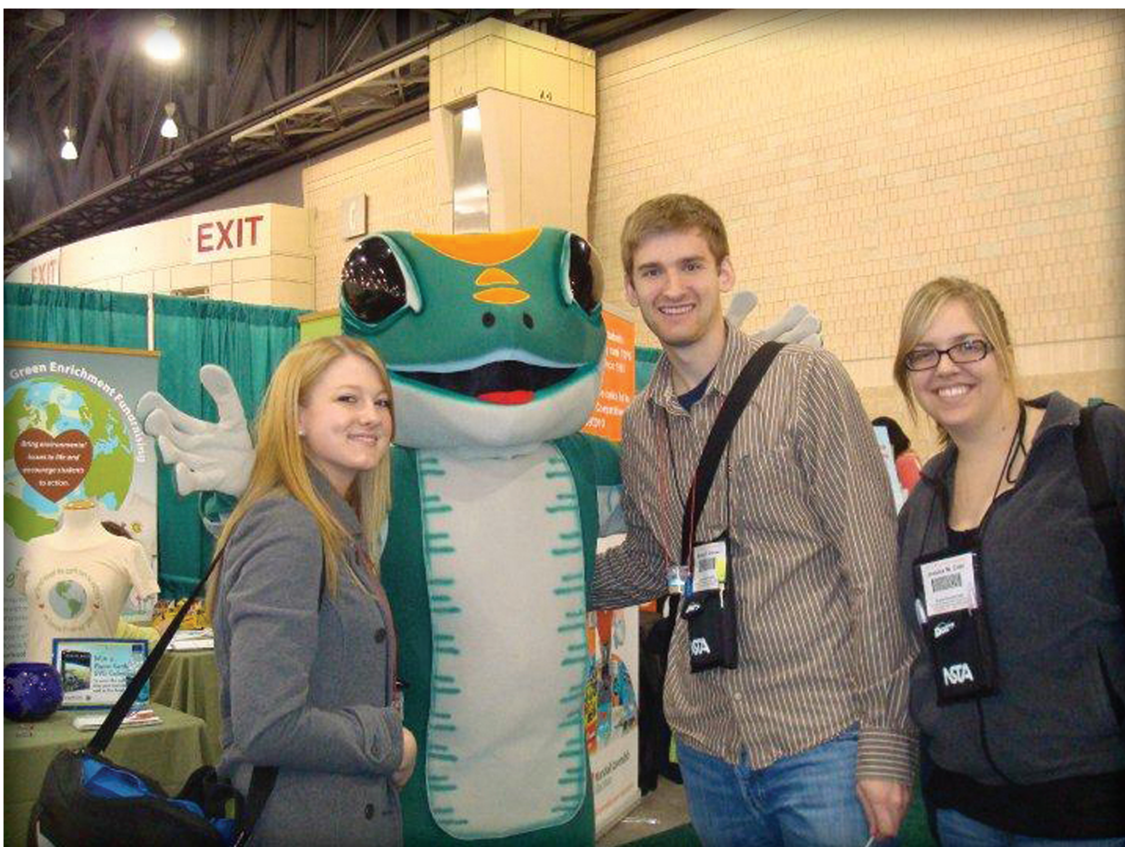
ISTA SPECTRUM

Fall 2010, Vol. 36, No. 2

The Journal of the Illinois Science Teachers Association

In this Issue: **Mentoring Relationships**
Middle School Writing Strategies
Purdue zipTrips
Examining Elementary Science Curricula
Galileo's Free-Falling Experiment



Plan Ahead:
ISTA Conference 2010 - November 4 - 6, 2010, Springfield

Spectrum

The Journal of the Illinois Science Teachers Association
Volume 36, Number 2

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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)*.

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Cover photo - Southern Illinois University at Edwardsville NSTA student chapter members Tanya Buechel, Aaron Gruel, and Jessica Crim examining all the resources and having fun at the exhibit hall at the National Science Teachers Association conference in Philadelphia. Photo courtesy of Stephen Marlette. See article on pages 25 - 29.

SPECTRUM

The Journal of the Illinois Science Teachers Association

Fall 2010

Volume 36, Number 2

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President's Corner

Gwen Pollock

Dear ISTA Friends,

As the summer draws to its inevitable end, with all of your busy-ness toward learning to teach more and better, and surely even some personal relaxation, I am hoping that you are refreshed and revitalized for the new school year. There is much to share with you.

Carol Baker, ISTA president-elect; Kendra Carroll, ISTA membership chairperson; and I were able to participate in NSTA's Summer Congress for Science Education in Las Vegas. Beyond the temperatures of 106 to 111, we were personally fired up with all sorts of ideas shared by the NSTA staff and delegates from other states' chapters. In some excited, but brief debriefing, Kendra shared some very interesting ideas for nurturing our members with possible weekend field trips in Illinois. Carol learned about some of the communications options that we should consider. I learned about options for resource development of business/industry partners, financial obligations that we need to handle, as well as a very important necessity for awareness and action for advocating (and maybe even lobbying) for greater excellence and support for science teaching and learning for all of you. More about this soon.

News from the federal level, shared by NSTA leaders, included these tidbits about the NSTA positions and anticipated Congressional and US Department of Education actions. NSTA leads the STEM coalition for the Hill, voicing support for the following items:

*The inclusion of science into the federal accountability system requirements, with stipulations about the kinds of assessments that are included (like performance-based testing, project-based work, and portfolio projects);

*Expansion and assurances of state-level grants for STEM initiatives (while the administration seems to be focusing on the loss of the MSP state grants, and a direction to competitive grants for the states);

*Dedicated funding for STEM teacher professional development, with a very clear definition of what STEM is and should be;

*An emphasis on K-8 science and math coaches;

*State-level P-20 STEM leadership councils to assess current needs for STEM and STEM-Ed pipelines, its integration into curricula, and partnerships with STEM stakeholders in business/industry and communities).

(I can send you a more explicit statement, upon request.)

Congressional action is expected to be slow related to the reauthorization of the Elementary and Secondary Education Act, still recognized as NCLB, but with anticipated Obama administration changes to be made to include the parameters of the Race to the Top, America Competes, Educate to Innovate, and Investing in Innovation programs, and so forth, all with a STEM emphasis. As of this writing, Illinois has been chosen as one of nineteen finalists in the RTTP competition (10-15 expected to be chosen for funding). Final decisions will be made by early September.

NSTA shared some of the successes of the National Lab Day opportunities with its 1,800 projects, matching 11,000 teachers and volunteers. ISTA will try to coordinate this opportunity next year.

The National Research Council has released the Conceptual Framework for science. The national review of this very important document closed on August 2, with anticipated refinements for final release early in 2011. I have studied over the framework and am impressed with the format. I have the best hopes for the next iteration of the document for our support and implementation. I do like the framework's ideas and models that they developed. I know that this is hard work and I am glad that such leaders have taken responsibility for improving the foundation of science standards that we can study, test, and further implement in our future.

See you at the fall conference - November 4-6. It promises to be a wonderful time for all in Springfield.

Gwen (gpollock@casscomm.com)

2009-11 ISTA Executive Committee

Vice President
Julie Gaubatz
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jgaubatz@hinsdale86.org

Secretary
Kathy Schmidt
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President Elect
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Community HS District 218
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Interim Treasurer
Pamela Spaniol
pamela.spaniol@yahoo.com

Past President
Jill Carter
Pekin Community HS
jcarter@pekinhigh.net

2009-11 ISTA Committee Chairs

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ISTA Conference	Harold Wilkinson, Gary Butler
Conference Program	Barbara French
Finance	Vice President - Julie Gaubatz
Membership	Kenda Carroll
Nominations and Elections	Past President – Jill Carter
Professional Development/Science Matters	Mary Lou Lipscomb
Publications Committee	Judith A. Scheppler

Join the ISTA listserve to Network Online!

ISTA encourages all of its members to join the listserve of our organization. News of timely value and networking opportunities are posted regularly. Safeguards have been incorporated to protect you from unneccessary electronic intrusions. Please send Kendra Carroll (kcarroll63@gmail.com) a simple note with your email in the body of the note and the wording on the subject line: please add me to the ISTA listserve.

Regional Directors

Region 1 Director 10-12a
Natacia Campbell
District 230
ncampbell@d230.org

Region 1 Director 09-11a
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mcorp@troy30c.org

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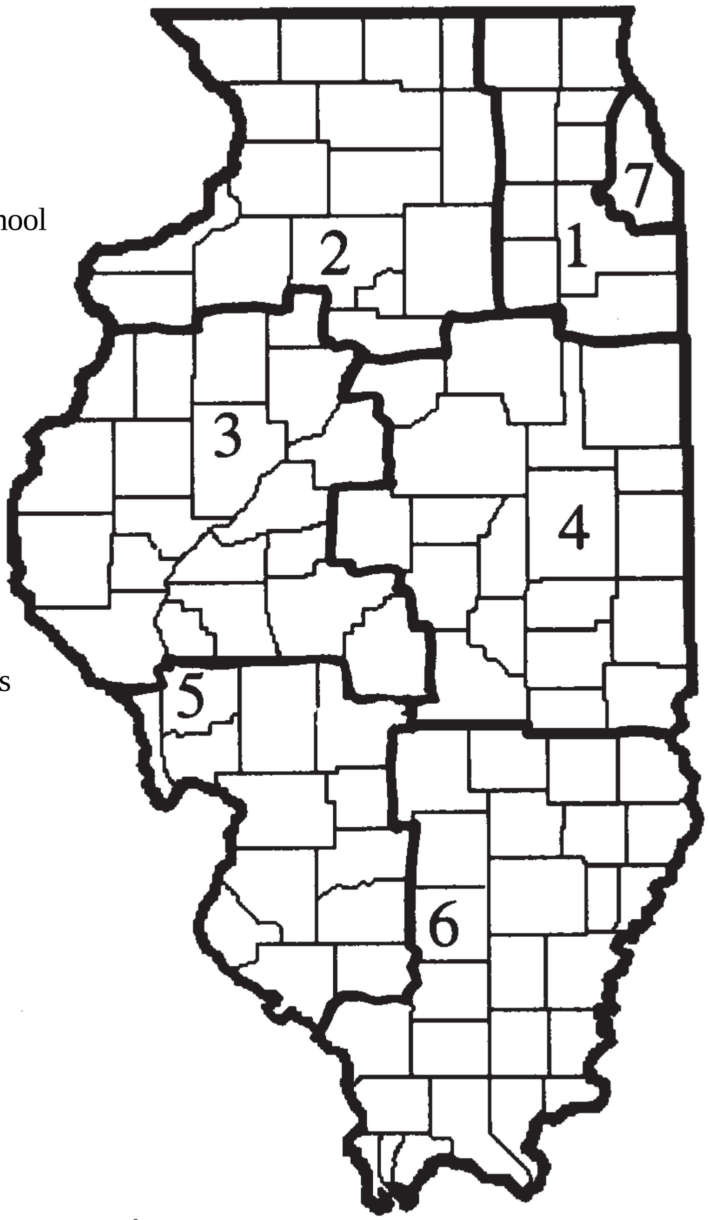

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Region 7 Director 09-11a
Christian Greer
John G. Shedd Aquarium
cgreer@sheddaquarium.org

http://www.ista-il.org/

According to ISTA bylaws, regional directors may serve only two consecutive terms. Directors noted with an "a" are in the first of a two-year term; those noted with a "b" are in the second consecutive two-year term.

Illinois Science Teachers Association

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

Name	Day Phone
Affiliation (School or Organization)	Home Phone
Address of Above Organization	Home Address
City, State, Zip Code	City, State, Zip Code
Email and/or Fax	County in Illinois/ ISTA Region (see map)

Check Applicable Categories in Each Column:

O Elementary Level	O Elementary Sciences	O Teacher
O Middle Level	O Life Science/Biology	O Administrator
O Secondary Level	O Physical Sciences	O Coordinator
O Community College	O Environmental Science	O Librarian
O College/University	O Earth Science/Geology	O Student
O Industry/Business/ Government	O Chemistry	O Retired
O Other___________	O Physics	
	O General Science	
	O Integrated Science	
	O Other______________	

Send form and check or money order, made payable to Illinois Science Teachers Association, to: Pamela Spaniol (email: pamela.spaniol@yahoo.com), ISTA Membership, PO Box 312, Sherman, IL 62684.

Membership Option (see below)______ FFSE Membership Yes/No _____ Amount Enclosed ______

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*; 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.
Option 5: Institutional membership - $75.00. Institutional membership entitles the member institution, for a period of one year, to two subscriptions to the *Spectrum*; 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.
Option 6: Initial Certificate Option - $20.00. Full membership benefits to beginning teacher in the first to fourth year of teaching.

Fermilab Friends for Science Education (FFSE): Thanks to an ISTA-FFSE board agreement, for Options 1, 4, 5, and 6, teachers may receive a regular $10 membership in the FFSE for an additional $4.
See http://ed.fnal.gov/ffse/ for membership details.

Illinois Section - American Association of Physics Teachers (Is-AAPT):
Option A: College faculty will receive both ISTA and IS-AAPT memberships for $55 (+$20);
Option B: K-12 faculty will receive both memberships for $45 (+$10);
Option C: Full time college students and retirees will receive both memberships for $15 (no additional charge);
Option D: K-12 teachers in their first through fourth year of teaching will receive both full memberships for $30 (+$10).
See http://isaapt.org/ for membership details.

2011 ISTA Election

Plans are already underway for our next election. It will again take place online via Survey Monkey in January of 2011. In order to vote, your dues must be up-to-date. You will receive an email notice by January 10, 2011 from me, Jill Carter, immediate past president. The email will contain a link to our ballot on Survey Monkey. If you do not receive this email from me by that date, please contact me promptly at jcarter@pekinhigh.net. Occasionally, emails are blocked by a school's spam filter. I won't know when this happens unless you contact me. Biographical information and a rationale for serving for every candidate will appear on this site along with the ballot. This year we will be electing a president-elect, a vice president, and a secretary, as well as one regional director from each of our seven regions. In addition to voting for the officers, you may vote for one regional director from each region. If you prefer not to vote for regional directors outside of your region, you certainly can choose to vote just within your region.

We must have your current email address in order for you to vote online. Please contact our membership secretary, Pam Spaniol, at pamela.spaniol@yahoo.com if you have a new email address.

All paid up ISTA members will vote online for this election. However, if you would prefer a mailed paper ballot please contact Pam Spaniol (email address above) by November 17, 2010.

We would also like to encourage our members to run for a regional director position or an officer position. This is a great way for you to become professionally involved in your organization. We have three board meetings a year. Look for the application form on our website at http://www.ista-il.org or contact your regional director. We would love to have a full ballot!

Jill Carter
Immediate Past President
jcarter@pekinhigh.net

Cultivating Illinois Science

ISTA's 43rd Annual Conference

November 4 - 6, 2010
location: Springfield, Illinois

Thursday Evening:

5PM - 8PM Reception and Exhibit Hall Opening
Special Program for Pre-Service Teachers

Friday:

Conference Sessions - Up to 9CPDUs available
Luncheon Keynote - Alan McCormack, NSTA President
Luncheon - Celebration of New and Outstanding Teachers of Science
4:00 PM - Exhibit Hall Door Prize Raffle
5:00 PM - Regional Receptions

Imagine and Invent: Create a Great Future

Alan J. McCormack
President, National Science Teachers Association
Professor of Science Education
San Diego State University

Friday Gala at the Illinois State Museum!

Saturday:

ISTA Business Meeting
9:00 AM - Tours and Workshops

Check the ISTA web site (http://www.ista-il.org/) for tour and workshop updates.

Exhibitors will be open from 5-8 pm on Thursday and 7:30 am to noon and 1:15 to 4:30 pm on Friday. Many exhibitors and ISTA will be raffling off valuable door prizes at 4 pm Friday in the exhibit hall

Please Join us in Abraham Lincoln's Hometown!

Visit the Exhibit Hall!

Below is our beginning list of vendors available to you at the conference.

Exhibit Hall Openings

Thursday 5-8PM
Includes Reception

Friday 7:30AM - Noon
and
1:15 - 4:30PM

Prizes available for visiting the vendor booths!

