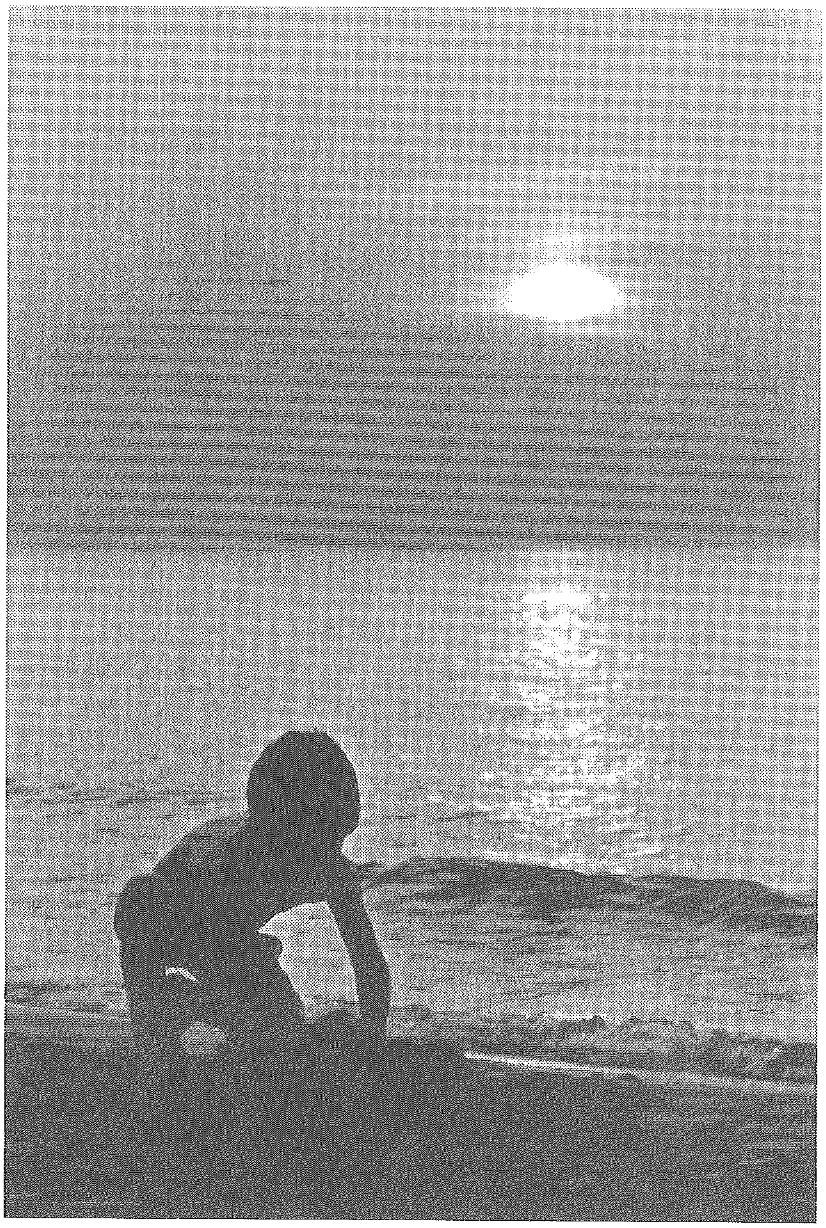
SPECTRUM

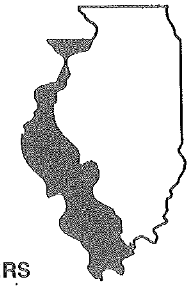
THE JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION



SUMMER 1995

SPECTRUM

JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION
Volume 21, Number 2, 1995



SPECTRUM is mailed from the University of Illinois, Champaign.

Submissions and inquiries regarding the journal should be sent to:
Diana Dummitt, Associate Editor
ISTA SPECTRUM
University of Illinois
College of Education
1310 South Sixth St.
Champaign, IL 61820
(217) 244-0173
e-mail: ddummitt@ux1.cso.uiuc.edu

Subscription requests or changes should be sent to:
George Zahrobsky, Membership Chair
P.O. Box 2800
Glen Ellyn, IL 60138

The Illinois Science Teachers Association (ISTA) is a state chapter of the National Science Teachers Association, 1742 Connecticut Ave. NW, Washington, DC 20009.

Typist:
University of Illinois
College of Education
Word Processing Center

Printer:
Flying Color Graphics

Cover Photo:
Courtesy of the IL-IN Sea Grant,.University of Illinois

SPECTRUM IS PRINTED ON RECYCLED/RECYCLABLE PAPER

ISTA NEWS

PRESIDENT'S SUMMER LETTER

It is with great enthusiasm that I begin my term as President of ISTA! In the coming months, science educators in Illinois will face many challenges and opportunities. The membership of ISTA will play an increasingly important role in the reform of science education in this state . If ISTA is to assume itsproper role in science reform, we must all become more active participants in the process.

I have three goals for ISTA during my term in office:

1. Expand the range of services that ISTA provides to its members.
2. Increase the number of ISTA members who actively participate in Association initiatives.
3. Facilitate greater two-way communications between the ISTA Board and the membership.

I look forward to working with the ISTA Board members to achieve these goals.

In the remainder of this letter I want to address some specific issues of importance to ISTA members.

The Illinois Academic Science Standards are currently under development. This document will impact every science educator in the state. Be assured that ISTA is well represented on the team developing the standards. President-elect Doug Dirks is co-chair of the development team. In addition, Region 3 Director Karen Zuckerman and I serve as team members.

As the National Science Standards and the Illinois Academic Science Standards are published, teachers will need professional development to effectively implement them in their classrooms. This is one example of expanded service that ISTA can provide to its members. I will be working with Gwen Pollock of the State Board of Education to develop a workshop model that can be disseminated around the state to assist teachers in making effective use of the standards.

I envision this as the first of many projects that ISTA will be working on in conjunction with the State Board of Education. As you read Gwen Pollock's column you realize that as State Science Coordinator, she has a plethora of ideas for improving science education in this state. It is my intention to work with Gwen on implementing some of these ideas. Likewise, ISTA will be presenting initiatives to the State Board for implementation support. I look forward to working with Gwen on program development that will support the goal of improving science education this state.

Illinois is on the brink of a technological revolution. The state allocated five million dollars for technology programs last year. State Superintendent Spagnolo expects the allocation to triple this year. As science educators, we must be aggressive in seeking funding to achieve connectivity for our students and for ourselves. The promise of Internet connections for all the teachers in the state will soon be realized. One of reasons for increased communications between the ISTA Board and the membership is to provide timely information about opportunities such as this. ISTA is going to establish a home page on the World Wide Web to provide members with just such information.

In closing, I want to express my appreciation to David Winnett for his tireless efforts to raise the stature and improve the efficiency of ISTA during the past two years. Thanks, Dave for a job well done.!

As the school year comes to a close, I wish you a restful and productive summer. While you are relaxing, keep in mind that Gary Butler and his convention committee members will be working hard to finalize the preparations for this year's convention. Mark your calendars for the Pre-conference on September 28 and the convention on September 29 & 30. This year's Pre-conference will focus on technology and will include presentations by State Board of Education personnel on current development plans and presentations of the state of the art technology programs for science education. I hope to see each of you in Springfield in September.

Sincerely,

Bernie

Bernie Bradley
President, ISTA

356 4943

MARK YOUR CALENDARS!

September 28-30, 1995
ISTA Annual Convention
Prairie Capitol Convention Center
Springfield

Gary Butler
Convention Chair
(217) 786-6630

EDITOR'S LETTER: TAKE ANOTHER LOOK AT YOUR *SPECTRUM*

When was the last time you received your copy of the *Spectrum* and really looked it over thoroughly? I don't mean simply flipping through it to see what articles were in it and deciding which ones to read. Have you looked at the way it is organized, the variety of things included (both articles and other items of interest), the quality of the journal's paper and cover, etc.? I've had opportunities to peruse science journals (some of which should really be called newsletters) from various states. Some state science teacher organizations still use multi-page dittos for their "journals." Many have stacks of pages, stapled together at one corner, with the stack folded in half and mailed to members. Frankly, the quality of our *Spectrum* is far and above most of what I found out there. The quality of the *Spectrum* has steadily improved over the past several years. The credit for that rests squarely on the shoulders of our associate editor, Diana Dummitt. Next time you see her, let her know what you think of the *Spectrum*. And if you are not likely to see, drop her a note.

Even with the level of quality as it is, we're always looking for ways to improve the *Spectrum* further. Let me know what ideas you have in that regard. We've discussed numerous ideas, tried some, kept some and discarded others. The *Spectrum* is your journal. It is a tool for the members of ISTA to use to communicate and share with each other. It is not simply the end goal to be attained every three months, nor is it a tool to be used by only a few persons. To that end, I invite each of you to consider sharing with your science teacher colleagues throughout Illinois by using the *Spectrum*. Share news of upcoming events, of good quality resources you've found, or of science activities/lessons that work well for you. Use the *Spectrum* to network with others, or to link up with others having common interests or concerns. Share the *Spectrum* with someone who is not an ISTA member, and encourage that person to join our organization.

An old saying states that a chain is only as strong as its weakest link. We have many strong links in ISTA, and the *Spectrum* is one of the strongest. It is certainly something to be proud of. Become active in helping to keep it strong, keeping it vibrant and in tune with your needs. It is your journal! Read it, use it, learn from it, and contribute to it! If you wish to contact me, there are several avenues through which that can be accomplished. You can write to me at Department of Elementary Education and Reading, Western Illinois University, Macomb, IL 61455. You can telephone me at 309/298-2101 (or 298-1961 to leave messages). You can send me a FAX at 309/ 298-2222. Or you can communicate via internet e-mail (finsonk@CCMAIL.WIU.BGU.edu). I look forward to hearing from you!

Kevin

Kevin D. Finson, Editor

SPRING ISTA BOARD MEETING SUMMARY

INTRODUCTION: President David Winnett called the meeting to order at 9:00 am at the Best Western (Cunningham) in Urbana, IL. There were no corrections to the minutes of the previous meeting. Dave Winnett reported that membership is up dramatically, with over 4,000 members. Effective next fall, dues will be increased to $25.00 as per the decision made by the Board last year.

SPECTRUM: David Winnett announced that Kevin Finson will serve as the new editor of *Spectrum*, with Diana Dummitt remaining as asociate editor and Mike Waugh handling *Spectrum* fiscal matters through the University of Illinois where the journal has been housed. This month, over 4,000 copies of the *Spectrum* will be published. Diana received a request from a subscription service for the *Spectrum*, and the Board discussed library rates.

CONVENTION: David Winnett announced that approximately 2,300 people attended the 1994 onvention at Pheasant Run. The site was more expensive than originally anticipated. Among the new procedures instituted by the Board for organizing ISTA conventions are that Diana Dummitt will be both the exhibit chair and registration chair. Gary Butler is the local convention chair for the 1995 ISTA convention to be held in Springfield, IL. The theme of the conference will be "Science in the Land of Lincoln." The main speaker will be the "bug lady" from the University of Illinois, Mae Bernbaum. The preconference focus will be on "Technology and the Teaching of Science." We are planning to have a state agency room at the conference in which information from various state agencies can be disseminated by representatives from those agencies. In two years (1996), the ISTA convention will be held October 10-12 at the Merchandise Mart in Chicago. The 1997 convention will be held in Peoria on October 9-11 at the Pere Marquette Civic Center.

FUTURE BOARD MEETING: The next ISTA Board meeting will be held June 24-25 at the University of Illinois.

PRESIDENT'S REPORT: David Winnett thanked the Board members for the jobs they did over the past year. He also announced the NSTA convention will be in St. Louis next year, March 28-31, 1996, and that several members of ISTA serve on the NSTA planning committee.

ELECTION REPORT: Diana Dummitt reported that 2,700 ballots were mailed. The results of the election are as follows: President-elect, Douglas L. Dirks; Vice-President, Donald J. Nelson; Secretary, Maureen S. Jamrock; Region I Director, Ann Rubino; Region II Director, Cathy A. Flannery; Region III Director, Donald T. Powers; Region IV Diretor, Jim Zimmerman; Region V Director, Dean Dittmar; and Region VI Director, Suzanne M. Asaturian.

ISBE UPDATE: Gwen Pollock reported that there has been a drastic restructuring of ISBE. She also reported that the science safety initiative is to be delivered to schools in the fall, with additional supplements planned.She needs "horror stories" to document theneed for chemical disposal for schools, and is thus asking for documentation of accidents or stories to support that effort. Gwen stated the ISBE now has an Environmental Standards Initiative in place.

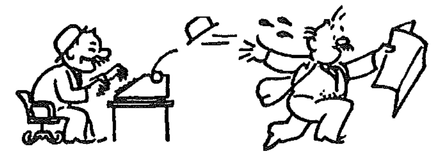
NEW PRESIDENT: Bernie Bradley, new ISTA president, assumed office. He wishes to promote wider participation of the membership. Bernie distributed a format for three types of initiatives to accomplish this: policy, programs, and governance. The intent was to get the ideas in written form so they would have more chance of being remembered and implemented. Bernie would like to see ISTA's continued involvement with ISBE in the development of science-education related policies.

OTHER: Board member responsibilities were discussed, as were philosophical approaches to budgeting. The meeting was adjourned at 1:58 pm.

REPORTS FROM REGIONAL DIRECTORS

REGION I

Hi, ISTA Members. I'm Ann Rubino, the new ISTA representative for Region 1. My science interest is primarily with the elementary level, since I have taught science as a specialist in grades 1-5 for several years, and previously directed a pull-out program for identified gifted, grades 3-8. I recently completed a project with Museum of Science and Industry, the teacher's guide for the Take Flight exhibit. Currently I am consulting and writing full-time, with my primary focus the promotion of science for elementary students. I see a great need there, at both systemic and classroom levels, and hope to work with ISTA members to fill some of that need. Of course, as District 1 Representative, I will work to communicate other concerns of the members as well, and hope to hear from any of you who wish to share ideas. I believe ISTA can be a strong voice for the classroom teacher in communicating with state and national groups. You can reach me by mail c/o Fireworks Educational, Box 2325, Joliet, IL 60434, by phone at 815-725-9057, or by e-mail as ARubino1@aol.com.



REGION II

Hello. I am Cathy Flannery and I'm your newly elected ISTA regional director from District 2. For the past three years I have taught science at La Salle-Peru Township High School and prior to that time I taught junior high science and health education for twenty years.

As regional director I will be an active voice representing teachers in important matters related to science education. I believe that ISTA must continue to work to make the goals of all science educators throughout the state reachable. My serving ISTA will allow me the time and opportunity to focus my energies and work at developing science activities that can be used to influence other teachers to teach science to children.

If you have any questions or concerns about science education in Illinois, please contact me. My mailing address is La Salle-Peru Township High School, 541 Chartres Street, La Salle, Illinois 61301. My phone number is (815)223-1721. I also can be reached at flannery@rs6000.ivcc.edu via E-mail. I am looking forward to serving you.

REGION III

Hello, I'm Don Powers and I'm your newly elected ISA representative from Region 3. For the past six years, I have been on the faculty at Western Illinois University in Macomb. Prior to that time, I taught junior high and high school science and math in Iowa for eight years. On the more personal level, my wife, Kathy, and I are raising five children: Sarah, Laura, Mark, Rebecca and Anna.

As District Representative, I was elected not just by those members residing in Region 3, but by members throughout ISTA. Therefore, I am a representative of all the members of our organization. While the annual conference is a major event for ISTA, our group is also involved in many other aspects of sccience education within Illinois. Some of these areas include the formation of statewide goals for science and acting as a two-way communication link between the state and national science organizations. To function effectively as your representative, I need to hear from you about ideas and concerns you have related to the state of science education.

If you have any concerns about the status, present or future, of science education in Illinois, please do not hesitate to contact me. My mailing address is Science Education Center, Department of Elemetary Education and Reading, Western Illiniois University, Macomb, IL 61455. My phone number is (309)-298- 1258 or 298-1961 and the local FAX number is (309)-298-2222. If you have the technology in place, I can also be reached at dpowers@ccMail.wiu.bgu.edu via e- mail. Please feel free to contact me with any concerns or ideas you have about science education within Illinois. I look forward to serving you.

REGION IV

Hello. I'm Jim Zimmerman, your newly elected ISTA representative from Region 4. For the past sixteen years I have taught 5th grade at Thomas Paine Elem. in Urbana, IL. I have a wife, Linda, and three children from Middle School age on down to 1st grade. Their names are Michelle (12), Josh (10), and Leah (7).

Science and technology education, both in and out of the classroom, has been a strong interest since I have begun teaching. I love to do hand's on, inquiry based science with my students and I am also very active in providing teacher inservice in the areas of science and technology. I try to utilize technology into all parts of my curriculum as a way to enhance and improve student learning.

As a district representative for ISTA, a major goal of mine is to promote and help facilitate the use of technology to enhance science education. This is especially true in the use of telecommunications and access to the internet. As a classroom teacher with internet access, I have seen the wealth of information that can be brought into the classroom to enhance what students are learning. This is especially true in regards to science related resources. Data bases containing current weather, earthquake, NASA, and environmental information are easily available. The ability to connect and collaborate with colleagues or other classes from around the world through e-mail can give science lessons and projects a much wider scope. The ability to obtain and utilize sources or information is one of the greatest resources we can bring into the classroom to our students. The need to make this happen as quickly as possible is one of the most important challenges we as educators face today. I plan to work hard at making this a reality for ISTA.

If you have any thoughts or ideas on this matter I would appreciate hearing from you. If you are a science educator and have e-mail access I would appreciate knowing your e-mail address so that you can be added to a growing listservice of science educators. My mailing address is: Jim Zimmerman, Thomas Paine School, 1801 James Cherry Dr., Urbana, IL 61801. My e-mail is jimz@ncsa.uiuc.edu My phone number is:School: 217-384-3602, Home: 217-344-3778. I look forward to serving you.

REGION V

My name is Dean Dittmar. First of all, thank you for the opportunity to serve as your newly elected Region 5 director. As a former agriscience/horticulture teacher at the Waterloo High School from 1985-90, I plan to share my hands-on, applied experiences with you and hope to gain new insights of the academic science area. I will definitely try to meet and work with everyone in the next two years.

Currently, I am working as ana agricultural education field advisor for the Facilitating Coordination in Agricultural Education (FCAE) project of the Illinois State Board of Education and the Illinois Committee for Agricultural Education. I cover 31 counties in southern Illinois most of which are south of Interstate 70. I live in Carbondale and have an office in the Agriculture Building of SIU-Carbondale. I assist K-12 teachers in updating and integrating their curriculum with science concepts and agricultural,hands-on, applied activities. I promote the agricultural industry to school staff, students, parents, and the general public as the food and fiber industry is no longer jus cows, sows, and plows. In the last five years, I'm sure that I have met many ISTA members through agriscience kit workshops and agricultural awareness activities that I have presented at teacher institutes, exhibits, SIUE MASH kit inservices, and other specific school visits and workshops.

Science and agriculture are a unique pair. Science concepts are related to why things happen. Agriculture takes that science concept and makes things happen in a real life situation. Both are needed for end products of food, shelter, and clothing. Both are needed for a student to efficiently learn. I hope to help science teachers integrate agricultural activities, and I hope to help agriculture teachers integrate science concepts. Please feel free to contact me at my office or at home anytime. You can reach me at home, 121 Holiday Trace Drive, Carbondale, IL 61901, phone 618/529-2698 or at work, SIU-Carbondale, Agriculture Bldg., Office 158C, Carbondale, IL 62901-4414. I have an answering machine on 24 hours a day at both locations. Please feel free to contact me with questions, concerns, and comments.

REGION VI

My name is Suzanne Asaturian. Thank your for recently electing me as Region 6 representative. I recently attended my first ISTA board meeting and feel that our president, Bernie Bradley, has progressive goals for our organization. It is exciting to feel that we can grow stronger as a scientific association to help each other in many ways and to spread scientific literacy. This is my first year to serve on the ISTA board. I teach high school biology at Carbondale Community High School. I have also taught at Gorham 5-12 and Giant City School 6-8. I am currently working with Science Club and Science Fair students. My hardest science fair project yet is attempting to control the variables in my daugahter, Sarah, who is 2 1/2 years old.

In our region, Southern Illinois University-Carbondale has much to offer students to encourage scientific literacy, including the annual Regional Science Fair, held in March or April; the annual Science Symposium, held in March; the Expanding Your Horizons (for women), held in February; the Minorities Research Summer Program; the Howard Hughes Summer Research Program; the Minorities Engineering Summer Research Program; and the K- 6 Hands-On Training Workshop for Teachers this June, which provides both a stipend and opportunities for graduate credit. I would like to help announce in our region those programs that are available in your area, as well as news of awards received in science and math. Please let me know what information you have. You can reach me at home, 3923 Boskydell Road, Carbondale, IL 62901, phone 618/457-4548 or at school, Carbondale Comm. H.S., 200 N. Springer Street, Carbondale, IL 62901, phone 618/457-3371, ext 242.

Gwen Pollock
ISBE
100 N. First Street
Springfield, IL 62777-0001
(217) 782-2826
GPOLLOCK@spr6.isbe.state.il.us

DID YOU KNOW?

I am pleased and anxious to tell you about a project which is happening now for us in science in Illinois (the other learning areas are involved likewise, but, of course, science is our concern!!). The Illinois Academic Standards Project has begun in earnest. I want to tell you the available details about the project, the membership of the Science learning team and the projected timeline for the project.

The project will involve two years of work and will result in three components. A vision document will present the rationale for the project and prepare educators and other interested constituencies for subsequent components. The major product of the project will be a VOLUNTARY framework which identifies Illinois State content standards and learning benchmarks. The project will refine the answers to the question: "What should all Illinois students know and be able to do?" The project teams (science, math, language arts, fine arts, health/physical development, social sciences and foreign languages) will identify academic standards in the context of the eight Illinois Education Goals, and the 1985 State Goals for Learning. Our charge is to use the national standards (in our case, the latest draft of the National Research Council Science Education Standards) and current research (like Project 2061 Benchmarks, etc.) The third portion of the project will support the conversion of the vision into classroom reality by providing resources/ examples of curriculum, teaching and assessment strategies, teacher training and school leadership initiatives.

The academic standards will fill a void in the current system of goals/assessment /curriculum planning which has been frequently cited by school districts throughout Illinois. The standards are expected to promote better understanding of the learning goals by parents and the general public. The project team is led by Lynne Haeffele, former director of ISBE's Scientific Literacy Center and IASCD Past President Michael Palmisano.

