SPECTRUM

Spring 2008, Vol. 34, No. 1

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The Journal of the Illinois Science Teachers Association

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Apprenticeships in Scientific Research
A Walk for All Seasons
Revisiting the Learning Cycle

Plan Ahead:
ISTA Conference 2008 - November 13-15, 2008

Spectrum

The Journal of the Illinois Science Teachers Association
Volume 34, Number 1

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

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Cover photo courtesy of David Joseph Horn See article "The Development of a Curriculum for Middle School Science Students Visiting Millikin University in Decatur, Illinois" on pages 15 - 17.

SPECTRUM

The Journal of the Illinois Science Teachers Association

Spring 2008 Volume 34, Number 1

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Jill Carter

Pekin Community High School

Greetings fellow ISTA members!

As I write this letter, our school year is rapidly coming to a close. It is a time to reflect on our successes for the year as well as the things we want to improve upon for the next school year. It's also time to think about summer.

What are you doing this summer? Taking classes, travelling, spending time with family and friends, or simply taking a well-deserved break? Whatever you plan on doing, consider writing for the *Spectrum*. What could you possibly write? Here are some suggestions:

- Have you done any action research within your own classroom? Let us know about it! This could turn into a peer-reviewed article.
- Is there an issue facing science educators that is important to you? Perhaps you could write a commentary piece or an essay.
- Did you try out a new lab or put together a new activity this past year? Please share it with your peers. We can all benefit from each others ideas.
- Do you have any "words of wisdom" or tips for preservice or new teachers? Consider writing an article that is geared toward those entering our profession.
- Are you nearing retirement or did you recently retire? How about writing about your experiences during the last years of teaching? Do you have any advice to offer others about retirement?
- Did you learn some fabulous new ideas or new content in a summer class you took? Let us read about it.
- Did your summer travels involve science in any way? Did you spot any shrinking glaciers, coral reefs, animals in the wild, or beach erosion? Were you involved in nature photography, hiking, going on a safari, or scuba diving? Did you see people engaged in environmentally responsible behaviors? Or did you find something upsetting?
- If you have young children or grandchildren, did you have a chance to see nature through their eyes? Write an essay!

We hope to hear from you!

I'd also like to take this opportunity to thank our outgoing regional directors, Susan Dahl, Don Terasaki, Randal Musch, Linda Shadwick, John Giffin, and Brent Hanchey, for their dedication and hard work on behalf of ISTA. Please join me in welcoming our new regional directors. Please contact them with your questions, concerns, and ideas. The organization is only as strong as our membership is active!

- Lynne Hubert – Region 1
- Laverne Logan – Region 2
- Sherry Spurlock – Region 3
- Kristi Van Hoveln – Region 4
- Tom Foster (re-elected) – Region 5
- David Abendroth – Region 6
- John F. Loehr – Region 7

2007-09 ISTA Executive Committee

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Minooka Community HS
dengel@mchs.net

Secretary
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Public Relations	Tom Kearney
Professional Development/Building a Presence	Mary Lou Lipscomb
Publications Committee	Judith A. Scheppler

Do *You* Know an Exemplary Science Student?

Remember, ISTA members in good standing, who would like to honor one high school science student each year, may request an **ISTA medallion and certificate** by contacting sherryduncan@insightbb.com.

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

Regional Directors

Region 1 Director 08-10
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Region 1 Director 07-09
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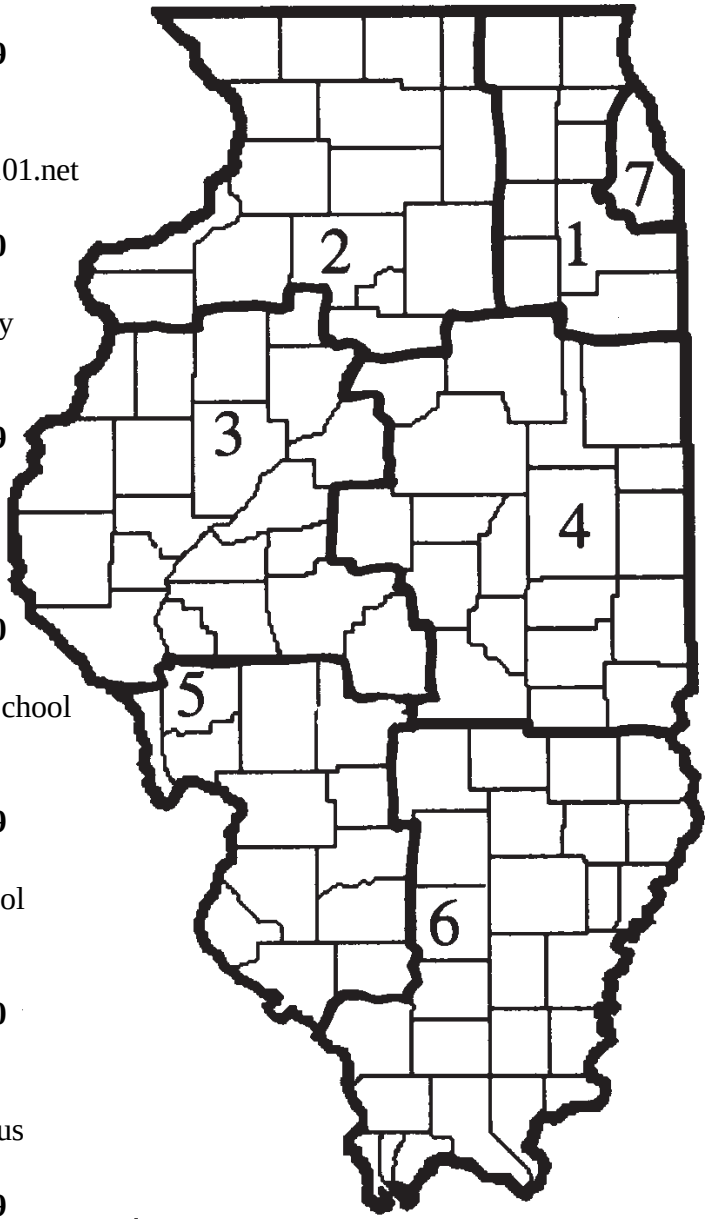

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http://www.ista-il.org/

Illinois Science Teachers Association

2008 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: Sherry Duncan (email: sjduncan@insightbb.com), ISTA Membership, PO Box 295, Urbana, IL 61801.

Membership Option (see below)_____ FFSEMembership 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.

A Future in Science Starts Now
2008 ISTA Conference
November 13 - 15, 2008

The 2008 ISTA conference committee is looking forward to an information-packed and fun-filled fall science education conference. The conference theme is "A Future in Science Starts Now." It will be held at the Pere Marquette Hotel and the nearby Peoria Civic Center, November 13-15, 2008.

Exhibitors will include textbook and learning materials publishers, technical equipment manufacturers, science equipment suppliers, museums, government agencies, non-profit educational organizations, service suppliers, and professional organizations. Anyone intererested in purchasing science education supplies can compare competitors and talk directly with company representatives. Many free posters and materials are provided. Also, exhibitors donate thousands of dollars of materials which are raffled off to conference participants.

Breakout sessions and workshops will include physical, life, and Earth/space science topics as well as practical teaching and learning approaches and institutional science issues. An emphasis this year will be on preparing for the 2009 Illinois Year of Science observance.

The Thursday exhibit hall opening, the Friday luncheon, and the Friday night Gala offer exciting and fun opportunities to network with colleagues. Science teachers in training learn about materials, services, and jobs available and are admitted at a low student rate.

We hope to see you there and that you will be enriched by your attendance!

