SPECTRUM

ISTA

Winter 2010, Vol. 35, No. 3

The Journal of the Illinois Science Teachers Association

In this Issue: Ecological Education
Write About Nature
Green Roofs
Snow Rollers
Water Cycle

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

Spectrum

The Journal of the Illinois Science Teachers Association
Volume 35, Number 3

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

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

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

Cover photos - A few of the conference exhibitors at ISTA's annual conference on science education. Photographs taken by Larry McPheron and Kristi VanHoveln.

SPECTRUM

The Journal of the Illinois Science Teachers Association

Winter 2010

Volume 35, Number 3

Table of Contents

Articles

ISTA News

President's Corner

Gwen Pollock

Happy New Year and New Semester!

A quick report: All of us on the ISTA board are working even more diligently to provide our organization with new settings for our advocacy for better science teaching and learning and high-quality professional development, better support for our membership, and innovative partnerships with other leaders in Illinois. There are some emerging partnerships which include our offers for top-quality teacher expertise to help develop, pilot-test, or critique resources and opportunities for you and your classrooms. Contact me if you want to be a part of the partnerships, especially if you have ideas for us to pursue.

A completely different stream of consciousness: I learned about an out of the ordinary idea for you to consider, explore for yourself, imagine how it could work where you are, and hopefully, even borrow forever to mimic the 'wonder' of such displays for your students. I learned about *Wonder Cabinets* from Lawrence Weschler's book, *Mr. Wilson's Cabinet of Wonder…Pronged Ants, Horned Humans, Mice on Toast, And Other Marvels of Jurassic Technology.* These cabinets, and sometimes even entire rooms, predated museums, and were often found in affluent homes, filled with artwork, natural specimens, and unique oddities. I did just a little research on the concept and found several interesting descriptions and explanations, starting with:

http://en.wikipedia.org/wiki/Museum_of_Jurassic_Technology
(This has several really cool quotes and descriptors.)
http://www.wondercabinet.com/wonder/index.html
http://harvardmagazine.com/1998/07/right.wonder.html especially the closing paragraph
http://www.bookpage.com/9703bp/nonfiction/mrwilsonscabinetofwonder.html

I shared the idea with the folks from NSTA as they are working on the details of the interior designs of the new John Glenn Center for Science Education in Arlington, Virginia. I suggested that this could be a place to display all sorts of things that have pushed our imagination from all over the country. Chapter members could submit entries to their chapters with winning entries to the NSTA site, so that the diversity could be extraordinary and could be a link from each organization to the national office.

I don't think that I am suggesting an exact set of cabinets, according to the Medieval designs, but all teachers have accepted objects of wonder from their students, which have pushed their collective nature about wondering. I was hoping that teachers might want to have such wonder cabinets in their schools. Let me know if you are wondering about this yourself. Maybe we can set up a new forum on our new website and share interesting ideas and questions between us.

Gwen - gpollock@ista-il.org

2009-11 ISTA Executive Committee

Vice President
Julie Gaubatz
Hinsdale South High School
jgaubatz@hinsdale86.org

Secretary
Kathy Schmidt
Jay Stream Middle School
2Schmidt1345@sbcglobal.net

President Elect
Carol Baker
Community HS District 218
Carol.baker@chsd218.org

Interim Treasurer
Pamela Spaniol
psmela.spaniol@yahoo.com

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

2009-11 ISTA Committee Chairs

Archives	Kathy Schmidt
Awards	Tara McDonald
ISTA Conference	
Conference Program	Kristi Van Hoveln and Kathy Schmidt
Finance	Vice President - Julie Gaubatz
Membership	Kenda Carroll
Nominations and Elections	Past President – Jill Carter
Professional Development/Building a Presence	Mary Lou Lipscomb
Publications Committee	Judith A. Scheppler

Join the ISTA listserve to Network Online!

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

Regional Directors

Region 1 Director 08-10a
Lynne Hubert
Joseph Sears School
lhubert@kenilworth38.org

Region 1 Director 09-11a
Margaret Corp
W.B Orenic Intermediate School
mcorp@troy30c.org

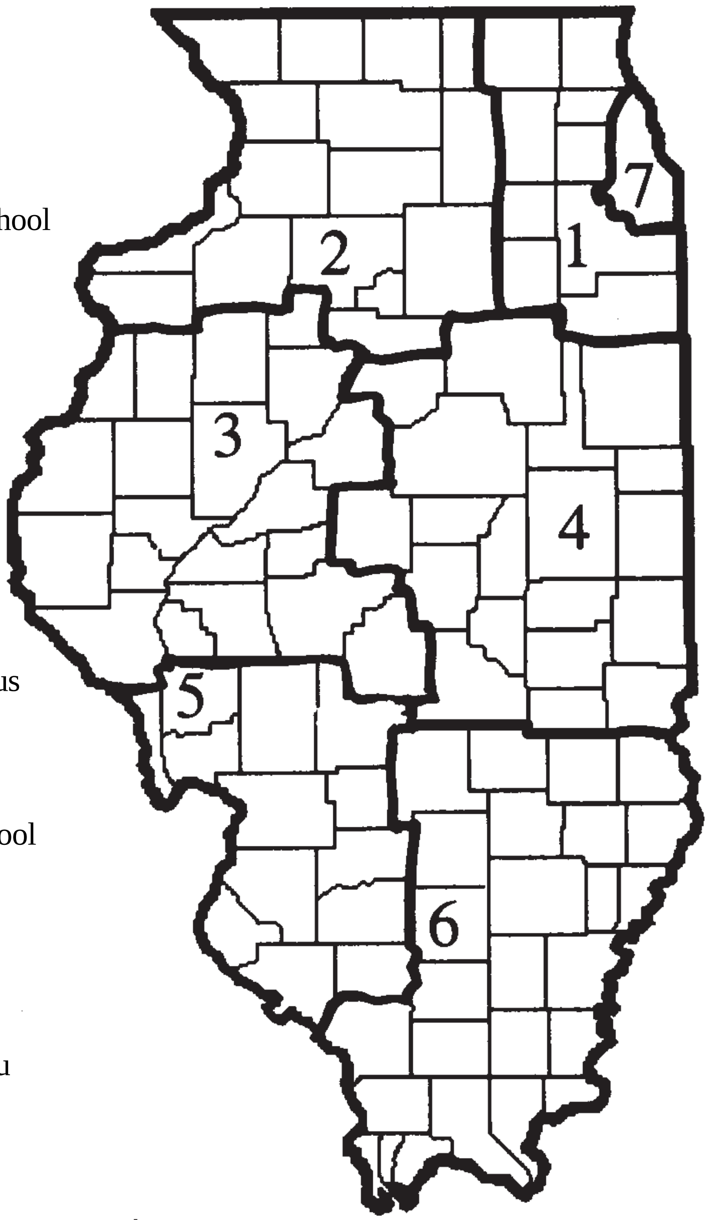
Region 2 Director 08-10a
Laverne Logan
Western Illinois University
LK-Logan@wiu.edu

Region 2 Director 09-11a
Amy Sandgren
Rock Island Regional
Office of Education
amy.sandgren@riroe.k12.il.us

Region 3 Director 08-10a
Sherry Spurlock
Pekin Community High School
sspurlock@pekinhigh.net

Region 3 Director 09-11a
Bob Wolfffe
Bradley University
rjwolffe@bumail.bradley.edu

Region 4 Director 08-10a
Kristi Van Hoveln
Milford Grade School
kestnerk@milford.k12.il.us



Region 4 Director 09-011a
Kendra Carroll
Shiloh CUSD #1
carrollk@shiloh.k12.il.us

Region 5 Director 08-10b
Tom Foster
Southern Illinois University
tfoster@siue.edu

Region 5 Director 09-11a
Kathleen Roper
Hoyleton Public School
kroper@washington.k12.il.us

Region 6 Director 08-10a
David Steele Abendroth
Red Hill High School
dabendroth@roe12.net

Region 6 Director 09-11b
John R. Clark
jrc2346@yahoo.com

Region 7 Director 08-10a
John Loehr
Chicago Public Schools
jfloehr@cps.k12.il.us

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

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

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

Illinois Science Teachers Association

2010 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 Middle Level
O Secondary Level
O Community College
O College/University
O Industry/Business/ Government
O Other___________

O Elementary Sciences
O Life Science/Biology
O Physical Sciences
O Environmental Science
O Earth Science/Geology
O Chemistry
O Physics
O General Science
O Integrated Science
O Other______________

O Teacher
O Administrator
O Coordinator
O Librarian
O Student
O Retired

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

ISTA Thanks

ISTA 42nd Annual Conference Exhibitors

Please patronize our conference exhibitors

Abrams Learning www.abramslearningtrends.com
American Society for Clinical Lab Sciences - Illinois www.ascls-il.org
Apperson Education Products www.appersonedu.com
Aurora University -George Williams College, Earth and Space Science www.aurora.edu
A Zoo to You www.azty.net
Bedford, Freeman, and Worth and WH Freeman Co. www.bfwpub.com
Carolina Curriculum www.carolina.com
Caterpillar Inc.—*Ground Rules* Reclamation Video and Lesson Plans www.cat.com
Central Illinois Blood Center www.cicbc.org
Challenger Learning Center, www.challengerlearningcenter.com
Chicago Council on Science and Technology www.c2st.org
Chicago School Supply www.chicagoschoolsupply.com
CPO Science www.cpo.com
Delta Education www.delta-edu.com
Department of Natural Resources http://dnr.state.il.us
Eastern Illinois University www.eiu.edu
Environmental Education Association of Illinois www.eeai.net
Fisher Science Education www.thermofisher.com
Flinn Scientific www.flinnsci.com
Frey Scientific www.freyscientific.com
Glencoe/McGraw-Hill www.mcgraw-hill.com
GraphTech Systems www.graphtechsys.com
Illinois Association of Aggregate Producers www.iaap-aggregates.org
Illinois DestinationImagination www.destinationimagination.org
Illinois Environmental Protection Agency www.epa.stat.il.us
Illinois Junior Science and Humanities Symposium www.ijshs.siu.edu
Illinois Mathematics and Science Academy www.imsa.edu
Illinois Petroleum Resources Board www.iprb.org
Illinois Science Teachers Association www.ista-il.org
Illinois Section - American Water Works Association www.isawwa.org
Illinois State Museum www.museum.state.il.us
Illinois Virtual School www.ILvirtual.org
Illinois Water Environment Association www.wef.org/
It's About Time-Herff Jones Education Division www.herffjones.com
Lab-Aids, Inc. www.lab-aids.com
Lakeview Museum of Arts and Sciences www.lakeview-museum.org
Lights for Learning www.lights4learning.org
Little River Research and Design www.emriver.com
McGraw-Hill Contemporary www.mcgraw-hill.com
MicroTech Microscope Sales and Service www.scopeman.com
Monsanto Biotech Mobile Training Unit www.monsanto.com
Museum of Science and Industry www.msichicago.org
Nancy Larson Publishers www.nancylarsonpublishers.com
National Geographic School Publishing www.ngsp.com

ISTA 42nd Annual Conference Exhibitors

National Science Teachers Association, www.nsta.org
NSTA Press www.nsta.org/store
Northpoint Horizons www.northpointhorizons.com
Pasco Scientific www.pasco.com
Peoples Education www.peopleseducation.com
Peoria Academy of Science www.peoriaacademyofscience.org
Peoria Park District - Forest Park Nature Center www.peoriaparks.org
Project Learning Tree www.plt.org/
PBS Educational Media www.pbs.org/teachers
Richland Community College Bioenergy Trailer www.richland.edu
Riverside Scientific www.riversci.com
Sargent Welch-Science Kit-Wards www.sciencekit.com
Scope Shoppe, Inc. www.scopeshoppe.com
SKOL Manufacturing - Green Roofs www.skolmfg.com
Teach the World www.teach-the-world.com
Trees Forever www.treesforever.org
USDA-APHIS Plant Protection and Quarantine www.aphis.usda.gov
US EPA Sunwise Program www.epa.gov/sunwise
University of Illinois Extension Radon Education Program www.takeactiononradon.illinois.edu
Vernier Software and Technology www.vernier.com
Western Governors University www.wgu.edu
Whale Times and NOAA www.whaletimes.org
Zula International www.zula.com

ISTA 42nd Annual Conference Committees

Kathy Schmidt/Kristi Van Hoveln- Program Chairs
Sherry Spurlock - Volunteers Chair
Dr. Judith Scheppler - Publications Chair
Julie Gianessi - Gala/Special Events Chair
Harry Hendrickson - Vendors Chair
Karen Zuckerman/Carol Johnson - Promotions
Harry Hendrickson - Logistics
Gwen Pollock/Tara McDonalad - Luncheon
Colleen Martin/Barbara French/Gary Butler - Registration
Kristi Van Hoveln/Larry McPheron - Photography

A Special Thanks to members of the Organizing Committee:
Gary Butler, Kendra Carroll, Harry Hendrickson, John Loehr,
Tara McDonald, Gwen Pollock, Pat Schlinder, Sherry Spurlock,
Kristi Van Hoveln

ISTA 42nd Annual Conference Sponsors

Sponsor of
ISTA Teachers Awards - for 5 Years!
and the
ISTA Conference Presidents' Luncheon

Thank You ExxonMobil!

