## SPECTRUM Fall 2005, Vol. 31, No. 2



In this Issue: Building Bridges Digital Information Fluency Field Trips GIS



Look for: NSTA Midwestern Area Conference Information NABT 2005 Convention Information

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## Spectrum

The Journal of the Illinois Science Teachers Association Volume 31, Number 2

*Spectrum* is published three times per year, in spring, fall, and winter, by the Illinois Science Teachers Association, Illinois Mathematics and Science Academy, 1500 W. Sullivan Rd., Aurora, IL 60506. Subscription rates are found with the membership information. *Subscription inquiries should be directed to Sherry Duncan (email: sjduncan@uiuc.edu).* 

Send submissions and inquiries to the editor. Articles should be directed to individual area focus editors (see next page and *write for the SPECTRUM information*).

Judith A. Scheppler, Ph.D. Coordinator of Student Inquiry Director of the Grainger Center for Imagination and Inquiry Illinois Mathematics and Science Academy 1500 West Sullivan Road Aurora, IL 60506 quella@imsa.edu

On the cover: Kendra Carroll and Jacquelyn Meadows share their research on The Cost of School Instruction. (see article on page 7.)

The Illinois Science Teachers Association recognizes and strongly promotes the importance of safety in the classroom. However, the ultimate responsibility to follow established safety practices and guidelines rests with the individual teacher. The views expressed by authors are not necessarily those of ISTA, the ISTA Board, or the *Spectrum*.

## SPECTRUM

The Journal of the Illinois Science Teachers Association

Fall 2005

Volume 31, Number 2

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## ISTA News President's Corner

Raymond J. Dagenais, Ed.D.

Illinois Mathematics and Science Academy



The prospects of a new season are benchmarks of progress. Classroom activity carries the waning days of summer into the sights and smells of autumn. Along with the more moderate temperatures that fall brings come classroom reviews of what had transpired last spring and introductions of new ideas designed to capture the imagination of our students.

So, what are these prospects? For students, it may be the joy of discovery that is a result of their inquiry into science. Broadening their knowledge base opens new vistas for exploration. As their understanding of the world of science deepens, connections become more evident. Communicating their understandings to others helps them refine and further develop their notions of nature.

For us, it may be a question of how to further develop ourselves as teachers. Each new school year provides challenges that offer us the potential to grow. It may be that we need to increase our knowledge of new subject matter that is unfamiliar to us or even to deepen our understanding of a scientific discipline that we have been teaching for a number of years.

In addition to these prospects, we may see the need to learn new ways of helping our students increase their scientific knowledge, deepen their understanding of nature through scientific inquiry, and communicate their thoughts in clear and accurate ways. Developing new understandings and learning new classroom strategies require an investment of time and effort.

One of the ways ISTA assists us in this process is to collaborate in offering professional growth opportunities such as the up coming National Science Teachers Association Midwestern Area Convention to be held November 10 - 12, 2005, at Navy Pier in Chicago. This event should not be missed by Illinois science teachers. Go to http://www.nsta.org/ conventions and click on the Midwestern Area Convention link for information on registration and convention offerings. A printable registration form can be accessed at http://www.nsta.org/main/pdfs/2005AreaConvRegForm.pdf. There is a registration fee discount for ISTA members. ISTA does not have membership ID numbers so you may leave this space blank. You must hold current ISTA membership to receive the fee break. For ISTA membership information contact Sherry Duncan at sjduncan@uiuc.edu.

As these prospects of the new season become reality use them as benchmarks of progress that earmark a successful school year for all students and those who care about science education.

Yours truly, Ray Dagenais

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### Do You Know an Exemplary Science Student?

Remember, ISTA members in good standing who would like to honor one high school science student each year may request an **ISTA medallion and certificate** by contacting sjduncan@uiuc.edu. This award program is supported by contributions from the Illinois Petroleum Resources Board.

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**ISTA Service** – If you are interested in taking a more active role in the organizational operation of the Illinois Science Teachers Association consider running for the position of ISTA Regional Director. For more information contact Dr. Marylin Lisowski, ISTA past president and elections chair, at mlisowski@eiu.edu.

### **ISTA General Membership Meeting**

The Illinois Science Teachers Association will hold its 2005 general membership meeting, sponsored by Prentice-Hall, on Thursday, November 10, from 5:00 PM – 7:00 PM during the NSTA Midwestern Area Conference in Chicago. Check the ISTA website at http://www.ista-il.org/ or final conference program for location.

### National Science Teachers Association MIDWESTERN Area Conference

### in Chicago, Illinois

### World-Class Science Nov. 10-12, 2005 www.nsta.org

### Conference Room Rates: Sheraton Chicago Holiday Inn Chicago City Centre Best Western Inn of Chicago

### \$169 single/double \$139 single/double \$119 single/\$128 double



### **Illinois Science Teachers Association**

2005 Membership Application Please print or type and fill-out complete form

Name		Day Phone	
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Government	<b>O</b> Physics	•	
O Other	O General	Science	
	O Integrat	ed Science	

Send form and check or money order, made payable to Illinois Science Teachers Association, to: Sherry Duncan (email: sjduncan@uiuc.edu), ISTA Membership, College of Education, 51 Gerty Drive, Champaign, IL 61820.

O Other\_\_\_\_\_

MEMBERSHIP OPTION (see below)\_\_\_\_\_

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### **ISTA Membership Categories**

Option 1: Full membership dues - \$35.00. Full membership entitles individuals to the following benefits: a one year subscription to the *SPECTRUM* and *ISTA ACTION*; inclusion in the members-only ISTA-TALK listserv; notification of regional conferences and meetings; voting privileges; and the opportunity to hold an ISTA officer position.

Option 2: Two-year full membership dues - \$60.00. Two-Year full membership entitles member to full membership benefits for two years.

Option 3: Five-year full membership dues - \$125.00. Five-year full membership entitles member to full member benefits for five years.

Option 4: Associate membership dues - \$15.00. For full-time students and individuals who are on retirement status. Entitles member to full menbership benefits, with the exception of the opportunity to run for office.

Opiton 5: Institutional membership - \$75.00. Institutional membership entitles the member institution, for a period of one year, to two subscriptions to the *Spectrum* and *ISTA Action*; notification of regional conferences and meetings, and a reduced registration fee for the Annual ISTA Conference for a maximum of three members of the institution.

### The Cost of School Instruction Kendra Carroll<sup>1</sup> and Jacquelyn Meadows<sup>2</sup>

<sup>1</sup>Shiloh CUSD #1, <sup>2</sup>Egyptian Com. School District

One of the many critical factors that are known to contribute to the success of teachers' effectiveness and students' learning is the availability of essential materials for instruction and student use. An opportunity has been presented as a part of the Illinois Mathematics and Science Partnerships (IMSP, Title II, Part B) program to explore this factor. While requests for education funding are commonly voiced, we have probably never explained about the actual needs and costs of filling those needs—such as the costs of an individual graphing calculator or microscope or probeware or even beakers, and so forth. When costs to classroom, building or district sets are considered, the concern for adequate funding is elevated. Our research focuses on identifying and expressing these needs for teachers' requests for quality materials that are essential in preparing students for today's real world necessities as productive citizens and work force members.

The Illinois Science Teachers Association polled their membership to verify the basic classroom needs and extend their imaginations to include the kinds of equipment and materials that would meet current and future needs for their students after leaving their classrooms. Many teachers indicated the need for simple materials, such as containers and spoons for mixing, food coloring and markers. Consumable items, such as chemicals and dissection materials, can take a real "bite" out of a classroom budget each year. For this reason, we found that many educators supplement school supplied funds with their own money.

Bigger budget items such as sufficient microscopes and slides for an entire class were requested by the life science instructors, regardless of the grade level. Chemistry teachers considered balances to be necessities for their classrooms. Unfortunately, a basic electronic balance can cost upwards of \$400 and an analytical balance, necessary for advanced chemistry and biology courses can cost \$1500, well beyond a typical classroom budget. Teachers feel the need for more advanced items, such as laptops and probeware, in order to keep their students current with developing technology.

Teachers expressed concern regarding the strain on classroom budgets when supplying safety equipment. The cost of required safety equipment for an elementary classroom could be enough to prevent teachers from conducting many activities. Providing classroom sets of goggles and gloves or having access to the proper disposal containers or eye wash stations is many times simply too much of a burden. This strain is magnified at higher grade levels with the need for acid and flammable storage cabinet, emergency showers, fire blankets, and spill clean up kits.

Illinois' teachers and their professional organizations are intimately aware and professionally passionate about meeting the needs of their students in mathematics and science. Our work is vital to the teaching and learning for Illinois' current and future economic successes. We have spoken with a common voice to provide factual input for more informed decision-making. We feel that our work can lay the groundwork for improving Illinois' K-12 teaching and learning settings for mathematics and science.

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### **Teacher - to - Teacher**

### Educators Share Information, Lessons, and Tips Mary Lou Lipscomb, Editor

**Illinois Mathematics and Science Academy** 

Teachers have a "bag of tricks" that they use on a regular basis or from time to time to spark or maintain interest, keep things moving, and/or help students understand a concept in a way that is unique or different. Also, from time to time teachers create and provide valuable professional development opportunities for one another. Think about sharing these activities or ideas with colleagues and provide professional development opportunities for others. If you have an idea you would like to share, please send it to me at lipscomb@imsa.edu.

In this issue teachers from elementary, middle and high schools around the state have shared some great ideas that you may want to incorporate into your repertoire as you plan for the new school year. A sincere "Thank You" goes to those who submitted ideas and information for this issue.

+++++

Help your students write good lab procedures ...

Debra Ditkowsky, a point of contact at Lincoln Park High School in Chicago shares a great idea that she originally observed in the classroom of Helena Stansikas a junior high teacher at Madero School.

She writes:

Lego sells sets in toy stores containing thirty-five or less pieces that are used to construct small toys. Each set costs between \$1.00 and \$5.00. The directions for construction of the toy consist entirely of pictures (no words at all). My students work in groups to produce written instructions on how to build the Lego toy (words *only* - no pictures). Then, I remove the picture instructions and place the Lego pieces and student-written instructions in a plastic resealable bag. I then write the model number on both the bag and the student-written instruction sheet.

A new group is asked to try their hardest to follow the written instructions to build the toy. This is not an easy task, in my honor's classes sometimes only half the models built are similar to what they should look like; in regular classes, none are.

I then ask the students to evaluate the written instructions constructively, reminding them that the "great instructions" their group wrote, probably didn't contain enough detail either. Then, they assign grades to themselves for trying, and to the other group for success. (The lowest grade allowed for the group which wrote instructions is a C-.)

Finally, I give them the actual picture instructions for the toy they were trying to build and they try again. The procedure is repeated until all of the groups can follow the written instructions and get a toy similar to the intended toy. For the rest of the year, the quality of their writing is much improved. I have used this activity successfully with a wide variety of students.

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### ping kids honest...

