SPECTRUM

ISTA

Spring 2012, Vol. 38, No. 1

The Journal of the Illinois Science Teachers Association

In this Issue: **Single-Tasked Brain**
A "Third Tier" Undergraduate Inquiry into Teaching Methodology
Reflection in Professional Development

Plan Ahead:
Illinois Science Education Conference - November 1-3, 2012 in Springfield
NSTA National Conference on Science Education - April 11-14, 2013, San Antonio,Texas
27th Annual WIU PreK-8 Science Update Conference - April 19, 2013

Spectrum

The Journal of the Illinois Science Teachers Association
Volume 38, Number 1

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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 from ISTA Archives: Round table discussion from a 1990's ISTA conference. See page 15; the ISTA Archives Committee is looking for past conference photos and other ISTA memories.

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

The *Spectrum* is printed on recycled/recyclable paper

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Table of Contents

P. 2 President's Corner
P. 3 - 6 ISTA Information
P. 5 ISTA Membership Application
P. 6 Lions at Lyons
P. 7 Three Illinois Schools Named Green Ribbon Schools
P. 8 - 12 2012 Illinois Science Education Conference
P. 13 - 15 26th Annual PreK-8 Science Update Conference
P. 15 Share Your Memories!
P. 16 - 18 UNESCO/Volvo Environmental Awards
P. 19 - 20 Perspective: Education is Not Parfocal

Articles

Who is the Culprit? A "Third Tier" Undergraduate Inquiry into Teaching Methodology
P. 21 - 27 *Amanda Dabulskis, Amy O'Connell, Kristen Trinowski, Jessica Krim*

Reflection Runs Deep in the Still Waters of Professional Development
P. 28 - 36 *Rachel Shefner*

The Single-Tasked Brain: A Case Against Multitasking
P. 37 - 43 *Richard NeSmith*

P. 44 ***Spectrum* Author Guidelines**
P. 45 - 46 **Paid Advertising**

ISTA News

President’s Corner

Carol Baker

Hello Illinois Science Teachers!

It’s hard to believe another school year has come to an end! I hope this issue of the *Spectrum* finds you enjoying your summer break. The end of the school year was an exciting time for science teachers around the country since we were all able to see and comment on the first draft of the Next Generation Science Standards (NGSS). It is especially exciting here in Illinois since Illinois is one of the lead state partners in the process of developing the standards. The standards were released to the public in mid-May and were open for a three week review and public comment period. The Illinois Science Teachers Association partnered with the Illinois State Board of Education (ISBE) to hold a few meetings around the state to introduce and answer questions about this first draft version. After this three week review period, the comments and survey results will be reviewed by the writing team and revisions will be made. Sometime in the fall, a second draft will be available. To keep up to date on the progress of the Next Generation Science Standards, please visit the ISTA website at www.ista-il.org or the ISBE NGSS website at www.isbe.net/ngss/.

Conference planners are busy planning the 2012 Illinois Science Educators Conference. It will be November 1-3, 2012 at the Springfield Crowne Plaza Hotel. Many wonderful presentations have been submitted; there will be something for every science educator and several sessions about the Next Generation Science Standards! You can register and find out more information on the ISTA website, www.ista-il.org.

ISTA Archives and Past Conferences

Do you have an interesting story related to an ISTA conference? Do you have any interesting ISTA related story you wish to share? What are your memories of ISTA? The ISTA Archives Committee is planning a display of ISTA history at this year’s Illinois Science Education Conference , and requests your assistance. Do you have any photos of past conferences you would like to share? If so, please share them with the Archives Committee; either digital or hardcopies are welcome. Please indicate if you wish the hardcopies to be returned. Please include as much identifying information with the photo as possible (date, location, individual(s) in photo, and so forth.).

Please send any photos and stories to Don Powers, Maurice G. Kellogg Science Education Center, Western Illinois University, Macomb, Illinois 61455. Or email them to DT-Powers@wiu.edu. If you have questions you can contact Don at (309) 298-1258.

ISTA Forums

ISTA Forums are open and ready for ISTA members to share ideas, comments, and resources. In a previous eblast, you received a password to get into our forum pages. The forums can be accessed under the membership tab on our website. Now that school is out, please visit the forums and share something today.

Have a wonderful summer and I look forward to seeing all of you in Springfield in November!

2011-13 ISTA Executive Committee

Vice President
Natacia Cambell
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natacia.campbell@gmail.com

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Awards	Jill Bucher
ISTA Conference	Gwen Pollock
Conference Program	Paul Ritter and Natacia Campbell
Finance	Vice President - Natacia Campbell
Membership	Kenda Carroll
Nominations and Elections	Past President - Gwen Pollock
Professional Development/Science Matters	Mary Lou Lipscomb
Publications Committee	Judith A. Scheppler
Informal Science	Susan Herricks

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.

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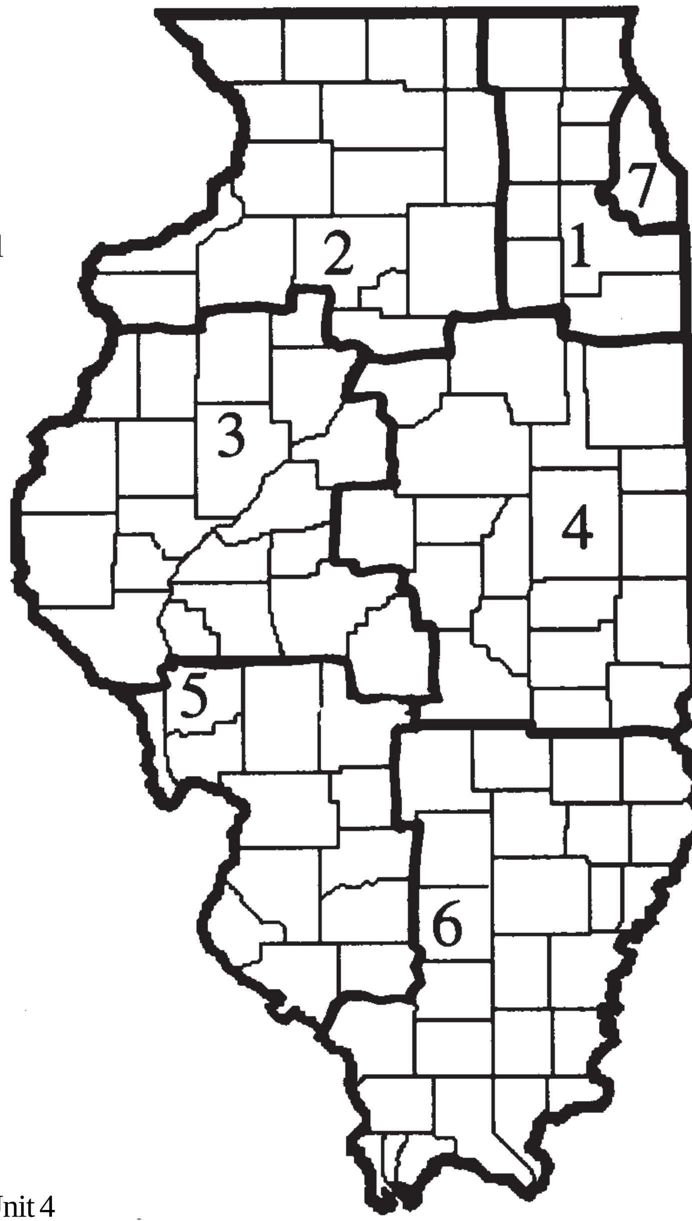

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Region 7 Director 11-13a
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http://www.ista-il.org/

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.

Lions at Lyons

The Illinois Association of Biology Teachers (IABT) recently hosted "Lions at Lyons" with wildlife geneticist Jean Dubach, wildlife vet Michael Briggs, and vet tech Beth Ament at Lyons Township High School. Participants received a classroom exercise on determining maternity and paternity in lions. Included in the photo are (left to right) Debi Karavites-Uhl, IABT president; Tara Bell, ISTA secretary; and Jason Crean, region 1 director.

National Science Teachers Association

National Conference

on

Science Education

nsta.org

San Antonio, Texas

April 11 - 14, 2013

Future ISTA Conference Plans

(tentative)

2012 Crowne Plaza Hotel, Springfield, Nov. 1-3
2013 Tinley Park Conference Center, Oct. 24-26
2014 NSTA National Conference in Chicago, March 2015

Three Illinois Schools Named Green Ribbon Schools

U.S. Secretary of Education Arne Duncan, White House Council on Environmental Quality Chair Nancy Sutley, and Environmental Protection Agency Administrator Lisa Jackson jointly announced in April the first-ever U.S. Department of Education Green Ribbon Schools (ED-GRS), a list that included seventy-eight schools from twenty-nine states and Washington D.C. Three Illinois schools were honored, following nomination by an Illinois State Board of Education sponsored selection committee.

"Science, environmental, and outdoor education play a central role in providing children with a well-rounded education, helping prepare them for the jobs of the future," said U.S. Secretary of Education Arne Duncan. "U.S. Department of Education Green Ribbon Schools demonstrate compelling examples of the ways schools can help children build real-world skillsets, cut school costs, and provide healthy learning environments." U.S. Department of Education Green Ribbon Schools is a federal recognition program that was announced in September 2011. Honored schools exercise a comprehensive approach to creating green environments through reducing environmental impact, promoting health, and ensuring a high-quality environmental and outdoor education to prepare students with the twenty-first century skills and sustainability concepts needed in the growing global economy.

"Schools that take a green approach cut costs on their utility bills, foster healthy and productive classrooms, and prepare students to thrive in the twenty-first century economy," said Nancy Sutley, chair of the White House Council on Environmental Quality. "These Green Ribbon School award winners are taking outstanding steps to educate tomorrow's environmental leaders, and demonstrating how sustainability and environmental awareness make sense for the health of our students and our country."

The seventy-eight awarded schools were named winners from among nearly one-hundred nominees submitted by thirty state education agencies, the District of Columbia, and the Bureau of Indian Education. More than three hundred and fifty schools completed applications to their state education agencies. Among the winners are sixty-six public schools, including eight charter schools and twelve private schools. In total, the schools are composed of forty-three elementary, thirty-one middle, and twenty-six high schools with around fifty percent representing high poverty schools.

"These Green Ribbon Schools are giving students and educators what they need to maximize learning and minimize risks like asthma and other respiratory illnesses, ensuring that no child is burdened by pollution in or around their school," said EPA administrator Lisa P. Jackson. "Today's winners are protecting our children's health and opening up environmental education opportunities for students. The EPA is proud to help recognize the Green Ribbon award winners and will continue working to improve the environment of our nation's schools and helping prepare students to succeed in the emerging green economy."

Please congratulate the 2012 Illinois Green Ribbon Schools!

Academy for Global Citizenship, Chicago, Illinois
Thomas J. Waters Elementary School, Chicago, Illinois
Prairie Crossing Charter School, Grayslake, Illinois

Next Generation Science: Foundations and Futuristics

Illinois Science Education Conference
November 1-3, 2012

Planning for the 2012 Illinois Science Education Conference (ISEC) started with the evaluation of the 2011 conference and an initial planning meeting on February 25. Current sponsors include the Illinois Association of Chemistry Teachers, Illinois Association of Biology Teachers, Environmental Education Association of Illinois, and ISTA. Other science education associations are welcome. Each sponsoring association will conduct its own meeting during the conference and will identify, recruit, and organize interesting presenters for session strands.

The conference will be held November 1-3, 2012 (Thursday evening thru Saturday noon) at the Crowne Plaza Hotel in Springfield, IL. Mark your calendars! The conference theme is Next Generation Science: Foundations and Futuristics. Gwen Pollock is serving as conference chair, and vice-chairs are Natacia Campbell and Jason Crean.

The online Call for Presentations closes June 30. Program chairs Paul Ritter and Natacia Campbell will work through the summer with strand coordinators and the program committee to notify presenters, finalize the program, and make it available in August. We anticipate twenty diverse strands with over one-hundred and forty presentations, workshops, and field sessions.