Apperson Education Products
Bitwixt Software Systems
Chicago Council on Science and Technology
CPO Science
DELTA Education
Fisher Science Education
Flinn Scientific
Frey Scientific
Glencoe/McGraw Hill
Houghton Mifflin Harcourt
Illinois Agriculture in the Classroom
Illinois Association of Aggregate Producers
Illinois Coalition of Community Blood Centers
Illinois Department of Natural Resources
Illinois Department of Public Health
Illinois Mathematics and Science Academy
Illinois Petroleum Resources Board
Illinois Section of the American Association of Physics Teachers
Illinois State Museum
Key Curriculum Press
Lab-Aids
Lights for Learning
Nancy Larson Publishers
PASCO Scientific
Presidential Awards for Excellence in Mathematics and Science Teaching
Sargent Welch/Science Kit/Wards
The Scope Shoppe, Inc.
University of Illinois Extension - Radon Education Program
University of Illinois - School of Integrative Biology
Vernier Software and Technology

Vendors and Exhibitors for the ISTA Conference on Science Education can Contact:

Harry Hendrickson, Executive Director of ISTA
218 Cumberland Drive
Rochester, IL 62563
Email: hhendrickson@comcast.net
Phone: 217-498-8411; Fax: 217-498-8408

Grand Evening in the Museum

ISTA Celebrates ...

New Teacher Awardees

Jeong Choe
Illinois Mathematics and Science Academy

Kathleen Fritsch
Proviso East High School

Kristen Piggott
Deerfield High School

Daniel Prieto
Cissna Park School District

Gregory Wallace
Marist High School

ExxonMobil Outstanding Teachers of Science

Mark Carlson
Illinois Mathematics and Science Academy

Jason Crean
Lyons Township High School

Glen Flodstrom
Washington Junior High School

Barbara French
Illinois School for the Visually Impaired

Cheryl Johnson
Casey Westfield Junior High School

Kathryn Eggert
Prescott Magnet Cluster School

Conference Highlights

Listed below is just a sampling of the great presentations to be found at the ISTA conference!

Wind for Schools
Fun for All: Integrating Math and Science with Your Fourth and Fifth Graders
Data Visualization
Operation: Tectonics Fury
Got Dirt? Growing Healthy Kids
Light Reflection: The Shopping Mall Problem and More
Taking the Mystery out of Chemistry
NASA and Team Robotics
The Light Stuff: Solar Bursts Across the Curriculum
Teaching Nature of Science and Science Inquiry in an Earth Science Classroom
Forensic Anthropology
Making Your Classroom Relevant: Community Action, Engaged STEM, and Global Climate Change
Incorporating Research Projects into the High School Science Classroom
Grow Your Mind: Hands-On Activities to Sprout Learning in Science
Action Research as Advanced Professional Development for Experienced MS Science Teachers and Teacher Leaders
Involving Students in Community Stewardship to Extend Learning Beyond the Classroom
Enabling Twenty-First Century Science Education
It's as Easy as Planting a Seed
Geographic Information System in the Classroom
An Innovative Integrated Science Learning Center for Urban High Schools
Launching Self-Directed Learners and Teaching for Meaning Through Problem-Based Leaning
Nanoparticles: Engaging Students with Hands-on Nanotechnology Laboratory Activities
Integrating Physical Science and Geometry
Biodiesel in the Classroom
Making Sense of Drops on Cents: Understand the Influence of Variables on Outcomes
Myths and Misconception About the Sun-Earth Connections
Inquiry for Beginners: The First Steps for a Physics Curriculum
Science Career Investigation: Sparking Student Interest Through Career Exploration
Use Polymers to Amaze Students by Creating 3-D Objects in Your Classroom
National Board Certification and You
Introducing STEM Activities in the Elementary and Middle School Classroom
A Ten Day Water Environment Curriculum
Making Science Primary in Reading
Gross Day
Hooking Kids with Haunted Physics
Science Is a Foreign Language: Teaching Science Literacy at the Secondary Level
Biotechnology Basics for Middle School
Integration of Science and Math (STEM) in the Pre-K Classroom
Executive Function Curriculum in the Science Classroom
The BP Disaster in the Gulf is an Environmental Nightmare! Solution: Stop Exploring in the US?
Human Anatomy and Physiology Activities
Acing the ISAT with Standards Driven Experiments
Ethical Issues for the Science Classroom

Flash Drives
with
Conference Proceedings
available for $10

Every presenter is invited to submit their PowerPoint presentations, conference hand-outs, resources, and other materials in digital format to ISTA. ISTA will then sell flash drives for $10 with ALL conference materials. Get yours at the registration booth!

Conference Volunteers Needed!

Want to meet new ISTA colleagues?
Volunteer at the conference!

Contact Loretta Meeks (loretta@uis.edu) if you're interested.

New Teachers Reception

Sponsored by
Patrick Schlinder
Representing
The Scope Shoppe, Inc.
and
Flinn Scientific, Inc.

Hotel Information

Crowne Plaza Hotel
$115 single or double room
800-589-2769
www.cpspringfield.crowneplaza.com
Group Block Code: SCI

Springfield Holiday Inn Express
$90 single or double
800-HOLIDAY
www.hiexpress.com
Group Block Code: STA

Call by October 14 and identify yourself as an ISTA conference participant.

Illinois Science Teachers Association
43rd Annual Conference on Science Education
Springfield Crowne Plaza and Holiday Inn Express—November 4-6, 2010
Advance Registration

YOUR INFORMATION—please print clearly or type; all fields are needed; * fields will appear on your badge.

First name*________________________________ Last name*________________________________
Job Position/Title*____
School/Affiliation*____
Business Mailing Address_______________________________ Business phone________________
City*________________________ State________ County____________________ Zip________
Home Mailing Address _______________________________Home phone____________________
City__________________ State_____ Zip_______
Email ____
Name of guest/spouse attending conference with you*_______________________________________

Please check:

I prefer to receive mail at ____Home OR School/Business ____ I can be a presider for a session ____
I prefer non-meat Friday luncheon meal_____ I have taught 4 years or less _______
I'll need Special Assistance ______ (briefly describe:____)

Discipline(s)-check all that apply		Position(s)-check all that apply	Grade(s)-check all that apply
□ Earth sciences □ Elementary sciences □ Biology/Life sciences □ Environmental sciences	□ General sciences □ Integrated sciences □ Physical sciences □ Chemistry □ Physics □ Other_______________	□ Teacher □ Supervisor/Coordinator □ Administrator □ Student □ Retired □ Other__________________	□ Elementary □ Middle/Junior HIgh □ High School □ 2-yr Community College □ 4+-yr College/University

CONFERENCE REGISTRATION—Thursday, Friday, Saturday Options

Registration Fees with Postmark Deadlines—*Circle your choice*				Payment Totals
Status option	Postmarked by 10/1/10	Postmarked by 10/21/10	Postmarked after 10/21/10 or on-site	
Full, current ISTA member	$125	$140	$150	Registration: $______
Full, ISTA membership renewal	$160	$175	$185	Spouse fee: $______
Full, non-member	$160	$175	$185	Gala $______
Full, Institutional member (up to three individuals)	$120/each	$135/each	$145/each	Saturday tour or workshop $_________
Full, Student including membership	$30	$30	$30	Dual Membership $_________
Thursday evening only	$70non-mbr $35 mbr	$75non-mbr $40 mbr	$80non-mbr $45 mbr	TOTAL $_________
Saturday only	$70non-mbr $35 mbr	$75non-mbr $40 mbr	$80non-mbr $45 mbr	
Non-teaching spouse/guest Friday Luncheon	$20	$20	$20	Payment Method:
Special events: see Description Page (may be sold at registration, pending space availability)				By Check #______
• Saturday tours: Choice 1st ___; 2nd___; 3rd ____		$10		By Purchase Order (attach)
• Friday evening Gala		$35		By Credit
• Dual membership options				LINK:______
• FermiLab Friends of Science Education		$4		Instructions:
• IL Section-Am. Assoc. of Physics Teachers Option A___$20; B___$10; C____$0; D____$10		$_____		Convenience fee of $5

Please make checks or purchase orders payable to Illinois Science Teachers Association. Send to ISTA Membership Secretary Pam Spaniol, PO Box 312, Sherman, IL 62684. Admittance to conference only by registration. If your registration is received by 10/23, you will receive confirmation by email. All materials will be available at conference registration desk.

Saturday, Nov. 6, ISTA Field Trips or Workshops as of 5/13/10

Notes: 1. All field trip tickets are provided on a first-come, first-served basis. Since travel arrangements are based on registrations, no refunds will be made at the conference unless all chosen tour choices are unavailable.

2. While making great efforts to organize these science-related field trips, ISTA reserves the right to cancel any trip. If the minimum number is not reached, the maximum is exceeded, or it is cancelled for other reasons, the registrant will be transferred to another field trip indicated on the registration form preferences. If the second or third choice is unavailable, the participant will, after consultation by email or phone, be transferred to another field trip, or the field trip fee will be reimbursed.

3. If field trip slots are available, tickets will be sold at the conference registration desk up to noon, Friday, November 5. Check at the registration desk for field trip availability. Tickets can be traded or transferred to others.

4. ISTA has set a fee of $10 for each field trip to cover school bus transportation and certain other expenses. The Wind Energy tour requires a tour bus and an additional $10 will be collected.

5. Please remember that all tour guides are donating their Saturday time as a service to science teachers. Please thank them for their dedication and willingness to share information about their profession.

Field trips: Specify 1st, 2nd and 3rd choices by letters on your conference registration form.

A 9am - Noon Taylorville Waste Management Landfill and Electric Generating Plant and Adjacent Buckley Greenhouse. Methane from the landfill is collected and run through Cat generators to produce electricity for about 10,000 people. The waste heat from the generators is sent to Buckley's hi-tech greenhouse incorporating about five acres. Buckley's optimizes genetic and environmental factors and employs about thirty people to produce plants sold by retailers throughout the Midwest. Minimum/maximum: 15/50. Accessible.

B. 9am - Noon National Surveyors Museum with Science on a Sphere, and Tour of the Abraham Lincoln Presidential Museum. Min/max: 20/40. Accessible.

- **Science On a Sphere (SOS)** is a six-foot suspended globe developed by NOAA, using four video projectors and five computers to display dynamic animated images of the Earth's atmosphere, oceans, animal migration patterns, global warming trends, hurricane paths, and more. Projected images include the Sun, Mars, and Moon.

- **The Abraham Lincoln Presidential Museum** has educated, entertained, and provided a magical, multimedia experience for over 2.5 million visitors since it opened in 2005. The new *Team of Rivals* exhibit will open in October 2010, and there will be special events marking the 150th anniversary of Lincoln's election to the Presidency. A special welcome and tour is planned for science teachers. Teachers must bring school ID.

C. 9am - Noon University of Illinois at Springfield. Clinical Laboratory Science - Solving Medical Mysteries. Over 70% of medical decisions involve laboratory data. Participants will do real and mock laboratory tests to solve the mystery of what is wrong with a fictitious patient. A variety of medical laboratory professions will be introduced and the educational requirements will be reviewed. Min/max: 10-20. Accessible.

D. 9am - Noon Southern Illinois University Medical School, State Police Forensics Lab, Illinois Department of Public Health Lab, and Illinois Environmental Protection Agency Lab. Springfield medical zone. Min/max: 20/40. Accessible.

- The Pearson Museum at the SIU Med School. Since 1980, this museum has collected, preserved, and interpreted the history of medicine, health care, nursing, dentistry, and pharmacy, emphasizing the Midwest.

- The Illinois State Police Forensics Lab is one of nine located throughout the state. Personnel at these labs process evidence collected from crime scenes, using such advanced techniques as DNA analysis and automated fingerprint systems. About 98% of their casework originates from local law enforcement agencies

- The Illinois Department of Public Health also operates labs in Chicago and Carbondale. IDPH labs maintain advanced laboratory capabilities including advanced molecular diagnostics to detect and monitor threats to human health. Clinical and environmental sections perform analyses for various diseases, HIV, newborn testing, lead levels in children, food and dairy products, and water.

- Illinois Environmental Protection Agency Labs perform over 1,200,000 annual analyses of environmental samples collected by EPA field staff. IEPA also tests water for public water suppliers participating in the Community Water Testing Program reported on the annual Consumer Confidence Reports. IEPA operates organic and inorganic chemistry and microbiology labs in Springfield and accredits private environmental labs.

E. 9:15am - 11:45am Lincoln Land Community College/Illinois Section American Association of Physics Teachers. "The Latest in Pedagogies for the Teaching of Elementary Physics," Lincoln Land Community College, Sangamon Hall Room 2211. Hosts: Dave Sykes and Tom Snyder, professors of physics, LLCC. In this workshop participants will be exposed to a collection of the most effective teaching strategies as evidenced by physics education research. Attendees will work with peer instruction, inquiry, just-in-time-teaching, workshop physics, and other recently developed teaching techniques. All participants will leave the workshop with a thorough understanding of the latest in physics education. Min/Max: 10/20. Accessible.

F. 9 am - 12:30pm Starhill Forest Arboretum, near Petersburg. Visit this research and educational arboretum operated by Guy and Edie Sternberg and Illinois College. In its forty-eight acres, greenhouses and nursery, thousands of varieties of trees are bred and propagated, with an internationally recognized emphasis on oaks. Teachers will learn about the opportunity for field trips and online resources provided by Starhill Forest Arboretum, as well as the Sternbergs' scientific silviculture methods and gracious hospitality. Min/Max: 8/30. Tour includes hiking over moderate terrain.

G. 9am - 12:30 pm Wind Energy Tour. In 2009, wind energy produced 1.8% of the country's electric power. Visit Horizon Wind Energy's Rail Splitter Wind Farm. Straddling the border between Tazewell and Logan counties, this 100.5 MW wind farm was built in early 2009 and consists of sixty-seven 1.5MW GE wind turbines. The electric power produced by the wind farm is sold into the regional market, and the associated renewable energy credits are used by organizations to meet state renewable energy mandates or to voluntarily reduce the environmental impact of their operations. The tour will be led by the former GE site manager of the farm and hosted by Horizon Wind Energy in cooperation with Illinois State University. Part of the presentation will be on the tour bus. $10 additional fee for tour bus will be collected. Min/Max 20/40. Accessible.

Member Notes

This column is devoted to news from our members. Do you have a birth, marriage, job promotion, new job, or retirement you'd like to announce? Just send the information to me. Please include everything you'd like to appear in the announcement. You must self-report this. If you know of the death of any ISTA members (or retirees who were past members), please send that information to me as well. My email address is: schimm_julie@yahoo.com.
Thank you! Julie Gianessi

Birth
Kristi Van Hoveln, former region 4 director, and husband Darin have a new son, Jack Nicholas. He was born May 25, 2010. Jack was 8 pounds 13 ounces. Congratulations!

Do *You* Know an Exemplary Science Student?

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 pamela.spaniol@yahoo.com. The fiirst medallion is free of charge; additional medallions may be obtained for $15 each.

This award program is supported by contributions from the Illinois Petroleum Resources Board.

ISTA Shirts For Sale!

ISTA has polo shirts and denim shirts for sale. The shirts are blue, with the ISTA logo; ISTA is red and the State of Illinois outline is in white.

Indicate style, size, and number:

Polo Shirt	Women's	Men's	S - XL cost $22;	XXL costs $24
Denim Shirt	Unisex		S - XL cost $24;	XXL costs $26

shipping and handling: add $4 for 1-4 shirts
add $6 for 5-12 shirts

Make checks out to ISTA and mail to: Lynne Hubert
4243 W. Lee St., Skokie, IL 60076

Greetings from the ISTA Awards Chair

Greetings!

My name is Tara Bell and I am serving as ISTA awards chair. I have taught middle school science for the past four years. I am very excited to share some of the highlights from the 2009-10 ISTA awards cycle with you!

This was a very exciting year for ISTA awards, with many new honors and developments. First, the awards committee selected six talented teachers from across the State to receive the ISTA/ExxonMobil Outstanding Teacher of Science Award in March. The teachers completed an application and submitted letters of recommendation, along with artifacts from their classroom. Each recipient received $1000. In June, the committee selected five up-and-coming science stars for the ISTA New Teacher of the Year Award. These teachers were nominated by colleagues or administrators, and will receive $400. A biography of each of the five 2009-10 ISTA new teacher awardees can be found on the following pages.

