SPECTRUM

THE JOURNAL OF THE ILLINOIS SCIENCE TEACHERS ASSOCIATION

SUMMER 1994

ILLINOIS SCIENCE TEACHERS ASSOCIATION

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ISTA NEWS

SUMMER PRESIDENT'S LETTER

Dear Science Educators:

Never have I been more encouraged about the future of Science Education in the State of Illinois. There are several efforts underway that will impact our schools in a very positive way. But before I elaborate on these projects let me first express my sincere appreciation to Gwen Pollock for organizing such a warm and friendly reception for ISTA members attending the NSTA convention in Anaheim. It was great to sit and chat with our members in the relaxed atmosphere of sunny Southern California. Remember NSTA is in St. Louis in 1996! Now let me briefly detail the various state initiatives in science education.

• Science Literacy Projects were showcased for state legislators in the rotunda of the capital building. Thanks to Gwen, Lynn Haeffle, and all of the grant sponsors, it was an impressive display of Science, Mathematics, and Technology education.

• The ISTA performance assessment project is being widely disseminated throughout the state. Hundreds of teachers are being given the opportunity to develop their own complex generated assessment instruments for science.For more information about the handbook, contact your local educational service center or give me a call at (618) 692-3065.

• Bob Fisher's committee is currently meeting to review state science teacher certification standards and then make recommendations to the State Board. If you would like input to this important committee, call Bob at ISU and share your thoughts. I know the committee is making plans for an open forum on the topic at the ISTA convention so watch for their announcement.

• Bernie Bradley and Jenny Grogg continue to explore a new vision for ISTA and will lead a discussion of this concept at our summer board meeting. Jenny would like to hear from the membership regarding how ISTA can better serve your professional needs. If you have any comments please give Jenny a call at the ISU Lab school.

• The executive board of ISTA has been meeting with the board of the Illinois Council of Teachers of Mathematics, the directors of the Teacher Enhancement Network, and Members of the Center for Scientific Literacy for the purpose of discussing collaborative efforts between the organizations. A letter was sent to the state superintendent of schools and the chair of the governor's advisory committee on Science and Mathematics Coalition, detailing our interests in becoming involved in the state Science and Mathematics Coalition.

• If you remember from my first presidents letter, I shared with you why ISTA must become an active participant in the decisions that are impacting the science classrooms of Illinois teachers. I still believe this to be a high priority for our association and until a significant number of the organization's members tell me differently I intend to persevere in this.

• Finally, Do not miss next year's convention at Pheasant Run Convention Center. Steve Pieritz and his committee are pulling together the most impressive conference program ISTA has ever offered its members. If at all possible plan on attending the preconference activities on Thursday. This year's focus is on the direction we should be taking in science education goals and outcomes and will feature some of the great science educators of our time.

If any are all of these diverse efforts are of personal interest to you, I encourage you to contact myself or any other ISTA officer and make your feelings known. As you can see ISTA is on the move to improve science education in our state and we need your involvement.

Good Sciencing,

David Winnett

Fun at the ISTA reception in Anaheim. "Big cheese" Winnett is in the back row on the left.

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DID YOU KNOW...

As the new ISBE consultant, I would like to be able to "funnel" information directly to science teachers around the state easily. I think that the SPECTRUM could be an excellent forum for giving you the newsy tidbits I learn at ISBE.

I had been a secondary science teacher for eighteen years before taking my new position at ISBE. I know my experience as a classroom teacher is proving invaluable in the decisions which now face me, here at the Center of Scientific Literacy. I also am thankful for the opportunity of working with the Presidential Awards of Excellence for ISTA so that I have come to know personally some of the best teachers of the state.

I have come to realize that there is so much I need to learn, so much I am learning that I need to share and so much I need to be able to depend on local teachers to help to make decisions every day in this position. I am hoping to use this column as a way to network to the professional science teachers around the state. This could become quite a springboard for wider use of bulletin boards though ISBE or even Internet as they become more and more widely used through the state. Please feel free to contact me a ISBE, N-242, 100 North First Street, Springfield, 62777 or call 217-782-2826. I would like to hear about special projects, events, etc., that I can visit or share on a wider, more statewide scale.

On that note, let me begin some of my newsy notes. Some of these will be asking for your input or your expertise and time, so beware!

1. Probably by the time you read this issue, I will be well into the massive anxiety attacks related to the Science, Technology and Society (STS) Interagency Project set for the last week in June. This project will join the STS teaching strategies with the environmental education expertise of the Department of Conservation, Agriculture, Energy, and Natural Resources and the Environmental Protection Agency, complemented by the School Improvement Process requirements. Fifteen middle school teams of 5 or more teachers were accepted for participation. The details are unrolling to be quite an exciting adventure in learning. There are to be two call-back sessions, one at Cahokia Mounds and another at Lincoln Home National Historic Site, during the 1994-95 school year. I will be writing about our journals of learning in upcoming issues of SPECTRUM. Each of these teams will receive a $2000 planning grant to work on an STS unit using their own community's natural and cultural resources with assistance from the state agencies. The plans are that these schools will be demonstration sites for other schools to share what they have learned. The plans also include extending this project into the high school arena the following year. If all goes well, during the early spring of 1995, brochures will be sent to all high schools for application for the summer 1995 training and 1995-96 training. More information will follow. Call me if you have questions.

2. New information from ISBE—work is beginning on Curriculum Connections. This assignment will produce correlation between the existing fundamental learning goals and knowledge and skill statements to the emerging national standards. The Mathematics and Fine Arts components are on their way now, since the national standards have been released in their learning areas. When the National Science Education Standards are released (summer/fall expectation), then the committee work will begin for the sciences. Let me know of your possible interest or suggestions in this endeavor.

Watch for more exciting opportunities in the SPECTRUM!

Don't Forget!

1994 ISTA Convention

November 3-5, 1994

Pheasant Run Convention Center

Steve Pieritz, Convention Chair

Indian Trail Elementary School

Frankfort, IL 61904

(815)469-6993

ARTICLES

Thomas O. Jewett
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THOMAS JEFFERSON—SCIENTIST

President John F. Kennedy, while entertaining a group of Nobel Laureates, quipped that this was probably the greatest gathering of intellect in the White House since Thomas Jefferson dined there alone. Jefferson, third President of the United States, was probably our most accomplished man in public life as well as the most versatile. Jefferson was considered expert in anatomy, civil engineering, physics, mechanics, meteorology, architecture, and botany. He was able to read and write Greek, Latin, French, Spanish and Italian. He was recognized as a pioneer in paleontology, ethnology, geography, anthropology and botany.

A fine mathematician and astronomer, he could reckon latitude and longitude as well as a sailor. He calculated the eclipse of 1778 with great accuracy and was able to make suggestions for the improvement of almanacs on the equation of time.

During his lifetime, he was an infallible oracle to half the population of the country and a dangerous demagogue to the other half, but was universally recognized as a man of scientific as well as literary attainments. Jefferson was so familiar with every subject discussed by ordinary people and talked so fluently and with such confidence, that he was considered a monument of learning by his fellow Virginians.

There is a story that on one occasion, while stopping at an inn, Jefferson spent an evening with an educated stranger from the North who was so charmed with his conversation and amazed at his learning that he inquired of the innkeeper who his companion might be.

> When he spoke law, I thought he was a lawyer; when he talked about mechanics, I was sure he was an engineer; when he got into medicine, it was evident he was a physician; when he discussed theology, I was convinced he must be a clergyman; when he talked of literature, I made up my mind that I had run against a college professor who knew everything." (Curtis, 1901)

Jefferson's greed for knowledge was insatiable, and he eagerly seized all means of obtaining it. It was his habit in discourse with all classes, the laborer as well as the man of science, to turn the conversation upon that subject with which his companion was best acquainted, whether it was farming, shoemaking, anatomy, astronomy, or fossils. Having drawn all the information his companion possessed, he noted it down in his memorandum book for future reference.

Because of this wide range of knowledge, he was ahead of his time in several lines of inquiry and advanced of contemporary scientists. Even so, Jefferson never failed to acknowledge that in science he was "an amateur."

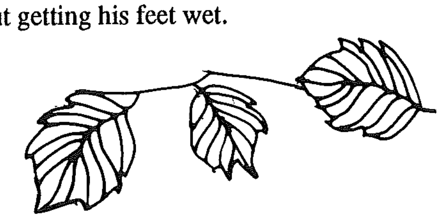
This did not stop him though, from advancing propositions and solutions with equal audacity. He had an opinion on every subject for every comer. Jefferson was not always right in his ideas regarding science, and he wrote on many subjects on which he was not an expert.

> In his own scientific work Jefferson was often inaccurate, impractical, and visionary; as a patron of science he was zealous, industrious, and benevolent. His inquisitive mind sought for the truth in every direction, but his fertile imagination suggested deductions that were sometimes absurd and often fantastic. (Curtis, 1901)

Combine this with the fact that he was without a sense of humor and rarely told a story and seldom enjoyed one, and that witticisms and jokes were wasted on him, one can understand why he believed: There was a large herd of mammoths wandering wild in the Mississippi Valley. That there was a mountain of pure salt eighty miles long and forty miles wide near the mouth of the Yellowstone River. And, that the Creek Indians were descendants of ancient Carthaginians.

Jefferson was always ready to accept new discoveries and adopt new theories, even when they might contradict his own beliefs. In the spirit of the Enlightenment, with its faith in human reason and science, he maintained an open receptive frame of mind to all discoveries and scientific speculation. He believed that science held the key to knowledge of society, and this outlook, combined with his reformist, humanitarian, and utilitarian proclivities, motivated much of his life and thought.

Jefferson visualized science as essential utilitarian. His sight focused upon the benefits that science could provide humanity. His interest in inventions gives a key to his interest in science in general, which was the ultimate practical application of scientific discoveries for the good of man. The idea of ultimate practical application seems to have always been in his mind. He seems never to have followed any line through mere pointless curiosity, but that sometime, somehow, all knowledge would prove to be of some practical value. Monticello, Jefferson's home, is filled with examples of his scientific philosophy. An inventor of great ingenuity, Jefferson's practical innovations include: the swivel chair, the polygraph, letter press, hemp brake, pedometer, mouldboard plow, sulky, folding chair, dumb-waiter, double acting doors, a seven day clock, and a windvane on the eastern portico that enabled him to see which way the wind was blowing without getting his feet wet.



The entry hall at Monticello was made by Jefferson into a museum to display his many scientific interests, including fossils and specimens from the Lewis and Clark Expedition. The scientific results of this expedition, under Jefferson's instructions, were far-reaching. For two years and four months the expedition collected Indian vocabularies, botanical and mineralogical specimens, made topographical maps, sought fossils, charted waterways and observed Indian cultures.

Jefferson's interest in the West was intense. He also commissioned Zebulon Pike's expedition in 1806. The Lewis and Clark and Pike expeditions were the precursors to the United States Geological Survey and stand as one of the outstanding feats of Jefferson's administration.

Throughout his governmental career Jefferson never lost an opportunity to promote scientific inquiry. His strict construction of the Constitution and narrow views upon the subject of states' right never prevented him from using the authority and money of the Federal Government for the advancement of science.

He recommended to Congress a coast survey to accurately chart the coast of America. This project later evolved into the United States Coast and Geodetic Survey. His expert testimony before Congress, also led to the establishment of the Naval Observatory and the Hydrographic Office. Jefferson's report to Congress on a plan for the uniformity of coinage and weights and measures, based on the decimal system, was expanded into the national Bureau of Standards.

As Secretary of State, he was also the head of the Patent Office. He laid the cornerstone of our patent system and patent laws and is considered the father of the patent office. He took pride in this duty and gave personal consideration to every application for a patent that was filed between 1790 and 1793.

Jefferson, an inventor himself, never applied for a patent, which was consistent in his belief in the natural right of all mankind to share useful improvements without restraint:He felt that inventions can not in nature be a subject of property and that the promiscuous granting of patents was not only against the theory of popular government, but would be pernicious in its consequences. (Curtis, 1901) The majority of patent applications during his tenure were rejected. Only 67 were granted, among them a patent to Eli Whitney for the cotton gin.

Jefferson's enthusiasm, especially during his term as President, was a most important factor in bridging before the people the value of science. His interest in paleontology helped to make it a respectable pursuit and he was largely responsible for bringing together the materials for its advancement.

His interest is fossils also brought upon him ridicule by his political opponents who felt his interest in science meant wanton and deliberate neglect of his proper duties and of atheism. William Cullen Bryant penned this poem:

> Go, wretch resign thy presidential chair,
> Disclose thy secret measures, foul and fair,
> Go search with curious eye, for horned frogs,
> Mid the wild Louisianian bogs;
> Or, where the Ohio rolls his turbid stream,
> Dig for huge bones, thy glory and scheme.
> (Clark, 1943)

One of the first glimpses of Jefferson's interest in fossils can be found in his *Notes on the State of Virginia.* It is his most impressive scientific achievement, in which he recorded his observations on flora, fauna, mountains, rivers, climate, population, laws, politics, economics, agriculture, manufacturers, ethics, religion, customs, and Indians of his native state. Had he not gained fame as a statesman, he would still be remembered today as a scientist, if for no other reason than the scientific elements of the *Notes. Notes* was the first comprehensive treatise to be published on any section of the United States. It was the precursor to reports now issued by the government.

Notes grew out of a questionnaire relayed in 1780 to Jefferson from the Marquis de Barbe-Marbois, Secretary of the French Legation in America. The French, having entered the way on the side of America, sought information regarding the geography, climate, people, resources, and customs of their new ally. The request came near the end of Jefferson's rather unsuccessful term as war governor of Virginia. When the request came he seriously considered resigning the governorship to devote himself to the project.

Jefferson had planned *Notes* to be essentially a statistical survey of Virginia; instead, it grew to be a fascinating and enlightening commentary on many aspects of American life and history. In the work Jefferson passes from simple descriptions to scientific explanations and then to a vivid and eloquent literary portrayal of the subject at hand.

In *Notes,* Jefferson sets out to refute the contentions of Count de Buffon that the animals common to both the old world and the new are smaller in the new and have degenerated. Jefferson pursued Buffon's beliefs for many years. Not only were the animals of America attacked by Buffon but also its native inhabitants, whom Buffon considered degenerate, feeble and savage.

Jefferson had a longtime interest in the American Indian. He explored Indian mounds and had compiled an extensive comparative study of Indian vocabularies. Unfortunately, this work was lost. When he left Washington, after his presidential term was over, the study was packed and shipped by boat. The boatmen took it for granted that the ex-President was returning from office with untold wealth, and supposing by the weight of the trunk that it contained silver or gold broke into it. The study was scattered to the winds. His work though, has earned him, by some, the title as one of America's first anthropologists.

In *Notes* Jefferson writes at length on his native state's agriculture. This was not unusual for Jefferson since he felt that America had been designed by the Creator for an agricultural country. He believed that the United States would be populated by educated, yoemen farmers throughout its history. Because of this, agriculture was among his greatest scientific interests, besides his own economy being depended upon the revenues generated by his farms.

Throughout his life Jefferson experimented in agriculture with studies in crop rotation, soil cultivation, animal breeding, pest control, agricultural implements, and improvement of seeds. Jefferson stated: "The greatest service which can be rendered any country is to add an useful plant to its culture" (Bennett, 1944). He imported plants and trees from abroad and tried growing olives, oranges, almonds, and French grapes at Monticello. So eager was he to improve the agriculture of his country that as Minister to France, he even broke the law.

> At that time no one was allowed to send rice seed out of Italy. Falling back on what he terms "the higher law," Jefferson induced a muleteer to run a couple of sacks across the Appenines. Having no faith in the muleteer's honesty, he filled the pockets of his boat and overcoat with the best rice of Italy. The muleteer failed to reappear, but the small store from his pockets reached the president of the Agricultural Society of South Carolina. These were carefully sown and watched and were the origin of our present staple, the best rice in the world. (Curtis, 1901)

As Minister to France, 1784-89, he observed European developments in science, industry, agriculture, and education. An Englishman wrote of him: "he was always on the lookout for new ideas to send home" (Bennett, 1944). While in Europe he endeavored to discover the secrets of the French perfume industry, hoping to import the art to America. He was the first American to report on James Watt's steam engine. He introduced to America the threshing machine. While in Paris he studied balloon ascensions and wrote several papers upon what he called "the aeronautical art," During this time in Europe he kept four colleges in America advised of all new inventions and discoveries.

Jefferson undertook these extra duties because he felt that science was the most certain means of advancing social progress and human happiness, for his goals were essentially humanitarian in science, as they were in all aspects of his life. Science, to Jefferson was an extension, a tool, to help bring about his enlightened political philosophy and a way in which to lead his life. He, personally, saw himself not as Thomas Jefferson_lawyer or farmer or statesman but as Thomas Jefferson—scientist. He wrote upon his retirement: "Nature intended me for the tranquil pursuits of science, by rendering them my supreme delight" (Benson, 1971).

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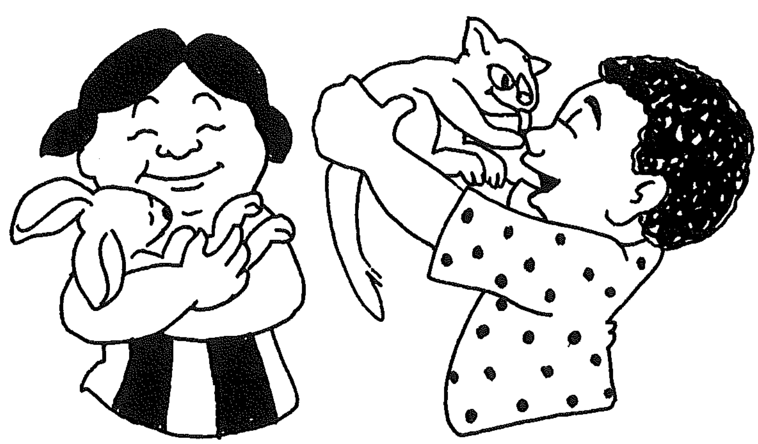
LAKE COUNTY SCIENCE TEACHERS REAP BENEFITS OF ISBE LITERACY GRANT TRAINING AT ESC 2

Lake County teachers from 16 districts and 22 buildings are gaining expertise and confidence in the application of effective teaching practices in science through programs developed and delivered by myself and funded through the Illinois Board of Education Science Literacy Grants. Now in my fourth year as Science Coordinator, I have taken teachers through a rigorous training program that has proved to have a significant impact on teachers' motivation and ability to teach science K-8. Initial programs at Lake County Educational Service Center in Grayslake focused on unit development in all areas of science culminating in the creation of kits and manuals with materials ready for immediate classroom use. Since the early program in 1989-1990, many new and innovative approaches to hands-on kit building have been implemented and favorably received by teachers.