The Science Learning Team is led by Dr. Doug Dirks, President-Elect of ISTA and myself. Other members include: Dr. William Fraccaro, Johnson School, Warrenville, Lillian DeGand, Peterson School, Chicago, Dr. Jerry Foster, DePaul University, Chicago, Melanie Wojtulewicz, Chicago Science Supervisor, John Thompson, IMSA, Aurora, Rion Turley, O'Fallon Township High School, O'Fallon, Sharon Wynstra, Rockford Schools, Curriculum Director, Dr. Emil Jason, SIU-E, Chemistry professor, Marilyn Sinclair, retired, Champaign schools, Ray Dagenais, IMSA, Aurora, Joyce Champion, retired administrator, Cairo Schools, Karen Zuckerman, Hollis School, Peoria, Bernie Bradley, Newberry Academy, Chicago (ISTA President), Noreen Winningham, Nichols Middle School, Evanston, Dr. Kevin Finson, WIU, Ethan Allan, TAMS, Chicago, Lynne Hubert, Shedd Aquarium, Chicago and Sam Bowen, Argonne National Laboratory. I am sincerely proud to be associated with such a combination of some of the best for science in Illinois. Most of our team members are ISTA members and many have been very active ISTA board members and several have been recognized as ISTA/Presidential Award of Excellence nominees.

The tentative timeline is such that the teams' products, in draft form, will be reviewed by the Mid-Continent Regional Educational Lab in Colorado this summer. The first draft, for public review will become available in September, by being sent to all schools and many other institutions. The ISTA convention in September will be the first professional organization opportunity to review the standards and benchmarks. Several sessions at the convention will be organized to allow for comments and suggestions. The review process will continue through the fall, with an expected spring completion for revisions. It is hoped that document delivery will be possible for the fall of 1996. (Quite ambitious!!) I do think you will be proud of our work.

On a second note, I would like to offer an opportunity for a special national performance assessment field test. I have only received the preliminary information about this SCASS project. This field test is designed to evaluate the performance of individual science exercises and provide scaled statistical indicators of their performance for the several states which are participating in the project. Participation is voluntary and could be very beneficial. However, the project is on a national scale and I know few of the real details. There is a linked exercise set, consisting of a module, performance event, and performance task linked by a common topic or theme, a calibration module that covers several content areas and a questionnaire. Now for the really exact details---27 elementary school, 27 middle school and 25 high school classrooms are needed. The due date is IMMEDIATE. I can send you a copy of the letter which explains the project (if you call my office 217/782-2826 and ask for the SCASS letter) and then you can apply directly to ALLEN DOOLITTLE, Director, 2201 North Dodge Street, P. O. Box 168, Iowa City, IOWA 52243 or call him at 319/337-1000. I would appreciate your consideration of such participation. Well, that's all for now--It should be enough.

The Environmental Literacy for Illinois 2000 Strategic Plan for Environmental Education is now available for open review and comment. Quite a group of contributors has worked for design/create/develop a workable plan for the systemic effort for environmental education for Illinois learners. If you would like to receive a copy of this plan, please call 217/782-2826 and ask for the EL plan. I will send it to you immediately. Your input will be essential to the success of the plan. More will be available soon — a special session at the ISTA Convention in September will provide the details.
Have a good summer!

ISTA Annual Convention
September 28-30, 1995

Prairie Capitol Convention Center
Springfield

TRANSPORTATION INTEREST SURVEY

NAME ______________________________

SCHOOL/ORGANIZATION ______________________________

ADDRESS______________________________

____
City State Zip

PHONE ______________________________

HOME ADDRESS ______________________________

____
City State Zip

PHONE ______________________________

I am interested in the following type(s) of group transportation

_____Coach Chartered Bus*
_____Amtrack
_____Greyhound/Trailways
_____Airline

I would like to arrive:

_____ Wednesday Evening
_____ Thursday Evening
_____ Friday Evening

**Return on Saturday only*

Please return this survey to:

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

PLEASE RETURN BY: August 15, 1995

Julie Desmarais and Barbara Detwiler
Gurrie Junior High
La Grange, Illinois

INCLUSION TWO POINTS OF VIEW

Two years ago, our school made the decision to end its modified science class and place the special needs students into the regular science program with a special education teacher or assistant for support. When this decision was made, many questions and concerns arose in the minds of both the classroom teacher and the special education teacher. This article gives both points of view as the program went from conception to being a viable program.

Science Teacher: The idea of having a modified science classroom was not working. The special needs students had little motivation since they knew they were branded as different when placed into the modified science class. A change was warranted, but I had concerns about meeting the needs of both the students with IEP's and without IEP's in a regular science classroom. Would the special needs students be overwhelmed with the content of a regular classroom which includes the required science fair project? Would the content and labs have to change to such a degree that the regular students would be bored, or would students loose out on content and labs because the pace would have to be slower with the inclusion of the special needs students?

Special Education Teacher: Along with all of the positive aspects of this change in science delivery, some concerns also came to mind which would have to be addressed. The science teachers would have to be open to having another instructor in the room with them in a co-teaching arrangement. This type of arrangement meant that the teachers would have to be comfortable with and willing to work together in the presentation of the material. This would require flexibility, communication, and time for planning which was not available except before and after school. Also, the amount of content that the special needs students would be able to digest would not be equal to their peers. The science teachers would have to be flexible in their expectations and allow the students to complete modified lesson assignments. Lab partners would have to be carefully chosen in order to maintain a balance of ability levels. Finally, the science fair requirement would have to be reviewed and modified to meet the special needs students' ability level. On reviewing my concerns, I was pleased to note that none of them seemed insurmountable.

Science Teacher: Now that this program has finished its second year, I can see only the positive aspects of including the special needs students into the regular heterogeneous science classrooms. At present in our school, the special needs students are for the most part clustered into one regular science class for each grade level because of the availability of the special education teachers. I have learned from the special education teachers to put instruction into shorter steps, which has helped both the special needs and the regular students. The achievement level and the motivation level has gone up for the special needs students, and the achievement of the regular students in that class is comparable to the other science classes. The regular students like having two teachers in the classroom since the wait time for having a question answered or receiving assistance is much shorter. When new texts were decided upon for our school, the decision was made to go with a text that would promote more hands-on and problem solving science experiences since this meets the needs of all of our students. The process of doing a science fair project has been modified for the special needs students with templates and investigations that lead to success. The only negative aspect of this program has been finding time to meet with the special education teachers to differentiate the program.

Special Education Teacher: As I thought, none of the concerns proved to be insurmountable because over the past two years, special needs students have been successfully involved in the regular science classes. Both the students and the teachers involved in this project have been learning and growing as the program evolves. The science teacher is responsible for the overall planning of the class because it is no different from the other science classes throughout the day. The special education teacher is responsible for the modification of the content. This entails several types of modification. One modification is redoing the study guides which the students complete over the content found in the book. The revised study guide filters out the extraneous information to assist the special needs student in focusing on the important content issues. Even with the content modified, the students still require assistance in reading the text and filling out the study guide, and this is another responsibility of the special education instructor. Within the class period itself, monitoring of students in order to keep them on task, organized, and focused on the activity at hand is yet another adaptation provided by the special needs instructor. Finally, a science fair resource book was developed through a collaborative effort between the eighth grade science teacher and a special needs teacher in order to assist the inclusion students in completing the experimentation segment of the project.

As we look back over the past two years, we can honestly say that through the inclusion of special education students and the collaboration of the science and special education departments, growth and change have come to the science program. From both points of view, this change has been a positive and productive way to meet the needs of all students at our school.

Michael L. Bentley, Ed.D.
Associate Professor, Science Education
National-Louis University
Evanston, Illinois 60201

WHAT WE CAN LEARN FROM SCIENCE EDUCATION IN AUSTRALIA AND NEW ZEALAND

In 1994 my family and I spent three months in Australia and New Zealand as part of my sabbatical leave project with National-Louis University. During this time I visited both urban and rural schools and held discussions with children, parents, teachers, principals, Ministry of Education officials, and teacher educators. I also experienced being a school patron, as my daughter, Sarah, attended kindergarten (called "prep" in Victoria) at Richmond Primary School, an urban public school near our residence in Melbourne. I will first share some general observations, then focus more on science education.

Australia, which is about the area of the continental U.S., has a population of approximately 17 million living in seven states. Most of the people live in coastal cities - the interior is largely desert. Western Australia, the largest state, is bigger than Alaska, with most of the people concentrated in Perth. The most populous is New South Wales, with the largest city, Sydney, as the state capital. The second largest city is Melbourne, capital of Victoria, where I spent most of my time. Australia was settled by Europeans about a century after America, but the two countries share much in common. Australia doesn't have the legacy of slavery that we still contend with in the U.S., but it does have a history similar to ours in the treatment of its native people. Also, like the U.S., Australia has a large immigrant population, most of whom are Asians and Polynesians.

New Zealand is a small country of about three million inhabitants, with Auckland as the largest city. New Zealand has a large population of indiginous Maori people, who still strive for equality in that society.

From what I could see, neither Australia nor New Zealand have the disparity of resources that we have in the U.S. between schools in poor vs. wealthy communities. Nowhere 'down under' did I find the kind of neglect and abandonment of schools that I've seen in places like Chicago. One source of the disparity in the U.S., of course, is the use of the property tax to fund schools. In Australia, states more equitably fund schools from general revenues on a per-pupil basis. Also, schools in neighborhoods with more disadvantaged children receive additional support.

In addition to funding, another key feature of schools is how they are governed. The trend to site based management is more advanced in Australia than in the U.S. This differs by state, but in Victoria, schools are governed by a local council (Fuhrman & Johnson, 1994). Generally each state has a ministry of education which provides guidance and support to the schools. In New South Wales, for example, ten science consultants serve schools throughout the state. Fuhrman and Johnson (1994) have written with admiration of Victoria's "combination of school-site autonomy and centralized direction" and suggest Victoria would be a good model for American public schools.

Other differences include the school calendar and the requirements for school principals. At least in Victoria, principals must have been successful as teachers for ten or more years. Australian children have more school days than we do and the school calendar is divided differently, too. The summer break is much shorter than ours, but there are two week breaks between terms. The school year begins near the end of January (during the Southern hemisphere summer) and consists of four terms of nine to ten weeks each with a break between terms of two weeks, with a longer summer break from before Christmas to the end of January (yes, Christmas is a *summer* holiday).

Typically, the school day starts at 9:00 am and ends at 3:00 pm. Many schools have a full hour for lunch, while all have at least 45 minutes. During this time, children play outside or go home. Often, one teacher rotates as playground supervisor while the others are free of supervisory duties.

Both Australia and New Zealand educators take pride in their primary education, which consists

Children at Jurien State School (K-10); Western Australia of the grades we call "elementary." Educators there have been leaders in applying constructivist learning theory in their elementary classrooms. In the 1960s and 70s, seminal research on how children learn science was conducted in these countries (Osborne & Freyberg, 1985). In Australia and New Zealand, the child-centered, constructivist curriculum is the standard to be achieved. This means, ideally, that instruction begins with children's interests and is developed by language-oriented instructional strategies. While this standard certainly doesn't exist in every case, the teaching of science in the best classrooms is rooted in this approach. In many classrooms. I observed children who were engaged both in hands-on and related reading and writing activities. In teaching science this way, the goal is for children to retain their curiosity about the natural world while developing scientific understandings.

Like the U.S., educators in Australia and New Zealand have been involved in curriculum reform. With the publication of new national curriculum standards and frameworks, these countries have made science a major subject for the K-6 curriculum. In Australia, the Keating government issued the companion documents, the *Australian National Science Statement and Profiles* (Curriculum Corporation, 1994), which are to be the framework each state uses to create its own curriculum document. This is the same process that is intended to be used in the U.S. with our own National Science Standards.

In Victoria, the *Curriculum and Standards Framework* (Board of Studies, 1994) addresses science as well as the other school subjects. This draft framework aims to balance local school perogatives with the new national standards of school achievement. The framework will be accompanied by an assessment system requiring every child to be tested twice between K and grade 6. Implementation of the *Framework* and the assessment will begin in 1995.

Victoria's *Curriculum and Standards Framework* divides the science content for the elementary level as follows:

Strand	Substrand
Earth & Beyond	• The changing Earth • Our Place in Space
The Physical World	• Electricity & Magnetism • Light & sound • Force & Movement
Life & Living	• Living Together • Structure & Function • Biodiversity, Change & Continuity
Natural & Processed Materials	• Materials: Structure, Properties and Uses • Reaction & Change

In the document, the above content is discussed at seven levels covering prep (K) through grade 10, which are the compulsory school years. Science procedures and processes (the process skills) are included too, and span all strands (Board of Studies, 1994). New South Wales, Australia, has produced its own state framework for science (Board of Studies, 1993), which is very different from Victoria's. The latter document may have to be reconciled to the national *Science Statement and Profiles.*

In the New Zealand curriculum document for science, adopted in 1993, science is considered in six learning strands, as follows:

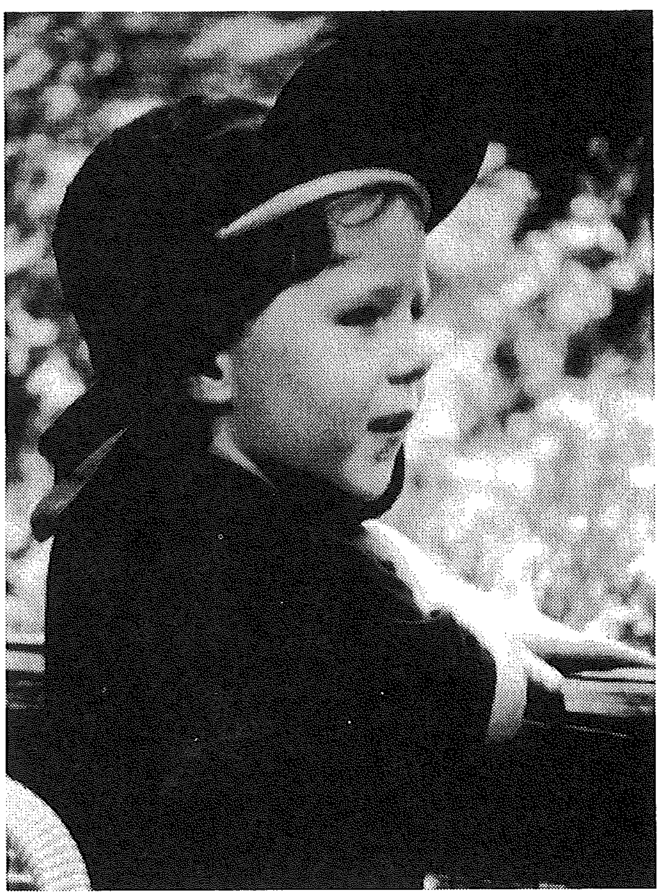
- Making sense of the nature of science and its relationship to technology;
- Developing scientific skills and attitudes;
- Making sense of the living world;
- Making sense of the physical world;
- Making sense of the material world;
- Making sense of planet Earth and beyond.

The first two are the *integrating* strands. The last four are the *contextual* strands. The curriculum in science can be modelled by a 3-D matrix with eight levels of achievement set out within the frame of four contextual strands and two integrating strands (Ministry of Education, 1993).

In terms of substance, the New Zealand and Australian curriculum documents are more similar than than different. They both consider science a key elementary subject. They both reflect a constructivist view of learning. Both encourage a "science-technology-society" approach to science education. Both identify similar science content for the elementary curriculum. In these ways, both documents also are similar to our own *Benchmarks* (1993), published by the American Association for the Advancement of Science as the companion to *Science for all Americans* (1989), and to the draft documents of our Science Standards (1993 - the final draft is due to be released in 1995).[2]

In Australia and New Zealand, the new frameworks have received mixed reviews. On the one hand, science educators are pleased to see science in the same class as reading, writing and arithmetic as basic subjects in the elementary curriculum. They also are pleased that more attention is focused on aspects of science that generally have been neglected in the curriculum, such as science and technology, and science and society issues. On the other hand, some educators 'down-under' fear the frameworks are overly prescriptive and might lead to less diversity and creativity in the development of science programs in the schools. Certainly, by their nature, standards and frameworks restrict the curricular choices of schools and teachers. Further, they often lead to state and national tests that enforce compliance.

Kelvin Smythe (1994), a former school inspector, criticizes the New Zealand framework for focusing on skills, which he says is an aspect of science education that is easy to measure, while neglecting the affective domain, which, he points out, is more fundamental to learning at the elementary level. Overall, he does not admire his country's new framework: "The document is technocratic in style, tone and imagery. It lacks warmth, humanity, and a sense of the inspirational ...(T)he Maori cultural references seem out of place, even laughable....The *New Zealand Curriculum Framework* is without merit. It has...no redeeming features." (p. 5, 6) Smythe also criticizes the framework for not distinguishing between the generalist nature of elementary schooling and the specialist secondary level: "Overall, there should have been a detailing of the differences between primary and secondary schools in terms of organisation (sic) and culture, and the implications of these for syllabus development and implementation." (p. 7)



Despite the criticism, the curriculum frameworks are documents that 'down under' educators will have to live with for many years to come (as we will have to live with ours, once its out). For teachers, much effort and energy will be required to make the transition from the old curriculum to the new, and not just in science but in several subjects. Schools will need to provide teachers with opportunities to discuss the documents and what they mean for classroom instruction.

The likelihood of a successful transition certainly will be enhanced by the availability of well-crafted curriculum materials that meet the content requirements of the frameworks and standards. *Science Alive* is a new program that can help teachers and schools in meeting the challenge of curriculum renewal. The program is now being published by Rigby Education after three years of research and design by a team of educators and writers from Australia, New Zealand, Canada, the U.K., and the U.S. Rigby is well regarded among elementary teachers as a publisher of *Literacy 2000*, and other whole language instructional resources. *Science Alive* integrates hands-on activities in a program focused on children's conceptual development.

Science Alive features a child-centered, constructivist instructional approach, which is clearly delineated in the Teacher's Resource Book (TRB). The TRB guides teachers in ways to engage children in science topics by identifying questions, issues, and problems that relate each topic to the children's concepts and experience. In *Science Alive*, children develop understanding through exploring ideas, carrying out investigations, interpreting data, and making connections. Children construct knowledge also through communicating and clarifying their thoughts and by applying ideas in new situations.

Science Alive is a helpful tool for schools in meeting the challenge of curriculum change because it is a "language and literacy" based program, and the language arts are usually a strength of elementary teachers. Saying its a language-literacy based program doesn't mean is isn't also a "hands-on" program. The TRB is loaded with suggestions for engaging, hands-on activities. Additionally, the program provides "activity cards" on stiff card stock for even more hands-on activities, many of which are integrative of other areas in the curriculum. The TRB is designed to help teachers organize their units and lessons, manage the activities, and assess children's progress. The materials and equipment required for *Science Alive* activities are generally available in schools and homes.

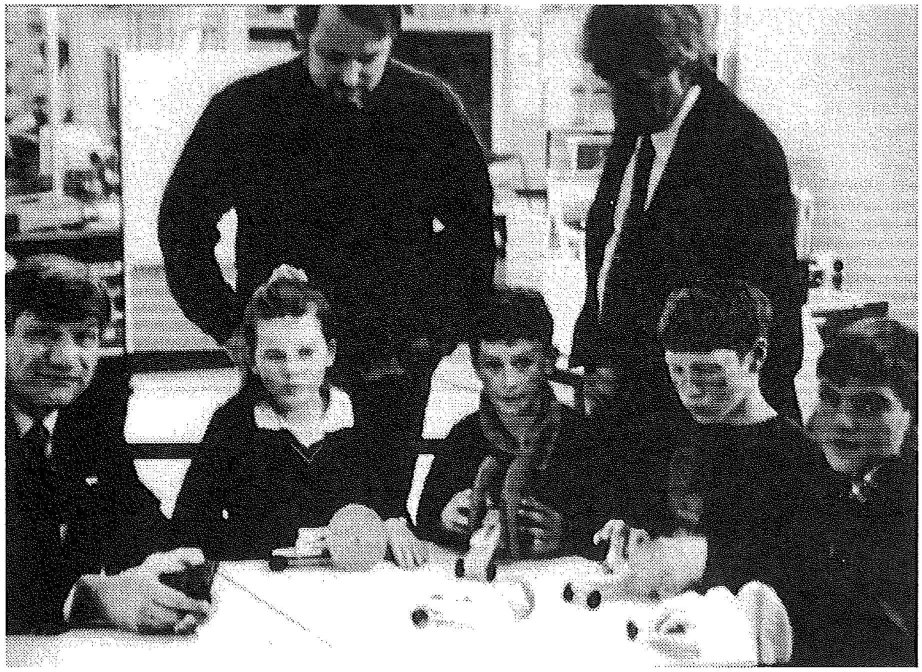
Three units are offered at each grade level, one each focusing upon the earth/space sciences, physical science, and life science, however, the grade levels are merely suggested and the materials can be used appropriately at many levels. The textual materials, which are in the form of tradebooks rather than textbooks, include a big book and four small books per unit. These books support children in their knowledge construction by providing solid "scaffolding" - for example, by focusing on major ideas, and by building upon ideas through the levels. Conceptual themes are developed both vertically, as well as across the units from life, to physical, to earth/space.

The texts also provide scaffolding for children in their knowledge construction through superb pictures and graphics. The bold visuals engage children's attention and interest, and stimulate them to get involved in investigations.

As a supplement, *Science Alive* also provides a powerful instructional resource in the program's laserdiscs. These can be used in innumerable ways, including the production of multimedia hypercard stacks. The computer can be used to engage students in a variety of scientific simulations, or 'microworlds' (diSessa, 1988). Thus, *Science Alive* includes a role for technology in teaching science.

In conclusion, elementary science education in Australia and New Zealand, like in the U.S., is in a period of transition and renewal. New national frameworks identify important content and achievement benchmarks, while new curriculum materials, such as *Science Alive* are available to help schools provide the child-centered education for which these countries are famous. Certainly, there are risks in the introduction of the new frameworks, but educators should not forget that the chief aim is for children to retain their curiosity about the natural world while developing scientific understandings.

Faculty and students at Ararat North (Ballarat) Primary School, Victoria



References

American Association for the Advancement of Science. (1989). *Science for all Americans* (Project 2061). Washington, D.C.: American Association for the Advancement of Science.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy: Project 2061*. N.Y.: Oxford University Press.

Board of Studies/Victoria. (1994). *Curriculum & standards framework (draft for consultation)*. Carlton, Victoria: Author.

Board of Studies/New South Wales. (1993). *Science and technology K-6 syllabus and support document.* North Sydney, New South Wales: Author.

Curriculum Corporation. (1994). *Science - a curriculum profile for Australian schools*. Carlton, Victoria: Author.

di Sessa, A.A. (1982). Unlearning Aristotelian physics: A study of knowledge based learning. *Cognitive Science*, 6, 37-75.