Paul Vandersteen, point of contact and chairman of the science department at Neuqua Valley High School in Naperville, shares a tip that is used with great success by teachers in the science department there.

When students do a self-evaluation based on a rubric or grade their own quizzes, we ask the students to put away all writing utensils. Then, we hand out *green* pens. The green pens are used to make the corrections. This technique avoids the temptation of dishonesty in this process. Very simple, but effective.

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### Managing lab materials with a large class size and a small amount of time for science...

Mary Webb, point of contact and fourth-grade teacher at Cerro Gordo Elementary School in Cerro Gordo, keeps her time and students organized. She writes that her class does experiments almost every day as part of their hands-on curriculum. She recommends using kits her school has purchased as they have all the materials necessary for the students to complete the experiments and a well written student (and teacher) manual.

### Mary writes:

To move things quickly and save congestion with twenty-seven students moving around—I have a wheel divided into four colored sections mounted on poster board that is magnetized to stick on the white board (or chalk board). Each section of the poster board is labeled with the name of a different job—materials manager, time keeper, reporter/recorder, and principal investigator. Each student has a name tag with a color dot that is the same as one of the colors on the wheel. The students are divided into groups of four and each student in a group has a different color dot. When the color wheel is spun, each color is by a different job description—that color person in each group then does that job. The job wheel is turned daily so a new person has that job each day. So, with twenty-eight students, I only have seven people out of their seats getting materials for their group, or seven recorders, writing up their group's findings.

Before class, I divide up the materials so that each group has its own "materials box" with their group's materials in it. The materials boxes are each labeled with a group letter or number and each group is assigned a letter or number. They then have all their materials on one place and the materials manager can easily pick up the needed supplies very quickly and easily.

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A great activity to demonstrate the concept of angle of incidence equals the angle of reflection when teaching about light...

Kevin Wilmot a POC from Harris School in Decatur writes about an activity to build understanding for use with primary and intermediate grade-level students.

Preparation: Find a wall with enough empty floor space in front of it to draw a two to four meter long protractor on the floor. Put an "X" on the wall with tape as close to the floor as possible. Draw a large

semi-circle using the "X" as the center and indicate positions every 10 degrees or so on which students will sit. Label each position from 10 degrees nearest the wall to 90 degrees perpendicular to the wall where the X is labeled. Choose a ball, less bouncy is better.

Activity: Have students sit at labeled spots in a semi-circle facing the wall. If there are not enough spots for whole class, have students take turns. Ask a student sitting at the 20 degree spot on the left to roll the ball to the "X" on the wall. Ask students to predict who, (what number) the ball will roll back to. It should roll to the student sitting at the 20 degree mark on the right side of the semi-circle. Try again with other spots from left and right sides of the semi-circle, until students are able to accurately predict where the ball will roll. Then explain that light is reflected by a mirror in the same way.

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Three teachers wrote to recommend their favorite web sites to help students get organized and find information.

Vince Maccagnano, a Key Leader and teacher at Gwendolyn Brooks College Preparatory Academy, writes to share the web site http://homeworkspot.com. He says that it is a very helpful source for ideas for students, parents and teachers. The students can get help for their homework. Elementary through high school teachers can use it for a side variety of topics and activities. Parents will find links to topics of interest to them regarding children and education.

From the web site:

"HomeworkSpot.com is a free homework information portal that features the very best K-12 homework-related sites together with engaging editorial in one high-utility, educational spot. With the help of students, parents and teachers, our team of educators, librarians and journalists has scoured the Web to bring you the best resources for English, math, science, history, art, music, technology, foreign language, college prep, health, life skills, extracurricular activities and much more. For your convenience, we have made every effort to organize these resources into grade-appropriate categories for elementary, middle and high school.

"HomeworkSpot.com also features a powerful reference center that provides free, immediate access to many of the world's best libraries, museums, and current event sources. Because no homework is complete without a study break, we have also included a wide assortment of fun, mind-stretching, horizon-expanding activities, diversions and events."

Susie Kautzer, a point of contact and seventh grade science teacher at Dupo Junior High School in Dupo, would like to recommend a website called *Quia Web* the address is http://wwwquia.com. For a fee of \$35.00 per year a teacher can have a webpage free of advertising. The students can go directly to your webpage and look at vocabulary word lists, take quizzes, and play games with the vocabulary. Sue says, "I also use it to post assignments for the week. The great thing about it is once you have put in your vocabulary or other information, when you renew the subscription the next year everything has been stored and you can make adjustments for the new school year as needed."

Another helpful site that Sue recommends is http://www.schoolnotes.com. She lists it as a link on her website and posts her class notes there. Since she does not use a textbook this is a great way for students to get notes that they may have missed.

Wayne Schimpff a POC for the Von Steuben Metropolitan Science Center, in Chicago indicates that the *Illinois International High School Initiative* website http://www.ips.uius.edu/ihs/index.php would be of interest to teachers wanting to link their students to the new an exciting field of global education.

### From the web site

Visitors are invited to "explore the first statewide international education program in the nation helping to prepare students and teachers to be globally aware citizens with world-class skills, knowledge, and culture." On the site there are links to various activities and conferences for students and teachers as well as links to the various participating schools.

Wayne also recommends the site *iEARN*, http://www.iearn.org/, an international network of educators who want to share and connect their classes with others classes around the world. Wayne states, that it's a great resource to use to engage students with students in other cultures and in other parts of the world that have the same or similar assignments and concerns.

### From the web site:

*iEARN*, which began in 1988, is the world's largest non-profit global network that enables teachers and young people to use the Internet and other new technologies to collaborate on projects that both enhance learning and make a difference in the world.

If you have lab or classroom management hints, great websites you have used, science activities, lessons, or demos that you have found to be effective with your students, please send them to me electronically at lipscomb@imsa.edu, fax them to 630-907-5893, or mail them to me at 1500 West Sullivan Road, Aurora, IL 60506-1000.

### Write for the Spectrum!

The *Spectrum* is actively seeking articles, tips, announcements, and ideas that can be shared with other science teachers. Articles should be sent to the appropriate Area Focus Editor, listed below. Other submissions and inquiries should be addressed to the Editor, Judy Scheppler, at quella@imsa.edu. Please send all submissions electronically. Further information about writing for the *Spectrum* can be found at: www.ista-il.org/spectrum.htm

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Illinois Mathematics and Science Academy

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### **Book Review**

Richard A. NeSmith

### Skandera, H. & Sousa, R. (2003). *School Figures: The Data Behind the Debate*. Stanford, CA: Hoover Institute Press.

As educators, we are all very aware that *everyone* knows how to teach because: 1) everyone tells us how to do it, and 2) everyone (nearly) has been through the process of sitting through courses and being educated. The "facts" and "figures" however, are not always clear and that which the media



capitalizes on is not always accurately portrayed. We, teachers, each seem to get lost in the microcosm of our own school, our own district, and sometimes our own state. *No Child Left Behind* has now caused even greater concern for education in the entire nation. If we are going to improve we must certainly know the facts...the real facts, and in their proper context. And, of course, we need to know how these facts compare to one another, or if they are even comparable at all. I do not know about you, but I definitely do not have the time, energy, or the desire to track down all the important facts regarding public education in America. Well, the very reason for this sound bite is to tell you *that it has already been done for you*! It is sound (produced by the Hoover Institute, Stanford University), it is current (copyright 2003), it is written in such a way that you do not get lost or confused by the statistics or the analyses. And, guess what? It is very inexpensive for a 342 glossy page, 2-3 color illustrations book (\$15 paperback).

Now, I know that some of you are going to protest that you are not a stats-geek...but with School Figures: The Data Behind the Debate, you do not have to be. Hanna Skandera and Richard Sousa (both research fellows at the Hoover Institute/Stanford) discuss recent findings and the statistics on schools, teachers, achievement, expenditures, school reform, and students and their families. This book came across my desk and though it "seemed" like an interesting subject, I doubted I would do more than reference it. Upon picking it up, however, and thumbing through the glossy pages I found myself pausing to view the graphs, charts and tables. Before the day was ended I had picked it up several more times and...well, the rest is history...I could not put it down. I not only found it easy to follow and understand, I consider it factual and rather nonbiased in its analyses. Much of what the media provides about education to the American consumer is, without saying, biased and agenda-ridden, and is nearly always only a piece of the truth generally taken out of context. School Figures assist the reader in comparing apples with apples. Such current concerns and controversies as whether a teacher shortage exists, the report card on charter schools and how they affect the educational system, home schooling, test scores and how they relate to achievement, the trend in school spending, and how family demographics affect your students and their schools. With over seventy figures and seventy tables this book is easy to read, easy to comprehend, and will help educators get a proper perspective on what research on education has revealed on our nation, the states, and our own educational domicile. I see that I will truly be referencing this text in the future...especially now that I have 16 ounces of yellow highlighter on the pages from cover to cover. I do recommend that every teacher and every educator secure a copy of this text. I do not know if I have ever owned a copy that was so "chock-a-block" full of useful information. This has been the best \$15 I have spent this summer. This book, and others, can be order online at: www.hoover.org or http://wwwhoover.stanford.edu/publications/books/schoolfigures.html

## Articles

### Physical Science Resources for Preschool and Early Elementary School Teachers

Jean Paine Mendoza Millikin University

Between birth and age 8, children learn about physical phenomena by interacting with objects around them.

Three-year-olds Min-Yung, Sinwoo, and Eddie, all native Hongol speakers in an American preschool, have spent several minutes on an outdoor bowling game introduced by their teacher. They have almost mastered predicting and controlling the path of the rubber ball they aim toward nine cardboard tubing "pins"; most of the time, they knock down at least a few pins. Min-Yung notices that the tubes roll when Sinwoo accidentally kicks them. "Watch!" he calls to his companions, grabbing a tube and running to the top of the playground's low hill. He leans over and releases the tube. It rolls toward Sinwoo, who blocks it with her feet. All three laugh. Eddie grabs a tube, climbs the hill, and calls out to Sinwoo: "Catch it!" His release goes awry; he pushes the tube instead of just letting go, and it bounces downhill several feet to Sinwoo's right. "Oh!" Eddie groans. "Funny Eddie," exclaims Min-Yung. The trio continues to roll cardboard tubes in various ways until the teacher announces the end of outdoor play.

Ms. Burns and her first grade class are clustered around a playground climber. Each child carries a recloseable plastic bag. Every bag contains a raw egg, surrounded by some kind of packing devised by the child who carries it. One by one, the students ascend the climber and drop their bags onto the gravel below. They scramble down and retrieve their bags, rushing to see – "Did my egg break? Did yours?"

Motion, force, trajectory, speed, gravity, inertia - lecturing about such topics to preschool and elementary-age children has never been especially fruitful. Instead, a great deal of evidence suggests that between birth and age 8, children learn about physical phenomena every day by interacting with objects around them. They move about, they touch things – pushing, pulling, dropping, throwing, mixing, building, demolishing, observing - and as they do so, they begin to notice and speculate about connections: correlation and possible causation. They gain a great deal from opportunities to use rollers, balls, pulleys, levers, inclines, pendulums, tubing, magnets, water, and so on. Through trial and error, they form their own hypotheses about how things work. Teachers have much to contribute to such experiences and learning, particularly in classroom environments that are set up to invite the children into investigations.