The 2008 ISTA conference hotel is the Hotel Pere Marquette in Peoria. The Thursday (November 13, 2008) pre-conference session will be held at the Hotel Pere Marquette along with several conference breakout sessions on Friday (November 14, 2008) and Saturday (November 15, 2008). Expect to meet friends and colleagues at one of the many social gathering spots on the premises. The Hotel Pere Marquette is a short walk to the Peoria Civic Center where exhibitors will have all the newest supplies, equipment, and science education resources on display.

Hotel Pere Marquette

The Illinois Science Teachers Association has **reserved a limited block of rooms at the Hotel Pere Marquette for conference attendees**. Be sure to mention that you are registered for the Illinois Science Teachers Association conference in order to reserve a room at the special conference price of:

- Single or Double $98.00, which includes breakfast

Room rates are per night and are subject to taxes and applicable charges. Parking is free for registered guests. To reserve a room at the conference rate you must contact:

http://www.hotelperemarquette.com
Reservations only: 1-800-447-1676
Information: 1-309-637-6555

Call for Presentations

Illinois Science Teachers Association 2008 Conference
A Future in Science Starts Now
Peoria Civic Center & the Hotel Pere Marquette
Friday & Saturday, November 14 and 15, 2008

Deadline for Submission: Postmarked by Friday May 30, 2008

Principal Presenter: (Only Principal Presenters will be notified of presentation acceptance and scheduling.)

Name: _____ Day phone _____

Affiliation/School _____ Evening phone _____

Mailing Address _____ Email _____

City, State, Zip _____

Additional Presenter(s): Please attach additional sheet.
Title of Presentation: _____
Program Description (exactly how you want it to appear in the program) – 25 word limit**:**
_____
_____
_____
_____

Detailed Description of Presentation (for committee review purposes only) – 200 word limit)**:**
Please attach additional sheet. This description will only be used by the program committee for presentation selection purposes.

***Preferred presentation date:** ☐ Friday (50 minutes only)
☐ Saturday – Select one: __ 50 minutes**;** __ 1 hour, 50 minutes**;**
__ 2 hours, 50 minutes

**The Program Committee will attempt to honor the preferred presentation date, but due to scheduling issues this may not always be possible. All presentations longer than 50 minutes will be on Saturday only.*

Check the intended audience: ☐ preK-3; ☐ 4-6; ☐ 7-8; ☐ 9-12; ☐ K-12; ☐ preservice; ☐ college/university; ☐administration

Subject: ☐ biology; ☐ chemistry; ☐ earth science; ☐ environmental; ☐ general/integrated; ☐ physics; ☐ technology; ☐ other (specify) _____

Equipment: I will need an overhead & screen: ☐ yes; ☐ no. In order to minimize costs, presenters needing other equipment must furnish their own.

Room Set-up: All rooms will be set up with tables unless requested otherwise: _____

Safety: All ISTA presentations must conform to NSTA minimum safety guidelines for presenters. Check the ISTA website for those guidelines: http://www.ista-il.org. Will you be using chemicals or hazardous materials? ☐ yes; ☐ no; If so, please describe: _____
_____

Agreement: I have read and understand the NSTA minimum safety guidelines for presenters. I agree to conform to these guidelines while giving my presentation at the 2008 ISTA Annual Conference. I understand that I will be notified via **email** by June 30, 2008 as to whether my presentation proposal has been accepted or not. If I must withdraw my presentation request, I agree to notify ISTA *no later than* September 5, 2008, so that another presenter can be found in order to fill my slot.

Signature: _____ Date: _____

Note: ISTA requires that all presenters register for the conference.

Return to: Donna Engel, Conference Program Chair
Minooka Community High School
301 South Wabena Avenue
Minooka, Illinois 60447
dengel@mchs.net

Illinois Science Teachers Association
41st Annual Conference on Science Education
Peoria Civic Center & the Hotel Pere Marquette
November 13-15, 2008
Pre-Registration Form

Deadline for Early Bird Pre-Registration: Postmarked by October 11, 2008

Deadline for Advance Registration: Postmarked between October 12, 2008 and November 1, 2008

Registration on or after November 2, 2008: On-site only

Fill out form completely. Print clearly. Information will be used for our records.

Name: _____ Spouse/Guest Name (if attending) _____

Home Address _____ Home phone (_____) _____

City/State/Zip _____ County where you work _____

Affiliation/School _____

Business Address: _____ Business phone (_____) _____

City/State/Zip _____ Email _____

☐ Check here if you need special assistance due to handicap (describe on extra sheet).

☐ Check here if you would like to be a presider for a session.

☐ Check here if you have been teaching 3 years or less.

☐ Check here if you need a non-meat meal.

Pre-Conference Registration (Thursday only)
(Includes Exhibit Preview and Exhibit Hall Preview Reception)

☐ Registration $75 _____

Conference Registration (Friday and Saturday)
(Includes Thursday Exhibit Preview, Exhibit Hall Preview Reception, Friday lunch, & Saturday brkfst.)

Please circle correct amount.

Registration Fees	**Earlybird** 10/11/08	**Advance** 11/01/08	**Full Rate** After 11/1
☐ Current ISTA member	$120	$135	$145
☐ Nonmember (includes one-year membership)	$155	$170	$180
☐ Institutional members (up to 3 individuals) *	$115person	$130/person	$140/person
☐ Full-time student	$30	$30	$30
☐ Saturday only (Exhibit Hall not open)	$65	$70	$75
☐ Non-teaching spouse/guest (no meal)	$15	$15	$15

Enter Registration fee _____

Social Events (Tickets for these events will not be sold at the door)

Thursday Reception in Exhibit Hall (4:00 to 7:00 pm) No charge, but please register $00.00 _____

Friday Luncheon – Hotel Pere Marquette – No charge, but please register $00.00 _____

Friday Night **GALA** (bus, drinks, food, light show, drinks, prizes, awards– open to anyone attending Thursday, Friday, and/or Saturday. **DON'T MISS THIS!** $25.00 _____

Total Due: _____

* Please send all registrations in the same envelope.

Make checks payable to: Illinois Science Teachers Association. Send to **Sherry Duncan, ISTA Registration, P.O. Box 295, Urbana, IL 61801.** No one will be admitted to any part of the convention without registering. If your registration form is received by November 3rd you will receive a confirmation in the mail. If it is received after that date, you may pick up your information at the registration area in the Peoria Civic Center.

ISTA New Teacher of the Year Award

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.

Requirements:

- Must be a teacher with their 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, and trend setting practices in the field of science
- This is a one-time award per awardee

Awardees:

- Honor 3 to 5 teachers with initial certificate in the field of science from throughout the State of Illinois
- Awardees honored with a one-year membership to ISTA
- Recognition in ISTA *Spectrum* journal
- Recognition at ISTA convention luncheon
- Teacher of Science "Idea Pack"
- Certification of recognition

Timeline:

- Nominations submitted by June 30 of 2008 for school year 2007-2008 Awards
- Selection committee makes decision of awardees July/August 2008
- Awardees notified in September 2008
- Awardees honored at 2008 ISTA annual convention luncheon

Application:

Name of Nominee:_____

School: _____

School Address: _____

Home Address:_____

Home Phone:_____ email address: _____

Current Teaching Assignment: _____

Year Teaching (circle one): 1st 2nd 3rd 4th

Include a list of college(s) attended, degree received, and the year degree was received

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

Nominated by: _____

School: _____ ISTA Region: _____

Nominations may be submitted either electronically or by mail.