Fuhrman, S. & Johnson, S.M. (1994, June). Lessons from Victoria. *Phi Delta Kappan*, 75(10), 770-774

National Committee on Science Education Standards and Assessment. (1993, Februrary). *National science education standards: An enhanced sampler.* Washington, D.C.: NRC.

Osborne, R. and Freyberg, P. (1985). *Learning in science.* Portsmouth, N.H.: Heinemann.

Smythe, K. (1994). The New Zealand Curriculum Framework. *Developmental Network Newsletter*, 2, 5-12.

Ministry of Education. (1993). *Science in the New Zealand Curriculum.* Wellington, N.Z.: Learning Media.

National Science Resources Center. (1989). *Science for children.* Washington, DC: National Academy Press.

National Science Teachers Association (1992). *The content core: A guide for curriculum designers.* (Scope, Sequence, and Coordination of Secondary School Science Project). Washington, D.C.: Author.

[1] Based on a paper presented at the Annual Meeting of the Illinois Science Teachers Association, St. Charles, Ill. Nov. 1994.

[2] The National Science Teachers Association (1992), also has issued its own recommendations for reforming science education, but these have focused more on the secondary level.

Beverly Sussman
861 Indian Spring Lane
Buffalo Grove, IL 60089

A DREAM COME TRUE
WASHINGTON, D.C. – HERE I COME

Receiving a Presidential Award is a great honor; accepting it in Washington, D.C. can only be described as "awesome". I would like to share my experience with you.

The week's activities began with registration, orientation and a dinner/dance held in the main ballroom at the 5 Star ANA Hotel in Georgetown. Representatives from the National Science Foundation, National Science Teachers Association, National Council for Teachers of Mathematics, and the PAEMST Program Director were present and welcomed us to D.C. This was the first chance we had to meet everyone and socialize with each other.

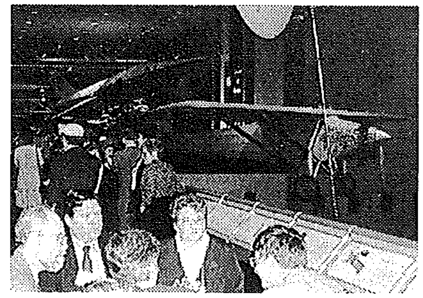
During our stay in Washington, there were many opportunities to talk to each other and share ideas throughout the week. We talked on the bus, during meals, sitting in the hotel lobby or just walking from place to place. Sometimes we were assigned to specific tables during meals which gave us a further opportunity to meet different people. There was one structured sharing activity called Teaching Experiences Workshop. It was conducted according to disciplines: Earth Science and General Science, Biology, Chemistry, Physics and Physical Science. First we had lunch together, and then we shared our favorite teaching experiences. My session had fifteen other presenters. Imagine listening to fifteen terrific ideas in one session! In addition, we each received a math and science book listing favorite ideas from every PAEMST participant.

There were workshops sponsored by the National Science Foundation. The topics included: New Directions at NSF, Science Standards, Evaluation and Assessment, Scientists Working With Teachers, Internet and Science for All Students. In addition to discussions, there were individual and group activities. These workshops gave us another opportunity to meet and talk with different teachers.

We visited many special places during our visit. Our first breakfast together on Wednesday was held in the Library of Congress. This was a legislative breakfast, and we were seated according to states. The keynote speaker was The Honorable Steven Schiff, Republican Congressman from New Mexico. The previous Monday, I met with my Congressman, John Porter (see picture left) in his office and on Thursday morning with our Illinois Senators, Paul Simon and Carol Moseley-Braun, at a breakfast meeting in the Hart Office Building. I presented each of them with a T-shirt from my school and an invitation from The Space Shuttle Club at Ivy Hall Middle School in Buffalo Grove to attend the fourth launch of Space Shuttle ENDURANCE.

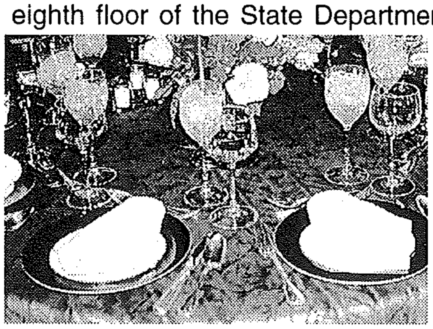
Another one of our breakfasts was held at the historic Willard Hotel directly across from the White House. This is a very beautiful hotel with a lot of history. President Lincoln resided at this hotel because the White House was empty and had no heat. He would sit in the lobby, meet with people and discuss the business of government, hence, the word lobbyist was born. Upon entering the hotel lobby, the seal from every state is visible in the ceiling. After the breakfast, we each received a special door prize and then attended a session to provide us with information on how to spend the $7,500 each honoree/school had received.

Our dinner on Wednesday was held at the National Air and Space Museum; it was a reception and dinner buffet held in the Pioneers of Flight Gallery. Afterward we attended a special program in the Langley Theater. What an incredible experience to eat dinner overlooking the famous planes of the The Wright Brothers, Lindbergh's Spirit of St. Louis, Amelia Earhart, contrasting with the Apollo 11 Spacecraft of Armstrong, Aldrin & Collins.



Thursday proved to be the most exciting and busiest day of all. It began with a breakfast in the beautiful Colonnade Room (the beauty of the room overshadows the food) at the ANA Hotel. Our next destination was the Baird Auditorium in the National Museum of Natural History. Group pictures were taken and the awards were presented by Neal Lane, Director of the National Science Foundation, and John Gibbons, Assistant to the President for Science and Technology. The ceremony felt exactly like graduation. One row went up at a time and each person waited for his/her name to be called. We accepted the award, shook hands and had our pictures taken. Our Awards Luncheon was held at The Historic Car Barn in Georgetown. A very leisurely lunch was had by all. Excitement grew as we anticipated our next stop...The White House. Security was very tight and to our disappointment, we had to check our cameras along with our coats. A Marine quartet played music as we were led into the East Room for the address by First Lady, Hillary Rodham Clinton. When the First Lady left the East Room, she left instructions for the guards to take down the security ropes and allow "the teachers" to walk, unencumbered, into the rooms. This was very exciting because it is something that is never done; it really made us feel very special. We left The White House with the secret service looking on and boarded our buses back to the hotel.

There was very little time, less than an hour, to get dressed for the reception and dinner held on the eighth floor of the State Department. This was the most formal and elegant of all our activities. In the ceiling is a relief image of the Great Seal of the United States, visible throughout the diningroom. First we had cocktails and hors d'oeuvres and then a full sit-down dinner with each person served elegantly by waiters dressed in black tie and continually changing plates," just like at home!"



Saturday afternoon, which was set aside for sightseeing, I had the opportunity to visit the Challenger Training Center. These centers, located around the United States, are a living memorial to the 1986 crew of the Challenger Space Shuttle. The center is set up to train children to perform the jobs of astronauts and mission control workers during a simulated mission. All participants are given a specific job on one of the crews; communication is done via the computer. After approximately forty-five minutes, the two crews change places so everyone has an opportunity to be an astronaut and a mission control specialist. This is similar to the simulated mission at my school. My students would have loved this ! It would be great to have a center in Illinois.

The last scheduled activity we had was on Saturday night aboard the cruise ship, Spirit of Washington. We sailed up and down the Potomac amidst the lights of Washington, D.C. It was a beautiful and exciting night with dinner and dancing. As wonderful as this night was we knew that our week was coming to an end and for many of us this would be the last time we would see each other.

Most of the teachers brought along something to represent his/her state and during our entire stay in Washington, we all traded these momentos with each other. I have collected state pins, magnets, pens, cups, book marks, soil, liquor, bumper stickers, key chains, screw driver and pencils. They make great keepsakes of this wonderful week.

The main purpose of everything we did and accomplished in Washington was to make all of us feel appreciated, respected and most important, to feel special because we are teachers. Teaching was continuously portrayed as a most important profession and we were made to feel proud of our chosen fields. We were honored as a group, and I was thrilled to be included !

My week in Washington, D.C. was extraordinary; I will never forget it and I will continue to cherish these memories forever.

A special thank-you to everyone involved in the PAEMST Awards. A very special thank-you to Mary Lynn Ernstthal (Presidential Awards for NSTA). She was ALWAYS there for us.

Teachers Clearinghouse
for Science and Society Education Newsletter
The Day School
1 West 88th Street
New York, NY 10024

NATIONAL SCIENCE EDUCATION STANDARDS DRAFT PUBLISHED

"Scientific literacy for all students is a national goal." Thus begins the "Call to Action" of the November 1994 draft of the long-awaited *National Science Education Standards*, which present themselves as a "contribution toward achieving that goal," which is to bring benefits in personal decision making, political problem solving, and economic productivity. To this end, the *Standards*, which embrace not only content but also science teaching, the professional development of science teachers, science education assessment, science education programs, and science education systems, "are directed to all who have interests, concerns, and investments in improving science, education, schools, and society in the United States," including science supervisors, science educators, curriculum developers, publishers, scientists and engineers, school administrators, school board members, parents, representatives from business and industry, and elected officials as well as science teachers, "who have the ultimate responsibility for helping students understand science."

The "Call to Action" is reiterated in the Introduction which comprises Chapter I of the *Standards* draft. Here the goal of the *Standards* is delineated as creating "a vision for the scientifically literate person . . .," and "scientific literacy" is defined as "the knowledge and understanding of scientific concepts and processes required for participation in civic and cultural affairs, economic productivity, and personal decisionmaking." The seven principles underlying the *Standards*—equity, excellence, understanding, active learning, "less is more," authenticity, and "systemicity" (see boxes on pages 22 and 23)—are stated and elaborated upon.

The first standards to be presented—in Chapter II—are those for science teaching (see box). They are prefaced by five underlying "assumptions":

- What people learn is greatly influenced by how they are taught.
- The actions of teachers are deeply influenced by their vision of science as an enterprise and as a subject to be taught and learned in school.
- Cognitive research indicates that knowledge is actively constructed by a student through a process that is individual and social.
- Actions of teachers are deeply influenced by their understanding of their students and the relationships they have with them.
- Teachers are continuous learners, inquiring into the understanding of science, their students, and their teaching practice.

"To highlight the importance of teachers, these standards are presented first," the first page of the chapter states. But throughout the chapter it is repeatedly made clear that teachers "alone are not responsible for reform" but "must be provided with resources and time, and they must work within a collegial, organizational, and policy framework that supports reform efforts." In addition, "students must learn to take responsibility for their own learning."

Each of the standards—in Chapter II through VII—is followed by a "bulleted" list of things that will enable the standards to be met. Except in Chapter III, which presents the professional development standards, each "bulleted" item is further elaborated by one or more short essays, which do not bear a one-to-one correspondence with the "bulleted" items. By and large, the professional development standards call for reform in the education of science teachers to parallel that called for in the science education of students—with emphasis on such aspects as inquiry, coordination, and lifelong learning.

Chapter IV presents assessment standards, with the astute observation that "Assessment practices and policies provide operational definitions of what is important." Chapter IV also makes it clear that science content in the traditional sense is *not* all that is important. In addition to "understanding scientific facts, concepts, principles, laws, and theories" are listed "the capacity to reason scientifically, the ability to inquire, the capacity to use scientific principles to make personal decisions and to take positions on societal issues, and the ability to communicate effectively about science." Noting that "educational measurement theory and practice have been well developed primarily to measure student knowledge about subject matter," Assessment Standard B emphasized that "it is important to develop and use assessments which measure *all* (emphasis added) the valued outcomes, not simply those that have been traditionally measured." For, it concludes, "if all the outcomes are not assessed, teachers and students will redefine their expectations to only the ones assessed." To aid in the assessment of these "other" outcomes, examples of prototype assessments comprise more than half of Chapter IV.

Although they comprise more than half of the *Standards* draft, the content standards in Chapter V contain the least that is new. Their division into the eight categories—1) Science as inquiry, 2) Physical science, 3) Life science, 4) Earth and space science, 5) Science and technology, 6) Science in personal and social perspectives, 7) History and nature of science, and 8) Unifying concepts and processes—differs little from what Bob Yager presented a year ago at the Ninth National STS Meeting and Technological Literacy Conference and was reproduced on pages 6 and 7 of our Winter 1994 issue. And "state framework committees, school and school district curriculum committees, and developers of instructional and assessment" who have been using Project 2061's *Benchmarks for Science Literacy* can rest easy in that the National Research Council of the National Academy of

Sciences, under whose auspices the science education standards have been developed, believe that use of the *Benchmarks* "complies fully with the spirit of the content standards" in the *Standards* draft.

The paramount importance of the first category, "Science as inquiry," is repeatedly stressed throughout the *Standards* draft. On page V-3 it is stated to be "a basic and controlling principle in the ultimate organization of and activities in students' science education." The *Standards* draft envisions "inquiry" as

> a step beyond "science as a process," in which students learn skills, such as observing, inferring, and experimenting. The new vision includes the "processes of science" and requires that students combine those processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science.

"Five essential functions" of inquiry are listed as follows:

- It assists in the development of understanding of scientific concepts.
- It helps students "know how we know" in science.
- It develops an understanding of the nature of science.
- It develops the skills necessary to become independent inquirers about the natural world.
- It develops the dispositions to use the skills, abilities, and habits of mind associated with science.

The physical science content standards focus on experiences that will foster the development of three primary concepts: the atomic structure of matter, the relationship between force and motion, and energy. The content standards for the life and earth and space sciences show a parallel in evolving from individual organism and objects at the K-4 level to systems at the 5-8 level to the evolution of systems and cycles occurring in them. In addition, with the atomic structure of matter established in the physical sciences for grades 9-12, the molecular basis of living organisms is included at this level as well.

The science and technology standards focus on design, which is seen as "the technological parallel to inquiry in science." "The sequence of four stages—stating the problem, designing and implementing a solution, evaluating the solution, and communicating the problem, design, and solution—provides a framework" for these standards. Similarly, the "Science in Personal and Social Perspectives" standards (previously known as "Science & Societal Challenges") are founded on "health, populations, resources, and environments," which "provide the foundations for students' eventual understandings and actions as citizens." Interestingly, two of these four topics are the titles of two of the three-volume Globe series on *Science, Technology, and Society*, described on page 3 of our Winter 1993 issue. The "History and Nature of Science" standards seek to employ history to illuminate the nature of science and, at the grade 9-12 level, cite their alignment with the Project 2061 *Benchmarks*.

The "Unifying Concepts and Processes standard echoes Project 2061 as well, for both emphasize the value of themes as a way to integrate "a range of basic ideas" that "present a synthesis of major ideas and an intradisciplinary view of science." As with the assessment standards, the chapter of content standards contains several examples of teaching and assessment that would enable the standards to be met.

The final two chapters present standards that were not even on the agenda when the Science Education Standards Project was first conceived: program and system standards. Both "address issues related to the vision, support, and integration of the teaching, content, and assessment standards, but the program standards address those issues from a point of view close to the experiences of students—the classroom, school, and district—and the system standards address them from the point of view farthest from students—the national, state, community, and sometimes the district levels." The important thrust of both sets of standards is the importance of coordination—not only among the various components of the science education community to whom this *Standards* draft is addressed but also among the various disciplines (both the *National Standards for Geography* and the National Council of Teachers of Mathematics standards are cited). These standards also reinforce the importance of the support teachers must receive from the entire science education community, as already noted in Chapter II.

As noted in its own introductory chapter, the *Standards* draft have indeed created a vision—a vision of equity in science education based on both teacher and student learning through inquiry, coordinated across grade levels with other disciplines, in which process of science shares a greater part of the stage with its content. Although teachers are ultimately responsible for fulfilling this vision, they are not required to "go it alone," and resources must be allocated to foster needed collaboration between educators and teachers, teachers and teachers, teachers and students, and students and students. It is clearly a vision of systemic reform, which the *Standards* draft says "students could not achieve . . . in most of today's schools."

Achievement of this vision will need to be guided by the teaching as well as the content standards, with attention paid that whatever is taught will also be assessed. This will require new curricula, which are repeatedly distinguished in the *Standards* draft from content: "Content is what students should learn. Curriculum is the way content is organized." Program Standard B notes that "Because curricula are complex, designing curricula draws from the teaching and assessment standards, as well as these program standards and the content standards." The same standard observes that "Integrated and thematic programs can be powerful approaches to curriculum; however, they require skill and understanding in their design and implementation. . . . the transformation of the content standards into curricula is complicated and time consuming."

System Standard C understates that "Achieving the vision contained in the *Standards* will take more than a few years to accomplish." More realistically, the Epilogue states that "The *National Science Education Standards* are a first step on a journey of educational reform that might take a decade or longer." But there can be no holding back. Program Standard D asserts that "missing resources must not be used as an excuse for not teaching science. . . A science program based on the *National Science Education Standards* is a program constantly moving toward replacing such improvisation with necessary resources." "Deliberate movement toward the vision of science teaching presented here is what is important if reform is to be pervasive and permanent."

Keigue of Martin Luther King Elementary School in Cambridge, MA, is quoted as saying. If you were the principal of this school, what decision would you make?

National Science Education Standards Draft — November 1994

I. Introduction - Underlying Principles

A. All students, regardless of gender, cultural or ethnic background, physical or learning disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain higher levels of scientific literacy than they do currently. This is a principle of equity.

B. All students will learn all science in the content standards.

C. All students will develop science knowledge as defined in the content standards and an understanding of science that enables them to use their knowledge as it relates to scientific, personal, social, and historical perspectives.

D. Learning science is an active process.

E. For all students to understand more science, less emphasis must be given to some science content and more resources, such as time, personnel, and materials must be devoted to science education.

F. School science must reflect the intellectual tradition that characterizes the practice of contemporary science.

G. Improving science education is part of systemic education reform.

II. Science Teaching Standards

A. Teachers of science plan an inquiry-based science program for their students.

B. Teachers of science guide and facilitate learning.

C. Teachers of science engage in ongoing assessment of their teaching and of student learning.

D. Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.

E. Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.

F. Teachers of science actively participate in the ongoing planning and development of the school science program.

III. Standards for the Professional Development of Teachers of Science

A. The professional development of teachers of science requires learning science content through the perspectives and methods of inquiry.

B. Professional development of teachers of science requires integrating knowledge of science, learning, pedagogy, and students and applying that understanding to science teaching.

C. The professional development of teachers of science enables them to build the knowledge, skills, and attitudes needed to engage in lifelong learning.

D. Preservice and inservice professional development programs for teachers of science are coherent and integrated.

IV. Assessment in Science Education

A. Assessments are consistent with the decisions they are designed to inform.

B. Achievement and opportunity to learn science must both be assessed.

C. The technical quality of the data collected is well matched to the consequences of the decisions and actions taken on the basis of its interpretation.

D. Assessment practices must be fair.

E. The inferences made from assessments about student achievement and opportunity to learn must be sound.

V. Science Content Standards (abilities or understandings to be developed as a result of activities at respective grade levels)

A. Science as Inquiry
1. Abilities of/necessary to do scientific inquiry
2. Understanding about scientific inquiry

B. Physical Science

K - 4
1. Properties of objects and materials
2. Position and motion of objects
3. Light, heat, electricity, and magnetism

5-8
1. Properties and changes of properties in matter
2. Motions and forces
3. Transformations of energy

9-12
1. The structure of atoms
2. Structure and properties of matter
3. Chemical reactions
4. Forces and motions
5. Conservation of energy and the increase in disorder
6. Interactions of energy and matter

C. Life Science

K-4
1. Characteristics of organisms
2. Life cycles of organisms
3. Organisms and environments

5-8
1. Structure and function in living systems
2. Reproduction and heredity
3. Regulation and behavior
4. Populations and ecosystems
5. Diversity and adaptations of organisms

9-12
1. The cell
2. The molecular basis of heredity
3. Biological evolution
4. The interdependence of organisms
5. Matter, energy, and organization in living systems
6. The nervous system and the behavior of organisms

D. Earth and Space Science

K-4 1. Properties of Earth materials
2. Objects in the sky

5-8 1. Structure of the Earth system
2. Earth's history
3. Earth in the solar system

9-12 1. Energy in the Earth system
2. Geochemical cycles
3. The origin and evolution of the Earth system
4. The origin and evolution of the universe

E. Science and Technology
1. Abilities to distinguish between natural objects and objects made by humans
2. Abilities of technological design
3. Understanding about science and technology

F. Science in Personal and Social Perspectives Standards

K-4 1. Personal health
2. Characteristics and changes in populations
3. Types of resources
4. Changes in environments
5. Science and technology in local challenges

5-8 1. Personal health
2. Populations, resources, and environments
3. Natural hazards
4. Risks and benefits
5. Science and technology in society

9-12 1. Personal and community health
2. Population growth
3. Natural resources
4. Environmental quality
5. Natural and human-induced hazards
6. Science and technology in local, national, and global challenges

G. History and Nature of Science

K-4 1. Science as a human endeavor

5-8 1. Science as a human endeavor
2. Nature of science
3. History of science

9-12 1. Science as a human endeavor
2. Nature of scientific knowledge
3. Historical perspectives

H. Unifying Concepts and Processes
1. Order and organization
2. Evidence, models and explanation
3. Constancy, change, and measurement
4. Evolution and equilibrium
5. Form and function

VI. Science Education Program Standards

A. All elements of the K-12 science program are consistent with the other *National Science Education Standards* and with one another and are articulated within and across grade levels to meet a clearly stated set of goals.

B. The curriculum in science for all students in grades K-12 includes all the content standards in a variety of curriculum patterns that are developmentally appropriate, interesting, and relevant to students' lives, emphasizes inquiry as a tool for learning science, and connects to other school subjects.

C. The science program should be coordinated with the mathematics program to enhance student use and understanding of mathematics in the study of science and to improve student understanding of mathematics overall.

D. The K-12 science program gives students access to appropriate and sufficient resources, including time, materials and equipment, space, teachers, and community.

E. All students in the K-12 science program must have equitable access to opportunities to achieve the *National Science Education Standards.*

F. Schools are communities that encourage, support and sustain teachers as they implement an effective science program.

VII. Science Education System Standards

A. Policies that influence the practice of science education must be consistent with the program, teaching, professional development, assessment, and content standards while allowing for adaptation to local circumstances.

B. Policies that influence science education should be coordinated within and across agencies, institutions, and organizations.

C. Policies need to be sustained over sufficient time to provide the continuity necessary to bring about changes required by the *Standards.*

D. Policies must be supported with resources.

E. Science education policies must be equitable.

F. All policy instruments must be reviewed for possible unintended effects on the classroom practice of science education.

