SPECTRUM

THE JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION

WINTER 1998

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JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION
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ISTA NEWS

WINTER PRESIDENT'S LETTER

In January 1996, former Illinois State School Superintendent Joseph Spagnolo announced that Illinois public schools could use IGAP results instead of local assessment data for school improvement purposes. Illinois educators received the news enthusiastically. The burdensome school improvement process in place before 1996 required faculties to create, validate, and use what seemed an excessive number of local assessment instruments. Teachers and principals were glad to get out from under an authoritarian system that required extensive analysis of assessment results. Repercussions from that ill-fated attempt at school improvement abound today.

One consequence of the Spagnolo decision was that school faculties no longer felt compelled to analyze any assessment data, either IGAP or local assessment, for school improvement purposes. Most of us view assessment data as summative, not formative. We use end-of-chapter or end-of-unit tests to rank students and assign grades. Rarely do we analyze assessment data to uncover errors in student thinking or to detect ill-conceived teaching strategies or curriculum structures. Scholars such as Grant Wiggins and Richard Stiggins have failed to change our thinking and practice in this area. I know of few faculties among the 4,000 public schools in Illinois who meet regularly to systematically analyze and discuss assessment results with the goal of improving student achievement in science or any other content area. Science teachers, with their experimental and analytical skills, should be leaders in the use of assessment data to improve student achievement. Regrettably, in this area, our training fails to inform our practice.

A second system failure in the post-1996 school improvement era lies with the state education agency. In a bureaucracy where initiative is seldomly applauded, staff failed to notice that Illinois teachers might use IGAP results in new ways.

Had they responded to this new direction, they might have provided teachers with useful information in teacher-friendly formats. Let me give you some examples. Today, few teachers see individual student IGAP reports, although this essential information is provided to administrators in every school in Illinois. Individual reports disclose the percentage of questions by goal that each student answered correctly. By graphing these data, teachers can see how well their students performed at the goal level. While it would be extremely helpful to compare school and state mean goal scores, the latter information is not reported and is hard to get. In November I requested the state mean scores for the four goals in science for the 1997 IGAP test. I am sure that I will get those statistics, but I do not have them yet. The agency should provide that information in all content areas along with the student reports. The agency also should release IGAP test items each year along with an item analysis. This practice would help students, parents, and teachers understand what science and other content is being assessed, how well students are learning the content, and whether students hold misconceptions that should be corrected. In a statement posted on the ISBE web page, agency personnel state that they aren't going to offer teachers an IGAP item analysis because teachers told them that an item analysis wasn't helpful without having the test questions. Apparently the agency polled a few teachers, telling them up front that the agency wasn't going to release any IGAP questions, but questioning whether teachers would like an item analysis anyway. In my view, that poll proceeded to a wrong conclusion by beginning with the wrong premise. Give us the questions and the item analysis.

For the past two years I have argued that teachers should take control of their profession by doing what good practice demands and by asking service providers to give teachers what they need to be successful. Using state assessment results to improve student achievement is another area in which we teachers can do much better and where agency staff can do more to help us.

Doug

RENEW YOUR ISTA MEMBERSHIP TODAY

CHECK THE ADDRESS LABEL ON THE BACK OF THIS ISSUE.

UNLESS IT SAYS 1/2000 OR LATER YOUR MEMBERSHIP HAS EXPIRED.

MEMBERSHIP FORM AND PAYMENT MUST BE RECEIVED BY FEBRUARY 15, 1999 OR YOU WILL NOT RECEIVE ANY MORE ISSUES OF THE SPECTRUM OR ISTA ACTION.

PLUGGING IN TO THE FUTURE

THANKS TO ALL OUR WONDERFUL VENDORS WHO DONATED THEIR TIME, ENTHUSIASM AND PRODUCTS TO HELP MAKE OUR 1998 CONVENTION A HUGE SUCCESS!

COMMERCIAL

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Carolina Biological Supply Co.
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Dimensions in Learning
Dynamic Graphics
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Glencoe/McGraw-Hill
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Great Source Education Group
Grolier Publishing
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Environmental Ed Assoc. of Illinois
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Illinois Farm Bureau
Illinois Math & Science Academy
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Illinois Soybean Association
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NCRTEC
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Space Explorers, Inc.
Steel Recycling Institute
United States Space Foundation
Wisconsin Society of Science Teachers
WYSE-Worldwide Youth in Science and Engineering
Young Entomologists' Society

"Everyone Teaches, Everyone Learns"
1999 Annual Meeting of Illinois Science Teachers Association
October 1-2, 1999
Prairie Capitol Convention Center
Springfield, Illinois
CALL FOR PRESENTATIONS
DEADLINE FOR SUBMISSION: APRIL 1, 1999

PLEASE COMPLETE A FORM FOR EACH PARTICIPANT (You may duplicate this form).
I can be available for o Friday's program o Saturday's program o either day

PLEASE PRINT OR TYPE AND FILL OUT COMPLETE FORM

Name ______________________ Day phone ______________________

Affiliation (School or Organization) ______________________ Home phone ______________________

Address of above organization ______________________ Home address ______________________

City, State, Zip Code ______________________ City, State, Zip Code ______________________

e-mail and/or FAX ______________________

Title of presentation (10 word maximum) ______________________
Program description as you wish to appear in the program book (25 word maximum)

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DUE TO LIMITED SPACE, PRESENTATIONS MUST BE LIMITED TO 50 MINUTES.

I. Type of Session	II. Intended Audience	III. SubjectArea
o hands-on workshop	o preschool	o earth and space science
o demonstration	o elementary	o chemistry
o lecture	o middle/jr.high	o physics
o other	o high school	o biology
	o college	o ecology/environment
	o teacher preparation	o science/tech/society
	o general	o technology
	o other	

IV. Equipment Required o overhead projector o slide proiector

Note: We are prepared to furnish only overhead, screen, and slide projector. Other equipment, including computers, needs to be furnished by presenters. If you need any special arrangements or equipment, including internet connection, contact Diana Dummitt ASAP at 217-244-0173, e-mail ddummitt@uiuc.edu

V. How many participants can you accommodate at your session?
o 30-50 o 51-80 o 81-150

PLEASE ATTACH A ONE PAGE ABSTRACT OF YOUR PROPOSED PRESENTATION.
As a professional, nonprofit organization, the Association is unable to reimburse participants for travel or other conference expenses. ALL PARTICIPANTS INCLUDING PRESENTERS, ARE REQUIRED TO REGISTER FOR THE CONFERENCE. This form is not for commercial or non-commercial exhibits. It is only for educators!
All Presentations are required to conform with the NSTA safety guidelines.

Signature________________________________ Date____________________

SEND OR FAX SIGNED FORM AND ABSTRACT TO:
Diana Dummitt, ISTA, College of Education, UIUC, 1310 S. Sixth Street, Champaign, IL 61820
Phone (217)244-0173 **Fax** (217)244-5437

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TWO ILLINOIS TEACHERS TRAVEL TO ANTARCTICA

Visit the coldest, highest, windiest and most pristine continent on earth this austral summer (the Illinois winter!) with Betty Trummel and Hillary Tulley. These two Illinois teachers were selected to travel and work in Antarctica through participation in Teachers Experiencing the Arctic and Antarctic (TEA). This program is funded by National Science Foundation branches of the Directorate for Education and Human Resources and the Office of Polar Programs. This field season three went to the Arctic and eight new teachers will work in the Antarctic.

Betty Trummel is a fourth grade teacher at Husman Elementary in Crystal Lake Illinois. Betty was involved in the Cape Roberts Project and working in Crary Lab from October 10th until December 10th. She worked with Dr. Ken Verosub from the University of California, Davis. The primary goal of the Cape Roberts project is to obtain the climate history of Antarctica for the past 65 million years. In particular the researchers are trying to study the history of Antarctic glaciation dating back to the Cretaceous. This project will also determine whether Antarctica has always been located at the south pole.m of the Ross Sea. The drilling season will be 2 months long. Cores will be analyzed in Crary Lab for changes that can be used to determine the age of the core samples. This will enable scientists to obtain a history of climatic and tectonic events in Antarctica.

Hillary Tulley will have a true Antarctic field camp experience - living in Scott tents, being immersed in beautiful surroundings and having frozen peanut butter for lunch. She will join Dr. George Denton's team from the University of Maine in Beacon Valley. Beacon is one of Antarctica's ice free Dry Valleys, accessible from McMurdo Station via helicopter. Beacon is about 1200 m in elevation and overlooks the Taylor Glacier. The research team will be sampling buried ice which is has been dated as being 12 million years old. The age has been determined by argon 40/argon 39 dating of volcanic ashfall. If this ice is indeed this old, this speaks strongly to the stability of the East Antarctic Ice Sheet, which has implications for our current climatological questions. Ice in Eastern Antarctica is attached to ground above sea level, while that of Western Antarctica is "grounded" below sea level. The West Ice sheet is thus vulnerable to ocean warming.

The work this year will help elucidate the history and stability of the Antarctic Ice Sheet and perhaps even to help understand how climate may work. You can follow our adventures and experience the science with us.

The TEA website is www.glacier.rice.edu. Click on the pink button in the lower right corner - Teachers Experiencing Antarctica.

TEA is possible only because it is a partnership between teachers researchers, students and school districts. We would like to thank Districts 47 and Districts 219 for the support they have demonstrated for us to be able to participate in this extraordinary opportunity.

NSTA FUTURE CONVENTIONS

1999 Annual Convention and Exhibition
Boston, MA
March 25-28, 1999

2000 Annual Convention and Exhibition
Orlando, FL
April 6-9, 2000

2001 Annual Convention and Exhibition
St. Louis, MO
March 22-25, 2001

2002 Anual Convention and Exhibition
San Diego, CA
March 27-30, 2002

2003 Anual Convention and Exhibition
Philadelphia, PA
March 27-30, 2003

Dick Seng
2407 Kentucky St.
Racine, Wis. 53405

A GRAND TIME FOR SCIENCE

Join the Wisconsin Society of Science Teachers for their Convention, April 22-24, 1999 at the Grand Geneva Resort and Spa.

For current information, check out the web site at: www.genevaonline.com/~wsst/wsst.html.

The keynote speaker at the banquet will be Frank Ogden, a futurist who sometimes goes by the nickname of "Dr. Tomorrow".

The 1999 convention will see a return of the Saturday Luncheon, during which time, the satellite feed will be used to talk to Researchers at the Rocky Mountain Institute. Their topic for discussion will be the use of Hyper cards for the 21st Century.

At Thursday night's social in the Exhibit Hall, entertainment will be provided by the Jazz band, "Main Stream". Friday night's dance music will be provided by "The Milwaukee Revue". Wisconsin science teachers welcome you to Lake Geneva for "A Grand Time for Science."

NEW MISSION STATEMENT VOTED ON BY MEMBERSHIP AT THE 1998 ISTA CONVENTION AT THE ROSEMONT

THE ISTA MEMBERSHIP WAS ASKED TO VOTE ON ONE OF TWO MISSION STATEMENTS AT THE ANNUAL CONVENTION IN ROSEMONT. HERE IS OUR ORGANIZATION'S NEW MISSION STATEMENT:

The mission of the Illinois Science Teachers Association is to provide proactive leadership that will improve science education and achievement for all students by promoting effective classroom practices, supporting sustained professional development opportunities, facilitating communication, collaboration and networking opportunities, and advocating for the needs of science teachers.

Thank you to all members who submitted a survey and to those who indicated that they were interested in assisting with the implementation of our organization's goals. We can always use more input! Contact me at the address on the inside front cover of the *Spectrum.*

Edee Wiziecki
Strategic Plan Committee Chair

DON POWERS
REGION 3 DIRECTOR

1999 looks to be an active time for the Region 3. On February 13th Western Illinois University will host the regional competition for the Illinois Science Olympiad. Currently over 20 junior/middle and high schools have registered to take part in a variety events including the Egg Drop, Battery Buggy, Road Scholar, Nature Quest plus many more. This is always an exciting opportunity for students to apply the science skills they have acquired to real situations. Spectators are invited to come to Horrabin Hall, WIU to watch the events. For more information contact me (309) 298-1258.

On April 16th Western Illinois University will again be the site for the Annual K-8 Science Update Conference. For form for this event is on page 8 of this issue of the *Spectrum.*

Next fall from Sept. 30 - Oct. 2 the Annual ISTA Conference will be held in Springfield. Preparations are already underway for this event and you can help. Everyone has at least one favorite activity or idea they use with their students. Why not share that idea by making a presentation at the 1999 Conference? If the thought of getting up in front of your colleagues is intimidating then do a group presentation with another teacher in your school. It's only half the work and I know when it is over you would say that it was fun! Look for the Call for Presentations is on page 3 — fill it out and send it in today. This is your conference and it's really what you make of it. So attend and share your ideas!

For a the past few years ISTA has had a presence on the Internet Superhighway but hasn't really kept up with the flow of traffic so to speak. ISTA is now making a concerted effort to get back into the flow of internet traffic. The organization has contacted individuals at WIU to maintain the ISTA website. The website has been redesigned and new information is being added. Check out the new and improved ISTA website at www.ista-il.org and see all the information that's now available. If you have suggestions related to the website then let your ISTA Officers and Regional Directors know.

Wishing you the best in 1999.

GEORGIEAN BENSON
REGION 4 DIRECTOR

NATIONAL BOARD CERTIFIED TEACHERS

In November 1998, the number of National Board Certified Teachers in Illinois increased by 20, including the first two teachers certified in science. Congratulations to Anna West and Michael Lach, both teachers at Chicago high schools.

Anna West, a teacher for 32 years, is now teaching Biology and Anatomy & Physiology at DuSable High School. She has worked with curriculum and education at Malcolm X College, Board of Education, and a private school. Anna said that she pursued the certificate for "intrinsic reward." She said the "feeling of accomplishment is worth it." As a mentor, she will provide support to current science candidates.

ISTA Region 7 Director **Michael Lach**, presently teaching Physics and Environmental Science at Lake View High School, is in his eighth year of teaching. Michael has also worked in New York City and New Orleans public schools. He was impressed with the NBPTS process because "they asked the questions I wanted them to ask, forcing me to rationalize my decisions and my actions in light of my students and the goals I set for them. Unlike most other awards and grants, which seem to look for showy activities, a checklist of good practice, or have a focus on a resume and not on results, the NBPTS process was solidly about good teaching and learning."

The National Board for Professional Teaching Standards (NBPTS) is an organization of teachers and other education stake holders working to advance the teaching profession and to improve student learning. The mission of NBPTS is to operate a voluntary system to certify teachers meeting high and rigorous standards for what teachers should know and be able to do.

The certification process involves a two part assessment based on the teaching standards. The first part involves over 150 hours spent developing a portfolio completed in the classroom. This five section portfolio includes student work, videotapes and other teaching artifacts which are supported by commentaries and reflections on the goals, activities, and effectiveness. After the completion of the portfolio, the candidate demonstrates knowledge and abilities in four separate (90 min. each) assessment center exercises.

1997-1998 was the first year of Science certification for teachers of Adolescent & Young Adult (Ages 14-18+) students. The certificate for science teachers of Early adolescence (Ages 11-15) was released in December, 1998. There are about 10 teachers in Illinois who are currently pursuing science certification. Another science certification for teachers of Middle Childhood (Ages 7-12) is planned for release in a few years. The Generalist Certificates for Early Childhood, Middle Childhood, and Early Adolescence cover skills and knowledge across all areas of the curriculum, including a major science component within the portfolio as well as in the assessment. For further information check out the web page (www.nbpts.org) or call 1-800-TEACH.

email: gbenson@net66.com
For state support: Penny Potter: Penny618@aol.com

Robert Fisher, Chair, ISTA Certification Task Force
Professor of Science Education, Director, CeMaST
Illinois State University
Normal, IL 61790-5330
Phone 309 438 8768
FAX 309 438 3592

STANDARDS FOR TEACHING SCIENCE

A panel of 25 science teachers and science teacher educators have developed a proposed set of standards for the initial preparation and continued professional development of science teachers. The work of the panel is another step in the process begun over two years ago by the ISBE as part of a new framework for teacher education. This framework has resulted in a new certification structure effective in January 1999. Information on the program can be found at <http://www.isbe.state.il.us/isbesites/bulletins/special/Issue99/99S-04.html>http://www.isbe.state.il.us/isbesites/bulletins/special/Issue99/99S-04.html.

New teachers will receive an initial certificate which is valid for four years of teaching. The standard teaching certificate will need to be renewed every five years, based on the results of an individual professional development plan. Guiding the process for all institutions and all teachers is a three-part standards set: The NCATE standards for teacher education programs; the Illinois Professional Teaching Standards for all teachers; and standards developed for each content area or specialization. It is the latter set of standards that are still under development.

The proposed standards for teaching in each specialization, including those for science, will be distributed by ISBE in mid-January. More details about that distribution will be forthcoming. A public comment period will be held until the end of February. As a part of that feedback process, twelve focus group discussions will be scheduled across the state by the ISBE office responsible for this process. In addition, a work session for science teacher eductors will be held on the ISU campus on February 12th. Individual comments will also be invited. Additional information on the ISBE activities by calling the Division of Professional Certification at 217/782-2805 or through the ISBE homepage at <http://isbe.state.il.us/>http://isbe.state.il.us.