Even so, teachers of preschool children and elementary students sometimes feel more comfortable with so-called "nature study" than with venturing into the physical sciences. In fact, experience indicates that resources about nature study outnumber those that focus on facilitating learning in other scientific domains during preschool and the elementary years; activities aimed at middle school and high school classrooms are often too technical and perhaps even too hazardous to be adapted for younger children. This article offers a small sampling of print and web resources than can help preschool and elementary teachers plan rich and engaging physical science investigations.

The Web site of the National Association for the Education of Young Children (NAEYC) features some articles related to physical sciences in the early childhood curriculum. They include:

- Learning Through Water Play http://naeyc.org/ece/2003/03.asp

- Color and Light Integrated Planning Wheel http://www.journal.naeyc.org/btj/200209/ CLPWheel.pdf

- Celebrating a Young Learner at Work: Marcus the Scientist http://www.journal.naeyc.org/btj/200309/

- CelebratingAYoungLearner.pdf (Users with older computers may find that these pdf files load slowly or irregularly.)

Teachers and caregivers who want to address the Illinois Early Learning Project through preschool physical science activities can make use of Web links provided via an online version of the Standards (http://illinoisearlylearning.org/standards/ index.htm). Users can connect from any Benchmark to a list of Internet resources selected by the staff of the Illinois Early Learning Project (IEL). Among the Tip Sheets produced in the past year by the IEL staff are three that provide simple instructions to caregivers and preschool teachers for activities in the physical sciences:

- Out and About with Preschoolers: Science in the Built Environment http://illinoisearlylearning.org/ tipsheets/built.htm

- Playground Physics: Hang In There! http://illinoisearlylearning.org/tipsheets/physicshang.htm Resources about nature study outnumber those that focus on facilitating learning in other scientific domains during preschool and the elementary years.

- Playground Physics: Watch for Falling Objects http://illinoisearlylearning.org/tipsheets/physicsgravity.htm

One need not be knowledgeable about Jean Piaget's work to find ideas for potentially rich activities in *Physical Knowledge in Preschool Education: Implications of Piaget's Theory* by Constance Kazuko Kamii and Rheta DeVries (1993, Teachers College Press). Among of the strengths of this book are its emphasis on creating environments that facilitate children's investigations, and the expectation that teachers closely observe children at work and ask thoughtful questions to gain insight into what the children are thinking about their experiences.

The Regents Center for Early Developmental Education at the University of Northern Iowa maintains Web pages devoted to activities that are related to those discussed in the Kamii/DeVries book. Their list of online activity sheets can be found at:

http://www.uni.edu/coe/regentsctr/ classroomactivities.html. Titles include *Blowing Activities*, *Boards and Rollers*, *Commercial Physical Knowledge Games*, *The Pendulum*, *Water Activity*, and *Target Ball*. Some Regents Center pages may be slow to download; users may have better luck with html than with the pdf versions.

The above preschool-oriented resources tend to focus on children's open-ended explorations,

during which adults support learning primarily by providing materials, time, and by asking questions to help children think critically about what they are doing, often guiding them to further investigation of their own ideas and theories. A number of other resources focus on helping children acquire specific physical science knowledge; such as learning about turbines or finding out about friction.

The official Website of the American Chemical Society (http://www.chemistry.org), for example, features a number of suggestions for hands-on activities aimed at elementary age children on their "Wondernet" pages (http:// www.chemistry.org/portal/a/c/s/1/ wondernetdisplay.html?DOC=wonder net\topics\_list\index.html). Titles include Different Slides, Different Rides; The Bookland Bridge; and Friction: A Hot Topic. The online instructions have been adapted from two books produced by the American Chemical Society: The Best of WonderScience Volumes 1 and 2. Educators who would like to own the books, which include hundreds of classroom activities, can order them from the chemistry.org Web site.

The Eisenhower National Clearinghouse Web site (http://www.enc.org) features, among other things, articles by and for teachers of children in kindergarten through early elementary school. Among the articles containing ideas for physical science activities are the following:

#### - Physics Fun

http://www.enc.org/features/focus/archive/across/ document.shtm?input=FOC-002776-index

- Teaching Activities and Standards for Each Grade Band

http://www.enc.org/features/focus/archive/ chemistry/document.shtm?input=FOC-003516index

- Basketsful of Math and Science Learning http:// www.enc.org/features/focus/archive/across/ document.shtm?input=FOC-002782-index The physical sciences are natural sites of inquiry for preschool and early elementary age children.

Classrooms using the Project Approach often become involved in across-the-curriculum studies with strong physical science components. Examples can be found on the Project Approach Web site (http://www.project-approach.com): The Clubhouse Project (preschool) http://www.project-approach.com/examples/ previous/clubhou.htm The Water Project (second grade) http://www.project-approach.com/examples/ previous/water.htm

Of course, no activity is guaranteed to generate interest on the part of the children in a classroom, no matter how authoritative its source may be or how enthusiastic the response of other teachers. If one idea doesn't "take off", try something from another resource. Follow the students' ideas and interests, too. The physical sciences are natural sites of inquiry for preschool and early elementary age children.

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### Building Bridges to Success by Building Relationships Richard A. NeSmith

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Relationship building seems more and more significant in motivating and facilitating student learning than we ever knew.

As you read, this summer is over or at least the summer holidays. The summer heat, however, is not. Amazingly, we have witnessed the entire country in a heat wave nearly unprecedented since our keeping of weather records. One can only wonder how anyone could question the existence of global warming. In all probability, the weather will continue to be sporadic. Sporadic is a word that us middle school teachers know a lot about. It is the unpredictable stage of preadolescence-adult one moment and child the next. It is a fun age, though, you have to admit. Actually, if you did not admit it you probably would not be teaching at the middle level. But the middle level learner is so "cool" and has so much potential, and yet, I always wondered just how much science content was I able to teach my students. We can test, assess, drill, elaborate, and test some more, but the real bottomline results will not be known for many years.

Have you ever noticed that years later when students return to you (and, admittedly the number is usually quite small) that they do not come back to you to tell you what a wonderful job you did on the DNA transcription and translation units? They never do. Instead, they talk about the "good times" they had in class, the friendships, the embarrassing moments, special times, and specific victories in their own lives. I suppose I have become a student of the relationship-building/bond that occurs between a teacher and a student. It seems more and more significant in motivating and facilitating student learning than we ever knew. It just seems that we all need someone who believes in us. someone who will be our friend even when we fail, and someone to give us a chance and yet accept us as we are. Not to sound too emotional or gushy, we truly need to recognize that the cognitive domain is only a *piece* of the puzzle...it is not the puzzle. Bloom's taxonomy, which you all remember (as you roll your eyes), also included the affective and the psychomotor domains. In the past the psychomotor tended to be restricted to being a physical education application, however, the implementation of handson activities in our classes has certainly adapted and adopted the psychomotor domain in this respect. In the past the affective domain, the somewhat forgotten step-sister, like Cinderella, was fairly neglected if not forgotten. Research is now beginning to recognize a puzzle-effect of the three domains and that the affective domain is just as important as the cognitive. Yeah, I know...you are thinking, "Tell that to NCLB." Well, it is true; we cannot address the cognitive domain unless we also address the affective domain. Feelings, emotions, preferences, attitudes, sensitivity, reactions, attachment, behavior patterns, and so forth. may not be "testable" but are all windows that can be used by the science educator to apply to, and with, the cognitive. This, among other things, causes relationships between a teacher and his or her student to be a vital chain in the opaque, and sometimes frustrating, business we call education. Knowledge is certainly vital...but so is the list of characteristics above. Knowledge alone will not

create a life-long learner. Building relationships, however, with students, will create bridges from the unknown to the known. Yes, we are science teachers and we teach science and we teach students. But building a relationship with students creates the bridges necessary to helping them to be successful in life...even if they never remember the parts of the flower, or the differences in simple and complex machines.

I suppose my goal with this rambling is to encourage each of us to stop and realize this new school year how important our calling is, and how important teaching science is to our hormonallycharged, high-energy preadolescents. And, yet, to recognize that the power and influence I have on students, regardless of their race, socio-economic status, or IQ, is predominantly fostered by my attitude, response, and empathetic concern for each individual, not to mention my desire for their success. The power I have is actually the power of influence. If I can reach a student by building a relationship with that student, then that student can walk over that bridge from the middle/junior high school to the high school and, then beyond. So much can be established at the middle level...it is pivotal and thus worthy of our efforts and our investment. Building bridges is all a matter of building relationships. I teach the graduate level endorsement courses for middle level. Students, mostly practicing

teachers, are often surprised at how much of the middle level concept is based on building relationships.

In closing, here is the challenge. We all build some relationships, but there are some students that we may unofficially give up on or simply avoid. Let this new school year be a challenge for you to reach out to those "unlovelies" and to try to win them back into the fold. Challenge them, be firm with them, be open with them, but encourage and accept them as they are. When your students enter the room and begin working on the various assignments and activities that you have creatively designed (all summer? < laughing>) just for them, look around and begin to note those who just do not want to be there. Make them your "mission" for this year. Make yourself a few goals and benchmarks to remind you that you are going to reach the nonchalant. It can be done. I have done it. You have done it. And, we need to be doing a lot more of it. It really is part of our calling. Once you begin to see a ray of light, a speck of hope, then you are well on your way to having a great year. And, I know it will be a great year.

If you are interested in submitting your "victory" stories of how you have reached the uninterested, apathetic, and indifferent student, send your stories to me at BioScience\_Ed@yahoo.com.



### Home-School Links: Take Home Game Boards Frances Steward<sup>1</sup>, Diana Goff<sup>1</sup>, Sandra Hebert<sup>2</sup>, Michael Bradford<sup>3</sup>, Christina Moran<sup>1</sup>

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Family take home game boards help to make parents aware of the content being taught in the class-

### room.

#### Abstract

This paper exemplifies how to design takehome game boards for sixth graders and their parents so that they may develop positive, nurturing relationships and support school learning and retention activities. Adolescents enjoy competitive interaction with the diverse abilities of parents and family members. Game boards are entertaining and replace drill and practice for assessment of content recall, math calculation, and problem-solving skills.

#### Introduction

Berger (2004) recommends that homelearning activities concurrently match the instructional unit of study. As family members play content games with take-home game boards, children discuss meaningful applications learned in the classroom; paraphrase definitions in their own words; and share their understandings of unit concepts. Parents are given the opportunity to observe their children using information at an independent level and can determine exactly what is needed for review. Interactive game playing exemplifies "socialization methods: affective, operant, observational, cognitive, socio-cultural, and apprenticeship" (Berns, p.42, 2004).