G.Responsible individuals take the opportunity afforded by the standards-based reform movement to achieve the new vision of science education portrayed in the *Standards.*

John L. Roeder

THE NATIONAL SCIENCE EDUCATION STANDARDS HOW STS-FRIENDLY ARE THEY?

When Bob Yager led a roundtable discussion on the current status of science education reforms at the Ninth National STS Meeting and Technological Literacy Conference last January, he referred to five of the eight categories of science content standards as "STS-friendly." Mindful that my coverage of the "July '93 Progress Report" in our Fall 1993 issue had expressed dismay that a previous prototype standard on the "STS-friendly" topic of decision making appeared to have been consigned to oblivion, STS-friendliness was uppermost in my mind as I read the recently published *National Science Education Standards* draft.

I was pleased to note that I didn't have to search very hard for STS-friendliness. First of all, the five "STS-friendly" categories of science content standards are still there. Other STS-friendly indications are frequent emphases on the importance of coordinating education in science with that in other disciplines and the statement that "use of *Benchmarks for Science Literacy* by state framework committees, school and school district curriculum committees, and developers of instructional and assessment materials complies fully with the spirit of the content standards." And while I did not find the previous prototype standard on decision making, I did find decision making emphasized in one of the four goals of the *Standards*: "to educate students who are able to

- use scientific principles and processes appropriately in making personal decisions;
- experience the richness and excitement of knowing about and understanding the natural world;
- increase their economic productivity; and
- engage intelligently in public discourse and debate about matters of scientific and technological concern.

In fact, three of these four goals are clearly STS-related.

I was also pleased to see STS-friendly statements scattered throughout the *Standards* draft (see box). And, as I pondered the paramount emphasis placed in the *Standards* draft on inquiry, it occurred to me that while not all inquiry learning is STS-based, STS learning is certainly inquiry-based. Thus, STS can be considered to be "*Standards*-friendly"!

A Sampling of STS-friendly Statements in the *National Science Education Standards* draft

"Science has a rapidly changing knowledge base and an expanding relevance to societal issues." (p. III-1)

"The personal and social aspects of science become increasingly emphasized in the progression from science as inquiry to the history and nature of science." (p. V-2)

"An important part of science education is to give students a means to understand and act on personal and social issues." (p. V-7)

"A long-term goal of school science is citizens who can speak and write intelligently about science-related issues." (p. V-11)

"Middle school students are generally aware of science-technology-science issues, but the awareness is probably a result of the media." (a reason to include STS in the classroom, p. V-97)

"There is some research supporting the idea that S-T-S (science, technology, and society) curriculum helps improve students' understanding of various aspects of science- and technology-related societal challenges." (p. V-159)

"Regardless of organization, the science program should emphasize understanding natural phenomena and science-related social issues that students encounter in their world." (p. VI-7)

SPECIAL INTERESTS

The Gene Exchange
June 1994

HARDY HYBRIDS

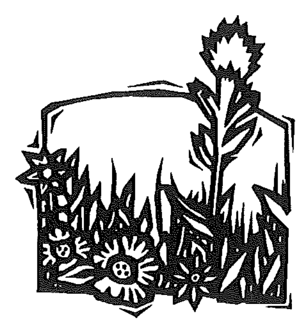
One environmental risk of transgenic crops is that genes will flow from the crop to wild relatives and create new—and perhaps worse—weeds. Whether or not this will happen depends on several factors, including the selective advantage conferred by the transgene and the relative hardiness of the first generation hybrid in comparison to the wild relatives. If the crop-weed hybrid survives in competition with the wild relatives, then crop genes have a chance of moving into wild populations.

Some might expect that crop-weed hybrids would not compete well against wild plants in natural settings. After all wild plants are continually undergoing selection for the features which aid survival in those environments. But that is not necessarily the case. Instances are known where serious weeds have developed as a result of gene flow from nonengineered crops to wild plants (see chart below), indicating that the hybrids must have survived well enough to transfer crops genes into their wild relatives. But little experimental work has been done on the issue. Most research in the past has focused on the contaminating effect of genes flowing from the wild population into the crops rather than the other way around.

Two University of California scientists, Normal Ellastrand and Terrie Klinger, recently performed careful experiments demonstrating that under controlled conditions the first generation hybrid between a wild and cultivated radish is hardier than the wild radish*. In fact, the hybrids produce 15% more fruit and seeds under the experimental conditions than wild radishes.

While this advantage would not necessarily be exhibited in natural settings, it provides a strong basis for expecting that the hybrids would do well enough in the wild that any genes they possess—including transgenes—would be passed on to wild radishes. Once in the wild populations, the new genes would be selected for if they provided advantages to wild radishes. This might happen for example, if the new gene conferred resistance to insects. If t he transgenes provide no disadvantage, but were merely neutral, they might nevertheless be retained in the wild population.

* T. Klinger and N. Ellstrand, Engineered genes in wild populations: fitness of weed-crop hybrids of *Raphanus sativus*, *Ecological Applications* 4:117-120, 1994. See also T. Adler, Crop-weed offspring show hardy streak, *Science News* 145:151, 1994.



Examples of Gene Flow from Crops to Wild Relatives Producing New or Worse Weeds

GENE FLOW FROM			RESULT
Crop	**to**	**Wild relative**	
pearl millet	to	wild millet	shibra, a weed[1]
sorghum	to	Johnson grass	more aggressive types of Johnson grass[2]
corn	to	teosinte	weedy types of teosinte[3]
rice	to	wild rice	weedy rice[4]
foxtail millet	to	wild green foxtail	weedy giant green foxtail[5]

1 J. Brunken, J. de Wet, and J. Harlan, The morphology and domestication of pearl millet, *Economic Botany* 31:163-74, 1977.

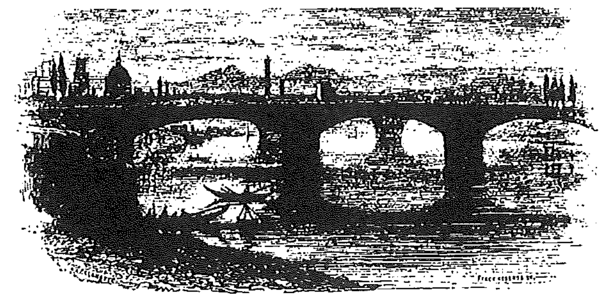
2 H. Baker, Migration of weeds, in *Taxonomy, Phytogeography, and Evolution*, ed. D. Valentine, 327-47, London: Academic Press, 1972.

3 J. Doebley, Molecular evidence for gene flow among *Zea* species, *BioScience* 40:443-48, 1990. H. Wilkes, Hybridization of maize and teosinte, in Mexico and Guatemala and the improvement of maize, *Economic Botany* 31:254-93, 1977.

4 S. Barrett, Crop mimicry in weeds, *Economic Botany* 37:255-82, 1983, and references therein.

5 H. Darmency, The impact of hybrids between genetically modified crop plants and their related species: introgression and weediness, *Molecular Ecology* 3:37-40, 1994; I. Till-Bottraud, et al., Outcrossing and hybridization in wild and cultivated foxtail millets: consequences for the release of transgenic crops, *Theoretical and Applied Genetics* 83:940-46, 1992.

The Groundwater Gazette
ENR
Illinois Department of Energy and Natural Resources
325 West Adams, Room 300
Springfield, IL 62704-1892
217-785-8577



NATIONAL DRINKING WATER WEEK GIVES WATER A HAND

Because high-quality drinking water is so often taken for granted by the general public, AWWA has long recognized a week each spring to publicly laud the important role water plays in maintaining community health and well-being.

National Drinking Water Week encourages water utilities, the news media, and community groups to "spread the word for water". The week and its theme to spread the word promote increasing awareness of water issues and the commitment to water-responsible actions. Communities from all over the United States and Canada are invited to participate in this week-long water awareness event. Since the late 1980's, AWWA has promoted National Drinking Water Week with other national organizations. These organizations have united to form the National Drinking Water Alliance.

The alliance recommends three basic principles to guide water-positive actions; conserve water, protect it, and become involved in local decisions that affect water sources and water quality.

The 1995 NDWW kit includes posters, news releases, media feature ideas, radio public service announcements—along with new pieces such as door hangers, bookmarks, and placemats. It was mailed free of charge to utility members of the American Water Works Association (AWWA). For individual members and others can obtain kits for $10 from the National Drinking Water Week headquarters, AWWA Public Affairs Department, 6666 West Quincy Ave., Denver, CO 80235; (303) 794-7711, ext. 4114; fax (303) 794-7310.

On-line News

The American Association of Water Works has maintained a presence in cyberspace for fifteen years, since the introduction of WATERNET. Now, CompuServe's Drinking Water Section, a subsection of the Earth Forum, offers services such as a library and discussion center. It also allows for interactive on-line conferencing. The Drinking Water Section, created by AWWA vice-president Mike McGuire, was created to help utilities comply with the Information Collection Rule. CompuServe users can reach the DWS by typing GO EARTH and following the menus.

WaterWiser, the USEPA-funded water efficiency clearinghouse, is on-line on the Internet. The clearinghouse offers a discussion center and library through the Universities Water Information Network, located at Southern Illinois University. It contains summaries of articles from AWWA publications and WATERNET. Plans for the future call for expanding the library to include full-text copies of articles and product information, such as low-flow water fixtures. WaterWiser's Internet addresses are gopher.uwin.siu.edu and www.uwin.siu.edu . For more information contact John Wright at (303) 347-6134, Linda Elinoff at (303) 347-6133, or e-mail to watwiser@awwa.org .

The AWWA Research Foundation utilizes both CompuServe and the Internet. Project Managers and AWWARF researchers not only communicate through e-mail, but they participate in discussion groups, file documents in libraries around the Internet and exchange chapters of research projects. For more information about AWWARF activities, contact Joel Catlin, AWWARF project manager at jcatlin@awwarf.com or ailges@awwarf.com . (Source: AWWA MainStream February 1995)

Available Resources

The Comprehensive Water Education Book. Based on the assumption that children learn best by doing and convinced that water literacy—understanding people to water relationships—will help solve present and future water problems, *The Comprehensive Water Education Book* is a water science curriculum for grades K-6. Cost: $8.75, including shipping. The International Office of Water Education, Utah Water Research Laboratory, Utah State University, Logan, Utah. 1994.

Resources Catalog. This catalog lists publications that are distributed by the Office of Agricultural Communications and Education (OACE) at the University of Illinois. Most of the publications are intended for the general public—especially farmers, consumers, and families. The numerous publications related to farming interpret results of agricultural research and suggest practical applications. Other publications cover home and family issues, forestry, gardening, soil, water quality, and the impact of farming on the environment. Research bulletins, are technical and intended for scientific investigators. They report the results of research conducted at the Illinois Agricultural Experiment Station. Videotapes are developed by faculty in the College of Agriculture with help from communications specialists in OACE. Their main purpose is to support Extension programs and resident instruction; however, many of the tapes are also useful for schools as well as for the general public. For more information, contact University of Illinois, Office of Agricultural Communications and Education, Information Services, 67-C5 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801 (217) 333-2007.

MINI IDEAS

Jim McGaughey
Botany Department
Eastern Illinois University
Charleston, IL 61920

CONDUCTING A BIOASSAY

A bioassay is a procedure commonly used to determine the impact of substances on the growth of living organisms. In a bioassay, test organisms are exposed to varied concentrations of a compound with unknown toxicity. Changes from the norm in terms of growth or some other relevant response by the plant or animal are noted and analyzed. Regulatory agencies, agricultural chemical companies and the pharmaceutical industry all utilize bioassays to determine the effects of new products on the environment. I believe that bioassays represent a worthwhile activity for secondary science students. The materials to be utilized are inexpensive and readily available. Once the mechanics of this technique become familiar, bioassays become a research tool for junior high and high school science students to conduct investigations of their own construction and of particular interest to them.

The example used for illustration examines the effects of increasing concentrations of common table salt on the germination of radish seeds. Such an assay can serve as a model for the effect of salt used to de-ice highways on the germination of seeds along roadsides in spring. From the data collected an IC_{50} (Inhibitory Concentration) can be determined, i.e., the concentration which inhibits germination of the seeds by 50% relative to the control.

Materials (per group of students)

7 16 mm X 150 mm test tubes	1 overhead marker
1 test tube rack or holder	40 radish seeds
1 15 cm ruler	10% solution of table salt
7 35 mm film canisters	distilled water

7 12 cm X 4.5 cm strips of filter paper
1 cottage cheese container or similar container with lid

Procedure

1. Place a piece of masking tape on each film canister and label: Control, 10%, 5%, 2.5%, 1.25%, 0.625%, 0.312%. Label the cottage cheese container with the group's name.
2. Line the inside of each canister with one strip of filter paper (the ends of the paper will overlap).
3. Using a probe, wood splint or similar object push 4 seeds into each canister between the filter paper strip and the inside of the film canister. The seeds should be approximately 1 cm below the rim of the canister.
4. Make two marks on each test tube; one 5 cm from the bottom, the other 10 cm from the bottom. Label the tubes: Control, 10%, 5%, 2.5%, 1.25%, 0.625%, and 0.312%.
5. Fill the Control tube with distilled water to the 5-cm mark. Return it to the rack.
6. Fill the 10% tube to the 10-cm mark with the test solution provided. Pour half of this solution into the tube labeled 5% (up to the 5-cm mark). Add distilled water to this tube to bring the total volume up to the 10-cm mark. Mix thoroughly. This solution now has a concentration of 5%.

Pour half of the 5% solution into the tube labeled 2.5% (up to the 5-cm mark.) Add water to this tube to bring the total volume up to the 10-cm mark. You now have a 2.5% solution. Mix thoroughly.

Repeat this procedure until all dilutions have been made.

7. Pour the contents of each tube into the appropriately labeled film canister.
8. Place the canisters into the cottage cheese container and cover. Set the containers in a area with a temperature of approximately 21 C (70 F). Appropriate tables or frames can be constructed by students to record results. Progress can be checked daily with final tallies of seeds germinated recorded on the seventh day.

Data Collection

Observe and record the number of seeds that germinated in each concentration after seven days. Assemble data from the entire class. Students can calculate percent germination from this data per each concentration and plot this on a graph which compares concentrations (horizontal axis) vs. percent of seeds that germinated (vertical axis). The IC_{50} can be determined by: i) extending a line from the 50% mark on the vertical axis to a point where it intercepts the line of the data graphed, and ii) from this point extending a line downward to the horizontal axis. The IC_{50} can now be read directly from the horizontal axis.

For example, assume ten lab groups plant 4 seeds in each salt dilution. After 7 days the following results for seeds germinated were obtained: 10% salt - none, 5% salt - none, 2.5% salt - 6, 1.25% salt - 18, 0.625% salt - 31, 0.312% salt - 38, Control - 39. From these results, the IC_{50} will be between 1.25% and 0.625% (again, the concentration of salt at which 50% of the seeds failed to germinate.)

Obviously, this particular activity may yield a wide range of values for the IC_{50}. However, at this point it may be possible for the students to narrow the range of values by changing the dilution scheme (this may take some coaching). With your assistance students can construct a procedure that would represent a dilution scheme of 1:10 at each step using a similar technique and similar materials. Additional activities may include having students suggest other materials that might be substituted for salt. Then let them try it!!

Harry Manos
Schurr High School
820 N. Wilcox Ave.
Montebello, CA 90640

SAFE ELECTRICITY KITS

Hands-on Electricity

There has been a tendency for some teachers to avoid units in basic electricity and magnetism because of the potential of electrical shock. What is needed is a way to teach these topics in such a way that eliminates such hazards and does not require the use of wall outlets. There is an abundance of hands-on demonstrations and ideas that fit these criteria, although there are a number of pitfalls that need to be avoided. The Mentor Teacher Program in the Montebello Unified School District financed and sponsored a teacher initiated project to develop kits in electricity and magnetism that use only batteries and hand-crank generators: basically "safe" electricity. These kits are low in cost, easy to assemble, inexpensive to duplicate, and were distributed to all elementary and intermediate schools in the district.

The intent was to develop "user friendly," "shock free" electrical kits that were essentially fool-proof, would work every time, and that could be used by both teachers and students. A set of instructions were written that were concise and simple to follow. Finally, since elementary and intermediate schools have little or no science budget, the kits had to be inexpensive to reproduce, and if possible there had to be a way to produce them for distribution to the schools so that each school had at least one kit to use in demonstration and as a prototype for teachers to use as a model to make other kits on their own.

Developing Kits

Photograph 1 shows the circuit boards that were assembled for the kits. All the connections are visible and a simple knife switch is used to open and close the circuit. The boards are painted bright orange to be attractive and to help hold student interest. The boards have metal battery holders instead of plastic for durability. Similarly, porcelain bulb sockets and knife switch bases are used instead of plastic. These boards are operable with two D-cell batteries or with a hand crank Genecon generator. Only brass screws are used to assembly the boards to prevent rusting.

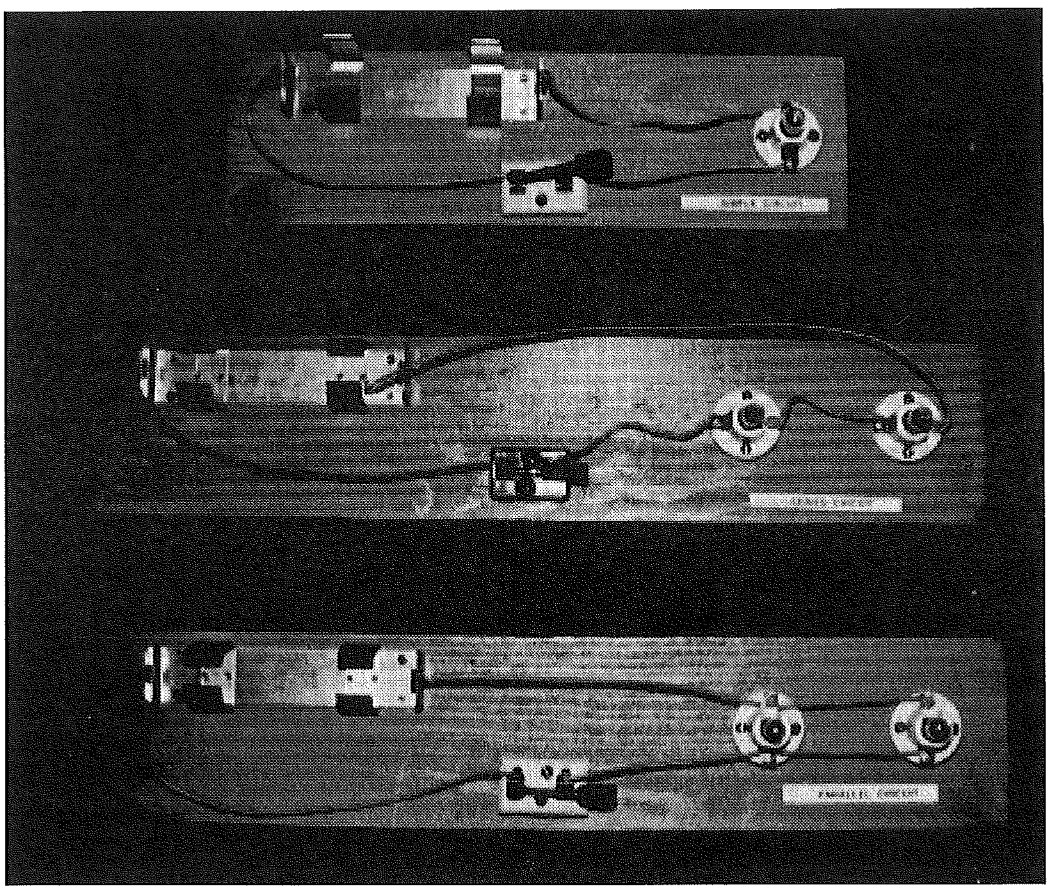


Photo 1. The three boards with circuits showing visible connections and a simple knife switch to open and close the circuits. Battery holders use two D-cell batteries. The simple "flashlight" circuit, top, was placed in the elementary school kits. The two circuits, series and parallel, were supplied to the intermediate school and high school kits.

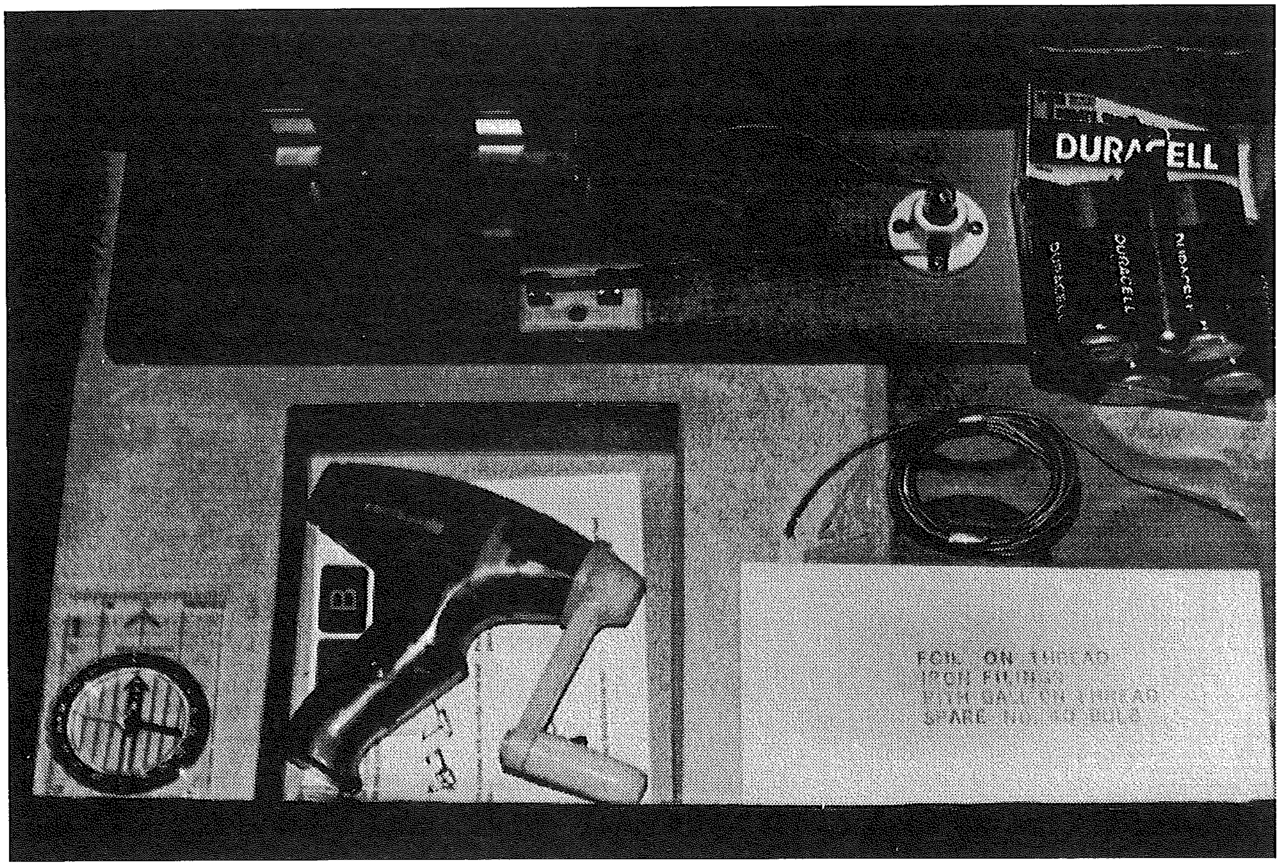


Photo 2. Elementary school "Safe Electricity Kit" packaged for delivery. The kit contains a simple circuit on a board, batteries, magnetic compass, clear acrylic plastic sheet, coil, Genecon generator, and an envelope containing foil on a thread, iron filings, pith ball on a thread, and a spare #40 bulb for the simple circuit. Not shown are the instructions and the resource book supplied with each kit.