Information on the February 12th meeting will be available at:
<http://www.ilstu.edu/depts/cemast/>http://www.ilstu.edu/depts/cemast/

<http://coe.ilstu.edu/rlfisher>http://coe.ilstu.edu/rlfisher

<http://www.ilstu.edu/depts/cemast/>http://www.ilstu.edu/depts/cemast/

13th Annual K-8 Science Education Update Conference

FRIDAY, April 16, 1999

Western Illinois University Science Education Center

Intended for teachers at the elementary and middle school level. We do our best to invite enthusiastic teachers representing the primary, intermediate, and middle school levels. The conference includes:

Hands-On Science Activities Science Materials Displays

Curriculum Resource Displays
Activities Representing New Science Programs
Teacher Presentations
Science Children's Literature Displays
State Education Agency Displays

- Over 20 presentations will be made by classroom teachers K-8 during the morning sessions. These 50 minute presentations will provide practical and classroom tested ideas for science activities and will include a variety of informational handouts and activities sheets.
- In the afternoon, we will again provide the popular **MINI-SHARING SESSIONS** where participants can rotate to tables of their choice to spend 15 minutes receiving information on a specific topic, demonstration or activity and receive a brief handout for reference. Time will permit participants to visit 4 or 5 stations of the 15 or more options at each of two levels \ (K-3) and (4-8).

A PARTIAL LIST OF TOPICS FROM LAST YEAR'S MEETING INCLUDES:

- Earth cycles
- Exploring the ocean
- Butterfly gardens
- Did you ask the right question?
- Children's literature & science
- A classroom without walls
- Teaching science with puzzles
- Nutrition is elementary
- Science in your shopping cart
- Habitats for lifelong learning
- Nature's for me
- Super science lessons & activities
- Rocks n' rolls
- Forest pulse - The beat goes on!
- Renewable resources...protect our environment
- Discovering groundwater
- Frog & toad become scientist
- Peers, partners, and projects...
- New aquatic Illinois kit
- Easter egg science
- Digging up clues

- **ANNOUNCEMENTS CONCERNING FUTURE WORKSHOPS, INSTITUTES AND OPPORTUNITIES IN SCIENCE AND ENVIRONMENTAL EDUCATION.**

Each school district should have a representative in attendance to take information back to share with others, including the many handouts and references distributes.

SCIENCE UPDATE CONFERENCE REGISTRATION FORM

NAME ______________________ SCHOOL ______________________ DISTRICT__________________

ADDRESS__________________________ CITY ______________________ STATE ____ ZIP________

SCHOOL PHONE __________________________

Registration Fee - $ 25.00 Make checks payable to **Western Illinois University**

Circle one **Payment Enclosed** **Payment to follow from the school district**

RETURN FORM TO:

Dr. John B. Beaver, 1 University Circle-HH47, Western Illinois University, Macomb, IL 61455

309/298-2065 or 298-1777

Registration fee covers refreshments, lunch, and handouts.
Confirmations will be returned, if received by April 9th,with a campus map and parking information.

_____ Check here if you are interested in a **FREE** Trial Membership in the Illinois Science Teachers Association (For Non-Members). You will relieve two Spectrums, the journal of the ISTA with information about the organization and the Fall Conference.

SPECIAL INTERESTS

Valerie Keener
IDNR
524 South Second Street
Springfield, IL 62701-1787

UNDERSTANDING ILLINOIS' WETLANDS

Understanding Illinois' Wetlands is a supplemental document that was developed as a Master of Science project for the Environmental Administration program at the University of Illinois-Springfield. It was designed to help Illinois citizens better understand their state's wetland resources. The text is used to explain the following topics concerning Illinois wetlands: what they are; why they are important; what is their status; what is being done to protect them; and how concerned citizens may help. The information may be used as a resource for educating others about wetlands in a variety of settings.

The Illinois Department of Natural Resources' Educational Services Section and Office of Resource Conservation are trying to determine the feasibility of adapting this document for use in high school curricula. If you are a high school teacher who incorporates wetlands into your lessons, we would be happy for you to review Understanding Illinois' Wetlands and give us your input. By contacting Ryan Taylor at the address below, you will receive a copy of the booklet, a questionnaire and a postage paid return envelope. We ask that you return comments to us by February 28, 1999. Thank you for assisting with our survey!

Ryan Taylor
IDNR Office of Resource Conservation
524 South Second Street
Springfield, IL 62701-1787

WHAT'S HAPPENING WITH WET?

In its first full year in Illinois, Project WET (Water Education for Teachers) has "streamed" through the State sprinkling ideas on the workings and wonders of water.

PROJECT WET is an interdisciplinary water education program intended to supplement a school's existing curriculum.

The goal of Project WET is to facilitate the awareness, appreciation, knowledge, and stewardship of water resources through the development and dissemination of classroom-ready teaching aids and through the establishment of state sponsored Project WET programs.

Project WET offers the educator: activity guides and modules designed for K-12, computer simulations, water history publications, groundwater flow models, a series of children's story and action books and a water resources information network.

PROJECT WET is special because

- All materials have been developed, field-tested and evaluated by researchers, teachers, and kids!
- WET addresses a wide range of water-related disciplines including the natural sciences (hydrology, geology, chemistry, and biology) and social sciences (economics, sociology, and political science).
- Topics covered in WET materials include: atmospheric, surface, and groundwater resources, water quality and quantity, management, and conservation.
- The program is sensitive to special needs children and incorporates culturally diverse perspectives.
- Activities and models take into consideration the various learning styles of children.
- Because materials and activities are coded for language arts, math, science, music, art, and other subject areas, WET "fits" into a school's existing curriculum.
- Age appropriate critical thinking and problem solving skills are built into WET activities and materials.
- Each state will have a project WET sponsor who will distribute materials and facilitate workshops and local planning.

Illinois became a Project WET state in 1995 under the sponsorship of the Environmental Education Association of Illinois (EEAI) with Marylin Lisowski as the State's coordinator. Three facilitator training sessions were conducted in which 61 educators became facilitators. Through their dedication and efforts, over 20 workshops and/or presentations were offered in Illinois. At these events, over 400 participants became "immersed" in water education activities.

Several Project WET workshops are scheduled for the coming months including facilitator training. If you are thinking about taking the plunge and getting involved with the opportunities that Project WET has to offer please feel free to contact Marylin Lisowski at cfmfl@eiu.edu or 217-581-5728 or www.uxi.eiu/~cfmfl.

A SPECIAL INVITATION FROM FRIENDS OF FERMILAB

OPEN HOUSE

Fermilab's Lederman Science Center

Sunday, February 9, 1999

1:00 - 5:00 p.m.

Batavia, Illinois

Join teachers who are past, present and future participants in our programs. Learn about our programs from the teachers who developed them and those who use them in their classrooms. Win a door prize from our science store or win a special family science outing or special treat for a handful of your students.

We have resources for you whether you work in the neighborhood or visit us on the Internet.

Over 15,000 students visit Fermilab every year to conduct field studies in the prairie or learn about Fermilab science and technology at the Lederman Science Center exhibits.

View curriculum materials, trade books, CD ROMs, software products, videodiscs, reports, periodicals, newsletters, etc. The Teacher Resource Center houses a preview collection of over 9,000 resources for science, mathematics and technology classrooms. Visit our online catalog at http://lepac1.brodart.com/search/fm. The TRC is one of 10 demonstration sites for the Eisenhower National Clearinghouse.

Try our online classroom instructional materials:

- Over 150 engaged learning classroom projects
- Access to physics data for use in introductory physics classes
- Access to prairie data for intermediate and midlevel classes
- A *Fermilabyrinth* of online versions of the Lederman Science Center exhibits

Current staff development opportunities include:

- LInC Online - creating a network of education leaders who effectively use technology to support engaged learning.
- Phriendly Physics - developing understanding of physical science concepts and how to teach them at the elementary level.
- Summer Research Appointments - providing opportunities for teacher to do science.
- Teacher Networks - facilitating the exchange of teaching ideas.
- Workshops for prairie and physics field trips - preparing teachers to teach one of four instructional units.

Kirk Winters
Kirk_Winters@ed.gov
ISTA-talk mailing list
ista-talk@lists.csi.cps.k12.il.us

27 SCHOOL REFORM MODELS

TWENTY-SEVEN SCHOOL REFORM MODELS are described in a new publication from the Department of Education's National Institute on the Education of At-Risk Students. "Tools for Schools" is designed to help practitioners & policymakers who want to improve the performance of schools with significant at-risk student populations. The description of each model tells...

* What is the model?
* Why did it get started?
* How does it work?
* What are the costs?
* How is the model implemented in a school?
* What is the evidence that the model is successful?
* Where can I see it?
* Whom do I contact?
* The research base.

Below are a sampling of 10 descriptions. Please note that while all 28 models have been supported by the Institute, the purpose of this publication is to provide information about these models, not to endorse or promote any of them.

The complete publication is available online at:
http://www.ed.gov/pubs/ToolsforSchools/

THE U.S. GEOLOGICAL SURVEY has just opened a new web site called "Water Science for Schools: at http://water.usgs.gov/droplet . The site is intended for students of all ages who want to learn about the many aspects of water -- from what it is to how it is used. Includes are "water basics," "Earth's water" (ground water, surface water, etc.), "water use," a water "picture gallery" (floods, houses on stilts, etc.), an "activity cener" (where one can participate in surveys, questionnaires, etc.), and "special topics" (acid rain, why is the ocean salty, etc.). For further information, interested persons can contact Howard Perlman at hperlman@usgs.gov or write to him at U.S. Geological Survey, 3039 Amwiler Road, Suite 130, Atlanta, GA 30360 (or call him at 770- 903-9114).

1. A Tool for Instructional Planning

A planning tool for developing an integrative service delivery plan that focuses on giving students who show the least & most progress on significant outcome variables intensive instruction & related service support. The goal of the program is to provide an analytic procedure for identifying students most in need of special help, based on student achievement & other outcome data routinely collected by schools & school districts. By identifying students in the lowest 20th & highest 20th percentiles, 20/20 Analysis pinpoints those students for whom the existing instructional & related service program delivery is least effective, so that it can be adapted to suit their individual needs.

2. Advancement Via Individual Determination (AVID)

An "untracking" program designed to help underachieving students with high academic potential prepare for entrance to colleges & universities. The AVID approach to untracking places previously underachieving students (who are primarily from low income & ethnic or linguistic minority backgrounds) in the same college preparation academic program as high-achieving students (who are primarily from middle or upper-middle income & "majority" backgrounds). AVID features a rigorous academic elective course with a sequential curriculum for grades 7 through 12 that focuses on writing, inquiry, & collaboration as methodologies to accelerate student progress.

3. Community for Learning Program

A broad-based, school-family-community, coordinated approach to improving student learning. The major premise of this school-based intervention program is that the national standards of educational outcomes can & must be upheld for all students, including those who are "at the margins." A centerpiece of the Community for Learning Program is an integrated design framework for a collaborative process of finding ways to harness all of the resources, expertise, & energies in linking schools with other learning environments, including homes, churches, libraries, public- & private-sector workplaces, & postsecondary institutions to support the learning of each student.

4. Consensus Standards Model

A school reform project of the Center for Research on Education, Diversity, & Excellence, University of California, Santa Cruz. The model is based on 5 standards of effective pedagogy for at-risk students. The standards reflect the intentions of the standards-based reform movement to ensure high expectations for all students & those principles of teaching & learning on which educators, researchers, & program developers across theoretical domains agree. They represent consensus in educational research & theory about maximizing teaching & learning for all students, but especially those at risk due to limited-English proficiency, cultural diversity, poverty, race, or geography.

5. Consistency Management & Cooperative Discipline

A research-based, classroom & school reform model that builds on shared responsibility for learning & classroom organization between teachers & students. The program works with geographic feeder systems of schools from pre-kindergarten through 12th grade that includes all students, teachers & administrators in one geographic area of the city. The program provides sustained messages to children about what it means to be self-disciplined. Messages that are changed every year or are inconsistent for every classroom diminish discipline & achievement.

6. National Network of Partnership Schools

Includes school, district, & state members & provides each with research-based guidance, support, materials, & networkingopportunities to assist them in building strong school-family-community partnerships. Partnership programs are based on school improvement goals & the needs & interests of students, parents, & teachers. The main structures an Action Team for School, Family, & Community Partnerships & research-based framework of 6 types of involvement strengthen family & community connections within any school improvement model. The approach also may be used to organize comprehensive whole-school reform using Action Teams & connections with families & communities to guide plans & activities for all school goals & objectives.

7. Roots & Wings

A comprehensive, whole-school reform model designed to place a high floor under the basic skills achievement of all students while building problem-solving skills, creativity, & critical thinking. It builds on the extensively evaluated Success for All program, which provides research-based curricula for prekindergarten, kindergarten, & grades 1-6 reading, writing, & language arts; one-to-one tutoring for primary grade students struggling in reading; & extensive family support services. To these, Roots & Wings adds MathWings, a practical, constructivist approach to mathematics for grades one through five, & WorldLab, an integrated approach to social studies & science emphasizing simulations & group investigations.

8. Schoolwide Enrichment Model

Based upon a vision that "schools are places for talent development." The model uses the pedagogy of gifted education to make school more challenging & enjoyable for all students. The Schoolwide Enrichment Model "blueprint" for total school improvement serves as a practical plan for K-12 teachers & administrators to make this vision a reality. While detailed enough to provide educators with the means to successfully implement the program, the model provides the flexibility for each school to develop its own unique program in accordance with local resources, student population, & faculty interests & strengths. Two major objectives of the Schoolwide Enrichment Model include: providing a broad range of advanced-level enrichment experiences for all students & using student responses to these experiences as stepping stones for relevant follow-up.

9. Success For All

A structured whole school reform model focusing on students in grades pre-kindergarten through grade six. The model is designed to raise the achievement of students in low-performing schools. The idea behind Success for All is to use everything known from research on effective instruction for students in low-performing schools to prevent & intervene in the development of learning problems in the early years. A principle thrust is to ensure that every child in the school succeeds in learning to read at grade level by the end of the third grade. In addition to reading programs, Success for All provides one-to-one tutoring for primary-aged children struggling in reading, family support services, & other elements. A bilingual Spanish version of the program, called Lee Conmigo, has been developed.

10. Urban School Development: Literacy as a Lever for Change

A collaboration with a number of Chicago elementary schools on an initiative called Urban School Development: Literacy as a Lever for Change. Each school in the collaborative serves an impoverished community where student achievement is very low. The network includes 2 "continuing" schools that have been collaborating with the Center for several years, & 5 "new" schools (including 2 "probation" schools) that joined the network 2 years ago. The clustering enables schools to be a resource to each other. Additionally, to break down schools' isolation from outside expertise, the program also partners with the Martha L. King Early Language & Literacy Center at the Ohio State University. This is the National Center for Reading Recovery.

Making Schools Work for Every Child is a collaborative effort between the Eisenhower National Clearinghouse and the Equity Task Force of the National Network of Eisenhower Regional Consortia and Clearinghouse. The site helps educators create equitable classrooms; it offers journal articles, essays, and other science and math resources.
http://equity.enc.org

The Great Global Gallery has hundreds of images of the Earth, showing everything from global snow and ice caps to corals and mangroves.
http://hum.amu.edu.pl/~zbzw/glob/glob1.htm

For information on meteorology from A to Z, weather questions and quizzes, resources for kids and teachers, and more, check out the homepage of **Nick Walker, the "Weather Dude"** from Seattle's KSTW-TV.
http://www.nwlink.com/~wxdude

Homework Central is a 1.4 million-page academic research directory designed exclusively for students from elementary to college levels. Students receive free access to the more than 400,000 homework-related sites linked to the website. Each week, eight top schoolwork research sites (including science and math sites) are chosen by the editors.
http://www.homeworkcentral.com

PBS TO LAUNCH 'EDUCATION SUPERSITE'

A new online education team at PBS has designed and launched an "Education Supersite" on the PBS Online homepage, debuting in October. Building on the success of the Learn With PBS section of the homepage, the new site showcases PBS television programs and related educational resources with extended taping rights for preK-12 teachers; nearly 1,000 online activities and lesson plans correlated to national teaching standards; Ready To Learn services and activities; teacher professional development resources; and access to similar content from member stations. Surf to
http://www.pbs.org

Visit The Nine Planets at

http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html
This is the definitive quick resource for information about our solar system. Planets, moons, comets...you name it. The sun and anything within the sun's gravitational pull gets its own page here, complete with excellent pictures, data, and even a history of the heavenly body's discovery. The site also includes information on other solar systems and links to more information.

ED'S SATELLITE TOWN MEETINGS

On the third Tuesday of each month (8-9 PM Eastern Time) during the school year, U.S. Secretary of Education Richard Riley hosts the *Satellite Town Meeting*, a free, live, interactive teleconference about community efforts to improve teaching and learning. This is your opportunity to ask a question of the Secretary and his guests—drawn from communities like yours—on what works in schools and communities. For more information, call 1-800-USA-LEARN or see the website
http://www.ed.gov/inits/stm/ Program dates and topics include:

- Teaching Reading: Success Stories from School and Home on February 16, 1999
- Counting the Stars: Math, Arts, and Space Science on March 16, 1999
- Improving Teacher Quality: Shaping the Profession That Shapes America's Future on April 20, 1999
- High Standards at Work: Comprehensive Approaches to School Improvement on May 18, 1999
- School Leadership: Principals at the Center on June 15, 1999

GEOSCIENCE CAREER VIDEO

Careers for Geoscientists introduces atmospheric, oceanic, and solid-earth geosciences to high school seniors and college undergraduates. In this 40-minute video, geoscientists discuss current projects, including studying currents in the Chesapeake Bay, exploring for oil in Nigeria, and developing geologic maps. Discussions cover job requirements, the use of technology, and opportunities to work outdoors and travel.