Preset learning games are exemplified in the Frog Family Fun-Pack Set located on the web,http:/

/www.from.com. Each set consists of twenty-four week parental involvement, homework, or test preparation program. The games are appropriate for cross-grade level enjoyment. The playing cards have clear, well-written instructions in English and Spanish. The sets may be organized in a check out process or distributed for Family Fun Nights at school.

We concur that content game boards complement cross-curricular learning, academic support, and the child's subject-matter retention. Gunning (2005) categorized and defined one method for content retention as "rehearsing is....repeating something so as to remember it" (p. 279). In the take-home game board process, family members and children are repeating information in the following processes: 1) recall; 2) application; 3) examples; 4) context clues; and 5) interpretations.

In a game format at home, children are reviewing content knowledge in a risk-free learning environment. Playing games provides kinesthetic experiences as players practice effective listening skills advancing on the board. Inquiry and problemsolving skills are developed using various questioning types (Heil et al 1999). Games enhance content and concepts as students experience excitement, laughter, and joy of learning within the aesthetic domain. The game boards have built-in rewards for correct responses as the players move through the interactive paths. Family members may interact for the purpose of positively reinforcing their child's accuracy or giving spontaneous feedback.

Berns (2004) purports that individuals use personal traits as they interact with key persons to develop successful socialization outcomes. As family members and children progress along the paths of their science-math games, the interactive dialogue and success bonds special traits of academic security, increased confidence, and realistic value in learning. Mike Bradford, now a teacher at Monmouth-Roseville Junior High School in Monmouth, IL shared his home-school support using game boards in science. He believes in building classroom and home communication links as well as academic involvement.

#### Purpose

The main purpose of using science-math game boards is to help students reinforce and review the science-math concepts that are being studied (see Figure 1).

Family take-home game boards help to make parents aware of the content being taught in the classroom. Parents want their children to be prepared for school, and using game board activities allows parents to be that key person for instructional preparation in an innovative alternative strategy. Quality bonding time through family fun occurs just as a game of *Trivia* could motivate and supplement academic knowledge. Parents may not be qualified teachers but they can provide early experiences of guiding their children in cooperative activities at home (Barbour, Barbour, & Scully, 2005).

#### Adaptations

Take-home game boards can be used throughout the school year by adapting facts on the game board to the current instructional unit. Game boards may be considered as strategic frameworks in science or math. While keeping the same procedures, frameworks are cross-curricular; use higher-order thinking skills; and may change content; therefore, the game boards are strategic in nature. In following Barclay's (1996) examples of home learning activities, an alternative method for sending home the game boards would be to place them in "Take Home" bags. Each bag would contain a game board with a laminated card of directions for playing and returning the game. Home learning activities should be simple to follow, user friendly with minimal guidance, and include teacher-supplied materials (Barclay, & Boone, 1996).

#### **Parent Participation**

Parents or family members are actively involved in the activity by actually playing the game with their child. As they play, they receive a refresher course in science-math. The adults or older siblings in the game may be explaining, giving examples, creating other statements or terms similar to the game board items. To reinforce the concepts, it is worthwhile for students and parents to discuss mathematics (Stenmark, Thompson, & Cossey 1986). Discussing vocabulary for example in meaningful experiences that have been shared by the parents and child may enhance understanding and interpretation of the unit's concepts.

#### **Science Game Board Procedures**

The game board is sent home with a student approximately one week before the upcoming science test. The rules of the science-math game are quite simple. To begin the game, each player will roll the die. The player with the highest number will go first. Once the player has moved his/her token to the new space, the directions must be followed then a science-math question is given and answered. If the question is answered correctly, the player stays on the new space; however, if the player misses the question, he/she must return to the original space. Then the next player takes a turn. The player who reaches the *Finish* line first is declared the winner. Winner rewards are optional and available in the take home plastic bag.

Mike Bradford tells the students to have their parents sign the game board if they played the game with them. The student will then bring back the game board on the day of the test and receive ten extra credit points. (A slight variation is to have student-designed game boards for reviewing content.)

#### **Instructional Role Models**

Using strategic game boards becomes a successful means of role modeling at home with parents' coaching their children in concepts and skills. Mike Bradford exemplified role modeling of game board use with his Western Illinois University, pre-service teacher, Christina Moran. Christina learned the value of using strategic, science-math game boards and designed a Measurement Path game board. The Measurement Path game explored weather scales, weight, historical culture, story connections, and functional use of measurement. Students were able to learn concepts prior to calculations, then enjoy risk-free practice with both

Take-Home, Science Game Board: Vertebrates											
<u>Start</u>	Giv exa mar	ve an Define mple of a vertebrate mmal.		Bi bre wit	Birds Take a <u>I</u> breathe breath with ( ). and relax.		(. <u>Mo</u>	ove back e space.	Amphibiar have slimy ( )skin.	IS ,	Give an example of a reptile.
								Fish are ( ) blooded.			
											Give an example of a bird.
Give a examp an amphil	n ble of bian.	<u>Move</u> forward <u>three</u> <u>spaces</u>	<u>T or</u> Birds egg	⁺ <b>F</b> lay s.	A ma is ( blood	mmal ) ded.	Give exai of a	e an <u>(</u> mple <u>1</u> a fish.	<u>Go back</u> wo spaces		Reptiles breathe with ( ).
Mamm bodies covere ( ).	nal's are ed in										
<u>T or</u> A turtle reptile.	<u>F</u> is a										
<u>Roll</u> agair	<u>ı.</u>										
<u>T or F</u> Fish giv live birt	ve h.	<b>T or F</b> Most reptiles lay eggs.	Eating birdseed take a break.	Nan 5 cla vert	ne the asses o tebrates	Fish liv f in ( ) s	e <b>№</b> ).	love up_ two spaces.	Most fish bodies are covered with ( ).	;	Reptiles have( ), scaly skin.
	Birds are ( ) blooded.					lirds are() looded.					
Pare	ent S	ignature_								-	<u><b>T or F</b></u> Toads are amphibians.
Finish	A H ma	<b>or F</b> numan is a ammal.	Give ar exampl of a rep	e A tile. c	T or F All birds can fly.	Mov back th space	e Iree Is.	Gone fishing to relax.	<u>T or F</u> Snakes a amphibia	are ns.	Take a break and observe nature.

Figure 1. Take-home scinece game board: Vertebrates



Figure 2. Take-home game board: Measurement Path

concepts and calculations on the Take-Home Game Board: Measurement Path (see figure 2).

In a sealed envelope, parents are provided a letter that requests their participation in playing the game with their child, provides the purpose for playing the game with step-by step directions, and lists the materials for playing the game. Attached to the letter is an answer key for the response items on the game board. Also, additional game board questions are provided for replaying the game. The parent letter, the game board copy, materials (spinners and player pieces), blank game board copies for replaying with new questions, and winner rewards are placed in a take-home plastic bag that is sent home with the student one week prior to the testing week.

### **Math Game Board Procedures**

Put your markers on the square, *Start*. Move on the squares, follow directions, calculate the answer, and tell other players to check for accuracy. Players are to return to *Start* when an answer is incorrect whereas in the science game boards, players returned to a previous space. Response questions are used from the Draw A Card stack (see figure 3). Players with incorrect responses return to "Start." Chance cards were placed on the path for the player to move backwards and to advance forward to gain a reward. The first player to reach the square," Finish," is the winner and may receive an award that is provided by the teacher in the takehome plastic bag.

### **Three-fold Learning Benefits**

The first benefit achieved by the use of takehome game boards is to increase the communication of the teacher/parent and parent/child. Parents can see whether their child has learned the expected science-math concepts in the classroom and discuss them with their child. Just little bits of information can be shared during or after playing the game. The



Figure 3. Sample questions for draw-a-card/take-a-chance.

second benefit is that the game boards are a fun way to reinforce science-math concepts. Students often view this as playing rather than actual learning. Finally, the game boards help to increase the amount of time spent on learning science-math content. This is important because in many classrooms science may be under taught due to the hectic schedules of elementary teachers.

#### Summary

Parents, students, and teachers enhance learning and study time by using strategic, takehome game boards in science and math. The game playing is motivational and rewarding; thereby, a bond of appreciation is instilled for academic concepts at the knowledge and application levels. Communication between home and school is established by sending the game boards that match concepts in units of study with game questions and responses for parents and children to enjoy. Parents and teachers, alike, are instructional role models as they interact with students. We, the authors, challenge you to design school-home game boards to reinforce content retention and enhance student learning.

### References

- Barclay, K.H., & Boone, E. (1996). The parent difference: Uniting school, family, and community. Arlington Heights: IRI Sky Light Training and Publishing, Inc.
- Barbour, C., Barbour, N.H., & Scully, P.A.
  (2005). Families, schools, and communities: Building partnerships for educating children (3<sup>rd</sup> ed.). Columbus, OH: Merrill-Prentice Hall.
- Berger, E.H. (2004). Parents as partners in education: Families and schools orking together. Columbus, OH: Pearson-Merrill Prentice Hall.

Berns, R.M. (2004). Child, family, school, community: Socialization and support, (6<sup>th</sup> ed.). p.42. United States: Thomson-Wadsworth.Frog Family Fun-Pack Set. Retrieved on August 7, 2004, http:// www.frog.com Gunning, T.G. (2005). Creating literacy: instruction for all students, (5<sup>th</sup> ed.).
p. 279.Boston: Pearson Education Inc.

Heil, D., Amorose, G., Gurnee, A., & Harrison, A. (Eds.). (1999). *Family science*. Portland, OR: Portland University.

Stenmark, J.K., Thompson, V., & Cossey, R. (1986). *Family math*. Berkeley, CA: Regents, University of California.

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### Digital Information Fluency - An Integral Component of Science Education in the 21<sup>st</sup> Century

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Digital information fluency is the ability to find, evaluate and ethically use digital information efficiently and effectively.

Digital information fluency (DIF) is the ability to find, evaluate and ethically use digital information efficiently and effectively. DIF involves knowing how digital information is different from print information; having the skills to use specialized tools for finding digital information; and developing the dispositions needed in the digital information environment.

### **Digital Information Fluency: Why Is It Important?**

There are compelling reasons why science teachers and their students need to become skilled users of the Internet and online resources.

### Ready or Not, Online Sources Beginning to Dominate

According to a three-year study conducted by the Electronic Publishing Initiative at Columbia University, electronic resources have become the main tool for gathering information. Stated in the UC Berkeley's School of Information Management and Systems, "How Much Information?" 2003 Study, "Ninety-two percent of the new information was stored on magnetic media, mostly in hard disks." The new publication, *Guiding Student Research*, published by the National Consortium

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for Specialized Secondary Schools of Mathematics, Science and Technology, dedicates an entire chapter to e-research stating, "Electronic resources allow students unparalleled access to information and a plethora of new data, both unavailable a decade ago." This is also true for day to day activities as anyone who did their taxes has realized that you must go to the internet to find instructions and forms. Given these trends, the citizen of the future must be able to locate, evaluate and use digital information to survive in whatever profession they pursue.