With the generator connected to any of the circuit boards in place of the batteries a teacher can have one student crank the generator while another student opens and closes the switch. When the switch is open, there is no load on the generator. But when the switch is closed, the student turning the generator can feel the increase in load and actually see that quite a bit of work has to be done by turning the generator to keep the bulbs on the circuit board lighted. This can be quickly translated into an explanation of why parents want their children to turn off the lights when nobody is in a room to save energy and money.

Tables 1 and 2 show the equipment prepared for the elementary and intermediate schools. The items common to all kits are: Genecon generator, magnet, clear sheet of acrylic plastic for an overhead projector, 2 D-cell long-life 1-1/2 volt batteries, 18-inch section of 32/4 inch PVC pipe, and an envelope containing aluminum foil squares on thread, iron filings, a pith ball, a spare #40 flashlight bulb for circuit boards (see Photo 2). Each kit comes with a set of instructions for demonstrations and hands-on laboratory experiments for students.

The magnets used are "cow" magnets, or rumen magnets, so named because farmers force them down the throats of cows so that as the cows graze and swallow harmful bits of metal will stick to the magnet and not pass from the first stomach (rumen) into the other stomachs and insure or kill the cows. These magnets are strong, long life, permanent magnets. They are inexpensive and readily available at animal feed stores.

Place the magnet on an overhead projector; then place the acrylic plastic sheet over the magnet. Sprinkle iron filings over the plastic and the silhouette of the magnet and its magnetic field are readily projected onto a screen for all the students to see. With two such magnets one can show what the fields look like when like poles repel or unlike poles attract. The purpose of the plastic is to prevent the iron filings from sticking to the magnet. By lifting the plastic off the magnet, the filings may be reused.

PVC pipe is the kind used for lawn sprinklers and is readily available in building supply stores. A 10-foot section of 3/4 inch pipe can be purchased for about a dollar. It is so inexpensive that a few 10-foot sections can supply a whole classroom for a hands-on laboratory session in electrostatics. It can be charged very easily by rubbing it on a shirt sleeve, and it holds a charge for a long time.

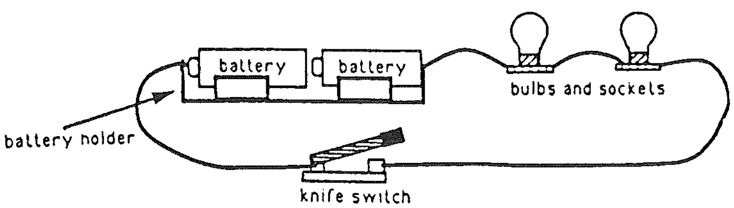
The magnetic compass is in a transparent plastic case so that it may be viewed on an overhead projector. There are several things one can do with a magnetic compass. First, students may be shown simply how to use a compass by the fact that it lines up to magnetic north and can give us direction. Second a cow magnet is brought near the compass will show the influence of magnetic fields on a compass. Third, if the generator is attached to the wire coil (about a dozen turns of 20-gauge stranded wire around the hand), and the coil moved in the vicinity of the compass while the generator is being operated, one can see that the coil has a magnetic field by the way it deflects the magnetic needle of the compass. If one stops cranking the generator, it can be shown that this magnetic field influencing the compass is due to the current in the wire, because the magnetic field is no longer present when the generator is not being operated and the compass no longer deflects.

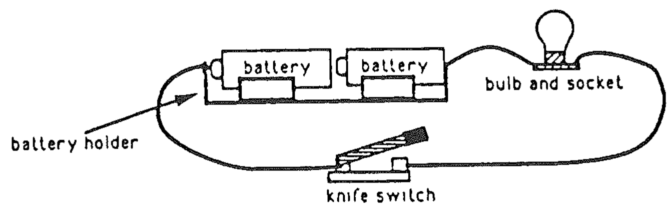
There are a couple of pitfalls in trying to get a compass to deflect due to the magnetic field around a current carrying wire. With the low current used, a single wire, or just a few turns of wire in a coil, does not produce a strong enough magnetic field to make the compass deflect. Another problem is that if one places about a dozen turns of wire around the compass, it is possible to have the magnetic field of the coil lined up with the earth's magnetic field in which case the compass will not deflect.

Resources

There are many science workbooks and training materials for teachers. The one we chose to place with the elementary and intermediate school kits was *Science Activities For Elementary Children* by Leslie Nelson and George Lorbeer, published by William C. Brown, Dubuque, Iowa, 1984. It contains several hundred student hands-on laboratory activities in all areas of science. Each activity is clearly presented and accompanied by a drawing or photograph. Teachers may have their own preference other than the one we supplied.

Although not described in this article, high school kits were also built and distributed. These kits reflected an increase in difficulty from those supplied to the elementary or intermediate schools. They included, in addition to the equipment supplied in the intermediate school kits, a piezoelectric crystal and "see-through" demonstration transformer. Most high school physical science teacher s will be able to apply this article to their own use.





Series Circuit

Purpose: To demonstrate the properties of a series circuit.
Apparatus: Circuit board containing, 2 D-cell batteries, 1 knife switch, 2 No. 40 flashlight bulbs and sockets, connecting wires.
Procedure: In this case, when the circuit is closed the bulbs are dim because the energy from the batteries is being shared by the bulbs. The two D-cell batteries supply 1-1/2 volts each, totaling 3 volts. Since the bulbs are in series, each bulb is using 1-1/2 volts, and together are using the to talk of 3 volts. Unscrew one bulb. The other one goes out as well. With only one switch all the lights are on or off at the same time.
Note: In the series circuit everything is connected to a single line and there is only one path for the current to follow. This series circuit is the same as the one used for some Christmas tree lights. When one light burns out, one has to check all the bulbs to find the burned out bulb in order to get the lights back on.

Simple Electric Circuit

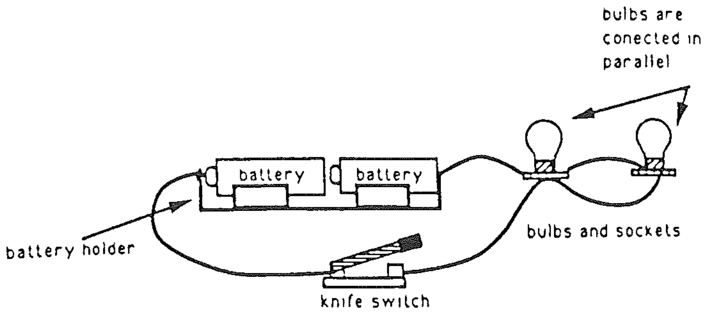
Purpose: To show the difference between an open and a closed circuit.
Apparatus: Circuit board containing 2 D-cell batteries in a battery holder, 1 knife switch, 1 No. 40 flashlight bulb in socket, connecting wires.
Procedure: When the knife on the switch is up, the light is out because no current flows since the circuit is not complete. The knife is open the way a door is open, so we say that we have an "open circuit." No current flows when there is an open circuit. Drop the knife switch all the way down so that contact is made. The light comes on. The switch is closed, so we say that we have a "closed circuit," meaning that the circuit is complete.
Note: This circuit is the same as one found in a flashlight, with batteries, switch, and bulb, except that everything is laid out on the circuit board

Table 1
Parts List
For Elementary School Kit

Simple circuit board containing battery holder for two batteries, knife switch, #40 flashlight bulb in socket, connecting wires,
Genecon generator, wire coil,
Magnetic compass, magnet,
Clear acrylic plastic,
Two D-cell, 1-1/2 volt long-life batteries, PVC pipe,
Envelope containing aluminum foil square on thread, iron filings, pith ball, spare #40 flashlight bulb for circuit board.

Table 2
Parts List
For Intermediate School Kit

Series circuit board containing battery holder for two D-cell batteries, knife switch, two #40 flashlight bulbs, two sockets connected in series, connecting wires,
Parallel circuit board containing battery holder for two D-cell batteries, knife switch, two #40 flashlight bulbs, two sockets connected in parallel, connecting wires.
Genecon generator, wire coil, magnetic compass, magnet, clear acrylic plastic, two D-cell, 1-1/2 volt long-life batteries, PVC pipe,
Envelope containing aluminum foil square on thread, Iron filings, pith ball, spare #40 flashlight bulb for circuit board

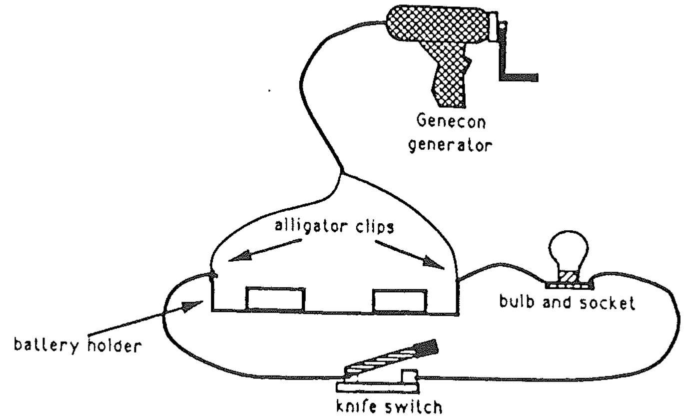


Parallel Circuit

Purpose: To demonstrate the properties of a parallel circuit.
Apparatus: Circuit board containing, 2 D-Cell batteries, 1 knife switch, 2 No. 40 flashlight bulbs, connecting wires
Procedure: When the knife switch is up the lights are out because there is no current flowing. The circuit is not complete. Drop the knife switch all t he way down so that contact is made and the lights come on. While the lights are on, unscrew one of the light bulbs so that it goes out. What makes this type of circuit different from the series circuit is that the other light will remain on. The other bulb is unaffected in any way by the one bulb being out when it is loosened.
When the circuit is closed and the lights are on, notice that the bulbs are of equal brightness. The two 2-cell batteries supply 1-1/2 volts each, totaling 3 volts. Each bulb is connected separately to the battery holder and each bulb is being supplied by the entire 3 volts. So, even when one bulb is out, the other keeps its brightness.

Note: In the parallel circuit the pairs of wires to each socket appear to be parallel: however, it is not the wires that are parallel, but the bulbs that are in parallel to each other. The current from the batteries runs along two, separate, parallel paths through the bulbs because the bulbs are parallel. This is the reason, unlike the series circuit, that we can unscrew one bulb and the other stays lit.

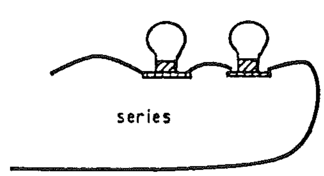
Our houses, schools and all businesses are wired in parallel so that we can have equal brightness in several places at the same time and so that we can turn lights on and off separately without affecting other lights that may be on or off

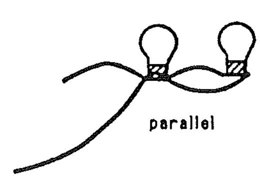


Generating Energy

Purpose: To generate electricity by hand. To show that work must be done to generate electricity.
Apparatus: Simple circuit board with batteries removed. Genecon generator connected to battery holder.
Procedure: With the switch open (up), crank the generator. You will notice that it turns easily with practically no resistance at all. Have someone close the switch while you are turning the handle and notice that there is resistance felt while turning the handle as long as the switch is closed. Naturally, the light is off when the switch is open, which is why there is no resistance felt while turning the handle. When the switch is closed, the light comes on. The resistance shows how much work must be done to keep the light on. The faster the handle is turned, the brighter the light will be.
Turn the handle at a constant rate to keep the bulb as bright as when the batteries are lighting the bulb and see how much work has to be done to duplicate the work of the batteries.

Note: Have the students perform this experiment and tell them that the reason their parents want them to turn out the lights when they leave a room is to save energy. You may want to give the image of not only having to pay for that energy, but it is like someone having to turn a crank to keep the lights on in a room when nobody is there. The experiment may be done with circuits in series or in parallel, as shown below.





More information from Gary Anderson, editor of *KATS*, the Kansas Association of Teachers of Science Journal.

Chemistry Related Lists

...!{ames,cbosgd}!pacbel!unicom!magnus	...!{ames,cbosgd}!pacbell!unicom!manus	Chemistry
CHEMCOMP@HUEARN.SZTAKI.HU	LISTSERV@HUEARN.SZTAKI.HU	Magyar Kemikusok Egyesuletenek Kibernetika Ii
CHEMCONF@UMDD.BITNET	LISTSERV@UMDD.BITNET	Conferences on Chemistry Research and Educati
CHEMCORD@UMDD.BITNET	LISTSERV@UMDD.BITNET	Gen. Chem. Coordinators Discussion Group
CHEMDISC@UMDD.BITNET	LISTSERV@UMDD.BITNET	ChemConf Discussion
CHEME-L@PSUVM.PSU.EDU	LISTSERV@PSUVM.PSU.EDU	Chemical Engineering List
CHEMED-L@UWF.CC.UWF.EDU	LISTSERV@UWF.CC.UWF.EDU	Chemistry Education Discussion List
CHEMIC-L@VM.TAU.AC.IL	LISTSERV@VM.TAU.AC.IL	Chemistry in Israel List
Chemistry@osc.edu	CHEMISTRY-REQUEST@oscsunb.osc.edu	Computational Chemistry List
chemistrytm@dhvx20.csudh.edu	chemistrytm-request@dhvx20.csudh.edu	Chemistry Telementoring
CHMINF-L@IUBVM.UCS.INDIANA.EDU	LISTSERV@IUBVM.UCS.INDIANA.EDU	CHEMICAL INFORMATION S
hyperchem@autodesk.com	hyperchem-request@autodesk.com	HyperChem Users
ORGCHE-L@RPICICGE.BITNET	MSMITH@AMHERST.EDU	Organic Chemistry
RADCH-L@FRCPN11.IN2P3.FR	LISTSERV@FRCPN11.IN2P3.FR	liste de distribution pour les RADIOCHIMISTEs

Physics Related Lists

ASIPP-L@ULKYVM.LOUISVILLE.EDU	LISTSERV@ULKYVM.LOUISVILLE.EDU	Chinese Plasma Physics Forum
ASTRO-PH@JPNYITP.BITNET	LISTSERV@JPNYITP.BITNET	Preprint server for Astrophysics
CIPE-L@UWF.CC.UWF.EDU	LISTSERV@UWF.CC.UWF.EDU	Computers in Physics Education
COND-MAT@JPNYITP.BITNET	LISTSERV@JPNYITP.BITNET	Preprint server for Condensed Matter
CUPLE-L@UBVM.CC.BUFFALO.EDU	LISTSERV@UBVM.CC.BUFFALO.EDU	Unified Physics
EM@decwd.ece.uiuc.edu	EM-request@decwd.ece.uiuc.edu	electromagnetics
GR-QC@JPNYITP.BITNET	LISTSERV@JPNYITP.BITNET	Preprint server for General Relativity & Qua
HEP-PH@JPNYITP.BITNET	LISTSERV@JPNYITP.BITNET	Preprint server for Particle Phenomenology
HEP-TH@JPNYITP.BITNET	LISTSERV@JPNYITP.BITNET	Preprint server for String/Conformal/Field T
ITP-L@TECHNION.TECHNION.AC.IL	LISTSERV@TECHNION.TECHNION.AC.IL	ITP-L - Institute of Theoretical Physics,
PHYSIC-L@VM.TAU.AC.IL	LISTSERV@VM.TAU.AC.IL	Physics List
physics@qedqcd.rye.ny.us	physics-request@qedqcd.rye.ny.us	Physics
PHYSICS@UNIX.SRI.COM	PHYSICS-REQUEST@UNIX.SRI.COM	Physics Discussion
PHYSICS@VM.MARIST.EDU	LISTSERV@VM.MARIST.EDU	Physics Discussion
PHYSJOB@CMS.CC.WAYNE.EDU	LISTSERV@CMS.CC.WAYNE.EDU	Physics Jobs Discussion List
prion@stolaf.edu	prion-request@stolaf.edu	Prions
SAPHYSIA@SAKSU00.BITNET	LISTSERV@SAKSU00.BITNET	Discussion forum on Saudi Physics Discussion
UFIT-L@VM.CC.METU.EDU.TR	LISTSERV@VM.CC.METU.EDU.TR	Applied Physics Group List UFIT-L

General Education Related Lists

EDTECH@MSU.EDU	LISTSERV@MSU.EDU	EDTECH - Educational Technology
ELEMUG@UICVM.UIC.EDU	LISTSERV@UICVM.UIC.EDU	Elementary School Users' Group
HST-L@WVNVM.WVNET.EDU	LISTSERV@WVNVM.WVNET.EDU	NASA Classroom of the Future Software/Curric
HYPEREDU@ITOCSIVM.CSI.IT	LISTSERV@ITOCSIVM.CSI.IT	Hypertext in Education
IMSE-L@UICVM.UIC.EDU	LISTSERV@UICVM.UIC.EDU	Institute for Math and Science Education
INFED-L@CCSUN.UNICAMP.BR	LISTSERV@CCSUN.UNICAMP.BR	Computers in Education
JEI-L@UMDD.BITNET	LISTSERV@UMDD.BITNET	Technology in Education Mailing List
K12ADMIN@SUVM.SYR.EDU	LISTSERV@SUVM.SYR.EDU	K-12 School Administrator Discussion
MSUPBND@UBVM.CC.BUFFALO.EDU	LISTSERV@UBVM.CC.BUFFALO.EDU	Math Science Upward Bound Discussion List
NEWEDU-L@VM.USC.EDU	LISTSERV@VM.USC.EDU	New Paradigms in Education List
NREN-Discuss@psi.com	nren-discuss-request@psi.com	National Research Education Network
RIP-EXP@BROWNVM.BROWN.EDU	LISTSERV@BROWNVM.BROWN.EDU	RI.K12.Experiences
SAIS-L@UNB.CA	LISTSERV@UNB.ca	Science Awareness and Promotion
SATEDU-L@WCU.BITNET	LISTSERV@WCU.BITNET	Satellite Educators Discussions
SCHOOL-L@IRLEARN.UCD.IE	LISTSERV@IRLEARN.UCD.IE	A list for primary and post-primary schools
VRSCHOOL@SUVM.SYR.EDU	LISTSERV@SUVM.SYR.EDU	Distributed Virtual Reality for K-12 educati
WVNK12-L@WVNVM.WVNET.EDU	LISTSERV@WVNVM.WVNET.EDU	Internet Access for K-12 Discussions
CA-CR-L@NMSUVM1.BITNET	LISTSERV@NMSUVM1.BITNET	Classroom assessment and classroom research
KIDSPHERE@VMS.CIS.PITT.EDU	KIDSPHERE-REQUEST@VMS.CIS.PITT.EDU	K-12 computing and general interest
KIDZMAIL@ASUVM.INRE.ASU.EDU	LISTSERV@ASUVM.INRE.ASU.EDU	KIDZMAIL: KIDS EXPLORING ISSUES
KIDLINK@VM1.NODAK.EDU	LISTSERV@VM1.NODAK.EDU	KIDLINK Project List

K R. Cranson
Great Lakes Geoscience
(517) 321-2473

TWO ASTRONOMY CLASSROOM ACTIVITIES

Mars Loop in Gemini 1992-93, 15 color slides + Classroom Activity, $12. *The Rarity of the June 1991 Gathering*, 10 color slides + Classroom Activity, $7.50. Order from Abrams Planetarium, Michigan State University, East Lansing, MI, 48824. Make checks payable to Michigan State University.

How about a couple of nice astronomy units? Jenny Pon at Abrams Planetarium has prepared two excellent hands-on classroom activities for your consideration. Both encourage critical thinking and collaborative learning as students examine motions of celestial objects. They are about as close to an actual observation experience as possible in a typical classroom environment.

Mars Loop in Gemini 1992-93 is my favorite. Jenny photographed the retrograde loop of Mars as it moved through the Gemini constellation between September 1992 and May 1993. Using a 35mm slide projector, students can project these images on a white surface (large sheet of white paper or a white marker board) to record the positions of Mars and several reference stars. Working out Mars' track by connecting consecutive positions of the planet produces a classic retrograde loop.

By allowing student teams to map Mars' trip through the reference stars with little or no prior explanation of what to expect, a real problem is generated. After the map of Mars's trace is complete, ask groups to form an explanation for their results. When all teams have reached a hypothesis, in writing, I would ask each group's spokesperson to present it to the entire class.

During presentation of each team's explanation, numerous unreasonable assumptions and misconceptions will likely surface. Identifying and discussing these ideas is an excellent technique allowing students to experience data use in forming and modifying a hypothesis. As teacher, you must recognize such inconsistencies and carefully call attention to them as the class attempts to reach consensus on the best hypothesis. If you subscribe to the "scientific method," this slide set is an excellent activity to investigating a real problem, using real data, based on real observations. It doesn't get much better.