Please join me at the ISTA annual conference in Springfield, November 4-6, 2010, for a conference session on Friday morning, *Opportunities Abound*, where I will discuss awards and professional development opportunities for teachers. ISTA will also be honoring the 2009-10 awardees, Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) winner, and finalists during the Friday luncheon.

I would like to strongly encourage all members to apply for ISTA awards. We know there are some great teachers in our membership; please share your efforts and accomplishments with us. It would be our pleasure to honor you! If any prospective members wish to apply for an award…what a great reason to join ISTA!

Please note that the 2010-11 ISTA awards cycle deadlines:

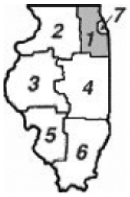
Outstanding Teacher Award (K-6) - February 1, 2011
New Teacher Award (K-12) - May 1, 2011

Thank you, ExxonMobil, for funding these awards and for your commitment to ISTA's mission of promoting excellence in science teaching and learning throughout Illinois.

For further information about the awards ISTA offers including applications, deadlines, and awardees, please explore the awards section of our website or e-mail me at tbell@ista-il.org

Looking forward to seeing your award application soon!

2009-2010 ISTA New Teacher of the Year Awardees

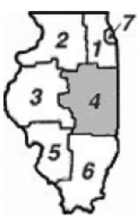


ISTA Region 1

Dr. Jeong Choe is entering her third year teaching at the Illinois Mathematics and Science Academy (IMSA) in Aurora. She teaches a variety of chemistry courses including Sophomore Chemistry, Biochemistry, and Advanced Chemistry. Jeong received her B.S. degree in 2002 and obtained her Ph.D in 2008, both from the University of Illinois at Chicago. In her short time at IMSA, Jeong has made an impact on students and faculty alike. According to her colleagues, "Jeong is a great role model, particularly for our young women who wish to pursue science." Jeong frequently utilizes formative assessments in her classroom, allowing her students to think more meta-cognitively and examine how they "know" what they know. If you visit Jeong's classroom, you will often find her someplace other than the front of the room, and she encourages students to actively participate and contribute to discussions. As a result, students have a great deal of respect for her and her high expectations. Jeong works frequently with students outside the classroom. In the past year, she coached the Science Olympiad team, helping them to reach third place in state competition. Jeong also plays an important role in reaching out to students other than those who attend IMSA. In particular, she teaches summer camps to junior high students during which they learn chemistry through unique and creative experiments, such as making ice cream with liquid nitrogen. Jeong's innovative teaching style and classroom, her connection to students both in and out of class, and her work with IMSA colleagues and other Illinois teachers are among the reasons she is one of ISTA's new teachers of the year. Congratulations, Jeong!

Kathleen Fritsch will begin her second year as a high school physics teacher in the fall of 2010. Kathy taught at Proviso East High School in Maywood last year. She earned a B.S. in geology from Illinois State University and a MAT from National-Louis University. Kathy made the wise decision recently to become a high school physics teacher. Prior to teaching physics, Kathy had a successful career in the field of engineering. In her short time as a teacher, Kathy has made sincere connections and lasting impressions with her students. Kathy has done an exemplary job as a physics teacher in a very difficult learning environment at Proviso East. She has had great success with students, many whom have math and reading levels below the state average. Nonetheless, Kathy enthusiastically and creatively inspires her students to want to learn physics. She regularly uses hands-on activities in her lessons to boost student achievement and engagement while incorporating technology to prepare students for the future. Kathy has revolutionized lab completion by making them internet-based, requiring results to be graphed on a computer, and offering a reward system for classes with passing lab scores. She has seen many students embrace technology as a result, and even has students who presented lab results using movie-making software. Kathy's students are very diverse and she has adapted her lessons to suit all learning styles in her classroom. According to her colleagues, "Kathy's classroom is vibrant and she teaches like a veteran." Kathy's commitment to her students, flexibility in her teaching style, and drive for excellence are among the reasons she is one of ISTA's new teachers of the year. Congratulations, Kathy!

Kristen Piggott is entering her fourth year as a science educator. She has taught a variety of courses including Biology, Chemistry, Physics, Astronomy, and Criminalistics at Deerfield High School in Deerfield. Kristen received a B.S. in biological sciences from Michigan State in 2005 and has nearly completed a master of arts in teaching degree at Wayne State University in Detroit. The first line of Kristen's nomination read, "If you want something done, you can count on Kristen Piggott." Undoubtedly, Kristen's endorsements to teach biology, chemistry, and physics have made her an asset to the science department at Deerfield High. Kristen understands what motivates students and how to design experiences to engage students in the curriculum. For example, Kristen designed a physics project, "Mousetrap Car," to help students learn energy conservation and a "Rock Band" project to delve into sound. Perhaps it is for this reason, her nominator exclaims, "Whenever I need ideas, I go to Kristen!" Kristen's organization shows in her classroom as she has a "toolbox" of study and organizational skills she shares with students. She provides students with weekly assignment sheets and maintains an up-to-date website to support their learning needs. As a new physics teacher, Kristen has worked with a team of teachers in writing lesson targets and sharing classroom strategies to support science skill development. Seeing the need for more technology support, Kristen volunteered to serve on the school's technology committee and has given presentations to the faculty related to technology. It is evident that she is very good at reaching beyond the science department to collaborate with others. Kristen's innovation, creativity, and collaborative skills are among the reasons she is one of ISTA's new teachers of the year. Congratulations, Kristen!



Region 4

Daniel Prieto will begin his third year as a science teacher in the fall of 2010. He is a junior high and high school science teacher in the Cissna Park School District. Dan received his B.S. degree in environmental education from Knox College as the inaugural student of the program. Dan currently teaches five courses as he is the only junior high science and high school environmental science instructor in his school. Nonetheless his nominator remarks, "Finding new science teachers with as much desire as Dan is difficult." While at Cissna Park, Dan has updated the entire science curriculum in the junior high to be aligned with state standards. While updating the curriculum, Dan also was able to initiate a junior high science fair. Recently, he revamped the high school environmental science course and is currently working on implementing a new forensics course. Keeping up with the times, Dan also created a Facebook page for all of his courses to allow students to track content, assignments, and monitor their progress. In addition to his teaching duties, Dan is also the webmaster for his school district, cosponsor of the junior high yearbook, and cosponsor of the freshman class. As an accomplished DJ, Dan gives back to the students by volunteering his time and equipment for school dances. Although Dan quickly learned that teaching is an expensive profession, he has found creative ways to make his budget stretch, including acquiring used books and receiving corporate grants to purchase supplemental materials. This past year, Dan started an innovative school supplies recycling program consisting of students collecting leftover school supplies to be reused when school resumes. Congratulations, Dan, on being named an ISTA new teacher of the year!

Region 7

Dr. Gregory Wallace is entering his third year as a science educator. Greg is a chemistry and honors anatomy instructor at Marist High School in Chicago. Greg received his B.S. in animal sciences in 1999 and his PhD in cell and structural biology in 2005, both from the University of Illinois. His PhD dissertation topic was gene therapies for muscular dystrophy, and Greg did postdoctoral research at the University of Chicago (2005-2008) on stem cell therapies for muscular dystrophy. Although Greg has only been a teacher for a short time, he displays strong leadership qualities and innovation in his classroom. According to his nominator, "Greg is one of the best teachers I have worked with in my forty year career." His gift is his ability to design creative activities to facilitate learning and engage students whom he calls his "young chemists" and "young anatomists." In his instruction, Greg relies heavily on inquiry activities and performance tasks to develop concepts. He also uses concrete examples that students are familiar with to connect chemistry with the real-world. One such example involved his bowling ball and a Google Earth map to demonstrate electron clouds. When learning about muscles, students played Simon Says, did the Hokey Pokey, visited the weight room, and played the card game Cardiovascular Sharks. Although he has achieved excellence in the classroom, Greg's contributions extend beyond. He is the sponsor of the Science Club, engaging students in engineering events, experiments, and a bridge building competition. It is easy to see that Dr. Wallace's commitment to utilizing inquiry in the science classroom and sharing his expert knowledge with students are among the many reasons he is an ISTA new teacher of the year. Congratulations, Greg!

Top, left: Membership secretary Kendra Carroll and Casey-Westfield Junior High principal Carol Wetherell present ISTA/ExxonMobil Outstanding Teacher Award and $1000 check to Cheryl Johnson.

Top, right: Region 2 director Carol Schnaiter presents ISTA/ExxonMobil Outstanding Teacher Award and $1000 check to Glen Flodstrom.

Bottom, left: Region 7 director Christian Greer, and Prescott principal Erin Roche present ISTA/ExxonMobil Outstanding Teacher Award and $1000 check to Kathryn Eggert.

ISTA Congratulates

Jason Crean

Recipient
of the
Presidential Award
for
Excellence
in

Mathematics and Science Teaching

ISTA congratulates member Jason Crean on winning the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST)! Mr. Crean is a high school biology teacher at Lyons Township High School in LaGrange. He will travel to Washington D.C. to receive his award, a $10,000 cash prize, and meet President Obama at the White House in the coming months. In addition to teaching at Lyons Township for nine years, Jason teaches graduate level courses at Saint Xavier University and is an adjunct faculty member at Aurora University and Illinois Benedictine University. He is also a curriculum designer and instructor in the Education Department at Brookfield Zoo.

Jason Crean is no stranger to being recognized as an exemplary science teacher and has several awards to prove it. He is one of ISTA's 2009-10 Exxon/Mobil Outstanding Teachers of Science. Additionally, he has received the Making a Difference award from the National Science Teachers Association, two National Association of Biology Teachers awards, and is an Illinois Association of Biology Teachers Outstanding Biology Teacher Award winner.

Jasonwill be attending ISTA's annual conference in Springfield, November 4-6, and will be presenting a teacher workshop about zoo genetics. Check your conference program for an opportunity to meetJason and his exotic birds after the Friday luncheon!

ISTA/ExxonMobil Outstanding Teacher of Science Award
Grades K-6

Purpose: The Illinois Science Teachers Association, with the generous support of ExxonMobil announces the 2010-11 ISTA/ExxonMobil Outstanding Teacher of Science Awards Program. Applications will be accepted from **K-6** grade science teachers who have demonstrated extraordinary accomplishments in the field of science teaching. ISTA and ExxonMobil plan to recognize grade 7-12 teachers in the 2011-12 school year.

The 2010-11 program consists of honoring up to seven science teachers throughout Illinois. A $1000 award may be presented to one **K-6** grade science teacher from each of the seven ISTA regions in the state of Illinois. Previous winners are not eligible.

This award is intended to recognize extraordinary accomplishment in the field of science teaching. Applicants must provide evidence that demonstrates accomplishments that go beyond normal classroom teaching. Descriptions of the previous two years of awardees and their achievements are on the ISTA website: www.ista-il.org.

Requirements:

1. Current ISTA membership.
2. Full time teaching assignment in grades K-6.
3. Teaching assignment in the ISTA region for which the application is submitted.
4. Written narrative (maximum of 500 words) describing the teacher's extraordinary accomplishments.
5. Evidence that supports the teacher's description of extraordinary accomplishments in the field of science teaching. Examples include: copies of newspaper articles, journal articles, grant applications and acceptance letters, letters from community agencies, action research reports, photos, and so forth. Do not exceed more than ten printed pages of evidence. Evidence will not be returned.
6. Vita or resume (one page, single sided) of teaching experience, professional activities, formal and continuing education, awards, and published material. Include current teaching assignment, home and school addresses, home and school phone numbers, and email address.
7. Two letters of support from individuals who can attest to the impact of the extraordinary accomplishments.
8. Previous Outstanding Teacher Awardees are ineligible.

Awardees:

- Honor up to seven full time grade K-6 science teachers.
- $1000 check payable to each teacher.
- Recognition in ISTA's *Spectrum*, on the ISTA website, and at the ISTA conference luncheon.

Timeline:

✓ Applications submitted by February 1, 2011.
✓ Selection committee makes decision of awardees, March 2011.
✓ Awardees notified in April 2011.
✓ Awardees honored at 2011 ISTA annual conference.

Nominations must be submitted either electronically or via U.S. mail by **February 1, 2011.**

Email nominations to: tbell@ista-il.org

or

Mail applications to: ISTA Awards Chair, Tara Bell
2523 N. 2950th
Marseilles, IL 61341

ISTA New Teacher of the Year Award

Purpose: The Illinois Science Teachers Association announces the 2010-11 ISTA New Teacher Award Program. The goal of this award is to recognize new teachers for excellence in facilitating science learning in their classrooms. This award aims to encourage some of the bright, up-in-coming teachers to continue to strive towards best practice and provide support for them along the way.

The 2010-11 program consists of honoring up to seven new teachers with initial teaching certification. Applicants must be nominated by an ISTA member or a school administrator. Benefits of this award include recognition from ISTA, a complimentary one-year ISTA membership, and the opportunity to participate in the new teacher panel at the ISTA annual conference. Descriptions of the previous year's awardees and their achievements are located on the ISTA website: www.ista-il.org.

Requirements:

1. Teacher with initial Illinois certification; indicate year of certification. List degree(s), granting institution(s), and year(s) obtained.
2. ISTA member (teachers can join instantly and enjoy a $20 reduced rate).
3. Must be nominated by an ISTA member or a school administrator.
4. Current teacher of science (can be teaching science in an elementary setting).
5. Completed application and biography (not to exceed 500 words) highlighting innovative teaching experiences, exemplary service, professional development activities, and trend setting practices in the field of science. Include school and summer addresses, school and summer phone numbers, and email address.
6. Previous New Teacher of the Year awardees are ineligible.

Awardees:

- Honor up to seven teachers with initial certification.
- Awardees honored with a one-year membership to ISTA.
- Recognition in ISTA's *Spectrum*.
- Recognition on the ISTA website.
- Recognition at the ISTA conference luncheon.
- Receive a teacher of science "Idea Pack."
- Certificate of recognition.
- Participate in the new teacher panel at 2011 ISTA annual conference.

Timeline:

- ✓ Applications submitted by May 1, 2011 for school year 2010-11 awards.
- ✓ Selection committee makes decision of awardees, June 2011.
- ✓ Awardees notified in July 2011.
- ✓ Awardees honored at 2011 ISTA annual conference luncheon.

Nominations must be submitted either electronically or via U.S. mail by **May 1, 2011**.

Email nominations to: tbell@ista-il.org
or
Mail applications to: ISTA Awards Chair, Tara Bell
2523 N. 2950th
Marseilles, IL 61341

Developing Local Physical Science Alliances for Illinois

Carl Wenning

Illinois Section of the American Association of Physics Teachers

The Illinois Science Teachers Association (ISTA) and the Illinois Section of the American Association of Physics Teachers (ISAAPT) are developing Local Physical Science Alliances (LPSA) for Illinois. Each of these LPSAs will serve as an informal professional science education society operating within a small geographic area. LPSAs are being created to help achieve the ends for which both the ISTA and ISAAPT were organized. Once fully developed, the memberships of LPSAs will meet four times per academic year to forge and sustain links between elementary school, middle school, high school, community college, and university faculty members who teach physical science (general science, Earth and space science, chemistry, and physics). Attendees will share ideas, develop learning-teaching modules, learn from one another, gain a sense of empowerment, and have a good time. Physical science teachers at all levels will increase their effectiveness by participating in these local alliances, but especially spend time promoting and developing horizontal and vertical relationships with other teachers. You are encouraged to attend, participate, and benefit. More information will be shared through our e-membership networks, as it becomes available.

The four draft physical science (PS) core ideas from the preliminary framework of the new science education standards (NRC, 2010) are being considered as the basis of the four school year meetings of LPSAs:

PS 1: Macroscopic states and characteristic properties of matter depend on the type, arrangement, and motion of particles at the molecular and atomic scales (structure and properties of matter).

PS 2: Forces due to fundamental interactions underlie all matter, structures, and transformations; balance or imbalance of forces determines stability and change within all systems (interactions, stability, and change).

PS 3: Transfers of energy within and between systems never change the total amount of energy, but energy tends to become more dispersed; energy availability regulates what can occur in any process (energy and its transformations).

