science curriculum. Each activity includes teaching tips, assessment suggestions, and reproducible worksheets. The 56-page book can be used in conjunction with activities in the *Teacher's Guide*, or used as stand-alone activities that can help students work with any data they will be collecting during the course of the curriculum. (*Database Basics* is also sold separately.) Students will learn how to:

- collect and describe data;
- investigate data quality;
- develop a database of their own;
- identify trends in data;
- apply basic statistical methods to their data
- develop appropriate graphs; and
- use data to make decisions.

To further give high school teachers a range of options for bringing environmental education into the classroom, the box set includes, at no extra cost, the EPA's *Guide to Environmental Issues* (86 pages) and *Getting Started: A Guide to Bringing Environmental Education Into Your Classroom* (140 pages). Technical support for using the CD-ROM is provided in a CD-ROM *User's Guide*.

Teach with Databases links local and nationally-collected data to help students understand the chemical history of their own community. The set provides context for learning in chemistry, biology, Earth science, and environment education classes. A wealth of hands-on activities helps students improve their ability to collect, investigate, and draw conclusions from data. To order, call NSTA Publications Sales at (800)722-NSTA. The *Teach with Databases* box set (#PB143X01) is available for $35.00. *Database Basics* (#PB142X) is available for $12.95.



SCIENCE EDUCATOR'S GUIDE TO ASSESSMENT

Assessment is now at "center stage." It has become increasingly important during the past decade, as educators and policy makers seek reforms to our educational system in response to national and international priorities. As science educators, we face a continual challenge of assessing what students know, what they are able to do, and what they value in learning science. Students need systematic feedback to understand their own strengths and capabilities in learning. A well-designed assessment program goes a long way in helping students reflect on their learning. Hence the importance of assessment reform.

Reform efforts, embodied in the *National Science Education Standards* and *Project 2061: Benchmarks for Science Literacy* call for widespread reform in science instruction and assessment. The *Science Educator's Guide to Assessment* explores the new advances in learning theory and how these insights enable educators to improve science assessment. This new book looks at the use of sophisticated assessments, using a variety of teaching strategies to help students develop their ability to learn and to solve problems in "real world" situations and contexts.

This book covers assessment formats and strategies appropriate for learning outcomes in inquiry activities undertaken in the classroom, laboratory, and outdoors. The designs of these assessment formats and strategies are based on the most recent research on assessment, instruction, and learning. The book includes many practical assessment examples—from Biology, Chemistry, Earth Science, and Physics for use in the classroom.

Rodney Doran, Fred Chan, and Pinchas Tamir, *Science Educator's Guide to Assessment* (#PB145X) is 210 pages and costs $27.95. To order, contact NSTA Publication Sales at 800-722-NSTA or 703-243-7100.

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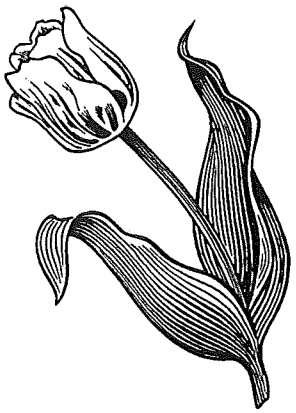

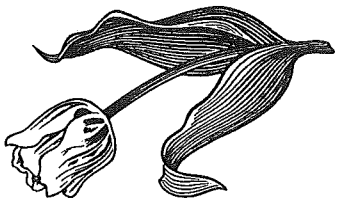

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YES, I WOULD LIKE TO CONTRIBUTE TO THE ISTA SPECTRUM

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Please print my contribution in the following issue(s):

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SPECTRUM welcomes black and white glossy photographs. We can sometimes use color pictures but they must be sharp with high contrast. Please enclose a stamped self-addressed envelope if you want your photos returned.

Send to:

Diana Dummitt
ISTA Spectrum
University of Illinois
College of Education
1310 S. Sixth Street
Champaign, IL 61820

BENEFITS AND ACTIVITIES FOR ISTA MEMBERS

SPECTRUM—Spectrum is the quarterly ISTA journal. The Spectrum provides ISTA members with association news and updates from ISTA officers, a column on state initiatives, articles, teaching techniques, exciting classroom ideas and information regarding upcoming meetings, conferences and educational opportunities.

THE ISTA CONVENTION—For over twenty-five years this annual conference has brought together educators and administrator through the state. Major speakers; over 200 group sessions, hands-on workshops, microcomputer labs; and more than 150 commercial exhibits are a few highlights of this outstanding program of renewal for science teachers.

LEGISLATIVE REPRESENTATION FOR SCIENCE EDUCATION—ISTA provides a direct line of communication between science educators and state officials. Our organization voices concerns and recommends programs and funding for science education.