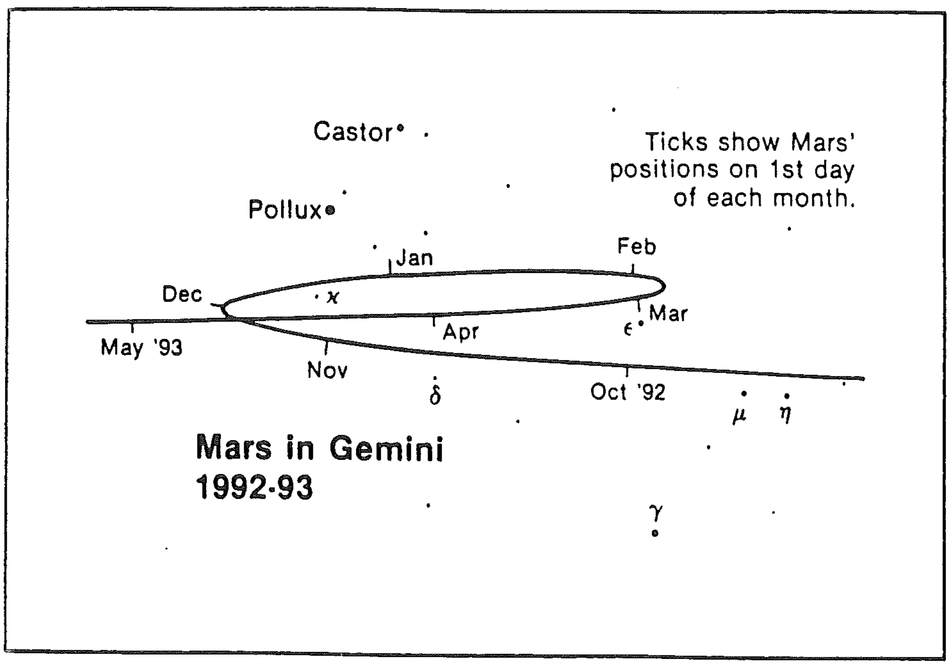


Figure 1: Sketch illustrating the retrograde loop of Mars through the Gemini Constellation between September 1992 and May 1993. By using the slides in sequence, students map this path through a group of reference stars including Castor and Pollux.

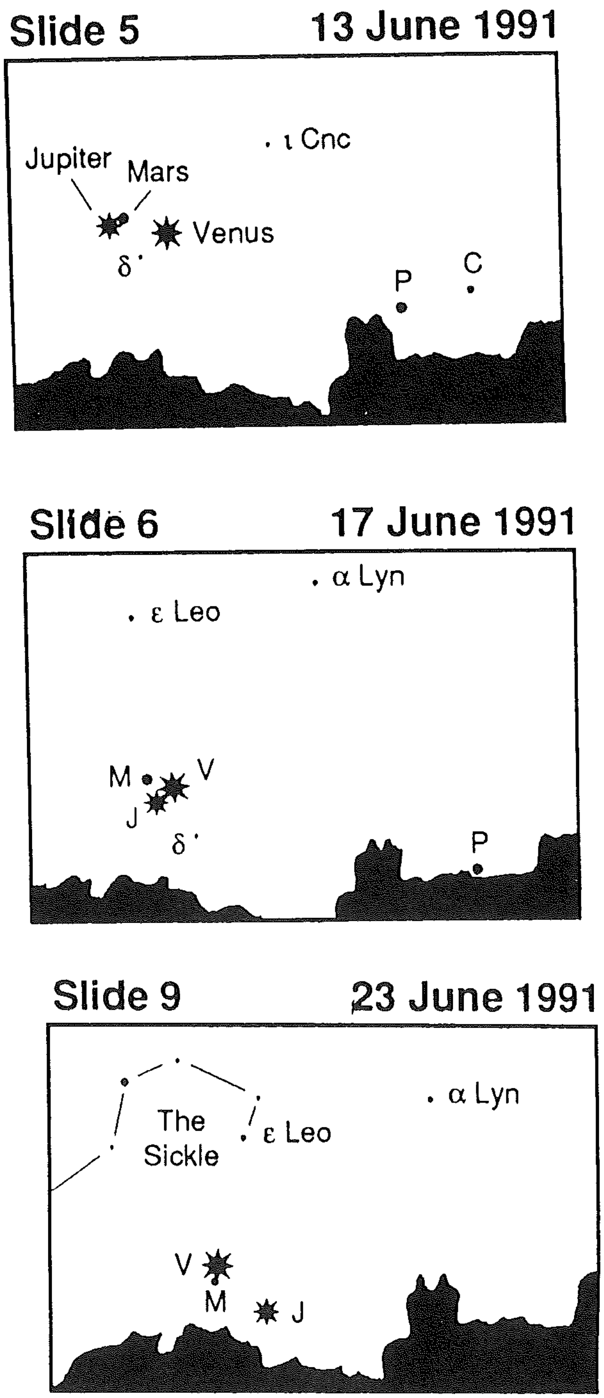
Mars Loop in Gemini 1992-93 comes complete with a teacher's guide outlining the activity procedure and materials needed. A sketch of Mars' loop and reference stars is also included (Figure 1), both in the guide and as a slide. Jenny has added a nice bonus by listing the brightness of Mars for each date and several related questions. This data can lead into a completely different activity based on the brightness of celestial objects.

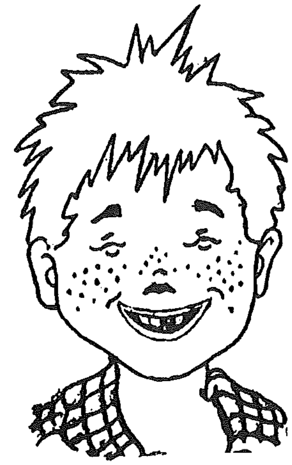
Using another slide set, but similar techniques, Jenny has prepared an activity that illustrates the relative position of planets, *The Rarity of the June 1991 Gathering*. Three planets, Venus, Jupiter and Mars, appeared very close together in the western sky (Figure 2). By mapping their relative positions over time, students experience actual observations that call for an explanation. This is the type of observation that early astronomers used in working out the nature of the Solar System.

Here is a good opportunity to bring a little history of science into your class or integrate history into science. What a great way to introduce the Solar System and planetary orbital motion. Like the Mars slide set, the gathering activity comes with a teacher guide and materials list.

I've used these activities in teacher workshops and with middle school students - they've worked well. It seems to me they can be adopted to a broad range of ages - perhaps as early as grade 5 through college. How the slide sets are used will depend on grade level and the teacher's style of instruction. These low cost astronomy instructional material represent an exceptional value and certainly worthy of your consideration.

Figure 2: Examples of sketches illustrating the positions of Jupiter, Mars and Venus during the period between June 4 and 30, 1991. Mars and Jupiter at their closest position (0.7°) in slide 5, the trio at their most compact gathering in slide 6, and Venus and Mars at their closest position (0.2°) in slide 9.





Do you have to constantly remind your students to keep their safety goggles on? Try this demonstration from Lynn Higgins at ICE '92...

A SIMULATED "ACID-IN-YOUR-EYE" ACCIDENT

Objective: to show students what could happen if they fail to wear their safety goggles in lab.

Materials: 1 or more raw eggs, white only
petri dish
6M or stronger HCl or H_2SO_4 or HNO_3
beral pipette or squeeze bottle
overhead projector

Procedure:

a. A large eye can be drawn on the bottom of the petri disk.
b. Place the egg white in the petri dish on the projector stage. Discuss the similarity of the transparent raw white to the eye's pupil.
c. Place several drops of the acid on the egg white. It will immediately become opaque.
d. Some students might suggest that you "Undo" the damage. (You might ask them if they have ever tried "uncooking" a hard boiled egg!) Try gently rinsing the acid off, neutralizing it with baking soda... It can not be made transparent again.
e. The petri dish can be passed around for the students to see that the protein has become denatured, or "cooked".

ADDENDA:

John Brodemus suggested covering the projector stage with black construction paper with one hole cut into it under the "pupil" of the eye. When the pupil becomes opaque.....
The denaturation is equally dramatic with a strong base such as NaOH.
Even when neutralized, the "cooked" area will continue to enlarge for several hours.
When HNO_3 is used, the white turns brilliant yellow: Looks like a fried yolk.
Concentrated sulfuric acid produces a nauseating purple-black ulcer in the denatured area.

David Lang
High School Technology Teacher
Athena-Weston School District, Oregon
Reprinted from *Technology Focus*, Winter 1989

HANDS-ON EXCITEMENT

A little inventing,
A little engineering,
A lot of excitement, and Hands-on problems solving

You have just discovered a bomb in the bottom of an elevator shaft in a metropolitan sky scraper. You are the only one who can defuse it, however, after defusing the bomb, you must get out quickly or be crushed by the descending elevator. The escape button is on the outside of the elevator shaft; there is no one around to help, so you must create a delayed timing device that will punch the escape button for you at just the right time. The only materials you have to work with are the pieces of junk you can find laying around and your own ingenuity. You succeed, of course, with time to spare.

The inventioneering project just described is called *McGyver Survivor* aptly named after the television series with a hero of the same name (permission was obtained from the producers of the series). The project was designed for middle school students but has been used successfully with students age 12 to adult.

Problem Task

Students in teams of two are challenged to create a delayed timing device which:

1. will push a button (mouse trap) between 15 and 20 seconds after it is activated.
2. must perform at least three different tasks before it pushes the button.
3. must be adjustable so the time delay can be regulated.
4. must operate unassisted once it has been activated.

The device can be as weird and wacky as students would like. Rube Goldberg devices like students see on cartoons are excellent examples to follow.

Materials

Students will need to bring materials from home: old or broken toys, parts of machines, rubber bands, marbles, balls, paper towel tubes, plastic containers and blocks and hoses are just a *few* of the items they should be encouraged to bring.

Tools

Electric drills, hand miter boxes, hot glue guns and various kinds of hand tolls are all that is required to build the *McGyver Survivor.*

Time Needed

It takes approximately 10 class periods for building the device and conduction trial runs.

Project Elements

Inventioneering projects provide an excellent means in which to promote critical thinking, problem solving and scientific investigation. When developing inventioneering projects, there are several elements that should be incorporated.

- The finished product is not as important as the process of making it.
- The problem task should be challenging and allow students to devise their *own* method of solving it.
- Materials used in inventioneering projects should include existing devices and products that can be torn apart and recycled.
- Inventioneering tasks should have many possible solutions.
- The projects should be exciting and enjoyable as well as challenging.
- The projects should encourage students to explore scientific principles and apply them to the problem.
- The projects should be short in duration so they can be integrated into any existing curriculum and run concurrently with other lessons.
- Needless to say, the projects should involve a liberal dose of hands-on learning.

Advantages Format

- We have all seen the wonderfully creative ideas students come up with for projects they want to build; unfortunately many of these ideas are beyond their skill level.
- By recycling existing items like gear assemblies from toys, wheels, broken parts, household utensils and combining them with hot glue and other fast fasteners, students *can* produce functioning prototypes of their invention ideas.
- By building projects that are out of the ordinary and frivolous, students also feel safe in pursuing their ideas without worry of doing it "right." There is no one "right" way of making inventioneering projects.
- Inventioneering projects can be constructed very simply or as complex as the student desires and still accomplish the goal. This allows students of all skill levels to achieve success.
- Inventinoneering projects are readily adaptable to group competition or contests. This appeals to most students and helps generate enthusiasm.
- Inventioneering projects enjoy a high success rate which makes them an excellent nucleus for additional learning activities, discussions and investigations.
- It's an excellent way to involve other departments, staff and community members and final run-offs can be held at school open house events bringing attention to what is happening in technology.
- Instructors as well as students are stimulated by the discovery that takes place during the project construction. Instructors will find themselves wanting to learn more about technology and science.

Developing Essential Skills

Technology is often defined as applying scientific knowledge to solve problems. For a student to be good at problem solving, there are essential skills that need to be developed and exercised. Creative thinking requires improvisation. The thinker needs to imagine unique ways of looking at common objects, of developing uncommon uses for those objects and transforming them in new ways. Flexibility and originality are the essence of creative thinking.

Feinberg, (1988) a former collaborator of television's Mr. Wizard show recounts, During my years with Mr. Wizard, we put together one Rube Goldberg contraption after another to illustrate scientific principles.

Invariably we would use household materials in unorthodox ways. psychologists call this type of creative thinking a release from 'functional fixedness.' You can use items for something other than what they were designed for".

Visual thinking, also called visualization or imagery, is the ability to see an object in your mind's eye. To be good at visual thinking, you must practice making mental pictures of objects and how they work or how they would look from different viewpoints.

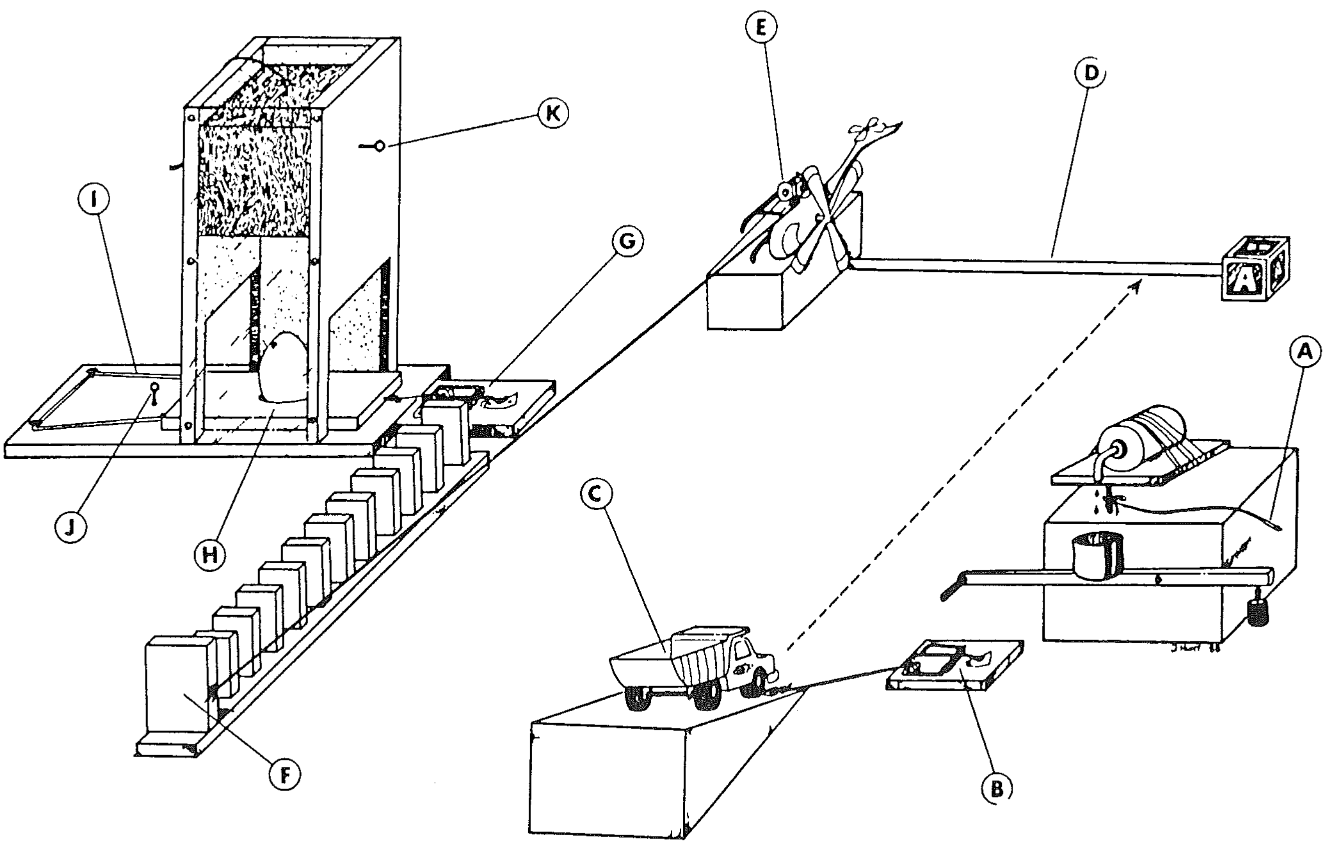
Experimentation is a process of trying out new ideas, planning, assembling, rethinking and reassembling. It's a can-do, let's-try-it-and-see way of thinking.

Humor, insight and creative thinking are closely related. Creative thinking is an insightful process: it involves a switch from an ordinary or conventional way of looking at a situation to one that is better. Humor often involves a similar process of seeing a situation in a new or unusual way. The new way of viewing a situation becomes humorous when it is bizarre, exaggerated, or appears to violate natural laws. Inventioneering projects like the *McGyver Survivor* are exercises in developing all these areas and they do it better than most of the traditional projects we have used in the past.

Conclusion

As technology teachers, we have traditionally used projects to teach basic skills, to reinforce what we teach and to take students beyond basics into creative application. We have students design it, fit it or build it. The project concept has been one of the prime motivators and student attractions in our program for decades. It may need a face lift and a bit of adjusting, but it's a valid approach to teaching new technology. Inventioneering projects, like the *McGyver Survivor* are *one* way we can focus on technology and still retain the project in our programs.

Reference: Reinberg, Henry, TIES ('88) Iss.One, 13-17.



To activate this delayed timing device, yank stick (A) out from under the platform, water dribbles into the cup which slowly depresses the level until it trips the mousetrap (B). The string on the trap yanks the block out from under the wheel of the toy truck (C). Gravity launches the truck down the ramp and across the floor, where it knocks a stick (D) away from the helicopter blade. The winding key (E) on the helicopter serves as a winch which pulls a string hooked to a hinged wooden block (F). The blocks fall domino fashion and trip mouse trap (G). This trap releases a sliding platform (H) on which an egg is sitting (representing you). The platform and egg are pulled to safety by rubber bands (I). Fifteen seconds after yanking the stick at (A), the pin (K) is manually pulled dropping the elevator, If the timing device has not removed the egg (Smashoo).

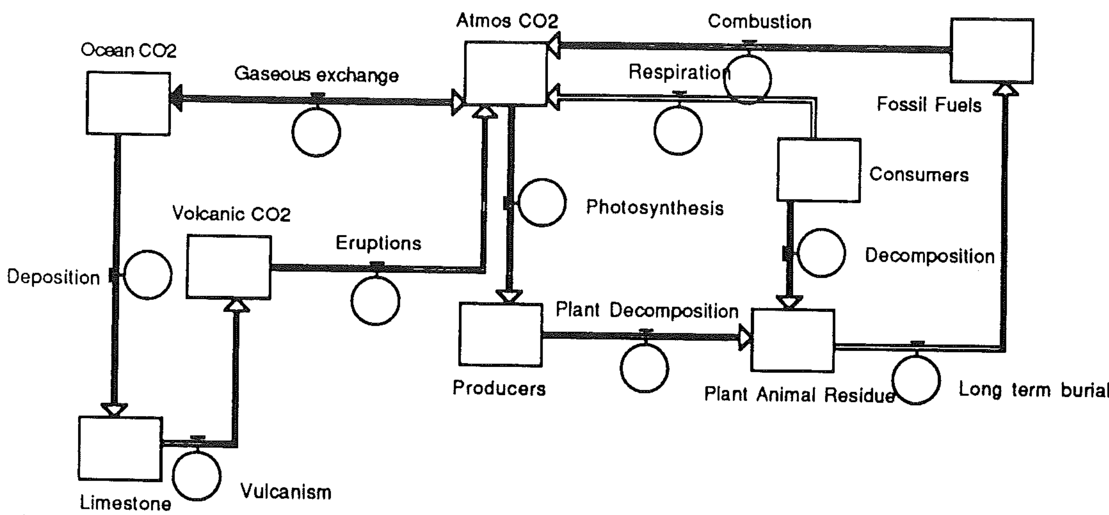
SYSTEMS IS OUR MIDDLE NAME: PART II

Student Activity 3 - Mapping the Flow of Carbon Through the Earth's System

After your students have had some practice in diagraming systems you may want to challenge them to construct a system map of the carbon cycle. They can keep the map from getting too confusing by restricting it to stocks and flows. (In the map below respiration by producers is not included. The amounts of carbon are small. To show them would make an already complex diagram additionally cumbersome.) An alternative to mapping the system is to give the students a copy of the map and ask them to analyze it by describing what happens to the carbon as it goes from stock to stock. Note the double arrow on gaseous exchange.

Information for the student

Physical stocks of carbon: atmosphere ocean fossil fuels limestone volcanoes
Biological stocks of carbon: producers (plants) consumers (animals) plant and animal residues.
The flows - actions that make the system go: combustion, respiration, decomposition, burial, photosynthesis, gaseous exchange, deposition, eruptions, vulcanism



Modeling the Earth's Largest System

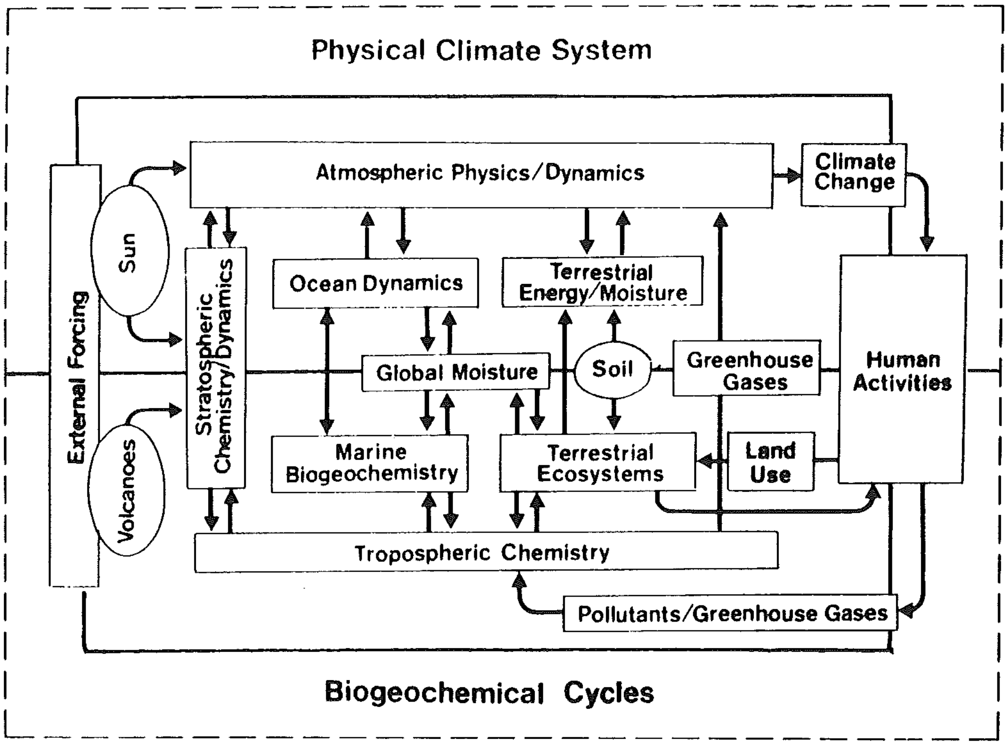
A monumental research project of the International Geosphere-Biosphere Programme is being undertaken by a task force of scientists from 10 different countries. The Global Analysis, Interpretation and Modeling program (GAIM) has its office at the University of New Hampshire in Durham. Its aim is to develop a model of the global biogeochemical system, and to couple it with models of the physical climate system already in use to predict more accurately future global climate changes. The purpose is to develop a model which will provide predictive understanding of the Earth system as a whole.