The conference starts with a reception and the exhibit hall opening from 5:30 PM - 8:00 PM Thursday, November 1, so come after school and meet your colleagues and the exhibitors. Food and refreshments will be available in the exhibit hall.

Recognizing that the conference starts just after Halloween, Patricia Sievert of the NIU STEM Center plans to bring their Haunter Physics and Spooky Science apparatus for viewing in dark and lighted rooms on Thursday evening and Friday morning, and will present a conference session or two.

Priscilla Skalac and Steph Marlette are organizing conference opportunities and special sessions designed for pre-service teachers.

The Friday Presidents' Luncheon features association presidents' comments, award recipients, and an inspirational speaker related to the new science standards.

New teachers (first four years of teaching) will again have their own very popular session on Friday with refreshments provided by Pat Schlinder.

NEW!! Friday Science Mart in the Exhibit Hall

Teachers or retired teachers having good used equipment, books, or materials they no longer need are encouraged to donate them to the conference where they can be purchased by others for tickets which will be issued to all teacher registrants. A committee is working on details for this garage type sale and requests all teachers or retired teachers to help by cleaning house and bringing in some items. Stay tuned for more details.

Harry Hendrickson handles exhibit sales and he asks teachers to request educational salespersons, association, and agency representatives, and professional development providers to bring their materials and information to the exhibit hall. Initial conference goals include attendance by five hundred K-16 science teachers, one hundred pre-service science teachers, one hundred administrators and academics, and one hundred exhibitors. Potential exhibitors can reach Harry at hhendrickson@ista-il.org or 217-498-8411.

Exhibit Hall

Exhibits will be open on Thursday from 5:30 PM to 8:00 PM and on Friday from 7:30 AM to noon and from 1:15 PM to 4:30 PM.

Star Trek Gala at the Crowne Plaza

Tara Bell and Barry Latham are organizing the Friday evening 6:00 PM - 10:00 PM Gala, which will be in the Crowne Plaza Hotel and will have a Star Trek theme, and featuring food, refreshments, networking, popular sound and light science, and some surprises.

Saturday Sessions with Workshops and Field Trips

A very interesting array of Saturday field trips, organized by Sandy Kennedy, is being planned. More details are linked to the registration form. They include:

A. Abraham Lincoln Presidential Library and Museum and the National Museum of Surveying - Science on a Sphere

B. Horizon Wind Energy's Rail Splitter Wind Farm

C. Illinois Petroleum Resources Board - Oil Drilling Sites

D. Adams Wildlife Sanctuary - Illinois Audubon

E. Rolling Meadows Organic Farm and Brewery

F. Illinois State Museum - Behind the Scenes

G. Dickson Mounds Museum and Emiquon National Wildlife Refuge

Workshops lasting more than an hour will be scheduled on Saturday and they will be offered on a sign-up basis with minimum numbers required. These workshops will be listed on the ISTA website in August and the sign-up deadline will be November 20.

Conference Registration

Online conference registration with a credit card is available through Northern Illinois University at:
http://registeruo.niu.edu/iebms/wbe/wbe_p1_main.aspx?oc=40&cc=WBE4012403
or
Mail paper registration form, with a check or purchase order, by completing and sending the form to ISTA, PO Box 312, Sherman, IL 62684.

Hotel Registration

A block of rooms is reserved until October 10 at the Springfield Crowne Plaza Hotel at a special conference rate of $110 + tax for a single or double room. To make your reservation call 217-529-7777 and mention SCI code, or go to:
http:www.crowneplaza.com/
redirect?path=hd&brandCode=cp&localeCode=en&regionCode=1&hotelCode=SPICC&_PMID=99801505&GPC=SCI

ISEC Field Trips
Saturday, November 3, 2012

Please check the ISTA website (www.ista-il.org) for updates

When registering, specify first, second, and third choices for field trips by letter. Transportation from the Crowne Plaza Hotel is included in the $20 fee. Some trips require additional fees, which will be collected prior to departure on November 3. See administrative details below.

Departure time for all field trips is 9:00 AM from the Crowne Plaza Hotel.

The following venues have been set as of May 25:

A. **Abraham Lincoln Presidential Library and Museum and the National Museum of Surveying - Science on a Sphere**
Begin your tour at the one-of-a-kind National Museum of Surveying in downtown Springfield, home of Science on a Sphere, NOAA's animated global display system that shows planetary data on a six-foot diameter sphere. Then, journey into Lincoln's world at the Abraham Lincoln Presidential Museum. See the all new "Illinois Answers the Call: Boys in Blue" exhibit. Find out more about the museum at http://www.alplm.org/museum/ALPLMvideo_preview.html.
Teacher admission free with school identification. Family members need to buy tickets upon entrance to each museum. See websites for current admission prices.
Return time: 1:30**.** Min 10/Max 40. Family adaptable. Handicap accessible. Subway available inside the Lincoln Museum.

B. Horizon Wind Energy's Rail Splitter Wind Farm
Visit the Horizon Wind Farm just north of Lincoln at the border of Tazewell and Logan counties. This 100.5 MW wind farm was built in 2009 and consists of seventy 1.5 MW GE wind turbines, enough to power approximately 28,000 average Illinois homes with clean energy each year. Led by an industry representative and hosted by Horizon Wind Energy in cooperation with Illinois State University, your tour begins when you board your bus.
An additional $10.00 fee is required for the tour bus.
Return time: noon. Min 20/max 50. Handicap accessible.

C. Illinois Petroleum Resources Board - Oil Drilling Sites
The Illinois oil and gas industry is utilizing new technologies to find and produce more energy from natural resources right here in our state, thereby reducing our dependence on foreign oil and creating jobs for Illinois citizens! We invite you to take this bus tour to oilfields in the Springfield and Decatur areas. Meet the people, see the exploration and production operations, and learn how this important energy source is recovered from beneath our feet in the Illinois basin.
An additional $10.00 fee is required for the tour bus.
Return time: 12:30. Min 20/max 50.

D. Adams Wildlife Sanctuary - Illinois Audubon
Home of the Illinois Audubon Society, the forty acres of the Adams Wildlife Sanctuary is an urban nature center situated in the middle of Springfield. Take a hike on the one-mile nature trail through woodland and restored prairie. Watch birds through the bird-viewing room that overlooks the woods and feeding area while learning bird identification techniques. Find out how Adams Wildlife Sanctuary functions in an urban setting. Dress appropriately for the weather if you wish to venture outside!
Return time: noon. Min 10/Max 30. Family adaptable.

E. Rolling Meadows Organic Farm and Brewery
Get a taste of the science of beer making while touring this microbrewery in Cantrall, just north of Springfield. See how this family owned organic farm and green microbrewery functions to bring an environmentally friendly product to central Illinois.
Return time: 12:30. Min 10/Max 20.

F. Illinois State Museum - Behind the Scenes Tour
This behind the scenes tour will be led by Illinois State Museum Director Dr. Bonnie Styles and features the Museum's Research and Collections Center (RCC). The RCC is a 100,000 square-foot support facility dedicated to collections care, research, and education. The RCC provides state-of-the-art space to care for and study important scientific and art collections, as well as laboratories and special program spaces for Museum scientists, historians, artists, and educators. You will see vast collections, which include over 11.5 million objects and specimens that range in size from the microscopic to the colossal; from pollen grains to mastodon fossils. The second part of this trip entails taking a short ride over to the Illinois State Museum for a self-guided tour with time to visit the Museum's unique gift shop featuring Illinois artisans.
Return time: 12:30. Min 15/Max 25. Family adaptable. Handicap accessible.

G. Dickson Mounds Museum and Emiquon National Wildlife Refuge
At the confluence of the Illinois and Spoon Rivers, Emiquon is a living laboratory and a model for wetlands restoration. Begin your trip with a tour of the Therkildsen Field Station, opened in 2008 by the University of Illinois at Springfield to provide learning opportunities for students, educators, and researchers. Weather permitting, take a short hike on The Nature Conservancy's Emiquon Preserve to the bluffs that overlook Lake Thompson or take a walk out on the boardwalks. Then, travel just a few miles down the road to Dickson Mounds Museum, a National Historic Site, and one of the major on-site archaeological museums in the United States. Dickson Mounds Museum offers a unique opportunity to explore the world of the American Indian in an awe inspiring journey through 12,000 years of human experience in the Illinois River Valley.
Travel time is one hour from Springfield. A box lunch at Dickson Mounds Museum is included.
An additional $10.00 is required for this trip.
Return time: 3:30. Min 20/Max 40. Family adaptable.

Field Trip Administrative Details

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 trip choices are unavailable.
2. While making great efforts to organize these science-related field sessions, ISTA reserves the right to cancel any field trip participation if the minimum number is not reached or the maximum is exceeded. If 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 refunded.
3. If field trip slots are available, tickets will be sold at the conference registration desk up to noon, November 3. Check at the registration desk for field trip availability. Tickets can be traded or transferred to others.
4. ISTA has set a fee of $20 for each field trip to cover transportation. Additional fees, if required, will be collected prior to the field trip. For teachers providing their own transportation and notifying ISTA on or before October 20 (when buses will be arranged), ISTA will reimburse the $20 transportation fee.
5. Additional family members may be taken on the field trips where "family adaptable" is indicated on the field trip description. Family members must pay the same fee as others on that field trip.
6. Please remember that all tour guides are working on Saturday as a service to science teachers. Please thank them for their dedication and willingness to share information about their profession.

Please continue to check the ISTA website: www.ista-il-org for field trip and program updates.

Illinois Science Education Conference—REGISTRATION FORM

Joint Partnership of ISTA-IACT-IABT-EEAI

Springfield Crowne Plaza Hotel--November 1-3, 2012

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 plan to be a session presenter____. I have taught 4 years or less____.
I prefer a non-meat luncheon___. I will donate science equipment or resources___. I'll need Special Assistance___. Describe______
I am a member of □ ISTA □IACT □ IABT □EEAI Membership#___________________(Membership will be confirmed)

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

CONFERENCE REGISTRATION—Thursday, Friday, Saturday Options

*includes Thursday reception 6-8 pm, Friday & Saturday continental breakfasts, and Friday noon luncheon.

Registration Fees with Postmark Deadlines—*Circle your choice*				Payment Totals
Status option	Postmarked by 9/29/12	Postmarked by 10/20/12	Onsite/ posted after 10/20/12	
*Full, current ISTA/IACT/IABT/ EEAI member	$130	$145	$155	Registration: $_________
*Full, ISTA membership renewal	$165	$180	$190	Spouse fee: $_________
*Full, non-member	$165	$180	$190	Gala $_________
*Full, Institutional member (up to three individuals)	$125 /each	$140/each	$150/each	Saturday tour $_________
*Full, Student including membership	$30	$30	$30	Saturday workshop $_________
Thursday evening only	$70	$75	$80	**TOTAL $_______**
Saturday only	$70	$75	$80	
Non-teaching spouse/guest (no Friday Luncheon)	$20	$20	$20	Payment Method:
Special events: see Description Page (may be sold at registration, pending space availability)				By Check #__________
Friday Evening Gala—entry, food, refreshments, fun.			$35	By Purchase Order #_______(attach)
Saturday Field Trips Choice 1st ___2nd___3rd____ See ad. details			$20	**By Credit Card—online only: www.ista-il.org No additional charge for online registration with credit card.**
A. Lincoln Museum & Nat. Museum of Surveying- Science on Sphere				
B. Rail Splitter Wind Farm				
C. IPRB petroleum drilling sites				
D. Adams Wildlife Sanctuary—IL Audubon Society				
E. Rolling Meadows Organic Farm and Brewery				
F. IL State Museum & Research & Collections Center				
G. Dickson Mounds Museum & Emiquon Natl. Wildlife Refuge				
SATURDAY WORKSHOP SIGNUP (see www.ista-il.org in August for details)				

Please make checks or purchase orders payable to Illinois Science Teachers Association. Send to ISTA Membership Secretary, PO Box 312, Sherman, IL 62684. Admittance to conference only by registration. If your registration is received by 10/22/12, you will receive confirmation by email. All registration materials will be at the conference registration desk.