ISTA Thanks

Chicago Council on Science and Technology

for their Generous Sponsorship of
the
ISTA Conference Presidents' Luncheon

New Teachers Reception

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

ISTA 42nd Annual Conference Registration Volunteers

David Abendroth
Carol Baker
Gary Butler
Kendra Carroll
John Clark
Barbara French
Julie Gaubatz
Robin Goettel
Emily Hauson
Sue Herricks
Mary Lou Lipscomb
Jim Martin
Katherine Narlow
Gwen Pollock
Amy Sandgren
Judy Scheppler
Kathy Schmidt
Troy Simpson
Pam Spaniol

ISTA 42nd Annual Conference Presentations Available

A digital copy of many conference presentations and handouts are available from ISTA. Materials from those conference presenters who submitted digital copies can be purchased on a 2GB thumb drive for $10. Make checks out to ISTA and mail them to:

Kendra Carroll
21088N 500th Street
Hume, IL 61932

Watch for Details of ISTA's 43rd Annual Conference

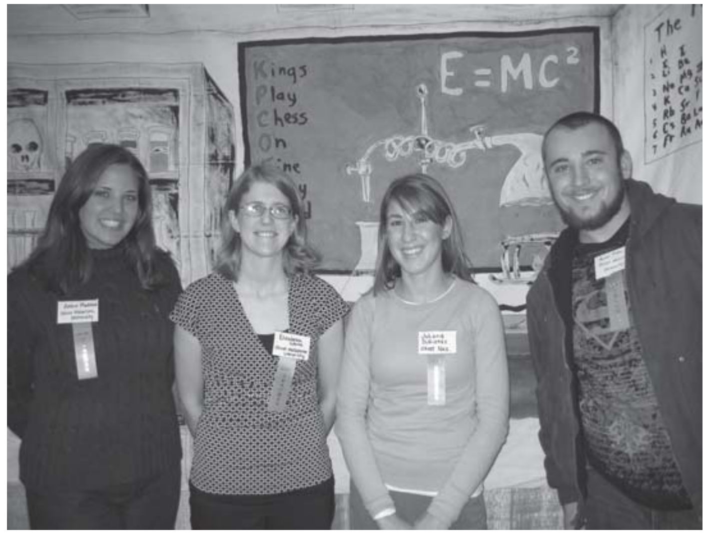
November 4-6, 2010
Thursday **Preconference** Possibilities:
Illinois State Museum
Survey Museum and Science on a Sphere
University of Illinois at Springfield
State Health, Materials, and Forensics Labs
Medical Facilities/Medical Museum

Friday Gala at the Illinois State Museum

Location:
Crowne Plaza Hotel/Holiday Inn Express
Springfield, Illinois

Please Join us in Abraham Lincoln's Hometown!

Above: ISTA president Gwen Pollock presents a plaque to IMSA president Max McGee as a thank you to the Academy for support of ISTA and science education in Illinois.



Above: A group of new teachers takes a break together at the conference.

ISTA

From so Simple a Beginning ...

The 42nd Annual Conference on Science Education was a big success!

Right: John Clark and David Abendroth, two current ISTA board members.

Right: Colleagues enjoying the conference together take a few moments to be photographed.

Right: Gwen Pollock (left) presents Colleen Martin (third from left) with an engraved ISTA keepsake as a small thank you for all of Colleen's organizational skills and time generously given to the annual conference.

Left: Carl Koch (fourth from left in the rear) poses with colleagues.

Above: Pat Schindler and Gwen Pollock mug for the camera.

Above: Executive director Harry Hendrickson enjoys the Presidents' Luncheon.

Below: The Presidents' Luncheon was a big hit with conference attendees.

Member Notes

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

ISTA Archives

The ISTA archives now reside at the Western Illinois University library, Macomb, Illinois, 61455. Contact Heather Richmond, WIU Archives, 309-298-2717, HD-Richmond@wiu.edu.

ISTA History: Excerpted from the first ISTA brochure in the archives.

ISTA had its origin at the Conference for Delegates of Science Teachers' Organizations (CDSTO) at St. Louis in March of 1966. Thirteen delegates from Illinois attended this NSTA leadership conference and subsequently were stimulated to strive toward the organization of an Illinois Science Teachers Association. Mrs. Elizabeth Rueck was elected as chairman, *pro tem.*

The impetus launching ISTA on its ultimate mission was interjected at the North Central Regional Conference of NSTA in Chicago on October 1, 1966. At this convention, Mrs. Rueck was instrumental in setting up a meeting concerning the organization of ISTA and extended an invitation to all interested teachers. Much to the surprise of everyone, a group of about two hundred teachers was in attendance. After discussing the desirability of starting an ISTA, a unanimous vote in its favor resulted. Mrs. Rueck of Barrington Consolidated High School was elected chairman, *pro tem.*

On December 4, 1966 she called an organizational meeting at Barrington Consolidated School. At this time, committees were appointed, and your ISTA continued to progress under the able leadership of Mrs. Rueck.

A $1.00 membership fee was required for ISTA charter membership for 1967.

ISTA Shirts For Sale!

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

Indicate style, size, and number:

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

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

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

Science Matters
Mary Lou Lipscomb
Science Matters Illinois State Coordinator

Science Matters in Illinois

Science Matters is an initiative by the National Science Teachers Association (NSTA) to bring content, news, and information that supports quality science education to parents and teachers nationwide.

In Illinois, Science Matters is supported by ISTA and cooperating partners to bring information to educators and others interested in quality science teaching and learning. Check out our new Illinois web page at http://www.ista-il.org/science-matters.htm.

To become a member of the Science Matters network and to receive monthly updates of professional development opportunities, opportunities for your students, and other resources go to the teacher section of the national Science Matters web site at http://bap.nsta.org.

Click on "Become a Point of Contact" on the left side of the page.
Select "Illinois" from the pull-down menu.
Enter your school's zip code and click "Find Schools."
Click on your school's name from the list (if your school is not listed, contact the Illinois state coordinator: lipscomb@imsa.edu).
Fill in all required information and click "Next."
Fill in any additional information in the "Demographics" section. Then click "Submit."

Do *You* Know an Exemplary Science Student?

ISTA members in good standing who would like to honor one high school science student each year, may request an **ISTA medallion and certificate** by contacting pamela.spaniol@yahoo.com. The fiirst medallion is free of charge; additional medallions may be obtained for $15 each.

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

ISTA/ExxonMobil Outstanding Teacher of Science Awards Program

Applications Due February 1, 2010

The Illinois Science Teachers Association, with the generous support of ExxonMobil, announces the 2009-10 ISTA/ExxonMobil Outstanding Teacher of Science Awards Program. Applications will be accepted from **grades 7-12 teachers** of science who have demonstrated *extraordinary accomplishments* in the field of science teaching**.** ISTA plans to recognize grades K-6 teachers in the 2010-11 school year.

The 2009-10 program consists of up to seven one thousand dollar prizes. A $1000 award may be presented to one grade 7-12 teacher of science from each of the seven ISTA regions in the state of Illinois. Previous winners are not eligible.

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

Criteria for consideration include:

1. Current ISTA membership
2. Full time teaching assignment
3. Teaching assignment in the ISTA region for which the application is submitted
4. Written narrative (maximum of 500 words) describing the teacher's "extraordinary accomplishments" in the field of science teaching
5. Evidence that supports the teacher's description of extraordinary accomplishments in the field of science teaching. Copies of newspaper articles, journal articles, grant applications and acceptance letters, letters from community agencies, action research reports, photos, and so forth. Do not exceed more than 10 printed pages of evidence. Evidence will not be returned.
6. Vita or resume (one page, single sided) of teaching experience, professional activities, formal and continuing education, awards, and published material.
7. Two letters of support from individuals who can attest to the impact of the extraordinary accomplishments in the field of science teaching
8. A completed application form with required supplementary materials submitted on paper and by US Postal Service postmarked by February 1, 2010.

Send applcations to:

ISTA Awards Chair Tara McDonald
Minooka Intermediate School
305 Church Street, Minooka, IL 60447
Email: taracmcdonald@gmail.com

Winners will be notified in March, 2010.

2009-10 ISTA/ExxonMobil Outstanding Teacher of Science

Awards Application Form

ISTA Region:_______

Name:____

Position (grade and subject taught):_________________________________

School Name/Address:____

____

School Phone Number:____

Email address:____

Home email address____

Home Address:____

____

Home Phone Number:____

I certify that the information provided in this award application is true and accurate.

Signed:____ Date: _________
(Applicant)

ISTA New Teacher of the Year Award

Applications due May 1, 2010

Purpose: The goal of this award is to recognize new teachers for their excellence in facilitating science learning in their classes. This award is to encourage some of the bright, up-and-coming teachers to continue to strive to be the best teachers that they can be.

Awardees will be honored with a one-year membership to ISTA, recognition in the *Spectru*m and at the ISTA 43rd annual conference luncheon, a certificate of recognition, and will receive a teacher of science *Idea Pack*.

Requirements:

- Must be a teacher with her/his initial certification
- Encouraged to be a member of ISTA (either student or teacher category)
- Must be nominated by an ISTA member teacher or school administrator
- Currently teaching in the field of science (can be teaching science in an elementary setting)
- Completed nomination form and biography highlighting innovative teaching experiences, exemplary service, professional development activities, and trend setting practices in the field of science
- This is a one-time award per awardee.

Application Information to Include:

Name of Nominee
School
School Address
Home Address
Home Phone
Email address
Current Teaching Assignment
Year Teaching (circle one): 1st 2nd 3rd 4th
Include all colleges attended, degrees obtained, and list the year in which the degree was obtained.

Attach a brief narrative about nominee. Include any pertinent background experience, innovative teaching styles and lessons, extracurricular involvement, professional development activities, unique attributes, staff, student, and community rapport which make the nominee an up-and-coming star science teacher.

Nominated by: ____

School: ______________________ ISTA Region: ____________________

Send applications to: ISTA Awards Chair Tara McDonald
Minooka Intermediate School
321 W McEvilly Road
Minooka, IL 60447
Email: taracmcdonald@gmail.com

Applications must be postmarked by May 1, 2010
Winners will be notified in June, 2010

Teacher to Teacher

Educators Share Information, Lessons, and Tips
Mary Lou Lipscomb
Science Matters/BaP Editor

Educators may engage in their own professional development in many ways. Professional development includes all of the activities in which teachers engage and learn to perfect their skills as educators. As lifelong learners, teachers accumulate a wide variety of knowledge and skills that they use to create new activities, lessons, or entire units. Teachers also use their accumulated knowledge to develop new ideas to spark or maintain interest, keep things moving, or help students understand a concept in a way that is unique or different. The sharing of these ideas, lessons, and units with colleagues provides professional development for all involved.

In this issue, educators have sent classroom management tips, ideas, and lessons that they have successfully implemented with students both in formal and informal educational settings.

A sincere *Thank You* to those who have shared their ideas.

Rust in a Bottle Demonstration

Rita Wakefield, a teacher at Brownstown Junior/Senior High School in Brownstown, has used this demonstration with both junior and senior high school students.

She writes that she puts steel wool in an empty two liter soft drink bottle. Then adds a small amount of water, just enough to dampen the steel wool, and puts the cap tightly on the bottle. Within a few days, the bottle will begin to collapse.

As the iron in the steel wool rusts, it uses oxygen from inside the closed bottle, resulting in a lower air pressure inside the bottle compared to outside the bottle. This causes the bottle to collapse. Air contains about 20% oxygen; once the oxygen is used up the reaction stops.

Rita writes, "I have used this [demonstration] in my junior high general science classes and in my high school physical science and chemistry classes. It encompasses many topics: chemical change, chemical reaction, limiting reaction, air pressure, air composition."

Bombs Away!

Mary E. Warren, a teacher at Hannah Beardsley Middle School in Crystal Lake, has used this activity in her eighth grade science classes**.** She writes, **"**Students in middle school struggle with the concept that the acceleration rate due to gravity is the same for all objects. The misconception that objects of greater mass will fall with a faster rate is very difficult to overcome."

Allowing students to do an activity which demonstrates that:

- objects of the same size and shape, but different masses fall at the same rate; and
- shows that the force applied to the surface hit by the objects is related to the mass of the object; helps them overcome this common misconception.

The concepts developed in this lesson are:

- Newton's second Law of Motion, and
- acceleration rate due to gravity is not due to the mass of the object.

The materials needed for each team of students are:

- several 1 inch diameter spheres made of different materials (for example: wood, steel, glass, styrofoam, aluminum, rubber, plastic)
- a triple-beam balance or electronic balance
- a tray deep enough to be filled with about 2-3 inches of play sand
- a 30 cm metric ruler

The students then select two of the spheres that have obviously different masses, use the balance to accurately measure the mass of each sphere, and then record the mass. They then gently shake the sand tray back and forth to level the sand.

Both spheres are then placed on top of the ruler which is being held flat-side parallel to the floor, approximately 0.5 meter to 1 meter above the sand tray. The ruler is then rotated so both spheres drop at the same time into the sand tray and the students carefully observe as the two spheres fall into the sand tray.

Finally, they measure the diameter of the crater made by each sphere.

Mary suggests the following analysis questions:

- Do the spheres fall at the same rate?
- Why does this occur?
- Do the spheres make the same size crater?
- What affects the size of the crater made by the sphere?

From the Editor

I recently became aware of a wonderful resource called *Teachers' Domain: Digital Media for Classroom and Professional Development*, an online library of more than one thousand free media resources, featuring media from NOVA, Frontline, Design Squad, American Experience, and other public broadcasting and content partners. The materials are easy to use and correlate to state and national standards.

There are video and audio segments, Flash interactives, images, documents, lesson plans for teachers, and student-oriented activities. Once you register (registration is free), you can personalize the site using "My Folders" and "My Groups" to save your favorite resources into a folder and share them with your colleagues or students.

There are several different versions of Teachers' Domain available through www.teachersdomain.org, including their standard K-12 edition, a college edition for higher education institutions, and customized state editions.

In the K-12 science area there are 403 resources related to Earth and space science, 253 related to engineering, 548 related to life science, and 431 related to physical science. The lessons in each of these science areas are further defined by clicking on the link. Grade level appropriateness is indicated in all lesson plans as well as detailed teacher direction and student pages.

The professional development area provides two session and eight session courses focusing on quality science teaching for which either continuing education credit or graduate credit may be earned. The courses are designated for teachers of grades K-4, 5-8, 5-12 or 9-12. In addition to the online coursework there is a section on teaching strategies.