The video is part of the American Geological Institute's Professional Careers Pathways in the Geosciences project. It costs $14.95, including s/h in the continental United States (AGI member price, $12.75). To order, contact Robert Tiffey at AGI at 703-379-2480 or e-mail rit@agiweb.org. For more information on the Career Pathways project, see:
http://www.agiweb.org/career/sloan.html.

This video is also a component of the Sloan Foundation's Career Cornerstone Series, a collaborative effort by engineering, math, and physical science societies. See
http://www.careercornerstone.org.

MathMol Hypermedia textbook:
http://www.nyu.edu/pages/mathmol/textbook/elem_home1.html

National Geographic Kids:
http://www.nationalgeographic.com/kids

Nine Planets Tour:
http://seds.lpl.arizona.edu/nineplanets/nineplanets/Nineplanets.html

Hologlobe Project:
http://www.si.edu/hologlobe

Museums & Learning: A Guide for Family Visits, available from the Department of Education, offers suggestions on how to make museum visits learning experiences for families with children ages 4-12 years. The 30-page booklet is available at the website below.
http://www.ed.gov/pubs/Museum

Another ED website titled **Think College Early** encourages middle school students to explore community colleges, universities, and career and technical colleges and offers information on financial aid, courses students need to take to prepare for college, and more.
http://www.ed.gov/thinkcollege/early

The **Academy for Educational Development** announces the **Millennium Project**, a two-year, online, mediated forum to explore the evolving role of technology in education. Learning technologies and their use in and out of the classroom will be emphasized.
http://millennium.aed.org

Your students will find a number of **Whelmers**—science activities and student demonstrations—at the site listed below, which is maintained by the **Mid-Continent Regional Educational Laboratory (MCREL)**.
http://www.mcrel.org/whelmers/index.html

Let elementary students find their own answers to science questions such as why is the sky blue? And why don't penguins' feet freeze? This collection of science questions and answers is taken from *New Scientist*, a weekly science and technology magazine.
http://www.last-word.com

The School for Field Studies
www.fieldstudies.org

Exploring Caves is an interdisciplinary set of materials on caves for grades K-3:
http://www.usgs.gov/education/learnweb/caves/excvteach.html

"Planet Neighborhood" Activity Center on the web has been launched. Planet Neighborhood looks at the way people across the nation are using down-to-Earth concepts and innovative technologies in their quest to preserve the environment.
http://www.pbs.org/planet

ACTIVE PHYSICS

Active Physics was developed by Dr. Arthur Eisenkraft and leading physicists, physics teachers and science educators under the auspices of the American Association of Physics Teachers and the American Institute of Physics. Active Physics only uses algebraic equations and graphs to represent ideas symbolically. It also provides instruction for the use of calculators and spreadsheets, and all reading materials are at the 9th grade level so that maximum attention can be focussed on physics principles. The thematic units are Transportation, Communication, Home, Medicine, Predictions, and Sports. Additional information about Active Physics can be obtained by visiting the Active Physics Home Page or

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US PHYSICS TEAM COMPETITION

For over ten years the American Association of Physics Teachers has organized and sponsored the United States Physics Team for competition at the International Physics Olympiad. The XXX International Physics Olympiad competition will be held in Padova, Italy, on July 18-27,1999. The goals of the Olympiad are to encourage excellence in physics education and to reward outstanding physics students. In addition, the AAPT is interested in the program's potential to have an impact on all students, not just the extraordinarily bright ones. Each year over 1,000 students take the preliminary exam. We would like to see every U.S. high school physics student take the program's initial qualifying exam. The benefits derived by students' participation, along with the physics community's encouragement, can be very important in students' lives. All students who take part in this program receive a congratulatory letter, a certificate recognizing their achievements, and the opportunity to have their names sent to some universities. We need teachers to nominate their students. If you have not received application or if you have any questions, please contact the AAPT office at (301) 209-3344 or email: aapt-prog@aapt.org

PHYSICS BOWL COMPETITION

The AAPT Physics Bowl Contest is sponsored by the American Association of Physics Teachers (AAPT) and Metrologies Instruments to generate interest in physics and to recognize outstanding high school physics students and their teachers. In 1998, Metrologic increased the number and amount of awards available. Ten $1,000 scholarships will be awarded to the top scoring students in the nation. In addition, sixty $100 scholarships will be awarded to the top two students in each division. All participating students will be recognized with a certificate from AAPT and Metrologic Instruments

The team competition is held in 15 regions, each with two divisions. Division I is for students in a first-year physics course; Division II is for students in a second-year physics course. A school's score in a division is the sum of the fou rhighest student scores in that division. To compete in a division, a school must have at least four students participating. A school may compete in either or both divisions, provided that it has at least four eligible students.

For more information regarding the 1999 Physics Bowl, to be held April21,1999, contact the AAPT Programs department at (301)209-3344 or send E-mail to: orgaapt-prog@aapt.org

Entry forms and payment must be received by March 29, 1999

ARTICLES

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THE CHALLENGES OF SCIENCE PERFORMANCE ASSESSMENT IN LIGHT OF THE NEW ILLINOIS LEARNING STANDARDS

In 1985, the Illinois State Legislature amended the Illinois School Code[1] to require that school districts develop science programs that emphasize both content and process as outcomes: what students should **know** and be able to do. The new Illinois Learning Standards[2] reconstituted the original four goals into three broad goals, each with from two to six learning standards, which are further specified in terms of learning benchmarks for five developmental levels from early elementary through late high school. Neither the old nor the new sets of goals and standards provide guidance in the area of assessment in a system where **doing** science is assumed to be as important as **knowing** science. The purpose of this paper is to briefly discuss the development of the science learning standards in Illinois, offer definitions for scientific literacy and performance assessment that share a common goal, and to discuss an approach for designing, administering, and evaluating useful authentic assessment instruments for the new science learning standards that will soon be in use in our state.

Science Standards and Performance Assessment

Although there is no universal agreement as to what is meant by scientific literacy, most participants in this debate agree on one thing — a scientifically literate person is not simply someone who can spew out science fact after science fact. A scientifically literate person should have a feeling for the nature and development of scientific knowledge; be able to talk coherently at some length about the social, environmental, and ethical ramifications of scientific and technological development; and be able to design and conduct an experiment to test a hypothesis. Hands-on/minds-on, inquiry-focused science programs, which recognize the necessity for students to get personally involved with the objects and ideas of science in addition to reading and talking about them, emphasize activities that focus on these aspects of the scientific endeavor.

Since Illinois does not have a state-mandated curriculum for school science, curriculum decisions are made at the local level, with the expectation that the locally developed curriculum for a particular subject area meet and exceed broadly-stated goals or outcomes for that discipline.

In the 1985 set of goals, the Illinois State Board of Education guided what the state's children should learn in their study of science through four broadly-stated goals with the following preface:

> *The purpose for studying science is to "develop students who are scientifically literate, recognize that science is not value-free, and are capable of making ethical judgements regarding science and social issues...*
>
> As a result of their schooling, students will have a working knowledge of:
>
> Goal 1: the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society;
>
> Goal 2: the social and environmental implications and limitations of technological development;
>
> Goal 3: the principles of scientific research and their application in simple research projects;
>
> Goal 4: the processes, techniques, methods, equipment, and available technology of science.

This was the extent of the guidelines for districts to follow for establishing a science program. It soon became clear that we were in need of a guide that was more comprehensive and inclusive with which to design our science programs. As a wide variety of professional organizations developed very specific goals, standards, and learning benchmarks, educators throughout Illinois began to push for curricular guidelines that would be more helpful while also allowing for the flexibility that was expected in our local districts. The result, after several versions and opportunities for public comment, produced the *Illinois Learning Standards* in July, 1997.

Let us look at the new science Learning Standards, specifically at Goal 11 which states: *Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.* Under that goal are listed two learning standards: A) Know and apply the concepts, principles and processes of scientific inquiry, and B) Know and apply the concepts, principles, and processes of technological design.

These standards imply an active, hands-on approach to science, one in which paper-and-pencil objective tests would not be sufficient to assess meaningful learning. At all levels of schooling, these standards identify activities that would need to be measured by an assessment approach that specifically looks at a student's level of competence in performing tasks that scientists engage in on a regular basis: formulating questions based on observation, controlling variables, and designing and carrying out procedures for testing hypotheses. Some call assessment of this type *alternative* assessment, while others refer to it as *authentic* or *performance* assessment. I prefer to use *performance assessment,* and define it in a way that was introduced by Shepard: *assessment tusks that are real instances of extended criterion performances.*[3] Students are presented with unique, everyday situations which

Early Elementary	Late Elementary	Middle School	Early High School	Late High School
Develop questions on scientific topics	Formulate questions on a specific scientific topic and choose the steps needed to answer the questions	Conduct scientific experiments that control all but one variable	Conduct controlled experiments or simulations to test hypotheses	Design procedures to test selected hypotheses; conduct systematic controlled experiments to test hypotheses

require the use of observation, inference, analysis, experimental design, and controlling variables, all of which are part of any hands-on science program. The teacher is then required to observe and make judgements about the degree to which students are able to complete the tasks.

Characterizing Performance Assessment

Performance assessment has the potential, more than traditional paper and pencil assessment tests, for finding out what students can **DO**. The use of performance assessment should not have as its goal the elimination of traditional paper and pencil tests. The argument for increased use of performance assessment mechanisms is that they have the potential for assessing different kinds of outcomes and provide different kinds of information relative to the improvement of learning and curriculum and Instruction.

How does performance assessment differ from traditional pencil and paper assessment? One major difference is that performance assessment more readily allows the teacher get an idea of what is "in the student's head," a vital determinant to what is ultimately learned. We may get some notion of what meanings the student has constructed about the task and its related concepts. We should also be looking for evidence of misconceptions that the students may have about the content.[4] The teacher can then address those misconceptions with the appropriate instructional help. The paper and pencil test generally only gives us an indication of the student's knowledge of the "right" or standard answer.

Questions arise about the difference between performance literacy and performance skill. The former refers to the student's ability to talk or write about the skills (processes) that s/he should to be able to perform. The latter refers to the ability and disposition to actually perform, with competence, those skills. Asking a student to respond to a drawing of a pencil placed next to a ruler to determine its length, may give quite different results when compared to giving the child a ruler and a pencil and asking him/her to find its length.5 These two different scenarios require different thought processes, but when children are not given the opportunity to try these skills themselves in a hands-on science program, we probably cannot expect that they will be able to perform them in a different context.

We now realize that we want children to be able to test hypotheses or generate questions that they formulate directly from their own experiences. For example, after a month or two of keeping a daily journal of the moon's appearance and position, the teacher asks the student to make a drawing to show the relative positions of the earth, moon, and sun during a full moon, and describe how and when the student could **show** (provide evidence) that the drawing is correct. This type of assessment requires the student to construct an original response based on his/her own experiences. In part, it requires that we present an assessment situation in which students are asked to immerse themselves in a "hands-on/minds-on" experience and come up with a hypothesis to test.

Learning from the work of others

Performance assessment is an increasingly important issue for policy makers. New York and California have been working for nearly a decade on developing ways to assess the performance skills of students at specific grade levels (grade 4 in New York and Grade 6 in California).[6] Their approach has been influenced in large part by the fact that they have a statewide curriculum and, therefore, are interested in assessing student progress on a statewide scale. They have developed a set of standard materials that are made available statewide and used at those specific grade levels. The results are then compiled and used to make some judgement about student learning. Illinois is different in that curriculum is developed at the local level. In the case of performance assessment, many Illinois school districts have tried to develop their own performance assessment instruments which reflect the nature of their local curriculum. Professional organizations and state agencies have conducted workshops with the aim of discussing and illustrating performance assessment ideas. These workshops aim to encourage teachers to try out their own ideas about performance assessment, and subsequently to use them in their classrooms. The effort has resulted in the development and trial of a variety of mechanisms for K-8. The workshop approach emphasizes the notion that practically any idea is worth trying, for no one has been successful so far at developing and refining a tried and true method of science performance assessment.

Some of the approaches to performance assessment that have been tried extensively are —

- Stations — students work individually, rotating through a fixed number of stations which ask them to perform specific tasks. Some of the tasks tend to be open-ended, but generally each station has a specific observable performance outcome.
- Open-ended "lab" situations — students work individually or in small groups on an inquiry-based activity that asks students to generate a hypothesis or a "researchable" question, design a simple experiment, collect and interpret data, and offer a conclusion based on those data.
- Portfolios — the student selects her/his "best" work from all of the completed assignments and projects done in a particular unit of study and presents them to the teacher in a "portfolio," or notebook.
- Writing Activities — a student is asked to write about a science activity that he or she has completed. The student's work is then evaluated using a set of criteria that emphasize organization, coherence, procedures, facts, interpretation, and scientific qualities (description of the phenomenon, methods used, etc.).

Why have we seen such an interest in performance assessment in recent years? It seems that the major reasons have to do with the desire to improve learning as well as curriculum and instruction. One of those improvements is reflected in an increased emphasis on critical thinking in our science programs, and this in turn will be seen as a significant component of the performance tasks that we select for our students. Stiggins has observed a direct connection between many of the complex science performance tasks being tried and the high-order thinking skills that are being emphasized. He describes a "portrait of valued achievement targets that was far more complex than had been previously realized."[7] We now have a much better idea of what worthwhile skills we want our children to have as a result of certain experiences that we provide in our classrooms. Most of these are more complex than simply being required to recall a specific bit of information concerning, for example, "How many planets can be found in our solar system?" Because the amount of available knowledge is increasing so rapidly, it makes much more sense for our students to be information managers requiring high-order thinking skills, not information memorizers.

Scoring and Evaluating Performance Assessment

Assessment by any mode, whether it is by traditional paper and pencil test or performance, has two distinct components. One is *describing what a student knows and can do. The other is evaluating* or scoring that description. Both tend to be relatively easy with paper and pencil multiple-choice assessment. The description is ordinarily whether or not the student can identify a "standard" or right answer. The evaluation ordinarily involves a count of correct answers, perhaps some method of weighting, the calculation of a standard score, and then the assigning of a grade (which is often used to compare or sort) that is either norm-referenced or criterion-referenced.

Both tasks, description and evaluation, are much more difficult when performance assessment is used. Description requires a relatively high degree of inference regarding what the student really knows, what s/he can do, and what s/he is willing to do. That *knowing, ability to do, and willingness to do, may be quite different from repeating "right" answers according to the textbook or teacher.* The problem of description is particularly difficult when the performance requires, as it should, the use and integration of multiple elements: process skills (observation, measurement, use of instrumentation, interpretation of data), and values of science (control of variables, open and accurate communication, replication, inference, etc.).

Once we have described the student's interaction with the performance task, the problem of evaluation still remains. Norm referencing seems inappropriate because different students may see very different, yet appropriate, questions in the same context. Even if the same question is addressed, students may approach it in different ways. Moreover, the questions that the student (or group of students) addresses may differ (and, indeed, may be more interesting and useful) from what was intended by the teacher or designer of the assessment instrument. In addition, the approach to exploring the question may be different, or even better, than the teacher had in mind. Similarly, the interpretation of data might differ, and appropriately so in such a case.

Sources of Ideas for Performance Assessment

Where do ideas come from for these assessment instruments? Many come from what are referred to as "rich phenomena" within the sciences. This terminology is often used to describe a scientific phenomenon, which, when presented to students for investigation, provides widely varied (and often unpredictable) possibilities. These activities are characterized as being open-ended, interesting and challenging to children, yet do not require a lot of expensive or sophisticated equipment. A good example would be an activity that I call "The Paper Towel" investigation. In this activity, students are asked to compare a number of brands of paper towels with respect to water absorbency or strength. The apparatus can be set up in a variety of ways, depending upon the specific question that is pursued, as well as the personal preferences of the people doing the activity. The teacher poses the following question: How do different brands of paper towel compare with respect to absorbency (or strength)? This is straightforward and amenable to investigation using a variety of processes of science. The inquiry skills which students can bring to bear on the problem are several. Among them are:

- a decision about the size or area of toweling used. This includes linear measurement and calculation of area.
- a decision about how to measure the amount of water added

to the samples of toweling — number of drops, perhaps. But are all drops the same size? Students may have to convert to milliliters and count the number of drops per milliliter.

- controlling variables comes into play when the decision is made about the size of the piece of paper towel used, as well as the angle of the piece of towel as drops of water are slowly added.
- replication — repeated trials with each brand of toweling, always using the same procedure.
- observation — when is a paper towel saturated?
- mathematics — calculating and using a ratio to express drops or milliliters of water per unit area of paper towel.
- inference /valuing — which brand of paper towel is **best?** Is volume of water absorbed per unit area the only criterion that should be used?
- reporting/communicating — writing a report which clearly states the question, describes the method of investigation, presents the results, and allows someone else to replicate the investigation to get similar results. In situations where students work in small groups, members of a team are constantly discussing their ideas as they proceed through the investigation.

Based on the original "researchable" question regarding absorbency, students' competencies on one or more of the above process skills can be assessed. Other variations on the paper towel investigation that 5th and 6th grade students have come up with include: use of an alternate liquid, such as rubbing alcohol, to produce different sized drops (investigating surface tension); evaporation rate and comparisons of evaporation rates of different liquids used. Such a "rich phenomenon" offers several possible variations.