26th Annual PreK-8 Science Update Conference
Hosted by Western Illinois University
Don Powers

On Friday, April 20th approximately one hundred and fifty science educators met on the Western Illinois University (WIU) Macomb campus for the 26th Annual PreK-8 Science Update Conference, sponsored by the WIU Science Education Center. The participants had over twenty presentations to select from, to attend during three sessions. Presentations (and presenters) included such titles as *Next Generation Middle School Science* (VeAnn Tilson and Paula Young); *Touch Another World: Exploring Meteorites and Meteor-Wrongs* (Brian Poelker); *Pond/Creek Critters* (Pat Sullivan); *Science Notebooks* (Tracy Trimpe and Cheryl McDaniel), and *The Science of Agriculture* (Dawn Weinberg and Margaret Harn). More than a dozen exhibitors representing both commercial and non-commercial entities also took part in the conference by hosting exhibits and providing door prizes. Some of the exhibitors included the Illinois State Museum in Springfield; Dickson Mounds Museum in Lewistown; MicroTech Microscope Sales and Service; Illinois Department of Natural Resources; Illinois Associate of Aggregate Producers; and Science Kit. Harry Hendrickson represented ISTA with the ISTA display and numerous freebies for participants. The Science Update Conference is financed in part by ISTA.

A series of twelve mini-sessions followed the morning sessions. Some of the mini-sessions included *Oreo Discourse* (Abha Singh); *Taking A Straw Poll on Levers* (Kevin Finson); *Literature Integration Through Science* (LaVerne Logan, Maranda Coomer, Dawn Cale, Rachel Hoffman, and Anna Olson); and *Making Your Own Pie Pan Speaker* (Sebastian Szyjka).

During the conference lunch, the Maurice G. Kellogg Award for Excellence in Science Teaching was awarded to Lisa Maxwell, elementary science teacher at Eugene Field Elementary School, Rock Island. This year's recipient was announced and introduced by Carol Van De Walle, a former colleague of Lisa's and an ISTA member. The Maurice G. Kellogg Award for Excellence in Science Teaching is named in honor of Dr. Maurice G. Kellogg, professor emeritus at WIU. Dr. Kellogg was also a charter member of ISTA and the third ISTA president (1971-1973).

The 27th Annual WIU PreK-8 Science Update Conference is scheduled for April 19, 2013.

2012 WIU PreK-8 Science Update Conference: The Maurice G. Kellogg Award for Excellence in Science Teaching. (left to right) Lisa Maxwell, 2012 Kellogg Award recipient; Carol Van De Walle, 2004 recipient; Dr. Maurice Kellogg; Julie Ann Bice, 2011 recipient); and Mary McMahon, 2009 recipient.

26th Annual PreK-8 Science Update Conference Photos

Conference sessions at the WIU PreK-8 Science Update Conference.

Clockwise: Top: ISTA Executive Director Harry Hendrickson recruiting future ISTA member. Top right: Region 3 director Ken Grodjesk talking to conference participants. Bottom right: Pat Sullivan explaining how to set up a pond in your classroom.

Share Your Memories!!!

Do you have an interesting story related to an ISTA conference?
What are your memories of ISTA?

The ISTA Archives Committee is planning a display of ISTA history at this year's Illinois Science Education Conference, and requests your assistance. Do you have any photos of past conferences you would like to share? If so, please share them with the Archives Committee; either digital or hardcopies are welcome. Please indicate if you wish the hardcopies to be returned. Include as much identifying information with the photo as possible (date, location, individual(s) in the photo, and so forth). Do you have any interesting ISTA related stories you wish to share?

Please send any photos and stories to Don Powers, Maurice G. Kellogg Science Education Center, Western Illinois University, Macomb, IL 61455. Or email them to DT-Powers@wiu.edu. If you have questions you can contact Don at (309) 298-1258.

Who can you recognize?

Former ISTA President John Staver at an ISTA conference.

More PreK-8 Science Update Photos

Jackie Perran (exhibitor for Lights for Learning) talking to participants.

Nina Walthall, Illinois State Museum, and Christa Christensen, Dickson Mounds Museum at the Science Update Conference.

UNESCO/Volvo Environmental Awards
Pontiac Township Students Take Third Place in Gothenburg, Sweden
Pontiac Township Students Named First in the US

Paul Ritter
Pontiac Township High School

Students from all over the world came to Gothenburg, Sweden at the Volvo Adventure Awards to compete in the world environmental education program. After experiencing tough competition from more than forty-five countries, just twelve teams remained to fight for the coveted Volvo Adventure Award. Working in partnership with the United Nations Environment Program (UNEP), the award gives the young and environmentally aware a voice to gain recognition and support for their life-changing ideas.

The US team, from Pontiac Township High School in Illinois, was coached by Mr. Paul Ritter, took third place after an intense two day competition with their initiative "The National Prescription Pill and Drug Disposal (P2D2) Program." The ultimate winners were the team from Paraguay, with the Brazilian team taking second place. Other competitors included students from the UK, China, Croatia, Egypt, Fiji, Russia, Tanzania, Turkey and Macedonia.

The Prescription Pill and Drug Disposal Program is a collaborative effort between communities, local pharmacies, police departments, hospitals, city officials, students, and water utilities. The purpose of the program is to educate the public about the harm done to the environment, and the misuse and abuse of pharmaceuticals, due to the current prescription and non-prescription drug disposal practices worldwide. The mission of the program is to provide communities with a proper method of pharmaceutical disposal that effectively reduces the misuse and abuse of pharmaceuticals, as well as ensures the quality of our water and wildlife for future generations.

The P2D2 program's published and free curriculum has expanded exponentially from its small classroom beginnings at Pontiac Township High School to schools and communities in over twenty percent of the nation. AP Spanish students have worked on the program in Houston, Texas by translating the website and informational materials. The program has had students in Taccoa, Georgia reaching out to communities on the issues surrounding drug abuse. The environmental students in Glenwood Springs, Colorado made their mark by helping their area communities understand the connection with their local river. Students at King Kamehameha High School in Kahuku, Hawaii, with their lead student Ms. Kaitlin Tavares, set up the Hawaii P2D2 program for the entire state. Ms. Jordyn Schara of Reedsburg, Wisconsin, as a freshman in high school, was responsible for the development of most of the pharmaceutical disposal programs in her state. In all, the P2D2 program has students in twenty-two states carrying the torch of change and speaking with loud voices. The response to P2D2 has been overwhelming. The educational opportunities, creation of proper disposal systems for pharmaceuticals, and cooperation of many organizations and communities is a testament to the students and their ability to make a difference.

After starting the P2D2 program, students had to consider the problem of how communities were supposed to afford appropriate incineration of the drugs. With that being said, the P2D2 students sought out Illinois State Representative Joann Osmond to ask if they could help craft a bill that she would sponsor, to pay for the disposal costs associated with proper pharmaceutical disposal. Working with Representative Osmond, the Illinois State Legislature, Illinois Governor Pat Quinn, and other schools, our students took their student-developed bill and lobbied in the Illinois House and Senate. This multi-million dollar piece of legislation has authorized law enforcement agencies to collect pharmaceuticals from residential sources and incinerate them in a manner consistent with the EPA rules. House Bill 2056, the P2D2 Bill, requires assessment to be levied against persons who commit specific drug offenses to pay for costs associated with disposal. After unanimously passing the Illinois House of Representatives and Senate, our students, who had worked so hard for the communities of Illinois, witnessed Illinois Governor Pat Quinn sign their Illinois House Bill 2056 into law while standing on the banks of the Chicago River on August 23, 2012. This project is the epitome of the "Think Globally, Act Locally" philosophy. In the short period of time that the P2D2 program has been up and running, it has been able to properly dispose of over 600,000 pounds of unused medication and as a result of the student's bill, Illinois will now have 100% of the counties participating proper pharmaceutical disposal.

Baylee Ritter, Taylor Ritter, Madison Pfaff, and Samantha Quinn from Pontiac Township High School, Pontiac, Illinois.

Throughout 2012, prescription drug disposal has been a hot topic in the USA. P2D2 is a group of teenagers who wanted to make a difference. They organized a drug collection program dedicated to keeping the water systems of their communities safe from damage caused by the improper disposal of medication. The team raised awareness by using local government and media outlets, and provided communities with permanent disposal containers and incinerators. The team has even passed numerous bills to make its efforts permanent, which are currently active in over twenty-two states. To date, they have prevented over 600,000 pounds of drugs from contaminating our precious environment.

The legacy of this awards program goes far beyond its timeframe; throughout the years, youth groups carry on with their school projects and ignite lasting change. In 2008, Team TGIF from Rhode Island promoted the recycling of cooking grease for refinement in to biofuel. Since then, more than 120,000 gallons of wasted cooking oil was collected, which produced about 100,000 gallons of biodiesel. The students drafted a waste cooking oil recycling law and had it passed in July 2011.

This unique competition brings together youth from across social, economic, and cultural divides, each of whom has identified ways in which to improve their communities. Apart from taking home the ultimate prize, this event unites young people who will potentially achieve something many politicians can't - change.

Volvo Adventure is a global environmental competition for young people, aged 10 to 16. The purpose of Volvo Adventure is to increase environmental awareness among young people worldwide, as well as to encourage young people to take on practical projects that will demonstrate they can make a difference to the environment in which they live.

Volvo Adventure is a joint project between AB Volvo and Volvo Cars. More information about Volvo Adventure is available at www.volvoadventure.org. More information about P2D2 and how to get started in your community can be found at www.p2d2program.org

For more information, contact Paul Ritter, president elect of ISTA and ecology teacher at Pontiac Township High School (815-844-6113). Note: Paul is also the 2011-12 National Environmental Science Teacher of the Year. Congratulations Paul!

Samantha Quinn, Taylor Ritter, Madison Pfaff, Baylee Ritter, from Pontiac Township High School, and Jordyn Schara, from Reedsburg Area High School, Reedsburg, Wisconsin.

Perspective

Education is Not Parfocal

David Abendroth
Red Hill High School

Whenever something is brought under close scrutiny, it is frequently described as being "under the microscope." This is so very true of education today, where each aspect of education is being observed and frequently criticized, including everything from education methodologies such as project-based learning to relating teacher evaluations to student performance.

The euphemism "under a microscope" is probably a good one. However, we need to have a better understanding of microscopy. Generally, the average high school compound light microscope has three lenses or objectives, low, medium, and high power. The lowest power provides us with a broad field of vision (FOV), the middle power gives us a more close up view of a smaller section, and the high power provides a detailed image of a very small section.

Our modern microscopes are calibrated to be *parfocal*, which means that when switching from a lower power to higher power, the images should almost be in focus. The problem is that the calibration is from the greatest magnification down, so switching from lowest power to medium power provides us with an image that is almost in focus, but not quite. The other conundrum that increasing magnification has is that as you increase magnification, you decrease resolution. This means that as you see smaller and smaller sections under greater magnifications, the resolution or clarity of the image decreases.

How does this apply to education? As we have moved away from the big picture of education and began to focus on individual aspects, such as pedagogy and project-based learning, we tend to lose perspective and clarity. Albeit, the goals of education are commendable, we too often get focused on the mechanics and forget the big picture. If we focus on individual aspects at too high of a magnification, we lose resolution and forget the goals of the whole. It is certainly true that an understanding of the basic components helps us understand the function of the whole, much in the same way that an understanding of the various types of epithelial or muscle tissues brings us to a better understanding of the overall functioning of the tissues or organs in question. However, the ultimate goal is to bring us to an understanding of the entire system, not just a component of the system. Another truism of microscopy is that the same lens does not always work for the specimen one might be observing. In microbiology, the standard objective does not have a high enough magnification, so we use an oil immersion lens which uses a fine oil to bend the light in towards the specimen. This should indicate to us that all lenses do not apply to all circumstances. Not all methods of assessment, either of the student or a teacher, fit everyone.

Our nation has achieved what it has by individuals thinking outside of the box and by being creative and innovative. Knowing this, it is astounding to me that we expect creativity and innovation within a framework of standards that creates a box in which teachers and students are forced to remain.