PS4: Our understanding of wave properties, together with appropriate instrumentation, allows us to use waves, particularly electromagnetic and sound waves, to investigate nature on all scales, far beyond our direct sense perception (waves as carriers of energy and information).

Not only will content theme serve as organizing themes for various LPSA meetings, but so will vertical and horizontal relationships. During the inaugural year, the meetings – each locally planned and based on the needs of participating teachers – will bring together physical science teaches from high schools, community colleges, and universities. They will pilot LPSA activities and improve them for utilization during the second year. During this second year, physical science teachers at the middle and elementary school will be invited to participate in these quarterly meetings.

Quarterly LPSA meetings also will focus on inquiry-oriented teaching – especially the development of inquiry sequences based on one of the author's articles, "Levels of inquiry: Hierarchies of pedagogical practices and inquiry processes" (Wenning, 2005). No longer should inquiry teaching be treated as an amalgam of interrelated activities. Rather, inquiry teaching will be seen as an incorporated set of activities based on a philosophically developed inquiry spectrum. The inquiry spectrum includes discovery learning, interactive demonstrations, inquiry lessons, and inquiry labs. Teachers at all levels will work cooperatively to create various inquiry sequences for physical science lessons from a single topic area as a professional development activity that they can immediately transport into their classrooms. An example using concepts from "work and power" is given below.

Discovery Learning

A. Students develop an understanding of the concept of work (in the physical sense) by lifting objects of different masses different distances. Distinguish between physiological work and physical work. (Is it work to hold a non-moving object?)

B. Students develop an understanding of the concept of power by running and walking up and down stairs. Ask: Are rates of exertion the same? and What term might we use to talk about energy expended over time?

Interactive Demonstration

A. Develop the mathematical definition of physical work, $W = Fd$. Have students determine the amount of work required to lift an object straight up a given distance. Ask questions about simple machines. Do they provide something for nothing? That is, free work?

B. Develop the mathematical definition of power, $P = W/t$, here as well. Power is the rate at which energy is expended. Note work-energy theorem if appropriate.

Inquiry Lesson

Using spring scales, determine the amount of work required to move a cart up different inclined planes at constant speed. Determine the values of F and d to calculate work. Compare. Help students see that work is independent of path moving vertically in the Earth's gravitational field from point d_i to point d_f.

$$W \neq f(path)$$

Inquiry Lab

Determine the amount of work performed by a DC motor as it lifts a mass m distance d in a gravitational field with strength g and at a constant speed. Next, determine the power required to perform this work in time interval t. Compare experimental work ($W = mgd$) with theoretical work determined from $P = IV$. Introduce the concept of efficiency (e). Determine e for the motor.

$$e = \frac{P_{out}}{P_{in}} = \frac{W/t}{IV}$$

While teachers at the elementary and middle school levels might not implement certain inquiry lessons and labs, they certainly will want to participate in them during LPSA meetings to develop a better understanding of the concepts. Teachers at the high school level and above can learn from elementary and middle school teachers about conceptual difficulties that students at all levels seem to share. The goal is for teachers to teach teachers so that we can improve the quality and amount of science learning with which the children of Illinois struggle each year.

You can learn more about LPSAs by attending our informational meeting at the fall ISTA meeting in Springfield, or by visiting our meeting display. If you would like to be part of these efforts to improve science teaching, please contact me at wenning@phy.ilstu.edu or watch the LPSA website at http://www.phy.ilstu.edu/lpsa/ which is currently under development.

References

National Research Council (2010). A Framework for Science Education: Preliminary Public Draft. http://www7.nationalacademies.org/bose/Standards_Framework_Preliminary_Public_Draft.pdf, retrieved 7/16/2010.

Wenning, C. J. (2005). Levels of inquiry: Hierarchies of pedagogical practices and inquiry processes. *Journal of Physics Teacher Education Online*, 2(3), 3-11.

Author Information

Carl Wenning is the 2009-10 president of the Illinois Section of the American Association of Physics Teachers. He is a semi-retired member of the Illinois State University Physics Department, and continues to work part-time in teacher education. He was director of the department's physics teacher education program from 1994-2008.

Articles

The Importance of Mentoring Relationships

Stephen Marlette
Southern Illinois University at Edwardsville

Introduction

In a prior Spectrum article, I introduced the concept of NSTA student chapters as a strategy for pre-service teacher development outlining both the benefits and challenges that face a chapter advisor (Marlette, 2007). In this article, I share insights on mentoring relationships and how I feel my opportunities to fulfill the role of mentor are enhanced by serving as a chapter advisor and involving myself with organizations like ISTA. The mentoring ideas presented here will apply to anyone that finds themselves in a mentoring role such as a cooperating teacher or senior faculty member in a department with new faculty. The article concludes with an invitation to participate in several exciting mentoring opportunities sponsored by the Illinois Science Teacher Association's Career-Building (CB) initiative.

Mentoring includes professional interactions, but it also means allowing interactions that stem from personal relationships.

What is Mentoring?

Daniel was a chapter officer during the 2006-2007 school year. We first met in a science methods class that I was teaching during his junior year. It was at this time he learned about the student NSTA chapter on campus. He joined the chapter, ran for office, and assumed a leadership position in the chapter the following fall. As he was preparing to graduate in the spring, he asked me to observe a science lesson he had prepared during his student teaching. Even though I was not assigned as his university supervisor, I wanted the opportunity to see him teach so I could write a stronger letter of recommendation. Frequently, this is where my relationships with teacher candidates end. After pre-service teachers complete student teaching, they leave the university with letters of support and aspirations of landing a teaching position that will allow them to apply the knowledge and skills they have worked so hard to perfect.

However, this is not how it worked for Daniel. Yes, he was a finalist for several openings, but he was not able to secure full time employment his initial year out. During this time, his family situation changed and the soon-to-be father felt the pressure to pursue employment opportunities afforded him in the business sector. The story could have ended here, but it does not. We maintained contact. I even invited him to present with me during the Teacher Researcher Day at a NSTA national conference. Whenever an opening crossed my desk, I would forward it to him. These types of activities kept his dream of becoming a teacher alive. I am happy to report that at the close of this school year, he sent me an email asking if we could get together for lunch. While his three-year-old son drank soda out of a covered cup, he described to me the full-time teaching position he had just accepted. To me, this was an awesome moment and it illustrates the difference between what I do as faculty member at a university and what it means to be a mentor.

Mentoring can make large differences in the transition from pre-service teacher education programs to the first years of full-time teaching.

When I do such things as attend chapter meetings, make announcements for student chapter activities and write letters of recommendations, I am doing what is expected. I am fulfilling my professional responsibilities. Mentoring includes these types of professional interactions, but it also means allowing interactions that stem from personal relationships. In defining the idea of mentor, the Committee on Science, Engineering, and Public Policy (COSEPUP) put it in terms of taking "…a special interest in helping another person develop into a successful professional" (COSEPUP, 1997, page 1). In the case of Daniel, this meant I needed to be willing to provide an additional investment of time. I started to move into the role of mentor when I agreed to schedule a non-routine observation that was not part of my faculty load, when I made time in my schedule to talk to him about his decision to become a teacher, and when I created an opportunity for him to attend a conference with me to present his work.

The Importance of Mentoring Relationships

The need for mentorship in educational systems cannot be overstated. I am confident for every success story like Daniel; there are dozens of others that go unnoticed. Consider the findings of a two year longitudinal study of beginning science teachers (Sadler and Klosterman, 2009). Data were collected from teacher candidates during their final year of teacher preparation and during their first year of fulltime teaching. In relation to the importance of mentorship, the researchers offered these insights, "…the longitudinal nature of our work and the contrasts among individual cases of teachers, who participated in a common teacher preparation program but experienced very different teaching contexts, offer a new window into the effects of mentorship for beginning science teachers. To illustrate this point, we call attention to the cases of Oscar and Tara. At the beginning of their teacher preparation program, Tara and Oscar demonstrated very strong science content backgrounds and creativity. Tara performed very well in her student teaching practicum and experienced very supportive school and classroom environments. After a rough start, Oscar also did very well as a student teacher in large part because of some well-timed advice from his cooperating teacher. By the end of year one, both participants looked forward to beginning careers as science teachers. Tara and Oscar began their teaching careers in very different settings, and the most ostensible difference was the level of support they received from their schools and colleagues. Oscar found himself surrounded by supportive colleagues eager to share ideas, listen to problems, and offer advice. In contrast, Tara felt completely isolated with no mentorship and very limited support. By the end of year two, Oscar, with the backing of his department, was making plans to overhaul the ninth grade physical science curriculum. By the end of year two, Tara was searching for ways out of her classroom through another school or another career," (Sadler and Klosterman, 2009, page 41).

I shared these examples of mentorship for two reasons. First, they illustrate in a tangible way the difference mentoring can make during the transition from pre-service science teacher education programs to the first years of full time teaching. Second, they provide the context to discuss several important ways professional organizations like ISTA and NSTA student chapters can play a role helping pre-service teachers before they begin the transition process.

Professional Organizations as a Means to Facilitate Mentoring

Opportunities for mentorship can happen through attending annual conferences, sharing a variety of professional resources, and participating in scheduled

Those offering mentorship assistance are different from those who perform evaluation.

chapter meetings and activities. For example, attending a professional conference can be a goal and an anchoring activity of a student chapter's year. Much coordinated activity is required to prepare for this event. It is especially rewarding for teacher candidates when they have opportunities to build their resume by making presentations. Besides gaining experience with goal setting, communication, and project management during the process of preparation for this event, important relationship skills are being forged. For me as an advisor, I find a rapport can be developed in ways not possible in the classroom. It can be difficult to obtain honest communication from someone when you are in an evaluative position such as their teacher or supervisor. This is why mentorship programs frequently make sure those offering mentorship assistance are different from those who perform evaluation. In my role as chapter advisor, the interactions and relationships that develop are more transparent. The officers can disagree with me as their advisor and not have to worry about it impacting their grade. However, the exchanges with me as their advisor are not nearly as important as what they are learning about the role their involvement in a professional community can play in relation to support.

When teacher candidates work together, they meet others in similar situations with similar career goals. Simply realizing they are not alone provides a measure of support. During their interactions, common issues often arise and trigger a connection point for mentoring. Sometimes this is an opportunity for me as an advisor to step in, but more frequently it becomes a situation where members in the chapter community have contacts with others or knowledge of a resource that might help to answer a question or address a need. For example, teacher candidates used their own contacts to locate and invite a panel of principals to share perspectives on interviewing skills and the logistics of preparing for a job search. In this way, these pre-service teachers are not only learning the importance of ongoing professional development, but they are beginning to establish personal networks of support. They are also developing strategies to build these networks before they leave the university. To me, this is the more important outcome.

The New Science Teachers' Support Network (NSTSN) has begun providing insights into the support and retention of new science teachers (Frazier & Sterling, 2009, 2010), but there is still much to be learned (Luft, 2007). However, Friedrichsen, Chval, & Teuscher (2007) have hypothesized that beginning teachers who leave the profession are weak in the area of support networks. I am not suggesting involvement in activities associated with professional organizations like these that have just been discussed can replace or be a substitute for weak internal support structures like Tara experienced in the new teacher example. Individuals like Tara may need more immediate day to day support from experienced teachers in areas suggested by Frazier & Sterling (2009). These include such things as: working with them to map out the curriculum, sharing when and how to teach safety, modeling best practice, assistance organizing materials and building daily routines, and maintaining a positive classroom environment. Rather

SIUE's NSTA student chapter officers for the 2010-11 school at the 2009 NSTA National Conference in Philadelphia, Pennsylvanian. From left to right: president-elect Elisabeth Knierim; president Victoria Taylor; vice president Lauren Deppe.

than replace these needed new teacher supports, what early involvement in a professional organization can do is prepare beginning teachers to cope with situations like this when they occur.

New ISTA Opportunities

Those seeking to provide mentoring opportunities like these that have been discussed will be interested in the innovative steps ISTA is taking in launching a career building (CB) initiative. This initiative includes increasing mentorship opportunities for pre-service teachers and those that work with them. For example, those attending the Forty-third Annual Conference in Springfield, Illinois on November 4-6, 2010, will notice reduced student registration fees that include a membership to ISTA. There will also be sessions specifically for pre-service teachers. This includes an opportunity for them to build their resume by sharing an activity in a Make and Take Exchange sponsored by the SIUE student chapter of NSTA. Tables will be set up exhibit hall style and presenters will demonstrate their activity as workshop attendees walk by. This invitation to present is extended to all teachers of science (any grade level/setting - formal or informal, in-service or pre-service). Both teacher educators and cooperating teachers are especially encouraged to use this as a mentoring opportunity and participate along with their teacher candidates. As an added bonus, those attending this year's conference will be able to listen to current NSTA president, Alan McCormack, professor emeritus in the College of Education's School of Teacher Education at San Diego State University. He will speak on the importance of early grade school science during the keynote address at Friday's luncheon.

In addition, I am beginning discussions regarding a special column in the *Spectrum* focused specifically on concepts and ideas relating to pre-service teachers. Column details are still in the formative stage, but initial ideas include: a section that

Call For Presenters
GET INVOLVED
in the Illinois Science Teacher
MAKE AND TAKE EXCHANGE
at the 2010 ISTA CONVENTION,
Springfield, Illinois, November 5 & 6

The Student Chapter of NSTA at SIUE would like to extend an invitation to share a favorite science activity at the 2010 ISTA Convention. If you are interested in being a presenter, please send an electronic copy with the information requested below by **Wednesday, September 22, 2010**. You will be notified of your acceptance, further presentation details, and the exact time and location by email or fax no later than Friday, October 1, 2010.

E--mail an electronic copy to the Illinois Science Teacher Make and Take Exchange coordinators: Dr. Jessica Krim jkrim@siue.edu, or Dr. Stephen Marlette smarlet@siue.edu

Name	School/Institution	
City State or Province Zip		
School Phone #	School Fax #	Home Phone #
Home Address		
City State or Province	Zip	
Email Address		
Activity Title: Brief Overview of Content Background: Description of your Make and Take Idea: *(with enough detail so others can under what to do)* Identification of how the Make and Take idea integrates the Illinois Learning Standards?		
Hints: Most make and take documents are 1 page; pictures or diagrams are a good way to add clarity; it is always appropriate to acknowledge the author/ source of an activity – a sample Make and Take can be provided upon request.		

would allow the sharing of innovative or insightful cooperating teacher/teacher candidate articles; scholarly teacher candidate assignments such as action research projects; or perhaps a description of unique and rewarding research experiences. Again, teacher educators and cooperating teachers would be encouraged to use this venue as a mentoring opportunity and help teacher candidates by editing or even co-authoring something. Over the next few months, I will be soliciting input to shape this initiative.

Conclusion

In this article, I have attempted to illustrate the importance of pre-service teacher mentoring and how professional organizations like NSTA student chapters and ISTA (including the career building initiative) can be used to enhance mentoring relationships. I close with a final thought. While the goal of a mentoring relationship may be to help an individual grow personally and educationally, there is not a single right way to carry this out. The nature of mentoring will depend on individuals involved and their circumstances. In my own personal experience, I have been mentored throughout my twenty-plus years in education. I am indebted to those individuals who allowed me access to their classrooms to observe them teach, helped me with science content when I was assigned to teach a class that I was not prepared to teach, listened to me as I thought out loud, shared their lesson and classroom management ideas, and worked side by side with me on projects. I am sure I did not recognize and appreciate the importance of what they were doing for me at the time. However, I am grateful and indebted to those who took time to invest in me.

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Using Writing Strategies in the Middle School Science Classroom

Jennifer Smith

Monticello Middle School

Writing can help students reflect and think critically about content.

Writing is a valuable tool for the middle school science teacher and can serve several purposes in the middle school science classroom. In the book, *Because Writing Matters*, the National Writing Project and Carl Nagin challenge teachers of all subject areas to use writing to "help students reflect and think critically about content" (2006, p. 54). Writing across the curriculum can help students master various forms of subject specific writing, such as science reports, or can provide students with the opportunity "to learn and retain content through more informal kinds of writing such as a journal or learning log" (National Writing Project & Nagin, 2006, p. 54). To further demonstrate the ways in which writing can be integrated into all subject areas, the National Writing Project and Nagin list inquiry strategies that are vital to the success of students both in the classroom and later when they enter the adult world. These strategies include "examining assumptions and prior knowledge, posing questions, making inferences and interpreting, establishing working hypotheses and testing interpretations, and finally, imagining" (National Writing Project & Nagin, 2006, p. 54). I use this in my own classroom and have found that the listed strategies are easily incorporated into the science curriculum and help improve student understanding of content.