Conclusion

Teachers whom I have observed and worked with have expressed a desire to be able to assess what children can do in science — to minimize the use of objective tests. They recognize that there is more to science than doing worksheets and memorizing vocabulary words at the end of a chapter. Many have good ideas about how to assess science process skills, but they also realize how labor-intensive it can be. Some of the challenges facing teachers who want to design performance assessment instruments are:

- Identifying useful and practical performance assessment procedures that will provide information on student learning and issues related to curriculum and instruction.
- Obtaining inexpensive materials that are needed for an assessment.
- Designing the assessment in a way that assures efficient use of time and space, minimizes confusion and questions, and manages student movement around the room during the assessment.
- Assistance for the classroom teacher on the day of the formal assessment (an extra set of hands, legs, and eyes).
- Development of a scoring method that is both effective at describing and evaluating what the students do in the assessment session.
- The classroom teachers who will be in charge must be totally familiar with the instrument, what it is intended to assess, what to do in the case of specific problems that might arise during the assessment session, and how it will be evaluated. The teacher should be directly involved in the evaluation process, if not completely responsible for it.

I have heard some teachers plead for ideas that will work in their classes with their students. If we go about science performance assessment in the manner I have described in this paper, we will not be able to satisfy this kind of request. Performance assessment instruments need to be developed **locally**, based on the needs of the local school districts and classrooms. Science coordinators and teachers have to be willing to try out their ideas, talk about the strengths and weaknesses of the instruments, and try them in a modified form.

What effect will such an approach have on the local curriculum? In states like New York and California, curriculum and assessment will probably continue to be developed together at the state level. In many other states, like Illinois, in which local school districts develop their own curriculum, performance assessment Instruments must be developed and tested based on local decisions regarding their own goals and objectives. In the case of Illinois with its new learning standards, it is quite possible that the emphasis on local development of performance assessment mechanisms will also result in a more hands-on/minds-on science program. If that happens, we will be making progress towards the kind of science instruction and learning that is most interesting and beneficial for an educated citizenry. If we are going to assess what students can do in science, we must be willing to go beyond the paper-and-pencil test.

1. Illinois State Board of Education, 1985, *State Goals for Learning and Sample Learning Objectives for the Biological and Physical Sciences.*

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INTEGRATING SCIENCE AND READING: READING, WRITING AND HANDS-ON SCIENCE ACTIVITIES

Introduction: I learned much about teaching reading and reading assessments during the 1997-1998 school year. I served on the Illinois's Right to Read (R_2R) Initiative's Best Practices subcommittee. The good news in Illinois about reading is evidently I am not the only teacher who paid more attention toward teaching his or her students how to read better. The results are in. We find the reading scores in Illinois public schools are going up during the 1996-1997 school year. The students' increased performance reverses a steady decline in reading scores from the previous three school years. We know that this turnabout is most likely the result of many factors and not just the **R_2R Initiative**. Some highly visible factors include increased school accountability, the Illinois Goals assessment Program (IGAP), and School Report Cards.

Some Background: My current position calls for working with the Illinois State Board of Education (ISBE) Academic Early Warning Watch List (AEWL) schools. Beyond that, the state Superintendent has named me the CHRISTA MCAULIFFE Fellow for the 1998-1999 school year. The fellowship work is integrating Geographic Information Systems (GIS) with the Illinois Middle School Groundwater Project schools. I am on a loan from East Peoria Community High School (EPCHS) to work at various AEWL schools identified by the Illinois State Board of Education. ISBE's Academic Watch List is part of a process resulting from the 1997 legislation commonly called IL public act or law 452. The work is exciting. I have had opportunities, during preparation for site visits, to see a variety of schools in the northern, the central and the southern parts of Illinois. I work on two teams called the AEWL school's external partner. The team includes a state Board policy advisor, an ROE Representative, a school's coach or facilitator.

Science with Reading: By now, readers might be asking like, "Why is this article about reading, and writing scores, published in a journal written mostly for science teachers?" Also, "Why does science concern teaching reading?" Well, those questions are easy enough to answer. However, first let me ask a rhetorical question, "What subjects, or topics should our students be encouraged to select to read and to learn from to become better readers?" The answer to that question and others like it, is likely social studies, and *science*. As educators, hope we find balanced instruction in schools. Balance between simply using basil reading texts used for teaching reading, and using social studies literature and science lessons also for teaching reading. What about reading literature on mathematics or the history of math? Which case exists at your school or district? I think we owe it to our colleagues to merge science, literature and social studies where and whenever possible, by making some attempts to integrate on all levels K-12.

Teachers need to reflect on deeper questions like, "Why are some students motivated to become independent readers or active learners while other students are not?" What about life long learners? A likely answer to these questions might be, "Maybe, (or maybe not) because of some teacher introducing their students to other subjects, like biology, or a topic like T cells." It may also be that we have inspired some students to learn more about both the known and the unknown. Searching for solutions to compelling questions may lead us closer to creating a community of learners.

Scientific Literacy: According to RANDOM HOUSE's Wester's College Dictionary, the word literacy, is the quality or state of being literate, especially the ability to read and write. I have concerns that many reading teachers are not making connections between how to teach literacy, and what to teach (e.g., science topics). In other words, the reading teachers may benefit from additional training in science.

It is entirely possible that an even greater concern about teaching scientific literacy exists in our science classrooms. The question, "How many or few preparations do science teachers receive to teach reading skills?" Science teachers may not be prepared at all to teach reading. This is especially so at the higher grade levels. Somehow we must improve on this situation. One phase of the **Illinois Right $_2$ Read Initiative**, the Teacher Preparation subcommittee, is attempting to resolve this concern. The alternative certification provisions could only worsen this scenario.

The state legislature funds the Illinois reading initiative with eighty-two million dollars. This amount is twice previous amounts spent on reading programs. Much is being done to address concerns and problems with literacy in the classrooms. What should science teachers be doing right now to make connections to reading teachers on all levels of instruction?

Reading in Science: Literature is rich with print materials about nature and science. Literary guilds have prized many renowned authors for writings about science, science fiction, space science and technology. This is true throughout history. Dr. Isaac Asimov, Arthur C. Clarke, and Dr. Carl Sagan are some that come to mind in our culture during modern times.

Example #1. Teaching reading in science includes taking students to the library to select science fiction books. Students read the books and they produce a sci-fi book report. All the books must be about space travel. It is an excellent strategy to introduce students to Space Science. It is also an excellent way to inspire students to read more and become better readers. Many reading specialists encourage cross categorical activities of this type. These types of teaching methods come under the new **Illinois R_2R Initiative Best Practices** sub committee' list of fourteen Reading Best Practices. (See text box figure 1)

Best Practice #1: Explicit Word Analysis Instruction, Including Phonics
Best Practice #2: Assessment to Inform Instruction
Best Practice #3: Instructional Planning
Best Practice #4: Collaboration and Reflection
Best Practice #5: Learning Standards
Best Practice #6: Independent Reading
Best Practice #7: Using a variety of genre
Best Practice #8: Appropriate Instructional Levels
Best Practice #9: Reading for purpose
Best Practice #10: Building Comprehension Strategies
Best Practice #11: Building Synthesizing and Analytic Strategies
Best Practice #12: Integration
Best Practice #13: Literacy Rich Environment
Best Practice #14: Family - Community Partnerships

Figure 1 Illinois Right to Read Initiative's Reading Best Practices, 1998

Writing in Science: Dr. Ralph K. Strong, former professor of chemistry, usually taught or reinforced his students' writing skills, at Huron University, SD, more than three decades ago. I remember that we were forever improving on our written papers in college. Presently in many secondary and higher education institutions, they incorrectly assume that students have good communications skills. The business community, research, and assessments suggest that reading and we should teach and reinforce writing on all levels.

Example #2. Some less than mainstream classroom writing activities that I have developed include, running a pilot team teaching program with English and Earth Science teachers. Teachers found common topics in their curricula. Teachers found matching subject matter in their basal texts. Some of these topics, in secondary English classes, included mythological writings entitled The Beginning of the World, and in science classes, The Origin of the Universe. Teachers found there are many topics that cross over. Reading lessons of this genre produce lively discussions about what is real and what is myth.

Assessment the end of Year One at the school showed that students' interest and learning had peaked. Students spoke excitedly about their first year classroom experiences well into their second year. The English and Science team teaching pilot ran two years between 1994 and 1996 at East Peoria Community High School.

Example #3. A simple writing activity to strengthen students' reading, writing and thinking skills is called the autobiography of selected chemical elements activity. This requires one period in the library and one or two periods to report to the class. Students usually write very creative fiction. The assignment requires telling the origin of the element, some morphs the element takes, and where the element ends.

Doing Science: Dr. Maury Kellogg, Professor Emeritus, at Western Illinois University and the late Dr. Jack Easley, formerly at the University of Illinois, had tremendous influences on so many science teachers. They personified the art of asking questions or the inquiry method. They inspired students and teachers to learn with a sort of passion. These professors refined the art of teaching to the highest order. Their impact of their science demonstrations ran deep into students' experiences.

These educators turned routine science classroom attention grabbers into powerful discrepant events. These discrepant events became authentic learning and teaching strategies for teachers for years to come. Students and teachers that saw these events became immersed in the learning process. As present day teachers, we need to remind ourselves that the way we teach and the quality of our work could become a legacy to our students, or simply forgotten.

We see another example of our progress at combined English and science meetings that have been very positive and thoroughly rewarding for all involved parties. The co-teachers are actively involved in every step on this expedition to explore the possibilities of merging English with science: by that achieving the project's main objective - improving reading and writing skills via hands-on laboratory activities and improving research and technology skills using the Internet.

Example #4. A final example unit of our Tried and True bridged curriculum plan includes the English students reading a story about early African culture, and while in science, the same students will be extracting metal from ore using primitive methods they think were developed long ago in Africa. Thus, we added a multicultural dimension to our pilot.

Subsequently, the students will gain knowledge of African culture via the Internet, by searching for data to support the hypothesis that primitive cultures in Africa developed early smelting techniques. Students then develop essays and formal presentations to conclude the students' work in this unit. Assessment is performed using rubrics and the School Improvement Plan outline.

Conclusion: Learning to like both reading and science is a favorable outcome of merging these disciplines. We can become more effective science teachers by joining forces with reading teachers on all levels. My personal and professional development has formed, not only because of strong mentors like Professor's Ralph K. Strong, Maury Kellogg, and Jack Easley, but also because of my innermost need to search for the truth about nature. Teaching reading and writing via science and technology topics is a natural and powerful combination. I find the outcomes from this and similar programs that I see to be very positive. Attainments of these outcomes are well worth the initial efforts required to make these changes. I know that my students and colleagues concur.

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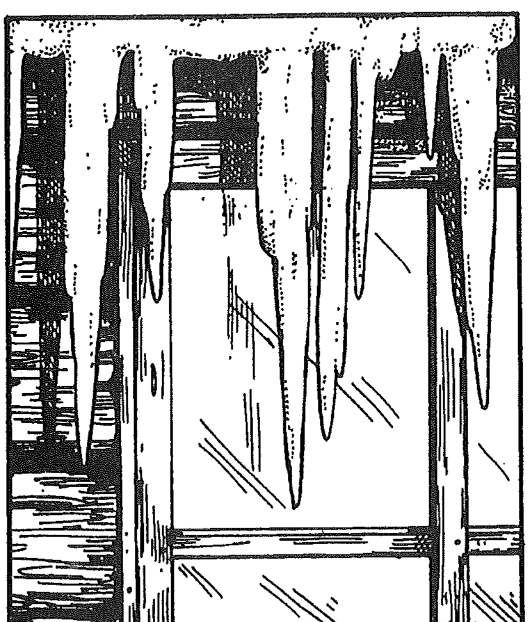

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THE HOW AND WHY OF ECLIPSES OF THE SUN AND MOON

Introduction

An eclipse of the sun occurs when the moon passes directly between the Earth and the sun whereas an eclipse of the moon occurs when the moon passes through the shadow of the Earth. During an eclipse, the sun, Earth, and moon are along a straight line. The order along the line for an eclipse of the sun is: sun, moon, Earth, whereas the order for an eclipse of the moon is: sun, Earth, moon.

Eclipses can be simulated in the classroom with a globe lamp to represent the sun, the student's head to represent the Earth, and a small Styrofoam ball held at arm's length to represent the moon. The globe lamp is in the center of a darkened classroom, and the student's stand facing it. By moving the moon(the Styrofoam ball) around the Earth(the students head) from right to left, the phases of the moon, as well as eclipses of the sun and moon, can be demonstrated.

The phase of the moon during an eclipse of the sun is New while the phase of the moon during an eclipse of the moon is Full. The time from one New or Full moon to the next New or Full moon is 29.53059 days. This time period is called the Synodic Period of the moon. However, an eclipse of the sun or moon does not occur at each New or Full moon.

The shape of the Earth's orbits around the sun is an ellipse. This orbit defines a plane. The orbit plane of the Earth around the sun is called the Ecliptic Plane. The shape of the moon's orbits around the Earth is also an ellipse. The orbit of the moon around the Earth also defines a plane. If the Ecliptic Plane and the plane of the moon's orbit around the Earth were the same plane we would have an eclipse of the sun at each New Moon, every 29.53059 days, and an eclipse of the moon at each Full moon, every 29.53059 days.

However, the orbit plane of the moon is inclined to the Ecliptic plane at 5.1%. This can be illustrated with a file folder. One half of the file folder represents the Ecliptic plane while the other half represents the orbit plane of the moon around the Earth. If one half of the file folder is held horizontal, the other half illustrates the angle between the two planes. Note that the intersection of the two planes is a line.

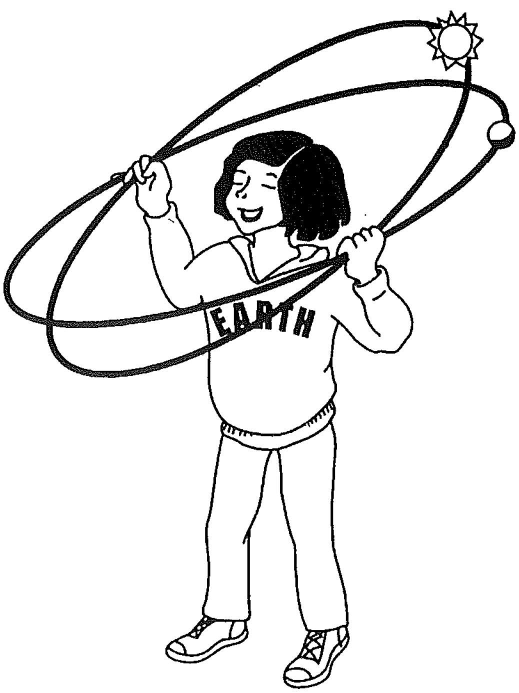
The point in the orbit of the moon around the Earth where the moon goes from below the Ecliptic plane to above the Ecliptic plane is called the ascending Node, whereas the point where the moon goes from above the Ecliptic to below is called the descending node. These two points define the "line of nodes;" that is, the line where the orbit plane of the moon around the Earth intersects the Ecliptic plane.

Eclipses of the sun can occur only when the sun and moon are at or near the same node, whereas eclipses of the moon can occur only when the sun and moon are at or near opposite nodes. The time for the moon to go from ascending node to descending node to ascending node is 27.21222 days. This time period is called the Draconic Period of the moon.

Eclipses and Hula-Hoops

Another way to think about eclipses of the sun and the moon is to use an Earth centered model. The sun appears to move around the Earth once each day, rising in the East and setting in the West. This can be simulated in our globe lamp model by having the student turn around to the left, counterclockwise as seen from above. But the sun also appears to move with respect to the background stars. This is the apparent motion of the sun with respect to the background stars. The apparent path of the sun with respect to the background stars is called the ecliptic. This can be simulated by having the students walk around a circle centered on the globe lamp, the sun, and noting that the globe lamp appears to move with respect to the things in the background, the stars.

The sun takes 365.2564 days to travel from one point on the ecliptic and return to that same point on the ecliptic with respect to the background stars. The sun appears to move on a circle about the Earth and requires 365.2564 days to make one complete trip. One trip around the ecliptic would be equivalent to traveling 360%. On average, the sun appears to move 360%/365.2564 days or 0.9856%/day. The moon takes 27.32166 days to make one complete trip around the Earth with respect to the background stars. On the average, the moon appears to move 360%/27.32166 days or 13.1764 %/day.



Hula-Hoops are easily available and can be used to represent the apparent paths of the sun and moon around the Earth. Take one of the Hula-Hoops apart and place it inside a second Hula-Hoop. Cut the first Hula-Hoop so that it will fit just inside the second Hula-Hoop and reassemble it. Place the first Hula-Hoop inside the second and locate two point on opposite sides, along the diameter of the Hula-Hoops. Drill holes in both Hula-Hoops in the plane of the hoops so that when a bolt is placed in the holes the hula hoops will pivot about the diameter. Insert the bolts and attach a washer and a nut to each bolt.

Let the outer Hula-Hoop represent the apparent path of the sun around the Earth, the Ecliptic. Let the inner Hula-Hoop represent the apparent path of the moon around the Earth. The diameter along which they pivot is the line of nodes. As seen from above, the sun and moon will appear to move counter-clockwise around the Hula-Hoops. The sun will take one year, moving at about one degree per day, to make one trip around the Earth, and the moon will take 27.32166, moving at about 13 degrees per day to make one trip.

If the orbit plane of the Earth, the Ecliptic plane, and the orbit plane of the moon were in the same plane, then we would have an eclipse of the sun at each new moon and an eclipse of the moon at each full moon. This can be illustrated by having the Hula-Hoops in the same plane.

The orbit plane of the moon is inclined to the orbit plane of the Earth by 5.1%. This can be illustrated by holding the two Hula-Hoops such that the two hoops are inclined at an angle of about 5% with respect to each other. Note that the two hoops overlap. The sun and the moon do not need to be exactly lined up at new moon for an eclipse of the sun to occur. The sun and moon are not points in the sky but have apparent size, about 0.5%. Because of this apparent size, you can think of the orbit of the moon overlapping the orbit of the Earth. Since the orbits overlap, there is a region along the ecliptic centered on the nodes where eclipses of the sun and moon can occur.