By the same token, it is an unfair assessment to assume that all specimens will achieve the same resolution when observed under identical microscopes. Returning to the analogy of tissue types, although muscle is muscle and epithelial cells are epithelia, there are different types of muscle and different types of epithelia, each with a similar function but with some basic fundamental differences in structure and function. The same can be said of students, they are all students, each with a similar function, yet each having differences, not only of their ability, but how they perform. It is ridiculous to assume that they are all the same and function in an identical fashion.

My daughter was reading through an excellent little book, "501 Tips for Teachers" by Dr. Robert Ramsey, and read to me a quote regarding testing which stated, "...that which is tested gets done." As true as this statement is, the general public, realizing that our educational system needs an overhaul, and we, need to closely evaluate education; we inaccurately assume that a microscope is a microscope. However, there are many types of microscopes varying from dissecting microscopes to scanning electron microscopes to compound light microscopes and transmission electron microscopes, many equipped with specialized features for specific functions. The scanning type microscope will provide us with varying details of surface structure and the transmission microscopes will show details of internal structure. In each case, the scientist will use the tool that will best illuminate the specimen to reveal the answer to the question she is asking, whatever that may be. In many cases, this involves using many types of microscopes and a dazzling combination of filters and gadgets. If the tool is insufficient to the task for which it is applied, the resulting data may be in error, regardless of the quality of equipment. This same concept should be applied to student and teacher evaluations. How often are we using good equipment, not designed for the task to which it is applied, and drawing conclusions based on flawed data?

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 first 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.

Articles

Who is the Culprit?
A "Third Tier" Undergraduate Inquiry into Teaching Methodology

Amanda Dabulskis, Amy O'Connell, Kristen Trinowski, Jessica Krim
Southern Illinois University Edwardsville

Abstract
As undergraduate science methods educators, we instruct teacher candidates about the benefits of student-centered learning experiences. In addition, we strive to create student-centered learning experiences for them in our college classrooms. This article demonstrates that in undergraduate education, one more step is needed for teacher candidates to "buy in" to this (or any) method of instruction that we as teacher educators hope to impart to our students, and that is to perform this instruction on their own in a structured and supportive environment. In the ideal student teacher setting, teacher candidates would be able to perform the skills they have learned in the university, and achieve similar results, however this may not always be possible due to internal and external conditions such as administrative politics, cramming for state and/or national tests, or the personal or professional theories of the cooperating teacher(s). Under the mentorship of a faculty member, Dr. Jessica Krim, this article is written from the perspective of three undergraduate students as they detail their journey of carrying out this third step by inquiring into their teaching practice. These students worked collaboratively as they constructed focus questions that would guide them in the examination of their pedagogical content knowledge, skills, and dispositions towards student-centered teaching and learning. In this study, two methods of teaching were compared in a field setting: 1) student-centered and 2) teacher-centered. Data was collected in the form of observation notes, student learning outcomes, and teacher candidate self-reflections. Outcomes that result from this study include a greater understanding of assessment, student learning, and preparation among teacher candidates.

How Our Research Began
There is always a difficulty that comes with starting a new project. Where to begin? What topic will be our focus? Will we be able to effectively communicate our ideas to others? There are so many questions we initially asked ourselves. For this activity, our team began with discussing our individual educational philosophies, and then we developed questions of topics that interested us in the field of education. From there, our project took off. We decided that the topic that appealed to us the most was student-centered learning, and that our focus question would be "Which method of instruction is more effective for student learning: Activity Before Content? (ABC) or Inform-Verify-Practice (IVP)?" We had experienced student-centered activities in our own Science Methods class, and they seemed to be effective. However, we were curious to see for ourselves if we could achieve the same results with the student-centered method (ABC) as we compared it with a teacher-centered lesson (IVP) of the same content. Ultimately, we feel that it is our goal as educators to provide the most effective instruction for our students to learn from, and by exploring this question in our own research project we felt that we could increase our growth and development as teachers, while at the same time creating a student-centered lesson that could be shared with our peers.

After deciding that our target grade level would be a fifth grade classroom, and arranging a location in which to teach our lesson, the next difficult question was: What topic to choose? The world of science is immense and the possibilities are endless, however we were able to narrow our choices by asking ourselves another question:

	ABC	IVP
	Pre-assessment	Pre-assessment
Engage	Posing the Problem	Demonstration/Explanation of the Mechanics of Water Pollution
Explore	Map Activity	Map Activity
Explain	Discussion/Demonstration	Wrap-up/Questions
Extend	Extend - Posters	

Table 1: Individual components of ABC and IVP approaches to teaching.

What is a topic that is both relevant in our society and provides valuable knowledge that students can take and apply to their personal lives? We felt that water pollution is a topic that is important to everyone, the effect of which can readily be seen in neighborhoods and cities, and presents particular relevance to the area in which we live; the state of Illinois is bordered by three rivers, the largest of which, the Mississippi River, comprises the entire western border of our state.

From this point, the process of creating our activity became more focused, but again we were stumped with yet one more question: What would students find engaging? What kind of games do they like to play? We felt that students of this age enjoyed solving mysteries, and if we created a lesson that combined water pollution with a mystery that students could solve, students would be engaged in problem solving while learning valuable lessons about environmental awareness and stewardship.

Research Questions

Aside from the implications this research experience would have upon our understanding of the way students learn, we also had considerations about our own development as pre-service teachers. As students in a certification program, we have often heard of the importance of continually questioning our instructional practices and the importance of trying new methods in the classroom. Throughout our tenure at the university we have had an opportunity to inquire into new pedagogy by conducting lesson studies in a vast array of subject areas. Through vigorous coursework we were introduced to research-based innovative methods for all subject areas, but we were still left with the question of how to implement them effectively. Can we facilitate these methods effectively in order to ensure understanding and success of all students? Will these methods even work for our students? Or is the traditional, less risky, method just as effective? After carefully considering all of these questions and everything we had learned about science instruction, we decided that our goal while conducting this research would be to evaluate two methods of instruction: *Activity Before Content* and *Inform, Verify, Practice*. Through developing two lessons, each using a different approach, we had the opportunity to practice our skills as inquiring professionals and see the impact that particular mode of instruction has upon learning outcomes for our students.

Research Design

The lesson was taught in two classrooms; one in which the ABC approach was used, and one in which the IVP approach was used. The lesson components common to both approaches were the map activity and the discussion. However, Table 1 illustrates the specific stages of each approach. For the purposes of this article, we describe both lessons, however because we favor the ABC approach, and wish to promote its use among the readers, we will describe that lesson in extensive detail in the coming paragraphs.

We took care to align each event within the ABC lesson to Illinois State Standards as well as ELA Common Core Standards, as is illustrated in Table 2. We used various forms of assessment, as well as approaches of teaching, such as whole class, small group, and individual work.

The goal of assessing this activity was to determine the amount of progression in student awareness concerning the issue of water pollution. After observing class discussion and analyzing student work it became apparent that students came away with the knowledge of why water pollution is an issue, how water pollution occurs, and methods to prevent this type of pollution. Skills practiced in this activity include interpreting maps, recording information, making observations and predictions, and problem solving.

Event	ISBE / ELA Common Core Standard	Objective	Assessment
Posing of the problem	Introduce 13.B.2f: Analyze how specific personal and societal choices that humans made affect the local, regional and global ecosystems (e.g., lawn and garden care, mass transit).	Students demonstrate interest in the coming activity	Formative *(whole class)*: Student interest and facial expressions
Map activity	11.A.2d: Use data to produce reasonable explanations.	Students use problem-solving skills to find the culprit	Formative *(small group)*: Student questions and comments as they work through this activity
Discussion / demonstration	Develop 13.B.2f: Analyze how specific personal and societal choices that humans made affect the local, regional and global ecosystems (e.g., lawn and garden care, mass transit).	Students develop an understanding of how water pollution can happen and how this relates to their map activity	Formative *(whole class)*: Student questions and comments as they observe the demonstration and answer questions posed by teacher
Poster	Various ELA Common Core Standards; L3.1f, L3.3a, L4.1f, L4.1g, L4.3a, L4.3b, L5.1d, L5.2a, also proficiency of 13.B.2f: Analyze how specific personal and societal choices that humans made affect the local, regional and global ecosystems (e.g., lawn and garden care, mass transit).	Students illustrate their understanding of how water pollution impacts their lives, and others in their community	Summative (*individual)*: Student poster or pamphlet.

Table 2: Alignment of events within lesson.

The Lesson

Materials and Teacher Preparation

For both the IVP (content first) and ABC (activity first) lessons the teacher will need to prepare the demonstration, a map, and a list of clues. The materials needed for a class of twenty-five students, with groups of five, include:

5 strainers (approximately 10 cm in diameter)
5 flat bottomed coffee filters
5 recycled spaghetti jars (or other container of similar size
1500g brown sugar (300g per group)
5 packages of Kool-Aid
1500g water (300g for each group)
5 maps
5 sets of clues

Map

Each map must contain the following: An image of the school, the school's water supply, and surrounding homes or businesses, drains, a river or stream, and pipes. The water becomes polluted by an undesirable practice near a drain or stream, so variables of location and practices must be considered when making the map. We found that it was best to provide each group with their own map (the culprit's location is variable), but identical clues, to emphasize that it is both location and practice that contributes to water pollution. The overall detail of the map can be adjusted for the grade level of the students, and should be as authentic as possible. An example of one of our maps can be seen in Figure 1.

Clues

Clues contain scenarios of families or businesses that take actions that could and could not pollute water. These clues will require students to identify desirable and undesirable practices within the community. Some practices included in clues can be bad, but when disposed correctly do not cause water pollution. Clues should be as relatable and real-life applicable as possible.

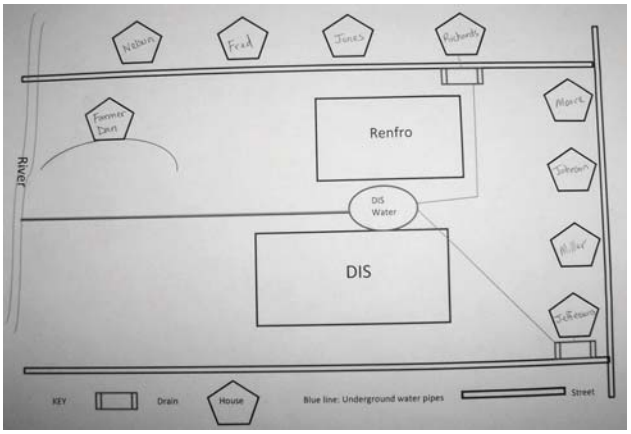

Figure 1. Example of a student-generated map.

Desirable Practices:

- The Richards family has two dogs. Billy has been slacking on his chore of picking up their waste, but his brother Dave makes sure he picks it up before every rainfall.
- Mrs. Jefferson washes her car in the driveway with biodegradable soap.
- Fred, a local mechanic, always disposes of chemicals like antifreeze and motor oil properly.

Undesirable:

- The Nelson family has a beautiful garden, and they make sure to use plenty of fertilizer on a continual basis. There can never be too much!
- Farmer Dan uses pesticides for all his crops.
- The Smith family pours chemicals such as bleach and paint thinner down the drain.

Note: Depending on the student's ability and grade level, these clues may need to be modified. For example, middle school students deserve a better challenge and will need a higher quantity of clues with a less-straight forward approach. Primary students will need a fewer amount of clues to establish the culprit.

Visual Representation (Demonstration)

In each spaghetti jar, pour approximately 5 cm of water. Place the funnel on the top of the jar. The bottom of the funnel should not be able to touch the water. Place the coffee filter in the funnel and add 300g of brown sugar to the filter. The Kool-Aid and remaining 300g of water will not be needed until students complete the activity. For an example of this, please see Figure 2.

Classroom Investigation

The ABC lesson should be taught with a student-centered approach in which the emphasis is placed on the teacher as a facilitator of student learning. The lesson will begin with a pre-assessment, so questions can be quickly modified to more accurately represent students' knowledge. We chose a KWL chart to use

Figure 2. Demonstration example.

as a pre- and post-assessment tool (Table 3), although other whole-class methods could be used, such as a brainstorming list, or using graphic organizers such as a concept map, or Venn diagram.