Examining Assumptions and Prior Knowledge

Science journals are a staple in my science classroom. While I use journals for a variety of purposes, they are an excellent way to asses my students' prior knowledge of a topic and to examine the assumptions they hold regarding an issue. Student journal entries help me gauge my students' familiarity with a topic and the sources from which they derive their information.

I begin using science journals to assess my students' prior knowledge on the first day of school. My students' first homework assignment is a science autobiography. I ask my students to write at least half a page about their thoughts, feelings, and ideas regarding science. I invite them to describe what they love about science, what they dislike about it, and to provide explanations for their answers. I also request that they include information regarding topics they would like to learn more about in science during the school year. This writing is very informal and I allow them to use a format that they are comfortable with. Some of my students choose to write a letter while others write in memoir fashion. I advise my students to be honest in their writing because what they write will influence the way in which classroom material is presented.

For me, the results of this assignment are two-fold. First, I am able to get an idea of who my students are as individuals. The answers also help me develop an understanding of the dynamics of each class. More importantly, this allows me to prepare more interesting lessons and create more meaningful connections for the students, especially those who are apprehensive about science. The second outcome of the assignment is that it gives me a baseline with which to compare the writing styles and writing needs of my students. The autobiography assignment helps me become familiar with the students' writing abilities. In this one

Circulatory System
Introduction Discussion

Working with a partner, spend some time exploring the models and materials to develop your thoughts about the following questions. Remember, if you cannot think of the answer to a question, write a question of your own. Be honest in your answers because the information you write will determine the activities in and flow of this unit.

Write three things you know about the circulatory system/heart and how you know them.
1.

2.

3.

What do you think is the purpose of the circulatory system? What evidence do you have?

What are some of the parts of the heart? How do you know?

How do you think the circulatory system works?

Why do you think it is important to know these things about the circulatory system?

What questions do you have about the circulatory system? Write at least three.

What are some experiments you would like to do, without performing dissections, to better understand the circulatory system?

Figure 1. Sample worksheet for the circulatory system.

Student journal entries help guage students' familiarity with a topic and the sources from which they derive their information.

simple assignment I am able to distinguish which of my students struggle with forming sentences, the students who love to write, and all of the students in between. I revisit the autobiographies throughout the year to ensure I keep the students' interests and needs in mind when I am creating lessons and to examine how their writing has progressed.

I continue to incorporate the science journal several times during the year as I introduce new topics because it allows me to tailor each unit and its goals to the needs of every class. I try to be creative with the prompts that I use when asking students what they know about a topic. For instance, instead of asking students what they know about white blood cells, I ask them to write about their life as a white blood cell. This allows the students to use their imagination a bit and still gives me a general idea of the level of understanding each student possesses about white blood cells.

Aside from using the science journals, I also use a partner writing task to assess students' prior knowledge at the beginning of each new subject. The first day of a new unit has my students sitting in a circle passing around books, models, and other various props that are somehow related to the topic. For instance, during a discussion about the circulatory system, I pass around books about blood and present charts and models of the heart, blood, and blood vessels. In addition, I display various assortments of student created projects, and, to capture student interest, a variety of fake blood. The students are allowed to work with anyone sitting close enough to talk to and for ten minutes are asked to complete a worksheet (Figure 1). If students do not have an answer, they can write a question instead. When the ten minutes have passed, we spend the rest of the time discussing what they have written.

Posing Questions

Students are full of questions but sometimes they have difficulty expressing those questions for fear of humiliation even though many of their classmates might have the exact same question. Using a science journal can help alleviate some of this pressure. This journal serves as a communication tool that helps me stay connected with the students. Every couple of weeks I ask the students to spend five minutes writing about how they feel science is going and give them an opportunity to reflect and ask questions. I read and respond to their journals, and if the same question shows up in more than one journal, I know that I have some reteaching to do.

Posing questions is also something that I have students do when we begin learning about a new topic. As previously mentioned, on the first day of a new unit I have students write down their questions about information included in the unit. During some units, I go back to the questions and talk about one of their questions that was not explicitly answered in class. I then have the students perform research to find the answer to their question. Once the research has been conducted, the student is required to write a short paragraph answering the question. The students then present their answers orally to the class. The students' finished papers are compiled into a class answer booklet that can be kept for future reference. This process helps the students recognize that I take their questions seriously and provides them with the opportunity to not only ask questions but to also perform research.

Making Inferences and Interpreting

Having students write down the inferences and interpretations they make regarding science is another way to incorporate writing into the science classroom. One method for documenting student inferences is to have students take notes about personal observations.

A method that I use in my classroom is to have students complete a T-chart while observing an experiment. On one side of the chart, the students can write what they observe during the demonstration and on the other side the students can write inferences or interpretations based upon each observation.

For instance, I use this technique with a brief review of density. I place different types of canned beverages (soda, juice, and so forth) into an aquarium filled with water. Each time I place a can in the water I ask the students to record their observation (floating, sinking, and so forth) and then in the next column have them infer why the can behaved in that manner. At the end of the demonstration the students use their charts to draw conclusions which we discuss as a class. Reviewing the students' charts gives me an idea of the students' abilities to make inferences based on observations.

Having students take notes from the textbook is another way I use writing to help students interpret information. I spend quite a bit of time at the beginning of the school year teaching my students how to take notes from a piece of text. When we start out, I give them sheets of paper to fill out while reading their textbooks. Once they are comfortable with the process of taking guided notes, I show them other note taking methods. During the last quarter of the school year, the students are able to write notes in whatever manner is most helpful for them as long as they do not write sentences word for word from the text. They are required to take the information presented from the text and interpret and rewrite it in their own words (or pictorial representations) to convey an understanding of the topic.

Essay questions on tests are another great way to get students writing. Using the revised version of Bloom's Taxonomy can be helpful in creating questions that require students to do more than just recall information (Anderson et al. 2001). I try to create questions that require students to understand, synthesize, and apply information. For instance, after learning about the nervous system and the senses, I ask the students to write a brief essay about a dangerous situation and how their senses and the nervous system work together to alert them of danger.

The science journal also comes into play in developing the strategies of inferring and interpreting.

Having students pose questions in a journal can alleviate student fear of humiliation.

A journal entry that I incorporate frequently into my class is the "Why did we do this?" entry. After completing a lab activity, I ask my students to take out their journals and describe why we performed the activity and what they thought I expected them to learn from it. This practice has been especially helpful to me because it will quickly show whether or not a lab met the goals I had set for the class. If the students have difficulty expressing the science concept we discussed, then I know that I must do some reteaching before we continue on.

For example, we performed a density experiment involving the measurement of gummy bears before and after being submerged in water. In their journals, many of the students wrote that the point of the lab was to learn that gummy bears expand in water. While the gummy bears did expand, the focus of the activity was to practice calculating density. After reading their journals, I led a class discussion about measuring the density of the gummy bears during the activity to get everyone back on track.

Establishing Working Hypotheses and Testing Interpretations

Developing writing skills is essential for students to both adequately develop and then convey the results of laboratory experiments. I use writing both formally and informally to assess my students' abilities to develop a hypothesis and review their interpretations. Informally, my students create a working hypothesis for class experiments. For each laboratory activity that we perform, my students are required to write a hypothesis on their lab sheets before they begin experimenting. This hypothesis consists of a statement of what the students believe will be the result of the experiment and then an explanation of their statement based on prior knowledge or experimentation. Again,

Developing writing skills is essential for students to both adequately develop and then to convey the results of laboratory experiments.

this informal writing gives me a picture of the knowledge obtained from class lectures and what they learned from previous school years or the world around them. This type of writing gives me insight into their abilities to make observations and each individual's ability to express their thoughts.

After an experiment has been completed, my students examine their data in relationship to their hypothesis and write a conclusion explaining whether or not their hypothesis was correct while providing evidence to support their conclusion. In their final lab reports, which I allow them to create using Inspiration software, the students type their hypothesis and conclusion in addition to all of the other portions of the experiment (materials, procedure, and so forth).

The students also write about their hypotheses on a more formal level towards the end of the school year in the form of a research paper. These papers are based on the students' science fair projects. Before beginning their experiments, the students must write a researched rationale in support of their hypothesis. Prior to the completion of these projects, I spend time reviewing proper writing techniques with the students to make sure they understand the proper procedures involved in formal report writing. I emphasize the fact that several people will be viewing their final projects and that they must follow the standard, accepted procedures for not only their experiments, but also for the written explanations of their work. The students turn in multiple drafts of their hypothesis and conclusions in addition to a research paper completed prior to the experimental phase of their project. This gives the students an opportunity to edit and improve their writing, helping them mature as writers and as scientists.

Imagining

Creativity and science go hand in hand. Yes, there are rules, laws, and formulas to be followed but creativity can help get the ball rolling on new ideas. Students should not be afraid to think outside the box or try something new. Giving students free reign over creating experiments has the potential to be hazardous in the laboratory. We are not faced by the same limitations when we allow creative writing in the science classroom.

One way I encourage this type of writing in my classroom is through the science journal. For instance, in order to gauge student understanding of how impulses travel through neurons, I ask the students to write an analogy comparing the neuron and its parts to an everyday item in terms of function. Similar to a previously stated example, I also have my students write about their life as a neuron. Topics like these work well for encouraging creativity. The students need to know scientific concepts in order to create their entries, but the manner in which I ask them to do so allows for more creative thinking than simply asking them questions about definitions. Using prompts such as this also allows the students to display their personality through their writing. In the past couple years of using these prompts, I have had numerous students convey the correct answer but none of them have written it the exact same way. Allowing and encouraging the students to be creative also makes grading countless essays more humorous and interesting.

Additionally, I encourage my students to write creatively at the end of each of our units. I require my students to complete a capstone project prior to each unit test as a way to help them better prepare for the assessment. For the capstone project students may work with a partner or on their own and must prove to the class that they understand the content conveyed in the unit. The students can communicate their understanding by writing a play, filming a movie, building a functional model, creating a board game, and so forth. I also give the students a number of writing related options. The students may write a magazine, a children's book, a song, a book of poetry, or a comic book. After creating their projects, the students share them with the class as a way to review for a test. Many times I will keep their projects to share with future classes.

Assessment

While it seems daunting at times, I assess each piece of writing my students complete. Going along with the National Education Standards statement that assessment should "focus on the science content that is most important for students to learn," I try to assess only the skills I have taught my students or ones I am confident they already know (National Research Council, 1996, p.79). For instance, I assess my students' spelling and grammar only when it interferes with the meaning they are trying to convey. I take off points if several words are misspelled or if there are incomplete sentences, but I avoid picking out small errors. For example, I do not explicitly teach or assess my students on proper semicolon usage. I am not as concerned about it as I am about their interpretation of data. Sometimes, such as with journals and other informal writing, I read the entries and assign a completion grade.

When I assess notes, I look to ensure that the writing is clear and conveys the appropriate message. When I evaluate essay questions on tests, I have a list of key words that I look for and check depending on the level of student understanding of the listed concept. Before the students even begin working on more formal writing, such as the reports for their science fair projects, they are given a rubric. I review the rubric with the students so they know how I will be assessing them even before they begin. These rubrics include points for scientific concepts as well as fluency, organization, and proper format. Finally, the students and I work together to create an individual rubric for their capstone project.

Conclusion

Writing is a skill in which each of our students needs to be proficient no matter what subject they are studying or what occupation they enter. Key writing strategies are also key science strategies, which makes the inclusion of writing in the science classroom a seamless transition. Writing provides the science teacher a method through which to communicate with students. It also helps students develop the skills necessary for learning science, and provides a creative outlet for both students and teachers.

Writing is a skill in which each of our students needs to be proficient no matter what subject they are studying or what occupation they enter.

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Purdue zipTrips™

Connecting Students and Scientists Through Electronic Field Trips

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Introduction

Student-scientist interactions are important to help students see how science is practiced in the real-world and to assist them in developing interest in science as a potential career choice. Field trips to scientists' workplaces and visits by scientists to classrooms are two strategies that teachers have traditionally employed to provide their students with opportunities to see scientists as role models. Unfortunately, there are economic and logistic constraints associated with school field trips and classroom visits by scientists. The recent economic downturn, for example, has resulted in cuts to many school budgets, limiting or eliminating field trips. A group of researchers and science educators at Purdue University, supported by the Howard Hughes Medical Institute, have developed Purdue zipTrips™, an alternative to traditional field trips and classroom visits that is both practical and cost efficient and that helps students to see science as an accessible and relevant career choice.

This article describes the Purdue zipTrips™ program, including the electronic field trip experiences and the resources available to participating teachers and students. We will also discuss preliminary program evaluation data indicating that participation in Purdue zipTrips™ benefits middle school students and teachers by providing a free virtual field trip experience to assist students in developing interest in science careers.

What are Purdue zipTrips™?

Purdue zipTrips™ are electronic field trips (EFTs) that offer middle school students a real-time,

Figure 1. Students take their resting heart rate.

Figure 2. Guide interviews Purdue University veterinarian.

interactive, memorable science learning experience. During each Purdue zipTrips™ experience, students and teachers "travel" to Purdue University electronically to visit and interact with scientists and learn about their exciting work. The zipTrips™ program teaches concepts in comparative biology and helps students become aware of the many careers in the biological and life sciences. The content and activities of each zipTrips™ program are based on the Indiana Academic Standards for Science and the National Research Council's National Science Standards. An external advisory board composed of teachers and administrators from four different school corporations recommended science concepts to teach in each of the zipTrips™ and provided feedback on pilot versions of the zipTrips™ live programs.

Purdue zipTrips™ incorporates many interactive elements to simulate a traditional field trip. Rather than simply watch the live broadcast, students are able to interact with the guide and Purdue University scientists via email and participate in activities such as taking their resting and active heart rates (see Figure 1), extending/flexing their knees to experience joint movement, and thinking like detectives to solve a case using scientific inquiry. Teachers can take a single classroom on a zipTrip™ or organize a zipTrip™ for multiple classrooms. On the day of the zipTrip™ we encourage teachers to gather students in a multipurpose room or auditorium, outside of their everyday schedule, in order to make the zipTrip™ more like a traditional field trip experience.

Each live Purdue zipTrips™ program contains four key components: live interactions with Purdue scientists; exciting prerecorded videos featuring diverse representations of science (such as: interviews with zoo keepers, a day-in-the-life of a scientist, students performing scientific investigations); interactive activities; and questions from the audiences (for example, studio, broadcast, and web). Each program is also hosted by an engaging guide and professional actress, Jessica. Figure 2 shows Jessica interviewing a Purdue University veterinarian. Although each Purdue zipTrips™ program corresponds to content emphasized in the Indiana Academic Standards for sixth, seventh, and eighth grades, the content of all three Purdue zipTrips™ are also aligned with Illinois Learning Standards 12A, 12B, 13A and 13B at the middle school level (see Table 1).

All three Purdue zipTrips™ highlight scientific habits of mind, the exciting work of scientists, and the diversity of people who choose science as a career. "We're All Animals" teaches students

Purdue zipTrips™ are aligned with Illinois Learning Standards.