The diagram at the top of the next page shows the subsystems and the parts that make up the Earth as a system. In the modeling that will be attempted the arrows are to be replaced by mathematical relationships. If the program is successful, super-computer runs will be able to model the whole Earth system.

A glaring omission:Earth as a dead planet

Existing general circulation models (GCMs) of the Earth's physical climate system are modeling the upper portion of the diagram. Great difficulties have been overcome in assembling the relationships that enable computers to model the physical climate system. The predictions that have been produced are the basis for our concern that excessive global warming will take place in the future. However, large areas of uncertainty remain, particularly in the areas of cloud and ocean dynamics. Still, the major hurdles have been cleared and fine tuning of the general circulation models is in progress. But even the best of the GCMs have left out an important part of the Earth's climate system. They have been modeling the physical climate system and treating the Earth as a dead planet.

It is obvious that changing climate has an affect on living organisms. The changes of the seasons is a familiar example. But living things can also effect the global environment. In



the ancient past tiny algae changed the global environment by introducing oxygen into the atmosphere. The introduction of excess carbon dioxide into the atmosphere by modern day human activities is another example. It is widely believed that continued burning of the tropical rain forests will have global climate consequences. The emission of methane from cows and termites may be part of the increased greenhouse effect. The extent of the influence of living things on the global environment is so great that it cannot be ignored.

The GIAM program

This program is attempting to put the life effect into computer models of a changing world. The view of the GIAM task force is that biogeochemical cycles of the Earth can be linked to general circulation models by the global hydrological cycle and variables such as greenhouse gases, land surface properties and Earth's albedo (reflectiveness).

The first phase of the research is focusing on the carbon cycle and its interaction with the nitrogen cycle. The scientific questions that are being asked are: What are the characteristic dynamics and controls on the carbon cycle; how is it being upset; how does it link up with other biogeochemical cycles; what are the links between climate and vegetation?

Analyzing the model

A model as complex as this may have limited use in the classroom. However, it does show the monumental difficulties that scientists face when they start thinking of the Earth as a whole system. Advanced students may gain a better appreciation of the interrelationships that operate in the Earth system.

The major components are shown as boxes in the diagram. They should be thought of as groups of computer subroutines that incorporate detailed knowledge of the relevant processes. The arrows represent the information flow necessary to describe the interactions among the subsystems.

Interested students can report to the class on why a selected component deserves to be included as part of the Earth system. Answering the question of how a particular component is related to the whole can connect the parts of the system together. For example: Why is Land Use a part of this model? (There are many ways that land use, through ecosystem change, can modify tropospheric chemistry and the amount of moisture in the air. One of them is forest removal which will reduce the absorption of carbon dioxide and reduce water vapor in the air.)

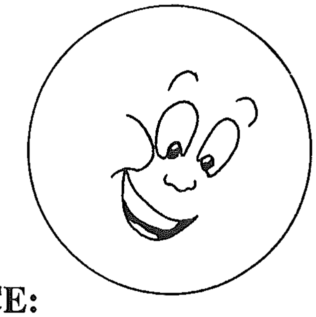
Human activities have been called an unintended experiment with our global future. A successful working global model may help warn us of impending changes to our Earth system before we commit them and give us the opportunity to make intelligent decisions.

Resources

Lees Stuntz, Exec. Dir., Creative Learning Exchange, 1 Keefe Road, Acton MA 01720 Phone (508)287-0070.

The activites in this article were formatted on STELLA II software. For information about STELLA II contact: High Performance Systems, Inc., 45 Lyme Road, Hanover, NH 03755 (603)643-9636

Sierraecology
Newsletter of the Sierra Club's
National Environmental Education Committee
Vol. 12, No. 2
Fall 1994
Pat Suter, Editor



ENVIRONMENTAL JUSTICE: ITS MEANING FOR THE EDUCATIONAL COMMUNITY

Environmental justice has become a watchword in response to the disproportionate impact of environmental degradation on communities of color and working peoples.

Since the inception of the environmental movement, it has become evident that modern industrial society, no matter what benefits are forthcoming, will not find alternatives to harmful production practices without pressure from a highly mobilized people. Corporate America won't be serious about finding alternatives to the way toxic materials are produced and managed as long as there are poor and minority areas to dump on and therefore, limited progress has been made.

Young people are especially vulnerable to the environmental risks imposed on marginalized communities. This makes the school classroom a particularly appropriate place for young people and their educators to learn about and organize for environmental justice.

Classroom Teaching Suggestions

Place cutouts or symbols on a map of your city (or county) to locate such public facilities as landfills, water treatment plants, composting plants, oil storage tanks, parks, generating plants, slaughter houses, hazardous waste and other recycling plants, libraries, feedlots, heavy industry, theatres, manufacturing facilities, hospitals, etc. Then add housing (both single family homes and multiple dwelling units) to the map. Study the completed map and discuss questions such as:

1. In or near which neighborhoods of your community are each of the different facilities found?
2. What are the ethnic and socioeconomic characteristics of residents in each of these different neighborhoods? How does the value of land compare in each location?
3. How is the location of the various facilities determined?
4. What does the term, "environmental justice" mean? Are there examples of environmental *in*justice in your community? If so, is anything being done about it? Is any legislation, local or national, pending to prevent environmental *in*justice?

If there is a current problem concerning the location of a public facility in your community, set up a role playing situation in your class. Assign such roles as county or city commissioner and/or other elected officials, planning department director, business person, neighborhood association representative, local senior citizen, local youngster, local adult, and Sierra Club or other environmental activist.

Also, assign roles as media representatives such as newspaper, radio and television reporters. Conduct a simulated public hearing. If the class comes to any conclusions as a result of this activity, write a letter to the county or city commission or to the editor of the local paper. Students need to be aware of environmental deterioration in their community and be taught ways to express their concern.

Suzy Thacker and Nadine Dickson
Jersey Village High School
7600 Solomon
Houston, TX 77040

TEACHING TIPS: SAFETY & SCIENTIFIC METHOD

At the beginning of a new teaching year before getting to the mean of their subject, high school science teachers are frequently given the task of refreshing and reinforcing previous learned information, anything from metric measurement of how to use a compound microscope.

We have used the following two activities to help our students refresh their memories concerning laboratory safety and scientific inquiry. Since we have used them for many years, we don't remember where they came from; we may have even written them ourselves. In any event, they can be used by any of the various disciplines in science.

ROLE PLAYING SAFETY SITUATIONS

This is a good ice breaker for the beginning of the year. we copy, and laminate these situations so they can be reused the next year. Each of our seven lab tables randomly picked one card and then spends ten minutes to discussing the problem(s) and the solution(s) with their lab partners. We follow this with a group presentation. Each group reads the card to the class and then demonstrates (with the necessary equipment) how the problem could have been solved. This is a good way to get input from the rest of the class as possible solutions are brainstormed.

Situation #1

Rapunzel and Prince Charming were doing a lab experiment that required a hot plate to boil a beaker of water. While leaning over the lab table to whisper sweet nothings in her ear, Charming accidentally pushed his lab notebook up against the hot plate. As you might have guessed, the paper caught file. In all the excitement Rapunzel leaned over and (yes — that's right...) her hair ignited too.

- Determine what you will do to stop this catastrophe and then go get the necessary materials.
- Next, determine how this fiasco could have been prevented.

Situation #2

During the lab one day, Bill and Ted were asked to look at and draw a dog tapeworm from a prepared microscope slide. While carrying the microscope in one hand and the tapeworm slide in the other hand. Bill tripped over Ted's backpack As would be expected, Bill and Ted's $500.00 microscope lay in pieces all over the floor. After carefully hiding the broken microscope in a nearby cabinet, Ted volunteered to get another microscope and find the tapeworm on the slide. He places the slide on the stage and turns the large, coarse adjustment knob to bring the worm into focus. All of a sudden — CRACK!!! — the slide is smashed to pieces by the high powered objective that someone had left in position.

- Identify the errors in technique that caused each of the above mishaps.
- Next, demonstrate how each of these situations could have been avoided.

Situation #3

The Derryberry twins, Mary and Larry, along with their half brother Harry were asked to heat a test tube, full of glucose solution, in a hot water bath. After placing the chemicals in the test tube, Larry placed a cork on the top to mix the contents of the tube. Using her finger, Mary then placed the corked tube in boiling water to wait for a reaction.

- What reaction did Mary, Larry and Harry get?
- Gather the necessary materials for this exercise and demonstrate the proper safe lab technique required for this situation.

Situation #4

During their microbiology uint, while studying common human microorganisms, the Tree sisters (Cherry and Magnolia) were asked to "kiss" a petri dish containing agar (a jello-like substance bacteria like to grow on). Three days later, proud of their results from the culture, the girls opened the petri dish to display the growth on the agar. In addition, they were anxious to show Mom and Dad how hard they had been working, so they tucked the petri dish in a purse and took it home to show the family. The next week, a surprisingly unusual epidemic of strep throat infections swept the community.

- Explain the sudden appearance of the widespread illness.
- How could this have been prevented?
- Gather the necessary materials from the above lab and demonstrate the safe lab procedure necessary for this type of experiment.

Situation #5

Carmine Cool, the handsomest guy in school is your fish dissection lab partner. It would be too embarrassing to wear your geeky glasses to class, so you wear your "Baby Doll" blue contact lenses instead. Half way through the lab your contacts become so hazy from the fumes that you accidentally but Carmine's finger. He is too cool to complain so he casually sucks the blood from his injured finger and continues with the lab.

- Where did you both lose your way?
- Gather the necessary materials and demonstrate the proper lab technique required for this type of situation.

Situation #6

Gertrude and Gerabaldi are feverishly dissecting their pet pig Ham Hocks, when Gertrude squirts preservative into Gerabaldi's eye.

- What should you do?
- Demonstrate the necessary first aid procedure for this situation.
- Describe the proper lab technique for this type of situation.

Situation #7

To your horror, you find that Darlena Dweeb had been assigned as your new lab partner. You and The Dweeb are to consult the MSDS for information on the lab chemicals to be used that day. The chemicals to be used in the lab are phenolphthalein indicator and hydrogen peroxide. Darlena refuses to examine the MSDS and then proceeds to accidentally switch the eye dropper in each bottle after their use. To her horror, she gets an unexpected reaction.

- Describe Darlena's unexpected reaction.
- Explain to Darlena the error of her ways.
- Demonstrate safe lab technique in this particular situation.

WORKSHOPS/FIELD TRIPS

SUMMER CREDIT CLASSES IN MONTANA

Montana Geology

5 credits; 400 level. June 26 through July 1. Tuition $290.

Based out of Anaconda, this class will travel throughout southwestern Montana to visit an array of geological field sites, allowing participants to develop an understanding of the geologic story of the Montana Rockies. Many of the field sites are at roadside locations, and some will be accessed by hiking. Opportunities for collecting of metamorphic, sedimentary, and igneous rocks and minerals will abound. There will be guided tours of an active open pit copper mine in Butte, the Superfund site in Anaconda, and of Lewis and Clark Caverns. There are no prerequisites for this class, and both elementary and secondary teachers are invited. Free lodging is available by contacting the instructor.

Yellowstone Geology

5 credits; 400 level. July 31 through August 5. Tuition $290.

There is, perhaps, no other locality in North America which offers the geologic diversity of Yellowstone National Park. Participants will visit and study numerous geologic sites and will experience Yellowstone in a way not possible for a casual visitor. The class will explore the geology of Yellowstone primarily from hiking trails which penetrate the park's backcountry. Hiking distances will be up to 12 miles round trip, at high elevations, requiring good physical conditioning. Our itinerary will include visits to: the Yellowstone volcanic caldera and its associated geysers and hot springs, Yellowstone's petrified forests, the summit of 11,000 foot Mt. Washburn (an extinct volcano), important fossil fish deposits, and the spectacular Beartooth Mountains. The rock outcrops which the class will visit range in age from 3.2 billion to 600,000 years in age, providing participants the opportunity to develop a clear understanding of the fascinating geologic history of the Yellowstone area. The instructor is an earth science teacher who worked as a park ranger in Yellowstone for 5 years. No prerequisites; both secondary and elementary teachers are invited to participate.

Montana's Missouri River

5 credits; 400 or 500 level. July 5 through 12. Tuition $290.

The setting for this class is the Upper Missouri National Wild and Scenic River, in Montana. The class will use canoes to float 150 miles of the Missouri in 6-7 days, exploring scores of historic sites along the river, and investigating the significance of the river in the settling of the west. The class will study the Lewis & Clark Expedition's experiences on the Missouri, and will visit several of the expedition's campsites. Additional topics will include the river's Indian history, steamboat travel, and homesteading by early settlers. The Missouri flows through spectacular badlands and breaks, exposing the geology of the region for study; the river corridor presents outstanding opportunities for studying the communities of plants, birds, mammals, and aquatic life.This class will involve traveling by canoe through a wilderness area, and canoe camping for several days and nights. Each participant must provide his own equipment and supplies (rental canoes are available locally), and must be physically capable of completing the 150 mile trip. No prerequisites; both secondary and elementary teachers are invited to participate.

Museum of Science and Industry Educational Programs!

Our latest additions to the Museum's "Uncommon Classrooms" are the Learning Labs, programs that provide focused, hands-on experiences for school groups visiting our new permanent exhibits. Geared towards teachers and students in grades 5–8, these labs emphasize peer-to-peer communication, problem-solving, investigation and discovery.

"IMAGING: The Tools of Science" Mystery at the Museum
In a fictitious scenario, five people claim to be the relative of a lucky lottery winner. Unfortunately, the new millionaire is unconscious and unable to identify her kin. Using the latest technology in biomedical and forensic imaging, students must rely on their research skills to weed out the impostors!
Workshops: August 12, 1995, September 16, October 21, December 2, January 6, 1996, February 24.
Time & Place: All workshop are from 9:00am–12:30pm at the Museum of Science and Industry.

"AIDS: The War Within" Fighting the War Within
Help fight the battle against this disease! Your students form teams to investigate and debate the pros and cons of vaccine development, biological research, prevention campaigns and more.
Workshops: August 12, 1995, September 16, October 21, December 2, January 6, 1996, February 24.
Time & Place: All workshops are from 1:30pm–5:00pm at the Museum of Science and Industry.

"Take Flight" Winging to the Rescue & "Navy: Technology at Sea" Operation Sea Search
In **Winging to the Rescue** a natural disaster threatens to destroy the Museum, and your class comes to the rescue! In an effort to transport scientific advisors, students use actual aviation tools and techniques to map flight plans, predict weather patterns and route rescue equipment. During **Operation Sea Search,** students control a surface carrier battle group and deploy teams to locate a mysterious submarine searching for a classified piece of equipment on an unknown island. The submarine's crew knows which island the equipment is on, so the students need to track the submarine toward the island it is headed and dispatch a team of SEALs to recover the equipment before the submarine reaches the island.
Workshops: August 26, 1995, September 30, October 28, December 9, January 20, 1996, March 2.
Time & Place: All workshops are from 9:00am–5:00pm at the Museum of Science and Industry.

All teachers are required to attend a workshop before bringing their students to the Museum's Learning Labs. A Teacher's Guide for pre- and post-visit activities will be distributed at this time. For more information, or to sign up for a workshop, call the Learning Labs Coordinator at (312) 684-1414, Ext. 2440.

WORKSHOP REGISTRATION FORM

Name______________________________

School Name______________________________

School Address______________________________

____

Phone Number______________________________

Grade Level______________________________

Class Size______________________________

Home Address______________________________

____

Phone Number______________________________

1st Choice Workshop______________________________

2nd Choice Workshop______________________________

Please return this form to:
Museum of Science and Industry
Attn: Jill Finney
57th Street and Lake Shore Drive
Chicago, Illinois 60637

AWARDS AND RECOGNITION

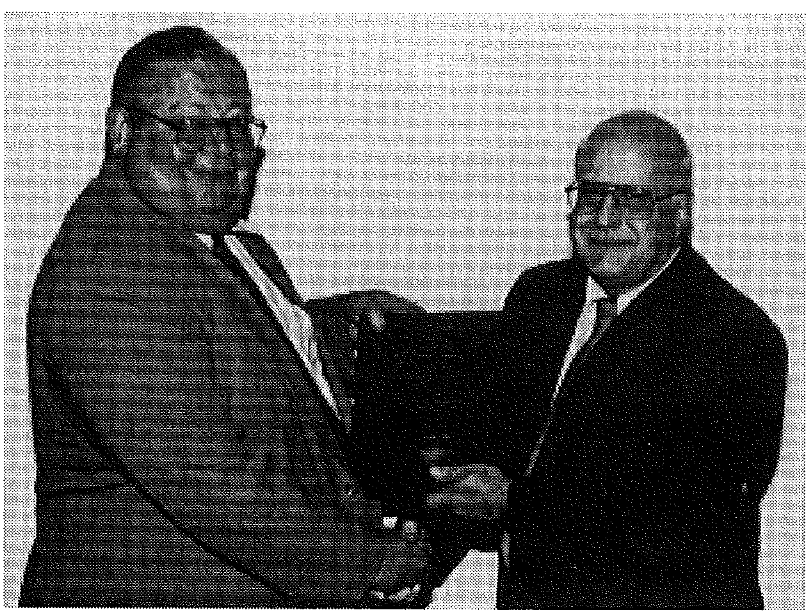
Estes Industries
P.O. Box 227
1295 H Street
Penrose, CO 81240 USA
Contact: Jim Kranich
(719) 372-6565

ESTES MODEL ROCKETRY "TEACHER OF THE YEAR" WILL RECEIVE SCHOLARSHIP TO SPACE CAMP

Are you a teacher who has used Estes Model Rockets to creatively motivate your students in science or math related subjects? If so, nominate yourself or a qualified teacher for the Estes Model Rocketry "Teacher of the Year" award! The winner will spend a week at Space Camp at the U.S. Rocket and Space Center in Huntsville, Alabama.

To nominate a teacher, simply send his or her name, address, home and work phone numbers along with detailed information on how they used Estes rocketry in the classroom during the current academic year to: Teacher of the Year Contest, Estes Industries, 1295 H Street, Penrose, CO 81240. Selection criteria includes ingenuity, originality, depth of study and realistic application. Photos will be helpful in choosing a winner. Also include the following: How the nominee learned about Estes rocketry, the number of years they've taught with Estes rockets, and the number and grade levels of teachers and students.

You or someone you know deserves a shot at this great opportunity to attend the nationally acclaimed Space Camp. Good luck to all!



Longtime ISTA member Fred Zurheide of Southern Illinois University-Edwardsville receiving the Distinguished Service Award of the Illinois Section of the American Association of Physics Teachers for 1994-95 from ISAAPT acting president William Conway of Lake Forest High School. Congratulations, Fred!

Suzanne Asaturian
Carbondale H. S.
Carbondale, IL 62901

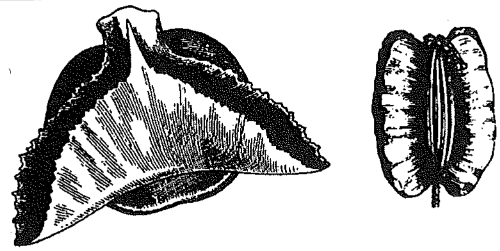
In 1992 my school superintendent nominated me for the NSTA Excellence in Teaching Award. I filled out the nomination packet and turned it in to Gwen Pollock. The selection committee recognized me as one of the top ten Secondary Science Teachers in the State of Illinois for 1993. Gwen invited me, my department chair, and my family to attend an award's banquet held at the ISTA Convention in Belleville, Illinois. This opportunity has strengthened my confidence in applying for grants and other awards, and helped me professionally in numerous ways.

After being elected Region 6 Director for ISTA, I shared with Gwen my appreciation for the award. It took me a few years of reflection to appreciate the benefits of being recognized by peers in Science Teaching. Applying for awards can be time consuming, but forces a personal evaluation of one's growth as a professional. After receiving this award, I began to write lessons to be published, write grants with other teachers, and really get involved professionally in science teaching. The rewards I reap from being active include meeting excellent teachers, learning new ideas and approaches to teaching in general, and sharing my ideas to help other teachers become excited about a certain topic.

Some rewards that you never expect come along after being recognized. I actually got asked to apply for my present position because of the announcement in our local newspaper. I am currently teaching Biology at one of the best high schools in Southern Illinois. Carbondale Community High School received the Red Apple Award from Scholastic Search this year.

I took the position of Region 6 Director so that I could give something back to the excellent teachers of this state. I urge every teacher to apply for awards, grants, and fellowships as often as possible. The rewards are many and the people you meet are so supportive and enthusiastic toward teaching in general and Science specifically.

EDUCATIONAL MATERIALS



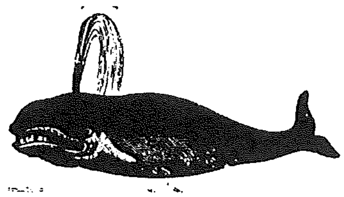
MISSOURI BOTANICAL GARDEN

Membership in the Missouri Botanical Garden includes a subscription to a bi-monthly *Bulletin*; free admission to the Garden, Shaw Arboretum, and Tower Grove House; invitations to special events and receptions; announcements of all lectures and classes; discounts in the Garden Gate Shop and rental fees for Garden facilities; and travel opportunities, domestic and abroad, with other members. Regular membership is $45, a Senior is $40. For membership information, call (314) 577-5108.

Educational services at the Missouri Botanical Garden include teacher training, demonstrations, activities, and lessons using the living exhibits; and special programs upon request. Help your students organize a plant survey research project of a nearby area. They should first select the area—school grounds, backyard, local park, a nature preserve, etc.—and then make a plan map of the area. They should try to identify as many of the plants in that area as they can. Identification can be done to the common name or the scientific name depending upon the age and expertise of your students. Do not encourage collecting of the plants. Collecting should be done only with knowledge of proper plant collecting and curation techniques. Caution the students to minimize disturbance of the natural habitats when they are doing their survey. Invite a local botanist to visit your class and give helpful comments concerning the survey.

Learn cultivation techniques for local native plants. Have your students collect, prepare, and plant seeds of native forbs or grasses. They should be prepared to provide proper care and maintenance of these plants while the seeds germinate and the seedlings grow. Ask the students to keep a log or journal of the growth characteristics of the plants throughout the year.

Encourage students to research the folklore of nature plants they should record the many uses of specific plants throughout the history of humans. They would even do a survey of plant folklore with their parents or other relatives (during a family reunion is a good time) recording plant remedies for health problems.