To engage the students, the classroom teacher should draw the students' attention to a problem that needs to be solved. The problem used in this lesson is: "There is something in our water supply that is making students and teachers sick. We need to find out what it is!" Explain to students that they will use clues to help catch the water pollution culprit. Each group of students will receive a map and clue sheet. For the purpose of this activity, and the classroom this was instructed in, we found groups of five students work best for collaborating ideas. Depending on class size and grade level this can be modified to groups of a smaller number.

Students are given the task of becoming pollution police, and through analyzing the map and clue sheet, groups will formulate ideas about possible culprits in the neighborhood who may have caused the school's water to become polluted. They are charged with the task of finding out three things: 1) What was the pollutant?; 2) How did it get into the water?; and 3) How could it have been prevented? For older grade levels, teachers can incorporate

What do we know?	What do we want to know?	What have we learned?
Polluted water is dirty.	How does pollution happen?	Improper disposal of chemicals can cause water pollution.
Oil spills cause water pollution.	How can we get rid of it?	Pollution happens when people want to get rid of stuff easily.
Trash can pollute water.	Why do people pollute?	People may not know what they are doing is bad.
Chemicals can pollute water.	How can we stop pollution?	We can stop pollution by educating others.
Water pollution is unhealthy.	What chemicals pollute water?	Oil, pesticides, fertilizer, paint thinner, paint, wax and soaps, garbage, and cleaners all create water pollution.
Paint can cause water pollution.		
Water pollution can cause diseases.		

Table 3: KWL chart used for assessment and guiding the activity.

topographic aspects into the map to reinforce the idea of pollution caused by runoff. Teachers can also check with city hall to see if they will provide a map of the sewage lines to increase the complexity of this experience.

Students will present their findings to the rest of the class. Students may offer several answers, given that they all have different maps, but all should be able to provide plausible explanations as to how the water became polluted. Presentations should include information about the culprit, what the cause of the pollution was, the area it occurred on the map, and what could be done to resolve the issue and prevent it reoccurring in the future.

Next, the students will be able to utilize a model of how contaminants can enter the water supply through a visual representation of ground water pollution. Each group should receive 12 oz. of water, a package of Kool-Aid, and a model that was previously prepared. The teacher will ask students to identify what each part of the model represents: water in jar (ground water), brown sugar (soil), Kool-Aid (pollutant), and extra water (rain). Students will add the Kool-Aid to the soil. Before adding the rain water, students will predict what will happen. Once they add the rainwater, it will trickle through the pollutant, soil, and coffee filter, polluting the ground water below. We chose to use Kool-Aid because it was brightly colored, and we thought that it would allow students to view the water more easily. While students are completing this group demonstration, the teacher should ask probing questions, such as "What is happening?" or "Why do you think this is happening?" Once the demonstration is complete, the teacher can ask one or two groups to describe what occurred in the demonstration, and how it connects to the map activity. The teacher will then begin the post-assessment phase of the lesson by directing the students' attention back to the KWL chart on the board, completing the "L" column, and summarizing the students' learning process from K to W to L. (Table 3).

For an extension of the investigation, students can create water pollution prevention pamphlets or flyers to hang around the school and/or their community (Figure3). This activity provides an opportunity to assess learning outcomes for individual students. Through this project students will show responsibility and be able to take ownership in promoting an environmentally conscious lifestyle for the school and their community. We assessed this part of the activity with a rubric (Table 4). To further extend this idea, teachers can develop a debate about environmental issues in the community, or to plan a field trip to a local water treatment facility, or stream. Additional resources are provided at the end of this article for teacher reference.

IVP Approach

In contrast to the activity first lesson, we began the IVP lesson with a K-W-L pre-assessment, and followed it by an instructor-led demonstration, similar to the student demonstrations utilized in the ABC lesson. After this demonstration, the instructor explained what each part (sand, Kool-Aid, water) represented and what happened as they poured in the water to the filter. They even explained to the students why it was happening. The students then completed the map activity. Once the students completed the map activity, the teacher answered

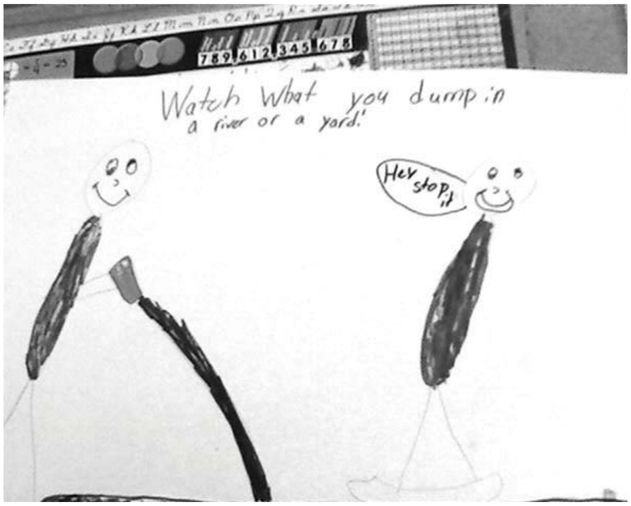

Figure 3: School flyer as an extension activity.

questions to wrap up the lesson and completed the "L" column on the K-W-L chart (Table 3). Unfortunately after all of this, there wasn't any time left over for students to design water pollution prevention posters, which left us with three main events to the lesson: The K-W-L chart, the demonstration and explanation, and the map activity.

Assessment and Outcomes

After teaching both IVP and ABC methods we noticed a significant difference in the engagement level and overall understanding of the content that was addressed in this lesson. Students in the ABC classroom were thoroughly engaged throughout every part of the lesson and commented that they felt a connection to the problem and really wanted to help solve the mystery. In the IVP classroom, students completed the map activity, and each group had a chance to discuss who they picked as the culprit. They did not want to move on to the demonstration without knowing the answer to the mystery: Who did the teacher pick as the culprit? What was the "right" answer? These students seemed to be fixated on the correct answer, rather than the process of how they achieved their answer. We did not notice this problem in the ABC classroom. The students in this classroom were very pleased and confident in whom they picked as the culprit because they had reasoning to back up their answer. The students were not concerned with who the teacher picked as the culprit; they didn't ask at all. In addition, observers of the class discussion in both classrooms noted that student responses in the ABC classroom promoted the value of prevention of water pollution and the importance of awareness in the community, while student responses in the IVP classroom did not.

Second, we noticed that we were able to utilize a variety of assessments to ascertain learning objectives during the ABC lesson however in the IVP lesson, the assessment that we used only measured whole-class and small-group understanding. There was not an opportunity to measure individual student learning outcomes, and we attribute this to the teacher-centered nature of each of the events taught during this lesson.

Lastly, in our experience as pre-service educators, we have heard several objections to "activity first" lessons, as teaching in this manner requires that the instructor be comfortable with ambiguity, prepare heavily prior to the lesson, and understand not only the content but the context that they are teaching to their students. The main complaint we have heard is that teaching in this way takes too much time. In our study, we found results to the contrary. Our ABC lesson not only provided more opportunities for assessment, it provided more opportunities for meaningful assessment, and it actually took less time than the IVP lesson.

Conclusion

Our results show that students have a deeper understanding for content when learning through the ABC method of instruction. Students who were taught through the ABC method gave in-depth answers and seemed confident in their solutions, while the students who experienced the IVP method were more concerned with getting the "right" answers. When reflecting upon this we felt that the students who were subject to the ABC lesson did not question whether their answers were right or not because they were confident in their abilities to explain their answer, which inevitably represented a deeper understanding of the content.

In the beginning of this article, we spoke about our desire to teach a lesson of our own design, and to try out these two approaches for ourselves. After reflecting upon this experience, we realize that the results gained from teaching these two lessons had an impact on the formation of our philosophy as beginning educators. It has established our belief in student-centered teaching, as it allows students to experience content in real-life, relatable, hands-on opportunities. As the educational philosopher John Dewey said,

Category	Points = 3	Points = 2	Points = 1
Organization of the poster / pamphlet	**Title and picture are clear**	**Title or picture is clear**	**Neither title nor picture is clear**
Message	Message is clear and utilizes appropriate grammar, punctuation, and spelling, and connects with title and picture.	Message is clear and utilizes appropriate grammar, punctuation, and spelling, and connects with either title or picture, but not both.	Message is unclear or does not utilize appropriate grammar, punctuation, and spelling, or connects with either title and picture, but not both.
Explanation	Explanation utilizes appropriate grammar, punctuation, and spelling, and fully explains the poster/ pamphlet.	Explanation utilizes appropriate grammar, punctuation, and spelling, but does not fully explain the poster/ pamphlet.	Explanation does not utilize appropriate grammar, punctuation, or spelling, and does not fully explain the poster/ pamphlet.

Total Score: _______ / ________ = ___________

COMMENTS:

Table 4: Rubric to grade poster or pamphlet. Students can choose to create either a poster or a pamphlet that will be hung up around the school. Whether a student chooses a poster or a pamphlet, both should include a title, message, and picture. Accompanying the item should be a paragraph explaining the meaning and intention of either the poster or pamphlet.

humans learn through experience. The more opportunities teachers give to their students to have these experiences, the more efficiently their classrooms will run, and the more effective their teaching will be. As student concept retention increases, time spent on review and repetition will decrease, and the opportunity to learn that much more will arise.

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Recommended Resources

http://www.mapsofworld.com/usa/states/illinois/illinois-river-map.html

Mississippi River:

http://www.nps.gov/miss/riverfacts.htm

http://water.epa.gov/type/watersheds/named/msbasin/index.cfm

http://www.fmr.org/

http://www.monsanto.com/ourcommitments/Pages/mississippi-river-watershed-project.aspx

Wabash and Ohio Rivers:

http://www2.illinois.gov/ltgov/pages/worcc.aspx

http://www.epa.state.il.us/water/tmdl/report/ohio-river/ohio-factsheet.pdf

http://www.epa.state.il.us/water/tmdl/report/wabash/wabash-river-final-tmdl.pdf

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Reflection Runs Deep in the Still Waters of Professional Development

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Finding time to reflect on your work can be difficult no matter your profession, and is particularly challenging in teaching. Professional development (PD) sessions can be a great opportunity to stop the clock, learn something new, and reflect on how what has been learned can impact practice. The Loyola University Center for Science and Mathematics Education (LUCSME) has been working with Chicago Public Schools (CPS) middle grade science teachers since 2003. We provide a variety of different types of professional development in middle grade science, from large-scale training on middle grade curricula, to one-on-one coaching sessions. The differences in size and scope of these activities require an assortment of reflection tools appropriate for the range of PD experiences we offer. The common purpose of the reflection tools is to enable teachers to articulate for us and for themselves the aspects of professional development that they find valuable to their practice. In this article, I present some of the tools that LUCSME has developed and/or used in the PD activities with middle grade science teachers.

What do we mean by *reflection*, and why do we think it is important? The reflection process can in some ways be characterized as thinking deeply about experiences, such as those we provide in PD, but it is more than that. The type of thinking that we hope to foster involves recognizing elements of the PD experiences that can lead to changes in a teacher's classroom practices. It is a two-step process: 1) What have I experienced? 2) How can I use that experience to make changes in my instruction? (Schön, 1983, 1987). As others have noted, what is learned as a result of reflection is at least as valuable as the reflection itself (Loughran, 2002). A variety of tools are needed in order to enable reflection that engages teachers in making sense of the PD elements, and connecting these elements to their practice.

Contextual Background

We are currently engaged with a subset of CPS elementary and middle schools to provide support for middle grade science teachers' implementation of inquiry-based science. Figure 1 illustrates some of the different types of professional development we have provided for middle grade science teachers during the past year. As can be seen from the figure, some professional development activities target large numbers of teachers and others focus on smaller groups or individual teachers.

We have been providing the first three types listed in Figure 1 since 2006. The curriculum-based professional development on the NSF-funded research-based SEPUP curricula (Lawrence Hall of Science) and the middle grades science endorsement courses began in 2003 as prominent components of the Mathematics and Science Initiative (CMSI) - see http://www.luc.edu/scaleup/index.php for details on mathematics and science reform in CPS. On average, 170 - 200 teachers attend at least one PD session.