Targeted Indiana Science Standards	Corresponding Illinois Learning Standards
All zipTrips™	
Standard 1: The Nature of Science and Technology • *Give examples of different ways scientists investigate natural phenomena and identify processes all scientists use…(6.1.2)* • *Give examples of employers who hire scientists…(6.1.4)* • *Identify places where scientists work…(6.1.5)* • *Explain that technology is essential to science…(6.1.7)* • *Identify some important contributions to the advancement of science, mathematics, and technology that have been made by different kinds of people, in different cultures, at different times. (7.1.5)* • *Explain that humans help shape the future by generating knowledge, developing new technologies, and communicating ideas to others. (8.1.8)*	Standard 13A, Level G: • *Apply scientific habits of mind, generating questions and strategies to test science concepts using critical and creative thinking, identifying instances of how scientific reasoning, insight, skill, creativity, intellectual honesty, tolerance of ambiguity, skepticism, persistence, and openness to new ideas have been integral to scientific discoveries and technological improvements…(13.A.2)* Standard 13B, Level G: • *Explore scientific technologies…, identifying advances in the past century, describing technologies used by scientists…(13.B.1)* • *Explore scientific concepts in career and technical knowledge and skills in everyday settings, interviewing adults to identify specific applications of scientific concepts or technological innovations…, and educational/training requirements for such careers. (13.B.4)*
"We're All Animals"	
Standard 4: The Living Environment • *…[Students] examine the similarities and differences between humans and other species. (6.4)*	Standard 12A, Level G: • *…[describe] how physiological systems carry out vital functions (e.g. , respiration, digestion, reproduction, photosynthesis, excretion, and temperature regulation). (12.A.1)*
"Disease Detectives"	
Standard 4: The Living Environment • *Explain that viruses, bacteria, fungi, and parasites may infect the human body and interfere with normal body functions…(7.4.11)*	Standard 12B, Level G: • *…explore the interactions between an ecosystem's organisms, examining types of interactive relationships…(12.B.3)*
"Genetics" (in development)	
Standard 4: The Living Environment • *Recognize and describe that new varieties of cultivated plants…and domestic animals have resulted from selective breeding for particular traits. (8.4.3)* • *Recognize and explain that small genetic differences between parents and offspring can accumulate in successive generations so that descendents are very different from their ancestors. (8.4.7)*	Standard 12A, Level G: • *…explore the science of genetics, tracing the history of genetics…, researching applied genetics in plant and animal breeding, or associating genetic factors for inheritance in humans, including genetic disorders. (12.A.3)*

Table 1. Science Learning Standards for Purdue zipTrips™

similarities and differences between humans and other animals. The feature segment of this live program is a visit to the Purdue University Equine Research Laboratory where a professor shows how technology, such as a treadmill designed for horses, helps researchers to investigate horse illnesses and injuries (see Figure 3). Students also learn how the horse's skeletal, respiratory, and circulatory systems compare to their own. This program was pilot tested in September of 2008 and is available for live public participation in September of 2010. In "Disease Detectives" the centerpiece of the live program is a visit to the Purdue Veterinary Teaching Hospital to watch a dog undergo a dental examination. Students learn how bacteria in the mouths of humans and other animals can cause diseases within the body. "Disease Detectives" was pilot tested in November of 2009 and will be available for public participation in November of 2010. The "Genetics" zipTrips™ live program is currently in development and will focus on scientists who use genetics in their research and careers. This program will be pilot tested during the fall of 2011 and open for public participation in the fall of 2012. See our website (www.purdue.edu/ziptrips) for more details about the schedule of upcoming zipTrips™.

An Integrated Field Trip Experience

To assist teachers in integrating Purdue zipTrips™ into their curriculum and to enhance students' learning outcomes, we have created supplemental resources for each of the zipTrips™ programs. These resources include lesson plans, activities, and online videos. Lesson plans are designed to allow teachers to extend the scientific concepts introduced in the zipTrip™ and to provide students with hands-on activities and experiences. For example, a lesson plan designed to complement the "We're All Animals" zipTrips™ program teaches students about the respiratory system; students build model lungs from everyday materials (plastic bottles and balloons) and measure their own lung capacity using colored yarn.

Each zipTrips™ program is accompanied by five online videos that feature short (approximately five minute) interviews with a diverse group of Purdue University scientists. The short videos provide students with opportunities to see the scientists discuss

Figure 3: Purdue University equine researcher demonstrates horse treadmill technology.

their work and also their unique pathways into science as a career. For example, the videos accompanying the zipTrips™ program "We're All Animals" are titled "A Week of Scientists." They include an interview with a spinal cord researcher motivated by his own experience with spinal cord injury as a young adult, as well as, an interview with a biomedical engineer who pursued a science career because it satisfies her curiosity and love for solving interesting puzzles. The videos accompanying the "Disease Detectives" zipTrip™ program highlight five scientists who work to detect and cure human, animal, and plant diseases. For example, one video features a veterinary microbiologist who describes a case she investigated in which a pet iguana was identified as the cause of a child's illness. She also mentions that she loves science because she enjoys answering questions using scientific methods and evidence. A second video features a plant biologist who describes herself as a "plant doctor" who helps farmers keep their crops healthy; she also mentions that she loves science because it gives her the opportunity to work outside in the field and use her skills to help people.

How can my School Participate in zipTrips™?

Based on feedback from our external advisory board of teachers, zipTrips™ offers a menu of options so teachers can design a unique experience for their classrooms. From lesson plans to online videos to live EFTs, this overall pick and choose model gives teachers the freedom to choose how best to implement the Purdue zipTrips™ materials in their classroom. There are important planning steps teachers should take to assure smooth implementation of Purdue zipTrips™ in their middle school science classes.

1. *Registration*

To register, visit www.purdue.edu/ziptrips. Click on "register." Fill out school registration information including school name, contact information, and technology information. This is a secure website which will not share private information, unless a school gives permission. After signing up, registrants will automatically be added to the Purdue zipTrips™ general listserv and grade level listserv to receive email updates about the program. Once logged in to the zipTrips™ site, it is important to read the "Teacher's Guide" and "Connecting to the Live Show" documents for detailed planning instructions.

2. *Room/Technology Preparation*

We suggest reserving a large space such as a multi-purpose room or gymnasium in which students can participate in the live program together. In this environment, they will also have room to move around and participate in the interactive parts of the

10:00 A.M. EASTERN (9:00 A.M. CENTRAL)
• Introduction— *Students stand up and say "Hello"!* • What's your favorite animal?— *Students shout out their answers.*
10:10 A.M. EASTERN (9:10 A.M. CENTRAL)
• Cheer on Whitey— *Students clap for the horse on the treadmill.*
10:20 A.M. EASTERN (9:20 A.M. CENTRAL)
• Heart Rate— *Students jump up and down in place, then take their own pulse.*
10:25 A.M. EASTERN (9:25 A.M. CENTRAL)
• Extension and Flexion— *Students practice extending and flexing their knees and elbows.*
10:35 A.M. EASTERN (9:35 A.M. CENTRAL)
• "Kid Detective"— *Students shout out clues to the mystery of what caused Lucy the dog to limp.*

Table 2. Example schedule provided in teachers' guide.

Front-load Approach
WEEK 1: short videos, and one lesson activity (optional pre-evaluation)
WEEK 2: two lesson activities
WEEK 3: short videos and one lesson activity
WEEK 4: live EFT (optional post-evaluation)
—OR—
Back-load Approach
WEEK 1: short videos (optional pre-evaluation)
WEEK 2: live EFT, one lesson activity
WEEK 3: short videos and one lesson activity
WEEK 4: one lesson activity
WEEK 5: one lesson activity (optional post-evaluation)

Table 3. Examples of two approaches to integrating Purdue zipTrips™ resources.

program. If possible, use a projector and screen to project the image large enough for all to see. We also strongly recommend having computers with internet capability in the same room for students to email questions to the zipTrips™ scientists during the program and possibly have those questions answered live on the air.

There are four different technology options for connecting to the program: satellite, broadcast, IP videoconferencing, and web streaming. Consult with your school technology specialist to determine which method is best for you. As for broadcasting, in 2009, zipTrips™ aired on most PBS television stations in Indiana and is currently working to expand to stations in Illinois, Kentucky, Ohio, and Michigan. Contact your local PBS station to request that they air the program.

3. Supplementary Materials

In addition to the live show, zipTrips™ offers lesson plans and online videos. It is recommended that these videos be used before or after the program in order to scaffold and/or reinforce the concepts of scientific inquiry, human to other animal comparisons, importance of disease research, and exposure to science careers. Table 3 shows two examples of how these supplementary materials could be used in relation to the live program.

The online Teacher's Guide also includes suggested questions to use before/after the online videos to prompt student thought and discussion about the featured scientists and science careers. Suggested prompts include: What does a scientist do? What types of tools or equipment does a scientist use? Who does a scientist work with? How do scientists answer a question?

4. Live Electronic Field Trip

The live show is the centerpiece of Purdue zipTrips™. The interactive 45- minute electronic field trip to the campus of Purdue University in West Lafayette, Indiana features Purdue zipTrip™ guide, Jessica, and interactions with scientists from the School of Veterinary Medicine, Department of Entomology, Department of Animal Sciences, and many others in various segments. There are prerecorded videos to introduce and explain concepts, but the majority of the show is in real-time.

Purdue zipTrips™ are expanding to Illinois PBS stations. Contact your local station to request that they air the program.

Survey items:	Users A./S.A	D./S.D.	NA/Non-users
Instructions on how to participate were clear	9	-	-
User guide was beneficial.	7	-	2
Length of the live presentation was appropriate.	9	-	-
Website was easy to navigate.	6	1	1
The activities were clearly written.	7	1	1
Live presentation engaged the students	9		
Classroom activities supported state standards.	9	-	-
Content of live program supported state standards.	9	-	-
zipTrips™ helped me teach the concepts effectively.	8	1	-

Table 4. Participating teachers' perceptions of Purdue zipTrips™. A./S.A. = agree/strongly agree; D. S.D. = disagree/strongly disagree; NA = not applicable.

We recommend that teachers prepare students at least one day ahead of time for the live program. For example, teachers can explain how to email questions to the scientists and if time allows, use the suggested discussion prompts from the Teacher's Guide. Using the online videos and lesson plans before the program can provide more context to the concepts featured in each of the zipTrips™. During each show, students will be called upon to get out of their chairs and participate in different activities. To help simulate a traditional field trip that includes movement and activity, teachers can encourage students to respond to the scientists and guide by following provided schedules (also found in the Teacher's Guide). For example, Table 2 displays the schedule provided for "We're All Animals."

One day after each zipTrips™ program, we post a link to the show archive on the website so that teachers may review the program with their students. Also, since there is not enough time for scientists to answer every email question on the air, the emails are compiled, and a list of frequently asked questions are distributed to the zipTrips™ listserv so that teachers may discuss them with their students.

5. Program Evaluation

All classrooms that participate in Purdue zipTrips™ are invited to assist in the evaluation of the zipTrips™ program. The goals of the evaluation are twofold: to improve the zipTrips™ program and to determine if the zipTrips™ increase students' interest in science careers. Participating in zipTrips™ evaluation involves students completing a short survey and assessment before and after zipTrips™ materials are used in the classroom (see Table 3). The short survey asks students about their perceptions of the zipTrips™ program and interests in science careers. Additionally, students are asked to draw a scientist and describe or label their drawing both before and after participating in the zipTrips™ experience. Through this assessment we hope to capture changes to students' ideas and stereotypes about scientists and science careers. We are also interested in teachers' perceptions of the zipTrips™ program and resources. Therefore, we also ask teachers to complete a short survey after the zipTrips™ experience. We want to know if Purdue zipTrips™ were useful to teachers and their students and identify ways we can improve zipTrips™ for future students and teachers. We also provide incentives for participation such as raffles for in-person visits from Purdue University scientists or other exciting prizes.

What are the Benefits of Participating in Purdue zipTrips™?

Preliminary feedback from teachers and students indicate that Purdue zipTrips™ helps teachers teach scientific concepts effectively and participation increases students' aspirations for science careers.

We conducted a program evaluation to examine the impact of participation in the "We're All Animals" zipTrips™ experience on teachers and students. We wanted to know the extent to which the supplementary resources were useful in helping the teachers prepare for the program. We asked teachers to indicate if they agreed or disagreed with several statements regarding their experiences with zipTrips™. Table 4 shows that all the teachers agreed that the instructions on how to participate were clear and that the length of the live presentation was appropriate. Similarly, all the teachers who used the user guide reported that it was beneficial for them. All but one user reported that the website was easy to navigate, the activities were clearly written, and that zipTrips™ helped them to teach the scientific concepts effectively.

We were also interested in knowing the impact of the program on students' aspirations for science careers. We asked the students, before and after their participation in zipTrips™, to indicate if they agreed/disagreed with the statement "I think I could be a scientist." The percentage of students agreeing with statement increased from 45.1% before zipTrips™ to 53.3% after the zipTrips™ experience. We asked the students in a post-participation survey to indicate whether they agreed/disagreed with the statement "I learned a lot about what scientists do from watching zipTrips™," approximately 78% of the students agreed.

Conclusion

Purdue zipTrips™ benefits middle school students by helping them to see science as an exciting and accessible career path. By participating in Purdue zipTrips™, students have the opportunity to see scientists as "regular" or "normal" people with great passion, motivation, and interest for solving problems and making new discoveries. Participating students become aware of diverse career opportunities in biological and life sciences. Teachers also benefit from participation in Purdue zipTrips™. The program provides field trip experiences without the cost, logistics, and student management hurdles of traditional field trips. Purdue zipTrips™ also provides resources that teachers can use to integrate the field trip experience into their curriculum.

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Examining Elementary Science Curricula Using Reform-Based Standards

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Teachers often rely on readily available or commercially published curriculum modules but are unsure of how to best use/modify these materials for effective teaching.

Abstract

Pre-service and beginning teachers often rely on readily available or commercially published curriculum modules but are unsure of how to best use/modify these materials for effective science teaching. In consideration of this issue, we conducted an analysis of two influential elementary science curriculum modules in the history of science education, the *Elementary Science Study* (ESS) and *Discover the Wonder*, based on the National Science Education Standards. These curriculum materials, in spite of their creative approaches to and continued influence on elementary school science instruction, were found to do poorly in accordance with the science and technology standard and should rather emphasize the development of the ability of technological design and ability to distinguish between natural objects and objects made by humans. This study has implications for the training or support of pre-service and beginning teachers regarding curriculum analysis, modification, and enactment of these materials for successful and effective science teaching.

Introduction

When it comes to teaching science, teachers often rely on readily available or commercially published curriculum modules but are unsure of how to best use/modify these materials for effective teaching. This is especially true for pre-service and beginning teachers (Davis, 2006; Schwarz et al., 2008). Thus, while a strong focus in our undergraduate elementary science methods courses has been on the use of inquiry and hands-on learning, we believe that pre-service teachers should also be exposed to various curriculum materials early in their training and given the opportunity to conduct their own analysis of those materials in an effort to guide their thinking about the effectiveness of such materials. Pre-service teachers are often concerned about teaching science (Appleton, 1995; Levitt, 2001). Guiding pre-service teachers' exploration into using such materials with an eye toward the national science standards may help them to plan and teach effective, inquiry-based science lessons. In consideration of this issue in our own elementary methods courses, we conducted an analysis of two influential elementary science curriculum modules in the history of science education, the *Elementary Science Study (ESS)* from the 1960s and *Discover the Wonder* from the 1990s, based on the National Science Education Standards (NRC, 1996).

Methods and Analysis

Introduction to the Two Selected Elementary Science Curriculum Projects

Two elementary science curriculum projects, *Elementary Science Study (ESS)* and *Discover the Wonder,* were selected and compared here. The *ESS* project, a National Science Foundation funded curriculum improvement project of the Education Development Center, Inc. (EDC) in the 1960s, involved more than one hundred scientists and educators in the conception and design of eighty units of study to be used in grades K through 8 (Education Development Center, Inc., n.d.; Lawlor, n.d.). *ESS* provides units leading to investigation in three groups - physical science, life science, and general education (logic, science-related mathematics, esthetics, and other areas) (Baptiste & Turner, 1972; Bredderman, 1983). These independent units are flexible and were not assigned definite grade levels (Carin & Sund, 1980). A typical unit consists of an instructional package of related materials - a teacher's guide, a kit of supplies and equipment (many items in the kit can be home made), data sheets for the children, films, film loops, and, in a few units, one or two information booklets (Gega, 1970; Lawlor, n.d.). *Discover the Wonder* (Scott Foresman Science) is organized into thematic modules. Grades K-2 each contain four modules, A-D, while grades 3-6 each contain six modules, A-F. Features of this program are the wealth of hands-on activities, math/science connections, cross-curricular activities, and multi-cultural connection in every module. This program also offers videodisks, videotapes, and interactive software.