All teachers receive a two-day intensive training reinforcing recommendations for Illinois State Goals 3 and 4 in process procedures. Materials used for training are based on the Edwards Aquifer Program developed in Texas and used by Texas School Systems and a manual I have developed, *How to Hypothesize*. At the completion of the activity-based training, teachers are supplied with grade-specific kits that directly apply to the incorporation of process skills in everyday activities of the K-6 teacher. Included in the grant program is a mentoring component which requires participants to deliver inservice opportunities in process skill methodology in their schools. In second semesters of the grant year, teachers have been involved in the review of numerous science materials from ESC 2's extensive science library. As they focus on a topic they would like to develop and teach, teachers follow like formats in unit development. A concept map defining unit outcomes is created and an overview is written. An interdisciplinary unit lesson plan to be taught in a 15 day period is also written with teachers working in teams of two or three teachers from similar grade levels. State goals are included as part of the plan as well as assessments that are embedded in the instructional pattern. The cooperative, colleagial approach to lesson development has proved to be one of the strong pluses in the program, with teachers expressing appreciation and enjoyment to work with others, sharing ideas, gaining expertise and being allowed the time to do so. With the large and varied number of reference materials available, teachers have an opportunity to become familiar with the best and most current science trade books, journals, manuals, videos and activity books, purchased or donated to the Center. One primary aim is to acquaint teachers with materials for enrichment of a current unit so that when future units are attempted, teachers know where to research any number of topics.

This year's science grant participants will receive a maximum of 11 days training. Of the nearly 90 participants, 48 have developed 23 units over a 4 day period from concept mapping to ordering of materials, itemizing references, lesson planning and manual design. An additional 37 teachers are currently completing more units. Available to teachers are the highly rated Voyage of the Mimi I and II series offered in two training sessions as well as Sciencesleuths with laserdisc. These technology components allow trained teachers to borrow the programs and use them in their classrooms. This summer, a week course in Hypercard for Science Teachers will be offered.

This unique set of learning experiences, available through the ISBE, has been especially valuable to K-6 teachers to give them the needed "pat on the back" as they design and complete a unit from start to finish. All have felt the pride of setting out to complete an overwhelming task and doing it! Congratulations to these teachers for accepting the challenge and for the support of the Grant Program.

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INTERACTIVE MULTIMEDIA FOR USE IN THE PREPARATION OF ELEMENTARY SCHOOL SCIENCE TEACHERS

Introduction

Teacher educators strongly advocate that preservice teachers be exposed and trained to use emerging technologies in order to best qualify them for teacher certification. The more popular elementary science methods texts used in conjunction with methods courses typically devote a chapter describing different technologies like computers, videodiscs, CD Rom, telecommunications, and interactive multimedia. However, whether those technologies are used by instructors in the actual delivery of the methods courses themselves, might be open to question.

At Northern Illinois University a project supported with funding from the Illinois State Board of Education, under the direction of Thomas Thompson, is being developed for use in the elementary teacher education program that will use interactive multimedia technology as an integral part of the elementary science methods course.

It has long been recognized that beginning teachers model themselves after their teacher teachers and professors. The N.I.U. project enables preservice teachers to observe positive role models of exemplary teachers teaching hands-on science to children and to observe professors using interactive multimedia in a college level course. In theory, by exposing preservice teachers to an increase in the number of positive role models of good hands-on science teachers, they in turn will model themselves in a similar manner. Further, if they observe professors using emerging technologies in the act of instruction, they in turn will comfortably use similar forms in technology when they begin teaching. This project is intended to accomplish both goals.

Project Overview

Elementary School Science Instruction: Capturing Excellence is a series of six CAV videodiscs containing images of exemplary teachers engaging a variety of children in hands-on science lessons. Each CAV videodisc contains a twenty minute hands-on science lesson, along with a reservoir of eight to twelve, thirty second episodes that relate to a different topic contained in each disc. The disc titles include: Process Skills I (Basic Skills), Process Skills II (Integrated Skills), Interdisciplinary Science, Methods of Instruction, Classroom Management, and Questioning. Each disc contains four audio tracks: 1) the lesson as it happened, 2) the teacher's reflections, 3) the children's reactions, and 4) a science educator's interpretations. The discs are intended for both Level I and Level III use.

Level I

Level I use is the easiest to implement into a teacher education program. During the introduction of new material, the instructor can quickly access video segments for expressed purposes. Immediately, students can observe an outstanding teacher illustrating the salient points of a lecture. For example, if the topic is classroom management, several different teaching segments can be used to bridge the gap between theory and practice with illustrations of how experienced teachers manage student behavior while conducting science activities. Videodisc technology enables the instructor to instantly select those portions of a science lesson which relate to the topic.

With the added use of the other three audio tracks, the preservice teachers can gain other perspectives of the same science lesson. For example, one can observe children assigned different roles in a classroom where cooperative grouping is employed. This technique is often used to reduce student movement and minimizes possibilities for discipline problems to arise. Typically one student is assigned to collect the necessary materials, a second is designated as a leader, a third may be assigned a doer role, and a fourth may be the recorder. By switching to a different sound track containing the comments of children, the viewer can hear how children view each of the roles. With the click of the remote control, the viewer can next hear the classroom teacher share additional insights into how he/she maintains control of children during high freedom times. Finally, the preservice teacher can listen to the comments of a science educator describe the theory behind the actual practice.

Short video clips can be accessed with the remote control in a span of ten minutes and the preservice teacher may observe three or four different teachers engaging different aged children in a variety of science activities on different topics in both urban and suburban school settings. Furthermore, four different audio perspectives are obtained because of the technology capability associated with videodiscs. Using the remote control enables the instructor to select items with efficiency, yet still providing the flexibility desired that enhances spontaneity for good class discussion. Sometimes video clips are shown followed by the introduction of a new topic. Other times a new topic is introduced, followed immediately with the video clip.

A second Level I use involves the use of barcodes. By reproducing sets of barcodes that correlate with selected chapters found in the methods textbook and giving them to the preservice teacher, they can access brief video segments that illustrate some science education pedagogy. For example, if they happen to be reading about the use of questions and questioning strategies, by scanning some printed barcodes, they can observe an exemplary teacher using a divergent question or demonstrating the results of good wait-time. Once again, the bridge between theory and practice is narrowed dramatically.

Level III

The final phase of this project is currently under development. Plans are underway to develop software for Level III use with preservice teachers. The DOS platform with the software, *Linkway Live*, has been selected as the two elements for making an interactive multimedia program for use by the preservice teachers. Upon completion, the viewer will be able to interact with a series of learning packages combining text with audiovisual images found on the videodiscs. The instructional design of the program will enable the viewer to complete CAI programs on a variety of science education topics. For example, one package will focus on different elements of a lesson plan. Those elements will be contained in the text of the software program. If the student wishes to observe the lesson from start to finish, he/she can click on a button and watch the television monitor. If the student wishes to hear a part of the lesson from a different perspective, he/she can click on the appropriate button and switch to a different sound track. Or, suppose the preservice teacher needs additional help with stating learning objectives? A click of a button will take the viewer on a subroutine on the writing of concept and process objectives. By clicking on another button, the viewer can observe a video clip of a science lesson illustrating a particular objective in action. The gap between theory and practice is narrowed with a real teacher engaging children in an actual science activity.

The interactive multimedia environment will be used in a variety of different contexts. For example, imagine preservice students watching a science lesson while listening to the classroom teacher talk about the rationale behind the lesson. Next, they watch the same segment through the eyes of the children. What inferences could the preservice teacher make about the objectives? Or, how would the preservice teacher assess the students in order to measure the concept and process skill objectives? Additional interactive components could be used to provide both text and visuals to assist the preservice teacher with a variety of instructional aids in learning to be an effective classroom teacher.

Student Feedback

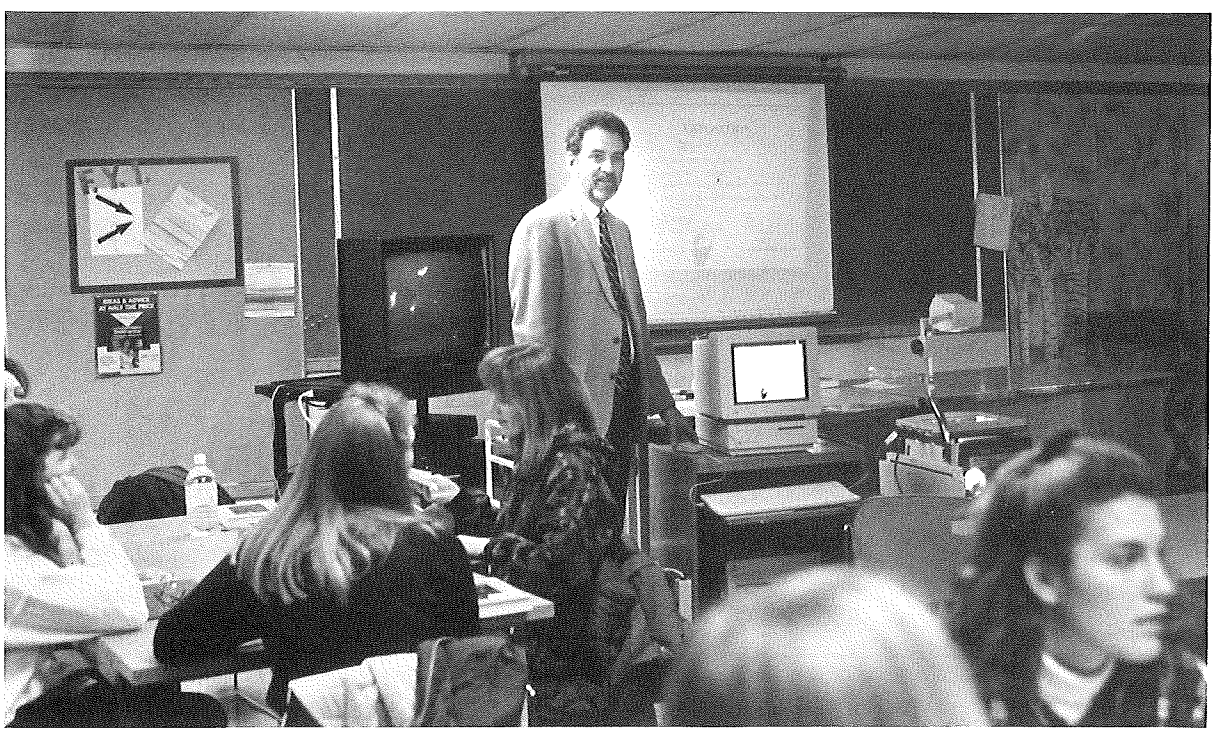
The final production of the first six videodiscs was completed in September, 1993. Since then, the videodiscs have been used on a limited basis, all with Level I instruction. In one instance, portions of the two videodiscs on Process Skills were shown to illustrate teachers engaging children in activities designed to apply selected process skills. In another, students were given a set of barcodes that enabled the viewer to quickly access a brief segments where teachers were asking questions of children during a science activity. The preservice teacher was challenged to identify the types of questions used and to analyze wait-times based upon student responses. To date, the informal comments received from the students have been positive. They find the visual examples to be very helpful by providing good examples of science teaching they can use as models. Students have responded with great enthusiasm when presented with the opportunity of working with the videodisc technology.

Distribution Plan

Multiple copies of the first six videodiscs along with software for Level II use will become available during the 1994 Fall Semester for those state supported universities involved in preservice elementary teacher education programs. Plans are underway to conduct staff development activities for science educators at these institutions.

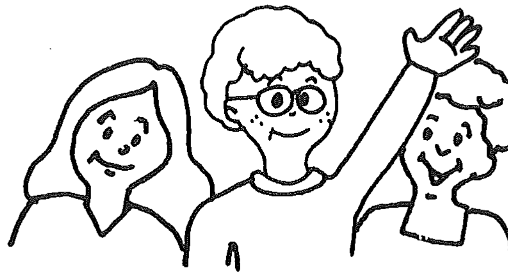
Final Thoughts

The value of placing preservice teachers with veteran classroom teachers who can serve as positive role models for quality elementary school science instruction is widely recognized as one of the single most valuable experiences in a teacher education program.



However, when the need to place 250 preservice teachers a year in contact with those types of elementary school teachers is a limiting factor, an alternative must be made available. The science instruction contained in the videodiscs described in this article may provide a partial solution to providing the kinds of role models necessary for use in a preservice program. They are not intended to substitute for a clinical experience, but to expand the number of role models for beginning teachers.

The teacher education program at Northern Illinois University has made a commitment to integrate the use of emerging technologies into its elementary teacher education program. The commitment extends to both professors and students. The set of eight videodiscs under the title *Elementary School Science Instruction: Capturing Excellence* will provide science educators with an extensive data base of both audio and visual examples of good teaching practices for use in preservice teacher education programs. Science methods instructors, with the use of Level I videodiscs, can be the positive role model needed to demonstrate the importance of using emerging technologies in the act of instruction to our beginning teachers. Formatted for use in an interactive multimedia environment (Level III), preservice teachers will gain easy access to a number of positive role models early in their teacher preparation. By modifying the software, it will be possible to develop an extensive data base of teacher education resources that will enable beginning teachers to view exemplary classroom teachers and learn how they plan, organize, instruct and assess their students. Simultaneously, the viewer will hear different perspectives of the lesson, thus providing added insights into the act of instruction.



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BUILDING PLAYERS: AN INTEGRATED APPROACH TO INSTRUCTION AND ASSESSMENT

During the summer of 1993 our focus became the creation of a first grade curriculum in which the students would become more aware of how their actions will effect our shrinking global environment. Therefore, we developed an integrated curriculum titled Building Players.

We felt it was important to develop a curriculum that would meet state guidelines for integrated outcomes and assessments. The core of the curriculum centered around children's literature books which contain a science theme. The diversity of the units integrated math, reading, social studies, language arts, art, science, health, and careers. The units include:

* Plants, Plants, Plants
* Not One More
* The Beautiful Sea
* Leap Frog
* Not a Drop to Drink
* Digging Up Dinos

From these books the children participated in various hands-on critical thinking activities, conducted and recorded simple experiments, did journal writing, collaborated on gathering research, and analyzed statistics.

The success of the program was dependent on being able to write integrated outcomes that succinctly unite the different subject areas incorporated in the units. An outcome for the unit Plants, Plants, Plants, was: students will conduct an experiment during which they will observe and maintain statistics, and write and graph conclusions. This outcome satisfies the state goals of math 3, 6, and 7; science 3; and language arts 3. By combining the state goals our role in the classroom became one of a facilitator instead of a lecturer. This allowed the students to become more active participants in their learning environment.

To assess the outcome in the unit Plants, Plants, Plants, the students conducted two experiments. The first experiment was to predict, measure, record and analyze the distance colored water would travel up a given celery stem. To meet the criterion of the outcome, the students were to complete the experiment with 80% accuracy. In order to fulfill the requirements of the State math goals, the students measured the distance the colored water had traveled up the celery veins and recorded this data, four times, at 30 minute intervals. This met State math goal 3. For State math goal 2 the students transferred the recorded data to graph form. Analyzing the pattern shown on their graph, the students were able to predict to the nearest inch the fifth measurement. This activity met state math goal 7. By following distinct steps during the experiment, the students recognized that there was a scientific method. This fulfills state science goal 3. At the conclusion of this experiment, the students wrote a short descriptive paragraph of the experiment thus fulfilling state language arts goal 4.

During the second experiment the students were divided into groups. Each group was instructed to deprive their plant of one of the necessary components for optimum plant growth. Over a three week period of time the students measured and charted the growth of a plant. This combination of activities met state math goals 2 and 3. By analyzing the patterns of the charted data, the students were able to predict which plants would reach optimum growth at the end of the three week period and which plants would not. State math goal 7 was met by this activity. The students were able to recognize the scientific method of the experiment, state science goal 3, by following distinct steps during the procedure. Each student then wrote a descriptive paragraph about their own plant and the changes that had occurred during the three week period, thereby meeting state language arts goal 4.

In developing our program, it was necessary for us to encourage the development of scientific literate citizens. Therefore, we deemed it a priority to integrate the curriculum so that the students may see science as a real world approach, not a separate entity. As we continued through the units we found it necessary to be flexible and open to change so that the students would continue to grow and be aware of their participation and importance in the global environment.

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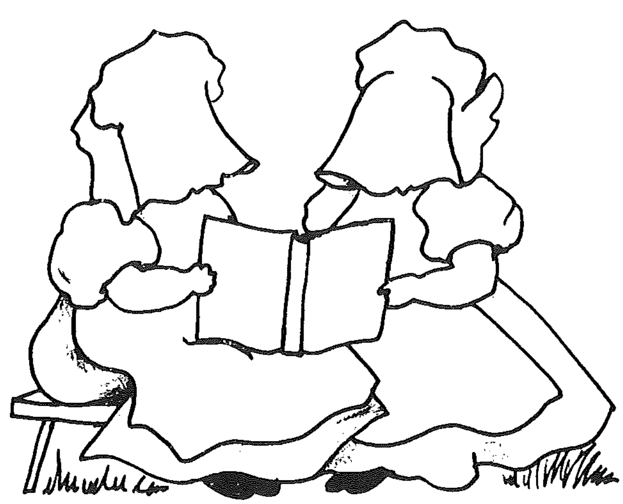

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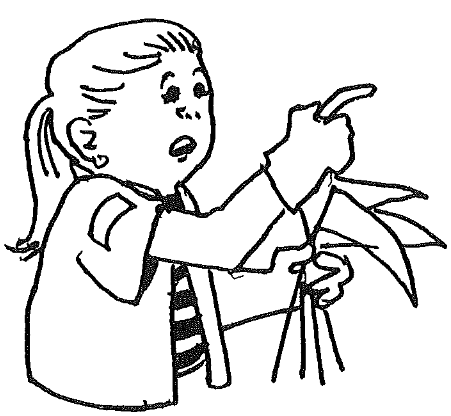
DO WE KNOW THE REAL PROBLEMS IN SCIENCE EDUCATION? ARE CURRENT REFORM EFFORTS AIMED AT THEIR RESOLUTION?