SAVE AMERICA'S FORESTS

Save America's Forests is "dedicated to improving the political strength of citizen groups, responsible businesses, and concerned individuals in all parts of the U.S. who share the common goals of the Save America's Forests platform, and representing their interests in the U.S. Congress. Member support services include the nationwide *Fax-Action Network*, the quarterly *DC Update*, a *Citizen Action Guide*, and the use of its office are headquarters for members' visits to Washington, D.C. To Save America's Forest's coalition works cooperatively to provide support to all regional forest protection campaigns and to take unified action in Congress to uphold and improve the strength of our nation's federal forest protection laws. "Save America's Forests, 4 Library Court, SE, Washington, D.C. 10003; (202) 544-9219.

A year's membership to Save America's Forests includes a copy of the popular *Citizen Action Guide*, plus newsletters, fax and/or mail Action alerts, and other benefits. Yearly membership levels are $25, $50, $100, and $20 (student). Write or call the Save America's Forests, 4 Library Court, SE, Washington, D.C. 10003; (303) 544-9219.

ANIMAL WELFARE INSTITUTE

Founded in 1951, the Animal Welfare Institute "promotes the welfare of all animals and seeks to reduce the total pain and fear inflicted on animals by man. Major concerns are destruction of elephants, whales and other endangered species, cruel trapping methods, excessive confinement and deprivation of animals raised for food, and mistreatment of animals used for experiments and tests." For information on the organization, or to order any of the following resources, contact the Animal Welfare Institute, P.O. Box 3650, Washington, DC 20007; (202) 337-2332.

Teachers may order a free copy of the *Endangered Species Handbook*, by Greta Nilsson, by sending a request on school letterhead to the Animal Welfare Institute. Additional copies of this resource are $5 each.

Membership in the Animal Welfare Institute costs only $25 for Regular and $5 for Student or Senior Citizen levels. Membership benefits include a year's subscription to *AWI Quarterly*, an invitation to the Albert Schweitzer Award ceremony, single free copy of an AWI book, special information mailings about whales, and the AWI Annual Report.

For a complete listing of all Animal Welfare Institute publications and videos, request a copy of their *Publications and Videos* brochure. Included in the brochure are publications and videos on humane education, trapping, attitudes toward animals, laboratory animals, wildlife, factory farming, and whales. Many of the publications listed are offered free.

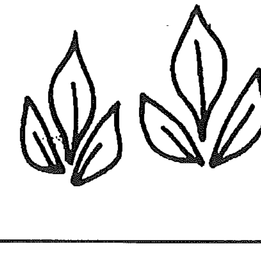
- Reference card that illustrates how plastic bags create less waste than paper bags. Call the Plastic Bag Information Clearinghouse at 800-438-5856.
- 1995 catalog of new and featured books, software, and videos from The College Board Publications, Box 886, New York; NY 10101; 800-323-7155; FAX: (212) 713-8143.
- SETI News, newsletter of the Search for Extraterrestial Intelligence project, which looks for transmissions using radio telescopes. Contact SETI Institute, 2035 Landeings Dr., Mountain View, CA 94043; (415) 961-6633; FAX (415) 961-7099; e-mail phoenix_info@seti-inst.edu (SETI's homepage on the World Wide Web is http://@www.metrolink.com/setl/SETI.html)
- 1995 catalog of educational materials, including science related ones, from Instructional Fair, Inc., PO Box 1650, Grand Rapids, Ml 49501; 800-253-5469; FAX 800543-2690.
- List of thematic units, books, and resource materials for elementary teachers from Learn Abouts, PO Box 661495, Sacramento, CA 95866.
- *Laboratory Safety Guidelines: 40 Steps to a Safer Lab,* available from Laboratory Safety Guidelines, Laboratory Safety Workshop, 101 Oak St., Wellesley, MA 02108; FAX (617) 239-1457.
- Request the *Endangered Issue Pac*—a folder with lesson plans, poster, and endangered species puzzle—from U.S. Department of the Interior, Fish and Wildlife Service, Office of Extension Education, Washington, DC 20240.
- Step-by-step Instruction kit for schools Interested in developing a recycling program. The kit Includes a 60page workbook with guidelines on how schools can qualify for a national achievement certificate and *WASTE WISE,* a booklet from the Aseptic Packaging Council. Write to Debra Roberts, U.S. Conference of Mayors, 1620 Eye St. NW, Dept. L94, Washington, DC 20006.

Looking for a way to reinforce your museum science projects for children? For Ideas for experiments or topics suited for different age groups? Or simply where to find the children's science book you need? Every *Teacher's Science Booklist* includes nearly 900 titles published since 1990. Each listing provides information on the author; physical characteristics of the book: ordering information; and a signed critical review that uses eight factors by which to assess quality. accuracy, currency, author's qualifications, organization and format, illustrative matter, literary qualities and reader appeal, balance and objectivity, and promotion of scientific attitudes and skills. Some fiction books, as they fit into scientific topics, are also listed to support the whole language approach used by many science teachers to break down the barriers between science and reading.

The books also are indexed by age level and organized by 16 different topic areas, from animals and astronomy to plant life and technology. A directory of publishers and a reference guide to recent science teaching resources round out the book.

Order the 182-page book for $18.95 from Michelle Wilson, Museum of Science and Industry, 5700 S. Lake Shore Dr., Chicago, IL 60037 (312) 684-1414, ext. 2476.

The Living Ocean: Biology and Technology of the Marine Environment explores the biology and ecology of the oceans and other aquatic environments and their applications in aquaculture and related technologies. *The Living Ocean* and its companion, *The Fluid Earth.* constitute the Hawaii Marine Science Studies (HMSS) program of the Curriculum Research and Development Group (CRDG). Together, they form a one-year multidisciplinary marine science course for students in grades 9-12. Each book may be used for a one semester course: *The Fluid Earth (t*eachers manual, $90; student textbook, $21.95; workbook masters, $12) in the physical sciences, *The Living Ocean* (teachers manual, $90; student textbook, $21.95; workbook masters, $20) in the biological sciences. The instructional materials are designed to accommodate the full spectrum of students' abilities and interest levels. For more information, call the CRDG dissemination office at 800-7998111.



The following information was excerpted from the April 1995 issue of *NSTA Reports*!

To help teachers navigate the information superhighway, this column contains a brief roundup of our favorite Internet resources. We'll give you the resource address and a brief description, but to avoid any system calamities, we recommend that you ask your network provider for advice on how to connect from your own PC or Mac.

World Wide Web (WWW)

- **Quantum** now has a homepage on the World Wide Web at
http: / / www.nsta.org/ quantum.
- **The Computer Learning as Partner (CLP)** program is an ongoing educational research effort at the University of California at Berkeley dedicated to informing and improving middle school science instruction. CLP research has created and refined a semester-long thermodynamics, light, and sound curriculum for achieving integrated sclence understanding using computers in the classroom. The CLP web site describes these efforts and provides a resource for science teachers, policymakers, and educational researchers. The address is
http://www.clp.berkeley.edu/CLP.html
- France's Ministry of Culture has placed four high-resolution pictures of last month's newly discovered **Combe d'Arc cave paintings** online This may be the only place where you can take a peek at them.
http://www.culture.fr/gvpda.htm
- **"Kid's Page"** has extensive links to volcanoes, puzzles, legos, Barbie, Star Trek, and almost every other imaginable and interesting place for kids on the Web.
http://gagme.wwa.com/~boba/kids.html
- **Spanky Fractal Database** has information about fractals.
http://spanky.triumf.ca/
- **The Paleontological Institute** of the Russian Academy of Science has a homepage at
http://ucmp 1.berkeley.edu/pin.html.
- **Geological Survey Education** has earthquake information and ideas for classroom activities.
http://info.er.usgs.gov/education/index.html
- **Explorer Home Page** has an extensive collection of math and science currlcula. Its address is
http://unite2.tisl.ukans.edu/wwwhome.html
- **Views of the Solar System** are available at the folllowing Web address:
http://www.c3.lanl.gov/~cjhamil/SolarSystem/homepage.html
- Weather maps and satellite images can be found at the following address:
http://www.mit. edu:8001/usa.html

Online Resources

- Precollege students and teachers interested in ethnobotany can Join the **Ethnobotany Monitoring Project,** which will give participants the opportunity to learn about and study plant species from their own traditions and those of other cultures. Participants may be able to contribute new information about useful plants through interviewing people and conducting experiments, At least one participating botanist will be online to regularly review the project, answer questions, and offer suggestions and assistance. Schools interested in the Ethnobotany Monitoring Project should register by notifying Project Coordinator Gabriell DeBear Paye at the following e-mail address:
gpaye@vmsvax.simmons.edu
- **Weather MBP** allows teachers to get current weather information at the following address: http://rs560.cl.msu.edu/ weather/
- **The Telescopes in Education program at Mt. Wllson Observatory** has a Web address.
http://www.mtwilson.edu/
- Check out NASA's **Ames Center** on the Web:
http:// quest.arc.nasa.gov/

MINERAL INFORMATION INSTITUTE

The latest free **teacher packet** from the Mineral Information Institute contains a 48-page Teacher Guide and Student Pages for primary and elementary grades titled *A Study of the Earth: Everything Comes From Our Natural Resources*; 4 posters—"Look Around...Everything is Made From Something," "Elements Comprising the Human Body," "If It Can't Be Grown, It Has to be Mined," and "From the Earth...A Better Life"; and a 16-page *Sources for More Information.* The Teacher Guide is adaptable to your style and the abilities and learning styles of your students; activities are suitable for individual, group, or full-class presentations; there is integration without stretching; and there is easy remediation for kindergarten and first grades and special-needs students. For the free packet, contact Mineral Information Institute, Inc., 475 17th St., Suite 510, Denver, CO 80802; (303) 297-3226.

The Mineral Information Institute has, in addition to their teacher packets, an ever-changing selection of pamphlets, activities, maps, and more from federal and state agencies involved in education; answers to questions; access to classroom speakers; tips on developing mentors for tours; and references to experts and other sources. Contact Mineral Information Institute, Inc., 475 17th St., Suite 510, Denver, CO 80202; (303) 297-3226.

The Institute for Chemical Education (ICE) offers a manual and videotape featuring hands-on tools for the classroom. **ICE DevICEs** contain directions for making 11 devices; each can be constructed in less than an hour for less than $30. Included are a magnetic stirrer, a balance, a mass spectrometer simulator, a chromatography column simulator, two miniature explosion devices, and more. Nearly all the materials needed are readily available at your local Radio Shack or hardware store.

If you are planning an inservice workshop, there are also videotaped Instructions that complement the manual. Your workshop participants (or your students) can follow the video and build instruments in as little as 10 minutes.

Order for $17.50 from ICE, Dept. of Chemistry. University of Wisconsin-Madison, 1101 University Ave., Madison, WI 53706.

What was the connection between early chemistry and magic? Why did alchemists think they could make gold out of lead? In **From Caveman to Chemist,** author Hugh Salzberg follows the development of chemistry from Stone Age ceramics and metallurgy to the achievements of the late 19th century. To order for $14.95 call ACS Publications at 800-227-5558.

Rodents and Rabbits: Current Research Issues, a new publication from the Scientists Center for Animal Welfare (SCAW), focuses on several topics, including requests for changes in U.S. Department of Agriculture regulations, recognizing stress in rodents and rabbits, anesthesia and analgesia for rodents and rabbits, and more. Order for $30 each or $20 each in orders of six or more. For more information, contact SCAW, Golden Triangle Bldg. One, 7833

The Izaak Walton League of America's **Save Our Streams** (SOS) Program recently published A *Citizen's Streambank Restoration Handbook.* The 111-page book teaches citizens about stream ecology, assessing watershed pollution problems, enlisting technical assistance, and designing a stream restoration project.

The book teaches citizens how to plan an effective restoration project that uses vegetation and natural stream forces to improve habitat and water quality and restore aesthetic values. The handbook also includes project budgeting information; case studies of successful SOS restoration projects, and an extensive bibliography. The handbook is available for $15 from Izaak Walton League of America, 707 Conservation Ln., Gaithersburg, MD 20878; 800-BUG-IWLA.

The Committee on Teaching Science of the International Council of Scientific Unions has published *Global Change,* a series of 70 secondary science classroom activities that investigate the physical and human dimensions of global change. Organized around six major topics The Atmosphere; Clues from the Past; Glimpses of the Future; The Carbon Cycle; Remote Sensing; Window on Global Change; Population and Land Use; and Oceans), the activities will supplement a wide range of courses, including chemistry, biology, earth science, physics, and general science.

The materials are based upon the research of International Geosphere-Biosphere Program scientists and have been pilot tested in schools in several different countries. The hole punched, copy master set of Global Change has student activities and teacher notes.

To order, send a check for $40, which includes postage and handling, to Global Change Protect, Dept. of Geography, Western Michigan University, Kalamazoo, MI 40008.

If you are teaching about weather and have a Macintosh computer in your classroom, check out *Blue Skies,* a new interactive program that gives K-12 schools a connection to weather and environmental images and animations. The program allows students to access interactive weather maps, international weather maps, weather animations, satellite data on the hole in _ the ozone, air pollution data, and famous weather events around the globe. *Blue Skies* is offered at no cost for educational pursuits. The program will run only on a color or gray-scale Macintosh computer (not Mac+ or Apple II). Either a direct Internet connection or a 9600 baud modem is needed, Users can then download the software through file transfer protocol or gopher. To get connected, contact The Weather Underground, Dept. of Atmospheric, Oceanic, and Space Sciences, University of Michigan, Ann Arbor, MI 48109; e-mail: blueskies@umich.edu

Where We Live: A Citizen's Guide To Conducting a Community Environmental Inventory is a practical, hands-on workbook to help citizens find information concerning their local environment and to use that information to further environmental goals. The book includes general information on human impact on the environment and instructions for creating a community environmental map. It also guides the reader through various environmental programs and available documentation of community environmental hazards.

The guide contains how-to sections on organizing a community environmental inventory; collecting and mapping information; examining water, air, Superfund, hazardous waste, and other resource issues; and examining a specific facility, wastewater treatment plant, or drinking water plant.

It includes addresses and phone numbers for state environmental and natural resource agencies in 50 states, as well as a listing of chemicals and their effects on humans and the environment. The final section of the book presents a series of exercises to help groups explore methods of approaching various community issues. The 336-page guide is available for $18.95 from Island Press, Box 7, Dept. 2PR, Covelo, CA 95428; 800-828-1302.

Lighthouse Express, a newsletter geared for children ages five to nine, features a picture book in each issue and presents activities focusing on math, science, and design technology that relate to the book. The activities are open-ended, problem-solving based, and cooperative in nature. A year's subscription of eight issues costs $10.50 for individual teachers or $25 for institutions.

Order from Sherron Pfeiffer, 14 Thornapple Dr., Hendersonville, NC 28739; (704) 692-4078.

YES, I WOULD LIKE TO CONTRIBUTE TO THE ISTA SPECTRUM

I have a good idea that I'd like to share!

Name: ______________________________________

School or Business: (name) ______________________________
(address) ______________________________
(city, state, ZIP) ______________________________
(telephone) (____) ___________

Home: (address) ______________________________
(city, state, ZIP) ______________________________
(telephone) (____) ___________

Title of Contribution:______________________________________

I would like may article to appear in:

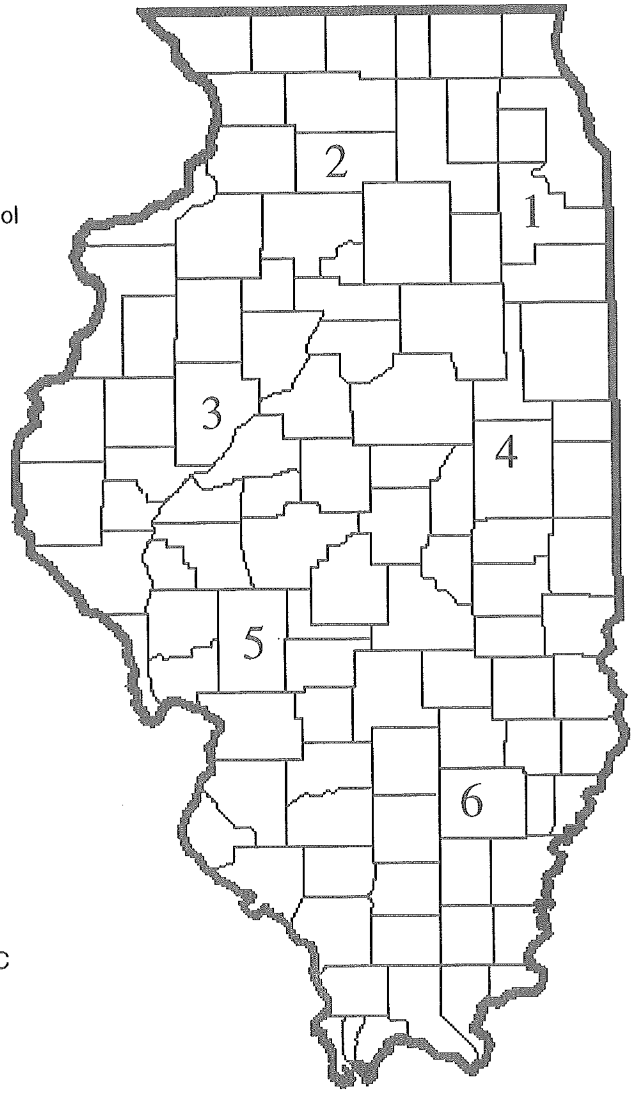
___**ARTICLES**
___**IN FOCUS**
___**SPECIAL INTERESTS**
___**MINI IDEAS**
___**REVIEWS**
___**POTPOURRI**
___**OPPORTUNITIES**
___**MEETINGS**
___**AWARDS/RECOGNITION**
___**FIELDTRIPS/WORKSHOPS**
___**EDUCATIONAL MATERIALS**

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

___**Fall** (due June 1)
___**Winter** (due September 1)
___**Spring** (due December 1)
___**Summer** (due March 1)

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

ISTA REGIONAL DIRECTORS



REGION I
Ann Rubino
c/o Fireworks Educational
Box 2325
Joliet, IL 60434
(815)725-9057
ARubino1@aol.com

Barbara R. Sandall
North Central Regional
Educ. Lab.
1900 Spring Rd.
Oak Brook, IL 60521
(708)571-4700
sandall@ncrel.org

REGION II
Cathy Flannery
LasSalle-Peru H.S.
541 Chartres Street
LaSalle, IL 61301
(815)223-1721
flannery@rs6000.ivcc.edu

Linda Duncan
Pecatonica Comm. Unit School
District #321
1200 Main Street, Box 419
Pecatonica, IL 61063-0419
(815)239-2550
FAX (815)239-2125

REGION III
Don Powers
Science Education Center
Western Illinois University
Macomb, IL 61455
(309)298-1258
FAX (309)298-2222
dpowers@ccmail.wiu.bgu.edu

Karen Zuckerman
Hollis Consolidated Grade
5613 W. Tuscarora Rd.
Peoria, IL 61607
(309)697-1325
FAX (309)697-1334

REGION IV
Keith Hanson
Northridge Middle School
1619 N. Jackson
Danville, IL 61832

Jim Zimmerman
Thomas Paine Elem.
1801 James Cherry Dr.
Urbana, IL 61801
(217)344-3778
jimz@ncsa.uiuc.edu

REGION V
Dean Dittmar
Southern Illinois University
Agriculture Bldg., Office 158C
Carbondale, IL 62901-4414
(618)453-6985
FAX (618)536-7734

Ann Scates
Dept. of C&I
SIU-Edwardsville
Edwardsville, IL 62026
(618)692-3065

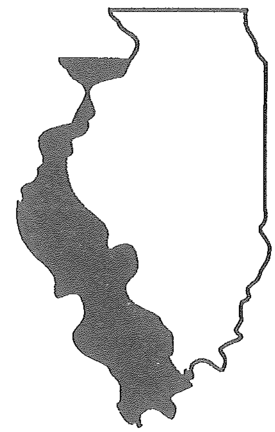
REGION VI
Wes Heyduck
Fairfield H.S.
300 W. King
Fairfield, IL 62837
(618) 842-2649

Suzanne Asaturian
Carbondale Comm. H.S.
200 N. Springer Street
Carbondale, IL 62901
(618) 457-3371
FAX (618)549-1686

Listing of Counties Comprising Each ISTA Region

Region I	McHenry, Lake, Kane, Cook, DuPage, Kendall, Will, Grundy, Kankakee
Region II	Jo Daviess, Stephenson, Winnebago, Boone, Carroll, Ogle, DeKalb, Whiteside, Lee, Rock Island, Henry, Bureau, LaSalle, Putnam, Marshall
Region III	Henderson, Warren, Knox, Stark, Peoria, Hancock, McDonough, Fulton, Tazewell, Schuyler, Mason, Adams, Brown, Cass, Menard, Pike, Scott, Morgan, Sangamon
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
Region VI	Fayette, Effingham, Jasper, Crawford, Marion, Clay, Richland, Lawrence, Wayne, Edwards, Wabash, Jefferson, Franklin, Hamilton, White, Jackson, Williamson, Saline, Gallatin, Union, Johnston, Pope, Madison, Alexander, Pulaski, Massac

ILLINOIS SCIENCE TEACHERS ASSOCIATION
MEMBERSHIP APPLICATION



NAME ____
LAST FIRST

DATE ______________________ REGION (SEE MAP) ________

HOME ADDRESS ______________________________________
STREET APT. NO.

____
CITY STATE ZIPCODE PHONE FAX/EMAIL

EMPLOYER ADDRESS __________________________________
STREET

____
CITY STATE ZIPCODE

(HOME ADDRESS WILL BE USED UNLESS OTHERWISE SPECIFIED)

PROFESSIONAL ASSIGNMENT ELEMENTARY ____ JUNIOR HIGH ____ HIGH SCHOOL ____
COLLEGE ______ OTHER ____

REGULAR MEMBERSHIP **$25.00**
ASSOCIATE MEMBERSHIP (RETIREES AND STUDENTS) **$15.00**

SEND FORM WITH CHECK OR MONEY ORDER TO:

GEORGE ZAHROBSKY
MEMBERSHIP CHAIR
P.O. BOX 2800
GLEN ELLYN, IL 60138

ISTA SPECTRUM
UNIVERSITY OF ILLINOIS
COLLEGE OF EDUCATION
1310 S. SIXTH STREET
CHAMPAIGN, IL 61820

NON-PROFIT ORGANIZATION
U.S. POSTAGE PAID
CHAMPAIGN, IL 61820
PERMIT #75

*****************************3-DIGIT 625
GARY L. BUTLER 320*
420 S. TOWER RD.
DAWSON IL 62520

SUMMER 1995