### Manage Vast Amounts of Information

Google, the operator of the world's most popular Internet search service is partnering with the nation's leading research libraries to convert their holdings into digital files that will be freely searchable over the Web. Now more than ever, students need help in managing vast amounts of online information.

### Improve Student Test Scores

High schools with computers that connect to library catalogs and databases average 6.2% improvement on ACT scores. The presence of more library computers is associated with 8% improvements for fifth and eighth grade ISAT reading scores and almost 11% for eighth grade ISAT writing scores. (Powerful Libraries Make Powerful Learners – The Illinois Study February 2005)

### Get Ready for Formal Testing

The growing relationship between academic success and digital information fluency is prompting a wave of formal testing. The Educational Testing Service (ETS) recently announced the launch of the ETS ICT (Information and Communication Technology) Literacy Assessment, a simulationbased testing program that measures postsecondary students' ability to define, access, manage, integrate, evaluate, create and communicate information in a technological environment. In addition, the No Child Left Behind Act includes the goal that every eighth grade student be technologically literate.

### User Beware

A 2002 study directed by BJ Fogg, a Stanford psychologist, found that people tend to judge the credibility of a Web site by its appearance, yet anyone can put up a Web page in minutes. There are no rules and no safety nets. The online presence of hoax Web sites, fraudulent information and deceptive practices abound. Online users need skills and expertise in evaluating the credibility of online resources.

### **Defining the Core Competencies of Digital Information Fluency**

Certainly millions of students, teachers and librarians are already using the Internet for learning and communicating. But do they have the skills to locate information with precision and evaluate the credibility of their findings? What does it mean to be an expert in Digital Information Fluency? A team from the Illinois Mathematics and Science Academy (IMSA) set out to define the core competencies of Digital Information Fluency.

Digital Information Fluency involves a specific problem-solving process (see figure). DIF is similar to other iterative problem-solving processes such as the Big6, the scientific method, or the writing process.

#### **Diagram: Digital Information Fluency Process** Model



### DIF involves knowing how digital information is different from print information.

Listed below are the core competencies that every learner should be able to demonstrate to function successfully in the digital information environment. The competencies correspond to the five phases of the DIF process.

### What information am I looking for?

-Learners create effective and efficient search queries;

-Translate a natural language question into a search query;

-Develop and apply vocabulary building strategies to effectively conduct a digital information search;

-Revise their search queries based on search results/feedback.

### *Where will I find the information?* Learners effectively and efficiently:

- Select digital collections,

- Select visible Web collections (and subcollections),

- Select invisible Web collections (and subcollections),

- Select other digital collections (and subcollections).

### How will I get there?

- Learners select digital search tools based on their effectiveness and efficiency;

Select features of a variety of digital tools based on the probability of effectiveness and efficiency;
Select appropriate search strategies to effectively and efficiently locate reliable digital information related to their academic learning goal(s);

- Learners apply appropriate search strategies to efficiently locate reliable digital information related to their information goal(s).

### How good is the information?

Learners evaluate the usefulness and quality of digital Information effectively and efficiently;
Evaluate the quality of a search result to determine its usefulness in the search process;
Evaluate the quality of a search result to determine the reliability of its content.

How will I ethically use the information?
-Learners ethically use digital information,
- Decide whether or not to integrate digital information related to a specific information task,
- Give credit to the source and/or author for the selected digital information.

### DIF involves having the skills to use specialized tools for finding digital information.

### Illinois Educators Become Power Users of Digital Information

Thanks to a Grant from the U.S. Department of Education – Funds for the Advancement of Education, the Illinois Mathematics and Science Academy (IMSA) has enrolled more than 700 Illinois educators in free workshops and online courses to learn the art of locating, evaluating and using Internet resources in the classroom. These professional development opportunities enable teachers to:

• Understand how Internet search tools work.

- Save time while searching.
- Increase the relevancy of results.
- Search the "Invisible Web."
- Evaluate Internet resources.
- Learn about citation methods and copyright guidelines for using online materials.
- Use free IMSA Internet tools and resources in their classrooms.

• Earn CPDUs or university graduate credits.

### Learning by Doing

Participants learn by doing in the skillsbased interactive workshops and online courses. They learn to become successful Internet searchers by applying strategies with a disciplined focus. That means understanding how to "search" the Internet instead of just "browsing" the Internet by using carefully chosen key words and by narrowing domains and time periods. It also means knowing how search engines work to determine what resources "can and cannot" be found on the Web. "Before I just felt like I would surf for hours and get little accomplished," said teacher Kelly Mulcahy of Woodrow Wilson Middle School, Moline. "Now I have more confidence searching and maximizing my time spent online. The kids love getting online and it is something we as teachers need to become more in tune."

### **Evaluating Internet Resources**

When conducting academic research, the ability to evaluate the validity and reliability of Internet resources is critical. Participants learned how to do just that. They examine the validity of the host Web site and related links, the expertise of the author and whether the author is also cited in other reliable publications. An evaluation process is needed because Web pages do not undergo the same rigorous selection process that is typically applied to information that appears in print publications. "Students no longer have access to preapproved information. This is both the scary and exciting part," said Learning Resource Center Director Daniel Russo of Batavia High School. "In life outside of school, students will have to face a whirlwind of good and bad information and we need to help them learn the skills to deal with it."

### Putting Skills to Work in the Science Classroom

Once teachers learn the art of finding good resources on the Internet, the real test and rewards come in using the knowledge to create dynamic lessons plans. That's just what happened when Belinda Veillon and media specialist Jane Larson from Nippersink Middle School in Richmond, Illinois co-designed a unit to teach sixth graders how to find sites with credible information on nanotechnology. This project, along with others in forensic science, plate tectonics, physics in sports, inventors and inventions, and other subjects appear on IMSA's Web site.

### A Center for Continuing Education

After Illinois educators complete the courses and workshops, the IMSA Web site (http:// 21cif.imsa.edu) is a hub for continuing education and community building. "While the formal courses and workshops are key components of the project, the Web site is a source for ongoing professional development," said Bob Houston, IMSA project director for 21<sup>st</sup> Century Information Fluency.

For example, the Web site features nearly 50 "MicroModules" which are short, online tutorials that cover a wide range of Internet topics about finding, evaluating and using Internet resources in a learning environment. Taking only 10-20 minutes to complete, the modules can be used anytime by anyone from sixth grade through adult learners.

The Web site's Community Center enables educators to become part of an online community where they can share ideas, problem solve and network. Here educators can be part of a weekly discussion forum, join a newsletter mailing list or visit a photo gallery of 21CIF members.

To learn more about the program offerings, visit http://21cif.imsa.edu . Funded by a grant from the U.S. Department of Education – Funds for the Improvement of Education, IMSA's 21<sup>st</sup> Century Information Fluency instructional programs and services are free of charge to Illinois educators.

### **References:**

Fogg, B. & Makovsky and Company.

Investigating what makes Web sites credible today. Stanford-Makovsky Web Credibility Study 2002. Retrieved February 15, 2005, from Web Site:http:// captology.standford.edu/pdf/Stanford-MakovskyWebCredStudy2002-prelim.pdf

Lance, K. (2005). *Powerful libraries make* powerful learners – the Illinois study.

### DIF involves developing the dispositions needed in the digital information environment.

Canton, IL: The Illinois School Library Media Association.

- Lyman, P. & Varian, H.R. (2003, October 30) How Much Information 2003. Retrieved July 30, 2005, from Web Site: http:// www.simsberkeley.edu/research/projects/ how-much-info-2003/
- Norman, C. (2004) CNI Spring 2003 [power point presentation]. *Epic: Online Use & Cost Evaluation Program*. Retrieved August 19, 2005, from Web Site: http:// www.epic.columbia.edu/eval/ eval04frame.html
- Thomas, J., & Scheppler, J. (2004). In guiding student research: making research happen in your school. *E-Research*, Lynchburg, VA: National Consortium of Specialized Schools of Mathematics, Science and Technology.
- Zeller, Jr., T. (2005, January 17) Measuring Literacy In a World Gone Digital. The New York Times Archive, January 17, 2005, Monday . Retrieved February 3, 2005, from Web Site: http://query. nytimes.com/gst/abstract/. html?res=F5071EF63E5C0C748 DDDA80894DD404482

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### Getting the Most Out of Field Trips: What Do We Do? What Should We Do?

Kent Schielke Ss. Peter & Paul School

... learning in a museum, as distinct from a classroom, is generally self-motivated and experiential ...

#### Field trips – Why do we take them?

Science teachers use field trips at all levels in the belief that out-of-classroom experiences will broaden and strengthen our students' learning by making a given subject, or a given aspect of a subject, more concrete; to allow students to see "real world" applications or examples; to allow them to "have fun" by a novel experience or in a novel setting; or simply to provide for a change in the school routine. We try to provide learning that can't be experienced or replicated in the formal classroom. Museums, in particular, are frequent destinations of science field trips, and beginning with the founding of the San Francisco Exploratorium in 1969, there has been a great increase in the number of specifically science-oriented museums, particularly "hands-on" museums.

Within the same period of time, there have been several studies of the learning process in museums; the practices and methods of conducting field trips; and the practices and methods by which learning on field trips may be enhanced or optimized. The combined research in science education and museum education indicates that teachers will increase the chances for learning by their students by using a variety of types of preparation prior to the field trip, methods of actually conducting the field trip, and reinforcing and follow-up activities following the field trip. But to what extent do we actually use the practices suggested by such models in our field trips? Do we see any connection between the success or failure of field trips, and the methods and models suggested by the research?

Field trips present logistical, safety and liability issues for schools, teachers and parents, and take students away from the normal schedule of formal classes. They can be expensive, and require a great deal of time and effort to organize, plan and carry out. All interested parties, especially we teachers, should be confident that field trips will yield the benefits they are believed to provide, and to be able to articulate what those benefits will be. But are those benefits actually being realized, and can we demonstrate them? Can we, do we have confidence that our field trips are "successful?"

#### A survey of field trips and teacher practices

The use of research-supported practices and the perception of success were the subject of a survey I conducted in May, 2003, with the cooperation of SciTech Hands-On Museum, in Aurora, as a part of the research for a master's thesis at Benedictine University. Teachers who took field trips of students in grades four to eight to SciTech during 2002 were surveyed on the demographics of their school and students; the purpose of their field trip; the practices used before, during and after the field trip; and their perception of how successful the field trip was in relation to the stated learning objective (if any) of the field trip.

SciTech is a community-based, children's hands-on science museum, and is based in a former post office building in downtown Aurora. It is situated on two floors of generally open space, and consists of an extensive number of exhibits for hands-on activities, primarily intended for children ages 6 to 14. The majority of exhibits illustrate

phenomena related to the physical sciences, such as sound, optics, electricity and magnetism, motion, properties of gases and liquids, and clouds and lightning. Elementary and middle school teachers regularly bring groups of students to SciTech for science field trips.