Take a few minutes to checkout Teachers' Domain; go to www.teachersdomain.org . You won't be disappointed!

+++++

If you have lab or classroom management hints, great websites you have used, science activities, lessons, or demos that you have found to be effective with your students, please send them to me electronically at lipscomb@imsa.edu .

Articles

Ecological Education for Urban Youth: Promoting Environmental Literacy Through a Place-Based Curriculum

Eva D. Danon

Chicago Botanic Garden and Northwestern University, Chicago

Environmental Literacy and Place-Based Education

Current conservation and restoration efforts are constantly challenged by a variety of factors that threaten plant diversity. Some of these threats include habitat fragmentation, altered hydrology, invasive species, land development, climate change, and lastly, limited public understanding and support. While scientific efforts to protect and restore native flora and ecosystems are crucial, in order for these efforts to be successful they require the support of community members. It is especially important to gain the support of younger generations who will become future decision-makers (Evan, Abrams, Reitsma, Roux, Saimonsen, & Marra, 2005; Geist & Galatowitsch, 1999). Public awareness on the local level is an integral step in solving this worldwide problem.

Participation of today's youth in conservation efforts highly depends on effective environmental education programs that promote environmental literacy. Environmental literacy is not only a fundamental understanding of natural systems, but it is also the ability to address environmental issues and challenges. Athman and Monroe (2002) emphasize that "environmental literacy is reached through instilling in learners knowledge about the environment, positive attitudes toward the environment, competency in citizen action skills, and a sense of empowerment" (p. 37). Environmental education should lead to environmental literacy of students and may be achieved by espousing various educational frameworks, including a place-based framework.

Place-based education promotes learning that is rooted in what is local.

Place-based education promotes learning that is rooted in what is local, concentrating on the unique ecology, history, and culture of a specific place (Sobel, 2004). It encourages collaboration of students, teachers, community members, and scientists from various generations and backgrounds to provide participants with a dynamic support system. Most significantly, place-based education can create an emotional attachment between people and their environment (Dewey, 1902; Louv, 2005; Orr, 1992, 1994; Sobel, 2004). In fact, current research proposes that having a sense of place empowers people to take pride in the uniqueness of their environment and therefore become conservation advocates (Godbolt, 2006). Evaluations show that projects connecting school learning with ecological restoration are successful in improving students' knowledge of, and attitudes toward, the local environment as well as their intention to act in environmentally responsible ways (Sobel, 2004).

Place-based education originates in practices of some indigenous cultures, which recognize the significance of their local environment and call upon it to teach important moral lessons. People's connections with their surroundings create respect and caring for the land. Anthropologist Keith Basso (1996) claims that "fueled by sentiments of inclusion, belonging and

The environmental education movement was predominantly formed in response to environmental dilemmas.

connectedness to the past, sense of place roots individuals in the social and cultural soils from which they have sprung together, holding them there in a grip of shared identity, a localized version of selfhood" (p. 146). This sense of place, this experience of engagement with the natural as well as social environment, becomes a cultural activity that is cultivated in younger generations. Because indigenous peoples traditionally lived close to nature, some maintained a deep-rooted connection with their environment. Consequently, drawing from their cultural and educational practices provides a starting point for rethinking how we approach environmental education in a modern context.

Historically, the environmental education movement in Western society was predominantly formed in response to environmental dilemmas such as soil erosion, dust storms, and flood disasters. In the 1960's, partially in reaction to Rachael Carson's *Silent Spring* (1962) the focus of environmental education began to evolve from being *about* the environment to incorporating humans and their impact *on* the environment. In 1976, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) described the goals of environmental education as the development of "a world population that is aware of, and concerned about, the total environment and its associated problems, and which has the knowledge, attitudes, skills, motivation, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones" (Athman & Monroe, 2002, p. 38). Place-based education uses local environments as a teaching context and has the potential for encouraging the incorporation of the surrounding natural landscape into modern urban cultures. Urban place-based education is especially important because environmental issues can be amplified in areas that have concentrated human population.

Place-based education also incorporates elements of inquiry learning and experiential education. The National Science Education Standards (1996) describe inquiry as "a set of interrelated processes by which students pose questions about the natural world and investigate phenomena; in doing so, they acquire knowledge and develop a rich understanding of concepts, principles, models, and theories" (p. 38). Experiential education emphasizes learners' direct participation in order to increase knowledge, develop skills, and strengthen values (Warren, Sakofs, & Hunt, 1995). Place-based environmental education addresses several objectives consistent with inquiry and experiential education:

- *Awareness* - to acquire an awareness of the local environment and the problems it faces
- *Knowledge* - to use an inquiry-based approach to gain both hands-on experiences and a basic understanding of the local environment and its associated issues
- *Attitudes* - to acquire concern towards the local environment and to instill motivation for actively contributing to environmental improvement and protection
- *Skills* - to acquire the skills for identifying and solving local environmental problems
- *Participation* - to encourage citizens to be actively involved at various levels in working toward resolution of local environmental issues by working with community members and organizations

While there are studies that relate environmental education with increase in critical thinking skills (Athman & Monroe, 2004), educational achievement (Liberman & Hoody, 1998), an interest in science (Xin & Bateson, 1999), and environmental attitude (DiEnno & Hilton, 2005), there are few studies that examine the use of ecologically place-based education and its effect on environmental literacy in urban citizens. There is surprisingly little research on this topic, especially involving underserved, urban youth (Fisman, 2005).

The College First Program

Although there is limited research on this topic, there are multiple environmental education programs offered in both rural (Burney & Dubey, 2006) and urban landscapes. One such program, College First, which is offered to students in the Chicago Public School system, is designed to increase participants' knowledge of, and interest in, the local environment. The Center for Teaching and Learning at the Chicago Botanic Garden (CBG) offers College First as part of fulfilling its mission. The program began more than ten years ago. It has annually accepted approximately twenty rising juniors and seniors from Chicago Public Schools who are recommended by teachers or counselors, are interested in science, and will be the first in their family to go to college. Students come from many different neighborhoods in Chicago and are transported to CBG by way of two bus routes. One bus route runs through the north side of the city while the other bus route runs through the south side of the city. The majority of the participants have been African American students who live in neighborhoods facing challenging socioeconomic conditions.

College First is an eight week, three part program that focuses on field ecology and conservation science, college preparation, and career mentorship. Students in the program use CBG and its community as a resource to learn about native ecosystems. Participants spend one portion of each day being mentored by a CBG staff member. Students work one-on-one with a staff member to learn more about specific career areas at the Garden as well as to gain valuable skills. College First participants have worked with mentors in the following areas: Horticulture, Plant Genetics and Seed Biology Lab, Aquatics Research, Education and Camp CBG, Plant Information, Soil Ecology, and Conservation Biology. For the other portion of the day, students come together as a group to participate in guided instruction.

CBG is an appropriate setting for environmental education programs because of its hundreds of acres of natural landscape and its commitment to conservation. CBG restoration ecologists work hard to incorporate native species into restored natural areas. These areas, which serve as outdoor classrooms for the program, include: Dixon Prairie, McDonalds Woods, Skokie River, and CBG Lake. It should be noted that CBG serves as a great location to introduce students to native ecosystems, but the majority of the ecosystems are human-made and are not naturally occurring landscapes. For this reason, College First participants are asked to compare the ecosystems found at CBG to a variety of nearby high quality natural areas that are frequently visited throughout the summer.

The City of Chicago provides a promising location for environmental education programs because it is attempting to be the greenest city in the U.S, an environmentally friendly city, as well as a center for environmental design and the manufacturing of materials for the production of alternative energy. City planners encourage the incorporation of green rooftops and tree-lined streets. Despite all of these efforts, most green access is limited to particular places, formal gardens (that is, CBG) and parks, which make it hard for city residents to have exposure to native organisms or natural areas. Moreover, some of the natural areas that are available, like forest preserves, are highly degraded and often places of unlawful activity (Every Block, Chicago, 2008). Thus, programs that strengthen environmental awareness of Chicago's young residents are especially important.

Although the curriculum varies a little from year to year, it focuses on conservation, biodiversity, and the ecology of the local Illinois ecosystems found at CBG (see Table 1 for a specific example). Also incorporated are surrounding restoration and conservation projects. Some of the ecosystems that are explored include Illinois prairies, woodlands, and wetlands with a focus on common, rare, and invasive plant species. Each weekly lesson contains in-class activities taught at the Center for Teaching and Learning, hands-on field activities on CBG grounds, and a field trip on Fridays to natural areas and universities (Figures 1 and 2). A featured guest speaks to the students on a weekly basis. The guest lecturers give brief summaries of how they decided to get involved in their field and provide a demonstration of their work. In order to help students develop a connection with the environment, the curriculum includes a summary of local land use from the pre-settlement era to modern agricultural practices. Students think about land use in a modern context by visiting and exploring local conservation projects and

Week	Theme	Example Lesson	Location
Week 1	Biodiversity and Stewardship	-discuss biodiversity and stewardship -learn about local historical land use -debate organic vs. conventional farming	CBG- Fruit and Vegetable Garden Offsite- Green Youth Farm
Week 2	Fundamentals of Botany	-make a herbarium specimen of an invasive plant -dissect plant parts and discuss functions	CBG- Native Plant Garden Offsite- North Park Village Nature Center
Week 3	Prairie Ecology	-learn about plant-animal interactions by conducting pollination observations on native prairie plants	CBG- Dixon Prairie Off-site- Somme Prairie
Week 4	Woodlands and Restoration	-create an experiment that compares earthworm abundance in a restored woodland to an area dominated by invasive species	CBG- McDonalds Woods Offsite- Ryerson Woods
Week 5	Wetlands and Watersheds	-compare the health of the Skokie River to the CBG Lake by using macro-invertebrates and chemical tests as indicators	CBG- CBG Lake and Skokie River Offsite- Volo Bog
Week 6-Week 8	Independent Research Projects	-research project topic and create experimental design, conduct research -present independent research projects	CBG-all locations

Table 1. Weekly themes and example lessons of the 2007 College First Curriculum.

restoration areas. Consequently, this program allows youth to learn about native ecosystems using a hands-on approach, see scientific research in action, and engage with community members, ultimately gaining the knowledge and skills to address environmental issues and challenges. In addition to daily instruction and mentorship, students are asked to develop a research project of their choice and present their findings at the end of the program.

Youth's Learning in the Program

Data that were collected and analyzed during one of the summers (2007) provide evidence for the students' learning about native ecosystems and its impact on their environmental literacy (Danon, 2008). Students increased their ecological knowledge about local ecosystems and gained an increased understanding of scientific practice. They also improved their attitude towards the environment, commonly referred to as environmental concern (Kaiser, Wolfing, & Fuhrer, 1999). These changes were captured by various surveys and embedded assessments, including pre- and post-knowledge assessments, attitudinal surveys, as well as in-class observations, journals, and analysis of final projects.

Students were asked a number of pre- and post-questions related to ecological content knowledge. For example, students were asked to define an invasive species. On the pre-program knowledge assessment many students left the question blank or gave answers such as, "plants that kills better/more useful plants," "an invasive species bullies the other species," or "when they attack the other plants and not make them grow." Students gave more scientific and ecologically sophisticated answers on the post-knowledge assessment. Examples of post-answers to the same question include: "invasive species - non native species that colonizes an area and out competes natives since they have no predators;" "an invasive species is a plant not native to the region, that comes and takes over the land, will come back year after year." Students were also asked to give an example of invasive species before and after the program. The majority of students left the question blank in the pre-assessment, but offered answers such as "buckthorn" or "garlic mustard" on the post-assessment. Throughout the summer program invasive species like buckthorn and garlic mustard were used to discuss local ecological issues. Thus, in general, students were more specific when answering post-assessment rather

Figure 1. College First participants using the skills they had gained in the program to identify plants in the remnant Somme Prairie.

Figure 2. College First students doing a comparative study on the CBG wetland systems.

than pre-assessment questions, and at times offered examples that related to their experiences over the summer program.

Not only did students show their increased understanding in assessments, but they also recognized themselves that their knowledge of science was improved. For example, Mary exclaimed, “I have learned more this summer than I learned all year in science class!” and Octavio commented, “This program has helped to improve my grades. My College First instructors have taught me about botany, what is a wetland, what is a prairie, and what is the difference between a savannah and a forest.”

As noted earlier an important part of the program was the students’ own projects (Figure 3). The projects were scored based on a rubric that included attention to asking a scientific question, developing an experimental methodology, identifying materials and supplies needed, carrying out the experiment and collecting data, analyzing data, and drawing a conclusion. Titles of some of the research projects that received the highest scores were: “What pollinates *Penstemon digitalis*?” “Genetic diversity of Hill’s Thistle;” and “*Medicago sp.* and *Brassica juncea* seed germination.” Students whose research projects were related to their mentors’ (CBG staff) expertise tended to score higher than students with research projects unrelated to the mentor’s specialty. Thus, guidance that students probably have received from their mentors made a difference in the quality of their work.

In addition to working with their mentors students also had the opportunity to learn about environmental careers guest lecturers (Figure 4). In a pre-post assessment students showed their increased knowledge regarding environmental careers. On average, College First students could list 50% more environmental science careers during the post assessment and were more specific in the types of careers compared to their pre-assessment answers. Students included positions like plant conservation scientist, geneticist, wetland ecologist, restoration ecologist, urban ecologist, biogeochemist, environmental lawyer, and soil ecologist after the program. Robert said, “Before this, I didn’t know anything about what a geneticist does. It really helped me understand how he works and thinks. After College First I want to pursue a career in science, like zoology or genetics.”