As part of CMSI, CPS also provided guidance for university partners regarding the design of courses for teachers towards obtaining a middle grade science endorsement. These design elements (content, pedagogy, classroom connection, and student work) are recommended as a way of safeguarding that the content courses provided would be relevant to teachers' work and practice, and actually build in time for reflecting on content in the context of middle grade classrooms. We offer three different content courses each year, on a schedule that allows the ambitious teacher to complete the six-course sequence in two years. Each course has between ten and twenty teachers.

We began providing coaching for middle grade science teachers in 2006. Instructional coaches work with middle grade science teachers on their

PD Type	Number of participants	Audience	Description
Curricular PD on SEPUP	40-75 teachers per session; as many as 150 per academic year	Any CPS 6-8 grade teacher with curriculum materials at their schools	54 hours of training are provided for each of three middle grades science curricula from the Science Education for Public Understanding Program (SEPUP).
Science Content Courses	Classes of 15-20 teachers	Any CPS teachers who wishes to obtain middle grades science endorsement	6 graduate courses in science content (3 offered per year) that partially fulfill state endorsement requirements
Coaching	One-on-one or school teams	6-8 grade teachers in 12 CPS schools	Instructional coaches work one-on-one with teachers to support high quality science instruction using SEPUP materials. Coaches' primary activities are modeling, co-teaching, observing and supporting the connection between the Common Core Standards, Next Generation Science Standards, and the science curriculum.
SEPUP Professional Learning Community (PLC)	Approximately 20 teachers/session	6-8 grade SEPUP curriculum users	Informal after school discussions on classroom activities, the impact of district initiatives on instruction, sharing ideas, facilitating peer observations between schools, etc.

Figure 1. Professional Development Types.

implementation of SEPUP, and provide leadership PD for principals and school leadership teams. Our coaching model, which we continue to modify as we utilize coaching in a number of projects, is informed by the Charlotte Danielson Framework for Teaching (Danielson, 2007), the instructional coaching work of Jim Knight and his colleagues (Knight, 2009), and the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 2005). Each coach mentors ten to twelve teachers, and sees each teacher at her or his school every one and a half to two weeks.

The newest addition to our middle grade PD portfolio is the SEPUP Professional Learning Community (PLC), which we began offering this academic year, 2011-2012. We designed this PD in response to a need articulated by the teachers we have been working with for more opportunities to share their experiences with other teachers. Our goal is to provide an environment where SEPUP teachers can interact and share experiences regardless of their level of familiarity with the curriculum. For the most part, CPS middle grades reside within K-8 schools;

Figure 2. Reflection Tools Used in Professional Development.

there are few actual middle schools. Also, in many of these schools, there is only one middle grade science teacher who teaches science to all sixth, seventh, and eighth grade students in their building, which heightens the need for interaction with others. We invite any teacher who regularly attends the SEPUP curricular PD, or has attended in past years, to attend. In this first year of implementation we are offering three or four after-school sessions with average attendance of sixteen teachers per session.

Reflection Tools

As stated above, we view reflection as a two-step process that enables recognizing and processing the content of the PD session, as teachers think about ways in which they may put into practice what has been learned. Figure 2 depicts the reflection tools we employ and the PD activities in which the tools are utilized.

We invite teachers who attend SEPUP implementation PD to take the Surveys of Enacted Curriculum (SEC) (Blank, Porter, & Smithson, 2001). This online self-report survey asks teachers questions about the instructional practices they use and about the content covered in their classrooms along with its cognitive demand on students. The survey is administered each year in the summer, and longitudinal growth can be monitored. Since the SEPUP PD reaches a large number of teachers, a survey tool that analyzes large amounts of qualitative data is particularly useful. In the science endorsement courses, while content is the primary focus, it is important to provide an opportunity for teachers to think about how the content they are learning connects to the teaching they do. Assigned journal reflections can be helpful in making these connections. Instructional coaches provide many different kinds of support for teachers, including offering feedback on teachers' classroom instruction. Deconstructing a video of classroom teaching with a coach can be very powerful, especially in conjunction with a guide we developed that helps to identify and characterize features of successful middle grade science instruction. Lastly, gatherings of teachers who informally share their common experiences can induce rich discussions that stimulate reflection for the speakers and the listeners.

The Surveys of Enacted Curriculum

The survey has two main sections. Part A asks teachers to describe their schools and classrooms, and to describe their professional development and course preparation experiences, their instructional readiness, instructional influences and opinions and beliefs, and their instructional activities in science, for a total of 150 questions, with answers reported on a Likert scale. Part B of the survey asks teachers about the content topics and subtopics they cover, how much time they spend on each subtopic and what the cognitive expectations (cognitive demand) are for each subtopic, using a modified Bloom's taxonomy scale. We will focus here on Part A of the SEC.

Teachers taking the SEC are asked to keep a target class in mind as they reflect on the previous year's instruction through questions about specific practices they may have used in the classroom that year. Fifty-six questions on the survey ask specifically about instructional activities in science. Sample questions from part A of the survey are shown in Figure 3. We use both parts of the SEC in program evaluation

How much of the total science instructional time do students in the target class do students use to engage in the following tasks?

1 - Little *(Less than 10% of instructional time for the school year)*
2 - Some *(10-25% of instructional time for the school year)*
3 - Moderate *(26-50% of instructional time for the school year)*
4 - Considerable *(More than 50% of instructional time for the school year)*

1. Do a laboratory activity, investigation, or experiment.
2. Watch the teacher demonstrate a scientific phenomenon.
3. Collect data (other than laboratory activities).
4. Work in *pairs or small groups* (other than laboratory activities).

Figure 3. Sample Questions From the Surveys of Enacted Curriculum (Blank, et al., 2001).

(maintaining teacher confidentiality, anonymity, and using aggregated data) and as a tool to facilitate teacher reflection. Returning to the notion of reflection being a two-step process, the mere act of taking the survey is the first step: cataloguing teachers' experiences. As a large group of teachers participate in this PD, the reflection tool needs to be adaptable to large numbers of participants, and the online SEC survey has the capacity to process a high volume of teacher responses.

The survey interface returns results to teachers in graphical reports immediately following the survey's completion. Interpretation of the graphs requires some support, which we give through additional dedicated PD sessions and during coaching sessions. These additional sessions scaffold the second step in the reflection process: using data gathered during reflection to make instructional plans to improve teaching practice. An example of the kind of data that the survey returns is seen in Figure 4, which depicts an output graph of science instructional practices. This example shows bar graphs of all of the data from the teacher's group in 2010 (in left hand column) and all of the data from the teacher's group in 2011 (the middle column), with their own data expressed as a percent (in boxes in right hand column). The user can control which data appear in the left and middle columns to compare to their own data, such as their project group, their state, or in some cases, their school. School data can only be viewed if more than three teachers have taken the survey in the school, in order to protect confidentiality. There is a learning curve for teachers to be able to retrieve and interpret the appropriate data, so we offer PD sessions for teachers dedicated to providing support for this task. Coaches also help teachers analyze their SEC data in individual coaching sessions, and have found it very useful (to both coach and teacher) as one tool to help characterize instruction, and to use these characterizations to make a plan for improving instruction. Next year we will modify our use of the survey and move from a yearly administration to a quarterly administration. We think this will provide better data, as teachers will be reflecting on smaller chunks of time, and data on instructional practices can be used formatively throughout the year. This tool is appropriate for our high-volume curriculum-based PD because survey administration costs are low, and the survey's potential to return a great deal of information about instructional practices for a large group of teachers is high.

Journal Responses

We offer specialized science content courses for middle grade teachers, designed to increase teachers' content knowledge, while connecting that knowledge to the middle grade classroom environment. One way to connect content to teacher practice is to simply ask the teachers about these connections. Journal reflections are assigned in every course in response to the following prompts: 1) How did you, as a learner, gain a deeper understanding of science content as a

Figure 4. Sample SEC Data.

(1) How did teachers gain a deeper understanding of science content as a result of taking the course?
I did not know that the cell membrane is a phospholipid bilayer with proteins imbedded in it. Because I now understand better how this bilayer functions, I was able to understand an article in *Scientific American* on the amyloid-cascade hypothesis for the development of Alzheimer's disease. This, as well as other course material covered, has given me a better understanding of the specific processes that are taking place within my body and any changes or disruptions to these processes may impact our body from working properly.
(2) How will they, as teachers, use the content material in their courses?
The new knowledge that I acquired helped to structure student learning in new ways and allowed me to provide more accurate and in-depth descriptions of the parts of the cell. Reviewing the nature of science in our class is something that is applicable at all grade levels of science instruction and was the least emphasized area of my instruction in the past before starting this master's program
(3) How are they progressing towards their goals as science teachers?
I know that I have improved as a science teacher, especially in the area of The Nature of Science, because my students have demonstrated a better understanding of what science is and how it is studied. I know that I am progressing as a science teacher. I am bringing these new ideas into my classroom because it makes the classroom a more engaging place to learn.

Figure 5. Journal Responses From Various Science Courses for Middle Grade Teachers.

result of taking the course?; 2) How will you, as a teacher, use the content material in your classes?; and 3) How are you, as a science teacher, progressing towards the goals that you stated in your application materials? These prompts correlate well with the two-step reflection process discussed here, with the first prompt relating to the first step (What have I experienced?) and the second and third prompts relating to the second step (How can I use that experience to make changes in my instruction?). Although this is a class assignment (graded only on completion), and teachers know that the instructor will be reading the responses, the prompts are broad enough to elicit some very insightful and specific responses, which illustrate the teachers' reflective thinking. Figure 5 displays some example responses to each of the prompts.

Videotaping and Piloting the *Guidance for Successful Science Classrooms*

The teacher-coach interaction is inherently reflective. Coaches' primary activities are modeling, co-teaching, observing, and supporting the connection between the Common Core Standards, *A Framework for K-12 Science Education* (NRC 2011), and the SEPUP science curriculum. Coaches also work with principals to identify and support good science instruction. During the current academic year, coaches have begun to videotape lessons encouraging teachers to view the videos on their own, and reflect on what they see based on the model developed by Jim Knight (2011). Teachers use a checklist while going through the video at least two times; one checklist focuses the teacher on their students' behavior, and the other focuses the teachers on their own instruction.

In an effort to align the tools we use throughout our program, we are modifying the checklist for teachers to include aspects of inquiry-based science instruction that our program emphasizes. These include instructional practices that teachers have already reflected on using the SEC. Another tool we are piloting that facilitates focused video-viewing is the *Guidance for Successful Science Classrooms*. Our team of instructional coaches and project staff developed this tool originally for use by principals who may not be familiar with what a middle grade classroom engaged in inquiry-based science lessons should look like. The district has been heavily invested in using the Charlotte Danielson Frameworks (Danielson, 2007) over the past several years, so the tool uses a scale similar to that seen in the Frameworks. Two other design influences were The Science Teaching Inquiry Rubric (Beerer & Bodzin, 2003), which shapes our thinking about inquiry instruction as occurring along a continuum, and the SEC. We deliberately used some of the language describing instructional activities directly from the SEC as another way of creating connections between the tools we use at the program level and those used at the teacher level. The alignment of tools we use for reflection may help develop a consistent language when discussing high quality science instruction, which we hope will be beneficial for communication at all levels of our projects. A sample row from the *Guidance for Successful Science Classrooms* is seen in Figure 6.

The tool we devised looks at ten aspects of science instruction using a scale that ranges from unsatisfactory to distinguished, with descriptions of each aspect at each point on the scale. We are continuing to work with principals on using this tool, but have more recently found it instrumental for coaches to hone in on these specific aspects of instruction with teachers and reflect on where they are on the scale. Coaches often ask teachers to rate themselves, and then carefully deconstruct with them why they gave themselves the rating they did. Coaches report this to be an advantageous means of having a targeted discussion. The design of the *Guide* is an iterative process, as it is shared with teachers, principals, district leaders, and project evaluators.