Types of Solar Eclipses

Three types of solar eclipses are possible: partial, total, and annular. During a partial eclipse, only part of the sun is covered up by the moon. During a total eclipse, the sun is completely covered by the moon at mid eclipse. Totality can last from a brief instant to a maximum of 7.5 minutes. An annular eclipse is a special type of partial eclipse. At mid eclipse during an annular eclipse, the moon does not completely cover the sun. A ring of sunlight appears or an annulus of sunlight.

Solar Eclipse Limits

A solar eclipse will occur at New Moon if the sun is less than about 17% on either side of a node. The maximum possible value is 18.5% and the minimum possible value is 15.4%. This corresponds to the overlap of the two Hula-Hoops. Recall that the sun appears to move about 1% each day along the ecliptic. The sun will spend a maximum of about 37 days and a minimum of about 31 days in this region where an eclipse of the sun can occur. The time from one new moon to the next new moon is 29.5 days. During any 31 or 37 day interval, one new moon must occur and two new moons may occur. When the sun is in the region where a solar eclipse can occur, at least one solar eclipse must occur and two solar eclipses might occur depending on when the new moon occurs.

A central(total or annular) solar eclipse will occur if the sun between 11.8% to 9.9%on either side of a node. The sun will spend a maximum of about 24 days and a minimum of about 20 days in this region where a central eclipse of the sun can occur. During any 20 to 24 day interval, no new moon might occur or at most one new moon would occur. When the sun is in the region where a central eclipse will occur, one or no central eclipse will occur depending on when the new moon occurred.

Types of Lunar Eclipses

Three types of lunar eclipses are possible: penumbral, partial and total. A penumbrial eclipse occurs when the moon is in the penumbra of the Earth's shadow. This is the part of the Earth's shadow that is partially illuminated by the sun. You are in the penumbra of the Earth's shadow when you are watching the sun rise or set and the sun is partially below the horizon. The penumbra is not very dark. For this reason, penumbrial eclipses go unnoticed. The darkest part of the Earth's shadow is the umbra. When the moon gets into the umbra, a partial eclipse occurs. When the moon is entirely in the umbra, a total eclipse occurs. The diameter of the umbra at the moon's distance from the Earth is about 9,210 km while the diameter of the moon is 3,476 km. The moon will easily fit inside the umbra of the Earth.

Lunar Eclipse Limits

A lunar eclipse will occur at Full Moon if the moon is less than about 12% on either side of a node. The maximum possible value is 12.25% and the minimum possible value is 9.5%. This corresponds to the overlap of the two Hula-Hoops. Recall that the sun appears to move about 1% each day along the ecliptic. Thus, the shadow of the Earth will move about 1% each day along the ecliptic in a direction that is opposite the sun. The sun will spend a maximum of about 25 days and a minimum of about 19 days in this region where an eclipse of the moon can occur. The time from one new moon to the next new moon is 29.5 days. During any 19 or 25 day interval, one full moon might occur or no full moon would occur. When the sun is in the region where a lunar eclipse can occur, a lunar eclipse might occur or might not occur depending on when the full moon occurs during the time when the sun is in the eclipse region.

A central(total) lunar eclipse will occur if the sun is between 6.7% to 3.7%on either side of a node.

The sun will spend a maximum of about 13.4 days and a minimum of about 7.4 days in this region where a central eclipse of the moon can occur. During any 7.4 to 13.4 day interval, no full moon might occur or at most one full moon would occur. When the sun is in the region where a central eclipse will occur, one or no total lunar eclipse will occur depending on when the full moon occurred.

Eclipse Seasons

For the moon to appear to cover the sun and thus produce a solar eclipse, the sun and the moon must be at or near the same node. For the moon to enter the Earth's shadow and thus produce a lunar eclipse, the sun and the moon must be at or near opposite nodes. These times when eclipses can occur are called eclipse seasons.

The two nodes determine a straight line in space, the line of nodes. When the line of nodes is pointing toward the sun, eclipses of the sun and moon are possible. The direction of the line of nodes changes slightly each year, about 19.4 degrees each year. The result is that the eclipse seasons occur about 20 days earlier each year. Normally, only two eclipse seasons will occur in a calendar year. But, it is possible for three eclipse seasons to occur in a calendar year. If the first eclipse season occurs in January, the second will occur in June, and the third will occur in December.

The attached table summarizes eclipses of the sun and the moon in order by month in ten year intervals: 1986 - 1995, 1996 - 2005, 2006 - 2015, 2016 - 2025. In the table L represents a Lunar eclipse, S represent a Solar eclipse, T represents a Total Eclipse, P, represents a Partial eclipse, Pn represents a Penumbrial lunar eclipse, and A represent a Annular solar eclipse. Thus S,T would be a Solar, Total eclipse and L,Pn would be a Lunar Penumbrial eclipse.

The eclipse seasons are apparent from this table. Note that the eclipse seasons occur about 20 days earlier each season. This is a result of the changing direction of the line of nodes.

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A Summary of Solar and Lunar Eclipses: 1986 - 1995

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
January					26 S, A	15 S, A 30 L, Pn	04 S, A			
February				20 L, T	09 L, T					
March		29 S, A/T	03 L, P 18 S, T	07 S, P						
April	09 S, P 24 L, T	14 L, Pn								15 L, P 29 S, A
May								21 S, P	10 S, A 25 L, P	
June						27 L, Pn	15 L, P 30 S, T	04 L, T		
July					22 S, T	11 S, T 26 L, Pn				
August			27 L, P	17 L, T 31 S, P	06 L, P					
September		23 S, A	11 S, A							
October	03 S, A/T 17 L, T	07 L, Pn								08 L, Pn 24 S, T
November								13 S, P 29 L, T	03 S, T 18 L, Pn	
December						21 L, P	09 L, T 24 S, P			

A Summary of Solar and Lunar Eclipses: 1996 - 2005

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
January				31 L, Pn	21 L, T	09 L, T				
February			26 S, T	16 S, A	05 S, P					
March		09 S, T 24 L, P	13 L, Pn							
April	04 L, T 17 S, P								19 S, P	08 S, A/T 24 L, Pn
May							26 L, Pn	16 L, T 31 S, A	04 L, T	
June						21 S, T	10 S, A 24 L, Pn			
July				28 L, P	01 S, P 16 L, T 31 S, P	05 L, P				
August			08 L, Pn 22 S, A	11 S, T						
September	27 L,T	02 S, P 16 L, T	06 L, Pn							
October	12 S, P								14 S, P 28 L, T	03 S, A 17 L, P
November							20 L, Pn	09 L, T 23 S, T		
December					25 S, P	14 S, A 30 L, Pn	04 S, T			

A Summary of Solar and Lunar Eclipses: 2006 - 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
January				26 S, A	15 S, A	04 S, P				
February			07 S, A 21 L, T	09 L, Pn						
March	14 L, Pn 29 S, T	03 L, T 19 S, P								20 S, T
April								25 L, P	15 L, T 29 S, A	04 L, T
May							20 S, A	10 S, A 25 L, Pn		
June					26 L, P	01 S, P 15 L, T	04 L, P			
July				07 L, Pn 22 S, T	11 S, T	01 S, P				
August		28 L, T	01 S, T 16 L, P	06 L, Pn						
September	07 L, P 22 S, A	11 S, P								13 S, P 28 L, T
October								18 L, Pn	08 L, T 23 S, P	
November						25 S, P	13 S, T 28 L, Pn	03 S, A/T		
December				31 L, P	21 L, T	10 L, T				

A Summary of Solar and Lunar Eclipses: 2016 - 2025

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
January			31 L, T	06 S, P 21 L, T	10 L, Pn					
February		11 L, Pn 26 S, A	15 S, P							
March	09 S, T 23 L, Pn								25 L, Pn	14 L, T 29 S, P
April							30 S, P	20 S, A/T	08 S, T	
May						26 L, T	16 L, T	05 L, Pn		
June					05 L, Pn 21 S, A	10 S, A				
July			13 S, P 27 L, T	02 S, T 16 L, P	05 L, Pn					
August	18 L, Pn	07 L, P 21 S, T	11 S, P							
September	01 S, A 16 L, Pn								18 L, P	07 L, T 21 S, P
October							25 S, P	14 S, A 28 L, P	02 S, A	
November					30 L, Pn	19 L, P	08 L, T			
December				26 S, A	14 S, T	04 S, T				

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MOONLINK/MOONLIT

Putting students in position to make connections has always been a challenge in high school education. For science teachers the connections to other disciplines are commonly with math or health. We thought it would be fun to attempt an interdisciplinary project linking science with literature. In order to begin this project a suitable vehicle was needed, and so a search began. NASA is currently developing the Discovery Missions and the 1998 project was the Lunar Prospector mission. As a spin off of the Prospector mission, the Moonlink education outreach was developed by Space Explorers in DePere, Wisconsin. We selected this program as our vehicle.

The Moonlink project involves a simulated mission launch for the students, followed by collection of actual data as relayed from the NASA probe orbiting the moon. It seemed natural to connect the real science with science fiction and other literature involving students from senior English classes. There were many challenges along the way.

Developing the science side of the project was routine. The space unit normally incorporated in the senior level science course was enhanced to include lessons on and history of NASA and the important Earth missions into space. Geology of the moon (selenology) and previous Apollo missions were added to student lessons. Extra lab activities were also incorporated including modeling the distance between Earth and the moon using athletic balls and jump ropes borrowed from the PE department, modeling crater formation on the moon, building jet propelled four wheeled moon rovers, charting the phases and movement of the moon through the night skies, and study of actual moon rocks borrowed from NASA. Videos of past missions, and industry-based videos were also secured and shown in class. The plan was to immerse the students in "Moon" science, past and present. Internet connections to mission control were made and students explored the profusion of information available through the World Wide Web.

The Web also connected us to other disciplines. These areas included an extensive science fiction bibliography of works related to the moon, a hyperlink to lunar mythology of various cultures, lists of classical and popular musical compositions related to the moon, historical articles and literary websites. The NASA site, steeped in real science, also offer exceptional interdisciplinary links.

Just as the development of the project was incorporated within the existing curriculum on the science side, so two senior English classes refocused their traditional syllabus. For example, students searched reading assignments for lunar references from Anglo-Saxon literature to contemporary poetry and prose. Students grew in enthusiasm as they began to collect references from works perennially on the syllabus, such as Shakespeare's *Hamlet* and Mary Shelley's *Frankenstein*. New additions to the syllabus included short stories: "The Sentinel" by Arthur C. Clarke and "The Wife's Story" by Ursula LeGuin. A new novel chosen for the course, *The Sparrow* by Mary Doria Russell, proved so popular with students that it has become a permanent addition to the senior syllabus. Moreover, on their own initiative students read the just-published sequel to the novel, *Children of God*. Both novels present an interdisciplinary approach to first contact science fiction, exploring scientific and philosophic issues. An exit project in English required collecting and analyzing works with lunar references in poetry, fiction, mythology, music, and art. In one phase of the project students created an original work in one of these disciplines. The level of intelligence and imagination displayed in the projects astonished the teachers.

Because of the academic schedule, Science and English classes met separately; however, we brought the classes together whenever possible. Since our students were not yet born when the last Apollo mission lifted off, we discovered that they could not comprehend the nature of an actual launch. To address this concern, we scheduled a practice launch with mission scripts provided by "Moonlink" in the school's computer lab. During the two hours, tension ran high, but when the simulation was over the students had gained insight into mission mechanics and specialties. Students worked in two-person mission specialty teams, each computer monitor displaying different instruments. For example, one screen displayed information for a science instrument, the neutron spectrometer, while another displayed information about guidance and navigation to control and track space craft trajectory. One student assumed the role of Mission Director, leading and directing all mission activities for the launch. Another student served as Public Affairs Officer, informing spectators of the launch progress (and glitches). The practice launch proved invaluable as preparation for our actual launch a month later. The rehearsal tweaked students' interest and deepened their understanding of the Lunar Prospector launch and mission. The experience also prepared them for responding intelligently and quickly when unexpected crises arose (as they do in real science). Our actual launch went smoothly and data began arriving.

Our students selected a 150 km site to study near the lunar South Pole. The site from which we expected to receive data lies within the Amundsen Crater. This location was chosen because of its close proximity to the sites NASA had designated with great potential for water deposits. When data began to arrive student teams worked to analyze and present reports on their findings to the whole group. In the process students encountered the difficulties inherent in collecting and analyzing actual data and realized that real science does not always proceed smoothly in textbook fashion.

In the summer before the academic year of our project we participated in a workshop at St. Norbert's College, near Moonlink headquarters. As a follow up, we also attended a training conference and certification program at the University of Wisconsin, Parkside. This session qualified us to contract with NASA's Lewis Space Center to exhibit and study actual moon rock specimens on our campus. Using microscopes as our primary tools, we had the opportunity to study first hand the selenology of Earth's moon. The moon rocks, national treasures, engendered awe among our students and other visitors. We enjoyed being caretakers of the moon rocks but felt great relief when our priceless charges were safely returned to NASA.

Interdisciplinary or cross curricular projects challenge teachers, students, and administrators. This project required a high level of cooperation and flexibility. New learning situations create new moments of stress for all. We suggest that maintaining a sense of humor is as important as seriousness of purpose in experiences like our Moonlink/Moonlit project. Simple rewards help. We were asking our students to invest extra time and great effort in accomplishing the mission directives. Lunchtime meetings were scheduled to bring the various classes together. "Launch Lunches" incorporated space-related games as well as critical announcements regarding mission logistics. During mission debriefings, special space-related snacks were served, such as Milky Way candy bars, Capri Sun drinks, Clementine tangerines, and specially secured "Moonpies." (The faculty involved enjoyed some Apollo malt beverages.) The meetings even had back ground music thanks to the students who had prepared audio tape mixes of popular moon linked songs.

The Moonlink/Moonlit project attracted attention beyond our school community. Our Public Relations Director, Andrea Hillistad, supported our efforts and assisted us to tell the story of the project. Students learned to communicate with the press, contributing to press releases, participating in interviews, and reporting on the progress of the mission. Students also played a key role in a special presentation to the school Board on the success and value of the mission.

The last word from our mission control: Do not abandon hope all ye who enter interdisciplinary projects. The journey is well worth the visit.

MINI IDEAS

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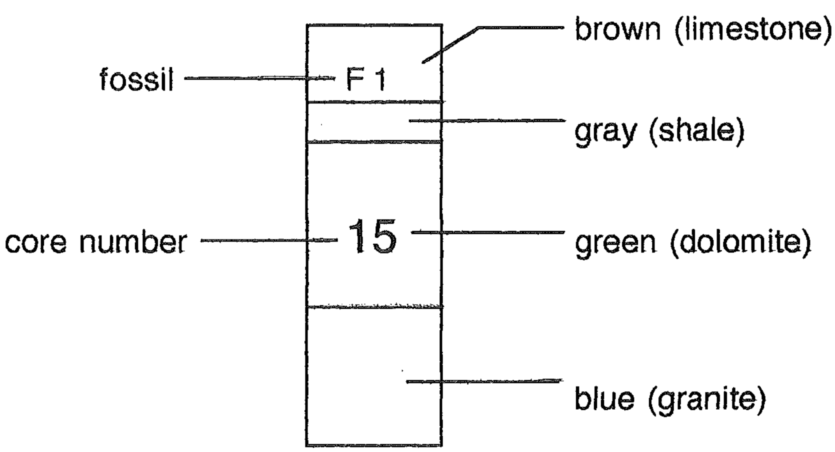
PAPER CORES: A GEOLOGY PROBLEM

My students take field trips over the rolling terrain of Central Illinois. From our viewpoint we can see glacial end moraines, sand hills, and streams, but must travel several miles to view a rare roadcut exposing bedrock. Students can learn about topography from their observations but the geology of the area doesn't permit a deeper view of the layers of rock buried deep below the glacial debris.

Sample Core



Paper Cores is a three-week culminating activity that draws on all aspects of geology studied in class, but in a new situation. Student teams are cast in the role of geologists and their job is to determine the safest location upon which to build a suburb. Twenty-four cores of varying depths are evenly spaced throughout the room in a large rectangle. These cores, along with the four site locations, are hung from the ceiling. This necessitates moving the desks and chairs to the periphery of the class room. (See Photo 1)

Each color in the core represents a particular strata of rock. The same color paper with the corresponding rock is found at the identification tables. For example, brown represents limestone in a core. A sample of limestone is placed on brown paper on the identification table for students to work with. Also, within the paper core, a symbol (F1 in the limestone) may be placed which corresponds to a fossil on the identification table. The fossils are identified, giving the students a clue as to the age of the rock layer.

Since this is a second semester activity, students in my class have already experienced much work in cooperative teams encountering problem solving situations. In the previous unit of study, students worked with geologic processes, rocks and fossils, geologic history and time scales. They come into this unit equipped with the tools to begin working on the problem but not knowing the answer.

Students enter the classroom, having previously been assigned to teams, and are presented with this problem. Your company has been hired to select the safest geological site for the building of a suburban development. The developers have purchased options on four sites (indicated by the letters A, B, C, and D). You and your team of geologists must examine the cores and make a detailed report for the developers about the suitability of building at each site.

To aid your report your team will need to:

a. construct a geological column containing all of the rock layers, in order, that have been deposited over the entire area.

b. identify specific geological processes that have occurred near each site and provide evidence for your claim.

c. create a topographic map of the entire area to scale and locate the sites on the map.

d. build a Styrofoam model of the area to scale.

