Informally SPEAKING

The Newsletter of the Informal Science Education Association of Texas **September 2003**

Inside . . .

The mission of the Informal Science Education Association (ISEA) is to improve science education in Texas by supporting partnerships among informal and formal educators.

Lowery gets into our heads

Dr. Larry Lowery, who is sometimes called "the father of inquiry," was the keynote speaker at ISEA's 6th Annual Conference, held in March at the McKinney Roughs Environmental Learning Center near Bastrop, Texas. Sharing recent and surprising findings from the field of brain research, Lowery challenged us to reassess our programs in light of this new knowledge, and to look for ongoing opportunities to teach science using inquiry.

The conference brought together 67 science educators from around the state to share ideas and experiences. As an informal science education site, McKinney Roughs also offered ample opportunities for learning outside of the sessions, and many attendees took advantage of pre-conference workshops by Texas Parks & Wildlife on fishing, GPS use, and other outdoor activities.

Lowery: "This is your brain."

FOCUS ON Building more successful relationships with teachers

If your informal institution is like many others, you may have one or two teachers with whom you have a regular, working relationship—if you're lucky! They are likely to be teachers who are already enthusiastic about science, and who "take charge" of their students while at your site. But most teachers are not like these teachers. They do not actively seek out informal science resources. As informal educators, we know the benefits of informal science education, and as the National Science Education Standards state, "the school science program must extend beyond the walls of the school to include the resources of the community." To understand why some teachers use informal science in their teaching and others do not, it is helpful to focus on the teacher as decision-maker.

Based on an in-depth, qualitative study of a diverse group of teachers who use informal science regularly (see the full report for the methods of study), I found that they share some important characteristics:

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Focus on: Teacher relationships, *continued from page 1*

1. These teachers have a strong passion for science, and are confident in their ability to teach science.
2. They practice a hands-on, investigative approach to teaching science in which the teacher acts as a facilitator.
3. They believe that using informal science is essential to their teaching of science.
4. They require strong support—from the district, principal, other teachers, and especially parents.

Interestingly, these teachers see the value of informal science very differently from each other, and as a result, they use informal science in very different ways. One kindergarten teacher in a high-income area sees informal science as an essential resource for her teaching and for her own professional growth. A 5th and 6th grade teacher in a low-income area uses informal science more as a laboratory for his class projects. And a 5th grade teacher in a mixed income area says that informal science serves as a partner in his quest to provide his students with challenging learning opportunities in science. Several of these teachers in my study may only visit one or two sites a year, but they have a project-based approach in which they work in partnership with informal educators. Others visit as many as eight sites per year. This partially depends on external factors, but ultimately it is the teachers' own personal preferences of how best to teach science. Clearly, there is more than one effective way to use informal science resources.

So what does this mean for informal educators?

1. Infuse your site with a genuine respect for teachers. This needs to be inherent in everything you do in education. Many sites do not see teachers as equal partners in education. Therefore, those sites do not have many working collaborations with teachers. Teachers must be seen as the decision makers.
2. If you are not already involved in preservice teacher education, get involved. Informal sites are perfect places for student teachers to gain confidence in teaching science, and those teachers are more likely to reach out to community resources later.
3. Know your strengths as an informal science site and emphasize them. Don't try to cover everything. The teachers in this study sought out sites that had the expertise and were always building on their strengths.
4. Allow for multiple entry points for teachers. Know that there is no best way to use your site. Different teachers may be especially interested in different things: the expertise of museum staff, various field trip options, the bookstore, outreach programming, or teacher workshops, for instance. Be flexible to teachers' needs.
5. Reach out to all parents—especially those in underserved populations. Parents apply pressure to principals and teachers, and they can help find money for projects and field trips. Parental support was talked about by all teachers in this study as being essential to their use of informal science. All other levels of support are secondary to the support that comes from parents.

The teachers in this study were the exceptional teachers. Because they are the ones already using informal science, there is much we can learn from them. In addition, these exceptional teachers can bring others along. They plan grade-level trips, take project ideas to their school, and encourage other teachers to use informal science. Pursuing a dialogue with these teachers will likely get the more reluctant teachers using your resources.