Former President Bush has established a national goal for improving science and mathematics education by the Year 2000. The nation's Governors first proposed such a goal noting the poor showing by U.S. students on international comparisons (Lapointe, Mead & Phillips, 1989). The President and the Governors have proposed three objectives for meeting the broad goal, namely: 1) strengthening the science and mathematics throughout the system with emphasis on the early grades, 2) increasing the number of teachers with substantive backgrounds in mathematics and science, and 3) increasing the number of college/university graduates in science, mathematics, and engineering, especially women and minorities. Such a new national goal sets priorities and provides needed support and direction for educational reform.



As the nation attempts to respond to this new goal for science education improvement, several clarifying questions must be raised. These include:
*What do we mean by "science"?
*What is "achievement" in science? How do we measure it?
*What is meant by "strengthening" science in schools?
*What constitutes a "substantive background"?

Without attention to these questions, the national goal and three objectives may have no meaning. If our leaders mean that U.S. students should perform better in existing courses, taught by standard methods, and evaluated with existing measures, we are ignoring the current indicators of success and the rich research findings that have emerged during the past decade. To debate what every literate American should know at the time of high school graduation and then to proceed with tactics designed to force every graduate to recite such a litany suggests that no learning will have occurred—even though test scores may improve dramatically. To assume that existing "achievement tests" are real indicators of learning would be utterly wrong. Care must be exercised as we discuss the goal, mount energies to meet it, and prepare to measure our successes.

Clear evidence exists that major changes are needed if improvement is to occur. And, the sooner we stop making minor adjustments and instead move to systemic changes, the sooner we will achieve the mark set by the President and the Governors.

Our major problems in science education include:

* Interest in science declines across the K-12 curriculum; the more a student studies science the worse his/her attitude becomes (NAEP, 1978).
* Nearly 85% to 90% of the most successful high school graduates (university physics majors and engineering students) cannot relate the concepts and processes they seem to know to real world situations (Champagne & Klopfer, 1984; Mestre & Lochhead, 1990).
* Creativity skills related to science (e.g., curiosity, questioning, predicting causes and consequences) decline as a result of typical science instruction (NAEP, 1978).
* Few students—even the most successful—can do anything with the science information and skills they master except to illustrate they can repeat them (Mestre & Lochhead, 1990).
* Most teachers (90%) remain wedded to their textbooks. Unfortunately, 75% of U.S. science teachers are satisfied with the existing books and their use (Harms & Yager, 1981).
* The typical high school graduate is not scientifically literate; over 90% do not meet such criteria which includes over half of the students electing college preparatory programs in science (Mestre & Lochhead, 1990; Miller, 1989; Yager & Penick, 1987). Exciting reform efforts (systematic by definition) are underway. These include:
* Project 2061, a gigantic effort sponsored by AAAS with financial support from the Carnegie and Mellon Foundations and the NSF (AAAS, 1988). Six school districts have agreed to undertake a complete overhaul of their K-12 programs utilizing the framework and the research findings of the Project leadership. The emerging modules are not likely to be available much before the year 2000.
* Scope, Sequence, and Coordination (SS&C), a huge project sponsored by the National Science Teachers Association and supported by NSF and DEd funds (Aldridge, 1989). The project began in 1990 with materials being developed and used in five sites including California, Iowa, North Carolina, Puerto Rico, and Texas. Sample materials and initial results are expected in one year—unlike the situation with Project 2061.
* Science/Technology/Society (STS), a reform effort headquartered at Penn State University and supported by two planning and networking projects by NSF (Roy, 1991). Separate consortium members focus on materials development, teacher preparation, teacher strategies, community-industrial partnerships, and special programs for underrepresented groups.

The STS reform is consistent with all 2061 guidelines and the SS&C elements. It has been proclaimed by NSTA to be the framework for needed reform:

> STS is the teaching and learning of science in the context of human experience. It represents an appropriate science education context for all learners. STS requires rethinking, restructuring, reorganizing, rewriting, and revising current materials used to teach science. STS involves learners in experiences and issues directly related to their lives. It empowers students with skills which allow them to become active, responsible citizens by responding to issues which impact their lives. (NSTA, 1990)

The science education community is not as united in purpose as is mathematics. The NCTM standards provide consensus, a sense of direction, and common goals. Nothing similar exists in science, including a definition of what science means for all learners. But NSF has awarded a major grant to the National Academy of Science to develop standards like those by NCTM. It remains to be seen whether this effort involves all the players and receives the reception and acclaim the mathematics standards have. Until this struggle in science is resolved, it may be pointless to consider instruments to use in assessing successes for meeting our important national goal in science education.

Central to current efforts for reforming science education is debate as to the central ingredients of science and the major goals for science in the general education of all people. Some argue that critical thinking is science. Others insist that science is what scientists know. This group might also agree that it is appropriate for all to know something of how scientists know what they know (i.e., the process skills employed by practicing scientists). This basic disagreement about the meaning of science, especially as it is appropriate for all K-12 learners, must be resolved if real reform is to occur.

George Gaylord Simpson has formulated a useful definition for science as we search for appropriate science for all students:

> Science is an exploration of the material universe in order to seek orderly explanations (generalizable knowledge) of objects and events; *but these explanations must be testable.* (Simpson, 1963; Brandwein, 1983)

Simpson's definition emphasizes the importance of personal experiences—i.e., the acts of exploring, explaining, and testing. All of these acts are things that all people can do; they tend to make science approachable for all—i.e., a human enterprise available now—not just after mastering a textbook, what a teacher knows, or a specialized vocabulary. Each step requires personal action, involvement, and thinking. When science is approached in such a dynamic way, students are involved with thinking and have ample opportunities for increasing their skills with thinking. But such an approach to science teaching is not the norm. Many problems are encountered as such changes in teaching are encouraged. Resolution of such controversies is vital as various reforms are suggested.

Simpson's definition, attractive to STS reformers, allows one to start with "science" as opposed to arguing that "it" may not be appropriate for all people. Unfortunately most people tend to view science as special knowledge; they approach it in classrooms as something that must be gone over—and mastered—before personal experience in science can occur. They see STS primarily as "add-on" ideas/dimensions for study.

For many the Constructivist Learning Model provides a framework for defining meaningful science learning and for assessing success (Yager, 1991). Major implications for teacher education and for attracting persons from underrepresented groups to science/technology study and careers emerge with its use (Loucks-Horsley et al., 1990). Basic to the model is the observation that meaning cannot be transmitted even to willing learners. Instead all learning must be constructed by each learner. Typical teaching assumes that standard explanations, concepts, and even specialized skills can be taught directly. Such erroneous assumptions about learning stand in the way of meeting the President's and Governors' goal relative to science education. The sooner we realize the real nature of our problems, the more likely we may be able to meet the goal and the three objectives advanced by our political leaders. This means we need clear understanding of the terms used in the national goal and the three objectives advanced by the President and our Governors.

For reform to occur the involvement, the thinking, and the support of all the stakeholders in science education will be required. There is little cause for optimism if more and more funds are appropriated and awarded (NSF and DEd nationally) to resolve problems not identified. We need actual evidence to use in making improvements that can lead to real reform. We must treat our problems as science (as advanced by Simpson). We must propose possible solutions to our problems and then test such ideas in the real world. We can learn from both our successes and our failures. We can progress in science education just as science has progressed through the ages. Such a time is ours! Can we build a community of leaders who are ready to clarify the problems, who can propose exciting solutions, who can add to our information base?

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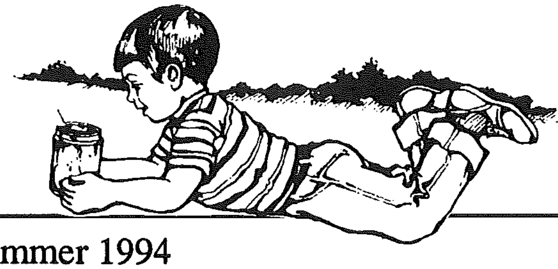

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A TRIP THROUGH THE SOLAR SYSTEM

Elementary and junior high students are fascinated with space and flight. Often times a school curriculum study will find that fractional units of aerospace are being taught at different grade levels. With this in mind, we combined the efforts of an entire school staff and student body into a school-wide unit of study ending in a school-wide aerospace day, which provided an experience beyond our imaginations.

Central Theme

To create consistency for the Aerospace Day from the Pre-Kindergarten through eighth grade it was necessary to have a central theme. The theme chosen was the book titled *The Magic School Bus, Lost in the Solar System* by Joanna Cole. In this book, a unique teacher named Ms. Frizzle uses a magic school bus and takes her class on a field trip to the planetarium. Upon arrival, the class finds the planetarium closed for repairs. Not to worry—Ms. Frizzle's bus launches itself into outer space, allowing the class to learn about the solar system as they visit the planets. Our adventure became very similar to the book with the only difference being our field trip was scheduled to visit Mission Control at NASA.

Grade Level Responsibility

Months prior to the day, each grade level was assigned a planet to research. The result of the research was a creation of a hall or classroom display representing the planet. The display was to include information and clues to describe the heavenly body. The only requirement was that the planet name not be revealed so as to create a mystery contest that was used with the visiting classes on Aerospace Day. In addition to the planet assignment for grades one through five, the pre-kindergarten researched the moon, and the kindergarten researched constellations which were included in the students' mystery game. Upper grade levels attacked much larger projects. For instance, the sixth grade created NASA Mission Control, the seventh grade did a presentation about Saturn, and the eighth grade created a futuristic Mars colony complete with life-sized plastic-bubble housing and lab modules.

In addition to the grade level assignments, the art department took on the responsibility of creating a magic school bus. An actual school bus was used so that the students would be able to ride on the bus. The bus was transformed with tempera paint, cardboard wings, stabilizer, and rocket boosters. Don't be fooled by the word cardboard! The wings and stabilizer were made of double pieces of cardboard connected by hot glue to inner reinforcement strips every six inches. The wings and stabilizer were fourteen feet long and measured four feet at the widest point and tapered down to two feet. These were held to the bus with two by four braces and C-clamps. The three boosters on the back of the bus were four feet long with a diameter of eighteen inches. Students were allowed to paint space scenes on the bus during their art classes, creating a vehicle which looked much like Ms. Frizzle's bus.

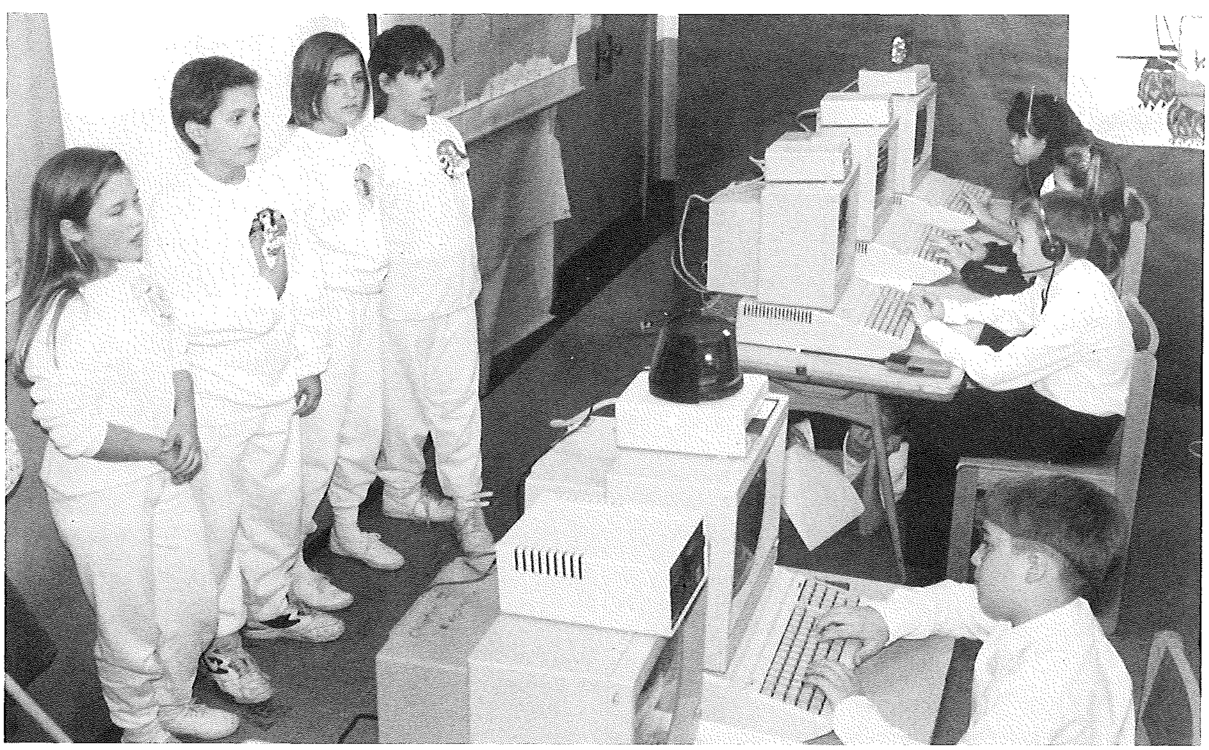
NASA: Mission Control

As a result of weeks of study on flight and the U.S. Space Shuttle program, the sixth grade transformed their science classroom into a NASA Mission Control center. Anything that resembled school was soon replaced with appropriate NASA articles. A portable stage surrounded by walls helped to create a tourist viewing platform. The rest of what was once a classroom consisted of twelve computers staffed by sixth grade students, large maps and a viewing screen which would be used during a presentation for the tourists.

While classes (tour groups) waited to get into mission control, they were able to study the famous astronauts, who were profiled in the hall, the paper mache Gemini capsule and the 9 foot tall Apollo 11 rocket. Upon entrance to Mission Control, the students observed NASA employees busy at work preparing for a shuttle launch. Once everyone was inside, the sixth grade students performed a skit adapted from the NASA booklet "Touch the Future: Link Your Classroom With Space." The skit was designed to explain the four main steps of a shuttle launch, with the end result being a mishap of a bus launching instead of a shuttle. The skit was made complete with slides of a shuttle launch along with sirens and flashing lights which signaled an emergency evacuation of the tourists which must be done immediately. The tourists left NASA and boarded the Magic School Bus to take a ride to the back of the school where they entered the building again to visit their first planet stop, Mars.

Mars Colony

Using materials from a NASA educational center and other sources, the eighth grade class did extensive research to learn about the conditions on Mars. By brainstorming and discussing what it would be like to live on the planet, what needs must be met, and what scientists would be needed to provide these needs, students began to plan a Mars colony. Our thinking was projected to the year 2030. It was decided to use life-size plastic bubble housing. Of course by 2030 a new plastic that could withstand meteor showers would be available! The bubbles were inflated by moving air circulated by a window fan. Three modules were constructed and connected by tunnels. One module was a housing unit complete with light weight lawn furniture. Another module was the laboratory-communications unit containing a narrow table where soil test kits, other experiments, meteorological equipment and a computer were set up. The final module was a greenhouse which housed a lighted grow-cart with various plants that provided food as well as an oxygen-carbon dioxide exchange. Hydroponics tanks were used as part of the display. Although students realized a colony such as this one would certainly include small animals such as chickens, fish etc. to be used as food, it was decided not to include these because they would be frightened by visitors on Aerospace day. The furniture was removed from the room and the walls



Mission Control: Astronauts are explaining their roles in a launch sequence were hidden with navy blue paper to represent night time on Mars. Two paper maché moons were hung, and the floor was covered with orange paper. The housing modules were measured, constructed, inflated, and furnished. After discussing that a gasoline engine would probably not work on Mars because of the small amount of oxygen, a go-cart was covered with foil and fitted with a "solar panel" and placed outside the modules. Students worked in small groups to write a skit for six scientists (pilot, biologist, meteorologist, civil engineer, medical doctor/dietitian, electrical engineer), and two technicians. The skit was the method chosen to give clues for the planet mystery contest on Aerospace day. Students wore paper industrial jumpsuits and motorcycle helmets for space suits. Red filtered spotlights gave an eerie glow to the colony. Sound effects included an air-lock opening and closing and at the climax of the skit an alarm sounded warning of an approaching dust storm. Of course at that time the visiting class must be evacuated immediately so they could be safely on their way to another planet before the storm arrived.

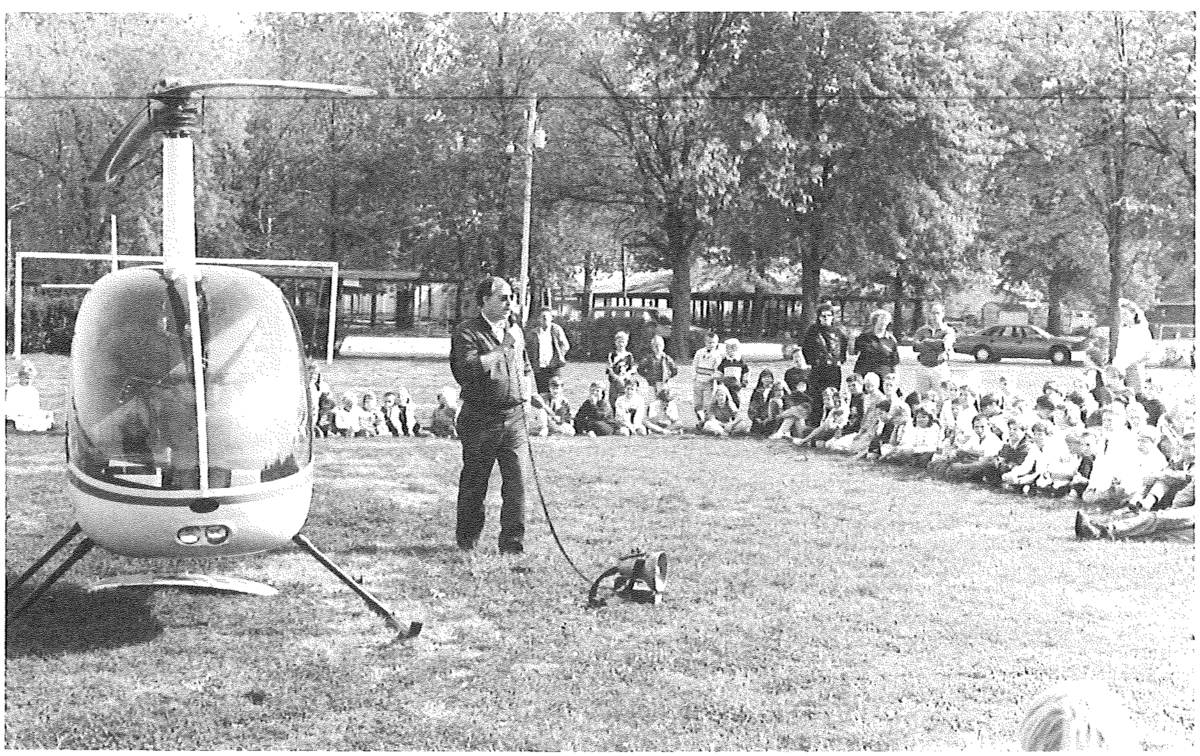
Guest Speakers, Demonstrations and Activities

In order to have a well-rounded day, many resources were tapped. A professional story teller started the day by retelling *The Magic School Bus, Lost in the Solar System*, the tale of Ms. Frizzle and her class's journey through the solar system. Ms. Frizzle herself (alias our principal), made personal appearances throughout the day to guide the students on their journey. This set the mood for the entire day.