Mail nominations to: Troy J. Simpson (email: tsimpson@watseka-u9.k12.il.us)
ISTA Region IV Director
Glenn Raymond School
101 W. Mulberry St.
Watseka, IL 60970

2009 - Year of Science

At the ISTA annual convention, we will be spearheading our plans for celebrating 2009 as the Year of Science. Nationally, special events are being scheduled and partnerships are being created which will focus on the achievements of science and how they can become science education opportunities for teachers and their students. The ISTA board of directors and officers are already planning activities throughout the state for teachers of science to celebrate our heritage and future.

In 2009, Year of Science participants will be celebrating science and seminal events in science, which include:
Darwin Day — This annual international celebration will have added value in 2009 as we celebrate the 200th anniversary of Darwin's birth and the 150th Anniversary of the publication of On the Origin of Species.
The 200th anniversary of the birth of Abraham Lincoln (whose contributions to science include founding the National Academy of Sciences, as well as creating the Land grant system of agricultural colleges through signing the Morrill Act, which was very important to the development of applied biological sciences).
The 400th anniversary of the publication of Johannes Kepler's first two Laws of Planetary Motion.
The 100th anniversary of the discovery of the Burgess Shale by the paleontologist Charles D. Walcott.
The 400th anniversary of Galileo's first use of a telescope to study the skies.
The 100th anniversary of the establishment of USDA Forest Service Experimental Forest and Ranges, the largest system of dedicated experimental sites in the US.

For more information, go to:
http://www.copusproject.org/yearofscience2009/

ISTA is looking for individuals to help plan, initiate, and organize events that could include a science and photography project with the Illinois Arts Council or a book review club. If you are interested in assisting, or have other ideas for the 2009 Year of Science, contact Gwen Pollock at gpollock@isbe.net.

Special Opportunity for Teachers with Graduate Degrees and Teaching Endorsements in Elementary and secondary Mathematics and Science

The Illinois Mathematics and Science Partnerships (IMSP) program has taken a slightly expanded format for helping K-12 teachers meet the endorsement requirements for their teaching assignments. Twenty-four partnerships are focusing on creating new or revitalizing existing graduate programs that will incorporate specific endorsement areas through graduate degree programs for cohorts of approximately 25 teachers. Not all of 600 openings in these 24 cohorts are filled at this point. Programs are available in: elementary mathematics and science education; middle and high school mathematics; and secondary biology, environmental science, chemistry, Earth and space science, physics, health sciences technology, and industrial/engineering.

Contact Gwen Pollock (gpollock@isbe.net or (217)-557-7323) at ISBE for more information.

Building a Presence For Science
Mary Lou Lipscomb
BaP Illinois State Coordinator

Building a Presence for Science (BaP) is an electronic network initiated by the National Science Teachers Association (NSTA) and implemented in Illinois by ISTA to foster communication, collaboration, and leadership among science educators. Through the network teachers and other science educators are provided with information about professional development opportunities and science teaching resources.

BaP 3.0 is up and running…
NSTA has just recently unveiled an all new BaP website. You can find it by clicking the BaP logo on the home page of the ISTA website, or go directly to bap.nsta.org. When you get there, if you are a network member, you can log in and go to your own webpage, check out the message boards, or change your contact information. If you are not a member you can sign-up to become a point of contact. For more information about BaP Illinois go to www.ista-il.org and click on the *Building a Presence Illinois* link.

Update your email to keep connected…
Updating your email address is extremely important as a member of an electronic network. If you have not been receiving the monthly BaP Illinois *Network News*, perhaps your email address needs updating. Another reason you may not be receiving the monthly eblast is that your email provider doesn't recognize the sender. Check with the tech person in your district to find out the best way to remedy the problem.

BaP state partners give back…
The Building a Presence for Science meeting at the ISTA annual conference was quite well attended this year. Participants learned about BaP and were able to sign on as points of contact for their school. Twenty of the attendees won great door prizes graciously donated by the following BaP state partners:

Fermilab
Flinn Scientific
Illinois Department of Natural Resources
Illinois State Museum
LabAids, Inc.
The Scope Shoppe
Science Kit and Boreal Laboratories

Thank you, one and all!

Learn more…
Whether or not you are a member of the BaP network, you are encouraged to check out the BaP webpage on the ISTA website (www.ista-il.org). From there you can link to the NSTA/BaP site. If you have any additional questions that are not answered by the websites, contact me at lipscomb@imsa.edu and I will do my best to help you out.

Teacher - to - Teacher

Educators Share Information, Lessons, and Tips

Mary Lou Lipscomb
Illinois Mathematics and Science Academy

Professional development involves more than going to workshops. It involves all the ways in which teachers learn to perfect their skills as educators. As lifelong learners, teachers accumulate a wide variety of knowledge and skills and use them to create ideas, activities, or entire units. Whether used to spark or maintain interest, keep things moving, or help students understand a concept in a way that is unique or different, sharing these ideas, activities, or units with colleagues provides professional development for all involved.

A sincere "Thank You" to the teachers for sharing their ideas.

Nanotechnology and *Conceptual Physics*…
Deborah Berlin and Mike Stancik at Glenbrook South High School in Glenview wrote that they recently developed a nanotechnology unit for the *Conceptual Physics* course they teach. They developed this lab and others while attending the Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems (Nano-CEMMS) summer workshop for teachers.

Silver nanoparticles have been integrated into materials ranging from baby bottles to food storage containers in order to generate antimicrobial surfaces. The goal of our lab was to test the claim that silver "nanosocks" are effective at preventing bacterial growth.

In this lab, students first discovered that silver nanoparticles could prevent bacterial growth by incubating a sample of LB broth with *E. coli* and silver nanoparticles and a second sample of just LB broth with *E. coli.* The sample with the silver nanoparticles showed no growth (the sample was clear the next day); the sample without nanoparticles showed growth (the sample was cloudy).

Students were then given a swatch of material from regular socks and a swatch from nanosocks. Students incubated each swatch separately with LB broth and *E. coli*. A comparison the following day showed that all of the regular socks led to bacterial growth. For nanosocks, the amount of bacterial growth varied by brand.

Similar labs are available at: http://www.nanocemms.uiuc.edu/content/education/online_labs/index.php

Science Songs Make Learning Fun…
Dan Olson, an eighth grade science teacher and point of contact at Woodrow Wilson Middle School in Moline, writes, "I have found that incorporating music jingles and raps can greatly increase a student's ability to remember content material. I have also found that giving students the freedom to perform these songs in the classroom creates a fun learning environment. If you are not very musically inclined – leave the song writing up to the students who are. I have provided one jingle and one rap as an example of what I have created for the students."

Scientific Method Rap

Once upon a time
Mr. Olson's task
Was to teach the science method
What more could he ask?
First you observe a phenomenon
Observe and infer, think of a solution.
Hypothesize with an if and then
Experiment in the lab time, time and again.
Collect all the data
Don't leave anything out

Conclude your results

Clear up any doubt.
This is my science rap
To repeat again;
Everybody say,
"The End."

Red Blood Flows

(to the tune of Jingle Bells)
(first verse only)
Dashing through the heart
Start in the right atrium
Flow to the right ventricle
Out the pulmonary artery
Make your way to the lungs
Make an exchange of gasses
Flow through the pulmonary vein and back to the heart we go -OH
Red blood flows, red blood flows, red blood circulates
Oh what fun it is to sing a bloody song tonight--*ite*
Red blood flows, red blood flows, red blood circulates
Oh what fun it is to sing a bloody song tonight!