Building and maintaining successful relationships with schools means understanding the common goal of educating children about science. In education, the classroom teacher has the most pivotal role. If you and your staff truly believe this, and you work to put your beliefs into practice, the rest will come much more easily.

by Dr. Christy Youker, Ph.D.

For a full description of this study and its methods, please see Youker's recently completed dissertation, entitled: "Teachers' Perspectives of Why and How They Use the Resources of Informal Science Education Sites," University of Texas at Austin, 2002.

Zigrossi's trends to watch

Sam Zigrossi of UT Austin's Dana Center presented the opening address at the March 2003 ISEA conference. He gave us a "heads up" on EarthScope, the huge, new, ten-year National Science Foundation project that is a seismic analysis of all of North America. Instruments will be set up in longitudinal lines from Canada to Mexico. Research questions center around predicting volcanoes and earthquakes and the formation of continents. The project begins in California and will be moved eastward annually. They will be in Texas in 5-6 years. The project will offer grants for education and outreach that raises public awareness through museum exhibits, documentary videos, linked web sites, and online newsletters. For more information, the project contact in Texas is Kathy Ellins (kellins@ig.utexas.edu), and the website is *www.earthscope.org*.

Sam also relayed news on the importance of accountability in public education and how this impacts informal education institutions. With the emphasis shift in public education from teaching to learning, he reports that in Texas and all across the country we are in a "Learning Culture." Through the Dana Center's Partnership for High Achievement project, they have learned that schools must set measurable high expectations, and that leadership capacity is more important than teacher training. The Partnership for High Achievement will enroll schools on a fee-for-service basis. With each school in phase one, they will help participants analyze identified problems, set goals and expectations, and implement a plan for change. Phase two will integrate school leadership, teacher professional development, and appropriate resources.

Informal institutions can be an important resource for change as well. Our challenge is to document the quality of our programming as it relates to the Texas Essential Knowledge and Skills. Are our school programs aligned? How do we assess their value to the schools as they strive to improve? Perhaps ISEA's role can be to offer evaluation workshops and seminars that address this issue that is so important to the success of our programming for teachers and school groups.

by Jan Wrede,
Cibolo Nature Center

Lowery talks about learning

How do we learn? Not only that, but how do we learn enough to become experts? According to Dr. Larry Lowery, an educator and scientist at the Lawrence Hall of Science, experts learn very differently from novices. Dr. Lowery delivered the keynote address at ISEA's conference, and the information he shared has wide implications for our work.

The study of development cognition began about 18 years ago when mathematicians and scientists tried to understand what makes some students care deeply enough about a subject to become experts. In the initial studies, experts were given a problem to solve, and were asked how they knew where to start in their problem solving and how they knew when they had arrived at a dead end. After giving the same problem to novices, it was noted that, although experts were not better at remembering facts, experts noticed finer details. All learners compare relevant prior knowledge ("critical competitors") with new stimuli to find differences, identify attributes, and build concepts. An expert is able to pick out smaller differences than a novice, and experts are better at pattern recognition. They have built frameworks of ideas and objects alongside of which they can lay new experiences. And experts have flexibility in approaching problems.

Understanding Brain Processes

As educators, how do we format our instruction to make novices into experts? First, we understand the processes of the brain that allow people to make sense of their world.

In the top center of the brain is the motor cortex, structured to direct the feet, hands, face, and tongue. The human tongue and face use much of the cortex, compared with other animals, and this is reflected in our developed language

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WEIRD SCIENCE FACT

The Australian billygoat plum contains 100 times the vitamin C of an orange.
(*www.firstscience.com*)

The next ISEA conference will be March 4-6, 2004, in Port Aransas.

Mark your calendar!

Comments on Lowery's keynote address, *continued from page 3*

and speaking abilities. Our motor cortex is involved in all learning and all movement.