Among the invited guest speakers was a hot air balloonist who demonstrated the inflation of a hot air balloon and explained lighter than air flight. A certified NASA representative shared lunar samples and spoke to the students about space exploration. In addition, a helicopter pilot capped off the day by landing his aircraft in the school year and speaking with the students.

Another activity consisted of students walking through a to-scale model of the solar system that stretched from the school through the city park located behind the school. The to-scale model was designed and constructed by the eighth grade math class and included to-scale models of the planets. Hovercrafts (plywood crafts that float on a cushion of air) were borrowed from Southern Illinois University at Edwardsville to provide another class activity. Each student had the opportunity to take a ride on a craft and experience what "weightless" flight feels like. Also, students were allowed to make and sample individual servings of space pudding as well as tasting a space drink.

Finally, the students were treated to demonstrations by their peers. The eighth grade filled an released hot air balloons. These student-made balloons were created from tissue paper and raised by hot air created by a Bunsen burner and piped through a coffee can chimney. Sixth grade students launched model rockets which they had constructed during their science classes.



Helicopter pilot talking with students

The Magic School Bus

Putting It All Together

With grade level planet displays in place, skits rehearsed, guest speakers scheduled and Ms. Frizzle attired, the stage was set for our all-school Aerospace Day. Students were anxious for their adventure to begin. One could feel the excitement in the air!

Classroom teachers were asked to create tailor-made class schedules by signing-up for the day's activities. Everyone was given a ticket to NASA as this was the first stop on their journey. No one knew what lay ahead. Classes were admitted into NASA at fifteen minute intervals. After a NASA "emergency" the classes were evacuated where the magic school bus sat waiting. As they rode the bus, the students were told my Ms. Frizzle that they were journeying through the solar system on their way to neighboring planets.

First stop was Mars. From there they continued to explore the other planets displayed throughout the school. On their exploration, they had to figure out what planet they were visiting from the facts displayed. In this way, teachers could assess learning, as everyone had been studying the solar system.

Parent Involvement

Parents were encouraged to visit during the day. For working parents, the solar system was presented in the evening. Students were allowed to be guides and take their parents to visit NASA Mission Control, the Mars Colony and the other classroom displays. Of course, parents were an invaluable help throughout the day by helping make space pudding, mixing space drink, and running the hover crafts.

Would We Do It Again?

After a few days rest, we most definitely would! Students are still buzzing about their part in the day. Families are watching public-access TV to see the day one more time. Parents and students have sent thank you notes with assurances that the day will not be forgotten.

The old saying that two heads are better than one certainly has proven to be true in this case. Isolated units that were once taught to a small group of students had became part of a unified, all-encompassing presentation of aerospace for an entire school. Combining all the grade level aerospace units made for a memorable, educational experience for 750 students, their parents, and the surrounding community.

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SOME FACTORS AFFECTING STUDENT PERFORMANCE IN PHYSICS

Question: What are some factors affecting student performance in introductory high school and college physics courses?

Physics at any level is thought of as a hard subject. Problems in passing physics in high schools, as an undergraduate or as a graduate student are common. Very often, passing a physics course means mastering the required problem solving techniques and solving problems of the course (Wright & Williams, 1986). One of the more common views of professionals in physics and nonprofessionals is that the mathematics used to solve physics problems makes the physics hard. Recent research, however, has shown that a physics problem is not treated like a math problem. Rather, it is the combination of qualitative aspects of physics problems combined with quantitative aspects of a physics problem and the qualitative aspects are more difficult to learn. The research pointed out that there are both concrete and abstract aspects to a physics problem which create difficulties for the learner (Tobias, 1988). While prior mathematical knowledge is a predictor of performance in introductory college physics, Hudson and Rottman, (1981) suggest that there are other factors in the completion of the course. Hudson and McIntire (1977) have pointed out that their studies show highly motivated students can overcome deficiencies in prerequisite mathematics and successfully complete an introductory college physics course. This conclusion, however, is based on a small sample.

One approach to the prediction of success in solving physics problems, thereby passing the course, is to deal with the cognitive structures of introductory physics students. Chi et al (1981) determined that expert problem solvers in physics had differently organized knowledge bases than novices. It appears that experts tend to sort problems according to the underlying physics principles and novices in contrast attended to the surface characteristics of the problem situations. From this information and other studies, they inferred that the knowledge of an expert is structured differently than novices. The experts possess more complete and adequate problem schemata. Chi et al (1982) contended that a cognitive structure adequate for problem solving is composed of problem schemata. They defined a problem schemata as a "set of elements of knowledge that are closely linked with each other within the knowledge base of the problem solver and that concern of a particular type of problem." (de Jong & Ferguson-Hessler, 1986). De Jong and Ferguson-Hessler (1986) have gone further, however, and maintain that the content of an adequate problem schema in memory is not limited to solution principles. There must be declarative knowledge such as principles, formulae and concepts, but also a problem schema should also contain characteristics of problem situations so that a connection between an actual problem and the problem schema is possible as suggested by Schoenfeld & Hermann (1982). It should also be pointed out that Reif & Heller (1982) have taken another approach and suggest that the knowledge of experts is organized in hierarchical fashion, and this means that their knowledge is arranged on different levels of detail so that the higher levels give abstract and general laws and definitions which are manifested and specified at the lower levels. De Jong and Ferguson-Hessler (1986) tested novice and expert problem solvers and found there is support for the Hypothesis that novice problem solvers have their knowledge organized in a more problem-type centered way than poor problem solvers. Once a student recognizes the relevant characteristics in the description of the problem, the declarative and procedural knowledge needed for the solution become available assuming the student has a basic knowledge of the physics and required mathematics.

A decade ago there was interest in Piagetian techniques which contrasted the abstract and concrete reasoners and techniques for changing the reasoning patterns of students in physics classes in college from concrete to abstract (Dukes & Strauch, 1984). At present, interest in Piaget and abstract and concrete reasoners has declined, but the research remains. There are different developmental levels of cognitive ability among college students in introductory physics as determined by Piaget's measures and in one study, over half the subjects did not appear to be at a formal operational level (Cohen, Hillman & Agne, 1978). Elkind (1962) found that only 58% of 240 college students could conserve volume, an ability Piaget theorizes occurs at the onset of formal operations and McKinnon and Renner (1971) found that about 50% of their sample of college freshmen could be classified as concrete operational, approximately 25% were between formal and concrete levels, while only about 25% were considered to be formal operational thinkers. However, later research showed little correlation between Piagetian level and final course grade, and the best predictor of success in college introductory physics was the SAT mathematics score (Cohen, Hillman & Agne, 1978). Thus, the researchers concluded that restructuring introductory college physics courses to meet Piagetian cognitive criteria was unnecessary.

In another study, it was demonstrated by Pallrand and Seber (1984) that the visual-spatial scores of liberal arts students were lower than those of physics majors, and that the students who dropped the course in physics tested the same on a mathematics skills test as those who successfully completed the course. This was taken to indicate that spatial ability is a factor in physics achievement. Students who withdrew tested lower in spatial ability, and that those who take physics courses, improve visual-spatial ability. The authors also referred to the classic study of Ann Roe (1952) that of the 64 eminent scientists studied, all possessed the ability to conceptualize visually at unusually abstract levels. Also, Siemankowski and

MacKnight (1972) found that science students, especially physics majors, possess more highly developed visualization skills than non-science students, indicating that the spatial visualization factor may be important in success in physics courses.

While the above studies make no distinction in gender, the fact remains that fewer females take physics in high school and in college. This points to a mindset which affects success in physics courses. My personal observations of physics and physical science classes in our high school, indicate that the boys do better than the girls and that the girls seem to avoid the laboratory work—especially in the lower level classes. Sells (1978) found that 57% of entering males of one college class had taken the fourth year of high school math while only 8% of entering females had done the same. Also, Sells reported that the women students especially did not feel they were prepared to take courses in calculus, physics and engineering. Tobias (1985) reported that many women students do not feel they have a mathematical mind and simply avoid courses such as mathematics and physics. Thus, many young women have developed cognitive structures which make them poor physics students since one must have a "mathematical mind" to be successful in physics problem solving. This contention is supported by work done by Ehindro (1986) on a Nigerian physics student population. In the study, it was determined that the interaction of sex-role stereotyped expectations and achievement were significant and that the lower expectations of the female students correlated with lower performance. Howe and Shayer (1981) had findings which further support this conclusion reporting sex-related differences on initial performance in favor of boys ten and 11 years old on a Piaget-related task of volume and density. They also allowed for the girls to interact with appropriate materials and with each other, however the girls did not catch up with the boys. Thus, the cognitive structures women develop in youth may affect expectations which affect performance in physics.

The curriculum and teaching may have an effect on student performance in introductory college physics and on high school physics. Despite the fact that high school students who take physics are generally exceptional as a group, tending to have high grade point averages, to perform well on standardized tests and tend to rank high in mathematical ability (Porter & Czujko, 1986), institutional, cultural and social factors affect a student's decision to take physics in high school. For instance, at Robeson High School in Chicago, simply a neighborhood school which all types of students attend, every student must take four years of science and four years of mathematics which includes physics. While good students generally will do well in most circumstances, when students of different learning styles and background are in high school physics, the teaching or the curriculum can become important in student success.

Many high school students have difficulty learning high school physics and Idar and Ganiel (1985) developed a remedial teaching method consisting of immediate and frequent feedback in a natural classroom setting. This method resulted in significantly higher achievement indicating that teaching method remains a factor in successful problem solving and therefore, success in high school physics. Supporting this research is the work of Halloun and Hesterenes (1987) who contend that the poor performance typical of most students in introductory college physics courses suggest that conventional methods for teaching problem solving are far from optimal. By contrasting the traditional lecture method to the dialectical large diagnostic test gains of low competence students and gains in test performance in the course were found. Minstrell (1984) has shown that the intensive dialectical method has resulted in success in teaching Newtonian mechanics. Wright and Williams (1986) found that a problem solving strategy(WISE) increased student and instructor perceptions of accuracy and promoted organization as well as performance. Although the greatest success of the WISE method was with those who had high math skills, students with low mathematics skills also showed improved performance.

The curricular aspect of a physics course may determine if a student passes or fails. After renewed interest in science courses at all levels due to Sputnik, two new courses were developed for high schools. PSSC Physics was an upgrading of the high school course with a view toward training future scientists and emphasized student observations and conclusions based on experimental evidence. Project Physics was more humanistically oriented and aimed at increasing physics enrollments in high school. PSSC was primarily a laboratory centered course, while Project Physics aimed at people interested in history, languages, music and so on. Later, courses were developed such as the PSI based on individualized instruction Pallrand & Lindenfield (1985).

While the PSSC and Project Physics have had their impact on contemporary high school physics courses, both courses have not succeeded in becoming adopted. In a nationwide survey by the Educational Testing Service, approximately 9% of United States High Schools used PSSC, 30-40% used Project Physics and the conventional course using *Modern Physics* as a text, was adopted by about 54%. Since passing a physics course is a test of problem solving in physics, it should be noted that an ETS survey of 1981 showed that there is no great difference between students who had taken different kinds of courses (Pallrand and Lindenfield, 1985). The basis for this conclusion is the College Board Physics Achievement Tests. The average for students who had taken the PSSC course was consistently higher by a small amount, but it is not certain if the difference was due to the course or to student selection since the PSSC is usually reserved for the better students. A survey taken by the American Institute of Physics found that 25% of those who earned bachelor degrees in 1983-1984, took PSSC physics in high school, and 12% took Project Physics (Pallrand & Lindenfield). Since problem solving in physics is a measure of who will pass a physics course, it appears that the type of course i.e., traditional, PSSC, or Project Physics has little bearing.

In conclusion, factors which may affect success in high school or introductory college physics, typically include cognitive structure such as formation of problem solving schemata. It appears that Piagetian concepts such as concrete and abstract reasoning are not as important as visual-spatial abilities, induced cognitive structures of sex roles, and external factors such as teaching style and, to some degree, curriculum. There is evidence that all are important in passing a physics course as measured by problem solving of physics problems.

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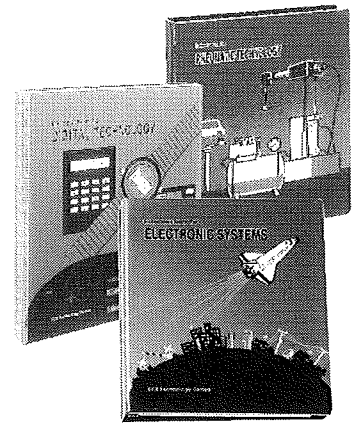

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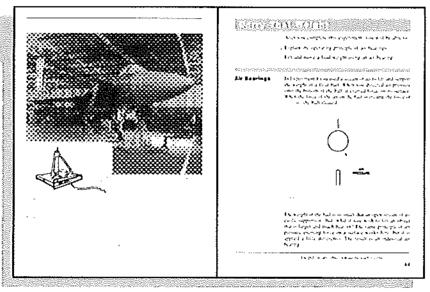

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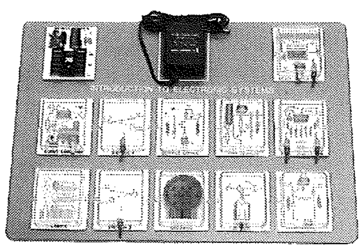

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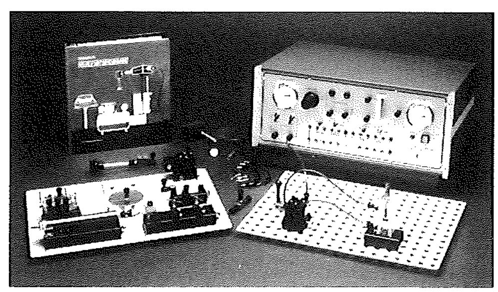

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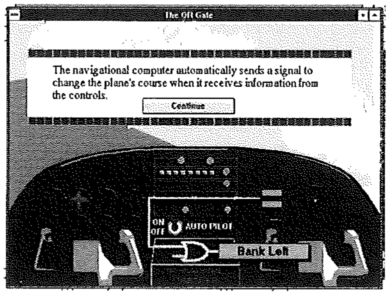

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EVALUATING THE "PROJECTS:" THE STATUS OF ENVIRONMENTAL EDUCATION CURRICULA IN ILLINOIS

For nearly twenty years the "Projects" have been essential sources of environmental education experiences for American school-age students. Project Learning Tree (1976), Project Wild (1983), Project Wild/Aquatics (1987), and CLASS Project (1983) are nationally recognized environmental education curricula that have been widely implemented in both formal and informal educational settings.

While the emphases of the Projects variesfrom trees to wildlife to community involvement in environmental issues, the basic training format for each is similar. Initially, interested individuals such as teachers, naturalists, outdoor educators, or youth leaders are trained to be workshop facilitators. This training usually occurs over several days and requires that the future facilitator become familiar with the philosophy, conceptual and instructional organization of the materials as well as the environmental education activities themselves. Following their training, facilitators are qualified to offer Project workshops to other educators. Typically, these workshops last about five hours and, as a result of their participation, those who attend the workshops receive a free Project manual. The basic premise of these workshops is that the participating educators will use the Project activities to heighten the environmental awareness of their students.

The Projects came to Illinois under the sponsorship of several state agencies and citizen organizations. The Illinois Conservation Education Advisory Board, the Illinois State Board of Education, and the Environmental Education Association of Illinois agreed to adopt Project Learning Tree in 1981 followed by Project Wild in 1984. CLASS Project was initially sponsored by the Illinois Wildlife Federation in cooperation with the Illinois State Board of Education and was first implemented in Illinois in 1985. In 1990, these three programs, along with Project Wild/Aquatics, Illinois Groundwater Curriculum, and Illinois Solid Waste Curriculum, were united under a ISBE Scientific Literacy Grant written and administered by the Environmental Education Association of Illinois. Since that time, EEAI has organized facilitator training workshops and provided stipends for the facilitators. Currently, the Illinois Department of Conservation, the Illinois Department of Energy and Natural Resources, and the EEAI house and supply the various Project manuals.

Since their inception in Illinois, over 10,000 individuals have been trained in at least one of the Projects. As a means of gauging the effectiveness of its training efforts, EEAI has sponsored Project evaluations in each of the past three years (Jacobson, 1993; Nelson, 1991; and Woodhouse, 1992). The three evaluations were conducted in order to gain reactions and feedback from those who have attended or conducted Project workshops. Three different groups were interviewed by telephone for these surveys: workshop participants, facilitators actively conducting workshops, and facilitators who have not recently conducted workshops. During the past three years, nearly three-hundred individuals have been involved with these annual Project evaluations. The 1993 evaluation incorporated the previous two years in order to identify trends that continued throughout the three years.