Students use the DAPIC problem solving approach. This is widely used in the technology industry and is used in the IMaST curriculum of which I am a writer. Integrated Mathematics, Science and Technology (IMaST) is an NSF sponsored project at Illinois State University with the objective of producing an integrated M/S/T curriculum for the middle school grades. In the DAPIC process students (D) define and restate the problem. They (A) assess the situation to determine the materials and equipment that will be needed to solve the problem. Students must ascertain what information is already known about the problem and what they need to know to solve the problem. Students develop a (P) plan to solve the problem and then (I) implement the plan. Students finally (C) communicate their results to classmates and others concerned.

Since students have already been presented with the problem, their first task is to restate the problem in their own words. Next students must assess the problem. As they survey the room, they observe cores hanging from the ceiling and rocks and fossils at identification tables. (Photos) Based on what they see in the room and the problem statement, students prepare a of list of things that they know and need to know.

Student teams then prepare a plan that will solve their problem. Tentative plans are submitted for approval. If the plan is good enough to successfully begin the project it is approved. During the implementation students often find that some step has been omitted. In this case the plan is modified as needed and students proceed with the project. As students implement their plan they also update their assessment of the problem daily. The "know" column

photo 1

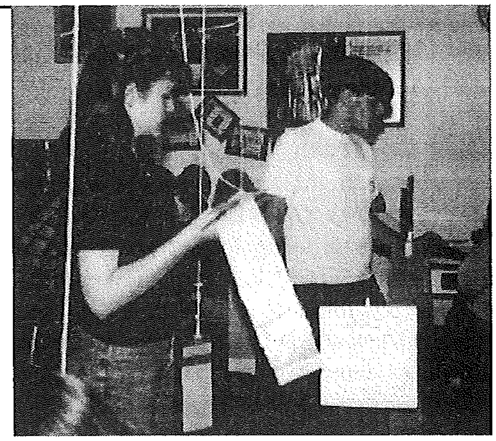
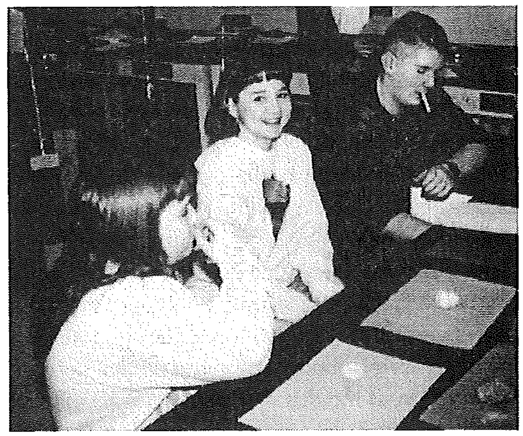


photo 2



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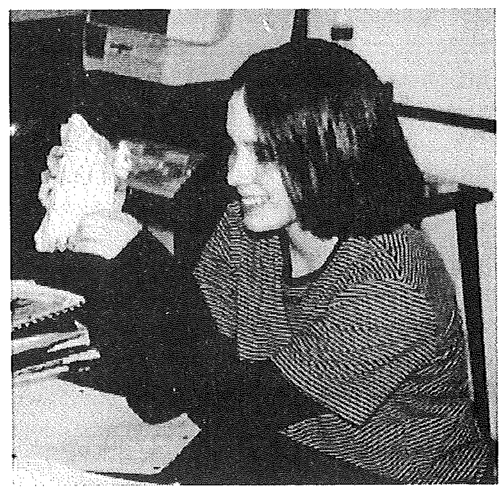

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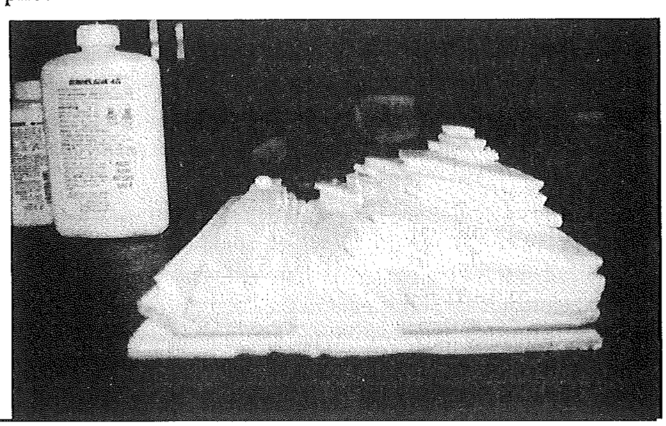

becomes a summary of what students have learned in the project. The "need to know" column provides a continuing goal for students to achieve each day.

Students make a list of characteristics of the ten rocks (grain size, texture, color, hardness, reaction with acid) and use the results of their data to identify the rocks using a key I devised. (See photo 2) When all of the rocks have been correctly identified teams write a short research report on each one. The reports describe the characteristics of the rocks and any possible geological hazards associated with the rock. The rock key also contains vocabulary words which are new to the students. As problems with terminology arise the words are listed in the "need to know" column. Upon resolving the problem students at that information to the "know" column. Students come to know the terms and their importance by constant use in a real setting. Fossil locations are also indicated in the cores. Students use variety of reference materials to identify the fossils and gain clues to the age of the strata.

Students measure the cores in detail. (See photo) The cores can be positioned to show a variety of geological processes including tilting, folding, or faulting. The thicknesses of particular strata can change between cores exhibiting erosion. By designating the floor of the room as sea level the various heights of the top of the cores above the floor can be used for elevation differences. This permits students to measure both the distance above sea level and the distance between cores.

After students have collected all of the data on the strata and correctly identified the rocks and fossils they are ready to interpret the data. Students organize the elevations and dimensions of the area to produce a topographic map. (See the example of student work and score in the appropriate box in the rubric.) Students have been introduced to topographic maps in a previous unit. This activity requires students to use their knowledge to create a map based on their data. Upon completing the map students use it as the basis of building a scale model of the area to scale. The scale model provides a true representation of the landscape. (See Photo 4)

Next, students search for the possible geological hazards for each site. Students arrange the strata, with information gained from the fossils, into a geologic column. The distribution of the rock strata under the surface allows students to deduce the geological processes that have occurred in the area. The rocks identified on the surface are immediate clues to building suitability. Processes encountered at the sites include volcanism, tilting, erosion, deposition, and faulting. Student teams research the rocks and processes associated with each site and include the information in the report to the developers.

The project appeals to students of all ability levels and learning styles. I have a range of students from special education to gifted in the classroom. All students are able to make contributions significant to the team in completing the project. Multiple learning styles are addressed. Students build and manipulate models, analyze and interpret data, and address problems in a cooperative, team environment. Time is allotted at the end of each period for students to reflect upon their team's accomplishments of the day, evaluate team progress, and add to their "know" and "need to know" pages.

The teacher assumes the role of science coach and facilitator. Each step in the team's plan is reviewed upon completion. If all is well, students proceed to the next stage. This process allows errors and misconceptions to be recognized and corrected promptly. I am free to move among teams and help as problems arise. Ample resources are available for students to allow themselves to find the answers to the questions they pose. Students also complete a midunit team evaluation form (see team evaluation form), permitting unseen conflicts to become straightened out at an early stage.

The idea for Paper Cores germinated from a combination of sources. During my summer work at Harvard in 1992 Ed Nawrocki and Nancy Huebner made a nice presentation using rocks to recreate a geological history. In 1994, at the Geological Society of America Annual Meeting in Seattle, I picked up Pete Palmer's video, *The Earth has a History*. Dr. Palmer does a wonderful job of showing how road cuts and canyons in the area of Boulder, Colorado can be used to assess the geological history of the area. We have neither canyons nor an abundance of road cuts in Central Illinois. The only way to permit students to analyze rocks in a geological column is to use cores. Obtaining and analyzing cores in the real world is an expensive proposition, but the process yields valuable information. Hanging paper cores in the classroom simulates the real world environment successfully.

Students do a variety of activities to provide them with enough information to help them begin to solve the problem. Rudimentary knowledge of geological time periods, topographic maps, rock characteristics and fossils is needed. These topics are introduced in the previous unit of study. Students use this knowledge as a stepping stone to solving the problem at hand. The GSA video, *The Earth has a History*, introduces students to the Law of Superposition and Law of Original Horizontality. The video packet includes a student activity to reconstruct the geological history of the flatirons area of the Rocky Mountains near Boulder, Colorado. It has proven to be a valuable resource along with the American Institute of Professional Geologists guide to geological hazards for home buyers.

Upon completion of the project students evaluate themselves, their team and teammates using the team, self and teammate assessments. These evaluation instruments are discussed with students at the beginning of the project in detail. The evaluation requires students to document their work, and that of their teammates, throughout the project. A scoring rubric is also included.

Summary

Paper Cores creates a learning environment in which all students can contribute and succeed. The goals and expectations of the activity are clearly delineated in the problem statement. Students assess the problem and create a plan of action to solve it. As students work though their plan they find

Team Evaluation

This data is confidential. Your classmates will not have access to it.

Your name ______________________________

Scale
3 = my team did this all of the time
2 = my team did this most of the time
1 = my team rarely did this
0 = my team didn't do this at all

_____1. Respect the opinions of all teammates

_____2. Discussed all sides of the problem.

_____3. Listened while others talked.

_____4. Accepted group decisions.

_____5. Used class time wisely to complete the project.

_____6. Made sure all team members could solve all of the problems of the project.

_____7. Helped all team members understand all aspects of the project.

_____8. Shared the work in the project.

2. Self Evaluation

Circle your opinion of your performance as a member of this team.

outstanding very good average poor no participation

Explain the reason for your opinion on the back. Include an explanation, in detail, what YOU did and how YOU helped your team mates complete this project.

3.Team Member Evaluation

Your Name ______________________________

Name of team member. ________________________________

Circle your opinion of the performance of this team member.

outstanding very good average poor no participation

On the back explain the reason for your opinion. Include the contributions of this team member to the project.

they must acquire specific, new skills. With minimal help, students teach themselves new terminology, contour mapping and topographic model building. Student teams search the cores, rocks, and fossils for patterns, yielding clues to the geological history of the area. Paper cores is a tactile simulation. Students handle representative cores, rocks, fossils and construct models. Students are encouraged to question and research to problem solve . Video and computer play a role in the presentation of introductory information and the organization and presentation of the data collected.

Constant monitoring of student work enables the teacher to provide additional help to individual teams as needed. Students submit a typed report, describing the geology and identifying the geological hazards of each site, and offer their opinion as to the safest location upon which to build a subdivision, based on hard facts and sound evidence. Along with the teacher assessment rubric, student evaluate their team, themselves and their teammates. Paper Cores is one my most enjoyable and successful activities.

Resources

Nawrocki, Ed and Nancy Huebner. 1992. Project ESTEEM Presentation. Harvard-Smithsonian Center for Astrophysics. Cambridge, MA

Palmer, A.R. *The Earth Has a History* (video). Geological Society of America. P.O. Box 9140. Boulder CO 80301

Creath, Wilgus. 1996. Home Buyer's Guide to Geologic Hazards. American Institute of Professional Geologists. Mido Printing Co. Denver, CO

Poelker, Brian. Paper Cores and Problem Solving. The Strata-ge Column, Ellen Metzger, Ed. *Journal of Geoscience Education.* National Association of Geoscience Teachers 45(4). pp381-385.

Activity Evaluation: Student work is evaluated both as a team and individually. The following scoring rubric has been developed for materials in both categories.

3 Points: Exceeds expectations. All material is complete and accurate with great attention to detail. Proper units of measure are used. The work is neat and well organized.
2 Points: Meets expectations. The work is complete, but may contain minor errors that do not affect the interpretation of the data or results. Proper units of measure are used. Neatness and organization are acceptable but can be improved.
1 Point: Does not meet expectations, but exhibits some effort. Errors occur in the material. Proper units of measure are not used or are omitted. Aspects of the work are unorganized. Neatness needs improvement.
0 Points: Unacceptable work. Major errors or omissions occur in the material. Proper units of measure are omitted. Material lacks detail. The work is unorganized and messy.

Individual scoring rubric

Materials turned in	3	2	1	0
Rock data sheet				
Fossil data sheet				
Know list				
Need to know list				
Rock reports				

Team scoring rubric

Materials turned in	3	2	1	0
Geological Column				
Geological Processes				
Topographic Map				
Scale Model				
Report to Developers				

Grading: A = mostly 3's, no 1's
B = an equal mixture of 3's and 2's
C = Mostly 2's with an equal number of 3's and 1's
D = Mostly 1's

Because of the close monitoring of student progress, unacceptable work is uncommon.

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INTRODUCING THE CONCEPTS OF LIGHT AND LASER THROUGH A GUIDED INQUIRY APPROACH FOR CONCEPTUAL CHANGE PARTS I AND II **

Part I — Introduction and Rationale

Inquiry is a system of questioning and knowledge seeking through systematic observation, measurement, and experimentation that aims to develop scientific knowledge and understanding (Cherif, 1988, 1998; Hurd, 1969; Schwab, 1962; Suchuan 1966). What we teach in science classes is clearly important, but how we teach it is even more so if we are to foster the students' appreciation and understanding of scientific knowledge and development. In working with science teachers and student-science teachers at both elementary and secondary school levels, many science educators have come to realize that a larger number of teachers feel uncomfortable using an inquiry approach and, what is more, most have difficulties asking relevant questions (Yager 1988, Cherif 1988, Moore 1989, Harper 1990). In helping to remedy this situation, in 1988, Cherif developed a guided inquiry approach consisting of six main questions that can be used to promote conceptual change by increasing a student's ability to analyze, synthesize, evaluate and relate scientific ideas to everyday life. In this paper, we state these questions, explain them, and show how they might be implemented as an inquiry approach to teaching light and laser concepts in the classroom.

The six main proposed questions to teach science for conceptual change through a guided inquiry method are:

1) What do you think will happen given this set of conditions? (If, for example, X is added to Y?)
2) What actually happened?
3) How did it happen?
4) Why did this happen?
5) How can we find out which of these hypotheses is the most reasonable?
6) How can you relate the investigated idea, concept or principle to your daily lives?

These questions are needed "to draw out the information that will match the intended learning outcomes which enable teachers to monitor the pupils' progress in learning through inquiry processes, and to derive meaning from scientific generalization" (e.g., Jacobson and Bergman, 1987; Cherif, 1988, 1993a). Furthermore, Cherif has argued that, "these questions help clarify both the purpose and identify the problem, by developing the statement of objectives. They also aid in the collection and interpretation of data, and the development of tentative conclusions and generalizations." An important goal is the establishment of a simple, common sense relationship between investigated problems, tentative conclusions, and the students' daily lives. See Table -1- for the nature and aim of each of these six guided inquiry questions.

Part II — Using The Guided Inquiry Approach To Teach About Light and Laser

Needed materials:

Give each group of three students a laser pen, a flashlight, a white sheet of paper (e.g., 17" x 14"), a piece of thick black paper, a pin, an adhesive tape, and two small mirrors.

Procedures:

Holding the laser pen in one hand and the flashlight in the other hand, ask all the groups the following predictive question:

1) What do you think will happen to the beam of light from the laser pen and flashlight when you switch them on?

When we ask "What will happen if..." we set the stage for the students to recognize the problem, and in turn capture their immediate interest. Furthermore, this question promotes the ability to think about and express a thought clearly (Cherif 1988, 1993a, 1998). The followings are examples of student's predictions at the seventh grade level.

1. Both the beam of light from the laser pen and the beam of light from the flashlight will appear as a single spot of light on the paper.
2. Both the beam of light from the laser pen and the beam of light from the flashlight will appear as a single bright spot of light in the center, but the light will fade as it moves away from the center.
3. The beam of light from the laser pen will appear as a single spot of light on the paper while the beam of light from the flashlight will appear as a dispersed hollow light.
4. The beam of light from the laser pen will appear as a dispersed hollow light on the paper while the beam of light from the flashlight will appear as a single spot of light.

All given predictions should be listed on the blackboard or overhead projector, and discussed by the class. To avoid too many ill-founded answers to this predictive question, Cherif has suggested (1988, 1998) that, "we should allow enough time for the students to discuss the problem with each other in order to sharpen or challenge their predictions. After there is no more discussion or concern about the given prediction, students are given the opportunity to test their own predictions by performing the experiment in the classroom." In this case, students will be allowed to switch on both the laser pen and the flashlight and observe the beam of light from both objects.

Table -1-

Proposed Guided Inquiry Questions In Teaching Science Concepts (Cherif, 1988, 1993a, 1998)

No	Guided Inquiry Question In Teaching Science Concepts	The Nature of The Question	The Aim and Objective of The Question
1.	What do you think will happen given this set of conditions? (If, for example, X is added to Y?).	Predicted question	To arouse interest, stimulate thinking and provide predictions.
2.	What actually happened?	Descriptive - discovery question.	To build an awareness of what actually happened.
3.	How did it happen?	Holistic - descriptive question.	To establish in students'minds the cause and effect relationship; To think of all the processes that took place as a total integrated whole; To provide general understanding of the process taking place and resulted in what actually happened.
4.	Why did this happen?	Causal question or reasoning explanation.	To develop and apply some kind of mental analysis that enable students to generate a reasoned and testable hypothesis (tentative explanations) using their ideas, experiences and understanding.
5.	How can we find out which of these hypotheses is the most reasonable?	Experimental question.	To provide the opportunity to actually plan and carry out experiments of their own. To gain the skills of designing experiments, testing hypotheses, reasoning and debating results.
6.	How can you relate the investigated idea, concept or principle to your daily lives?	Idea-application or testing-understanding-question.	To understand the idea or the concept under investigation; To master the inquiry processes; To apply reasoning pattern in other situations; To accept science as a way of knowing and understanding.