Informal Sharing

The SEPUP PLC came about somewhat organically, through a combination of needs articulated by teachers' and our coaches' (who lead SEPUP professional development) desires to impact larger numbers of teachers than they can through one-on-one coaching. We find that in many cases, once teachers have gone through the sequence of SEPUP professional development sessions, they do not return for a refresher even after many years. One reason for offering this PD is to attract teachers back to a

	In an unsatisfactory classroom…	**In a basic classroom…**	**In a proficient classroom…**	**In a distinguished (in addition to proficient) classroom…**
6. Students are analyzing and interpreting science info or data, orally or in writing	students either work individually with minimal interaction with peers, even when arranged in groups. students are given data and evidence and told how to analyze it.	students attempt to work collaboratively in groups. students participate in whole group-only discussions of data led by teacher. Students begin to develop their own explanations of data.	all members of student groups are engaged in collaborative data analysis. students formulate their own explanations of data.	students critique their own work/procedure, results, analysis, etc. students represent their findings through a variety of displays.

Figure 6. Sample Row From *Guidance for Successful Science Classrooms.*

What aspects did you enjoy most about the PLC session?
• Sharing out-discussing the Rubric-analyzing the difference between proficient and distinguished • Analysis Eval form—we need to keep looking at it • Rubric feedback opportunity • Small group discussion on Guidance for Successful Science Classroom.

Figure 7. Feedback From Professional Learning Community (PLC) Session #3.

setting where they can reflect on their SEPUP implementation in ways they may not have for a long time. We also expected that a multi-level assemblage of SEPUP users might produce interesting discussions through the variety of perspectives represented in the group. Some agenda items for these sessions are decided upon very close to the time of the meeting, to reflect current concerns by the teachers, or reactions to newly-released district initiatives, or general observations that coaches have made in the field. For example, a recent session involved a vetting of the latest version of the *Guide to Successful Science Classrooms*. The ten-row tool was dissected, and small groups were convened to discuss two to three related rows of the tool within each group. We collected each group's feedback, and continue to make revisions to the *Guide* using this feedback. We hope that the chance to provide input will lead to greater buy-in for tool use by teachers. Overall teacher feedback from this session, shown in Figure 7, confirms that teachers appreciate this opportunity.

The format of the sessions usually includes some small group collaboration followed by whole group discussion. The informal dialogue that emerges from these sessions captures and promotes teacher reflection on their practice. Teacher feedback on the SEPUP PLC has been very positive. Teachers' responses to our first PLC session are shown in Figure 8. It is clear from these responses that both steps in the reflection process are being enacted, as teachers report benefits to both sharing, and to listening to their peers and making action plans based on the discussions. Although it is difficult to find time for something that seems, at the surface, to be rather amorphous, we will continue to offer this PD and study its impact.

Conclusion

We do not leave all of the reflecting to the teachers. As providers of PD, we must also regularly reflect on our practice. In addition to looking at written teacher feedback from each session, we have regular meetings with all of the instructional coaches and project support staff. Coaches also fill out a coaching log which characterizes each interaction with teachers they are working with, and uses a coaching scale that is modeled after CBAM (Hall & Hord, 2005) to describe the implementation level of inquiry-based science instruction by each of their teachers. We use these data to reflect on how coaches are spending their time, and the degree to which the teachers they work with are moving along the implementation scale. Discussions follow regarding how to best support the teachers based on data from the log. This process fits again with our model: thinking deeply about the experience of coaching by filling out the log, and then developing an action plan based on the data from the log.

Another tool for reflection available at the program level is formal program evaluation. We work with both internal evaluators (based at LUCSME) and external evaluators, who help us by asking us many questions about our work. These questions challenge us to reflect on what our motivation is for some of our program activities, such as designing the tools described above, and help us look critically at the tools to ensure that the information they provide is useful. Most of our work is funded by grants, and the funders require regular reports prepared by our evaluators. These reports give us some perspective on our work, and lead us to make adjustments in our programs that can make our work with teachers more effective.

What aspects did you enjoy most about this PLC session?
• The structure of the meeting; open ended, free conversation, and so forth. • It was good to share ideas with other teachers. • Ideas to improve. • I like hearing about SEPUP from other teachers. • Discussion – Successes and Challenges. • Getting some feedback with how to handle special Ed (sic) students. • Discussion about pacing/how to incorporate literacy. • Talking about successes and challenges. • Listening to the successes of other teachers of IAES (especially ideas that I can implement).

Figure 8. Feedback From PLC session #1.

Reflection can be facilitated through a wide variety of tools; there is no one-size-fits-all tool. The type of tool that is selected should be appropriate for the size of the audience and the scope of the activity. Because the ultimate goal of reflection is to positively affect instruction, it is important that the tools themselves be regularly reflected upon, so that our practice of reflecting can also improve. The practice of reflection is continuous and iterative, and I can now add writing this paper as part of the process.

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The Single-Tasked Brain: A Case Against Multitasking

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Americas young people spend more time using media than they do engaging in any single activity other than sleeping.

As we attempt to adapt to the new era of technology, which presently changes at an exponential rate, one has a tendency to have to attend to many stimuli at one time. For example, the phone rings or a text message is received while the television is on, the iPod is playing, and the textbook is before the student as they prepare for their next science exam. This is called *multitasking* and this scene is rather typical for the majority of secondary students. Rideout, Foehr and Roberts (2010) noted that eight to eighteen-year olds spend an average of seven hours per day with digital media (p. 6). They noted the following findings from a study of 2000 youths in the United States regarding their use of digital media:

Eight to eighteen-year-olds ...
- on average, spend seven hours a day interacting with digital media through screens. When you factor in multitasking, they experience 10 hours and 45 minutes worth of media content daily.
- consume 20 percent of this media on mobile devices, cell phones, iPods, or handheld video game players.
- own a cell phone (66 percent) and an iPod or other MP3 player (76 percent).
-watch four-and-one-half hours a day of television (much of it on a platform other than a TV set). (Rideout, Foehr & Roberts, as cited in Mustacchi, 2011, n.p.)

Eleven to fourteen-year-old subgroup ...
- on average pack nearly twelve hours of media exposure into almost nine hours of media use a day (when factoring in multitasking).
- watch five hours a day of TV and movie content.
- own an iPod or MP3 player (80 percent).
- spend 68 minutes a day involved in social media on computers, including social networking, instant messaging, emailing, and watching videos on YouTube.
- spend one-and-one-half hours texting each day, starting in seventh grade. (Rideout, Foehr & Roberts, as cited in Mustacchi, 2011, n.p.)

"America's young people spend more time using media than they do engaging in any single activity other than sleeping" (Brooks-Gunn & Donahue, 2008, p. 3). There may have been a time when we encouraged youth to "turn that stuff off and focus just on your textbook." Or say, "You can't study with all of that commotion going on." However, the technology has become so commonplace that we seem to have grown to believe that the digital devices are an extension of their very nature, and a birthright for this generation. And, thus, the idea of multi-tasking evolved and has become somewhat of a mantra (Abate, 2008), and many of us have either felt defeated for not being very effective at multitasking, while others have actually become proficient in the practice. The thought tends to be that this is a new paradigm and one which the present generation has been blessed. In my own practice, I have noticed that multi-tasking can seem very productive and even pleasant at times. Nevertheless, the question should be "How does multitasking hold up against our present knowledge of how the brain learns and functions?" In other words, What do neurophysiological studies have to say about multitasking? What kind of learning does it produce? And, does multitasking cause us to be more or less

> **Multitasking is relatively new to the computer age and, literally, means the concurrent performance of several jobs by a computer.**

efficient in learning? And, finally, if multitasking is not the most effective means of studying, learning, or completing a project, then why are we so prone to believe that it is?

Multitasking Defined

The term *multitasking* is relatively new to the computer age and, literally, means "the concurrent performance of several jobs by a computer" (Merriam-Webster Dictionary, 2012). Dictionary.com (2010) defines multitasking as "the concurrent or interleaved execution of two or more jobs by a single CPU" (n.p.). As in "coined" terms, they are not always truly accurate. This 1966 term (Dictionary.com, 2010, n.d.) tends to be based on a misconception in describing the progression that occurs in a computer processor (viz., microprocessor). The computer processing unit is the "brain" of the computer, and processing is its function. The computer processes "instructions that it gathers from decoding the code in programs and other such files" (Make Use of, 2010, para. 3). Processing involves four stages: fetch, decode, execute, and writeback. However, a CPU can only process data in a sequential and linear manner, and that means do one thing at a time. So, in order to process another order or command it must stop what it is doing and then work on the new orders. The use of dual-processors did not eliminate this requirement but did decrease the amount of waiting time needed to complete processing, even as one CPU has to stop for the second to complete its course. Dual-processors, then, operate linearly, internally, and sequentially between themselves when in conjunction with other microprocessors (externally). In spite of the misconception conveyed by the term multitask, it has evolved into a working paradigm that suggests there is too much to do and not enough time to do it in; therefore, one must multitask (do more than one thing at a time; simultaneously) in order to get it all completed. The concept is that multitasking is a superior means of working and the preferred mode for learning by some. It has, especially, been associated with the younger generation as having better adapted to multitasking (Willingham, 2010).

The idea that the younger generation, growing up in the Digital Age, is blessed with the ability to multitask needs to be challenged. Granted, the technology encourages multiple tasking, not just for the newer generations but for all in the workforce. For example, it is not uncommon now to see two monitors connected to a single computer in order to provide the user with more desktop space, and to speed up the time needed to access data. Or, at some time, working with a notebook on one's lap and a tablet PC in one's hand is not entirely uncommon. But, can the brain process multiple tasks simultaneously? Is the brain, like the CPU, linear and single-task oriented? The research seems to suggest that the brain does not function in a non-linear way, but before evaluating the experimental data, let us examine what we already know about the brain.

Common Knowledge

From Piaget and Vygotsky early works, we know that the child's brain changes how concepts are perceived and how they are learned from what is known to what is unknown. We recognize that learning is facilitated by actions and performance enhances the retrieving process. Actual learning, according to Piaget, was the constant interaction between equilibrium and cognitive disequilibrium. We have since learned from clinical studies that learning alters the very chemical, electrical, and physical aspects of the brain. Synapses are formed and reinforced via myelin or removed (recycled), based on how that new information is assimilated or accommodated. Physiologically, learning is represented by the synapses and their connections. The more connections linked to specific information causes that information/concept to be more easily retrieved. Thus, intentionally connecting what we know of the cells, for instance, with what we know of tissue and bone, actually enhances our ability to recall much of what we understand regarding cells. As we build on previous knowledge and make those connections with other knowledge learned (teachers, however, need to actually do this for most students), then our perceptions become more holistic. Learning is very dynamic, and the brain is very plastic (malleable). Brain cells do not die off at the rate we once thought, and now we understand that neuroglia can also regenerate cells. And, in fact, nerve cells are continually added (via neurogenesis) to the cerebral cortex (Gould, Reeves, Mazyar, et al., 1999; Kempermann, 2006).

We have recognized that the brain is divided into a left and a right hemisphere, and that there is the natural tendency for certain parts of the brain to have specific functions. The arbitrator for the two hemispheres is the corpus collosum. The arbitrator for focus seems to lie in the amygdala and hippocampus. The former is the almond-shaped set of neurons located in the deep medial temporal lobe (Science Daily, 2010). The amygdala plays a role in controlling the emotions, as well as the fear and pleasure responses. Some have referred to it as the emotional anchor of the brain (Changing Minds, 2012, para. 8). Research has suggested that an abnormality in function in the amygdala could be the cause of such conditions as "anxiety, autism, depression, post-traumatic stress disorder, and phobias" (Science Daily, 2010, para. 5). In Bloom's Taxonomy (Krathwohl, Bloom, & Masia, 1964), the amygdala would be the control center for the "affective" domain, and if fear is the condition conveyed by the brain, then learning will not take place, which has been addressed in Maslow hierarchy of human need for safety (Maslow, 1943). There seems to be evidence that the amygdala, acting as a "thinking bypass" (Changing Minds, 2012, para. 3), has the ability to override the hippocampus (Levine, 2007).