Facilitators interviewed were qualified to conduct from two to six different workshops including Project Wild, Project Learning Tree, Project Wild/Aquatics, CLASS Project, Groundwater-Illinois's Buried Treasure, and Illinois Solid Waste Curriculum: The Three R's. Facilitators were asked to evaluate their training workshops and their instructors and were asked to offer recommendations for improving Project training workshops. Both workshops and instructors received extremely high ratings. The most common suggestion for improvement was to increase the number of activities highlighted during the facilitator training so that facilitators feel prepared to offer a greater variety of activities to their own workshop participants. Facilitators also wanted their training workshops to provide more information on how to plan and conduct a workshop.

When explaining problems they have faced in attempting to arrange and conduct a workshop, facilitators most often cited a lack of administrative support from the school districts in the area of the proposed workshop. Furthermore, facilitators felt that teachers had difficulty finding the time to attend their Project workshops. Facilitators were enthusiastic about the value of the EEAI-developed guide that correlates the Projects with the Illinois State Goals for Learning. They felt that the guide was useful to teachers in that it allowed them to justify offering environmental education activities in their classrooms, and it also helped to familiarize the teachers with the state goals. The facilitators, however, were not sure whether the teachers were taking advantage of this guide. In addition, the 1993 evaluation asked facilitators if they felt the Projects influenced the teaching behaviors of those who took the workshops. The facilitators were concerned about the lack of structured feedback that could inform them if teachers were making good use of the Project materials in their classrooms.

Facilitators who have not been actively conducting Project workshops explained that time limitations and lack of demand for workshops constrained them from being more active. It is interesting to note that inactive facilitators still wholeheartedly supported the Projects.

A goal of the three Project evaluations was to use facilitator feedback to improve facilitator training workshops. For example, due to the reasons for facilitator inactivity, it was suggested that the EEAI clarify to these facilitators where and when their services would be needed. Based on the uncertainty as to whether the Project workshops actually change teaching behaviors, there is a need to increase the dialogue between facilitators and teacher participants in the months following workshops. Positive feedback from participants would certainly increase the facilitators' sense of effectiveness.

Based on the facilitators' concern about the lack of support from school administrations, it was also recommended that the EEAI get more involved in "winning over" school principals and superintendents. Such efforts might include personal contracts between facilitators and principals or offering "mini-workshops" for principals within a district or area. The most effective means of convincing administrators, of course, is for them to actually see the Projects at work within their own schools.It is believed that additional administrative support would increase the number of teachers who might be released from their teaching responsibilities to attend Project workshops.

Project participants were also asked to evaluate the Project workshops and their workshop facilitators. Like the facilitators, the participants were very positive about both the workshops and the facilitators. Participants were asked which activities they used in their classrooms and how often they used these activities. The participants, like the facilitators, were most likely to use the activities they had been exposed to in the workshops. It was obvious that they felt most comfortable conducting those activities with which they were most familiar. As a result, it would seem that only a small number of the various Project activities are actually being used in the schools. It is important to note, however, that several of the interviewed teachers didreport integrating a wide variety of Project activities into their curricula.

The 1993 evaluation specifically addressed this issue and made several recommendations to increase teachers' repertoires of activities. Lengthening the workshops was seen as unrealistic because both facilitators and teachers could only devote a fixed amount of time to weekend or after-school workshops. However, several other options were suggested. Teachers could invite facilitators into their classrooms to lead a Project activity for students. This practice would introduce teachers to additional activities they could perpetuate in future classes. Teachers might request that specific activities be modeled for them. Additionally, teachers, within a single building or district, could meet to share their experiences with different Project activities. Such collaboration would enhance the environmental education activities of all the participating teachers.

It was also suggested that the relationship between participants, facilitators and the EEAI be continued beyond the workshop to increase the likelihood that the teachers use the Project activities and materials. One option would be periodic follow-up meetings between facilitators and teachers to increase the teachers' involvement with the Projects. This would also provide facilitators with the opportunity to "touch base" with their workshop participants. Follow-up sessions would necessitate additional funds to compensate facilitators for their extra efforts. Another approach might be the development of informal performance contracts to motivate teachers to use or increase their use of Project materials. Teachers would be asked to keep track of the Project activities they do in their classrooms, and EEAI would then recognize those teachers who made this special commitment to environmental education.

While the Projects have been well received by educators in Illinois, it is apparent that much remains to be done. The Project evaluations point out that half of the trained facilitators are actually involved in providing workshops. New approaches for planning, advertising and conducting workshops must be developed especially in areas of the state where few workshops are currently offered. In addition, more must be done to increase post-workshop communication between facilitators and participants. Such communication is crucial if the Projects are to have a lasting influence on environmental education.

All of the Projects are designed to be cross-curricular; however, the facilitators and participants interviewed during the three evaluations perceive the Projects as science related. Facilitators must find ways of emphasizing the value of the Project activities for other subject areas. Finally, Project evaluations indicate that the majority of Project participants are elementary teachers even though all the Projects are designed to have K-12 appeal. More must be done to increase the participation of middle school, junior high and high school teachers in the Projects.

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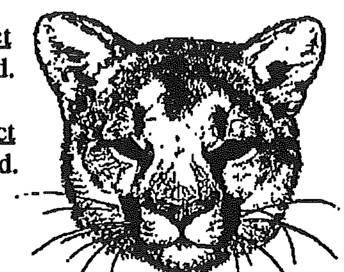

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THE EARTH FAIR: CELEBRATING AND LEARNING ABOUT THE EARTH

Warren High School's Annual Earth Fair was the brainchild of Amber Luczak, former president and founder of Mother Earth's Concerned Students (MECS), our school's environmental group. She envisioned an event which would unite the school and community in activities to celebrate and learn about the earth. The Earth Fair has blossomed into just such an event for our high school club, but it also offers many possibilities for all levels of students, both as a classroom and an extra-curricular activity. I invite science teachers at all levels to adapt the description that follows to their students' needs.

Imagine students shooting baskets to plug the ozone hole, racing to sort recyclables, and playing environmental jeopardy. Imagine displays of earth-friendly products, skits and songs on environmental issues, and a gallery of environmental art and literature. Imagine people playing Sim Earth, typing letters of concern about the environment to legislators, and visiting a library of earth books, magazines and brochures. Imagine vines and stanchions made of six-pack ring chains, trees made of paper towel tubes, and a student-designed, 30' backdrop of the earth. These are just a few of the images one can see every spring at the Annual Earth Fair sponsored by Mother Earth's Concerned Students (MECS) at Warren Township High School in Gurnee.

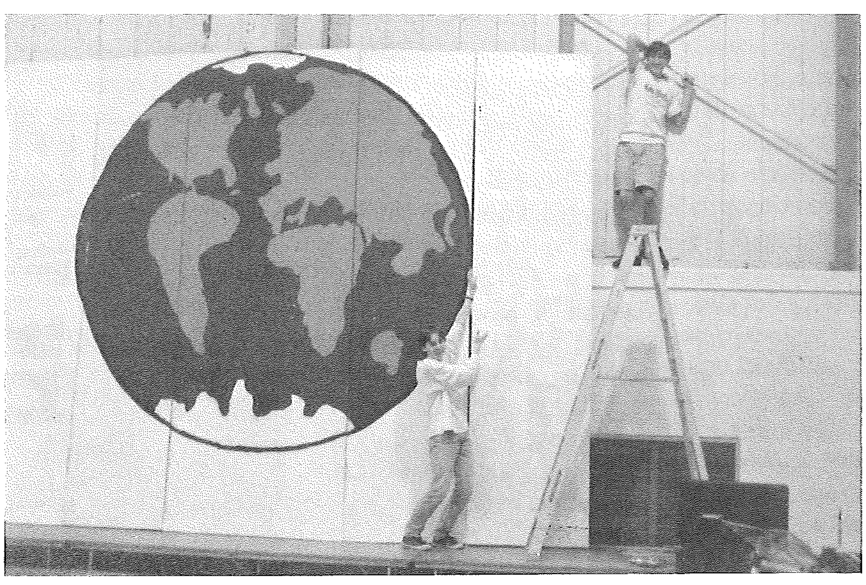
Hosting an Earth Fair brings many benefits to a school, its community, participants of all ages, and to those students involved in organizing the event. The event...

•raises and maintains awareness about environmental issues
•involves a wide cross-section of students from the school and community in "active" celebration of our earth
•provides avid environmentalists with a concrete way to express their deep concern for our planet
•teaches important concepts about the earth

Exhibitors, agencies and community members gain the opportunity...

•to see the school in a favorable light
•to promote their own products in a setting of high visibility
•to have a forum for their causes.

In short, the event offers positive public relations opportunities. Young and old, business and education, children and parents, students and teachers, and a diverse mix of students, clubs and departments within the school—all these can rally behind the common cause of preserving life on our planet.



While the event itself is a glorious day, I suspect the greatest learning occurs for the MECS members who spend six months planning the event.

They learn...

•to use computers—word processing for letters, databases for labels, graphics for posters and fliers, spreadsheets for budgets
•to use the phone correctly when they call area vendors and environmental organizations to solicit participants and donors
•to write proper business letters, trivia questions, news releases, ad copy, memos and thank-you letters
•strategic planning, brainstorming, working in groups
•how a complex institution such as a school or a community is organized
•about the environment

One MECS member showed what the Earth Fair taught her when she wrote in her college entrance essay that the Earth Fair, more than any other experience, had shown her what a great impact a few people could have on a whole community.

We hold our Earth Fair on a Saturday, usually about a week after Earth Day, which frees up many participants who might otherwise be committed to Earth Day events. We use our field house for earth games; our cafeteria for displays, prizes, and concessions; our lecture hall for dramatic and musical performances; and our resource center for letter-writing, computer games, and a library of earth literature. This year we will add a petting zoo outside the field house. We earn most of our funds for the event by recycling cans through our local Coca-Cola distributor, who offers a premium for cans of their product. The remainder of our expenses we earn through donations, a $2.00 admission fee, and a $.05 ticket to play a game. MECS attempts to follow the 4 R's: Reduce, Reuse, Recycle, and Reject. We buy recycled Xerox paper, reuse envelopes, double-side copies, and provide response forms that can be stapled and returned without an envelope. We gather used poster board and use the back side for our posters, and we make chains from the six-pack rings we gather in our cafeteria. These we use to rope off areas and make hanging vines and other decorative items.

MECS begins its work in November by watching videos of the previous year's fair and brainstorming new ideas. The students then form committees that perform the following functions:

CLUBS—Creates a list of school and community groups that might want to participate, invites them to lead an activity which matches what their club does (e.g., the newspaper staff might sponsor a booth where fair-goers make origami from old school newspapers.

GAMES—Researches and brainstorms games that could be adapted to an environmental theme. Creates packets with game descriptions and directions. Creates materials needed for games that other groups might sponsor. Some of the booths we have had at the fair include an environmental sculpture, milk jug bowling with an aluminum foil ball, where in the world is Carmen the Polluter, making recycled paper, a preschool center, R-C car road rally around environmental hazards, face painting, and the chance to wash the face of the earth—tossing wet sponges at faculty perched behind a replica of the earth.

EXHIBITORS—Creates a database of vendors and agencies who might display or donate environmental products. Sends letters, organizes responses, and assists vendors on the day of the fair.

DECORATIONS—Creates decorations from recycled or reusable items to establish environmental themes in hallways between fair areas and makes signs to assist with crowd control.

PRIZES—Finds, purchases and solicits donations of 100's of items for game and donor prizes. Decides how many game tokens each prize requires, displays items and runs the token redemption booth on the day of the fair.

MISCELLANEOUS—A computer committee helps all of us create databases and mail merges and keep track of our files. Two new committees this year are the Petting Zoo and Information Center Committees.

I highly recommend this activity for any school. There are many resources helpful to fair planners; I have included a list of some of my favorites. I advise that you start out small and let it grow gradually—our first year we sponsored only a field trip and a few lunch-time events. I also encourage you to involve students in every way possible to maximize what they learn about taking steady, dedicated action to help the environment, which is exactly what is required if we are going to save our planet.

Have a Happy Earth Fair!

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Environmental Agencies

DEJA, Inc., 927 N. Plum Grove Rd., Suite E, Schaumburg, IL, 60173. Sellers of the DEJA Shoes made of recycled, reused materials.

Earth Care Paper, Inc., P.O. 14140, Madison, WI 53714. Many recyclable products, paper and other. They're moving to California soon.

Energy Foundation, 440 Fairfield Av., Elmhurst, IL, 60126. Information on solar energy.

Forrest Keeling Nursery, Elsberry Missouri, 63343. Great source of baby trees in milk cartons for sale or give-away.

Gaia Theater, 6506 North Maplewood, Chicago, IL 60645. Phone: (312) 761-4233. Professional drama troupe that performs skits on environmental issues.

Global Response, P.O. Box 7490, Boulder, CO 80306-7490. Publishes a newsletter with information and names of people to write about global environmental issues. Both a lower grade and adult version.

Go Promotions, Chris Ortegon, 348 Fair Road, Elmhurst, IL, 60126. A complete line of materials made from recyclable products.

Green Planet: One Planet, One Store, 484 N. Main St., Glen Ellyn, IL, 60137. This stores carries a variety of the most environmentally friendly products, including green cotton T-shirts.

Illinois Recycling Association, 407 S. Dearboarn Street, Suite 1775, Chicago, IL 60605. Phone: 312.939.2985 Fax: 312.939.2536

Image Carpet Mills, 211 S. Ellyn Av, Glen Ellyn, IL 60137. Carpeting made from recycled plastic 3-liter pop containers.

Kauffman, Jack, 1613 Braden, Normal, IL 61761. Phone: (309) 454-7203. Musician and environmental health educator. Does powerful multi-media performances very popular among students.

Laesch Dairy, PO FBox 399, Bloomington, IL 61702-0399. (800) 343-9312. Recyclable plastic milk container program for schools.

PC Recyclers, 650 W. Grand Av., Buite 108, Elmhurst, IL 60126. Recyclers of computers and parts.

Re-Use Envelopes, 218D Street, SE D, Washington, DC 20003. Stickers you can place on used or salvaged envelopes.

Real Goods, 966 Mazzoni St., Ukian, CA, 95482-3471. Catalogue of environmental goods.

Real Recycled, 1541 Adrian Rd., Burlingame, CA, 94010. Recycled paper and other products, etc. Good prices.

SChool Recycling Assistance Program (SCRAP), a not-for-profit team devoted to promoting environmental education and action in DuPage County, Kay McKeen—Coordinator/ Teacher. Publishes Ripples, a rich resource of class activities and recycling/reduction activities. SCRAP also coordinates 2 conferences each year, one for teachers and one for students.

Seventh Generation, Colchester, VT, 05446-1672. Catalogue of earth-friendly products.

Wal-Marts. Local Wal-Marts donate funds to environmental organizations. They also carry many earth friendly products.

SPECIAL INTEREST

Illinois Department of
Energy and Natural Resources
325 West Adams, Room 300
Springfield, IL 62704-1892

PARTNERS IN ENVIRONMENTAL EDUCATION

Beginning with the 1994-95 school year, Illinois schools will have the opportunity to draw upon the resources of the state's business community to aid them in developing an appreciation for the environment among their students. The Illinois Chamber and the Illinois Department of Energy and Natural Resources (ENR) have created Partners in Environmental Education to link schools with companies that offer equipment, internships, training, instructional materials, tours and expertise in natural resource conservation and environmental protection.

In August, schools will receive a PIE directory listing all the services available, along with an order form to be sent to ENR's Information Clearinghouse. The Clearinghouse will forward the school's request to the offering business, which will contact the school to make arrangements to provide the service. The Illinois Chamber is assisting ENR to identify the businesses and the resources they have to offer.

Outdoor classrooms, computer demonstrations, scholarships...Illinois' business community has a wealth of resources available for environmental education.

Some of the pieces of the PIE include:

•Illinois Power has outdoor classrooms on its property where students are learning to create prairies and protect wetlands. More than 30,000 students have seen hawks and falcons flying through their classrooms in a program sponsored by IP.

•LONZA Mapleton, a chemical manufacturer near Peoria, has an Adopt-A-School program with the Illini Bluffs School District to encourage interest in chemistry.

•Abbott Laboratories underwrote the cost of biodegradable plastic bags used in the IL Dept. of Conservation's Kids for Conservation program.

•Kraft General Foods Environmental Institute supported the preparation of the "Solid Thinking About Solid Waste" curriculum for grades 6 through 9.

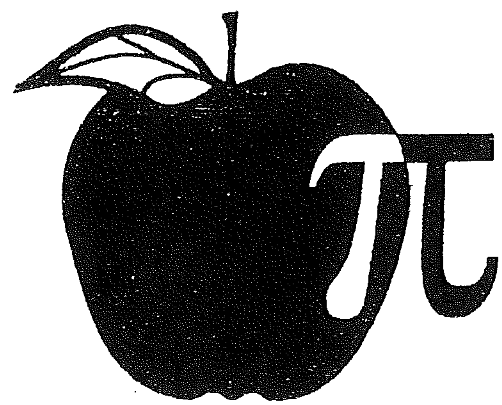
To receive your Partners in Environmental Education Directory at no charge call the ENR Information Clearinghouse at (800)252-8955. For TDD customers, call (800)526-0844 (Illinois Relay Center).

The Directory will be mailed in early August. Please help us spread the word. You may copy this announcement and distribute it to others who may be interested in becoming a Partner in Environmental Education. For more information, contact Carol McArthur, (217)785-0310, at the Illinois Department of Energy and Natural Resources.