ISTA HIGH SCHOOL AWARDS—This honor is awarded annually to high school students who excel in science. Awards are available to all high schools.

TEACHER AWARDS—ISTA sponsers a variety of awards for elementary, high school, and preservice teachers.

WEBSITE—Visit our website at: http://www.ista-il.org

1999 MEMBERSHIP CATEGORIES

Any person interested in science education is eligible for membership. All memberships include a subscription fo the SPECTRUM and a subscription to the new Newsletter, the ACTION. Write the number of the option for the membership category on the Membership Form on the back cover. Join now and your dues will be in force until January 2000. Membership year runs for the calendar year January 1 through December 31.

Option 1: Full Membership Dues- $25.00 Full Membership entitles individuals interested in Illinois science education to the following benefits: a one year subscription to the SPECTRUM, and ISTA ACTION. publications of the Illinois Science Teachers Association; notification of regional conferences and meetings; invitations to science issues activities; a reduced registration fee for the Annual ISTA Conference; voting privileges; and the opportunity to hold an ISTA Officer position.

Option 2: Two Year Full Membership Dues- $45.00 Two Year Full Membership entitles member to Full Membership benefits for two years.

Option 3: Five Year Full Membership Dues- $100.00 Five Year Full Membership entitles member to Full Membership benefits for five years.

Option 4: Associate Membership Dues- $15.00 Associate Student Membership applies to full-time students who are not currently employed as professional educators (Requires the signature and institutional affiliation of the student's professor). Entitles member to Full Membership benefits, with the exception of voting privileges and the opportunity to hold an ISTA Officer position. Associate Retired Membership applies to individuals who are on retirement status. Entitles member to Full Membership benefits, with the exception of voting privileges and the opportunity to hold an ISTA Officer position

Option 5: Institutional Membership - $50.00 Institutional Membership entitles the member institution, for a period of one year, to two subscriptions to the SPECTRUM and ISTA ACTION; notification of regional conferences and meetings; invitations to science issues activities; and a reduced registration fee for the Annual ISTA Conference for a maximum of three members of the institution.

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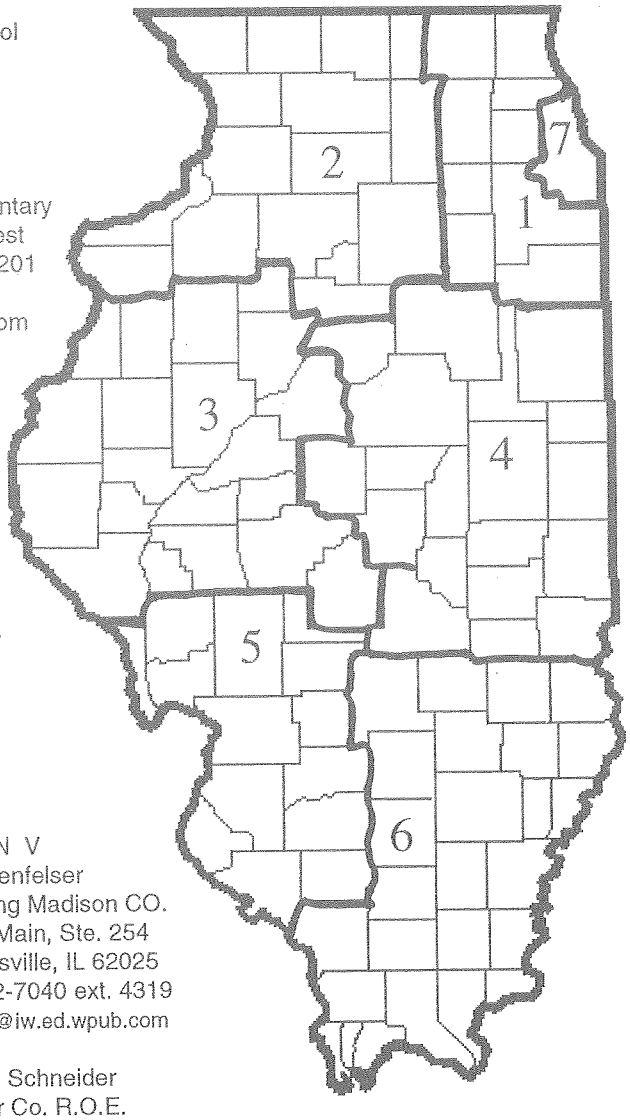

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ILLINOIS SCIENCE TEACHERS ASSOCIATION

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Send form and check or money order made payable to Illinois Science Teachers Association to: Diana Dummitt, ISTA Membership, College of Education, University of Illinois, 1310 S. Sixth Street, Champaign, IL 61820

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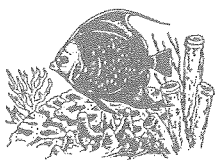

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