Lauren Umek, Urban Ecology Project Coordinator and Instructor for the Environmental Science Program at DePaul University and one of the guest lecturers, was born and raised in Chicago and has done ecological restoration in local neighborhoods for years. She spoke to the 2007 College First students about the invasive species *Rhamnus cathartica* and how it alters ecosystem functions. College First participants teamed up with Umek and DePaul undergraduate and graduate students to collect data on nonnative earthworm (*Lumbricus spp.*) abundance in woodland ecosystems. Students unanimously expressed that the visits by the guest lecturers were among the best parts

Figure 3. College First students work in the research lab (right) and explain their research project to fellow College First participants (left).

of the program. Their impact included helping alleviate students' fears toward certain ecosystems. While conducting an experiment with DePaul graduate and undergraduate students, Shayla was heard saying: "I picked up the worms with my fingernails! Today was a good day." Guest lecturers, like Umek, facilitated connections between students and actual contexts, issues, and projects that became the foundation of the students' learning.

Moreover observations revealed that students had a pre-existing fear in relation to particular local ecosystems. When asked to articulate their fears, students expressed feelings of trepidation towards elements of woodland ecosystems, such as, insects, spiders, mice, darkness, and characters from movies, such as *The Blair Witch Project*. Such fears were evident while the students were walking through a pathless wooded area of McDonalds Woods at CBG and the woods surrounding the Somme Prairie. Students expressed sentiments of discomfort when walking through wooded areas but seemed relaxed when required to cross a highway in order to get to the woodlands. When students were asked whether they had a greater fear in relation to the woodlands or crossing the highway, the majority of students answered "woodlands." Perhaps these fears are rooted to the youth's feelings that forest preserves and parks in their neighborhoods are unfamiliar or unsafe places. Some Chicago neighborhoods also have urban legends that one would get hurt if he/she went off the paved path of a forest preserve. Stories like these are usually passed along to younger generations (Umek, 2008, personal communication).

Figure 4. Lauren Umek, Urban Ecology Project Coordinator at DePaul University (left) and Jim Steffen, restoration ecologist at Chicago Botanic Garden (right) show students what they do.

Finally, in terms of the students' attitudes towards the environment, there was not any significant change between pre- and post-assessments as other programs have shown (e.g., Project Stewardship, 2001; Farmer, Knapp, & Benton, 2007; Barney, Mintzes, & Yen, 2005; DiEnno & Hilton, 2005; Kruse & Card, 2004; Pooley & O'Conner, 2000). One explanation may be that students who enrolled in the program had already a high concern for the environment to begin with and, thus, there was no room for any significant improvement. Another explanation may be students' pre-existing fear of woodlands. A recent study that assessed the impacts of environmental education on environmental awareness of urban students, taking socioeconomic status into account, suggested that improvement in local environmental awareness appeared only among students living in high socioeconomic neighborhoods (Fisman, 2005). Fisman defines environmental awareness as the children's awareness of "form and features" in their environment, and suggests that this trend is caused by lack of opportunities for children growing up in economically challenged neighborhoods to explore natural areas because of fears about personal safety.

Concluding Thoughts

Overall, students who participate in College First demonstrate improvement in aspects of environmental literacy. As the need for an environmentally literate citizenry amplifies, this program provides encouraging results. Its curriculum, developed from a place-based philosophy with an ecological focus, contributes to the improvements of participants' understanding of environmental issues, which is an essential component in dealing with the increasingly complex environmental challenges that face modern urban societies.

Thus, College First benefits urban youth in important ways. One way in which it may be strengthened is going beyond discussing the environment in the Chicagoland region as a place where humans interact with ecological systems, and encouraging students to examine the cultural, social, economic, and political complexities that influence ecological processes as well (Cole, 2007; Disinger, 2001). So far, the curriculum used does not touch upon the history of land use and modern agricultural practices of the greater Chicagoland region, and its main focus is on common, rare, and invasive organisms, making it *ecologically place-based*. Having a stronger connection to the participants' places and discussing their fears as well as solutions may maximize concern for the environment. In addition, calling upon students' everyday experiences and discourses and incorporating them into lessons may make the program more meaningful to the students. Promoting an ecologically place-based program that looks at the functions of local Illinois ecosystems but also fosters an underlying theme that concentrates on environmental issues in participants' neighborhoods could prove much more beneficial.

Perhaps future programs need to put more emphasis on incorporating conservation projects and community members who address environmental issues relevant to participants' neighborhoods. Knowledgeable community experts who link safety and ecological restoration may be a needed addition to urban environmental education programs. Making a conscious effort to include educators who were raised in backgrounds similar to the participants', offer a local perspective, and consequently serve as role models may be an effective strategy for building stronger environmental education programs. Not only will these environmentalists be role models but they will also be informal educators who support the place-based philosophy through their expertise in local environmental issues, content, and skills.

References

Athman, J. & Monroe, M. (2002). *Elements of effective environmental education programs. School of Forest Resources and Conservation.* University of Florida, Recreational Boating and Fishing Foundation.

Athman, J. & Monroe, M. (2004). The effects of environment-based education on students' achievement motivation. *Journal of Interpretation Research, 9*, 9-25.

Barney, E, Mintzes, J & Yen, C. (2005). Assessing knowledge, attitudes, and behavior toward charismatic megafauna: The case of dolphins. *The Journal of Environmental Education*, *36*(2), 41-55.

Basso, K. (1996). Wisdom sits in places. In S. Feld & K. H. Basso (Eds.), *Senses of Place* (pp. 53-150). Santa Fe, NM: School of American Research Press.

Danon, E.D. (2008). Ecological education for urban youth: Promoting environmental literacy through a place-based curriculum. *Unpublished masters thesis.*

Burney, D.A., & Dubey, E.M. (2006). Growing people: Community-based career development opportunities working with plants. *Plant Talk, 43*, 46-47.
Cole, A. (2007). Expanding the field: Revisiting environmental education principles through multidisciplinary frameworks. *The Journal of Environmental Education, 38*(2), 35-44.
Dewey, J. (1902). *The School and Society.* Chicago: Southern Illinois University Press.
DiEnno, C., & Hilton, S. (2005). High school students' knowledge, attitudes, and levels of enjoyment of an environmental education unit on nonnative plants. *The Journal of Environmental Education, 37*(1), 13-23.
Disinger, J.F., (2001). K-12 education and the environment: Perspectives, expectations, and practice. *The Journal of Environmental Education*, *33*(1), 4-11.
Evan, C., Abrams, E. Reitsma, R., Roux, K., Saimonsen, L. & Marra, P. (2005). The Neighborhood Nestwatch Program: Participant outcomes of a citizen-science ecological research project. *Conservation Biology, 19,* 589-594.
Every Block, Chicago. (2005-2008). Recent crimes reported by the police department. Retrieved February, 2008, from http://chicago.everyblock.com/crime/
Fisman, L. (2005). The effects of local learning on environmental awareness on children: An empirical investigation. *The Journal of Environmental Education, 36*, 39-50.
Geist, C., & Galatowitsch, M. (1999). Reciprocal model for meeting ecological and human needs in restoration projects. *Conservation Biology*, *13*, 970-979.
Godbolt, C. (2006). *Noho a kupa: Developing a Hawaiian sense of place.* Unpublished masters thesis, University of Hawaii, Manoa.
Kaiser, F.G., Wolfing, S. & Fuhrer, U. (1999). Environmental Attitude and Ecological Behavior. *Journal of Environmental Psychology*, *19*, 1-19.
Kruse, C., & Card, J. (2004). Effects of conservation education camp program on campers' self-reported knowledge, attitude, and behavior. *The Journal of Environmental Education*. *35*(4), 33-45.
Liberman, G., & Hoody, G. (1998). Closing the Achievement Gap. San Diego, CA: State Education and Environment Roundtable.
Louv, R. (2005). *Last Child in the Woods: Saving Our Children From Nature Deficit Disorder*. New York: New Algonquin Books.
Orr, D. W. (1992). *Ecological literacy: Education and the transition to a postmodern world*. Albany, NY: State University of New York Press.
Orr, D. W. (1994). *Earth in mind.* Washington DC: Island Press.
Pooley, J., & O'Conner, M. (2000). Environmental education and attitudes: Emotions and beliefs are what is needed. *Environment and Behavior, 32*(5), 17-22.
Project Stewardship. (2001). *Project stewardship: A conservation education program providing hands on stewardship experiences for secondary students*. The Nature Conservancy of Hawaii.
Sobel, D. (2004). *Place-Based Education: Connecting Classrooms & Communities*. Great Barrington: The Orion Society.
Warren, K., Sakofs, M. & Hunt, J.Jr. (Eds). (1995). *The Theory of Experiential Education.* Boulder: Kendall/ Hunt Publishing Company.
Xin, M & Bateson, D. (1999). A multivariate analysis of the relationship between attitude towards science and attitude towards the environment. *The Journal of Environmental Education, 31*, 27-32.

Acknowledgements
Many thanks to the 2007 College First participants for teaching me so much about urban environmental education. The program study would not have been possible without the support of a number of people at the Chicago Botanic Garden and Northwestern University.

From Observations to Poetry: Helping Students Write About Nature

Jean A. Mendoza
University of Illinois at Urbana-Champaign

One of the most important dispositions we can foster in children is the disposition to observe the world closely. Observation puts sensory capacities to work, gathering data that can be used to make sense of experience. Communicating effectively about observations has been essential for human survival. Helping children convey information from their observations to others is a key part of science education.

This article presents activities I have seen two experienced educators use to help their students communicate with others about things they have observed. Susan Post of the Illinois Natural History Survey, who trains teachers and community members, is an editor and published author who often uses observations of the natural world as the basis of her writing. Marjorie Klein taught kindergarten and first grade in Champaign, Illinois for many years until her retirement; she specialized in facilitating children's in-depth investigations of everyday things – corn, bicycles, buildings, and so forth. Children in Marjorie's classes often wrote about what they observed.

The activities described here start by engaging children in the act of closely observing then segue into a process of communicating about their observations. The final activity is the creation of nature poems using similes and other descriptive words.

Starting with Observation

One especially popular activity in Susan Post's workshops starts with small bags of natural objects that are remarkable in some way. It requires some preparation but the bags can be used year after year if stored properly. They can be called *mystery bags, treasures from nature*, or something similar.

Mystery bags are small bags of natural objects that are remarkable in some way, and can be used to help students observe nature.

Preparing the bags

- Collect a variety of relatively durable natural items from outdoors, enough for one object per student. If your school has a natural history collection, you might borrow some pieces from it for the bags. These items might include: unusual leaves; nuts, dry seed pods or seed heads; fossils or unusual pebbles; cast skins of insects or snakes; galls from plants; an empty mud dauber nest; a chip from a tree gnawed by a beaver.
- Put each item into a small paper bag (lunch-size is good) and fold the top over.

Introducing the activity

- Pass the bags out, asking students to leave their bags closed until each of their classmates has one. Explain that each bag has something in it, and each student's task is to observe his or her object carefully to get as much information as possible about it in a short time.
- Point out that they might or might not recognize the objects inside. They don't have to know what an object is to do the task. In fact, *not* knowing can add mystery to the process!

Initial observations

- Ask the children to open their bags and remove and examine their items without talking. (Talking will interrupt others' thoughts about their own objects.)
- Encourage the children to pay close attention to their objects, using all their senses - though they should not taste their objects, but instead imagine what those objects might taste like.
- End this observation period after 30 seconds or so and move to the next step.

One of the best ways to become comfortable with writing about the natural world is to read good nature writing.

Generating lists

For elementary and middle school students, the next step is writing *scratch notes* about the objects in the bags.

- Make sure each student has paper and a writing tool. Tell them that the paper is for taking rough notes – also called scratch notes – about their objects.
- Ask the children to start listing words and phrases that describe their individual objects: appearance, smell, feel, sound, and other characteristics. If someone is focusing only on color, remind him or her to think about the texture and weight of the object, or sounds that come from it when shaken, and so forth.
- Let the children know that they do not need to worry about proper spelling or neatness of handwriting for this part of the activity. The point is to get ideas down on paper.
- Give students about 1-3 minutes for this part of the activity, depending on how quickly the children are able to write and how engaged they are.

Sharing observations

If your class is not familiar with the concept of the simile - a word image that compares one object to something else using the words "like" or "as" – and if you do not want to introduce a lesson about similes at this time, the class can have a fruitful discussion about what they have observed. Have children take turns showing the class their objects and reading some of the words on their lists aloud. Children may especially like having a chance to guess what some of the items are.

If the children in your class know about similes, they are probably ready to use the list of prompts Susan Post gives to her workshop participants.

Communicating Through Similes

When Susan Post directed the mystery bag activity, she provided a template for a series of similes related to each of the senses. In fact, the task was for all participants to imagine themselves "speaking for" whatever was in their bags. Susan's list looked like this:

I look like …
I feel like …
I smell like …
I taste like …
I sound like …

You can hand out the list as a worksheet, or write it on the board for all to see.

- Explain to the students that the next step is turning their observations into similes that tell more about their objects than a simple list of words can say. (Note: Some people may want to substitute "as" for "like." "I look as brown as a hamburger" may express an idea better than "I look like a hamburger," for example.)
- Allow 5-10 minutes for this part of the activity, depending on how engaged the children are.
- When the time is up, invite children to read their simile lists aloud to the class.

Students often enjoy seeing the objects in others' bags and hearing their classmates' similes. It's a good idea to leave time for discussion: What do they think their objects are? Be prepared to tell them if they can't guess.

Turning Nature Imagery into Poems

The next step is to create poetry from the lists of similes or descriptive words. A couple of approaches are possible. One works well for students who have some experience with writing poetry. The other is well-suited to children – especially the younger ones – who are not familiar with creating poems.

Susan Post asked her workshop participants to create poems that told stories about their mystery bag objects using the similes from their lists. They could choose any form of poetry. Some were comfortable working with rhymes or with structures such as sonnet, haiku, or diamante. Others used free verse that incorporated their similes and other imagery. The same range of preferences is likely to show up in an elementary or middle school class.

Some students may want to create long, detailed story-poems that use many words in addition to their similes. Others may want to be brief. Point out to the class that what's important is creating a story or message about the object so that others can picture it. They will be using words to substitute for actually seeing and touching the objects.