FUND-RAISERS

Buy a Leaf

Students from Ashland, Illinois, refuse to *"leaf"* it up to someone else to take action. They have been selling scrap paper leaves for 25 cents each to any willing "hall walker." Students created a tree made from paper bags and "planted" it in the hall. The fifth grade students sell leaves, on which they write the leaf purchaser's name and tape it to the tree. After only two weeks into the project, they had already made \$20. Their goal is \$100 by spring, in order to purchase a tree and wildflowers for a school landscaping project. (Pat Sullivan, Recycling Director for Cass, Brown, Morgan, Schuyler and Scott County Schools, *Recycling News*)



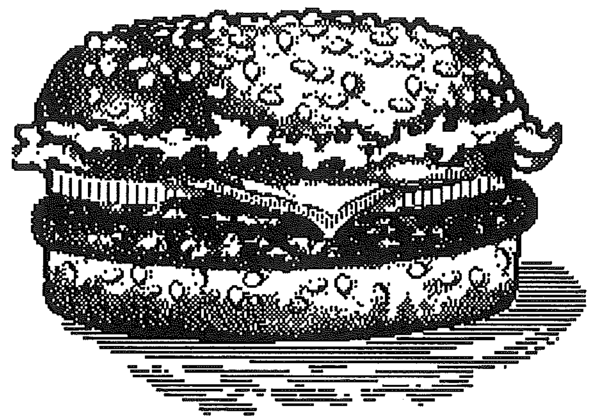
WASTE-FREE LUNCH

On a Waste Free Lunch day, students pack their lunches in reusable containers so there is less waste to throw away. **Valley View School**, in McHenry, holds a Waste Free Lunch every Wednesday. As an extra bonus, each student who packs a Waste Free Lunch gets a prize ticket. Winning ticket holders' names are announced the next day over the public address system. Each winner receives a free container or thermos to use in their next Waste Free Lunch.

Some other schools across the state have been very successful with their Waste Free Lunches too. At **Lowell Elementary School**, in Wheaton, every day is Waste-Free Lunch Day. **Holy Family School**, in Decatur, Illinois, uses the "Be nice, Use it Twice" idea when printing posters to let students know of upcoming Waste Free Lunch Days. St. Isidore reduced their garbage on Waste-Free Lunch Days and now routinely fills only one garbage can per day at lunch. During **Edison's School** Waste Free Lunch Day, the amount of waste dropped from their normal 25 pounds of garbage after lunch to only six pounds. **St. Charles Borromeo School**, in Hampshire, reduced their lunchroom waste by 13 pounds on Waste-Free Lunch Day. **El Sierra** School, in Downers Grove, did not even fill one garbage can the day of their Waste Free Lunch!

Glenn Brank
Water Education Foundation

CHEW ON THIS . . . THERE'S SOMETHING EXPENSIVE HIDING ON YOUR PLATE



Unlike the air we breathe, water isn't free. In fact, one Sacramento non-profit group, the Water Education "Foundation, has estimated the water cost that goes into filling an average plate of food. Their findings clearly show that significant water conservation measures will have to include modifying America's dietary habits.

With the concern over water shortages and mandatory water rationing in many communities across the United States, many people would be surprised to learn it can easily take as much as 10,600 gallons of water to produce a typical summer barbecue meal for a family of four (2 pounds of beef, 4 ears of corn, potatoes, and watermelon).

ASSOCIATING WATER USAGE WITH OUR EATING HABITS

A critical factor in connecting water conservation with what we eat rests in the discrepancy between the cost of water to residential users and the cost of agricultural users.

In California, for example, agriculture consumes as much as 85 percent of the state's water, but pays much, much less for it than other consumers. (This is probably true in other states, as well.) For instance, a San Jose resident pays 14 cents per 100 gallons of water and a flat rate of $4.35 a month, while a neighboring farmer only pays 1.5 cents per 100 gallons. So, while the 2,607 gallons of water needed to produce a steak actually cost $3.60, the rancher only pays 39 cents. This savings, made possible by $24 billion dollars in subsidies for the California meat industry, is passed on to the consumer.

However, since consumers don't see those astronomical water costs reflected in the price they pay at the supermarket, they don't realize that they pay, instead, by rationing baths, toilet flushes, and other necessary daily functions—measures destined to prove too little too late if unaccompanied by dietary changes as well. Here's how many gallons of water it takes to produce a single serving of the following foods:

Steak	2,607
Hamburger	1,303
Chicken	408
Pork	408
Eggs (2)	136
Watermelon	100
Margarine	92
Cherries	90
Milk	65
Corn	61
Cantaloupe	51
Rice	36
Oranges	22
Apples	16
White Bread	15
Almonds	12
Cola	10
Sugar	8
French Fries	6
Lettuce	6

These figures do not include water needed for harvesting, processing, transportation, or cooking.

David R. Stonck
C.S.T.A. Journal

REDUCING FAT IN THE DIET

Is the American Diet Dangerous?

Too many Americans die prematurely from diseases caused by poor diets. Half of Americans who die each year have diseases of the heart and blood vessels, and scientists recognize that the major cause of heart attacks and strokes in the excessive amount of fat in our diet. All types of cancer account for 22% of all deaths of Americans each year. Where cigarette smoking causes 35% of cancer deaths and also contributes to heart disease, the overload of fat in the average diet causes 45% of all cancer deaths! The the consumption of too much fat in the diet is probably the primary cause of death for almost half of all Americans who die each year.

The eating of so much fat is the major cause of obesity in America. It is interesting to note that Americans are 25% more obese than the Chinese although the Chinese eat 20 percent more calories than do Americans! This is because Americans eat three times as much fat as the Chinese do.

In a study published by Cornell University Press, June, 1990, Dr. T. Colin Campbell queried 6500 Chinese on 367 facts about eating and other habits. These people took in only 7% of their protein from animal sources while Americans get 70% from dairy foods or meats. Americans eat one-third more protein than do Chinese. With much less meat and no dairy products, the Chinese eat only a third the amount of fat Americans do; they eat twice as much starch, e.g., in rice and vegetables.

Many Americans incorrectly assume that they must eat large amounts of meat to get enough protein. However, the average American eats twice as much protein as is necessary. the quantity of protein that most adults need is only 35 to 40 grams a day. As an example, one hamburger provides more than a day's requirement of protein, fat, and phosphate. Additionally, meat and dairy products, although rich in protein, are usually also rich in animal fat.

About 3.5% of the weight of the human body is in the salt called calcium phosphate—the white, hard material of bones. Osteoporosis is a common bone disease resulting from an inadequate amount of calcium. Twenty million older Americans have this condition. Although the Chinese consume only half as much calcium as Americans do, they rarely have osteoporosis. The difference may be due to the fact that people who eat lots of meat need much more calcium because the excess phosphate from the meat is excreted in the urine as calcium phosphate. Thus depleting the body's supply of calcium.

Milk and dairy products are often described as a good source of calcium; however, the Chinese rarely eat and drink dairy products. They get sufficient calcium from plant foods such as beans and other vegetables. Moreover, many adult Asians and Blacks cannot tolerate milk because they lack the ability to digest lactose. These same people can eat cheese or yogurt because bacteria has already broken down the lactose in these products.

You Can Evaluate Your Foods

Nutritionists have determined that the average person should keep the percentage of calories in their diet below 30%. (The Chinese take in only 10% - 15% of their calories from fat.) (When we read a menu we can only guess at how much fat is in each food. In a grocery store, however, we can read the labels on packages and discover the amount of fat by doing a calculation. The chart accompanying this article gives several examples of how to do the needed calculations. In summation, then, the fats in our diets, which come primarily from meats and dairy product s, can contribute to problems of obesity, heart disease, osteoporosis, and cancer. Any American who wishes to reduce weight and minimize risks of these other disabling diseases should begin by reducing fat in the diet.

EVALUATE YOUR DIET

A package of cream cheese lists the following nutritional information: "The serving size is one ounce and contains 100 calories. A serving contains ten grams of fat." But each gram of fat provides 9.3 calories. Ten grams of fat provides 93 calories. Since 93 of the 100 calories in cream cheese come from fat, the cream cheese can be described as being 93% fat. Butter and margarine are almost 100% fat.

A brand of chocolate cookies has a serving size of two cookies at 0.88 ounce. These cookies provide 130 calories and contain 7 grams of fat.

$$(7\text{g of fat})\ \left(9.3\,\frac{\text{calories}}{\text{g of fat}}\right) = 65.1 \text{ calories from fat.}$$

65.1 calories are from fat or 50% of the calories in these cookies come from fat. 130 calories. You may have thought that cookies belong in the grain and bread group and contain little fat. Clearly fats are used in the cookie mix.

A brand of frozen toaster-size waffles has two waffles to the serving. Each serving contains 360 calories and 11 g of fat.

$$(11\text{g of fat})\ \left(9.3\,\frac{\text{calories}}{\text{g of fat}}\right) = 102.3 \text{ calories from fat}$$

102.3 calories from fat or almost 40% of the calories come from fat. 260 calories. Like the cookies, you probably thought that waffles belonging to the grain and bread group would be low in fat. The fats used especially come from palm oil. Although this is a plant oil, it has the same chemical composition of an animal—the most dangerous kind of fat. Many companies are now selling foods they claim to be highly nutritious. A frozen zucchini lasagna is advertised as containing fewer than 300 calories. The serving size is 11 ounces and 260 calories. Fat is at 7 g.

$$(7\text{ g of fat})\ \left(9.3\,\frac{\text{calories}}{\text{g of fat}}\right) = 65.1 \text{ calories from fat .}$$

65.1 calories from fat or 25% of the calories come from fat 260 calories. While this is below the 30% limit set by dietary guidelines, it is interesting to note that it still has more fat content than that contained in the average Chinese diet.

MINI IDEAS

Brian Poelker
Barbara Poelker
Larry Montgomery
Midwest Central Unit 191
Manito, IL 61546

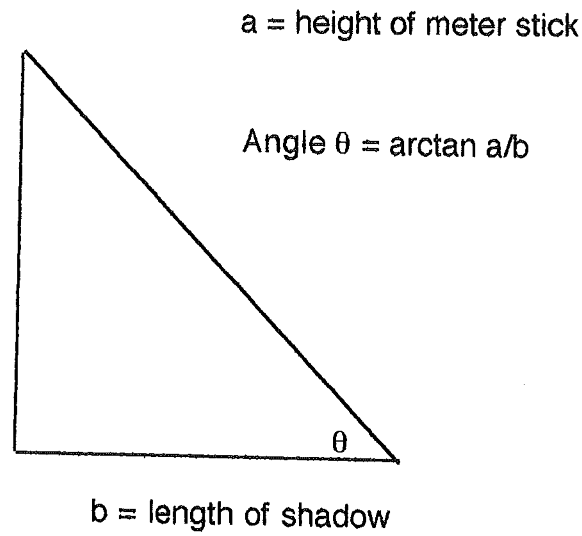
ERATOSTHENES AND THE EQUINOX: USING TELECOMMUNICATIONS TO CALCULATE THE CIRCUMFERENCE OF THE EARTH

About 2,200 years ago Eratosthenes first calculated the circumference of the Earth to a high degree of accuracy. Eratosthenes was a Greek philosopher and mathematician. He also was the head of the great library at Alexandria. There he read a papyrus scroll detailing the passage of the sun directly overhead on June 21 in Syene, 800km to the south. He noted that at that same date in Alexandria the sun cast a distinct shadow at noon. Upon measuring he found the shadow to be 7 degrees, about 1/50 of a circle. By multiplying the 800km by 50 the circumference of the Earth would be 40,000km - almost a perfect answer!

At the Boston NSTA convention I had the good fortune to have a conversation with MIT's Philip Morrison, author of *The Ring of Truth.* In his book Dr. Morrison uses the "Van of Eratosthenes" to recreate Eratosthenes' experiment in central Nebraska and Kansas by sighting the star Antares on successive nights at different latitudes. We talked about the experiment and how to use it for junior high students.

Rather than use a van, fellow eighth grade science teacher Gerry Larson of Hudson, Wisconsin and I decided to use telecommunications. We had our classes measure the angle of the sun at 1:00 p.m. CDT on September 22, the autumnal equinox. Any day of the year would have worked because the angle of the sunlight between the two towns is constant. We chose the equinox because the sun is known to be exactly over the equator and this gives a good reference point for students. It also provides other topics of discussion related to astronomy.

I first ask students to estimate the circumference of the earth and record the answer in their science journal. This will later be compared to the actual and measured circumferences. I usually find that students do not have a clear concept of how big the earth is, much less the rest of the solar system. Next I ask students to invent a method of measuring the angle of the sun without directly looking at it (for obvious safety reasons). Student inventions are generally based on measuring shadow length or the use of protractors and strings to measure angles. Students have produced very good methods of measurement on their own with a minimum of guidance. An example is based on a form of inclinometer that lined up the sunlight via shadows or perpendicular meter sticks that used arc tangent to calculate the angle.



The closer one gets to the equator the higher in the sky the sun is at noon. At the equator the sun is directly overhead. Students must subtract the angle of the sunlight from 90° to get the latitude. If the students measured the angle of the sunlight to be 50°, then the latitude would be 40°.

We practice measuring for a day and perform the measurements at noon on the equinox. We also measure the day before and the day after in case of clouds at our collaborating school. Students collect the data and evaluated the methods of collection to determine which apparatus had the least probability of error. The results are averaged and along the raw data are sent to the collaborating school.

Student data is compiled in table 1.

Table 1	Actual latitude	Ave. Measured latitude
Hudson, WI	45.0°	45.5°
Manito, IL	40.4°	41.2°
Difference	4.6°	4.3°

Manito and Hudson are not exactly on the same line of longitude so this provided a source of error for our measurements. This can be corrected for by measuring the elevation of the sun at local noon. This can be measured by using the altimeter method done by the high school physics class or one can look up the time of transit for the sun on a computer astronomy program. We use the Voyager program by Carina software.

We estimated the distance between the two towns at 500km from maps. To get a more precise measure we took the latitudinal coordinates of the towns and called the United States Geological Survey. The exact distance between the two towns was given by the USGS Earth Science Information Center at Reston, VA. Phone (703)648-6892 for information. In fact they provided the exact distance to the nearest ten-thousandth of a mile! The miles were converted to kilometers for our measurements. Because the cities were north - south in orientation we compared our answers to the polar circumference of the earth which is slightly smaller than the equatorial circumference.

The polar circumference of the earth is 39,678km. Student data for circumference was 507km (360/4.3) = 42446km. The student's error was 2768km. The percent error was 7%.

You can do this activity any sunny day of the year! Just hook up with another school on your longitude and measure the angle of the sun at the same time of day. If your school has INTERNET access you may find information under the University of Illinois' "Noon Project". If you use America ONLINE information was exchanged between teachers using the path Project Place/Idea Exchange/"How big is the earth?" by FSJAZZ. Students must work cooperatively with teams from other schools in other states. It's a great way to link problem solving, technology, history, geography, astronomy and the mathematics needed in science today.

Students at Midwest Central High School contacted several schools in other states (and Canada) on the 90th parallel. On the equinox they graphed the elevation of the sun throughout the day using altimeters. Using this method they could measure the elevation of the sun at exactly local noon. This is when the sun was highest in the sky. Local noon varies slightly with each school. This eliminates the small error due to longitudinal differences. High school students calculated the distances between the various towns by using latitudinal interpolation from maps. One degree on a map represents a distance of 110.22km. By finding the latitude the to the minute and second students can make a very accurate estimate of the distance between the towns involved. When the angles are exchanged the students can accurately calculate the circumference of the earth. This also provides physics students with a direct measure of the radius of the earth which can be used for solving certain gravitational problems.

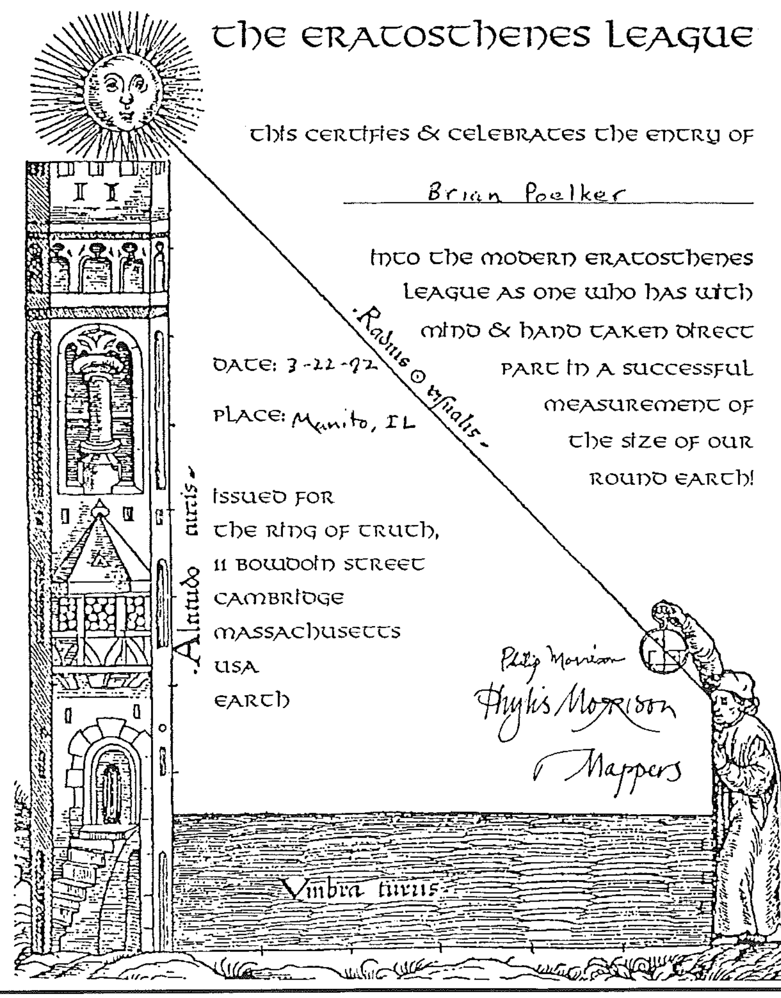
Midwest Central High School World History students study the history of mathematics and science at this time. Students created mind maps of their work. A mind map is outlining in a non-structured way. It can be used to summarize information from a guest speaker, material at the end of a chapter or experiment.

How to organize a mind map.

1. The central theme or main idea is clearly defined and placed in the center.
2. The "legs" or key concepts branch off the theme. The most important ideas stay near the center.
3. Links between key concepts are clearly seen.
4. The nature of the mind map's structure allows for easy additions.
5. Each mind map is different and unique to its creator.
6. A mind map is open-ended in nature. It allows for connections and associations.
7. Drawings and artwork enhance the ideas included in the map.

Mind Mapping: End of Unit Review of the History of Mathematics and Science

1. Students work in groups of four and compile a list of at least 50 characteristics of the unit.
2. Each group selects a team leader. Each group contributes five characteristics the leader records on the overhead projector. Each group must contribute different characteristics. The teacher may add five characteristics also.