Ecocaching to Overcome Nature-Deficit Disorder…

Kevin Emmons, a teacher and point of contact at Morton High School in Morton, Illinois, writes about the use of ecocaching. Ecocaching is the concept of treasure hunting for caches that the Earth has stored. He writes, "Why are ecocaches important in education? In our current global-centered society, there is a focus on urbanization of populations. Many of the children in the urban/suburban environments are not getting exposure to the Earth's natural beauty. Current research shows the importance of developing the naturalist intelligence in the developing adolescent. One prominent researcher, Richard Louv, considers the issue of such vital importance in education that he has referred to urban children as suffering from *Nature-Deficit Disorder*. [Louv, R. (2005) *Last child in the woods: Saving our children from Nature-Deficit Disorder.* Chapel Hill, NC: Algonquin Books.] Furthermore, with tougher budget constraints, teachers are finding it difficult to take field trips to locations where the children can explore and learn. This project hopes to assist teachers in meeting that need through the use of GPS technology."

For more information on the concept and process of ecocaching go to http://www.ilega.org.

Kevin has created two sets of ecocaches for the Peoria area:

- The Physical Geography of the Illinois River Valley Near Peoria
- The World's Largest Scale Model of the Solar System at Lakeview Museum

The map of Illinois found at http://www.ilega.org/ecocaches/illinoismap/Illinoismap.htm will link you to the various ecocaches that Kevin has developed. They can be used successfully with students of all ages.

Using WikiSpaces for Science Lessons…
Kristi Van Hoveln, eighth grade teacher and point of contact at Milford Community Consolidated School District 280 in Milford, writes, "The following technology idea has been used successfully by me with students in grade eight, but can be used in any grade with guidance."

She was able to set up a Wikispace for free (http://www.wikispaces.com) to allow her students to complete their science lessons online. But because the site is visible to others, before beginning she spent several weeks talking with the students about internet safety. She goes on to say, "I email the students their assignment each day and include labs, readings, or notes as attachments. The students still do labs in class, but all of their responses and their science notebooks are online. At the end of each chapter, the students print out a hard copy of their notebooks to share with parents and to use as a reference. The student motivation has been high; they love accessing the material online and not having to bring home books.

"There are many benefits to using Wikispaces. The site allows me to grade the notebooks and assignments from anywhere. Plus, I am able to communicate with all my students. The students are able to check and respond to each other's notebooks because they are online. It also makes it easy to compile notes from each student into a summary for the class.

"If you are interested in starting a Wikispace, sign-up for one, experiment with it, and then introduce your students to it. Start small and build on it. It is amazing what my students and I have been able to do with it since we started."

Listening and Learning in First Grade…
Pamela Breitburg, science lab teacher and point of contact at Zapatta Academy in Chicago, does hands-on activities with first through eighth graders. She writes, "Recently, when introducing the rainforest habitat to my first graders, I began class by having them listen to an audio recording; it was of rainforest sounds. Prior to class I downloaded three rainforest music sound files from the internet, for this purpose. I gave students paper and crayons and instructed them to draw whatever things they thought they heard. After about ten minutes I stopped the sounds and we discussed their drawings. Most figured out that it was the rainforest because of monkey cries and many different sounds of rain and birds. But it was interesting that some heard waterfalls and others heard rain. One student heard a horse, justifying that the plopping sound of the water sounded like horses hooves in the water. Some students drew trees and this afforded discussion about inference versus observation; they admitted they had not "heard" trees. Instead they had inferred that trees would be a part of a habitat with monkeys and birds. This activity and discussion was followed by a short video on the rainforest habitat. I heard many students validating the things they had drawn that they saw in this video to their neighbors. It was a fun and engaging lesson for everyone and set the stage for more learning about habitats."

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

The Development of a Curriculum for Middle School Science Students Visiting Millikin University in Decatur, Illinois

David Joseph Horn, Meghan Christ, Amanda Coleman, and Jessica Zange

Millikin University

There is an increasing disconnect between children and the natural world.

In *Last Child in the Woods*: *Saving our Children from Nature-Deficit Disorder*, Louv (2005) describes the increasing disconnect between children and the natural world, and discusses how this separation can have physical, psychological, and spiritual consequences. Simultaneously, a child's access to nature through schools is decreasing as a result of strained school budgets, parental concerns, and curriculums that de-emphasize natural history.

In the fall of 2007, we developed and implemented a curriculum for middle school science students that attempts to meet state education standards while providing experiential learning that integrates theory with practice. The curriculum took place on the campus of Millikin University in Decatur, Illinois and included an activity using the university's natural history museum, dissection in the laboratory, and a short hike to a local natural area.

The Curriculum

The curriculum is based on Illinois State Goal 12.B – "Know and apply concepts that describe how living things interact with each other and with their environment," using outcomes listed for late elementary and middle/junior high school (http://www.isbe.state.il.us). Specifically, the curriculum is designed to introduce concepts of macroevolution, adaptations, and diversity of life, as well as population growth, interactions between species (for example, predation) and food webs. The curriculum uses birds as model organisms, as birds are easily observable and identifiable, and an interest in birds may spark an interest in the study of other forms of biodiversity (Council for Environmental Education 2006). In addition, a curriculum using birds matches the expertise of the authors.

The curriculum is designed for students in grades six to eight, and is three hours in length. In addition, we are able to provide students with lunch and a tour of the campus. The curriculum begins with a welcome and introductory remarks, including a video clip from the series *Planet Earth* depicting courtship behavior of Birds of Paradise. When classes larger than twenty are visiting, or when multiple grades visit concurrently, we split up the students with each group performing the same activities, but in a different order.

The first activity is *Museum Mania*. In this activity, students visit the William Andrew Kuhnke Museum within Leighty-Tabor Science Center on Millikin's campus. The museum showcases the Earth's biological diversity and contains some rare bird specimens including Passenger Pigeons (*Ectopistes migratorius*) and the Kakapo (*Strigops*

habroptilus), the world's only flightless parrot. We have developed six stations at the museum and an associated worksheet (see photo on the cover.). At each station, students are asked to individually reflect on a question from the worksheet, and then a group discussion takes place about the station. The museum activity focuses on diversity of life, adaptations for survival and reproduction, predator-prey relationships, and threatened and endangered species.

Following *Museum Mania*, students dissect owl pellets in one of the biology laboratories. During the dissection, students use a taxonomic key to identify the species of prey found in the pellets. This activity reinforces predator-prey relationships introduced in *Museum Mania*. Following the dissections, we use the results to develop a food web involving owls, their prey, and example organisms from other trophic levels.

To further emphasize the concept of diversity of species, a bird walk to a local park one block from campus ensues. Prior to the bird walk, students receive training on how to use binoculars and a checklist to identify birds that are seen. The bird walk emphasizes the diversity of birds found in central Illinois and adaptations that different birds have for survival are contrasted. In addition to learning more about the diversity of life, bird watching has other benefits including fostering observation skills and recording observations (Magpiong 2007).

Upon completion of the bird walk, students take part in a predator-prey game. The game involves role-playing whereby students choose to be wolves, deer, or the resources deer need for survival. By varying conditions, students are exposed to the forms of population growth (that is, exponential and logistic), as well as predator-prey relationships.

During the fall of 2007, over one hundred students from Taylorville Middle School and Decatur Christian School participated in our curriculum. Taylorville Middle School participated in *Museum Mania* as part of a science night held at the university.

Students learn more about the education field by serving as educators, and interest in an educational career may subsequently increase.

Decatur Christian School brought approximately twenty students in each of the sixth, seventh, and eighth grades to participate in the full curriculum. In addition, we held an open house for faculty and staff at Millikin University, and hosted an afterschool program on behalf of Delta Sigma Theta.