One very simple possibility for some elementary and middle school students is to reorganize their simile lists into *riddle poems*. For example:

I sound like a rattlesnake.
I'm skinny and curved like a wavy line.
I smell like medicine that nobody wants to taste.
I feel bumpy like beads in a necklace
And I'm as brown as barbecue sauce.
What am I?
(Locust pod)

Fill-in-the-blank is another format that can help children focus if they are not familiar with poetry or if they have not done much other writing. When veteran educator Marjorie Klein taught kindergarten and first grade at University Primary School in Champaign, she provided templates to help children bring their thoughts together to write about things they had studied in-depth. For example:

Corn, corn, that _____ corn.
It ____ and it ____,
That ____ corn.

Even if they did not know the meaning of adjective, children easily understood that the first blank required a word (or words) that provided some sensory detail about the subject of the poem. The next two blanks can take verbs, short similes, or other descriptive phrases. The final blank calls for another descriptive word about the subject. Some students like to write as if they are talking to the subject of the poem, substituting "you" for "that."

One of the most important dispositions we can foster in children is the disposition to observe the world closely.

Students of any age who feel uncomfortable writing poetry may be surprised at what they can create using a format like this one, if they know that it is flexible and meant only to suggest where to put their ideas. Here are some examples:

Snake skin, snake skin, that tan snake skin.
It feels like paper and it smells like the woods,
That delicate snake skin.

Locust pod, locust pod, you rattling locust pod.
You smell green and you look wavy,
You seedy brown locust pod.

Extending the Experience

As Susan Post points out in her workshops, one of the best ways to become comfortable with writing about the natural world is to read good nature writing. Some examples of nature poetry include books by Carolyn Lesser and Thomas Locker, as well as *Song of the Water Boatman* by Joyce Sidman (illustrated by Becky Prange) and *Vulture View* by April Pulley Sayre (illustrated by Steve Jenkins). Other good nature writing for children – not necessarily poetry – includes *Ice Bears* by Brenda Z. Guiberson; (illustrated by Ilya Spirin) and *Chameleon, Chameleon* by Joy Cowley (photographs by Nic Bishop).

Listening to classmates' nature writing is another important way to foster children's dispositions to be close observers of the world. For parents, seeing what their children write enhances their understanding of what goes on in school. Creating a prominent classroom or hallway display of the writing students do in response to their mystery bags can serve as a bridge between your science program and home. The display can be changed throughout the year, with new student writing added to show progress in the children's observation and communication skills, and evidence that they are learning and growing.

Snow Rollers

R. James Vavrek[1] and Allen J. Pokracki[2]
[1]Henry W. Eggers School, [2]Scott Middle School

February 11, 2003 - Lincoln, Illinois
Much of central Illinois experienced log-shaped snowballs. They ranged in size from golf ball to over 30 inches (76 cm) long and 1 foot (31 cm) tall. The local media reported that snow rollers were also documented across many parts of Indiana and Ohio.

January 25, 2005 - Woodward, Oklahoma
Hundreds to thousands of mysterious cylindrical, hollow snowballs were discovered in rural fields and open areas in town and the county, at many locations during the early morning hours.

January 10, 2008 - Hastings, Nebraska
Snow rollers were discovered on lawns, open fields, school football and baseball fields, and other open areas in parts of central Nebraska and north-central Kansas.

Introduction

Snow rollers are considered rare meteorological events. The majority of individuals living in snow-prone areas have never seen one. Since they are so unusual it is likely that their formation goes under-reported, partially due to confusion as to what they are. The purpose of this paper is to allow Earth science students, science instructors, and other interested individuals the opportunity to learn about this rare meteorological event. Most of the time snow rollers appear as rolled-up snow bundles with hollow space in the center (Figure 1). Snow rollers occur under natural conditions and contrary to opinion are not formed by aliens or mysterious circumstances. They range from golf ball to 30 gallon (114 l) drum size. Snow rollers are fragile, forming during the night-time and early morning hours. They fall apart or collapse when sunlight strikes them or begin to melt when air temperatures rise or fall changing their composition. This paper will define snow rollers, describe their appearance, formation, superstitions, and provide photographs of their existence.

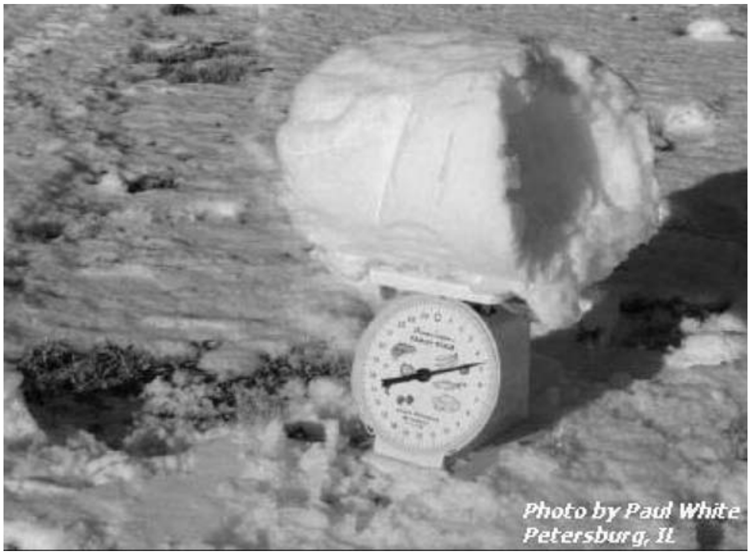
Definition

A snow roller is defined as a cylindrical mass of snow, predominantly found in mountainous or hilly terrain. They occur when snow, moist enough to be cohesive, is blown by wind down-slope or across land until it becomes too large for the wind to propel it any further. In some instances, they grow to the size of 3 feet or a meter in length and 6.5 feet (2 m) in circumference. Most diameters are 12 inches (31 cm).

Formation

Although most form in hilly terrain, they also form in open areas after the passage of a winter storm which produces strong gusty winds. Formation begins when wind suspends chunks of snow out of a snow field and slides or rolls it. In hilly terrain, gravity can move snow rollers as when a snowball, such as those that fall from a tree or cliff, lands on steep hills and begins to roll down hill. Wind provides this momentum in open terrain. They then continue to roll, bounce, and tumble, like snowy tumbleweeds. As snow rollers roll along, they pickup wet snow material along the way, in much the same way that snowballs are used in making snowmen. Additional snow adheres to this seed (chunk of snow) and the snow roller grows until

Figure 1: Snow roller was nearly 11 inches (30 cm) inches in diameter. Photograph by Paul White, used with permission.



combination of temperature, humidity, wind speed, terrain and of course, snow. There are four ingredients needed to produce snow rollers, they are:

First, the ground surface must have an icy, crusty snow, on which new fallen snow cannot stick.

Second, on top of this, about an inch or two (2.5 - 5.0 cm) of loose, wet snow, the sticky kind that makes for good snowballs, must accumulate with a temperature near the melting point.

Figure 2: Snow roller weighing nearly 5 lbs (2.3 kg). Photograph by Paul White, used with permission.

it finally becomes too heavy (Figure 2) or large for the wind or gravity to push it any further, it butts up against obstacles like vegetation, or encounters a slight incline in terrain, leaving behind a characteristic trail linking snow rollers origin to its final resting place (Figures 3 and 4).

Unlike snowballs made by people, snow rollers are hollow in the center since the inner layers, which are the first to form, are weak and thin compared to the outer layers which can easily be blown along, leaving what looks like a doughnut, rolled up carpet, or a jelly roll. The hollow inside of snow rollers are the result of centrifugal force that pulls moisture in the rolling balls to the outside. They resemble miniature bales of hay or logs.

People who have seen snow rollers are puzzled by their occurrence and have no logical explanation for them. Some individuals envisioned them as winter's version of crop circles, the work of winter spirits, or just a curious part of nature. Norwegian Ronald Amundson reported seeing cylinders of snow when he journeyed to the South Pole in 1911. Paul Siple, noted Arctic explorer, recorded balls of frost about 2 inches (5 cm) across on his South Pole trips. On January 29, 2000, Kansas State University's Weather Data Library documented snow rollers as large as 30 gallon (114 liters) drums in Russell County, Kansas. Snow rollers require just the right

Third, the air temperature should be near freezing, from 28° - 34°F (-2.2° to 1.1°C). If temperatures rise or fall, the characteristics of the ice crystals will change and they will collapse.

Fourth, a force must be present to build momentum. In open terrain a strong wind, usually 25 mph (40 km/hr) or higher, is needed to move and produce a snow roller, but not so strong as to roll them too fast, blowing them apart. On hilly terrain, the force of gravity or a combination of gravity and wind may provide the force needed.

Conclusion

In the realm of meteorology, snow rollers are somewhat unique and under-reported. Conditions necessitate specific temperature, humidity, wind speed, slope, and snow (water to snow ratio) that are categorized as packing. Snow rollers are frail and tricky to transport. Their survival depends on a fairly constant temperature and the absence of melting. Snow rollers have the characteristics of being log-shaped, and predominantly hollow. Because they form quickly, one would have to be exceedingly lucky to view the formation of snow rollers.

A sloped terrain provides the ideal place for formation, however, a beveled street or parking lot under the right conditions, can allow for smaller

Figure 3: Snow rollers near Lincoln Christian College near Lincoln, Illinois. Snow rollers move in an easterly direction. Photograph by Chris Geelhart, National Weather Service, Lincoln, Illinois; used with permission.

formations. Most people who live in snow prone areas of the country have never seen one in their lifetime. What is interesting is that snow rollers occur during the night-time or early morning hours possibly due to the more steady nature of winds during those hours. Snow rollers attain a size of 1 foot (31 cm) in diameter, a center that is hollow, and as long as 4 feet (120 cm). In some locations, hundreds to thousands may form in open or declining terrain.

References

Brutsaert, W., (1991) *Evaporation into the Atmosphere: Theory, History, and Applications*, Kluwer Academic Publishers, Boston, MA. pp 299.

Geer, I. W., editor, (1996) *The Glossary of Weather and Climate with Related Hydrologic and Oceanic Terms*, AMS, Boston, MA, pp. 272.

Lyons, W.A., (1997) *The Handy Weather Answer Book*, Visible Ink, Accord Publishing Ltd., pp. 397.

Snow Rollers in Central Illinois (2007) National Weather Service Forecast Office. http://crh.noaa.gov/ilx/events/roller.php.

Snow Rollers formed on Thursday (2008). National Weather Service Forecast Office. http://www.crh.noaa.gov//?n=news_13.

The American Red Cross, NWS/NOAA, (2001): "Winter Weather Definitions," pp. 11.

Acknowledgements

We greatly appreciate the following individuals who have given their time and expertise for improving this paper, they are: Jim Allsopp, warning coordination meteorologist, NWS, NOAA, Romeoville, Illinois; Llyle Barker, science and operations officer, NWS, NOAA, Lincoln, Illinois; Wendy L. Grebbien, science education, educator, Carlsbad, California; and Jennifer J. Vavrek, math, science, and gifted,and talented instructor.

Author Information

R. James Vavrek (RJVavrek@hammond.k12.in.us) is a science instructor at Henry W. Eggers School in Hammond, Indiana. Allen J. Pokracki (AJPokracki@hammond.k12.in.us) is a science instructor at Scott Middle School in Hammond, Indiana.

Figure 4: Snow rollers in Kansas. This photo was taken four miles (6.4 km) west of Jewell, Kansas by Ms. Annette Saint. Photograph used with permission.

Conservation of Energy: Teaching Environmental Science Using Green Roofs

Abha Singh
Western Illinois University

As we move deeper into the twenty-first century, population increases and subsequent development are placing larger demands on the stability of our natural environment. Sprawling urban areas are replacing habitats of a wide variety of plant, animal, and other organisms and the ever growing impervious pavement has led to erosion of the land. Although progress has been made to reduce point source chemical depositing, our streams and rivers, originally clear, are now becoming increasingly opaque. Some states have been especially changed with over 99% of the habitat being turned into farmland and urban areas, a major contributor to algal blooms and subsequent fish kills in the Gulf of Mexico (Environment Protection Agency, 2005).

In an effort to sustain current supplies of natural resources for future generations, policy makers, economists, engineers, and the general public need to shift toward a *triple bottom line* paradigm. Triple bottom line means organizations will measure their impact on economics (profitability), social conditions (jobs, culture, equity, human rights), and the environment (human and ecological health) before making any organizational decisions. Decisions should be made while considering economic, environmental and social impact. This paradigm should not only be utilized in global or national policy making, but also in local and personal decision making (Elkington, 1998). Sustainable technologies such as hybrid vehicles, geothermal heating and cooling, solar energy, and wind are beginning to play a greater role as these technologies reduce the environmental and social burden of conventional technologies (Michigan State University, 2001). This example will explore another alternative technology that is gaining prominence - green roofs.

A green roof is a collection of plants on the top a building (see Figures 1 and 2). Green roofs are an increasing technology for urban applications. A green roof can conserve the energy used by a building through increased insulation values. The vegetation and growth media help mitigate storm water runoff and reduce pollution both in the rainwater and surrounding air. The vegetation can also reduce the temperature on the roof, which helps in reducing the heat island effect. A green roof protects conventional roofing systems and may double the service life of the roof (Dunnette & Kingsbury, 2002). Ecological and aesthetic values of urban areas can be increased with the installation of a green roof. Furthermore, Tennessen and Cimprich (1995) report that a green roof has physiological benefits for building occupants.

This article will provide information and give guidelines on how students can research information to compare the triple bottom line of a green roof and a conventional roof. Materials for the green roof can be determined and the environmental impact can be assessed by conducting a life cycle assessment and storm water analysis. Economic feasibility can be determined by calculating annual energy savings and a payback period analysis. Social and further environmental considerations can be identified and analyzed. Finally, students can measure how much energy will be conserved by using a green roof.