3. Students were given two sample mind maps (included) and an explanation on how to make them.
4. Students organize the characteristics shared plus those of the group into 7 or fewer categories or information. (In the sample mind map the categories are: Greece, Rome, Egypt, Latin America, China, Early Modern Times with the Copernican Revolution).
5. Students then create their own categories and individually create mind maps from the characteristics available.
6. Students work on the mind maps at home and complete them in class the next day.

You can do this activity without linking with another school by having an *Equinox Day.* On the equinox the sun is directly over the equator. Measure the angle of the sun at noon. At the equator the angle of the sun is 90°. Measure the distance from your town to the equator on a map and you have all the information you need! (360 divided by the angular difference times the distance = Earth circumference)

Additional incentive is provided by MIT's Dr. Philip and Phylis Morrison. The Morrison's invite you and your students to join *The Eratosthenes League.* After you complete the activity send your data to the Morrison's at the following address:

Dr. Philip and Phylis Morrison
11 Bowdoin Street
Cambridge, MA 02138

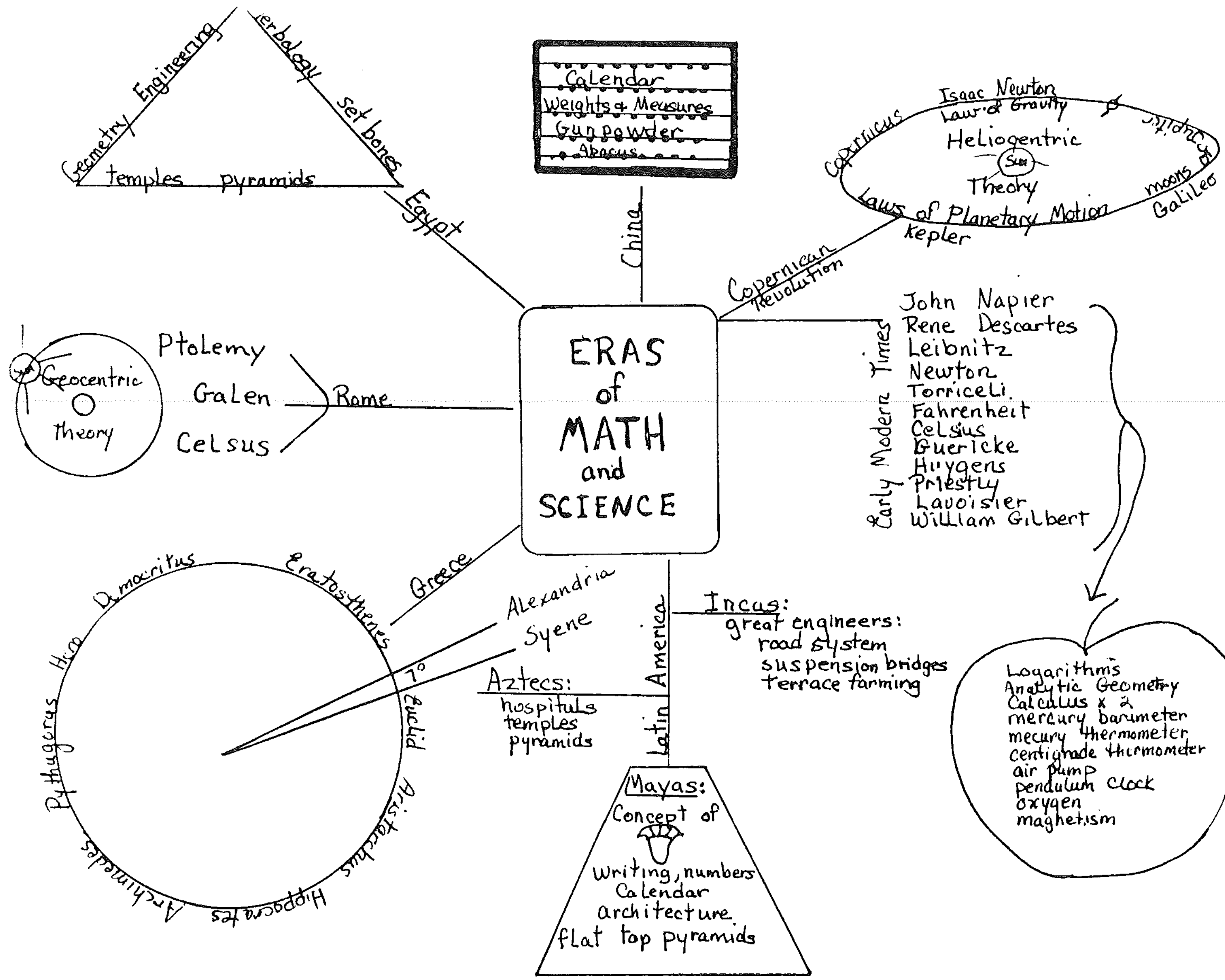
They are looking forward to hearing from teachers all over the country. They will send you the signed certificate that you can duplicate and give to your students.

Midwest Central Unit #191 students enjoy the activity, collaborating with other schools, the certificates and the accompanying publicity of the local papers. Your students can too.

Resources:

Morrison, Philip and Phylis Morrison. *The Ring of Truth.* Vintage Books. New York. 1989. ISBN 0-679-72130-4 9 (pbk)

Poelker, Brian. Erathosthenes Updated: A Grecian Formula for Measuring the Earth. *Science Scope* 16(6) March 1993 p. 18-19.



Teachers Clearinghouse
for Science and Society Education Newsletter
Spring 1983

RADIATION OF HEAT

Introduction

The term "radiation" is a term that invokes strong emotional responses, quite often negative. This is due to the use of the word in describing emissions from a nuclear reaction. However, radiation refers to anything that is given off. A person can radiate enthusiasm, a light bulb radiates light, and everything that is even a tiny bit warmer than its surroundings radiates heat. Radiant heat is transferred in the form of infrared electromagnetic waves. This type of wave is next to the red side of the visible spectrum of light. The heat lights that are used to warm french fries and newly-born babies are radiating heat in the form of infrared waves. Plants and animals all radiate certain wavelengths of infrared. Satellite photos can detect types of plants and crops and even diseased versus healthy plants by the type of infrared radiated.

Procedure

1. Detecting Your Own Radiant Heat: Hold your hand several centimeters from your cheek. You can feel heat being radiated from your cheek.
2. Different Surfaces Reflect Radiant Heat: Obtain an empty coffee can. Paint half the inside surface of the can flat (not shiny) black. Leave the other half of the can a shiny silver. Place a candle in the exact center of the can. The difference in the amount of heat being absorbed versus radiated back by each side can be detected by touch. The shiny surface reflects the heat and will not feel as warm. For a more objective measurement, melt some wax drops on the outside of each half prior to starting the experiment and stick in some used matches. The wax will melt and the matches will drop first on the black side, which is absorbing the heat.
3. Different Surfaces Radiate Heat at Different Rates: Obtain three identical cans. Paint one white, inside and out. Paint another black, inside and out. Leave the third shiny. Cut cardboard squares large enough to place over each can. Make a hole in each square to put a thermometer through. Place equal amounts of the same temperature warm water in each can, and place the cans in a cool location. Record the temperature of the samples every two minutes until they reach air temperature. Was there a difference in the rate of cooling? Which can was the best radiator of heat? Which was the worst radiator of heat?

Applications

1. Some household insulation comes with a shiny silver side. If you are primarily concerned with keeping the heat in your home in the winter, should the shiny side face inward or outward? What if you wanted to mainly keep the heat out in the summer? How would you make the insulation if you wanted to do both?
2. While preparing to make a baked potato you are about to wrap the potato in foil when you notice the foil is more shiny on one side. To cook the potato faster, which side of the foil will you face inward towards the potato?
3. Spaceships are usually depicted in movies as being shiny. Remembering that these spaceships have to pass through the atmospheres of planets and will heat up due to friction, do you think this is a realistic way to depict spaceships? Why or why not?

Charlene Koelling
Porta Comm. Unit Schools
Dist. 202
R.R. #2
Petersburg, IL 62675

CO-EXIST: LEARNING TO CARE FOR YOUR OWN ENVIRONMENTAL CORNER

People's imaginations are caught be saving endangered species, especially birds and mammals, especially if they have "catchy" names, and especially if they are not on "our own turf" getting in the way of our personal life. While teaching about the importance of saving plants and animals, I believe we have to start in our own corner, our backyards, streets, 'vacant lots, pastures and parks. Help students learn about the interdependence of all living things, about living in a different way, a way that involves at least a respect for all life and if possible concern and love for all life. This is a big objective. Love a slug, leech, paper wasp, tick? Start with an attempt at respect. Respect for an organism with good defensive techniques comes easiest.

Most students know very little about their local environment. What is out there and what is happening to it? Survival for all species, including us, means more people need to become more environmentally aware of their surroundings.

As biology teachers, we have it in our hands to help destroy, to protect, and even to renew our planet's resources. We can and we do have an impact on what will happen in the future—a devastated planet or a worthy habitat for all organisms, including ourselves. If we care about our local corner and get more people to care about their corners, we'll have a safe planet for all life. Sounds impossible? There's nothing wrong with thinking big. You do it in your corner and I'll do it in mine and watch what happens.

What "Good" Is It?

Directions: mark category 1, 2, 3, or 4 for each organism. Do this rapidly. The categories are: 1 - Good to have around for humans or in general. 2 - Would make no difference if it was around or not. 3 - Bad to have around for humans or in general. 4 - Not familiar with organism.

		1	2	3	4	
1.	Bobcat					
2.	Poison ivy					
3.	Slug					
4.	Vulture					
5.	Sugar maple					
6.	Coyote					
7.	Timber Rattlesnake					
8.	Garden spider					
9.	Garter snake					
10.	Mold					
11.	Paper wasp					
12.	Fern					
13.	Chicory					
14.	Cricket					
15.	Morel					
16.	Sunflower					
17.	Trout					
18.	Caterpillar					
19.	Chickadee					
20.	Cactus					

Diversity Creates Stability in Ecosystems

Explain this concept, and use an example.

Your Life Value Line

Everyone has different attitudes toward the value of life. After a year of studying life (biology), do some thinking about balances in ecosystems and the value of all life.

Write a paragraph on ecosystem stability, the "balance of nature." Review if necessary.

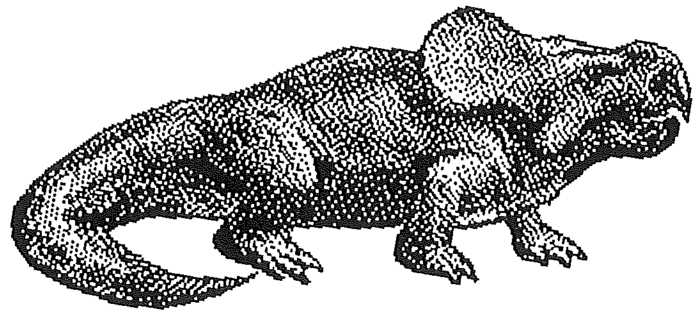
Then list names of <u>organisms</u> you would never kill and names of <u>organisms</u> you always or might kill if you encountered them.

Paragraph

Lists: Never Always or might

Vicky Martin and Marlys Johnson
Franklin Elementary School
Pullman, Washington

Larry E. Davis
Department of Geology
Washington State University



USING DINOSAUR TRACKS FOR INTRODUCING MATH RATIOS INTO THE ELEMENTARY CURRICULUM

Introduction

Dinosaurs! No other group of animals (living or extinct) has left a more lasting impression on human beings. For some, the fascination may be temporary and restricted to childhood, but these are the most formative years in our development. There is no better time to exploit this natural curiosity and stimulate a life long interest in scientific inquiry. Dinosaurs can be an excellent vehicle for: 1) developing and applying knowledge of observational facts, concepts, principles, theories, and processes of science; 2) developing skills in manipulating materials and equipment and in gathering and communicating scientific information; 3) developing and applying rational, creative, and critical thinking skills; and 4) developing values, aspirations, and attitudes that promote personal involvement of the individual with the environment and society (Brouillet, et al., 1988).

Study of Dinosaur Footprints

The study of ichnology (from the Greek iknos, meaning "trace or track" and logos, meaning "word or study") is the study of indirect evidence of past life called trace fossils. Trace fossils include such things as tracks, trails, and burrows. In light of new discoveries, such as dinosaur nests with eggs and extensive trackways, dinosaur ichnology is becoming increasingly important (Gillette & Lockley, 1989). The study of dinosaur tracks and trackways can be used to integrate math and science into the elementary curriculum.

Dinosaur Tracks and Ratio Activity

This activity has been successfully introduced into the second grade curriculum involving students from two classrooms working together as part of a collaborative teaching model. The first part of the activity involves a refresher in measuring and recording data using a five-inch length of string. Students were asked to work with a partner to measure eight items in the classroom and to record their results in the data record sheet (Figure 1). Converting the number of strings to inches reinforced the concepts of multiplication, fractions, and estimations when measured objects were not equal to whole numbers in string lengths. Cooperative pairs work together. Activity Time: Approximately 40 minutes. Materials: String, scissors, rulers, calculators.

The second activity involved using a foam core or cardboard replica of a theropod footprint at 100% scale (Figure 2). Working in pairs, students were first asked to compare their foot size to the length of their leg and develop a ratio. These data were recorded on the Dinosaurs and Me worksheet (Figure 3).

1. Cut a piece of string to the length of the student partner's foot (shoes off).
2. Measure the string length with a ruler and record.
3. Determine the number of string lengths from the arch of the foot to the hop bone. This was done as a foot: leg length ratio. For second grade students, this ratio is approximately 1: 3.5-4. Students easily understood half lengths from the earlier activity.
4. From this ratio, calculate the students leg length and record.
5. Repeat for each partner.

Utilizing this same concept and procedure, students were asked to measure a dinosaur footprint template and record the measurement. The footprint: leg length ratio for theropods is approximately 1:4 (Lockley, 1991) (Figure 4) and students were given this ratio. Butcher paper was attached to the walls and each team marked on the butcher paper the hop height of this particular theropod dinosaur. Students enjoyed seeing how tall they were compared to the dinosaur leg and could then speculate the approximate height of the dinosaurs. Activity time: approximately 30 minutes. Materials: String, scissors, rulers, calculators, marking pens, dinosaur footprint template, butcher paper.

An extension of this activity involves students writing a short story about the dinosaur.

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Gillette, D. D. and Lockley, M. G. (eds.), 1989, Dinosaur Tracks and Traces: Cambridge University Press, Cambridge, 454 p.

Lockley, M. G., 1991, Tracking Dinosaurs: Cambridge University Press, Cambridge, 238 p.

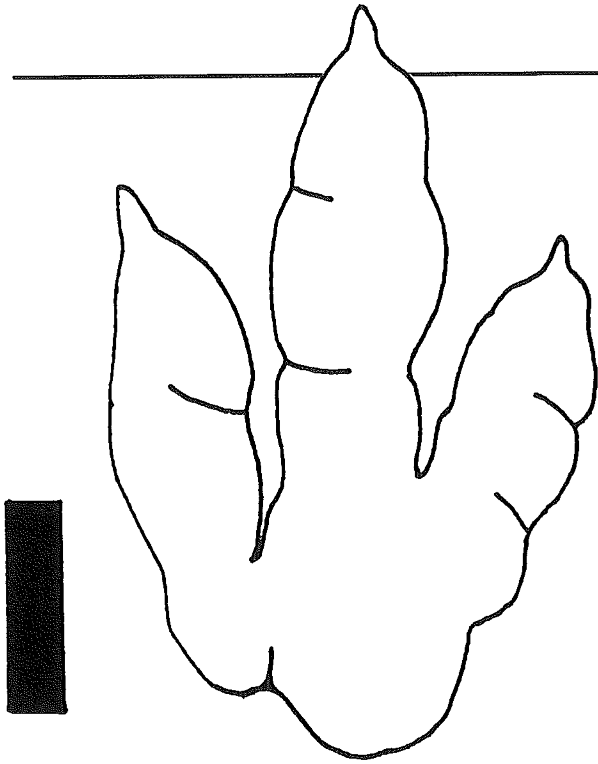


Figure 2. Make a transparency of this figure and place it on an overhead projector. Move the projector forwards or backwards until the black bar scale is exactly 10 cm. The dinosaur track is now actual size and can be traced to make a dinosaur foot template.

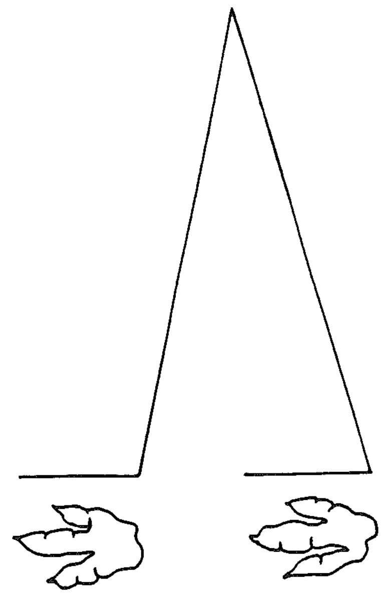


Figure 4. Estimating dinosaur hip height by multiplying footprint length by four. Modified from Lockley (p. 64, 1991).

Name: ____________________

Date: ____________________

Use your piece of string. Work with your partner. Measure the following 5 objects. Record your results.

	strings	inches
1. How tall is a desk?		
2. How tall is a door?		
3. How far is it across the room?		
4. How tall is your partner?		
5. How far is it around the top of the trash can?		

Find 3 more things to measure. Write the name of what you measure. Record your results.

	strings	inches
1.		
2.		
3.		

Figure 1.

Dinosaurs and Me

My Foot Size	Number of Strings for My Leg	Dinosaur Foot Size	Number of Strings for the Dinosaur Leg
Your 1 string = how many inches?	______leg strings = how many inches?	1 dinosaur foot string = how many inches?	______dinosaur leg strings = how many inches?