Training Future Teachers

Another important aspect of this project was the involvement of Millikin University undergraduates in all phases. M. Christ, A. Coleman, and J. Zange served as the primary creators and instructors of the curriculum. The students developed content for the curriculum; created course materials; designed displays for the museum; invited area schools and coordinated their visits; and are developing a webpage highlighting the curriculum being offered. Each student had a specific role that best matched their major and career interests. For example, as an elementary education major M. Christ was responsible for contacting schools, coordinating visits, and devising a curriculum that would meet state learning goals. As a biology major with an interest in environmental education, A. Coleman was responsible for creating the content of the curriculum. J. Zange, as someone interested in graphic design, is developing the website, and designed the curricular materials given to the middle school students.

The ability to provide Millikin students with such opportunities enhances the undergraduate experience and has several advantages. Students may gain important skills, and grow personally by taking ownership of all aspects of the curriculum. Students learn more about the education field by serving as educators, and interest in an educational career may subsequently increase. Like on-campus research,

experiences such as these provide students with critical thinking skills necessary for future positions, and engage the faculty in promoting stronger collaborative relationships with students (McCleery et al. 2005).

Conclusions

The development of a curriculum for middle school science students has helped over 100 students in the six to eight grades to be exposed to state learning goals while performing hands-on, interactive activities in a museum, laboratory, and outdoor setting. Participating in the curriculum has also provided a valuable experience for undergraduates interested in becoming K-12 teachers and environmental educators, while increasing the visibility of the sciences within the local community. We encourage middle school science teachers to work with local museums, nature centers, universities, and other entities to develop similar programs in your area.

In the future, we hope to expand our curriculum by tailoring curricular elements by grade level and the individual needs of the teachers whose classes may participate. We would also like to develop an off-campus component to the curriculum that would allow for follow-up activities at the students' school. Furthermore, we plan to incorporate a conservation activity into our curriculum. The activity would involve students learning more about the conservation of avian biodiversity and ways to take action. For example, students could build a birdhouse or construct a craft to reduce bird-window collisions.

Acknowledgments

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References

Council for Environmental Education. 2006. Flying Wild: An Educator's Guide to Celebrating Birds. Council for Environmental Education, Houston, TX. 366 pp.

Louv, R. 2005. Last Child in the Woods: Saving our Children from Nature-Deficit Disorder. Algonquin Books of Chapel Hill, Chapel Hill, NC. 323 pp.

Magpiong, D. 2007. This class is for the birds. New Jersey Education Association Review October 2007:6-8.

McCleery, R. A., R. R. Lopez, L. A. Harveson, N. J. Silvy, and R. D. Slack. 2005. Integrating on-campus wildlife research projects into the wildlife curriculum. Wildlife Society Bulletin 33:802-809.

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Apprenticeships in Scientific Research: Exploring Brain Functioning in a Research Lab and in a Seventh Grade Classroom

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Apprenticeships in science research settings allow teachers to participate in the scientific community and develop a more sophisticated view of the practice of science.

A Science Research Apprenticeship for Teachers

The Chicago Science Teacher Research (CSTR) program is an initiative by the faculty of four University of Illinois at Chicago (UIC) Colleges, directed by Dr. Andreas Linninger and in cooperation with the Chicago Public Schools (CPS) and industrial-interest groups, to address the need for engaging in-service teachers in emerging technologies. Participant teachers (called RET Fellows) investigate topics in domains such as, material sciences, nanotechnology, and biomedical and environmental engineering.

Apprenticeships in science research settings allow teachers to participate in the scientific community and develop a more sophisticated view of the practice of science (Richmond, 1998; Varelas, House, & Wenzel, 2005). One of the end goals of such apprenticeships is that teachers bring their experiences back into the classroom to benefit their students' learning. Since a decade ago, Cunningham and Helms (1998) have claimed that such an experience is needed in order to give teachers "the requisite knowledge—both sociological understandings of science and pedagogical knowledge" (p. 493). Studies have shown that apprenticeships in science research settings can enable teachers to implement worthwhile research experiences in their classrooms (Helmer, 1997).

In the summer of 2007 the principal author, Amani Abuhabsah, had the opportunity to be a part of the UIC CSTR program. In this program, RET Fellows work with a faculty mentor doing scientific, cutting-edge research, using state-of-the-art experimental and computational facilities, and sharpening their scientific and mathematical knowledge. They also take a bioengineering course at the graduate level. The RET Fellows attend weekly meetings and presentations, and they present weekly updates of their projects by giving presentations. A final report and presentation are the culminating artifacts of the summer experience, that is extended during the school year with a few meetings where RET Fellows share teaching modules that they have designed for, and implemented in, their classes related to their research. The rest of this article is written in the first person, capturing Amani's research experiences in the lab, and the types of research activities that she designed and implemented subsequently with her seventh grade classroom related to the topic she studied.

The NEAL Lab and My Project

My apprenticeship entailed working on a project that dealt with stroke rehabilitation through electrical stimulation in rodent models in UIC's NEAL laboratory (Neural Engineering Applications Laboratory), led by Dr. Rousche. One of the latest accomplishments of the NEAL lab is a new device to better understand the complexity of stroke damage by combining multiple techniques. The device incorporates stroke induction, and neurochemical and neurophysiological sensors. It measures electrophysiological brain signals before, during, and after stroke in the rat motor cortex, in an effort to characterize cortical neuroplasticity. The multi-modal device incorporates neurotechnology development in order to create a method to accurately assess bio-chemical-electrical spatiotemporal dynamics related to single neurons and/or multi-neuron clusters. The device will allow researchers to achieve a multi-factor analysis of the dynamic cascade of complex neuropathophysiological events in the peri-lesional zone following cortical ischemia and subsequent recovery of motor function. By using this device, the NEAL lab researchers aim to investigate the use of direct electrical stimulation of the brain as an alternative therapy for improving motor recovery following stroke in the rat model.

Early treatment of stroke outcomes can help minimize damage to brain tissue and lead to a better prognosis. However, not all patients are eligible for current treatments, thus, alterative therapies are important and vital. Doctors can inject t-PA, a clot-busting drug to help dissolve obstructions and restore blood flow to brain tissue. However, it must be given within a three-hour window, or the risk will outweigh its benefits. In order to develop effective alternatives, it is important to develop a better understanding of how the brain works before and after a stroke. According to the American Stroke Association, a stroke is a type of cardiovascular disease. It occurs when either a clot blocks a blood vessel that carries oxygen and nutrients to the brain, or a blood vessel bursts. When either occurs the brain does not get the blood it needs. Brain cells begin to die because of the disruption of blood flow. But, our body needs continuous blood flow, because, as the blood circulates through our body, it brings oxygen, nutrients, and blood sugar to the cells. During a stroke, this process is disrupted.

My research apprenticeship consisted of animal experiments which were conducted in compliance with the AAALAC accredited Animal Care Committee of the University of Illinois at Chicago. Male Sprague-Dawley (SD) rats (about 350-500 g) were used in this study. I trained them to walk across a beam and assisted in surgically implanting the multi-modal device in them. During the surgery, I watched the rodents' pulse rate and oxygen saturation, and I administered a paw-pinch reflex to assure a consistent depth of anesthesia.

Movement disorders are one of the most common outcomes of a stroke. In the beam-walking task, the rats had to cross a beam that was narrowed along its size and had an under-hanging ledge. A normal rat had no problem with walking across the beam at a constant rate while keeping both of his paws on the entire part of the beam. However, a rat induced to have a stroke produced foot faults (slips) with the hind limb and moved across the beam at a slower rate. The number of foot faults indicated the motor deficit.