To sustain current supplies of natural resources for future generations, policy makers, economists, engineers, and the general public need to shift towards a triple bottom line paradigm.

Figure 1: A Green Roof on a Building in Frankfurt, Germany.
Photo source: Environmental Protection Agency (http://www.epa.gov/heatisland/resources/pdf/GreenRoofsCompendium.pdf), used with permission.

What can be done?

In this section I will demonstrate the methodology that can be used to arrive at the actual design. The first step was to determine a project site.

Location

According to Greenroofs.com (2004) and the Australian Department of Environmental Heritage (2005), the first thing to find out about a green roof is its location. It would provide a great opportunity for an installation since the design would not have the same constraints as an existing roof. It could also be easier to account for public access in the building design. After a walkthrough of the building, the rooftop geometry is sketched. The rooftop capacity is determined. Easy access to the green roof is important for both maintenance and visibility to attract the public. A great advantage to putting an installation on this site is the research opportunities.

Methods of Green Roof Design and Components

A green roof can be designed for a new building or used to retrofit an existing building. Green roofs can be placed on almost any angle of slope, yet some locations require more design components to account for the geometry of the roof (Peck & Kuhn, 2000).

Structures still in the design phase are excellent opportunities for implementing a green roof. The rooftop can be planned accordingly, with enough open space and adequate sunlight. Since the building can be designed to incorporate a green roof, a loading capacity suitable for the chosen type of green roof can be provided. This also allows for a purer, more efficient cooperation between the two functions of a green roof which are protection of the building and habitat for plants and animals (Greenroofs.com, 2004).

A green roof can be added to an existing building, although it is limited to the constraints of the structure. A building may have many obstacles on the rooftop, making it difficult to prepare for a green roof. The weight capacity of a rooftop is an important thing to consider when retrofitting a building for a green roof installation. While additional structural support may be added, it is a difficult process and a lighter weight green roof would be recommended. The available capacity is a major factor in determining what type of green roof can be installed (Dunnette & Kingbury, 2002).

Types
According to Greenroofs.com (2004), the two main green roof categories are *intensive* and *extensive*. The building chosen often dictates the type of green roof that may be installed, the main reasons for this being the weight capacity and geometric suitability.

Intensive green roofs incorporate a wider variety of vegetation, including larger plants and even trees. The larger plants require more soil for their root systems, which adds a considerable amount of weight to the green roof. This category usually must be planned for in the design of a new structure as the required roof capacity is great.

Extensive green roofs are not intended for recreation, or to accommodate the weights of trees. Generally, these roofs cost less than intensive green roofs and can be retrofitted onto existing structures.

Basic Components
There are many options in green roof designs, though some elements are present in all installations (Figure 3). Basic components include insulation, waterproof membrane, root barrier, drainage layer, filter fabric, growth medium, and vegetation. The following discussion explores the extensive green roof type, since it was chosen for this project. Components not discussed here include irrigation systems and leak detection systems (Peck & Kuhn, 2000).

Insulation
A green roof can increase the insulation value of a roof through the vegetation and growing medium, but an insulation layer can enhance this benefit. Insulation is often a component of traditional rooftops, making it optional when retrofitting an existing building for a green roof (Environmental Protection Agency, 2005).

Waterproof Membrane
The waterproofing of a roof is important in traditional buildings, but has a greater significance in respect to green roofs. A green roof essentially stores water above the building, while traditional roofs only have water on them during rainstorms. This almost continuous presence of water makes a roof more prone to water damage if any leaks are present. However, with proper installation of waterproofing systems, a green roof may decrease the risk of leaks. Common waterproof membranes include PVC,

Figure 2: Green Roof on the Seattle Public Library. Photo source: Environmental Protection Agency (http://www.epa.gov/heatisland/resources/pdf/GreenRoofsCompendium.pdf), used with permission.

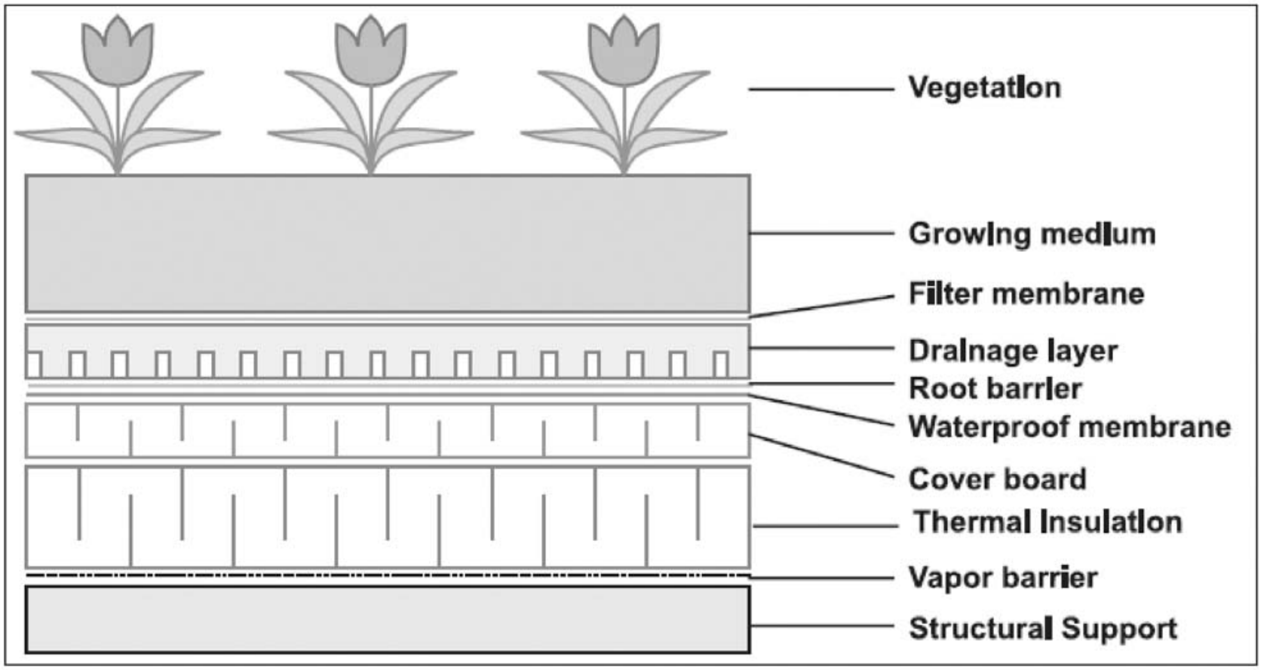


Figure 3: Typical Layers of a Green Roof. Image source: Environmental Protection Agency (http://www.epa.gov/heatisland/resources/pdf/GreenRoofsCompendium.pdf), used with permission.

EPDM rubber membranes, and thermoplastic polyolefin (TPOs) (Chin, 2000).

Root Barrier

The root barrier protects the traditional roof components from roots breaching the structure. Some layers present on rooftops are organic, which would be exploited by the roots. Root barriers can be physical or chemical. Chemical root barriers prevent further growth by killing the immediate root material. Physical barriers are not organic, making the roots resistant to breaching (Peck & Kuhn, 2000).

Drainage Layer

A drainage layer is necessary to direct excess water off the rooftop, especially for flatter roofs. Drainage layers may not be needed when a rooftop slopes more than five degrees. This layer also serves as a water retention area for the plants and provides aeration for the roots. Granular materials such as pumice, scoria, and expanded shale can be used as a drainage layer which also provides extra room for root penetration. "Egg-carton" drainage sheets are manufactured with dimples that resemble egg-cartons. These systems provide storage in the dimples, drainage through small perforations, and drainage channels between the dimples on the underside. This type of drainage layer is often integrated with other layers as part of a modular green roof system (Huff & Angel 1990).

Filter Fabric

The filter fabric serves as protection from erosion due to water drainage. This layer is often directly below the growth media when granular drainage systems are employed. It may be on the underside of a dimpled drainage layer system (Peck & Kuhn, 2000).

Growth Medium

The growth medium constitutes a large weight component in extensive green rooftops. Common growth media may include expanded clay or slate to improve water retention. Volcanic rock may help in reducing the overall weight (Peck & Kuhn, 2000). Topsoil is recommended for new installations to promote new growth in the harsher rooftop conditions.

Vegetation

Plants on a green roof need to be robust survivors, since the conditions on a roof top are harsh. There is often high sun exposure, high winds, and long, dry periods. The local climate should be considered when deciding on vegetation. The plants should be chosen from native varieties or plants common to alpine areas. Plants on an extensive green roof should be perennials to reduce the amount of maintenance needed on the rooftop (Temple University, 2005).

The costs and benefits of the proposed green roof can be determined by analyzing environmental impact through a life cycle assessment, storm water runoff averted, and energy savings via an energy audit. A payback period analysis can be conducted to determine the feasibility of the project (Temple University, 2005).

Life Cycle Assessment

As with all life cycle assessments, assumptions regarding longevity of product can be made. The assessment can assume a conventional roof system would last twenty-five years before needing replacement and a green roof would last fifty years before needing replacement. According to Dunnett and Kingsbury (2002) these are not extraordinary assumptions. They indicate that a conventional roof will last approximately fifteen to twenty years and a high quality (expensive) conventional roof will last thirty to fifty years. By comparison, an extensive green roof should last anywhere from fifty to one hundred years (Dunnett and Kingsbury, 2002). Similarly, Peck and Kuhn (2000) indicate that green roofs have more than double the life expectancy of conventional roofs. As illustrated by these estimates, the assumptions of the lifespan of the conventional roof are more liberal than that made for the lifespan of the green roof. It will also be assumed that roof replacement will consist of removing the waterproofing layers and insulation down to the roof deck.

Storm Water Analysis Methods

To determine the water retention requirements for the green roof, design storms (storms which do not exceed the design load of a storm drainage system) for an area were analyzed. A water budget analysis can be performed for each design storm to predict the reduction in runoff that would occur due to the installation of the green roof. Rainfall enters the control volume and is contained until the maximum water retention of 1.5 inches is reached. The water is released from the control volume through evapo-transpiration and runoff (University of Wisconsin Milwaukee, 2005).

Energy Audit

The economic viability of a green roof rests solely on the savings in annual cooling and heating costs as a result of the green roof. This energy audit can begin with an initial walkthrough to gain understanding of the heating and cooling systems as well as the general building atmosphere. Next, heating and cooling bills can be obtained and annual reduction in electricity can be determined. Finally, reduction of costs will be determined by assuming 25% annual savings in electricity bills due to less heating and cooling, based on estimates provided by Temple University (2005) and the Environmental Protection Agency (2005) who estimated 20-30% and 20-70% annual savings respectively.

Average monthly cooling costs can be estimated by determining the average electricity cost (per month) during non-air conditioning months. This average cost of electricity per month is subtracted from each month during air conditioning use thereby determining cooling costs for each of the six months when the air conditioning unit is operating. Annual savings were taken as 25% of the six month cooling costs (Environmental Protection Agency, 2005).

Payback Period Analysis

The payback period can be determined by identifying the probable cost of installation of a new conventional roof and the cost of installation of the green roof. This can be done by calculating the area of both roof sections by manually measuring the roofs and crosschecking the measurements to the plans obtained from facilities management. Installation cost of a new conventional roof can be made by determining the cost of the roof in 1995 and the cost of similar roofs today (Ulrich, et al. 1991). Both figures will be used to generate a range for the payback period when considering replacement costs of the conventional roof. The cost of the green roof is determined by reviewing the literature regarding implementation costs of a retrofit less the cost of installation of the current roof which is already in place and will be used as the waterproofing and insulation layers for the green roof (Temple University, 2005).

Finally, a green roof would provide plentiful opportunity for research in the areas of storm water management, energy efficiency, biodiversity studies, and sustainable development. This is an exceptional opportunity for students. Green roof technology is in its infancy. It is believed that advancement in this field could have major repercussions on the future of urban development (Greenroofs.com, 2004).

Not only can students learn about the new alternative technology of green roofs, they can learn about energy conservation. This is an example of applying content to real life by having students research the costs of energy usage at home. They can estimate based on the criteria listed to find out what it would cost if a green roof were installed. Using research and data from energy usage will help them understand how energy conservation can be done by simple modifications at home.

References

Australian Department of Environment and Heritage. Retrieved 4/6/2005 from www.npi.gov.au/database/substance-info/profiles/90.html.

Chin, D. A. (2000). Water resources engineering. Upper Saddle River, NJ: Prentice Hall.

Dunnett, N. & Kingsbury, N. (2002). Planting green roofs and living walls. Portland, OR: Timber Press

Elkington, J. (1998) Cannibals with Forks: The Triple Bottom Line of 21st Century. New Society Publishers Gabriola Island, BC.

Environmental Protection Agency . Document reporting on heat islands reduction strategies. Retrieved 4/10/05 from www.epa.gov/heatisland/strategies/coolroof.html.

Huff, F. A. & Angel, J. R. (1990) Rainfall Frequency Atlas of the Midwest. National Weather Service.

Michigan State University (2001). Student greenhouse project: Mental health and well being. Retrieved on March 30, 2005 from www.greenhouse2001.msu.edu/research/.

Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander (1998). The view from the road: Implications for stress recovery and immunization. Journal of Envrionmental Psychology, 18(2), 113-140.

Peck and Kuhn (2000). Design guidelines for green roofs. Toronto: Environment Canada. Tennessen & Cimprich (1995). Views to nature: Effects on attention. Journal of Environmental Psychology, 15(1), 77-85.

Temple University. Document reporting on annual energy savings from green roof. Retrieved 4/10/05 from www.temple.edu/env-stud/seniorsem/section3C.htm.