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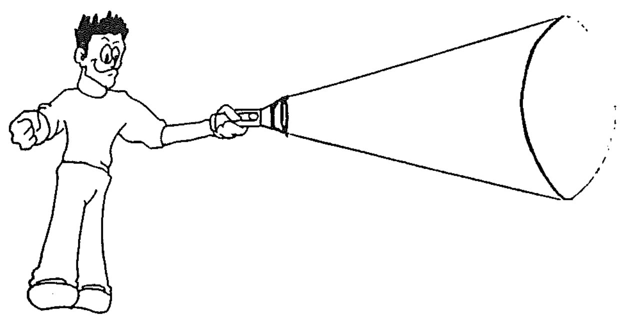
** Due to space constraints, Parts III and IV will appear in the Spring/Summer 1999 issue of the *Spectrum.*

2) *What actually happened to the beam of laser light and the beam of light from the flashlight when you switched them on?*

This is a descriptive-discovery question that is based on the careful observation(s) that characterizes any scientific process. To answer this question, students get the opportunity to test their own predictions by actually turning on both the flashlight and the laser pen and observing what actually happens

Students here need only write down or answer orally the actual final result. For example: The beam of the flashlight is scattered and bouncing all over the white paper, While the beam of laser light is a thin, bright and concentrated single spot on the white paper. When all the students become aware and agree about "what actually happened," they are asked to compare their predictions with "what actually happened."



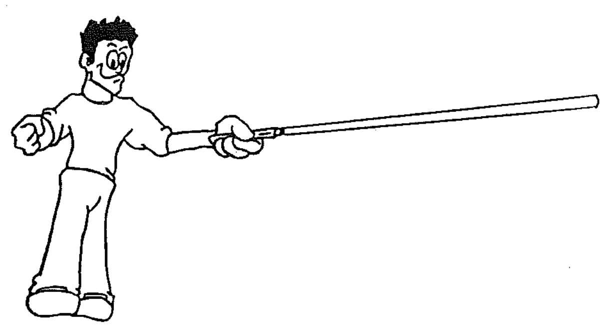


Figure 1: The beam of the flashlight is scattered and bouncing all over the white paper, While the beam of laser light is a thin, bright and concentrated single spot on the white paper.

3) *How did it happen?* Or *what are the steps that led to what actually happened?*

This is a holistic and descriptive question, and is aimed at a general understanding of the processes taking place (Cherif, 1988, 1993). Once again, observation and descriptive skills are developed and used. Here, students need to describe in detail all the previous steps they and/or the teacher have taken before reaching the final result. With this question they need to describe the empirical pattern that led to the final results. Cherif (1988, 1998) has stated that the objectives of asking this question are:

(a) to keep students up-to-date with the inquiry processes.
(b) to establish in their minds the cause and effect relationship and that the final results could not have happened without all the previous steps.
(c) to encourage students to think of everything that took place not as separate or isolated events, but as a total integrated whole.

Teachers should be cautioned not to pass over the question of "How did it happen?" too lightly:

> The holistic-description is important because it allows the student to demonstrate an understanding of what has taken place. Most of all, a holistic description shows that students can properly understand that the processes of science need not be broken down into separate activities which bear little resemblance to the true nature of the scientific activity. Furthermore, by giving students opportunities to engage in— and reflect upon— what they do, they gain some skills and information and develop an awareness of the problem. All these are necessary to help them deepen their understanding and appreciation of scientific knowledge and processes (Cherif, 1988, 1998).

As an example of how a student may answer this question, here is a seventh grade student's response:

> First, the teacher entered the classroom with some objects in her hands which she identified as flashlights and laser pens. Next, she gave each four students one flashlight, one laser pen, and one sheet of white paper. Third, she asked us to predict what would happened if we switch both the laser pen and the flashlight on. Some of us gave predictions which were written on the blackboard, and challenged by the rest of the students. Some of the predictions were erased from the blackboard and only a few were kept. Finally, the teacher let us turn on both the laser pen and the flashlight. The beam of the flashlight was scattered and bouncing all over the white paper, while the beam of laser light was a thin, concentrated, single spot on the white paper. Many of us asked why, but the teacher ignored us and continued by asking us how it happened.

4) *Why did this happen?*

This is the causal question or the reasoning explanation. The point of this question is that students are asked to generate a reasoned and testable hypothesis.

> To explain means to connect logically a cause to an effect, to provide the closest or most satisfying logical connection between the cause and the effect. Somewhere during this stage of the inquiry process, students start to develop and apply some kind of mental analysis, then test and modify their own hypotheses (individually and/or with their classmates) before they report them to the teacher. However, the aim of this question is to generate, not to test hypotheses. The latter is the function of the hypothetical-deductive question. Thus, to answer this question, the teacher must help students formulate their own answers from the obtained data, laws and theories at hand (Cherif, 1988, 1998, p. 15).

Teachers must remember that it is "the theory and not the experiment [that] opens up the way to new knowledge" (Karl Popper; cited in Hurd, 1969, p. 17). Therefore, the tentative explanations (testable hypotheses) offered by students should reflect their ideas, experiences and understanding, and thus present teachers with the opportunity to find out how and what their students think about the given instance.

The following are examples of students' testable hypotheses in seventh grade:

(a) The opening, or lens, of the laser pen is much smaller than the opening of the flashlight, and therefore, the beam of light which comes out of the laser pen is smaller and more concentrated.

(b) Since the laser light is red, and the flashlight light is white, the rays of the red laser light is thin and more crowded to each other than the bigger, more scattered white flashlight beam.

(c) The opening, or lens of the laser pen, can combine all the beams of light in one spot in the same way as placing a magnifying glass in the path of the rays from the sunlight and moving it until the sunlight appears as a bright spot of light on a paper.

(d) The mechanisms that produce the two beams of light are different.

Here, Cherif (1988, 1993a) has argued that "only those hypotheses that have proposed testable mechanisms must be considered. The students who generate hypotheses, but fail to propose a testable mechanism to test them should have their hypotheses rejected by the teacher."

5) *How can we find out which of these proposed hypotheses is the most reasonable or satisfactory?*

This question offers students the opportunity to actually plan and carry out experiments of their own. As a result, they will have the opportunity to gain the skills of designing experiments, testing hypotheses, reasoning and debating results, etc. Cherif (1988, 1998) has stated:

> This is an exciting, self-correcting stage where the students, while engaged in the whole process independently, are actually learning how scientists think and work. Since here, students are devoted to deducing the logical consequences of these hypotheses and explicitly designing and conducting experiments to test them; the analysis of experimental results will allow for some hypotheses to be rejected and some to be retained.

To use Popp's (1981) words, teachers should help students develop or enhance a frame of mind "which can allow familiar and perhaps 'pet' beliefs to be released in favor of alternative, better supported ones" (p. 14).

The following are examples of how seventh grade students test their hypotheses that were listed in question number four.

(a) The opening, or lens, of the laser pen is much smaller than the opening of the flashlight, and therefore, the beam of light which comes out of the laser pen is smaller and more concentrated.

The students reconstructed the experiment by using a laser pen and a flashlight pen as the source of the light beam. To the surprise of the students, the same result was observed by all of them: *The beam of the flashlight is scattered and bouncing all over the white paper. While the beam of the aser light is a thin, coherent and concentrated single spot on the white paper.*

The same student later proposed to test his hypothesis by shining the laser and the flashlight through a 2 mm diameter hole.

(b) Since the laser light is red, and the flashlight beam is white, the wave length of the red laser light is more concentrated than the bigger, more scattered white flashlight beam.

In this experiment, students first separated the white light into its rainbow of colors (red, orange yellow, green, blue, indigo, and violet) using a prism. Then, they placed a cardboard with a slit in the path of the rainbow colored light. The cardboard prevented all the colors from coming through except red, which went through the slit in the cardboard. Yet, they failed to get a thin, bright and concentrated single spot of red light from the flashlight similar to the one they got from the beam of laser light. Later, a few students suggested that they should place a magnifying glass on the other side of the slit of the cardboard so that the rays of the red light would be brought to a single bright spot. Again, they failed to get a thin, bright and concentrated spot of light. Again, *the beam of the flashlight was scattered and bouncing all over the paper, while the beam of laser light was a thin, bright , concentrated spot*

(c) The opening, or lens of the laser pen can combine all the beams of light in one spot in the same way as placing a magnifying glass in the path of the rays from the sunlight and moving it until the sunlight appears as a bright spot of light on a paper.

The students placed a magnifying glass on the opening of the flashlight; even by doing this, they failed to get the beam of the flashlight to take on the form of a thin, bright and concentrated spot.

(d) The mechanisms that produces the two beam of lights are different.

To test this hypothesis, students did a library research and found out how both a laser pen and flashlight work, without the help of their teacher. They discovered that white light consists of a combination of wavelengths of the visible spectrum all traveling randomly, while laser light consists of light of only one wavelength. In this wavelength, all the crests and troughs travel together to produce an intense coherent beam of light of one color.

In the light given off by the flashlight, there is a mix of crests and troughs. The waves interfere, are sometimes added together and sometimes canceled out. Eventually the light spreads out, decreasing its power. At a good distance from the flashlight, no light will be seen by an observe. In the laser, however, all the waves travel in step. The crests all travel next to one another. Light of the same wavelength that travels in step is said to be coherent light (Maton, et al, 1993, p. 117).

6) *Can you think of something we use in our daily lives that is designed and/or built on the same idea, concept, or principle we are investigating?* For example: *How many things can you think of that use laser and/or light in your classroom, in your home, and in your city?*

Cherif (1988, 1993a) calls this question an "idea-application" or a "testing-understanding" type of question. He argues that its aim is to help students generalize from the ideas at hand and to encourage them to think of science as a part of their lives. They can affect, and be affected by, science and its application. After students have named some objects that they think were designed on the same idea, they will be asked how their named objects work in the context of the relevant hypothesis (reasoning explanation). He states five objectives for this question:
(a) to make sure that students understand the idea or the concept under investigation, (b) to make sure that they master the inquiry processes, (c) to help them develop the ability of applying the reasoning pattern in other situations, (d) to see science as a part, not only of society, but also of themselves, and (e) to accept science as a way of knowing and understanding.

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MEETINGS AND WORKSHOPS

WILD IN THE CITY — URBAN RESOURCE TRUNKS

Chicago-area educators now have an opportunity to enhance their use of Project WILD and Project WILD Aquatic activities by checking out Urban Resource Trunks. Funding from the national Project WILD office and the Phillips Petroleum Corporation has allowed the Illinois Department of Natural Resources' Division of Education to develop five trunks to supplement Project WILD and five trunks to supplement Project WILD Aquatic.

Trunks contain materials that WILD workshop and focus group participants have frequently requested. All materials in the trunks are correlated to the appropriate WILD or WILD Aquatic activity. Publications include field guides, urban stories and activity booklets. An audio tape contains recordings of common mammal, bird and frog/toad calls on one side and guided imagery readings of "Water Wings," "Riparian Retreat" and "Stormy Weather" on side two. Three video tapes help illustrate Illinois wildlife. Numerous posters depicting Illinois species are included. Color photographs of fifteen species of urban animals are present as well as skulls, pelt pieces and tracks for most of them. A packet of animal photographs may be used with many activities. An owl pellet set for "Owl Pellets" is in the WILD trunk. Packets of materials for teaching "Cartoons and Bumper Stickers," "Rainfall and the Forest," "Wildlife as Seen on Coins and Stamps," "Aquatic Roots," "Fishy Who's Who," "Turtle Hurdles," "Water Canaries" and "Watered Down History" are among the many other items. The User's Manual provides urban activity adaptations, endangered species fact sheets, possible field trip sites and more.

Trunks may be borrowed from the Brookfield Zoo (708/485-0263, 312/242-2630), Chicago Academy of Sciences (773/549-0606), Field Museum, (312/922-9410) or the Illinois DNR Des Plaines office (847/294-4126).

Borrow a trunk soon and go *WILD in the City*!

ECOTEACH - 98-99 PROGRAMS FOR SCIENCE TEACHERS

EcoTeach is offering a special Ecological Study-Tour and Vacation to Costa Rica for Science Teachers and their quests. During the 8 - 10 we will visit 5 different ecological zones, participate in turtle protection work and see more animals and plants than you canimagine. Here are the details; **Where:** Costa Rica, coast to coast - San Jose, Monteverde, Gulf of Nicoya, Punta Leona Carara Reserve and more

When: All school breaks and vacations (later study-tour dates are also available)

Cost: $1,895 for eight days (10 days in summer) - air, hotels, meals, guides, etc. tax deductible

For: Science teachers and their guests - up to 20 people

With: Bilingual Costa Rican biologists from the Costa Rican Ecological Association Credit: Five university graduate science credits from the Heritage Institute of Antioch U.

To see: Tropical rainforest, forest canopy, nesting sea turtles, hatching hatchlings, exploding volcanoes, canopy, banana plantations, waterfalls, hot springs and althe usual stuff - monkeys, sloths, lots of birds- macaws, toucans, crocodiles, caiman, and more (what you will see depends on season and trip). To do: Hiking, night forest walks, snorkeling, volcano watch, birding, canopy tour

Food: Excellent local foods - generally family style

Accommodations: Great hotels

For more information contact:
Ralph Carlson, EcoTeach, www.EcoTeach.com,
PO Box 737, Suquamish, WA 98392
e-mail= ecoteach@kendaco.telebyte.com,
Phone 1-800-626-8992

The Academic Challenge - 1999

It's time to sign up for the 26th annual WYSE "Academic Challenge". Over **600 high schools** participated in 1998 to make it the largest competition ever. **7,000 students** competed in February at the Regional level (used to be called District) and we hosted over 1,800 of the best of these at the State Finals held at the University of Illinois at Urbana - Champaign in March.

For those of you who are not familiar with our program, let me give you some details.

- We offer tests in **English, mathematics, chemistry, biology, physics, engineering graphics** and **computer fundamentals**. A new "Materials Science" test will be piloted this year at one Regional site. The tests are AP level in difficulty, are 40 minutes long, are multiple choice format, and are guaranteed to challenge the "best and brightest" in your school. Each student on the team is charged **$10**.

- **SCHEDULE OF TESTING AND ADVANCEMENT - for a complete listing of the 40+ sites in Illinois, contact our office.**

Regional sites test between February 1 and 14
Sectional sites test between March 1 and 14
State Finals will be held by division of enrollment as follows

✓ **Division "Unlimited"** for those schools with enrollments greater than 1500 ..... **Tuesday, April 6**
✓ **Division 1500** enrollment equal to or greater than 700 but not over 1500 .... **Wednesday, April 7**
✓ **Division 700** enrollment equal to or greater than 300 but less than 700 .... **Thursday, April 8**
✓ **Division 300** enrollment of less than 300 .... **Friday, April 9**

FAQ (frequently asked questions)

1. *How do we do this?* Each school is asked to form a team of between 6 and 14 members. Each team member takes two tests.
2. *What if we are too small to form a team?* Schools who cannot form teams may send individuals to compete. These individuals are eligible for advancement all the way to State.
3. *How do we prepare?* This is up to you. Some schools have practices for team members while others just like to see what they can do.
4. *How do we sign up?* Thought you'd never ask......................

TO REGISTER FOR THE 1999 "ACADEMIC CHALLENGE" ... send us the following:

Your name   High School   School address   School Enrollment (9^{th} - 12^{th} grade)

you can fax it to us at **(217)244-2488**
E-mail it to **d-powell@uiuc.edu**
or send it by regular mail to:

WYSE, 2-141 ESB, 1101 West Springfield, Urbana, IL 61801 ***[(800) 843-5410]***

VISIT OUR WEBSITE FOR MORE INFORMATION AT www.engr.uiuc.edu/WYSE/

Ecology and the Chicago Region: from Cowles to Chicago Wilderness
1999 Spring Symposium

Henry Chandler Cowles – a remarkable intellect and inspiring scholar – revolutionized our understanding of ecology and of ecological succession. Through his studies of plant communities in the Indiana Dunes (first as a graduate student, then as a professor at The University of Chicago), Cowles introduced the concept of the landscape as a dynamic, ever-changing panorama. And he established ecology as the study of *processes*.

The tradition of the Chicago region as a center for the ecological movement continues today through Chicago Wilderness. Thousands of volunteers are restoring acres of land to stable ecological health. Chicago Wilderness is a coalition of 69 organizations and agencies in the Chicago region, including Indiana Dunes National Lakeshore, committed to protecting and restoring local landscapes and biodiversity.

To commemorate the 100-year anniversary of Cowles' classic doctoral dissertation and its continued relevance to Chicago Wilderness conservation efforts -- The Field Museum, the Indiana Dunes Environmental Learning Center, and Chicago Wilderness invite you to a Celebratory Symposium on **April 9 and 10, 1999.**

Ecology and the Chicago Region: from Cowles to Chicago Wilderness will take us on a journey that explores the impact of Cowles' studies on the understanding of ecology, and on the practical and theoretical applications of ecological restoration and conservation management strategies. Join us for a reception at The Field Museum on Friday evening (9 April), followed by a keynote address by Peter Vitousek, a renowned scholar of biosphere dynamics and soil development. On Saturday morning, presentations by and discussions with international and regional ecologists and conservationists focus on the impact and ramifications of Cowles' work for us today. Then in the afternoon, participate in one of seven exceptional field trips led by local experts involving topics such as succession, restoration, education, and the partnerships between natural areas and industry. Or examine management techniques at work during open houses featured at regional restoration sites.

After traversing your choice of dunes, prairies, marshes, wetlands, or savannas, settle down to a campfire, dinner and entertainment at the Indiana Dunes Environmental Learning Center.