It took a couple of days to train rodents to maneuver across a beam. The training began after a rat felt comfortable being picked up. Every time rodents followed directions, they were rewarded with a sugar pellet. A dark box, or home cage, was placed at the end of the beam as reinforcement, and the rat stayed there for a few moments after each trial. Along each side of the beam, there were 1 cm wide ledges that increased to 2 cm as the beam became narrower. This allowed the animal to place an impaired forelimb, providing a crutch for the animal to use when there was a deficit (Figure 1). The beam was marked so that the location of the fault could be noted for each limb, at every foot.

Studying Brain Functioning with My Seventh Graders

This research apprenticeship allowed me to gain knowledge and confidence in this newly acquired knowledge regarding the nervous system, especially the triggers and outcomes of stroke in the

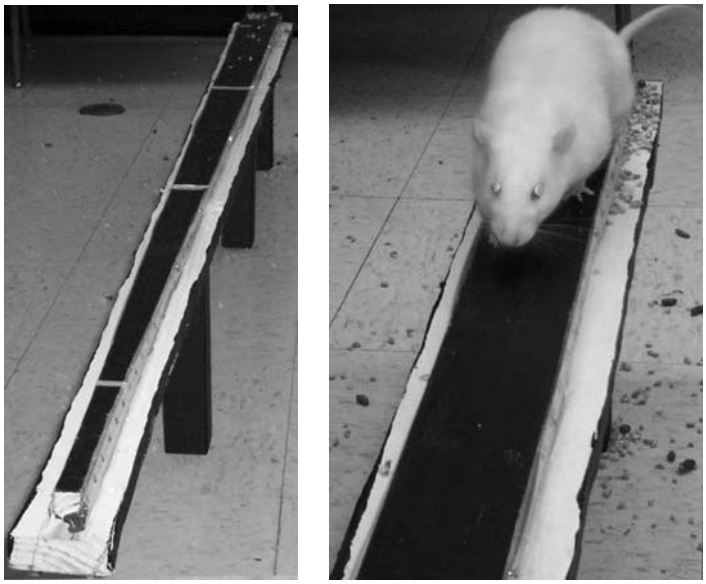

Figure 1. The beam used to assess hindlimb function and a rodent crossing the beam.

human body. Thus, I was motivated to find and use approaches to excite my students and engage them in this topic. I wanted to instill in my students the idea that in my science class we are scientists - exploring, studying, examining, modeling, understanding, finding out - like I was a scientist for a summer! The apprenticeship inspired me to find ways to emphasize connections among ideas.

Thus I embarked on creating a teaching module on one of the most extraordinary organs of our body—the brain! I put together several lessons where students get hands-on experience around the causes and outcomes of a stroke, develop their formal and informal communication skills to share scientific knowledge and understanding, and collaborate with their peers. The module is designed to help students understand the nervous system and the structure of the human brain, focusing on the cerebral, cerebellum, and brain stem regions. Below, I share briefly the module outline and offer examples of my students' work.

In the first lesson, I use a Know, Want to know, and Learned (KWL) chart entitled "Nervous System." I had students think about and write down in their journals their own ideas on the "K" and "W" parts, and then they shared with the whole class. With this information we compiled a chart together. Students asked questions such as: How large is the human brain? What is the nervous system? What is a stroke? The students' came up with more questions as the unit went on.

In the second lesson, we discuss basic brain anatomy, and students draw pictures of the brain based on what we have discussed (Figure 2). I follow this in the third lesson by showing them a visual representation of the brain and asking them to compare their drawings to the scientifically canonical picture of a brain. After discussing their

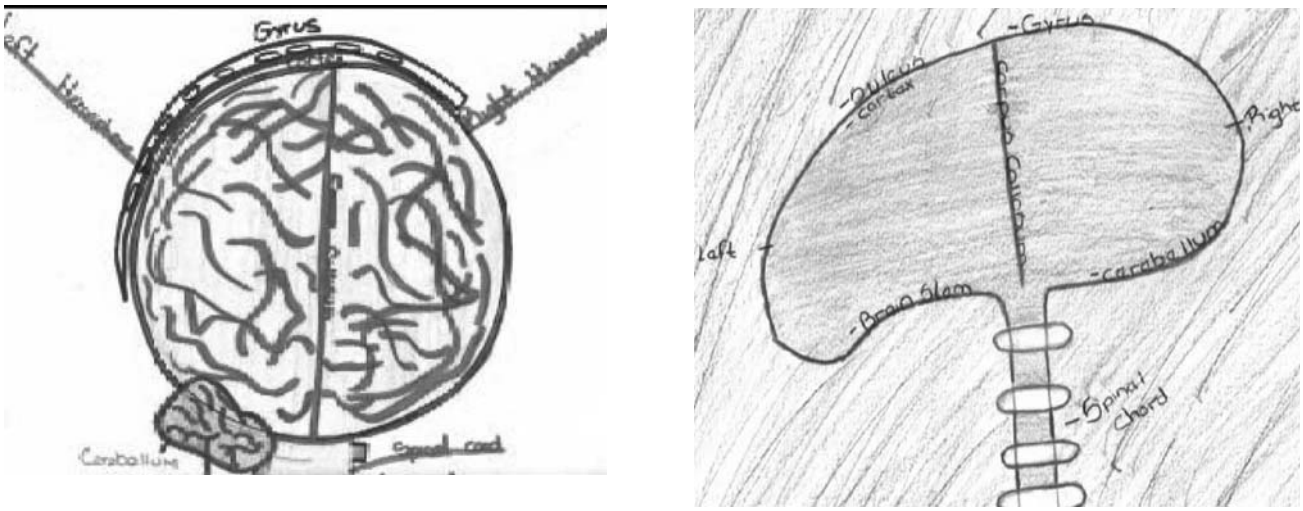

Figure 2. Examples of students' brain designs without having seen any visuals.

Figure 3. Two clay models of the brain produced by two student groups.

comparisons, students are asked to create a model of the brain using clay, play dough, Styrofoam, recyclables, and food. They can use different colors to indicate different structures to model a brain. The goal is to create reasonably accurate clay models featuring all of the major structures (Figure 3).

In the fourth lesson, we explore the idea that the brain performs all of its functions by receiving and sending signals through a network of fibers called nerves. Nerves are bundles of special cells called neurons. There are about 100 billion neurons in our bodies and they transmit signals. We discuss the different parts of the neuron—axon, dendrite, sheath, and cell body. This discussion is followed by students making neurons using pipe cleaners (Figure 4).

The following lessons (5-7) are used to study how neurons send messages through the nervous system to all parts of the body. The students participate in a role-playing game where they act as neurons sending signals as fast as they could. Through this drama activity, we investigate neurons, synapses, and the brain-body connection.

The following three lessons are devoted to dissecting a sheep's brain and comparing its regions to those of a human brain. While dissecting, students are able to see many of the different parts of the brain and talk and write in their journals about comparisons between human and sheep brains. Also in their journals, students write and draw their observations of the sheep brain.

We then move to two lessons that allow students to model blood vessels in the brain and simulate different types of stroke. Students recreate the "scene" of a stroke at the level of the blood vessel. They build models to explain a thrombus, embolus, and hemorrhage, using clear plastic tubing,

Figure 4. Pipe cleaner neuron.

Figure 5. Healthy artery.

two containers, play dough, Red Hot cinnamon candies, and one packet of Mentos per group.

Healthy Artery Model: Students pour Red Hots through the tubing to show how they flow through easily, stimulating normal blood flow (Figure 5). In their science journals, students write what each given item represents in their bodies.

Unhealthy Artery: Students place a piece of red play dough on the inside near the end of the tubing. The amount of play dough they chose to place in the tubing is up to the group. Students think about the amount of plaque built-up in their bodies to decide how much they should use (Figure 6).