With current technology, scientists can now view three-dimensional pictures of working brains to help track concept development. In these studies, a quiet brain that is engaged in internal thinking shows up on screen in greens and blues. When something new is seen or touched, a bright red or pink spot appears in certain areas of the motor cortex. These color bursts, called "first hand explosions," last less than 100th of a second, and they indicate that the brain is looking for prior knowledge in order to match the new stimulus against critical competitors. The learner is constructing a relationship. These first hand explosions are dependent on sensorial input, and a change in that sensorial input is required to make an explosion. For example, seeing a movement is a change in sensorial input, and this experience produces a first hand explosion. Interestingly, once an image enters the brain, the brain separates the image into colors, movements, shapes, and so on, and stores the different information in different parts of the brain. "Photographic memory" is a misnomer, since all of an image's components are stored separately.

Looking at the physical formation of the brain, development cognitive scientists pay attention first to the prefrontal lobes. The capabilities of this area of the brain include the ability to plan into the future, think in the past, and deal with ideas remote from us in space. World War II surgeons who separated prefrontal lobes found that their patients lost the ability to perform tasks such as counting silverware or finding their parked cars. Developmentally, prefrontal lobes are the last area of the brain to fully "turn on," which happens around adolescence. This is also the time that more advanced emotional components are turned on. (Ever wonder why adolescents feel immortal? It's their immature prefrontal lobes!)

Information travels through our 600,000 or so connections of dendrites, which can come and go, but gradually build up during our lifetimes. Dendrites can appear in the brain during fright, along with an adrenaline release and the rerouting of the stomach's blood supply to the brain. Too much fright, though, produces an excess of adrenaline, causing stress chemicals to be released, which prevents the formation of dendrites. Dendrites can also appear with curiosity. Hands-on experiences tend to have activated pathways, so this is a good way to begin learning.

The Order of Learning

There are three methods of instruction: hands-on, pictorial, and symbolic. Since the only way to get information into the brain is through one of the five senses, hands-on is the most powerful form of instruction. Yet, most of what we know is second hand, such as watching a television show about Antarctica as compared to taking a trip to Antarctica. The second hand form of instruction, pictorial, can build prior knowledge, which can be reinforced by first hand experiences. However, when you offer second hand knowledge *after* hands-on, experiential instruction, the learner explodes with the ability to take in many more details. The very last method of instruction, the symbolic, is book learning, and it is the one used most often in schools. Unfortunately, when using books, a person must already know something about the subject so that words can conjure up a picture in the mind.

If educators follow developmental stages, they introduce the construction of knowledge after the learner has the prefrontal skills of thinking in the past and future and working with remote ideas. Prior to that, teaching should rely on "stories," using names, sequences, and characteristics for instruction.

Implementing changes

Learners construct understanding for themselves. Books catalog facts, but often don't relate the facts. To understand relationships, there must be prior knowledge and the action of relating the facts. It is the understanding of relationships that creates learning. Immediate testing doesn't reflect true learning. When the student is tested two years after an activity, those relationships and ideas retained are evidence of actual learning. Sally Sherman of the Wetland Center in Baytown plans to bring back students who visited in the 5th grade and retest their comprehension again as 7th graders.

The most ideal way of curriculum design is to use concrete objects first, adding pictorial and symbolic instruction later. Linda Krause has decided to begin a planetarium show with the touching of a meteorite and add other concrete learning activities, as well.

The most common curriculum design is done in the order of symbolic, or presentations using words and descriptions before working with the hands on components. Curriculum writers for the Fort Worth Zoo are reordering the sequence of their work, putting in the first hand experiences at the beginning so children touch the artifacts and meet the animals before receiving the written lessons.

Dendrites build up over time. (Older people's dendrites and problem solving abilities don't diminish over time; thinking just takes longer with so many dendrites.) Dendrite connections can be stabilized with practice for skills such as playing an instrument or playing a sport, but practice doesn't stabilize knowledge. Instead, rehearsing the knowledge by using varied experiences can help stabilize the connections that build relationships. There are ways we can encourage this stabilization. Watch a learner working and ask how they found the answer. Ask them to find something that is similar. Use content that is worth learning to keep curiosity alive and dendrites forming.

by Margaret Russell,
Austin Nature and Science Center

For more information on this topic, see "How New Science Curriculums Reflect Brain Research" by Lawrence Lowery in *Educational Leadership* 56(3), November 1998.