Reserve your spot today! E-mail Tina Bentz at cbentz@fmnh.org or call us at 312-922-9410 ext. 550 for a full brochure and information about registration and fees. Special discounted fees are available for Chicago Wilderness staff, Volunteer Stewards Network and students.

This symposium is supported by a major bequest through the will of A. Watson Armour III. The Board of Trustees of The Field Museum is deeply grateful to Sarah Wood Armour and to her late husband, for their civic leadership and for their many years of generous support.

SIUC AGBASSADORS

The future is wide open for young people interested in pursuing a career in the broad industries of agriculture, forestry and food and nutrition.

We in the College of Agriculture at Southern Illinois University Carbondale want to help you introduce your students to the many opportunities available to them in our industries. The SIUC Agbassadors® team, now in its thirteenth year, is available to visit with you and your students free of charge. This team is ready to share the exciting and expanding world of agriculture, forestry and food and nutrition careers with students throughout the state. These energetic young people are also able to help students focus on the tools necessary for getting their collegiate life off to a great start. Whether it is speaking to an individual class, school or other group; talking one-on-one; or participating in a career fair, this enthusiastic team is ready to share their personal experience and knowledge with all students.

Together as a team, we can start working on your students' future!

We encourage you to personally meet our Agbassadors who are introduced to you on the back of this mailing. Please invite them to visit and share first-hand just what college life is all about.

Learn about these different opportunities:
Food and Nutrition
Agribusiness Economics
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Agricultural Resource Mgmt
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Animal Production
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Agricultural Technologies
Plant and Soil Science
Business Agricultural Production
Environmental Studies
Plant and Soil Science
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I f you would like an SIUC Agbassador to visit and tell your students about the many opportunities in Agriculture, Forestry, and Food and Nutrition.

JUST CALL US AT 618.453.3080 and speak with Tuesday Ashner, Enrollment Management Coordinator.

Hillary Tulley
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Betty Trummel
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TWO ILLINOIS TEACHERS TO TRAVEL TO ANTARCTICA

Visit the coldest, highest, windiest and most pristine continent on earth this austral summer (the Illinois winter!) with Betty Trummel and Hillary Tulley. These two Illinois teachers were selected to travel and work in Antarctica through participation in Teachers Experiencing the Arctic and Antarctic (TEA), funded by National Science Foundation branches of the Directorate for Education and Human Resources and the Office of Polar Programs.

Betty, a fourth grade teacher at Husman Elementary, worked in Crary Lab on the Cape Roberts project from October 10th until December 10th with Dr. Ken Verosub from the University of California, Davis. The primary goal of this project is to obtain the climate history of Antarctica for the past 65 million years. In particular the researchers are studying the history of Antarctic glaciation dating back to the Cretaceous and trying to determine whether Antarctica has always been located at the south pole.

The researchers worked on cores that are drilled from the bottom of the Ross Sea. The drilling season will be 2 months long. Cores will be analyzed in Crary Lab for changes that can be used to determine the age of the core samples which will enable scientists to obtain a history of climatic and tectonic events in Antarctica.

Hillary will have a true Antarctic field camp experience - living in Scott tents, being immersed in beautiful surroundings and having frozen peanut butter for lunch. She will join Dr. George Denton's team from the University of Maine in Beacon Valley. Beacon is one of Antarctica's ice free Dry Valleys, accessible from McMurdo Station via helicopter. Beacon is about 1200 m in elevation and overlooks the Taylor Glacier. The research team will be sampling buried ice which is has been dated as being 12 million years old. If this ice is indeed this old, this speaks strongly to the stability of the East Antarctic Ice Sheet, which has implications for our current climatological questions.

You can follow our adventures and experience the science with us. The TEA website is www.glacier.rice.edu. Click on the pink button in the lower right corner - Teachers Experiencing Antarctica.

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ENTER THE FLINN SCIENTIFIC CRYSTAL GROWING CONTEST

Flinn Scientific is sponsoring a crystal growing contest to stimulate student interest in science while teaching concepts of saturation and supersaturation. Entries may only be submitted by teachers at schools.

Three great prizes are available for the largest single crystal entry received no later than April 15, 1999.

1st place	$500 Flinn gift certificate
2nd place	#300 Flinn gift certificate
3rd place	$150 Flinn gift certificate

You are allowed to use a maximum of 500 grams of aluminum potassium sulfate per crystal. Crystals are judged first by mass, then by quality. Your completed entry form and photographs of your crystal must be received at Flinn Scientific by April 15, 1999. Each crystal requires its own entry form which can be downloaded from the Flinn website, www.flinnsci.com, or obtained by sending your request for entry form to: Crystal Entry Request, Flinn Scientific Inc., P.O. Box 219, Batavia, IL 60510.

Check out the Flinn Website for more detailed instruction and entry form. <www.flinnsci.com>

Edna Kleinbaum
404-373-3332

10 ILLINOIS SCHOOLS HOST CAMP INVENTION,

A SCIENCE AND CREATIVITY SUMMER CAMP WHERE 'IMAGINATIONS RUN WILD'

Ten schools in the Chicago area converted their classrooms into camp sites last summer. They were partner schools for Camp Invention, a national hands-on science and creativity camp.

The camp's slogan, "where imaginations run wild," best describes Camp Invention's philosophy. Unlike wilderness camps, there are no wild animals at this one week day camp -- just wild imaginations which help make science come alive for children.

The curriculum provides children entering second through sixth grades with hands-on activities that encourage creative solutions. The five daily activities at Camp Invention spark the imaginations of children while combining a science curriculum with some math, history and the arts - but most of all fun.

For example, campers disassemble old appliances found around the house and use the parts to make their own inventions. They discover the principles of motion by creating models of amusement park rides. They crash land on an imaginary planet and through creative problem solving figure out how to get back to earth -- while videotaping the adventure into their own science fiction movie.

"Kids love Camp Invention," said Randy Lange, a gifted resource teacher for McCarty Elementary School in Aurora. Ill., who serves as the school's camp director. "The camp's nontraditional, hands-on approach is a top notch way to get kids to think. Kids can direct their own learning rather than being spoon fed' and they walk away feeling successful. Because there are -more no textbooks, it can even give kids who sometimes struggle with reading and writing in school a whole new positive attitude toward school."

Camp Invention was started in 1990 at two schools by Inventure Place in Akron, Ohio, a non-profit resource center for creativity which houses The National Inventors Hall of Fame. Since then approximately 250 schools nationwide have hosted Camp Invention. It was introduced to the Chicago area in 1992.

The camps are a partnership between Camp Invention and the local school, which provides the facility. Teachers from each partner school serve as camp directors and teachers. Local high school and college students round out the staff, which has a low staff/camper ratio of one to eight. Camp Invention provides the curriculum, training, marketing, central reservation system and staff compensation. There is no cost to a school to host Camp Invention.

For more information visit Camp Invention's Web site at www.invent.org or call Danute Krebs, regional coordinator of Camp Invention in Chicago, at 630-904-0676.

1999 RAINFOREST WORKSHOP SCHOLARSHIP DRAWING

Call 1-800-669-6806 or email fgatz@earthlink.net by March 1, 1999 to enter a $1000 scholarship drawing toward a Summer Workshop in the Rainforest.There are no entry requirements. Join Jason Researcher Dr. Meg Lowman and a spirited faculty at the AMAZON Workshop (July 9-17, 1999 at $2250) to experience a 1/4-mile rainforest canopy walkway. During 1999, the Jason Project will broadcast JASON X from this site in the Amazon. Rainforest Workshops engage teachers in research with ornithologists, marine biologists, canopy researchers, geographers, and biodiversity experts. Instructors also include author/ illustrator Lynne Cherry (The Great Kapok Tree) and award winning photographer Gary Braasch. Graduate credit is available.

In addition to Rainforests, explore the Barrier Reef and Maya Archaeology in BELIZE (June 25-July 2, 1999). Ask about COSTA RICA, AFRICA, and other worldwide destinations. Check the Rainforest Workshops website for details: http://members.aol.com/EdWorkshop

OPERATION PHYSICS
Saturday, April 10, 1999
Simple Machines

Instructor:	Mr. Tom Holbrook University H.S., Normal
Place:	Champaign Schools Science Center 817 N. Harris Street Champaign, IL 61820
Time :	8:30am - 3:30pm, with lunch break

Information also posted on our web page
http://web.physics.uiuc.edu/outreach/workshops/

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, will set 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.

EDUCATIONAL MATERIALS

Subscriptions to Human Genome News
Newsletter that details the progress of the Human Genome Project. Contact the Human Genome Management Information System, Oak Ridge National Laboratory, 1060 Commerce Park, MS 6480, Oak Ridge, TN 37830; 423-576-6669; fax 423-574-9888; email bkq@ornl.gov; http://www.ornl.gov/hgmis.

A New Universe to Explore: Careers in Astronomy
Booklet that provides career guidance information for students and teachers. It offers preparation tips for careers in astronomy; sections for high school, college, and graduate students; and a special section called "Where Astronomers Work/" Write to The American Astronomical Society, 2000 Florida Ave., Suite 400, Washington, DC 20009, or see the AAS web page: http://www.aas.org/education/career.html.

Comprehensive Models for School Improvement: Finding the Right Match and Making it Work
This shows school administrators and other education decision-makers how the movement toward comprehensive school reform can benefit their students. It provides an overview of the factors that have led to widespread support for comprehensive school reform, including a discussion of the newly available federal funding. It also includes profiles of 17 school reform models that represent many of the best-known and most widely used options for comprehensive school improvements. In addition, the book contains a discussion of the essential components to look for in choosing a program that will work best in a particular school or district. The cost for the 144-page publication is $30 plus 10 percent of S/h with a $3.50 minimum. To order, contact Educational Research Service, Publication Orders, 2000 Clarendon Blvd., Arlington, VA 22201-2908; 1-800-791-9308.

Girls & Technology: An Idea Book for Educators and Parents
This includes classroom strategies by and for teachers, projects for girls to do at home or in class, tips for parents on encouraging daughters to learn about science, and the locations of on-line clubs in which girls can learn about science and technology. This 64-page book for teachers and parents of girls in grades 1-12 costs $15 including s/h. *Expect the Best*, a video compiled from conference workshops, and a companion resource guide can be included with the book as a package for $35 including s/h. To order, call the National Coalition for Girls Schools at 978-287-4485 or see http://www.ncgs.org.

Assessing Hands-On Science: A Teacher's Guide to Performance Assessment
This has been published by Corwin Press. The book tells how to use performance assessments to measure learning with hands-on curricula for grades K-12. It describes how traditional and performance assessments work with the same materials. It also discusses both analytic and holistic scoring systems. You can order the book for $25 by contacting he publisher at 2455 Teller Rd., Thousand Oaks, CA 91320-2218; 805-499-0774; e-mail order @corwin.sagepub.com

Science Alive!
This is a five-volume, award-winning, multicultural, English-Spanish science and environmental education curriculum. The guides sell for $25 each or $115 for a complete set: Energy Flow, Cycles, Communities, Interdependence, and Change. Send a purchase order to check to Science Oriented Learning, 1324 Derby St., Berkeley, CA 94702 (include sales tax in California and 10 percent s/h). For more information, call 510-644-2054.

Shaping Your Thinking in Science
This offers topic-specific graphic organizers where student sin grades 3-6 can organize and record scientific information. Graphics help to clarify important elements and relationships among concepts. Each set of 16 reproducible organizers supports science inquiry, reading, and research. Sets come with teacher editions with lessons and answers. The following topics are available: The Earth, Water, Animals, and Plants. To order copies, send $11.95 for each to Chameleon Publishing, 277 Green St., North Borough, MA 01532. For more information, call 508-393-5470 or send e-mail to champubl@aol.com.

The Celebrate the Century™ Education Kit Series from the U.S. Postal Service
Supported by NSTA, the U.S. Department of Education, and other education associations, this two-year program will provide teachers with free curriculum covering the decades from the 1900s. Designed primarily for students in grades 3-6, the curriculum kit features hands-on activities that integrate history with science, math, art, geography, language arts, social studies, and computer technology. Each kit contains a teachers guide, student activity magazine, computer activities and links to websites, interactive classroom visuals, educational games, and take-home projects to involve and inform parents. For information or to receive kits, contact Celebrate the century, U.S. Postal Service, PO Box 44342, Washington, DC 20026-4342; 1-800-450-INFO. The curriculum also can be viewed online at http://encarta.msn.com/schoolhouse. (Other websites connected with the curriculum are http://www.usps.com; http://www.usps.gov/ctc; and http://encarta,msn.com/ctc.)

JOIN THE ILLINOIS SCIENCE TEACHERS ASSOCIATION!

BENEFITS AND ACTIVITIES FOR ISTA MEMBERS

PUBLICATIONS—*Spectrum* is the ISTA journal, published in April, August, and December. 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 newly introduced **ISTA ACTION** provides up-to the-minute information on fast breaking news in Science Education and is published in February, June, and October.

THE ISTA CONVENTION—For over twenty-five years this annual conference has brought together educators and administrator through the state. Major speakers, group sessions, hands-on workshops, microcomputer labs, and extensive commercial exhibits are a few highlights of this outstanding program of renewal for science teachers. This year's convention will be held at the Rosemont Convention Center October 16-17.

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—Sponsored by Caterpillar, this honor is awarded annually to high school students who excel in science. Awards are available to all high schools.

PRESIDENTIAL AWARDS—ISTA participates in this NSF Program designed to identify and recognize exemplary science education programs at all levels.

WEBSITE—We are constantly updating our WEBSITE. Check us out at **http://www.ista-il.org**

ANNUAL MEMBERSHIP RENEWAL FOR THE 1999 YEAR

Join now and your dues will be in force until January 2000 (15 months). The new membership year runs for the calendar year January 1 through December 31.

MEMBERSHIP CATEGORIES

Any person interested in science education is eligible for membership. All memberships include a subscription fo the SPECTRUM, The Journal of the Illinois Science Teachers Association 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.

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.

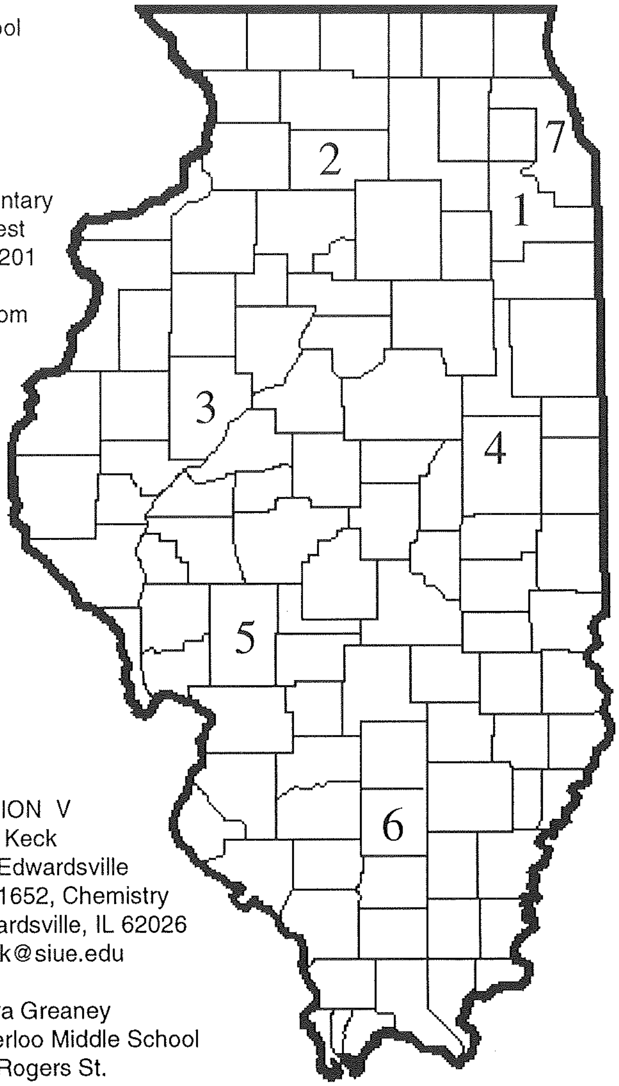
Option 2: Two Year Full Membership Dues- $45.00 Two Year Full Membership entitles member to Full Membership benefits for two years.

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.

ISTA REGIONAL DIRECTORS



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Region IV	Woodford, Livingston, Ford, Iroquois, McLean, Logan, DeWitt, Piatt, Champaign, Vermillion, Macon, Shelby, Moultrie, Douglas, Edgar, Coles, Cumberland, Clark
Region V	Calhoun, Greene, Macoupin, Montgomery, Madison, Bond, St. Clair, Clinton, Monroe, Washington, Randolph, Perry, Jersey
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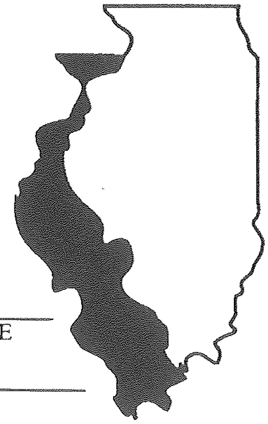
Region VII	City of Chicago only

ILLINOIS SCIENCE TEACHERS ASSOCIATION

MEMBERSHIP APPLICATION



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* MARK BOX NEXT TO ADDRESS YOU WANT YOUR ISTA MAIL SENT TO.
THIS INFORMATION WILL NOT BE MADE AVAILABLE TO ANY OUTSIDE GROUPS.

Check applicable categories in each column

___ Elementary Level	___ Elementary Sciences	___ Teacher
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MEMBERSHIP OPTION (See page 48)_______

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