Thrombus: Students pour the Red Hots through again with the plaque already in place and explain what happens. They write in their journals what their brain will do in this situation. What does blood do when it can not get through?

Embolus: Students use a Mentos candy as an embolus and show how it will get stuck in the tube and that the blood will build up behind it.

Hemorrhage: Students cut a hole in the tube and they think about what will happen if blood is poured into that tube. Students think about what causes a hole in the blood vessels, and discuss their answers. The whole module concludes with students creating their own illustrated information book on the nervous system that they eventually share with the whole class or a peer group depending on the time available.

Concluding Thoughts

I have been teaching the human body for four years, and my weakest part has been the nervous system. I used to think that it was too complicated to teach to my seventh graders, partly because of

Figure 6. Unhealthy arteries

my lack of deep knowledge on the topic. This apprenticeship helped me develop my understanding so that I could make the nervous system meaningful to my students. In the module I briefly presented in this article, my students studied the structure of the human brain, focusing on the cerebral, cerebellum, and brain stem regions, they explored what happens to the human brain during a stroke; and they realized how the neurons communicate using electrical signals and neurotransmitters. Furthermore, my students worked together to solve problems, design models, discuss possibilities, and, thus, they experienced important aspects of scientific practice. I hope that this module was an exciting educational experience for them that can serve as a catalyst for deciding to pursue science careers. My participation in the CSTR program was definitely an exciting educational experience in my career as a middle school teacher of science.

References

Cunningham, C., & Helms, J. (1998). Sociology of science as a means to a more authentic, inclusive science education. *Journal of Research in Science Teaching, 35,* 483–499.

Hemler, D. A. (1997). *Research experiences in teaching preparation: Effectiveness of the Green Bank preservice teacher enhancement program.* Dissertation Abstracts International, 58, 07A.

Richmond, G. (1998). Scientific apprenticeship and the role of public schools: General education of a better kind. *Journal of Research in Science Teaching, 35,* 583–587.

Varelas, M., House, R., & Wenzel, S. (2005). Beginning teachers immersed into science: Scientist and science teacher identities. *Science Education, 89,* 492-516.

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Useful Websites

Neuroscience For Kids:
http://faculty.washington.edu/chudler/chmodel.html
Overview of the Nervous System by NASA Quest:
http://quest.nasa.gov/neuron/background/nervsys.html
Neuroscience for Kids by Eric Chudler:
http://faculty.washington.edu/chudler/injury.html
Background Information:
http://kidshealth.org/parent/general/body_basics/brain_nervous_system.html
Activity 2: Sending a Signal
http://www.hallofhealth.org/sepa/curriculum/traumatic_brain_injuries.htm
Stroke Lesson
http://www.brainsrule.com/teachers/lesson_plans/brain_attack/hands_on_activity.htm
Sheep Dissection
http://www.hometrainingtools.com/articles/brain-dissection-project.html
More information on the CSTR program can be found on
http://vienna.bioengr.uic.edu/RET/index.html

A Walk for All Seasons

Julie Gianessi

Each season brings new colors with different scenery.

Here's a great activity to do with young learners from kindergarten through third grade! Each season brings new colors with different scenery. Why not observe it? You won't even need to travel very far! Take a walk around your school grounds. No permission slips or fees to collect, no bus rides to arrange. With this activity students will make observations, record data, and make meaningful connections through class discussions.

What do you need to get started? Which Illinois Learning Standards does this activity meet? How will students record their observations? I've written the answers to all the above questions in a lesson plan format. I've also included two sample recording sheets (figures 1 and 2).

Objectives

Students will:

- Follow oral instructions.
- Participate in discussions about the activity.
- Collect, organize, and describe data using tallies and pictures.
- Compare observations of individual and group results.
- Identify and describe patterns of seasonal change.

Illinois State Learning Standards Goals

Language Arts: 4.A.1c, 4.B.1b
Mathematics: 10.B.1b
Science: 11.A.1f, 12.E.1b

Materials Needed

- Recording sheet – one per team of two students
- Pencils – one per team of two students
- Crayons – if needed

Procedure

1. Be sure to take this walk yourself before taking your students out for the hike on your school grounds (or other setting) and observe your surroundings. For example, if you are taking a fall walk you'll want to make sure that nature is in the midst of autumn activities (e.g., the leaves are changing colors and summer flowers are not blooming). Look for potential safety hazards as well.
2. Partner students together.
3. Explain to students that they will be searching for color clues.
4. You'll want to show students the recording sheet and go over the directions prior to going outdoors. Now is also a good time to review behavior expectations when doing an outside activity.
5. The recording sheet has a list of colors on the left side (figure 1). If the students are in kindergarten or first grade you could have them color in the circle under the color word as a visual clue (figure 2). You may want to do this with some students who are older if there is a need to individualize this lesson.
6. Older students could use tally marks to record their observations.
7. Upon going outside, students will collect data about which colors they see during the season. For example, a boy sees a yellow leaf. He and his partner will make a tally mark in the yellow column. Another student sees an evergreen tree. She and here partner will make a tally mark in the green column.

8. Allow about 10 to 15 minutes to collect data. If too much time is provided, students may simply run into the same plants, insects, birds, and so forth. On the other hand, if your school grounds are vast or your students are very engaged in the activity, stay out there longer!
9. Return to your classroom and have students sit with their partner and review their data.
10. Start a class discussion. What colors did they find? Why? What color did they find the most often? What color was the rarest? Why? Was there a color that no one could find outside?
11. Collect each recording sheet. Keep them together. Next season go outside again and repeat the activity with a new recording sheet. Compare and contrast the findings for different seasons.

Author Information

Julie graduated from Eastern Illinois University in 2001 with an elementary education degree. She taught at Ridgeview Elementary School in Dunlap, Illinois for four years and currently is a stay-at-home mom. For the past two years she has served as special events chair for ISTA. Her mom/recruiter is ISTA president, Jill Carter!

Names _____

I went on a nature walk in _____. Here are the colors I saw.

Red	
Blue	
Green	
Yellow	
Purple	
Orange	
White	
Brown	

Figure 1. Color recording sheet.

Figure 2. Recording sheet with coloring circles.

Names _____

I went on a nature walk in _____. Here are the colors I saw.

Red	
Blue	
Green	
Yellow	
Purple	
Orange	
White	
Brown	

Revisiting the Learning Cycle and It's Implication to Science Instruction

Ovid K. Wong
Benedictine University

Introduction

The learning cycle is a science education strategy consistent with a number of contemporary learning theories that underscore the importance of experiential learning. A prototype concept of experiential learning can be traced back to 450 B.C when Confucius explained the learning implication of "Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand." John Dewey (Dewey, 1938) supported experiential learning where he pointed out an intimate relationship between the processes of experience and education. In the golden age of science curriculum development, Robert Karplus (Karplus, et al. 1977) and his colleagues originated a prototype of the learning cycle in the development of the Science Curriculum Development Study (SCDS). He described the process of learning in a sequence of steps. In 1984, David Kolb (Kolb, 1984) an education theorist published a book *Experiential Learning: Experience as the Source of Learning and Development.* In the words of David Kolb, he says, "Immediate personal experience is the focal point for learning, giving life, texture, and subjective meaning to abstract concepts and at the same time providing concrete, publicly shared reference point for testing the implications and validity of ideas created during the learning process." Later, Kolb's concept is acknowledged by academics, teachers, managers, and trainers as an understanding to explain human learning behavior. In essence, experiential learning is facilitating learning using direct experience. It is different from academic learning in which learning is acquired through the study of a subject without the connection to any direct experience.