Ulrich, Roger S., Robert F. Simons, Barbara D. Losito, Evelyn Fiorito, Mark A. Miles, and Michael Zelson(1991). Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology 11:201–230

University of Wisconsin Milwaukee (2005). Great Lakes WATER Institute Green Roof Project. Retrieved on April 5, 2005 from www.uwm.edu/Dept/GLWI/ecoli/Greenroof/ roofinstall.html

Greenroofs.com (2004). Green Roofs 101. Retrieved on April 20, 2005 from http://www.greenroofs.com/Greenroofs101/components.htm

Author Information

Dr. Abha Singh has a Ph.D. in science education from the University of Iowa, Iowa City. Her other major was environmental science. She serves as an assistant professor in Science Education and Elementary Education teaching both undergraduate and graduate courses at Western Illinois University (WIU). Part of her responsibilities includes supervising students and classroom teachers in field experiences. She also works with WIU Science Education faculty to conduct undergraduate environmental workshops in Project WILD and Project WET, to host the Illinois Regional Science Olympiad, and to conduct the pre-K-8 Science Update Conference. Her professional activities include working with grants, conducting in-service teacher workshops and courses for regional offices of education, and presenting at state and national conferences.

Middle School Students' Alternative Ideas on the Water Cycle

Hanna Kim
DePaul University

Abstract

The purpose of this study is to identify and address middle school students' conceptual misconceptions of the water cycle. Thirty-five seventh grade students from a public middle school in the Chicago, Illinois area were participants in this study. A questionnaire of seven open-ended questions was developed to assess student understanding of the topic studied. In some cases, more than one question, or a series of questions, was administered to better assess understanding of the concepts involved. The study centered on what students should know about the water cycle, as well as incorrect or incomplete prior knowledge. The results demonstrated that the students had varying degrees of understanding of the five concepts (the states of water, evaporation, temperature and humidity, condensation, and the water cycle process). However, most students had only partial knowledge of each concept, and could not articulate these concepts as a process of the water cycle at the end of the questionnaire. Several instructional suggestions for overcoming students' misconceptions were given, including confronting students with new information through carefully selected inquiry-based hands-on activities, engaging in small group discussions, and creating concept maps. The students' actual water cycle misconception lists found in this study can identify what types of ideas seventh graders actually possess, thereby providing invaluable information for middle school science teachers and pre-service teachers alike in addressing students' prior conceptions.

Introduction

When students begin a science lesson, we teachers expect that they will learn new concepts and gain understanding in response to our teaching. Many of us assume that if the student is paying attention and/or is motivated, they will simply learn what is being taught. In other words, we believe learning is the result of teaching. According to a constructivist perspective of learning that is based on Piagetian theory and the work of many other learning theorists (Ausubel & Hanesian, 1978; Atherton, 2005), learning occurs when children incorporate new concepts into the concepts that they already hold. In other words, the process of learning involves a cognitive change in which students must actively modify or reject their personal views in order to construct new concepts and theories. Part of a teacher's role is to create opportunities for children to add to their existing personal knowledge base.

Pre-existing knowledge is the foundation upon which new knowledge is constructed.

While paying attention to teaching and being motivated are both factors in learning, there is something even more important to be considered: what students already know (Henriques, 2002 & Sewell, 2004). Pre-existing knowledge is the foundation upon which new knowledge is constructed. New concepts are obtained only if they can be fitted to already existing knowledge. If the foundation is faulty or unstable, new knowledge may not stick. Analogous to constructing a building, if the foundation is not secure enough, new brick work may hold temporarily, but will not endure regardless of the perfection of the bricks or construction workers. In other words, new knowledge must be constructed properly or learning may not occur.

Importance of Study

Teachers must assess and identify what it is that children already know before they begin to teach. Student misconceptions about a given concept can, therefore, function as a starting point for instruction. When teachers are aware of student knowledge concerning a particular topic, they can begin to design lessons and activities that incorporate and challenge students' prior knowledge; however, merely challenging an idea does not guarantee that the idea will be changed. Teachers must engage learners in thinking by introducing a cognitive conflict - an idea that does not fit with their previous knowledge and which forces students to do something with the new information (Shymansky et al., 1998). If teachers are unaware of students' thoughts regarding a topic, the chance of creating that situation is low. Failure to design lessons in a way that takes into account students' prior knowledge may mean that the new topic being presented will not change their ideas, or will change them in ways that they do not desire, perhaps creating additional misconceptions (Fraser, 2000; Hellden & Solomon, 2004; Osborne & Cosgrove, 1983). Therefore, teachers should make sure that their lessons provide students with reasonable cognitive conflict(s) so that students may construct new knowledge while finding opportunities to correct previous misconceptions they might have had.

Studies have investigated children's ideas about the physical sciences (e.g., Driver, Guesne & Tiberghien, 1985; Stepans, 1994), but few studies have been conducted to understand specifically what children think about Earth science (Henriques, 2002). Previous research about students' misconceptions in Earth science can be classified into four subjects: the Earth and the Sun, seasons, air pressure, and water in the atmosphere (Schoon, 1995). According to National Science Education Standards (NSES) and Benchmarks for Science and Literacy (AAAS, 2003), students are expected to understand the water cycle and properties of water, including phase changes and cloud formation, in grades five through eight. Some studies assessing children's concepts of the water cycle have shown that middle school children hold many different notions about vapor, humidity, evaporation, condensation, and dew point (Dickerson & Karen, 2004; Henriques, 2002).

The purpose of investigating students' naïve/alternative/ intuitive ideas was to analyze their conception of the states of water, evaporation, temperature and humidity, condensation, and the water cycle process. This study identifies what types of ideas seventh graders actually possess, providing invaluable information for middle school science teachers in addressing students' prior conceptions. We wanted to know what students should know about the water cycle, as well as students' prior knowledge that is either incorrect or incomplete.

Procedures

The participants in this study were thirty-five seventh grade students (fifteen male and twenty female) from a public middle school located in Chicago. A questionnaire was developed, consisting of seven open-ended questions to assess students' understanding of selected water cycle system concepts. This questionnaire was based on five concepts concerning the water cycle, which had been included in the district's curriculum and taught to the students in grade seven during a period of approximately 90 minutes. The five concepts were as follows: changes in state, evaporation, temperature and humidity, condensation, and the water cycle process. Content area specialists reviewed each question and assessed them to ensure content validity. In some cases, more than one question or a series of questions assessed understanding of the concepts involved. This was done because at times, children appear to have a sound understanding of a concept, but further questioning may reveal that they actually do not understand the concept, or have a limited or incorrect view. In this study, students' incorrect or incomplete understandings about a topic are interchangeably termed *misconceptions* or *alternative ideas*. The specific questions used to elicit participants' understanding of the water cycle precede their responses in the result section.

Results of the Study

Concept 1. The States of Water

Question 1: In what forms does water exist in the atmosphere?

Thirty students answered that water exists in the form of liquid such as lakes, ponds, and oceans. Five students responded that water exists as a liquid and as vapor (gas), including clouds and fog. None of the students included ice (solid) as a state of water found in the atmosphere.

Concept 2. Evaporation

Question 2: What are sources of water vapor in the atmosphere?

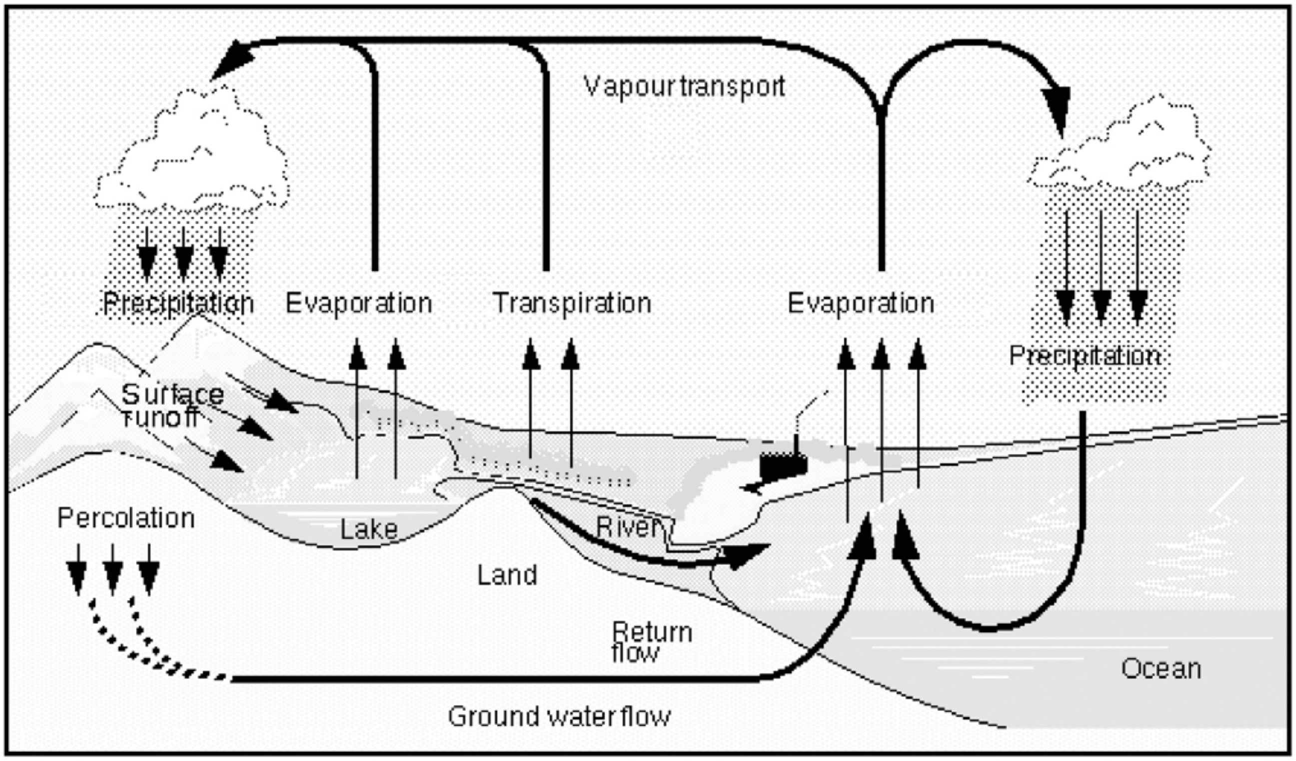


Figure 1: The Water Cycle Map example.

Twenty-seven students answered that water vapor comes from rivers, oceans, ponds, and lakes. Eight students gave abstract answers (for example, ozone and clouds) which had no relevance to the topic.

Question 3: Your friend is really sick with a high fever, and his mother rubs alcohol on his skin. After that, he begins to feel cool. Why do you think this is?
Fifteen students said that the alcohol's temperature is cool, so it makes him cool down. Six responded that it cleans the skin of dirt and oil, opens the pores, and allows air to enter; the strong smell makes the fever go away. Only four responded that the alcohol evaporates, which results in cooling the skin.

Concept 3. Temperature and Humidity
Question 4: Kenya is a country that is very close to the equator, and Alaska is close to the North Pole. Why do you think the amount of water vapor in Kenya would be almost ten times as high as it is in Alaska?
Twenty-two students answered that Kenya is hotter than Alaska, so water evaporated faster. Four students did not answer the question. Nine students said that Kenya is surrounded by water, so it is more humid; Alaska has more snow, so it is dry. Four students believed that Kenya is very hot, and clouds absorb a lot of water; by contrast, Alaska is cold and the clouds there do not soak up as much water.

Concept 4. Condensation
Question 5: Fill a metal cup with a mixture of ice and water. After a minute or two, what can you observe on the side of the cup in the summer?
All students observed water droplets/moisture on the side of the cup.

Question 6: Where does this water on the outside of the cup come from?
Most students failed to answer this question. They offered inaccurate ideas as to how water droplets formed outside the cup. They came up with answers including the ice inside the cup, the minerals, and the cup sweats. There were two students who answered that water comes from the sink and the ocean. Only five students responded that the moisture outside the cup came from water vapor in the air, correctly naming it condensation.

Concept 5. The Water Cycle Process

Question 7: Can evaporated water return to land? Explain how.

Most students thought that when it rains, the water gets into the rivers; water evaporates; evaporated water goes into the clouds, and then when the clouds have enough vapor, it rains, because the cycle allows it to rain and come back down. Overall, the concept of water cyclically coming back to the soil (the water cycle process) was not clear to all of the students.

Discussion and Implications

The researcher found that the students had varying degrees of understanding of the five concepts (the states of water, evaporation, condensation, temperature and humidity, and the water cycle process). They had partial knowledge of each concept, and could not articulate these concepts as a process of the water cycle at the end of the questionnaire.

Regarding the question about the states of water (question 1), it was of special interest that most of the students did not know that ice (solid) was included in the states of water in the atmosphere. An extension activity using dry ice (carbon dioxide, CO_2) might help them understand that one material can change into other states (gas and solid) under certain pressure/ temperature.

For question 2 regarding the concept of evaporation, students perceived water vapor as due only to evaporation from large bodies of water such as rivers and oceans. Several real-life examples explaining evaporation from small bodies (for example, a small amount of water in a bowl under the sun, wet cloth under the sun) may help them understand that evaporation happens everywhere, regardless of size.

Regarding question 3, students responded that alcohol itself is cold, so it helps skin cool down. Encouraging students to measure and compare the room temperature of alcohol and water would correct the misconception that alcohol is cooler than water.

For question 4, most students knew that there was some kind of relationship between temperature and humidity (water vapor), but failed to answer "how." They thought either Kenya was hotter than Alaska so Kenya has more water vapor, or that Kenya was hotter than Alaska so clouds in Kenya absorb more water than the clouds in Alaska. Overall, students thought humidity was related either to temperature or clouds, but they did not know how the two related to each other. Teaching the relationships between evaporation, temperature, and water vapor should be addressed, rather than teaching each concept separately.