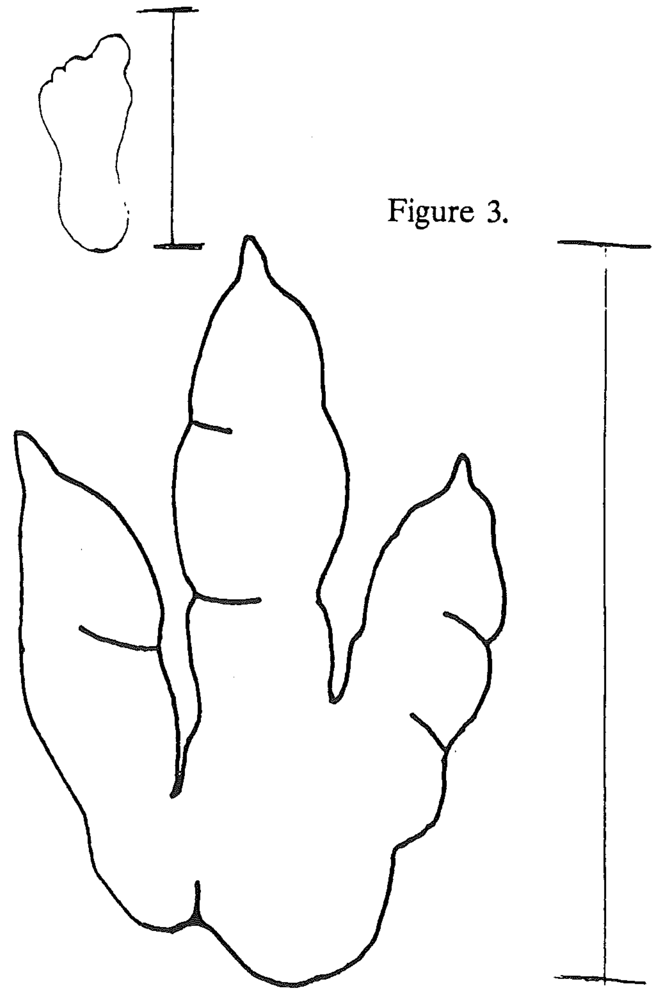


Figure 3.

Claire Hines
Reprinted from *Texas Science Teacher*

ADAPTING WRITING TECHNIQUES TO EARTH SCIENCE

Bringing Earth Science out of the pages of the textbook and into the lives of students should be a goal for us all. Instead of teaching science as isolated facts, students should be encouraged to relate it to their every day lives. Strategies taught in the New Jersey Writing Institute may help students relate how their lives are affected by the earth, using grammar in a meaningful context. Four teaching strategies taught in the NJWI have been adapted by the author for use in the Earth Science classroom:

- Listing
- Writing Roulette
- Pentad
- Clocking

LISTING

Purpose

Listing gives a definite activity to get students started and can lead to other associations. It gives a frame-work for putting things in order and can be used across the curriculum.

Procedure

1. In order to begin thinking about Earth Science, ask students to write 3 words below each topic that are somehow related to the topic.
2. Give 10 topics for students to write about.
3. Ask students to share with the class.
4. Relate this activity to topics students will study during the course.

Some Possible Listing Topics

List 3 ideas about the earth.
List 3 statements about the oceans.
List 3 statements about the sky.
List 3 statements about the weather.
List 3 words related to mountains.
List 3 words under rocks.
List 3 words under space.
List 3 words under environment.
List 3 words under minerals.
List 3 words under rivers.
List 3 words under earthquakes.
List 3 words under pollution.
List 3 words under fossils.
List 3 words under soil.
List 3 words under volcanoes.
List 3 words under resources

WRITING ROULETTE

Purpose

Writing Roulette will encourage co-operative learning and develop sequencing. This technique allows group members to participate in a risk-free environment.

Procedure

1. Group students.
2. Assign topics. Allow a predetermined time to work (Example: 5 minutes).
3. Each group participant then passes his/her paper to the left.
4. The students then will continue to write from the stopping point of the previous student.
5. Pass papers again after time is called.
6. Continue until a final group member has participated.
7. Return papers to owners; the owner shares what has been written by the group.

Some Possible Topics for Writing Roulette

Outlining a chapter.

Summarizing a chapter.

Writing a class lab report within a group based on teacher demonstration of a lab.

Writing a group lab report.

CLOCKING

As writing assignments are given, clocking could be assigned after the first draft is completed. The clocking technique allows students to proof read each other's paper before the final copy is written. When the paper is turned in, there should be no grammatical mistakes. Clocking could be done again on the final draft so that any errors in re-copying could be found and corrected. using this method, errors will be few and grades will go up!

Procedure

1. Students are seated in an outer circle and an inner circle with their drafts, a pen or pencil, and a sheet of paper titled, "This clocking sheet belongs to   ."
2. The first step is given and written on the clocking sheet. Example: Look for mistakes in title.
3. The students exchange papers with the person across from them. They check each other's paper for mistakes in the title.
4. If no mistakes are found, they initial the clocking sheet—whereas if a correction is needed, it is noted on that sheet.
5. Papers are returned to their owners when time is called.
6. Students on outside of circle move one chair to left when signaled. Students on inside of circle do not move.
7. Give second clocking assignment, having students write it on their clocking sheet, then repeat step 3 using the next area.

Possible problem areas for clocking

1. Look for mistakes in title.
2. Punctuation.
3. Spelling.
4. Word usage . . . to, too, two; there, their, your, you're; it's, its.
5. Capitals.
6. Sentence structure.

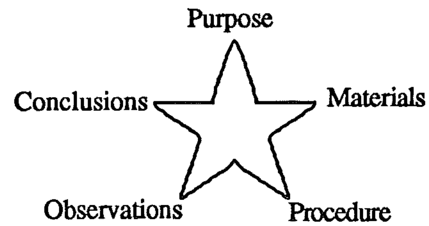
PENTAD

Purpose

The Pentad can be used to record information within a lab group, and allows each student to contribute to the assignment. The teacher will have one paper per group to grade.

Procedure

1. Each lab member chooses a different point of the star.



2. The lab is completed, allowing each member to record his/her lab step.
3. The group then hands in one completed lab sheet with names of all members.

Although one suggestion has been given using each writing technique, teachers should be able to adopt and adapt them to fit their unique situations.

Clair Hines teaches at Foster Middle School in Longview, TX 75601. She may be contacted at 903-758-6839.

STS Activities Page
Wayne Snyder
Clearinghouse for Science and Society Education Newsletter

LEARNING ABOUT NUCLEAR FISSION BY BUILDING A REACTOR MODEL

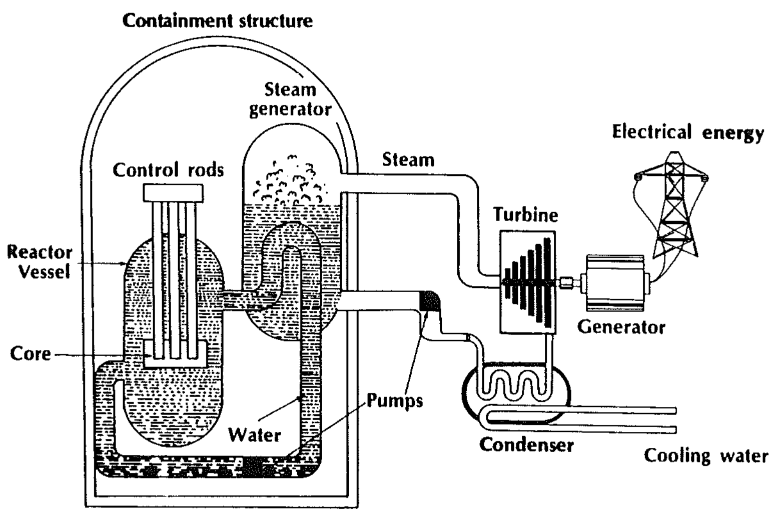
Definitions:
Fission - the splitting of a large nucleus into smaller nuclei
Thermal neutron - neutron moving slow enough to initiate fission
Moderator - material used to slow down neutrons. Examples: water, graphite
Fuel rod - rod containing pellets of uranium fuel, usually in the form of uranium oxide
Chain reaction - reaction in which a thermal neutron initiates fission and releases even more neutrons
to cause even more fission. Example:

Critical mass - the minimum amount of fuel needed to maintain a chain reaction
Control rods - rods which absorb neutrons to control the chain reaction
Shielding - protection from radiation
Instructions:
1. Obtain a sheet of cardboard. Decide on the area to locate your nuclear reactor model.
2. Following the diagram of a pressurized water reactor, build a reactor vessel and steam generator out of clay. Construct the water lines connecting them out of straws. What is the purpose of the reactor vessel? What is the purpose of the steam generator? Is the water going from the reactor vessel to the steam generator mixed with the water going from the steam generator to the turbine? Why?
3. Color code a bunch of toothpicks and record your coding key:

= fuel rods
= control rods

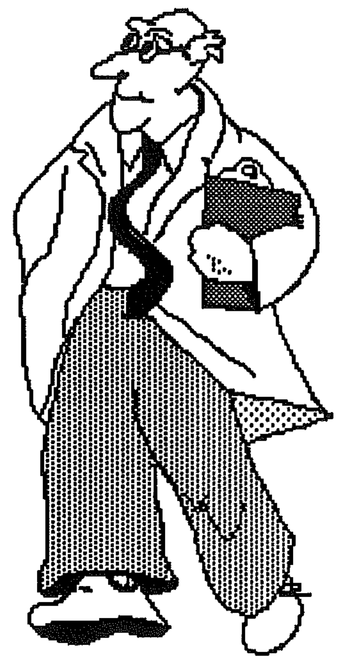
a. First we need some fuel. Lower some fuel rods into your reactor vessel. What do these rods contain? Does lowering them farther into the vessel increase or decrease the chain reaction? Why?
b. What particles are needed to start the chain reaction? What do we have to do to these particles?
c. The water in the reactor vessel acts as a moderator. Does the moderator increase or decrease the chain reaction? Why?
d. What particles are given off by the chain reaction? If we have a critical mass of fuel, what will these particles cause to happen?
e. Lower your control rods into the reactor. What is their purpose? Does lowering the control rods increase or decrease the chain reaction? Why?
4. Obtain the curved bottom of a 2 liter soda bottle, as follows: Cut the bottle in half, widthways. Hold the bottom half under hot water to loosen the glue, and the plastic support will pull off. Push the bottom outward to form a dome, and place it on top to complete your containment structure. What is the purpose of the containment structure?
5. You can now add the turbine generator to your model. What is the purpose of the generator? What is the purpose of the condenser cooling water?

Pressurized Water Reactor



reprinted from *The Oregon Science Teacher*

CHEMISTRY CHALLENGE: HOT AND COLD RUBBER BANDS



Find a weight that when suspended on a rubber band will almost double the length of the band. Heat the stretched rubber band using a hair dryer. What happens to its length? What happens as the rubber band cools? Without stretching a heavy rubber band, touch it to your lips or forehead. Does it feel warm, cold or in-between? Hold the rubber band slightly away from your face, quickly stretch it tight and touch it to your forehead or lip. Is it warmer or cooler than before? Hold the stretched band away from your face for a few moments to allow it to reach room temperature, then quickly let it relax to its original size and touch it to your face again. What is its temperature now? Repeat the experiment until you are sure of your results. In doing these experiments, use only new rubber bands that won't break.

When substances are heated, the increased molecular motion forces the molecules farther apart, so if you thought the rubber band would lengthen when heated—good guess, but no cigar. Rubber consists of long molecules, called polymers, that are loosely coiled. When rubber is heated, the atoms within the polymer chain increase their side-to-side motion, tightening the coils and shortening the molecules overall [see illustration]. Therefore, when the rubber band takes up heat, it shortens; when it gives off heat it lengths. As you found out, the converse is also true; when you stretch the rubber band, it gives off heat to its surrounds [including your lip] and feels warm; when you let the rubber band shrink, it takes up heat and feels cool.

EDUCATIONAL MATERIALS

GUIDEBOOK TO EXCELLENCE HELPS EDUCATORS TAP INTO SCIENCE AND MATH RESOURCES

The Eisenhower National Clearinghouse for Mathematics and Science Education (ENC) has just made it easier for elementary and secondary educators to locate Federal resources they can use as they strive to make US students first in the world in mathematics and science achievement. Working with the National Science and Technology Council, the Clearinghouse has compiled information from the 16 Federal agencies that support mathematics and science education. That information is presented in ten regional *Guidebooks to Excellence* that will be updated and reprinted each year. Each *Guidebook* contains information of national interest plus resources specific to the individual regions served by the Eisenhower Regional Consortia.

The *Guidebooks* offer three practical and useful categories of assistance. Section One described the misison, role in math and science education, and education offices for the 12 us cabinet departments and four Federal agencies. Section Two outlines national programs the departments and agencies offer for elementary and secondary education. Section Three explains the work of the Eisenhower Consortium in each region and alerts readers to specirfic regional Federal resources.

Educators may also access the Guidebooks online through the Eisenhower National Clearinghouse Gopher or ftp site at enc.org. Educators with Internet may download any or all of the Guidebooks from enc.org.

The US Departmentt of Education funds ENC to improve access to resources for mathematics and science education. Located at The Ohio State University, ENC is collecting curriculum materials to create the most comprehensive, up-to-date mathematics and science catalog in the nation. Later this year, ENC will make its full catalog available online through a toll free dial-in number. It will also be publishing a mini-catalog featuring curriculum materials that address equity issues in mathematics and science education.

To obtain a free print copy, while supplies last, of the *Guidebook to Excellence* for your region, contact the Eisenhower National Clearinghouse for Mathematics and Science Education, The Ohio State University, 1929 Kenny Road, Columbus, Ohio 43210-1079. Telephone: (614) 292-7784. E-mail: info@enc.org.

Amy Kosko
(703) 312-9248

NEW BOOK BRINGS WEATHER INTO THE CLASSROOM

WASHINGTON, D.C., February 1994—With *Project Earth Science: Meteorology,* a new book from the National Science Teachers Association (NSTA), the weather is as close as you make it!

The book comprises hands-on activities that give students the opportunity to make rain that will fall on their desks, create clouds in a jar and hail in a test-tube, track Hurricane Andrew, predict weather conditions, and much more.

Intended for grades 5-10, the book weaves activities and factual information around three key concepts: the origin and composition of the Earth's atmosphere, factors that contribute to weather, and the interaction of air masses.

Each of the book's 19 activities uses inexpensive, easy-to-find materials and includes a reproducible student unit and teacher guide. The student unit contains background information that introduces the concept behind the activity, instructions for doing the activity, and questions that challenge students to draw conclusions about what they have learned. More extensive background information and ideas for relating activity topics to other disciplines, such as language arts and social studies, are included in the teachers guide.

The book also contains a collection of 10 special readings on related topics ranging from smog and urban air quality to acid rain and the greenhouse effect. Appendices list descriptions of and contact information for meteorology curriculum projects, books, audiovisual materials, instructional aids, and reference materials for all grade levels.

Project Earth Science: Meteorology is the second volume in the Project Earth Science series, with funding from BP America.

The 229-page *Project Earth Science: Meteorology* costs $18.50 plus $3.75 shipping and handling. To order, contact NSTA Publication Sales, 1840 Wilson Blvd., Arlington, VA 22201; 800-722-NSTA (6792) or (703) 312-9270. Request stock no. #PB-103X. *Project Earth Science: Astronomy,* the first volume of the series, is also available for $18.50 plus $3.75 shipping and handling. Oceanography and Geology volumes are due out this fall.

The National Science Teachers Association is the world's largest organization committed to improving science education at all levels—preschool through college. NSTA's membership of nearly 50,000 includes science teachers, supervisors, administrators, scientists, business and industry representatives, and others involved in science education.

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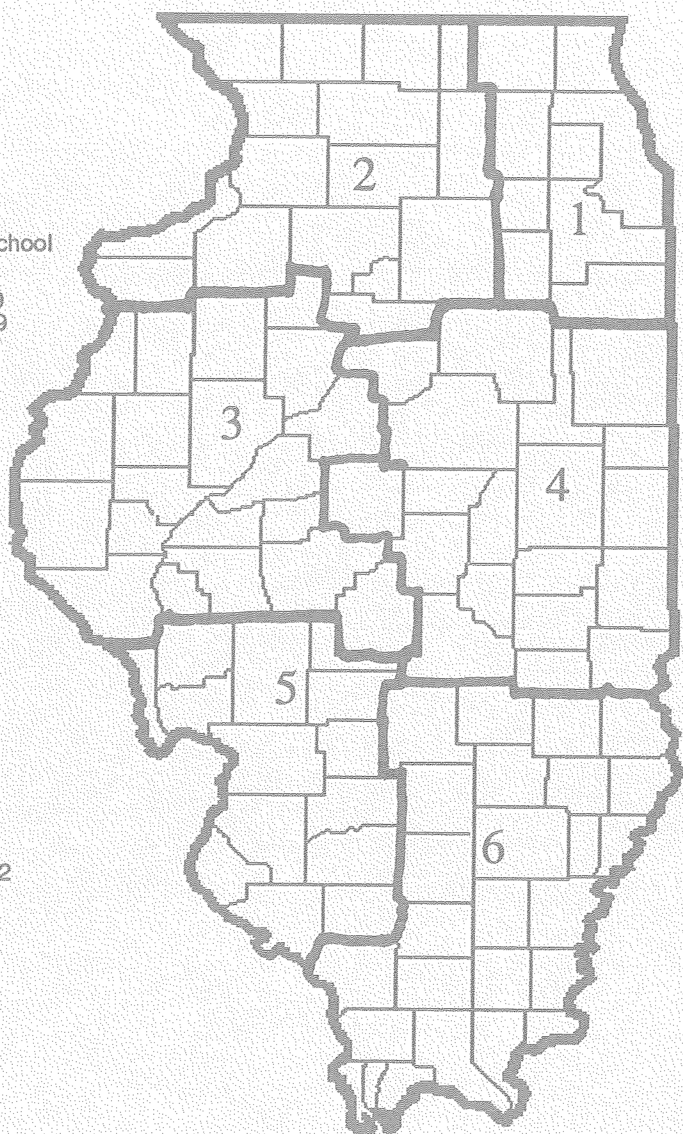

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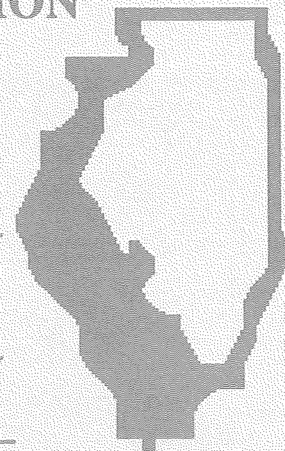

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