We chose to examine *ESS* and *Discover the Wonder* with the following considerations in mind. We wanted to have our pre-service teachers explore curriculum materials in light of recent changes to the National Science Education Standards. Since the national curriculum focus has changed over time, considering both an older and somewhat newer set of units met our goals. Moreover, it is our belief that teachers will hang on to "what works" within a curriculum unit, making curriculum decisions based on learning objectives and/or what constitutes best practice, regardless of the age of materials. Through carefully examining *ESS*, one of the federally funded curriculum projects in 1960s and 1970s, teachers will also gain insight into its continued influence on elementary science curriculum design and instruction since the project began fifty years ago (Lawlor, n.d.).

Comparison of the Two Elementary Science Curriculum Projects

While others have utilized Project 2061 criteria (Schwarz et al., 2008) for curriculum analysis, potential criteria for selecting good curricula may include the simple and obvious, use of the National Science Education Standards (NRC, 1996). This was judged as a good starting place for our first experience in curriculum analysis that could easily be translated to a pre-service teacher's understanding of how to choose effective curriculum materials. There are different sets of content standards for three grade levels: K-4, 5-8, and 9-12. Therefore, units or modules designed for grade 5 or 6 were not included in this comparison, and the content standards for Levels K-4 were the criteria to be used for comparing the two elementary science curriculum projects. A general comparison result is summarized in Table 1.

According to content standard A (science as inquiry), both of the two curriculum projects conform to it very well. *ESS*'s five major goals are rational thinking processes, manipulation, communication, concepts, and attitudes; rational thinking processes include observation, classification, measurement, data collection and organization, inference and prediction, variable identification and control, making and testing hypotheses, and process synthesis (Carin & Sund, 1980). It is easy to identify *ESS* units' alignment with content standard A regarding these processes. For beginning graphing, there is *Growing Seeds*. Classification at all levels is found in *Attribute Games and Problems*. *Behavior of Mealworms* stresses observation and controlling variables. Predictions based on previous data are made in *Changes*, and so on. Through these processes, children not only develop abilities necessary to do scientific inquiry, but also understand what a scientific inquiry is. In *Discover the Wonder*, real-world examples are used to encourage students to explore with hands-on experimentation which provides opportunities for students to work collaboratively with others. Through these hands-on activities, children also gain abilities and understandings related to scientific inquiry.

Science Content Standards: K-4	Elementary Science Study (ESS) (1960s)	Discover the Wonder (1997)
Standard A: Science as inquiry		
Abilities necessary to do scientific inquiry	Yes	Yes
Understanding abut scientific inquiry	Yes	Yes
Standard B: Physical Science		
Properties of objects and materials	Yes	Yes
Position and motion of objects	Yes	Yes
Light, heat, electricity, and magnetism	Yes	No. Electricity is not presented until the fifth grade.
Standard C: Life Science		
The characteristics of organisms	Yes	Yes
Life cycles of organisms	Yes	Yes
Organisms and environments	Yes	Yes
Standard D: Earth and Space Science		
Properties of earth materials	Yes	Yes
Objects in the sky	Yes	Yes
Changes in earth and sky	Yes	Yes
Standard E: Science and Technology		
Abilities of technological design	No	No
Understanding about science and technology	Yes	Yes
Abilities to distinguish between natural objects and objects made by humans	No	No
Standard F: Science in Personal and Social Perspectives		
Personal health	No	Yes
Characteristics and changes in populations	No	No
Types of resources	No	Yes
Changes in environments	No	Yes
Science and technology in local challenges	Yes	Yes
Standard G: History and Nature of Science		
Science as a human endeavor	Yes	Yes

Table 1. A comparison of how two elementary science curriculum projects conform/do not conform to the NRC Standards. Yes: conform; No: do not conform.

In general, both of the curriculum projects conform well to content standards B (physical science), C (life science), and D (Earth and space science). However, in *Discover the Wonder*, electricity is not presented until grade 5. In order to meet this standard, fundamental concepts and principles regarding electricity in circuits should have been introduced in its K-4 modules.

Few ESS materials conform to content standard E (science and technology). This makes sense given the age of these materials. *Microgardening* is one of the few. In this unit, children develop pure culture procedures adequate for carrying out experiments that lead to understanding the reasoning of the great pioneers in medicine, agriculture, microbiology, and food technology. In *Discover the Wonder,* only two chapters - *Flight Technology* and *Sound Technology* - introduce technological applications of science to children in grades 3 and 4. In order to conform to the science and technology standards, both curriculum projects must include more learning activities regarding abilities of technological design and abilities to distinguish between natural objects and objects made by humans.

ESS only conforms to one of the five standards in content standard F, which is science in personal and social perspectives. In the unit *Microgardening,* children grow pure cultures of a species of *Penicillium,* which produces penicillin, and then seed the cultures with harmless bacteria. The results of this experiment lead to a discussion of antibiotics in general and of Fleming's discovery of penicillin. From this discussion, children learn that science and technology have greatly improved our health. However, personal health, population, resources and environmental lessons have been left out in this and other ESS units. In contrast, *Discover the Wonder* meets standard F more effectively. Except characteristics and changes in populations, all the fundamental concepts and principles that underlie this standard are covered in this curriculum.

Both curriculum projects conform to content standard G - history and nature of science. Through the use of short stories or films, people who have made contributions to science are introduced to children. These stories highlight how these scientists worked and express the theme of this standard - science is a human endeavor.

Introducing the National Science Education Standards in teacher preparation programs as a tool for curriculum analysis will support pre-service and beginning teachers in learning to make connections between curriculum and standards.

Conclusion

After making a complete comparison between *ESS* and *Discover the Wonder* according to the National Science Education Standards (NRC, 1996), the following conclusions can be reached. First, both curriculum projects are investigation or activity-based, and conform well to the National Science Education Standards A-D. Second, both of the curriculum projects do poorly in regard to the science and technology standard and should emphasize more on developing students' technological design abilities and their abilities to distinguish between natural objects and objects made by humans. Third, *Discover the Wonder* does better than *ESS* with regards to standard F - science in personal and social perspectives. Most of the *ESS* units were published in the 1960s; many central ideas related to personal health, populations, resources, and environments might have been overlooked in this curriculum project back then. In contrast, *Discover the Wonder*, which was published three decades later, presents environmental lessons and attitudes and gives students the knowledge to develop their own attitudes and take action to promote the use of our natural resources. Finally, both curriculum projects conform to the standard regarding history and nature of science well because both include historical examples to help students understand the nature of scientific inquiry and science as a human endeavor.

Our research findings suggest that introducing the National Science Education Standards (NRC, 1996) in teacher preparation programs as a tool for curriculum analysis will support pre-service and beginning teachers in learning to make connections between curriculum and standards. In addition, it is our hope that by modeling and scaffolding the use of standards as criteria for analysis, instructors will support pre-service teachers in learning how to evaluate and make appropriate modifications to materials for successful and effective science teaching.

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Galileo's Free Falling Experiment: Then and Now

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Introduction
"If I am to drop a metal ball (10kg) and a wooden ball (1kg) of the same size, one from each hand from the same height above ground, which object will hit the ground first?" a science teacher asks. After a short pause, the first hand shoots up. "The metal ball will hit the ground first," one student answers. "And I agree," reaffirms another student. "Why would you say that?" asks the teacher. "Because the metal ball is heavy...and heavy object falls faster than a light object." The student answers with some confidence.

The teacher smiles and continues, "Let us assume that your suggestion is correct - that the metal ball falls faster than the wooden ball, because it is heavier. Now, let us tie the two balls together. What will happen then? Will the combination object (heavy and light ball tied together) fall slower, since the wooden ball holds back the metal ball? Or, will the combination object fall faster, since the combined object is now heavier - 11kg? What can you possibly conclude?" The students are now puzzled!

The above teacher and student exchange illustrates a science lesson that engages the interest of the students and elicits their understanding of gravity and acceleration of free falling objects following the conceptual framework of the learning spiral (Figure 1). As a professor of science education, I would like to share lessons I enjoyed and that worked well to underscore the importance of standard driven activities. Specifically, this article discusses the teaching of Illinois Science Learning Standard 13A and benchmark 13A3b to analyze the historical and more recent cases of science referencing the legendary free fall Experiment by Galileo Galilei in 1592. A science demonstration, a hands-on experiment, and computer simulation experiments will be presented to show the different methods of delivery. The teacher can use a combination of the deliveries to address the interests and learning needs of the students.

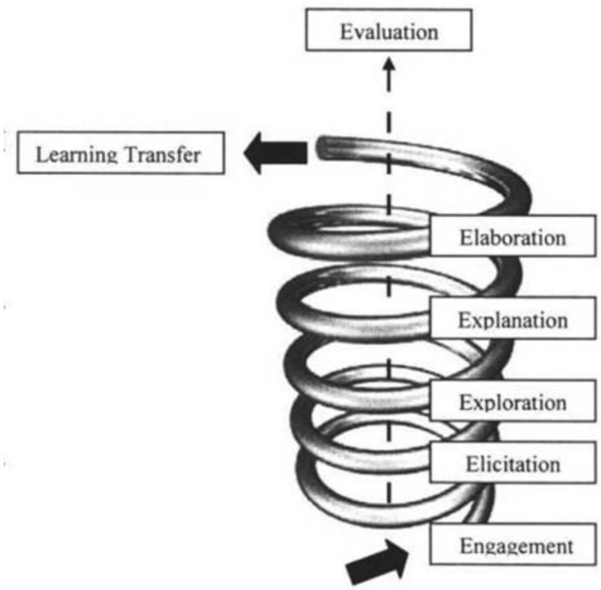

Figure 1. The learning spiral.

A Brief History
"If I have seen a little further it is by standing on the shoulders of giants."
Isaac Newton, 1676

Drop a coin and a piece of paper side by side. The paper takes much longer to hit the ground. That's why the great Greek philosopher Aristotle (384 BC – 322BC) wrote that heavy objects fell to the ground faster than light objects. The study of moving (falling) objects is not new. Aristotle proposed that the ideal speed of a terrestrial object is directly proportional to its weight, or objects fall at a speed relative to their mass. This was the result of his naked eye observation of moving objects in nature. Aristotle's repeated observation gives rise to his physics principle, and Europeans believed him for centuries. Now repeat the experiment, but make it into a race between the coin and your shoe. It looks like the coin and the shoe hit the ground at the same time. So much for Aristotle!

Legend (Drake, 1957) says that Galileo (Figure 2), who had a flair for the theatrical, performed a new test of an old idea about motion – a behavior of matter described long ago by Aristotle The test was a very interesting experiment of dropping a wooden ball and a cannon ball from the Leaning Tower of Pisa. He successfully argued and disproved Aristotle's incomplete and oversimplified theory about falling objects.

Contradicting Aristotle was considered heresy by many at the time, and Galileo was not invited back to teach at the University of Pisa after his experiment.

Figure 2. Galileo Galilei, 1564-1642 (http://www.mlahanas.de/Physics/Bios/GalileoGalilei.html)

That same year, though, he secured a position as chair of mathematics at the University of Padua. He remained there until 1610 (space.about.com). It is obvious that Galileo saw a discrepancy with Aristotle's "established" principle. Galileo fearlessly changed the course of history, because he was able to transform his calculated observations with evidence from quantitative measurements, rather than just describing things qualitatively. Remember, Galileo was a mathematics professor at the University of Pisa!

There were other historical experiments performed after Galileo that revisited the topic of motion using different methods of experimentation and data analysis. In a similar vein, can you trace the 1869 publication of the Periodic Table by Dmtri Mendeleev to understand the chemical properties of elements? How does Alfred Wenger's theory of continental drift (1869) transform to the more recent theory of plate tectonics? How does the work of James Watson and Francis Crick (1962) influence our understanding of information transfer in living materials through understanding the properties of the deoxyribose nucleic acid molecular structure?

The study of science from a historical perspective is always precious. Through science, students learn to understand the evolution of ideas through time. They learn the accepted practices and differentiate what is valid and what is biased. There are historical classics in every branch of science for students to understand the nature and practices of science. The historical accounts help us appreciate the significance of the validity and replicability of results, building upon the work of others to make intellectual progress (by standing on the shoulders of giants - Isaac Newton). Through recognizing risks (physical or even political like Galileo) involved in doing experiments, students understand a meaningful aspect of the scientific enterprise.

Classroom Implementation: The Teacher Demonstration Approach

Dropping two objects from a high elevation like Galileo did is dangerous and sometimes impossible to perform. Instead, the teacher can try the following simple demonstration.

1. Hold on the tip of the fingers of different hands a coin and a paper disc (same diameter as the coin) horizontally, one meter or more above the floor. Drop the coin and the paper disc at the same time. The coin will reach the floor before the paper disc. From this observation it is possible to conclude erroneously, like Aristotle, that heavy objects fall faster than light objects.

2. Now, place the paper disc on top of the coin horizontally and drop them together. Both objects will reach the ground at the same time. What happened? How can you explain this?

3. Now reverse the position of the paper disc and the coin. Place the coin on top of the paper disc. Repeat the drop. What happened? How can you explain this?

The lesson learned from this simple demonstration is that it is not the mass that causes falling bodies to fall faster or slower, but it is the air resistance. In the first demonstration drop, air resistance is applied only to the coin and not the paper disc. We can infer that air resistance and not the mass prevented the paper disc from falling faster - the same as the coin.

A teacher demonstration is sometimes not convincing to the students. It is an invitation to stir the curiosity of the students for further engagement. If the activity serves only as an engagement, then the scientific explanation of the free fall objects should not be included as a part of the demonstration. Students would want to do the demonstration experiment themselves (which they can), or do a different investigation of their own design to gain more hands-on experience.

Classroom Implementation: The Hands-on Approach

Let us fast forward time to the present day to perform the free-falling experiment in the classroom. To reenact the free fall experiment classic with a tweak is always nostalgic and fun. The traditional hands-on approach to the experiment will be presented in the following discussion.

Many experiments that are taught in the K-12 classroom start with a question that is testable by experimentation. "Do heavy or light objects fall faster?" is the question that we want to investigate and test. The teacher needs to give students background information and ask students to research information about the following questions: 1) What is mass and how is it different from weight? 2) Why does an object fall towards Earth? 3) What is gravity? Based on the research, a hypothesis statemensuch as "Heavy objects or light objects will fall faster." can be made.

The teacher can provide a number of heavy and light objects such as a dry sponge and a wet sponge (fully soaked); an empty plastic water bottle and a full plastic water bottle. The selection of the heavy/light pair of objects is critical. The sponges should be ideally identical in size; the plastic water bottles can easily be identical in size. The reason for choosing identical shape and sized objects is to avoid the incorporation of unneeded variables in the testing. Ask the students for heavy/light object suggestions, as they often come up with interesting ideas.

Develop a procedure to test the hypothesis. As part of the procedure, drop a heavy object and a light object at the same time. How can students ensure that the objects are dropped at the same time? Is it accurate enough to just release the objects from the hands? Observe which object hits the floor first. For this reason, two students are needed, since the student who drops the objects cannot accurately observe the objects hitting the floor at the same time. Repeat the dropping and observing of each pair of heavy and light objects, to minimize human errors of dropping and observing.

Make a data table to record the observations. Students can design their own data table, such as the example in table 1.

For enrichment, the same experiment with two items with the same mass can be compared. For example, use a flat piece of notebook paper and one that has been crumpled up. Here the mass is the same but the size or shape is different. Introduce a new variable – use a fan to create a wind. Will this new variable change the experiment results?

Heavy object	Light object	Results
Wet sponge	Dry Sponge	Upon releasing both …
Full plastic water bottle	Empty plastic water bottle	Upon releasing both …

Table 1. Sample student data table.

Classroom Implementation: The Computer Simulation Approach

Wouldn't it be nice if we could relive the experience of Galileo to conduct his free fall objects experiment? Unfortunately, there is no turning back of time. This is the fundamental problem of classroom education, that we are limited by the time factor. More critically, one can not perform a task endlessly just to get the essential learning out of that, when we inevitably make errors and fail along the way. Simulation education may hold the answer. Simulation education may come in many formats such as computer games, role-playing, or model building. But a true simulation has a specific goal in mind – to simulate or mimic a real system so that students can explore the problem, perform experiments, and conceptualize the ideas to minimize the restraint of the time factor.