Eighty-two teachers who teach one or more daily science classes in fourth through eighth grades were solicited for the survey. Each of the potential participants organized and led at least one science field trip to SciTech sometime during the school year in 2002. Twenty surveys were returned from eighteen separate schools. All of the solicited and responding participants were in schools in one of the following: the City of Chicago; the six county Chicago suburbs; downstate Illinois cities, and downstate smaller towns or rural areas. The majority of respondents were from the Chicago suburbs.

Of the twenty respondents, eight taught fourth grade, one taught a combined fourth / fifth grade, three taught fifth grade, one taught a combined fifth/ sixth grade, and three taught seventh grade. Therefore two-thirds of the responses were related to students in the fourth and fifth grades. Respondents taught in eleven public schools and seven private schools. Sixteen taught in schools with enrollments of 500 or less; sixteen taught in K-5 or K-8 elementary schools; and sixteen taught in schools in the Chicago suburbs. Only one taught in Chicago and the remaining three in downstate locations.

Fourth through eighth grade groups were chosen from the pool of visiting groups because most schools begin teaching science as a discrete subject only at grade four and above. I also confined the survey to students studying general science rather than specific topics such as biology or physics and for this reason excluded student groups of high school age. In addition, any high school groups would be older than SciTech's target audience.

Beyond general demographics about the respondent, and his or her school students, the survey focused on the following questions:

1) The specific purpose of the field trip, if any, and in particular if the field trip had a specific learning objective;

2) The use or non-use of specific practices used with the students prior to, during, or after the

field trip (formulated and condensed by me from the research literature); and

3) The respondent's perceptions of (a) either the enhancement or hindrance of success by the specific methods or practices used, if any, and (b) the success of the field trip as a whole in the achievement of the trip's purpose.

#### How (and what) children learn in a museum

Previous research indicates that learning in a museum, as distinct from a classroom, is generally self-motivated and experiential, and is socially mediated for children by adults, that is, filtered through the adults' knowledge and experience, and explained or discussed by the adults according to their assessment of children's prior knowledge and experiences. Children spend more time at exhibits and converse more specifically about the content and characteristics of an exhibit when they are with familiar adults mediating the experience than when they are alone, and appear to learn more together in a collaborative manner.

The conversations and interactions among children at a museum indicate that their sharing of mental models is a beneficial social construction of knowledge, by acting as a group to adjust to new information, sharing personal experiences connected to the museum events, and asking each other questions. Researchers suggest that this sharing allows them to test and challenge each other's models to arrive at an explanation satisfactory to the entire group.

A museum visit by itself may not provide enough time to change misconceptions about specific scientific ideas since most children will not give up a favored misconception without the time to discover it themselves, and at the same time, field trips have the potential for overloading students with new information and creating new misconceptions. So prompt follow-up to a field trip is necessary, whether in the nature of post-tests, comparison of before and after concept maps, or the attempted construction or replication by students of the museum exhibit or phenomenon observed, so that misconceptions can be assessed and promptly corrected.

#### How field trip learning may be enhanced

Researchers note the problem of the novelty factor of a museum or other non-classroom setting, which potentially distracts from learning for students by forcing them to take time to become familiar with the physical setting and the skills and processes needed for that setting. Without some prior preparation that creates a context for the museum exhibits to be observed, students will be distracted by questions like the location of the restrooms, or where and when they will eat lunch. How can we lessen or eliminate this sort of distraction? Pictures, slides, maps, diagrams, samples of museum materials, and information about the field setting or museum will aid in increasing familiarity prior to a field trip.

Researchers also suggest that learning can be prepared for and enhanced by specific actions such as preview of the museum exhibits to be observed; explicit integration of the content of the museum exhibits with the current classroom curriculum; taking the field trip earlier, rather than later, in the curriculum in question; focusing on the process skills that will be used at the museum, rather than a simple gathering of facts to be repeated later of "what you saw;" and some post-visit assessment and reinforcing activities, such as constructing models or imitations of the museum's exhibits or phenomena. They have observed that while at the museum, students are more engaged during the field trip when moving in small groups; if they have some degree of choice in movement; are not merely fact gathering on work sheets but observing and reflecting; interact with each other or with a mediating adult; and are allowed a variety of modes of documenting or recording the experience, such as video recorders, cameras, models and drawings. Concept maps (diagrammatic webs of connected facts and ideas), constructed by students both before and after a field trip, may be a particularly effective tool to provoke questions about the subject matter; encourage students to reflect on the field trip experience and document changes in their understanding of a subject studied; and allow teachers to assess the learning which has taken place.

#### What are we actually doing?

#### Prior to the field trip

Importantly, thirteen of the twenty respondents (65%) indicated that the field trip was motivated by a specific learning objective, while seven indicated that there was not (the latter including three second grade groups). Of those thirteen indicating a learning objective, nine (45% of the total) responded that the field trip was part of a specific lesson set or unit, and of these nine, one field trip took place before the unit, four during the unit, and four after the unit.

Prior to the field trip, fifteen of twenty respondents (75%) did one or more of the following: discussed the nature or content of SciTech's exhibits; provided brochures, diagrams or pictures of SciTech; discussed SciTech's purpose; or provided a field trip schedule or agenda. Five respondents used none of these practices. But only two of the twenty respondents (10%) used preparation materials recommended and prepared by SciTech.

Sixteen of the respondents (80%) discussed with students a connection to prior or current school curriculum of either specific SciTech exhibits or SciTech's general subject matter. But *none* of the twenty respondents practiced or rehearsed in advance any process skills, such as measuring, observing or recording of information, or use of any instruments or tools for the field trip (although it is not clear from some of the responses whether those respondents treated process skills as including particular observation skills).

Only four performed a formal assessment of the students' knowledge of the science principles or phenomena expected to be experienced at SciTech prior to the trip, while five had their students create a "concept map" or other reflection of the students' current knowledge or questions about what they expected to see at SciTech. Thirteen respondents did not perform *any* type of pre-trip activity to assess students' current knowledge.

#### During the field trip

Respondents reported a variety of means by which students moved through and around SciTech.

Only two (10%) moved as one group, while the other eighteen (90%) moved in either pairs or small groups. Five of the twenty student groups (25%) were permitted to move in pairs or small groups without specific adult supervision, two with prescribed tasks and three without. The other fifteen (75%) moved throughout the museum with either a teacher, adult chaperone or museum docent.

Six of the student groups (30%) were required to document specific facts about the museum, visit and record information or observations about specific exhibits, make specified measurements, or use prescribed prepared worksheets. Fourteen of the groups (70%) performed none of these activities. Students in three of the groups (15%) were asked to record their observations of their exhibit experiences, without any prescription by the teacher as to particular form or content, while seventeen groups did not. Three groups (including two of the above) were urged to use other media, such as cameras or tape recorders, to record their observations. The other seventeen groups did not. Eighteen of the twenty teacher respondents (90%) circulated among different student groups around the museum during the field trip, one remained with the entire class throughout the trip, and one worked entirely with a specific focus group of students.

#### After the field trip

Following the field trip, seven of the respondents conducted a formal assessment of the students specific to the trip, while thirteen respondents did not perform any post-trip assessment. Ten respondents required the students to produce some other form of written work following the trip, including five narratives of what students did on the trip, two descriptions of a specific exhibit or event, one personal reflection, one quiz, and one puzzle. Seven respondents required students to explain or interpret measurements or observations from the trip, or repeat or imitate them in class, while two groups created a "concept map," concept web, or other graphic of their understanding of some concept experienced or observed at the Museum. The other

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enhan	ced b	y pre	view
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exhib	its,	expl	icit
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field	trip	earl	lier,
focus	sing	on	the
proces	s ski	lls, p	post-
visit	assess	ment	

eleven groups did not perform either of these activities. Eight of the twenty groups did not perform *any* of the post field trip activities described above.

One of the student groups after their trip attempted to imitate or replicate objects or exhibits that they had observed or experienced at SciTech, and three created some artifact of their own, such as a drawing or model, to record their experience at the museum. The other sixteen groups did neither of these activities.

#### How "successful" was the field trip?

None of the twenty respondents reported that the field trip as a whole was either "somewhat" or "greatly" unsuccessful, or that any of the pre-, during- or post-trip practices either "somewhat" or "greatly" hindered the achievement of the overall learning objective.

Of the sixteen respondents who used one or more of the *pre-trip* activities inquired about in the survey, two reported that they had "no effect" on achieving the learning objective of the trip, eleven reported that they "somewhat enhanced" the learning objective, and three that they "greatly enhanced" the learning objective.

Of the practices used during the field trip, four reported "no effect" on achieving the learning objective of the field trip, seven reported "somewhat enhanced" the field trip, and nine reported that they "greatly enhanced" the field trip.

Twelve respondents used one or more of the listed activities after the field trip. Three reported "no effect" on the field trip, eight reported that the practices "somewhat enhanced" the field trip, and only one that the post-trip practices "greatly enhanced" the learning objective of the field trip.

Respondents reported the following perceptions of the overall success of the field trip in achieving its learning objective: three "no effect," nine "somewhat successful," and eight "greatly successful." Eleven respondents had performed one or more of all three of pre-, during and post-trip activities surveyed above. Of these eleven, five of them reported that the overall trip was "somewhat successful," while six reported that the overall field trip was "greatly successful."

#### Assessing the data

The overall respondent perception of success of the field trip appears to have the greatest correspondence with the use by teachers of practices during the actual field trip, but less so with regard to pre-field trip activities, and least with regard to practices used as follow-up after the field trip. This is almost the opposite of what the prior research in the review of available literature would lead one to expect.

Since many groups did not perform some type of pre-trip assessment, or integrate the field trip into a specific lesson set or unit, it seems that no good framework may have existed for adopting specific pre- or post-field trip practices for enhancing its potential success. The prior research literature (Anderson, 1999; Anderson et. al., 2000) suggests that the greatest enhancement in learning may come from either the use of concept maps (before *and* after the field trip, for comparison), or from the replication or construction by students of an exhibit or artifact that they observed at the museum and illustrates the desired subject principle or phenomenon. But at most, only four of the twenty groups engaged in this activity. Indeed, of the twelve respondents who utilized any post-trip activities, only one responded that they "greatly enhanced" the success of the field trip, and eight "somewhat." This was a lower number and percentage of "enhanced" responses than for both the pre-trip practices (three "greatly enhanced," eleven "somewhat enhanced") and the during trip practices (nine "greatly enhanced," seven "somewhat enhanced"). Interestingly, of the thirteen groups that had specific learning objectives for the field trip, there is an almost perfect correspondence between the perception of enhancement by the use of during trip practices and the overall success of the field trip.