News from around the state

South Plains Educational Resource Collaborative (SPERC) (Lubbock area)

SPERC is moving ahead with a number of exciting projects. We introduced our new web site in August: You can visit us at *www.hhmi.ttu.edu/sperc* to learn more about us and what we're doing. We have also formalized our membership and are growing steadily. Currently, there are 23 members representing a variety of disciplines in informal settings, from science to fine arts. The third edition of our resource guide for schools was published in August, and we are looking forward to our second annual Educator's Appreciation Night, hosted by Barnes & Noble on October 23.

SPERC has also developed a partnership for professional development. This partnership involves organizations who provide opportunities for teachers on a regular basis working together to develop programs that are complimentary but not redundant, and provides teachers access to program information in one place. Not only do we now know what's going on in our backyards, but teachers can see it all on one website!

We would like to extend a special thank you to our colleagues at Region 17 Education Service Center and the Lubbock Independent School District for their enthusiastic support of, and participation in, SPERC.

Austin Collaborative for Cultural Education Sites and Schools

ACCESS is continuing its successful program that provides traveling exhibits for local schools. These exhibits are developed by ACCESS member institutions with input from educators. ACCESS is also planning another season of its successful speaker series, bringing experts to address topics of interest to educators and families. ACCESS held a successful silent auction in August to raise money for the organization and its programs.

One new program of interest consisted of school visits by "Granny Van." Re-enactor Donnie Rinn of Rockdale visited Kocurek and Winn Elementary Schools on Thursday and Friday, May 15th and 16th, as Granny Van. She shared stories about her grandson George, a.k.a. the Texas author George Sessions Perry. The students thoroughly enjoyed hearing the stories and asking lots of questions about life in the early 1900's. Many thought she was actually Granny Van!

HU-LINC Informal Science Coalition (Houston area)

The John P. McGovern Museum of Health and Medical Science, Children's Museum of Houston, Friends of Hermann Park, Houston Zoo, Museum of Natural Science, Space Center Houston, Nature Heritage Society and the Houston Arboretum and Nature Center are the institutions and organizations that make up the HU-LINC Informal Science Coalition. The ISC has held several meeting throughout the year to discuss upcoming Family Adventure Days and to answer any questions or voice concerns and comments on the programs.

Family Adventures are quality learning experiences for students, families and teachers that are based on national, state, and HISD project CLEAR curriculum objectives in science and mathematics. Each institution adopts a number of HU-LINC Elementary schools to participate in the Family Adventure, which is absolutely free of charge to the schools and families. These rich resources are to assist not only families with their children's education, but also Houston ISD principals, counselors, and teachers in promoting mathematics, science, technology, and related careers for HISD students.

The last meeting was held on August 14th at the Houston Museum of Natural Science. The purpose of this meeting was to finalize the assigning of adopted schools to each institution. Once all of the institutions agreed on their assigned schools, the HU-LINC chairperson, Charlotte Haynes, approved the final drafts. The next meeting will be held on Thursday, November 13th at the John P. McGovern Museum of Health and Medical Science.

Conference odds and ends

The following resources were suggested by members as good places to get information about museum programming:

* The Visitor Studies Association, *www.visitorstudies.org*
* Group for Education in Museums, *www.gem.org.uk*
* The North American Association for Environmental Education, *www.naaee.org*
* United Way's Outcome Measurement Resource Network, *national.unitedway.org/outcomes*
* Outcome Based Evaluation from IMLS, *www.imls.gov/grants/current/crnt_obe.htm*

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Also, ISEA would like to congratulate the winner of our membership challenge: The person who recruited the most new members (and earned a prize) was none other than our esteemed President, Siri Lindholm. Way to go, Siri!