"Is simulation better than experience?" is often a question asked by students using simulation activities. The answer to that question is an unequivocal "yes and no." Hands-on learning experience with the real thing is always valuable. Unfortunately, that experience can be cost and time prohibitive. This is where simulated labs come into focus. Simulated labs are instructional by design. Simulation proponents would say that simulation is better, because it compresses time and removes extraneous details to concentrate on the main event. Unlike real life, simulations are optimized for learning – a major reason why computer simulation was chosen for this segment of the classroom implementation.

Let us visit a web-based simulation experiment (Figure 3). The web screen shows a representation of Galileo on top of the leaning tower. On the left hand side is a selection of the experiment material variables (a large cannon ball, a small cannon ball, and a feather), and experiment conditions (vacuum mode, normal mode). Follow the following steps to perform the free fall experiment.

1) Click on the "materials" and drag them to Galileo's hands. For example, Galileo can hold a large cannon ball in one hand and a feather in the other hand.

2) Click on either the "vacuum" mode or the "normal" mode icons to select the experiment condition. Normal mode means an atmosphere with air.

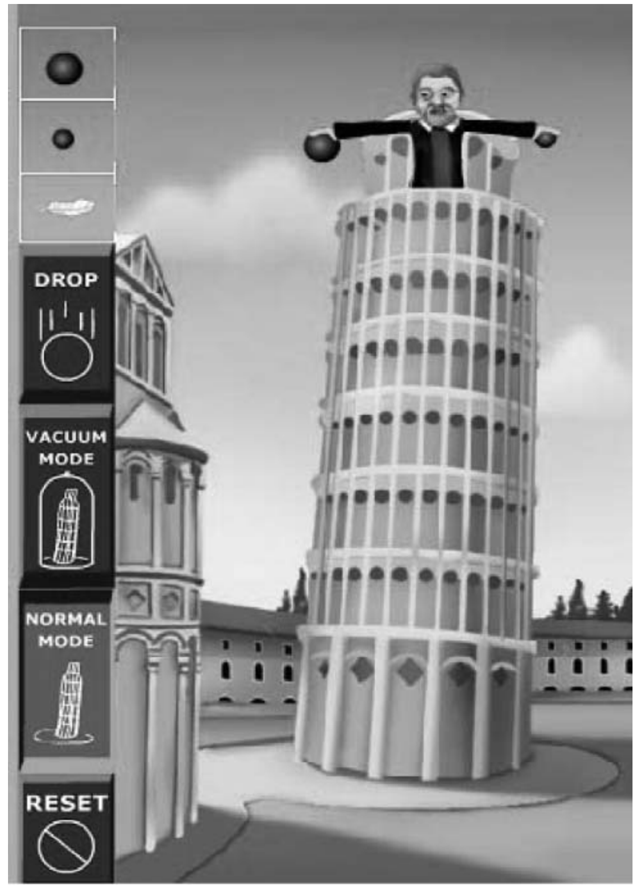

Figure 3. Galileo's free falling experiment **(**http://www.seed.slb.com/uploadedFiles/Science/Laboratory/Air_and_Space/Galileo_Drops_the_Ball/anim/en/index.html?width=740&height=570&popup=true)

3) Click on the "drop" icon to release the objects. Watch the fall of the released objects. Which object will hit the ground first?

This particular experiment is qualitative in nature, comparing the results under different experimental conditions using different falling objects. Though qualitative in nature, this simulation is a good re-enactment of Galileo's legendary experiment, it is free on the internet (http://www.seed.slb.com/uploadedFiles/Science/Laboratory/Air_and_Space/Galileo_Drops_the_Ball/anim/en/index.html?width=740&height=570&popup=true), and it is fun!

Another simulation extension (Figure 4) can be added to enrich the experiment. At the end of the last Apollo 15 moon walk in 1971, Commander David Scott performed a live demonstration (15http://

nssdc.gsfc.nasa.gov/planetary/image/featherdrop_sound.mov) for the television cameras. He held out a geologic hammer and a feather and dropped them at the same time. Because the demonstration was essentially done in a vacuum, there was no air resistance and the feather fell at the same rate as the hammer, as Galileo had concluded hundreds of years before.

Figure 4. Hammer and feather drop – Apollo 15 (15http://nssdc.gsfc.nasa.gov/planetary/image/featherdrop_sound.mov)

Let us now try a more sophisticated simulation free fall experiment by Explore learning.com, using another web-based simulation exercise. Figure 5 is a screen shot of the experiment (http://www.explorelearning.com/showing index.cfm?method=cResource.dspView&ResourceID=650 the leaning Tower of Pisa in the middle. It has on the left, a selection of material variables (ping pong ball, golf ball, soccer ball, and watermelon). On the right are the experiment conditions (air and vacuum). This activity provides a speed dial measured in meters per second at the bottom of the screen to measure the rate of the falling objects. Follow the following steps to perform the experiment.

1) Click the "Air" radio button on the right hand side of the screen to select the experimental condition.

2) Click to select an object (ping pong ball) and drag the object to the tower. You can place and select any elevation of the tower (indicated by the vertical measuring scale) as desired.

3) Click the green "start" button represented by the side way triangle on the top-right hand side of the screen to drop the object.

4) Observe and record the speed on the dial.

5) Repeat the same experiment (if needed) by clicking the loop arrow (purple button) on the top-right hand side of the screen.

6) Stop (pause) the experiment (if needed) by clicking the red button (with two parallel vertical lines) on the top right hand side of the screen.

7) Do a new experiment using a combination of falling objects and the experimental conditions.

In the true spirit of science, this simulation experiment can be performed using a wide selection of variables (objects and experiment conditions). In addition, experimental results can be observed qualitatively or recorded quantitatively. An example of an Excel data chart (Table 2) and an Excel data graph (Figure 6) are shown, although a data graph is automatically generated by the experiment.

How can the simulation experiment be differentiated to accommodate for different learning needs? How can the teacher differentiate the following in the lesson?

- Input (teacher delivery of instruction),
- Output (student demonstration of knowledge and skills),
- Time (duration of activity, time chunking, and so forth),
- Size (of objects, of learning groups, of reading fonts, number of problems, and so forth),

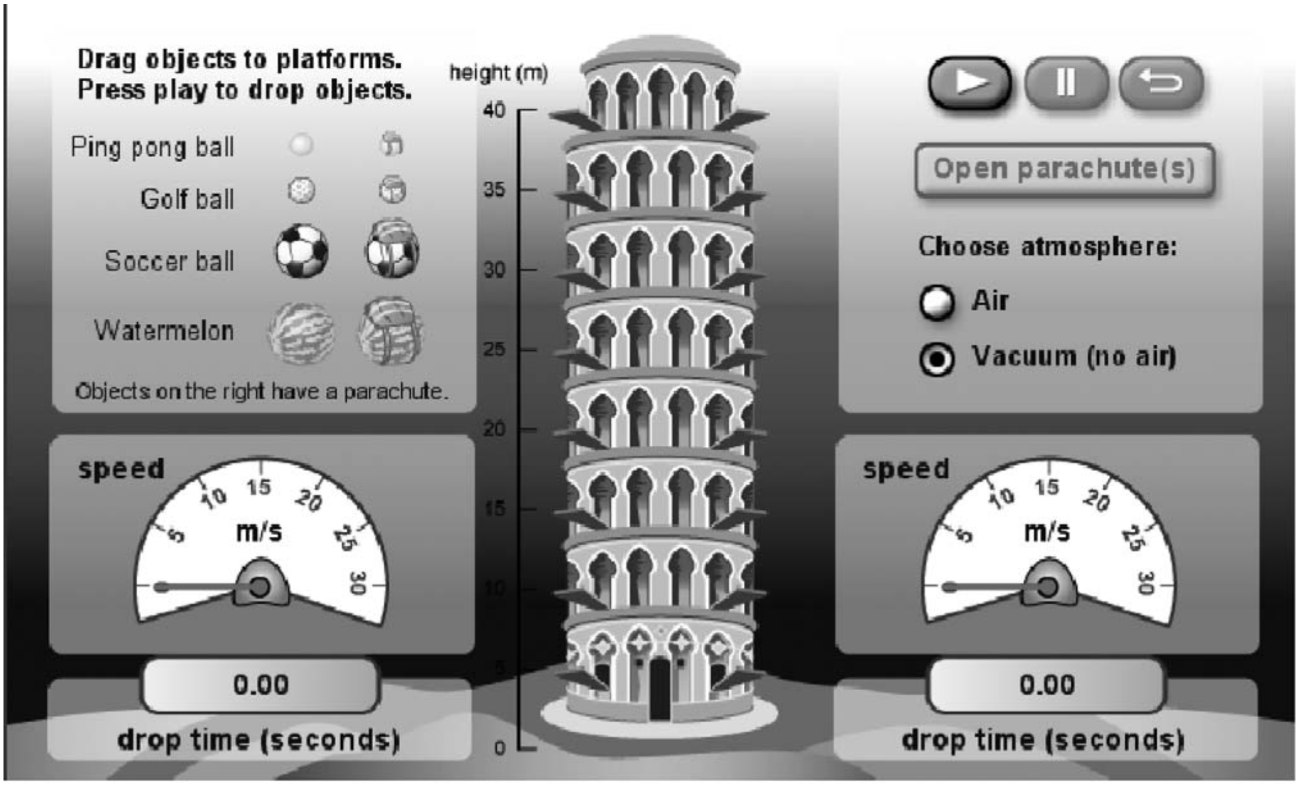

Figure 5. Galileo's free falling experiment (II) http://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=650

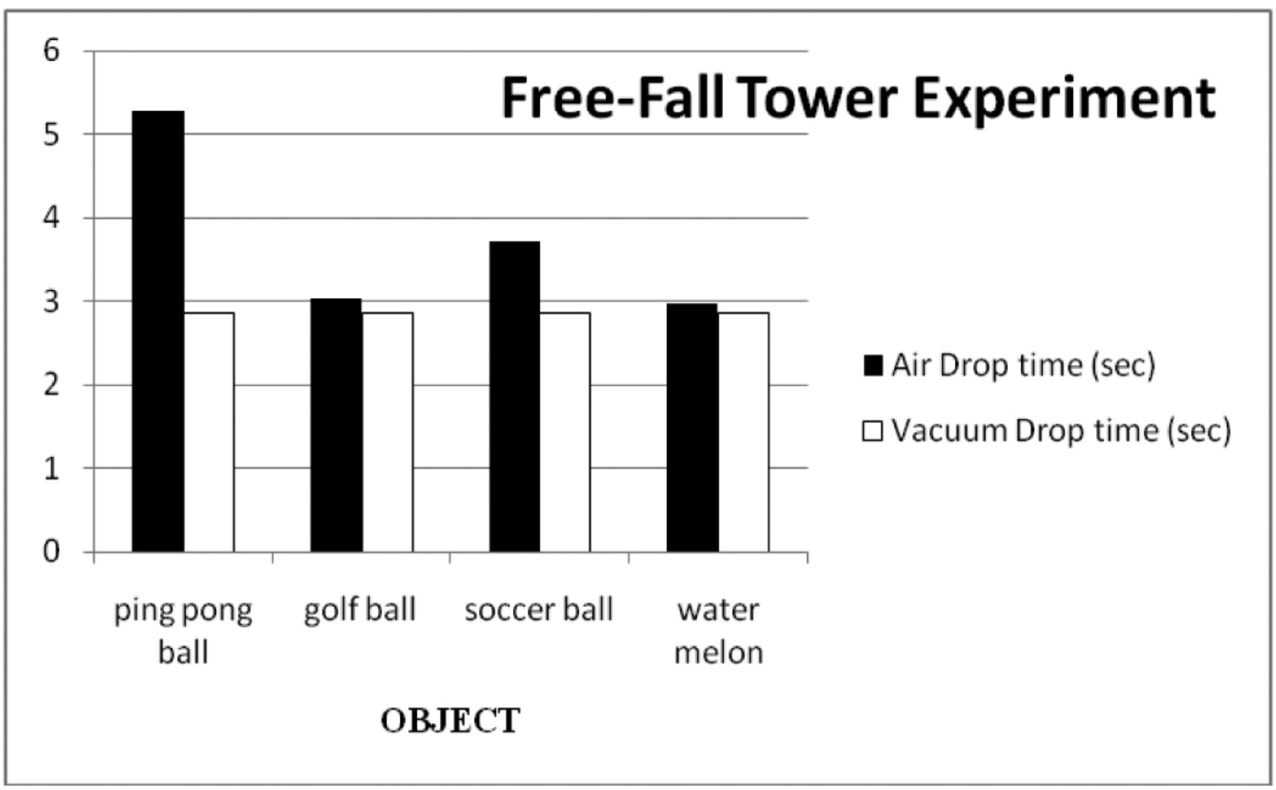

Figure 6. Galileo's free falling experiment (II) data graph in Excel format

Object	Air	Vacuum
	Drop time (sec)	Drop time (sec)
ping pong ball	5.29	2.86
golf ball	3.03	2.86
soccer ball	3.72	2.86
water melon	2.97	2.86

Table 2. Galileo's free falling experiment (II) data in Excel format

- Level of difficulty (complexity of work, reading, and so forth),
- Level of participation (student division of labor in group learning),
- Level of support (use of calculator, wall posters, peers partners, and so forth).

There are two valuable features of the simulation program. One is that the free fall experiment is among a collection of two hundred other mathematics and science experiments of the entire elearning program. Two, there is also an indispensable student management tool that keeps track of individual progress and achievement of students in the class. Explorelearning is a subscription, web-based program, and it is not free.

Conclusion

The scientific discoveries and principles of free-falling objects can be tracked over two thousand years. Human curiosity has sparked scientific endeavors since the dawn of time. Students of science are naturally curious, and science educators can leverage students' curiosity to teach effectively. There are many good science ideas that teachers can include in their teaching. Good science ideas are timeless. Rekindle an old science idea, tweak it with your pedagogical ingenuity, and keep it fresh for the curiosity of many generations of learners to come.

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Galileo's Free- Falling Experiment (II): *http://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=650*

Hammer and Feather Drop – Apollo 15: *15http://nssdc.gsfc.nasa.gov/planetary/image/featherdrop_sound.mov*

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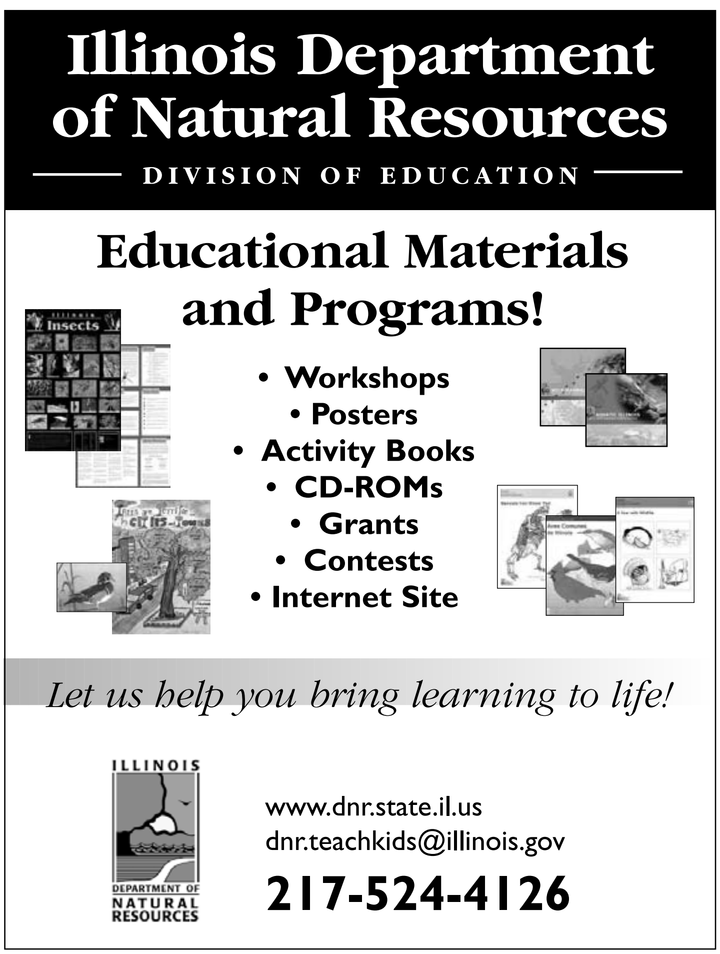

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