What can we make of this in assessing our own practices for field trips, and what we can and should use to enhance the chances of real, measurable learning from a field trip? First, the survey respondents' perception of success of their field trips appears largely intuitive and qualitative. I suspect that if questioned in more detail, the respondents would say they know that their students know and understand more about a particular science idea or concept after having visited SciTech than before. Their intuition may be entirely correct. It comports with most observers' intuition. But is it based more on our conditioning and expectations, rather than actual measurement? How many of us have ever even attempted to quantitatively measure the increase in understanding of specific science concepts as the result of a field trip, or to compare using a field trip to teaching methods which might be used in the classroom?

Second, the perception of success of the field trip may be primarily due to what I consider a tactical focus of teachers (including myself) in carrying out the actual activity of the field trip. That is, given the time, trouble and expense of planning, organizing and conducting the field trip, it may well be that by the time the day for the field trip actually comes and goes, we are relieved that everything simply goes without incident – no child gets lost, sick, hurt, in trouble, or doesn't have fun. If the field trip occurs without any of these, then the trip is a success. Add to that the press of time we all face on a day-to-day basis, and it is not surprising that most teachers are kept from doing more than a general integration of the field trip into the overall curriculum, let alone a precise and particular assessment of the learning from taking the trip itself as compared to not taking the trip. But if so, then where are we left in justifying taking the field trip at all? Do we have a strong, clear, quantitative case for taking our students on field trips?

### **Turning research into practice**

My study began, in part, with the basic question of whether field trips enhance the learning of science, and whether that enhancement can be demonstrated in an objective manner. The prior research provides models for the structuring and use of field trips, and suggests the specific practices we can use before, during and after science field trips to enhance our students' learning, and to reinforce, confirm and assess that learning in ways that objectively support our sense of success of the field trip. The responses to my survey indicate areas in which teachers could use greater guidance and training, or to which they could give greater time and commitment, in the use of these practices, and which would ultimately provide a stronger justification for the time and expense of field trips.

1. Research by the teacher to assure that the museum or other field trip destination can provide the basis for the stated learning objective.

2. A clear and specific learning objective, firmly connected to a unit or lesson which is a part of the ongoing curriculum.

3. A consistent method of pre-trip and post-trip assessment of the students' understanding of the subject matter of the field trip and learning objective, in particular using methods like concept maps or word webs.

4. Pre-trip preparation to eliminate students' potential confusion from the novelty factor, and discussing or practicing measurement or observation skills specific to the museum, targeted subject matter and exhibits.

5. Letting students move in small groups to explore the desired exhibits, and use a variety of written, graphic or oral media to record their visit.

6. Having students replicate the operation of exhibits observed, or build their own models of museum exhibits, and explain how they work.

7. Specifically compare the understanding of the learning objective of a student group which took the field trip versus one which did not, and assess the difference in methods used in the classroom.

These are merely a few steps that could be taken to increase the value of field trips as a tool we all use, rightfully but perhaps not always wisely or efficiently. We will all be better positioned to demonstrate and defend our use of field trips, and have a better subjective sense of their success, by having a framework of clear, concrete ideas and practices, integrated into our curricula, and clearly supported by the existing research.

### **Selected references**

- Anderson, D. (1999). *The development of science concepts emergent from science museum and post-visit activity experiences: Students' construction of knowledge*. Unpublished Doctor of Philosophy thesis, Queensland University of Technology, Brisbane, Australia (used with permission of the author).
- Anderson, D., Lucas, K. B., Ginns, I. S., & Dierking, L. D. (2000). Development of knowledge about electricity and magnetism during a visit to a science museum and related post-visit activities. *Science Education*, 84: 658-679.

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### Science Investigations with GIS: Helping Students Develop the Need to Know More

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### GIS opened the door to a lot of thinking, and, just as important, wonderment.

This article describes a school-university collaboration for innovative science teaching and learning. As collaborators, we worked together during the 2004-2005 school year to enact science inquiry projects in which sixth graders learned to investigate the earth using a geographic information system (GIS). Our goals were not just for the students to learn the science concepts being studied, but also to develop the skills and habits of reflective inquiry.

Our collaboration was supported by a National Science Foundation Research on Learning Environments grant (REC #0337598) to study ways to design curriculum to maximize the benefits of GIS for students. In the first year of the project we enacted two earth science units: Climates on Earth and Earth Structures and Processes. Both of these units built on prior work by Northwestern University's Center for Learning Technologies in Urban Schools, and used MyWorld GIS software, developed by the GEODE Project (http:// www.worldwatcher.northwestern.edu/myworld/). MyWorld is a GIS application designed for the classroom, which provides tools of GIS in a form that is simplified and scaffolded for younger students (Edelson & Gordin, 1998).

### What Is a GIS?

A geographic information system is a database connected to a map. Information in the database can be viewed on the map represented by different colors, or by objects of different sizes, shapes, or colors. The GIS is interactive, which means that users can zoom the map in and out, choose how the information should be displayed, and submit queries to the database to answer specific questions. GIS's are used in many natural and social science professions, and are increasingly seen in everyday life as well, such as GIS web sites for driving directions, address locators, and so forth. GIS's are still relatively uncommon in K-12 classrooms, although in recent years more schoolfriendly software like MyWorld has become available, and there is a growing community of GIS educators. An excellent overview of GIS from the United States Geological Survey can be found at http://erg.usgs.gov/isb/pubs/gis\_poster/.

### What Were the Earth Science Units?

Kim Alamar's class studied *Climates on Earth*, an investigation of differences in sunlight and temperature in different cities around the globe. Students used *MyWorld* and a collection of web pages to study thirty cities distributed across the continents (see figure 1 and table 1). Investigations of the data led to students generating theories about the impact of various factors on temperature, and their own models of how the sun affects the earth differently at different times of the year. José Trigueros shared the same students for Spanishlanguage social studies and math, and was a collaborator in the design of the *Climates on Earth* 

Table 1. Climates on Earth unit overview.

Geographies studie	d Va	ariables studied	Inquiry question	ns
<ul> <li>Anchorage, AK</li> </ul>	, USA 🛛 🗖	Daily temperature high and	<ul> <li>How is yo</li> </ul>	ur city's climate
<ul> <li>Ashkabad, Turk</li> </ul>	menistan	low	similar to,	and different
<ul> <li>Beijing, China</li> </ul>	•	Average surface	from, othe	r cities'?
<ul> <li>Billings, MT, US</li> </ul>	SA	temperature, by month	<ul> <li>How and w</li> </ul>	why does your
<ul> <li>Boston, MA, US</li> </ul>	SA 🔹	Elevation	city's loca	tion affect its
<ul> <li>Cairo, Egypt</li> </ul>	•	Latitude	climate?	
<ul> <li>Cape Town, So</li> </ul>	uth Africa	Sunrise, sunset and	<ul> <li>What factor</li> </ul>	ors affect your
<ul> <li>Chicago, IL, US</li> </ul>	5A	daylight hours	city's climate	ate, and how?
<ul> <li>Dublin, Ireland</li> </ul>	•	Average monthly		
<ul> <li>Helsinki, Finlan</li> </ul>	d	precipitation		
<ul> <li>Hilo, HI, USA</li> </ul>				
<ul> <li>Katmandu, Nep</li> </ul>	al			
<ul> <li>Kuwait City, Ku</li> </ul>	wait			
<ul> <li>La Paz, Bolivia</li> </ul>				
<ul> <li>Lagos, Nigeria</li> </ul>				
<ul> <li>Lhasa, China</li> </ul>				
<ul> <li>Manaus, Brazil</li> </ul>				
<ul> <li>Mexico City, Me</li> </ul>	exico			
<ul> <li>Miami, FL, USA</li> </ul>	<b>\</b>			
<ul> <li>Moscow, Russia</li> </ul>	a			
<ul> <li>Nairobi, Kenya</li> </ul>				
The North Pole				
<ul> <li>Oslo, Norway</li> </ul>				
<ul> <li>Punta Arenas, (</li> </ul>	Chile			
<ul> <li>Quebec, Canac</li> </ul>	la			
<ul> <li>Quito, Ecuador</li> </ul>				
<ul> <li>Reykjavik, Icela</li> </ul>	ind			
<ul> <li>Santiago, Chile</li> </ul>				
Singapore, Sing	gapore			
The South Pole				
<ul> <li>Sydney, Austra</li> </ul>	lia			
<ul> <li>Yakutsk, Russia</li> </ul>	a			



Figure 1. *MyWorld* screen from Climate Causes showing the average surface temperature for July 1994, with the case-study cities dieplayed as white dots.

project, as well as other GIS social studies investigations.

Carlos Rodriguez's class studied *Earth Structures and Processes*, an investigation of crustal formations (mountain ranges, trenches, islands) in different parts of the Earth and their relationship to earthquake and volcano distributions. Students used *MyWorld* and documents from the curriculum to become experts on fifteen specific formations (see figure 2 and table 2). Investigations of the data led to students generating theories about plate motion and direction, and how plate motion shapes the various Earth structures. Jennifer Leimberer was the primary curriculum designer for this unit.

Both units use a common curriculum design approach which Jennifer Leimberer describes as "The Top 10" (Radinsky et al., 1999). This approach involves giving the class a large number of case-study locations to specialize in, dividing up the full set of data into smaller geographies. (Note: although it is called "The Top 10," there may be more than ten case-study locations!) For example, as shown in tables 1 and 2, in Earth Structures and Processes, the "Top 10" case studies are fifteen unique "structures" of the Earth's crust, while in Climates on Earth the "Top 10" case studies are thirty cities. José Trigueros also used the "Top 10" approach for a project studying Native American cultures.

A goal of the "Top 10" curriculum design is to divide up big and complicated sets of data into smaller chunks for students to specialize in, so that the students themselves can make their own observations, and then introduce them to the whole class discussion. There are many opportunities to use cooperative learning structures to help the small groups process the information they are working with. Once students have become familiar with their smaller geography, the goal is to support the whole class in combining the separate observations about all these locations, so that all students learn to analyze the entire set of data.

#### **Swimming in Data**

In our classrooms this year, GIS opened the door to a lot of thinking, and, just as important,

wonderment. The first view of a GIS data map, seeing so many data on the screen at once, always sparked excitement and wonder— "Woah! Look at that!" It also raised questions and curiosity— "How in the world could there be so many earthquakes? Why are there so many right *there*?" The instant access to information played a critical role in the students' ability to develop their own questions. In many cases we found it best to leave them "hanging" and wondering, so that their own questions and curiosity would move the investigation forward. We wanted to build and deepen that curiosity.

These investigations brought huge amounts of data into the classroom, even compared to other inquiry projects we had done in the past. The GIS made tremendous amounts of information immediately accessible to the students, with many variables at their fingertips—instant data! How cold? How high? How big? How long ago? All of these variables were available at the click of a mouse for locations all over the world (see tables 1 and 2).

To take advantage of this instant access to information, we had to find ways to help students develop the *need* for the data. They had to be motivated to explore the data for a reason. It's easy enough for us as educators to throw facts at them, but it is not as productive, and it is unlikely to be a memorable experience. Giving students access to a large amount of information, and helping them learn to make decisions and find their way through it, is a much more stimulating and memorable experience. It helps instill in them the confidence and the desire to discover more on their own.