Science Teachers Association of Texas and Affiliate MEMBERSHIP APPLICATION

One Form Per Person - Form Information Valid Through May 31, 2004 - Fill Out Completely

STAT I.D. _____ Date _____

First Name _____ Middle Initial _____ Last Name _____

Address _____

City _____ State _____ Zip _____

ESC Region _____ School/Campus _____

District/Business _____

Home Phone _____ Office Phone _____ Fax _____

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Job Description (all that apply)	Grades Taught (all that apply)	Subjects Taught (all that apply)
☐ STUDENT TEACHER ☐ TEACHER ☐ SUPERVISOR/CONSULTANT ☐ DEPARTMENT HEAD ☐ PRINCIPAL/ADMINISTRATOR ☐ COLLEGE/UNIVERSITY PROFESSOR ☐ SCIENCE SPECIALIST ☐ STUDENT ☐ BUSINESS ☐ RETIRED ☐ Other:_____	☐ K ☐ 9 ☐ 1 ☐ 10 ☐ 2 ☐ 11 ☐ 3 ☐ 12 ☐ 4 ☐ 2 YR COLLEGE ☐ 5 ☐ COLLEGE/UNIV ☐ 6 ☐ 7 ☐ 8 School (Mark one) ☐ PUBLIC ☐ PRIVATE	☐ ELEMENTARY SCIENCE ☐ INTEGRATED SCIENCE (K-8 ONLY) ☐ ANATOMY & PHYSIOLOGY ☐ BIOLOGY ☐ INTEGRATED PHYSICS & CHEMISTRY ☐ PHYSICS ☐ CHEMISTRY ☐ GEOLOGY/METEOROLOGY/OCEANOGRAPHY ☐ AQUATIC SCIENCE ☐ ENVIRONMENTAL SCIENCE ☐ ADV. PLACEMENT; INTL. BACCALAUREATE ☐ INFORMAL SCIENCE EDUCATION ☐ TEACHER EDUCATION

Ethnicity (optional-statistical use only): ☐White ☐ Black ☐ Hispanic ☐ Asian ☐ Native American ☐ Other

National Science Teachers Association: ☐ Member ☐ Point of Contact ☐ Key Leader

☐ I do NOT want additional mailings about science events and opportunities.

	ORGANIZATION		RENEW	NEW	AMOUNT PAID
STAT	**Science Teachers Association of Texas** Regular and Student-$20/Institutional or Corporate-$200/Retired-$5		[ ]	[ ]	_____
ACT2	**Associated Chemistry Teachers of Texas**	$10	[ ]	[ ]	_____
ISEA	**Informal Science Education Association**	$10	[ ]	[ ]	_____
ISET	**Integrated Science Educators in Texas** Regular and Student-$7/Life or Institutional-$100/Corporate-$300		[ ]	[ ]	_____
TABT	**Texas Association of Biology Teachers**	$10	[ ]	[ ]	_____
TAEE	**Texas Association for Environmental Education**	$10	[ ]	[ ]	_____
TCES	**Texas Council of Elementary Science** Regular and Student-$10/Life or Institutional-$100/Corporate-$300		[ ]	[ ]	_____
TESTA	**Texas Earth Science Teachers Association** Regular-$10/Life-$100/Corporate-$145/Family-$18/Student Teacher-$2		[ ]	[ ]	_____
TMEA	**Texas Marine Education Association**	$10	[ ]	[ ]	_____
TSAAPT	**Texas Section Amer. Assoc. of Physics Teachers**	$5	[ ]	[ ]	_____
TSELA	**Texas Science Education Leadership Association**	$10	[ ]	[ ]	_____
TTOPS	**Texas Teachers Organization for Physical Science**	$7	[ ]	[ ]	_____

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Don't miss...

ISEA at CAST!

October 30 - November 1 in Houston

ISEA reception

Wednesday the 29th, 6-8 p.m., Radisson Celestial Room

ISEA sessions

Summer teaching positions in informal science: Much more than a job!

Sat., 9:30 a.m., Reliant 200; Contact: Christy Youker, christyyouker@texasbb.com

and

What can informal science education do for you, your students, and your classroom?

Fri., 9:30 a.m., Reliant 204; Contact: Siri Lindholm, siri.lindholm@tpwd.state.tx.us

ISEA booth in the exhibit hall

Part of the "Informal Science Aisle" -- stop by for great information and conversation!