Regarding questions 5 and 6 about condensation, most students responded that water droplets on the side of the glass came from the ice in the cup. Several students knew that the moisture outside the cup came from water vapor in the air which explains condensation. Hands-on activities using colored ice (for example, red or blue) in the glass could help the misconception that the water drops came from inside the cup, since students would be able to see the difference in color.

Question 7 assessed the understanding of the whole process of the water cycle. Students tended to view the water cycle by focusing on evaporation and clouds. This means that children focus on the liquid aspect of the water cycle. For example, water (liquid) goes from the sea into the clouds; liquid water is stored in the clouds and falls back to the Earth as rain. They saw the whole process of the water cycle as being a series of evaporations without condensation.

The results of this study support the studies of Dickerson (2004) and Henriques (2002) that found that middle school children hold many different notions about vapor, humidity, evaporation, condensation, and dew point. The results revealed that students saw the water cycle as rain without knowing the processes of evaporation, condensation, and precipitation, including hail and snow.

Conclusions and Recommendations

There are several ways that teachers can overcome student misconceptions.

First, identify mistaken beliefs. Being aware of wrong beliefs and knowing what they are is the first step in attempting to overcome them. Many studies have identified common student misconceptions in a wide variety of areas, including science. Teachers can easily access this information, but if they want to know their own students' misconceptions, they will need to simply ask students or prepare a quick questionnaire. Then, with the responses in-hand, teachers can plan their lessons/experiments/demonstrations to address these known misconceptions. Learning of students' misconceptions at the beginning of a lesson is going to be of little to no use for a lesson that has already been planned. It is therefore recommended that teachers discover any misconceptions before they plan a lesson.

Second, present students with new information. Teachers can best address misconceptions by presenting information which conflicts with the students' erroneous beliefs. Students are then forced to compare what they know with what is presented to them and must either reconstruct their knowledge or reject the new information. As shown in the study with seventh graders, students will construct new knowledge only when existing knowledge fails to meet their need to make sense of the world. This means new information must be presented in a way that is relevant to particular groups of students. Offering students new information through carefully selected inquiry-based, hands-on, minds-on activities is recommended. For example, regarding the question on the concept of condensation, most students answered that the water droplets outside the cup came from the ice in the cup. If the teacher used colored ice in the cup, students would remediate their misconception by observing the clear drops outside the cup. In another example, if the teacher prepared several liquids (including alcohol and water) for students to measure at room temperature and then had students rub their skin with the two liquids, students would never say that alcohol is cool so it makes the skin cool. Teachers should present qualitative experiments asking inquiry-type questions such as What makes you think that?, What causes this?, What is the reason for that?, What made you decide to do it that way?, or Can you think of any other ways to do that? Teachers need to ask follow-up questions of their students so they can learn what students truly think. What all this means is that educators must carefully examine the so-called misconceptions to see if they are indeed untrue.

When teachers plan instruction to confront misconceptions, they need to know if their students really have misconceptions or are simply stating their incomplete understanding. Teachers must help students clarify, probe, and challenge their current ideas during the lesson. Through an inquiry process, teachers can help students unravel false ideas and construct new knowledge. Teachers must then provide students with the opportunity and support to develop a more accurate set of beliefs on which to build true scientific understanding. Teacher-planned activities, collaborative discourse, and small group discussion with peers can yield some success in overcoming common student misconceptions. Convincing someone else that you are right and they are wrong requires a thorough understanding of the concepts under consideration. Having a teacher act as a facilitator to maximize exposure to incorrect beliefs in these group discussions is very important. In other words, teachers must provide a forum in which students can confront mistaken beliefs. If the teacher cannot answer, he or she should offer to research and make sure to follow-up with a discussion of the results. Several researchers (Derbentseva and others, 2006) have found evidence that asking students to create concept maps or charts in which they construct a correct framework for new knowledge, has been successful in overcoming wrong beliefs or preventing them from having fragmented knowledge, particularly if it is done in cooperative groups. For example, teachers could ask students/groups to create a map of the water cycle to see if they can articulate the concepts of evaporation, condensation, and transportation properly to explain the whole process of the water cycle at the end of the lesson/group discussions (Figure 1).

Third, studies (Aron, Francek, Nelson & Bisard, 1994; Schoon, 1995) show that teachers' misconceptions about Earth science concepts are at least as prevalent as middle school students'. With relatively easy access to information, teachers should not hesitate to suggest that students themselves find the answers to any questions they might have regarding a topic, rather than having teachers who are unsure of the answers providing them. Middle school teachers who are expected or encouraged to teach subjects outside their areas of expertise are also in danger of contributing to wrong beliefs - beliefs that may become barriers to learning not only throughout students' secondary schooling, but also throughout tertiary education. In grappling with content that is unfamiliar to them, teachers may unwittingly pass their own misconceptions on to their students. Professional development for teachers is essential, and is a matter that education systems cannot afford to overlook.

Most teachers do not have enough time to collect misconception data from their students or from research. If a list of topic related misconceptions were made available, teachers could review this list while planning instruction in order to include lessons which challenge students' ideas. A students' misconception list and its implications, like the water cycle in this study, can be useful information for practicing teachers (K-12) as well as for preservice teachers.

References

American Association for the Advancement of Science. (2001). *Atlas of Science Literacy.* Washington, DC: Oxford University Press.

Aron, R.H., Francek, M.A., Nelson, B.D. & Bisard, W.J. (1994). Atmospheric misconceptions. *The Science Teacher, 61*, 1, 30-33.

Atherton, J (2005). *Learning and Teaching: Piaget's developmental theory.* Retrieved: March, 2009, from http://www.learningandteaching.info/learning/piaget.htm

Ausubel, D., Novak, J., & Hanesian, H. (1978). Educational Psychology: A Cognitive View (2nd Ed.). New York: Holt, Rinehart & Winston.

Derbentseva, N., Safayeni, F., & Canas, A. J. (2006). Concept maps: Experiments on dynamic thinking. *Journal of Research in Science Teaching, 44, 3,* 45-60.

Dickerson, D. & Karen D. (2004). Eighth Grade Students' Understanding of Groundwater. *Journal of Geoscience Education, 52, 2,* 178-181.

Driver, R. (1985). Beyond appearances: The conservation of matter under physical and chemical transformations. In R. Driver, E. Guesne, & A. Tiberghien (Eds.),Children's Ideas in Science (pp. 145-169). London, UK: Open University Press.

Fraser, A. B. (2000). *Bad meteorology*. Retrieved March, 2009, from http://www.ems.psu.edu/~fraser/BadMeteorology.html

Hellden, G., & Solomon, J. (2004). The persistence of personal and social themes in context: long- and short-term studies of students' scientic ideas. *Science Education, 88,* 885-900.

Henriques, Laura. (2002). Children's ideas about weather: A review of the literature. *School Science and Mathematics, 102, 5, 202-215.*

Osborne, R. J., & Cosgrove, M.M. (1983). Children's conceptions of the changes of state of water. *Journal of Research in Science Teaching, 20,* 825-838.

Sewell, A. (2004) Constructivism and student misconceptions: Why every teacher needs to know about them. *Australian Science Teachers Journal, 48,* 4, 24-28

Schoon, K. J. (1995). Misconceptions in the Earth sciences: A cross-age study. Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, CA. (ERIC Document Reproduction Service No. ED 306 076).

Shymansky, J.A., Woodworth, G., Norman, O., Dunkhase, J., Matthews, C., & Liu, C. (1998). A study of changes in middle school teachers' understanding of selected ideas in science as a function of an in-service program focusing on student preconceptions. *Journal of Research in Science Teaching, 30,* 737-755.

Stepans, J. (1994). *Targeting Students' Science Misconceptions*. Riverview, FL: IdeaFactory, Inc.

Author Information

Hannah Kim teaches science methods for pre-service teachers at DePaul University. Her research focuses on science and literacy, educational technology, and science curriculum reform in CPS.

Write for the *Spectrum!*

The quality of the *Spectrum* is directly proportional to the relevance of its contents to you, your practice, and your classroom. You can assist colleagues across the state by sharing your wisdoms and experiences. You will also gain from this opportunity.

- Obtain experience in publishing, and a citation for your resume or CV.
- Receive feedback from the educators across the state about your ideas.
- Participate in an endeavor that is central and key to science and science education - the communication of ideas and the sharing of knowledge! Information is most validated and honored when it is held up to peer scrutiny and shared.

Your manuscript should:

- Be submitted digitally, saved in Word format;
- Preferably, be less than 3000 words in length, but articles of substance of most any length will be reviewed and considered for publication;
- Include all authors' names, affiliations, email addresses, and a brief biographical sketch of three or four sentences;
- Include illustrations - sketches, photographs, figures, graphs, tables - when appropriate. These should be numbered and referenced in the text by figure or table number. Each illustration should be at the end of the document on a separate page, with title, caption, and legend (if appropriate), and not embedded within the text. Photographs should be jpg images, included as separate files. Illustrations should be back and white, of good composition, and high contrast. Any illustrations that the authors did not create and do not own need to be accompanied by permission to use the illustration and credit to the creator/owner needs to be provided with the illustration and caption.
- Include references and in-text citations in APA style;
- Be original, - include a statement indicating whether or not the article has been published or submitted elsewhere. The Spectrum publishes original manuscripts and does not reprint previously published work.

Send us:

- A new slant on an old favorite
- Educational book reviews
- Successful curriculum
- Laboratory experiments
- Tried and true demonstrations
- Class activities – How did *YOU* do it?
- Science content updates
- Hot topics in hot, timely, and cutting edge fields!
- Action research in your classroom – How did you change your practice and why?
- Words of wisdom – Are you a veteran with a key tip for newbies?
- Travels and vacations involving science
- Science educator commentaries and issues – retirement, assessment, NCLB, lab safety
- Portfolios
- Innovations that you have found to be successful with science students
- Science through children's eyes – perhaps your child or grandchild
- Interesting and unique professional experiences

***Consider including*:**

Student assessments
Anecdotes and student quotes
Data, with statistics, that supports your work
Illustrations – figures, photos, tables, charts, diagrams, graphs, sketches

Advertising

Index to Advertisers

A program of the

Illinois Society for the Prevention of Blindness

It's never too early to learn how amazing yet vulnerable our eyes are. Active, curious children are particularly at risk of eye injuries from sports, fireworks or unsupervised experimentation.

Eye Spy is a 3rd/4th grade educational program presenting basic eye anatomy, vision care and safety awareness.

The teacher's curriculum includes a PowerPoint presentation, student activity sheets and a parent letter. Download the curriculum at **EyeHealthIllinois.org** or come to the site to sign up and we'll send you a CD-ROM. You can also call **800.433.4772**.

FREE to educators and school nurses thanks to a generous grant from the W.P. and H.B. White Foundation.

Radon Poster Contest

Radon is a colorless, odorless, radioactive gas that causes lung cancer. For non-smokers, radon is the leading cause of lung cancer. The radon poster contest is for students in science, art and health classes, after-school programs and school organizations, as well as home schools and youth groups: Here's an opportunity for students ages 9 -14 to win $50 and $100 savings bonds and a trip to Washington D.C. for the National Radon Poster Contest. This is a fun, educational way to learn about the health effects of radon. For contest information: refer to this website: www.TakeActionOnRadon.uiuc.edu. Click on "Teacher Resources" and 'National Radon Poster Contest." Posters are due to any local University of Illinois Extension office on or before March 1, 2010. For more information, contact: cindy.ladage@illinois.gov
Ph. 1-800-325-1245 or 217-785-9889.

Mathematics and Science Professional Development Day

at the Illinois Mathematics and Science Academy®

No "Talking Heads" here! Just lots of things to DO and take back!

More than 20 sessions for middle school teachers, high school teachers, and even some that cross-over!!
Here are a few sample sessions:

An Inquiry Carnival
Hands-on activities will expand your awareness of the process skills necessary for inquiry-based science.

Chem Demos That Start 'Em Thinking
Demonstrations can prompt students to generate questions and start thinking. You'll practice demonstrations and discuss ways to cultivate student understanding.

Construction Projects to Teach Physics - Learn about successful projects that teach how physics concepts can be applied to the real world - then build something yourself!

CoolHub.IMSA - Collaborative Innovation Networks
Engage students through networking media to learn from each other and experts around the world.

Gene Expression in *E. coli* - Give students experiences to understand multiple concepts in molecular biology. From analysis of enzyme mediated reactions to interpretation of gene regulation, this model is adaptable to different levels.

Date: Friday, February 26, 2010
Time: 7:30 a.m. – 1:30 p.m.
Location: IMSA, 1500 W Sullivan Rd. Aurora
easy access from I-88 with free parking!
Questions: 630-907-5950 or bisinger@imsa.edu
Cost: $12
5 CPDUs available!

Register today! Go to www.imsa.edu and click on Mathematics and Science Professional Development Day under HAPPENINGS AT IMSA to get more details or to register.

Program Generously Supported by the Abbott Fund

Mark ISTA's 2010
Conference on Science Education
on YOUR calendar!

November 4 - 6, 2010

Location:
Springfield, Illinois

Crowne Plaza Hotel/Holiday Inn Express

Friday Gala at the Illinois State Museum

Illinois Science Teachers Association
ISTA
www.ista-il.org

ISTA SPECTRUM DISTRIBUTION CENTER
Illinois Mathematics and Science Academy
1500 West Sullivan Road
Aurora, IL 60506

PRESORTED
STANDARD MAIL
U.S. POSTAGE PAID
CHAMPAIGN, IL 61820
PERMIT #880

Winter 2010

Make plans now!

ISTA's 43rd Annual Conference on Science Education

November 4 - 6, 2010
Springfield, Illinois

Crowne Plaza Hotel/Holiday Inn Express
Friday Gala at the Illinois State Museum

Thursday **Preconference** Possibilities:

- Illinois State Museum
- Survey Museum and Science on a Sphere
- University of Illinois at Springfield
- State Health, Materials, and Forensics Labs
- Medical Facilities/Medical Museum

Please join us in Abraham Lincoln's hometown!