One way to give students a need for data was to promote a lot of debate among students about the data they were finding and what they meant. It was not enough for students to look at the earthquake data and say, "Our plate boundary is here." They had to convince another group of students that they had enough data to support their interpretation (see example discussion in figure 3). Even at the end of the unit many students still had questions and uncertainties about their "final" answer to an inquiry question. We saw this

Table 2. Earth Structures and Processes unit overview.

Geographies studied	Variables studied	Inquiry questions
<ul> <li>The Andes Mountains</li> <li>Baja California</li> <li>The Hawaiian Islands</li> <li>The Himalayas</li> <li>Iceland</li> <li>Japan</li> <li>The Java Trench</li> <li>The Mariana Trench</li> <li>Mt. Etna</li> <li>Mt. Kilimanjaro</li> <li>Mt. Popocatepetl</li> <li>Mt. St. Helens</li> <li>Mt. Vesuvius</li> <li>New Zealand</li> <li>St. Helena Island</li> </ul>	<ul> <li>Earthquake location, date, magnitude, depth</li> <li>Volcano location, type</li> <li>Elevation, bathymetry</li> </ul>	<ul> <li>What has caused your earth structure to form where it is?</li> <li>What plate is it on?</li> <li>How is that plate moving?</li> </ul>



Figure 2. *MyWorld* screen from *Earth Structures and Processes* project; elevation/depth, earthquakes (1 year), volcanoes, and a yellow 25° box around each Earth structure being studied.

La Boom La	Ana:	OK. So it's right there and then it goes up in there
the second se	Carmen:	Oh yeah
	Ana:	And you guys only say that part or what?
E APPENDING STREET	Carmen:	Yeah. We say it's all the way up to – Oh, now I see!
	Marta:	Up to there. Up to here
the second se	Carmen:	Because look, this is the African plate, that's a good point
1.32 3.41 5 13 - 197 2 4 1 - 28 1 1 P	Ana:	Yeah, but it connects to that too. So, it's all the plates,
		Africa and Sicily and like part of Europe
	Marta:	But Mr. Rodriguez, didn't he say that –
The second	Carmen:	See, but look it wouldn't be able to connect. It's just up to
E E E E		here.
	Ana:	Wait. I can't see anything. So, I don't know where you are.
The second second	Carmen:	I'm there. I'm where you – I'm where you say to connect
	Ana:	Where?
	Carmen:	I'm right here. But it can't connect
	Ana:	There's volcanoes there and everything so
	Carmen:	I know but look

Figure 3. Students debating a plate boundary in the Earth Structures and Processes unit.

uncertainty as a sign of strong learning rather than a weakness—a part of learning to be a scientist.

This is a different kind of teaching. With so much information available in the GIS, the teacher does not, and cannot, know all the answers. As teachers we had to become comfortable with being surrounded by complex information, and helping the students learn to "swim" in the data. It gave us empathy for the confused feeling our students often have! Rather than looking and finding the right answer "right there," they needed to make decisions about what to look at, and then decide what that was showing them. This required the students to clearly describe what they were seeing, clarify what their question was, and decide where to go next.

#### **GIS Inquiry and Language Development**

It might be surprising that a database tool like GIS would have a lot to do with language development. However, the visual nature of the data (see figure 4) and the need to pull together many types of data in developing explanations pushed students to communicate. Students had to develop language to share their observations and explanations. What do you see? What are the rules of this map? Are there any patterns? What might they mean? What inferences can you make from that? It was essential to give students space and opportunity to use language to explain what they

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were seeing, and how they were thinking about it. They needed to explain not only what they understood, but what their confusions and questions were.

We focused on making the inquiry experience a shared and public one. Students' ideas and questions were talked about, written down, and posted publicly in the room. This helped our classes develop a shared vocabulary for talking about the data. Not only words, but students' rerepresentations of the data were also shared publicly—small graphs and tables, dots and lines drawn on wall maps (using acetate to protect the maps!), hand-drawn pictures showing a concept or theory. These not only helped communicate students' ideas, but also gave the whole class a set of referents to point to in discussions.

This shared vocabulary and common set of referents gave us an opportunity to promote the use of science vocabulary in classroom talk. Words like "hemisphere," "equator," "poles," "subduction zone," "buckling zone," and "earthquake activity" became necessary in order for the students to clearly indicate what they were trying to say. This is different from having to learn these words for a vocabulary test. Students had to use these concepts in order to explain their own thinking—their questions, observations, and explanations of the data. Concept words sometimes became paired with gestures to communicate their meanings, such as



Figure 4. MyWorld map close-up on Japna displaying earthquake and volcano data. Exactly where are the plate boundaries?

combining the word "subduction" with one hand sliding under the other, or pointing to one's waist when referring to the equator. These gestures often helped the students as they were just beginning to grasp a concept.

### **Challenges of Using the Technology**

We did face difficulties in using this technology. Computers with enough memory to run more recent operating systems (such as MacOS 10.3 or Windows XP) ran the software very quickly, with few problems. The older computers, on the other hand, really crawled. This left students frustrated, waiting and waiting for the screen to load, or clicking and clicking until the computer crashed. Students are accustomed to fast responses and have no patience for a slow computer! Sometimes we had to juggle groups and computers to make sure each

group had enough time with the software on a high-functioning computer.

We decided that the best way to conduct these investigations was with computers in the classroom rather than going to the computer lab, so that the GIS would be integrated with other hands-on and reading activities. We wanted students to be able to ask and answer their questions within the flow of everyday classroom activity. Luckily we were able to access laptops for the project-one school had a mobile lab of Macintosh laptops, and for the other school, we were able to borrow six Windows laptops from the district for two weeks. (At both schools we submitted grant proposals this year to purchase new laptops, and we have plans to seek other funds as well. A set of good laptops is an invaluable resource for inquiry teaching!)

Once students had access to the GIS, they were able to quickly master the tools to conduct their investigation-zooming in and out, panning around the globe, turning data layers on and off, and changing projections and views to see what they wanted. As teachers we had anticipated the need for lots of carefully structured explanation of the software, but as it often happens, the students jumped right in and learned it quickly. In many cases they asked how they could get more data into the GIS! As adults, we are often nervous about presenting to children all of the aspects of a computer tool that we think are powerful or important to understand. Students need, of course, to be presented some information, but it is at least as important that they have time to explore and get comfortable with the software themselves.

#### What Worked

#### Small Groups Sharing Perspectives

We found that having students work in groups of three at the computers was more productive than working individually. Group members had to come to decisions together, so there was more language used, more interaction, and even arguments at times about interpreting the data. Such interactions opens students up to a wider spectrum of possible ways to think about the data, and forces them to communicate clearly and articulate their own ideas.

Even when a group had arrived at a consensus, often one group member had nagging doubts about a particular conclusion. Sometimes this even occurred at the time of final presentations at the end of the project. We encouraged students to voice their differences of interpretation in order to develop their own questions and observations, rather than just trying to quickly get to one right answer. It was one of the most powerful things to see students continuing to wonder and question science concepts and data, even after a project had finished. Some students came back weeks later with something new they had heard of or thought about that changed their thinking about the investigation.

#### Getting the Data Out of the GIS and Into the Room Another strategy that we eventually developed was finding many ways to get the data

out of the computer, which can be a bottleneck, and distributing them around the classroom. This involved students copying particular data onto their own data sheets, graphs, tables, or paper maps in their science folders. The act of transforming data from GIS to another representation is a powerful learning tool for the students. They start to realize that they can decide not only what data they want to look at, but also how they want to look at these data. Students used separate data sheets or graphs to compare particular places, or to show only those data points that supported or contradicted a certain theory.

Students also made their data analysis products public. They posted their graphs, their data tables, and their drawings of their theories on big posters or wall maps displayed around the room. This allowed other students to think about their classmates' ideas, use them as examples, and use the visual classroom displays to help them develop their own explanations and interpretations.

Furthermore, it was important for students to generate their own data sets in order to better understand the data in the GIS. For example, students looked up daily temperatures and sunrise and sunset times for their individual cities, and made graphs of this information that they taped onto a big wall map. This process helped them understand that the temperature readings by month in the GIS come from other sources—they do not magically appear in the software, but rather they are gathered by someone for a particular purpose. This is an important realization that may help students not to trust data just because they are in a computer.

### Having Other Documents with Related Information

In both units, students had documents to read that gave them context and background information that was important for the inquiry. In some cases these documents were provided on web pages that were linked through the GIS, so that students could click on a point on the map and read the document. For example, we created information pages about each city for the Climates on Earth unit (see figure 5). In other cases students had printed reading materials, such as "Junior Assistant Letters" and photographs for each Earth Structure, and myths from various cultures giving explanations of how Earth structures were formed. It was valuable to have information stored not just in the GIS, but in several different places, so that students could work at putting it all together themselves.

### Challenges and Benefits of Teacher-Researcher Collaboration

Collaborating on this research project has been a powerful learning experience for both teachers and researchers. We have collaborated in designing materials and instructional strategies, and also in studying students' thinking using data we gathered in the classrooms – videotapes, transcripts, our notes, and student work.

For teachers, venturing out into new and unfamiliar territory, especially one that involves the use of new technology can be stressful. Trying these new things within a research collaboration carries the additional challenge of being "under the microscope," as cameras are rolling in the classroom. Each unfamiliar element requires extra time and energy to figure out. How will I make this fit into everything else? How will I find time to digest this information?

For researchers, building long-term relationships with teachers and students in schools requires a big commitment to logistics and troubleshooting. It takes time and effort to manage to be in the right place at the right time, and teachers are so busy that collaborating researchers need to find ways to make the connection without overwhelming the school partners.

However, there is no question in our minds that the time and effort invested by all of



Figure 5. Sample inofrmation page for the city of Lagos, Nigeria, from the Climates on Earth unit.

us is paid back a hundred times by the benefits of collaborating—benefits for ourselves as reflective practitioners, for the larger community of educators, and especially for students' increased opportunities for rich and meaningful learning. Teaching and research should not be separate professions—both are at their best when they inform and learn from each other. Teachers gain chances to reflect on their own practice, and especially on aspects of their students' learning, that their busy work-day does not usually allow them to see. Researchers gain chances to deepen their theoretical frameworks by the insights and depth of teachers' knowledge of their students and their teaching, and by experiencing the combination of theory and practice on a daily basis.

### References

Edelson, D. C., & D. Gordin. (1998). Visualization for learners: A framework for adapting scientists' tools. *Computers and Geosciences*, **24**(7), 607-616. Radinsky, J., Loh, B., Mundt, J., Marshall, S., Gomez, L.M., Reiser, B.J., & D. C. Edelson. (1999, April). Problematizing complex datasets for students: Design principles for inquiry curriculum. Poster presented at the annual meeting of the American Educational Research Association (AERA), Montreal, Canada.

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