The hippocampus is a small banana-shaped/seahorse-shaped organ projecting in both hemispheres of the brain. It provides negative feedback regulation of the stress response and is particularly susceptible to deteriorating changes caused by chronic stress. Its main responsibilities include short-term memory, spatial navigation, creating episodic memory; and, thus, manages more factual memory/recollection memory than the amygdala (Changing Minds, 2012; Vyas, Mitra, Shankaranarayana, et al., 2002). It, likewise, is

In spite of the misconception conveyed by the term multitask, it has evolved into a working paradigm that suggests there is too much to do and not enough time to do it in; therefore, one must multitask (do more than one thing at a time; simultaneously) in order to get it all completed.

involved in "creating new memories and is one of the few areas in the adult brain where there is neurogenesis (birth of neurons)" (Changing Minds, 2012, para. 10), as well as memory forming, organizing, and storing. As best we can determine, the hippocampus is the control (retrieval) center for accessing long-term memory (Cell Press, 2011).

The brain, at first glance, might appear to be very adapted for multitasking; however, upon a closer look we find that is only true with non-cognitive processes (breathing, heart beating, regulating temperature, and so forth) and motor processes (driving a car, riding a bicycle, chewing gum). We can drive and carry on a conversation, but for the most part, the driving involves motor skills (no pun intended) that we have developed over time. A new driver, for example, is not as prone to talk when behind the wheel. When it comes to cognition and learning, the brain is very much linear. One cannot think of more than a single thought at a time. One can block out undesirable stimuli, but one does not truly have the ability to take in all the stimuli. The brain is very selective. Safety is its first priority. For example, we have all had the experience of reading a book and, in a peripheral manner, monitoring our environment. However, you are not cognitively focused on both. In fact, if the environment becomes too uncomfortable, you can end up realizing that you just read several pages and have no idea what you read…for your mind can only hold one thought at a time. Once safety (and comfort) is

When we fail to focus on a single task at a time, we are being less effective than if we seek to do a single task.

established, then the brain can refocus on that which we want to read or learn. This causes the comparison to the microprocessor to be even more authentic, for like that CPU, the brain is limited on what one can cognitively concentrate on at any given moment. The hippocampus and the amygdala, like the CPU, are acting as the airport control tower when monitoring, but are much more like a telephone when we are thinking or learning. Regarding whether multitasking is an effective mode, we have to consider the sequential, linear properties of the brain. This brings us back to one of the original questions: What do neurophysiological studies have to say about multitasking?

Neurophysiological Studies

Ophir, Nass, and Wagner (2009) conducted a study in which two-hundred sixty-two university students participated from a convenient sample. The five-part study first utilized a questionnaire survey to determine how well students believed they were at multitasking. Participants were asked a series of questions to determine whether the participants believed they were good at multitasking or not. Then, through a series of three different experiments, the study sought to "address whether there are systematic differences in information processing styles between chronically heavy and light media multitaskers" (Ophir, Nass & Wagner, 2009, p. 15583). By use of an index for media multitasking, groups were classified as heavy and light media multitaskers. These two groups were then paralleled along established cognitive control dimensions. Ophir, Nass and Wagner (2009) found that the: "Results showed that heavy media multitaskers are more susceptible to interference from irrelevant environmental stimuli and from irrelevant representations in memory. This led to the surprising result that heavy media multitaskers performed worse on a test of task-switching ability, likely due to reduced ability to lter out interference from the irrelevant task set. These results demonstrate that media multitasking, a rapidly growing societal trend, is associated with a distinct approach to fundamental information processing" (p. 15583).

Myth #1 - That multitasking saves time.

Lin (2009) also found that "Heavy media multitaskers performed worse on task switching than light media multitaskers" (p. 2). It should be alarming that those who multitask are "more susceptible to interference from irrelevant environmental stimuli" for this means that they are losing (or have lost) the mental skills necessary to determine what is relevant and what is not (Ophir, Nass & Wagner, 2009, p. 15583). The ability to discern what is important and what is not is vital in learning. To be unable to make that distinction is an obvious sign that these students will be academically affected in some way. It is almost as if multitaskers find it difficult to ignore irrelevant information; as if their brains cannot tune out the vast media inflow. Gorlick (2009), a spokesperson for Stanford University and the origin of the study, put it this way, "People who are regularly bombarded with several streams of electronic information do not pay attention, control their memory or switch from one job to another as well as those who prefer to complete one task at a time…(para. 2).

This tends to put a damper on the idea that multitasking is an effective means of coping with *too much to do and too little time to do it in*. In fact, those who thought they were proficient or very proficient were the worst at multitasking. In other words, when we fail to focus on a single task at a time, we are being less effective than if we seek to do a single tasks. The brain, apparently, can cope with the deluge of stimuli, but not in an effective or efficient manner. This leads us to a final question: If multitasking is not the most effective means of studying, learning, or completing a project, then why are we so prone to believe that it is?

Brain Habits

The brain is an organ that operates the entire system of our bodies and is programmed for survival. The brain, however, naturally focuses on the unusual. It

Myth #2 - That multitasked-learning is as good as single-task learning.

thrives on that which is extraordinary, unique, or novel. This is especially true of the adolescent brain (Kelly, Schochet & Landry, 2004). And, although each individual's brain is wired differently, the brain remembers the unusual things very well. As one is bombarded with stimuli, one will tend to focus on that which is different, although we do have the ability to train and discipline our minds to focus at will. Multitasking causes split-attention problems (Ben-Shaul, 2003). Abate (2008) states that "What now passes for multitasking was once called not paying attention" (p. 9). In essence, it seems reasonable to acknowledge that the brain can either be focused and concentrate cognitively (much as a laser concentrates light) to learn, accomplish, reflect, and so forth, or superficially scan the horizon, much like a radar; as if to spread one's attention (Springer Science. 2012). However, for focusing on a single task to be encouraged requires that the internal locus of control system provide a greater intrinsic reward with the activity than that which might be produced by the general stimuli around us. For example, as science teachers, many of us chose the profession, not just because we wanted to make a difference in the lives of young people, but, also, because we loved the subject matter. That is, our brains found pleasure in what was being learned.

One has probably had the experience of having read and studied and actually gotten pleasure, internal reward, gratification, and even became enthusiastic, from what was being learned. And, we tend to enjoy further what we invest in the most. This is intrinsic, but requires some discipline in order to activate the reward. Without this fundamental core, we are prone to jump from stimulus to stimulus, and become more superficial scanners, though still experiencing some mental reward. There is some evidence that multitasking actually gives us an "emotional boost" and makes us feel good (Ohio State University, 2012, para. 3). In other words, the brain will do whatever is possible to avoid lack of stimulation (or boredom), and multitasking seems to be one way to provide the mind with variety. It might also be that multitasking is a means of helping us think that we are accomplishing many things, when, in fact, we are doing so at the cost of being inefficient. Multitaskers, according to this study, are not only bad at multitasking, but they are worse than the non-multitaskers on every individual task presented. However, the study also revealed that those who were worse at multitasking were convinced that they were quite proficient and could handle multiple tasks at once. There was an attitude of self-confidence that was not backed up by their results. Abate' (2008) provides us with what he refers to as myths regarding multitasking. These are:

- Myth #1 - That multitasking saves time.
- Myth #2 - That multitasked-learning is as good as single-task learning.
- Myth #3 - That multitasking is the forte of the young. (Abate, 2008, pp. 9-11)

Multitasking is not as an efficient mode of learning or completing a task as we may have believed. Multitasking may actually be multiple interruptions, which means that the brain must continually stop and start over as we move from task A to B to C, and then back to A. Sousa (2011) has pointed out that the switching of task creates a cognitive loss in which the working memory has to reprocess what it was before the interruption (para. 3). The disengaging is very close to starting over; however, the student may believe he still has all the information still intact in the working memory (Sousa, 2011). The cognitive loss affects the learning (and the type of learning based on where in the brain it occurs). We have the tendency to multitask because: a) we think it helps us get more done, and b) it actually provides us with some sense of pleasure or reward for the brain does not have to focus on specific but, instead, goes into more of a scanning mode. And, though we are awash in technology, we begin to become habituated (a nice word for addicted) to the multiple interactivity our digital devices provide. This could explain the agitation

Myth #3 - That multitasking is the forte of the young.

It would seem that running the television, texting, and having ones science book open for study, is not the most effective or efficient means of learning.

that one gets when they attempt to go without their technology (Turel, Serenko & Bontis, 2008). It would seem that running the television, texting, and having one's science book open for study, is not the most effective or efficient means of learning, for multitasking may produce some levels of learning, but it is *a very different kind of learning*, which we will examine in another study.

Multitasking, or task-switching, provides us with rewards and helps us to convince ourselves that we are very busy in trying to get everything done. Nass noted, "We have not yet found something that [multitaskers] are definitely better at than people who don't multitask" (Frontline, 2002, para. 18). Willingham (2010) proposed, "One of the most stubborn, persistent phenomena of the mind is that when you do two things at once, you don't do either one as well as when you do them one at a time" (p. 25). Multitasking, however, is becoming ingrained in our society. We need to recognize that multiple interruptions are roadblocks to efficiency and learning, and though the trend to multitask continues to grow, it may well be that this practice is already altering the minds of our youth. Multitasking is not a gift that has been bestowed upon a new generation. It may well be a mental fix for the brain (Turel, Serenko & Bontis, 2008). Multitasking could explain why students study but then perform poorly on criterion-based tests, or simply cannot demonstrate that they actually know what they think they know from studying while watching television or listening to their iPods. Maybe mom had it right after all? She often said, "Go to your room and close the door and sit there and study in silence." More technology might not actually mean more learning (Kulesza, DeHondt & Nezlek, 2011).

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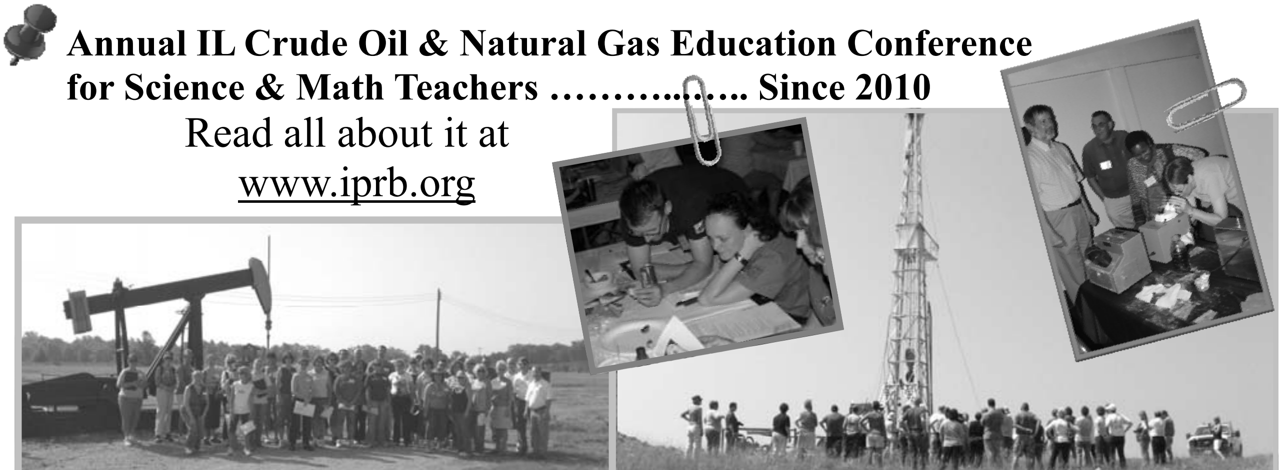

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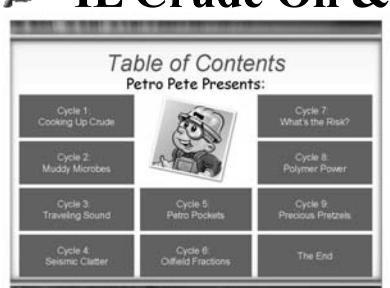

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						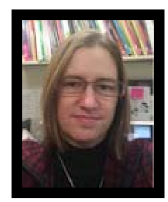
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