Learning is complex in that it is a continuous non-linear process. Nevertheless, Kolb's model, which splits experiential learning into stages, helps us better understand and use the processes. The quintessence of the learning cycle in general includes five basic overlapping phases which are *engagement*, *exploration*, *explanation*, *elaboration*, and *evaluation*. In *engagement*, the teacher mentally engages students to whet their interest and curiosity about a problem, issue, or topic. Engagement is an invitation to learning. In *exploration*, the teacher encourages the students to explore ideas and establish an experience base. In *explanation*, the teacher solicits explanations from the students based on the established and prior knowledge to strengthen understanding. In *elaboration*, the teacher challenges students to apply their conceptual understanding to different situations and to make purposeful connections and transitions. In *evaluation*, the teacher encourages students to assess their learning and evaluation provides opportunities for teachers to evaluate student achievement of educational objectives. The five phases of the learning cycle is graphically summarized in figure 1.

> Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand.

The learning cycle influences classroom practices and textbook design in science education in many ways. When college textbooks present the topic of science teaching the learning cycle has been referenced as a model. One science education textbook says "The activities portion of the text follows the 5-E model of instruction… This Learning Cycle Model, introduced early in the text,

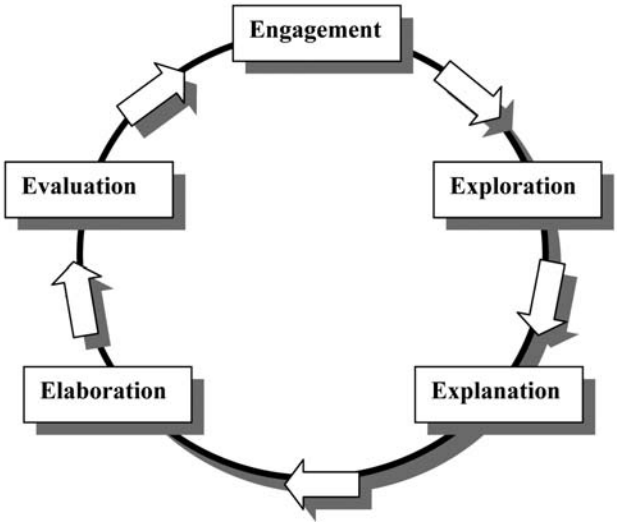

Figure 1: The Learning Cycle

reflects the National Science Education Standards (NSES) Science as Inquiry Standards, seamlessly integrating inquiry and the standards to create a science teaching framework best suited for engaging students in meaningful science learning while provide accountability opportunities for teachers" (Carin et al. 2005). Other textbook publishers apply the learning cycle to develop lessons stressing that the cycle is what scientific inquiry should be. Some colleges use the five Es of the learning cycle as a template of lesson planning and a model of inquiry-based instruction. Chances are your students already use parts of the learning cycle when they actively solve problems and perform inquiry-based learning.

Issues of the Learning Cycle

What are some issues that you, as a classroom teacher, may face when implementing the learning cycle with your students? Human's quest for knowledge evolves over time. It is the application in the classroom that invites reflection and suggestions for improvement. There are four major teaching issues stemming from the learning cycle. The issues are: 1) the obscurity of student's prior knowledge with reference to students' misconceptions; 2) the less than strategic placement of learning evaluation; 3) the cyclic nature of the phases; and 4) the two dimensionality of the cycle.

Where do we appropriately address students' misconceptions in the learning cycle? A student may come to class already with an established preconception of the topic. Unfortunately, some of the preconceptions are also misconceptions. These misconceptions, if not clarified and corrected, will interfere greatly with new learning. When was the last time we heard students say that it is hot in the summer because planet Earth is closer to the Sun at that time of the year? How do we proceed to teach the four seasons if students are reluctant to give up their prior misconceived knowledge? The effective teacher will need to offer an alternative hypothesis to stimulate the student's curiosity, to invite the student to question his prior knowledge, and to encourage the student to explore a better explanation for the issue at hand. When was the last time we heard students explain that the mass of a tree comes from the absorption of water and nutrients from the soil? How is this misconception interfering with the instruction of photosynthesis? Effective teaching should be powerful enough to dislodge misconceptions and that should be done at the beginning phase of the learning cycle distinct from the engagement phase. A study by Malcolm Swan (Swan, 2001) confirmed that students whose teachers addressed and corrected misconceptions, rather than simply using remedial measures, achieved, and maintained higher long-term learning results. Misconceptions should be elicited or drawn out for examination and clarification. For that reason an elicitation phase should follow closely after engagement.

The placement of evaluation in the learning cycle is at the very end. This is meant to be a summative assessment, we assume. Nevertheless, this evaluation process can be strengthened by the addition of continuous formative assessments, connecting to all phases of the cycle. A teacher in the process of inviting and engaging the students to learn found out that students had marginal understanding of some prerequisite knowledge. This formative student assessment prompted the teacher to revisit an old concept and to hold back the next phase of exploration for the time being. The adjustment of teaching strategies is continuously guided by the informative assessment of the teacher,

otherwise known as fine tuning. In this way, assessment informs instruction and it permeates the phases of the cycle.

Kolb's circular nature of the learning cycle cannot be taken literally, for the simple reason that the last phase of evaluation logically does not go right back to engagement at the very beginning. If the meaning of the cycle is taken literally then learning will keep going round and round, never reaching a destination. When learning is taken as a journey, then the circular path needs to be reconfigured to show a distinct beginning and a distinct finish. It is proposed that successful learning transfer can be the designated exit of the cycle. Interestingly, if the circular path is flat and continuous it would be impossible to designate an exit. Hence the problematic two dimensionality of the learning circle is logically the next issue of discussion.

Many teachers believe that the learning cycle is a form of scaffolding. The building of a physical scaffold depends on the meticulous "layering" of the structure. A new layer of learning is built on the structure of a previous layer and so on. If the building knowledge is likened to the building of a scaffold, then the learning cycle will no longer be flat or two dimensional. Instead, the learning cycle will become a three dimensional circular structure or spiral going up. The building of a structure going up also implies an increase of potential energy as defined by the new higher position gained. Learning with a high potential energy has a better chance to make connections to other areas of learning. The expression of saying that teachers bring students to a new height of achievement may be offered to explain literally the three dimensionality of learning.

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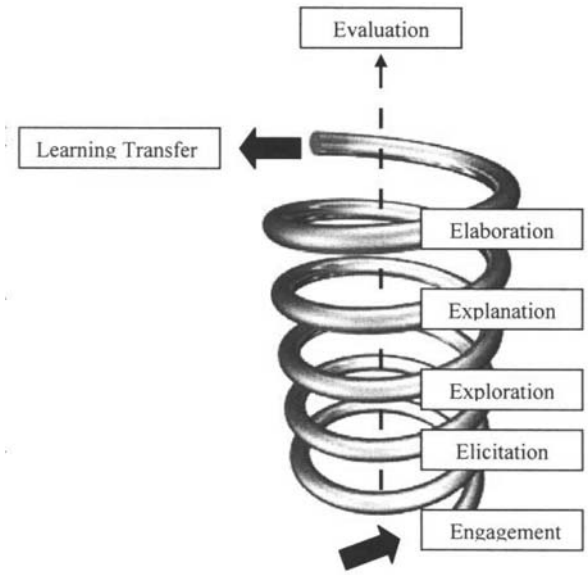

Figure 2: The Learning Spiral

The Learning Spiral

In view of the four issues of the learning cycle discussed, a suggestion is made to improve the obscurity of handling student misconception; the placement of evaluation at the end of the cycle; the circular path of the cycle with no apparent exit; and the challenging interpretation of the two dimensional cycle. A suggestion for improvement follows. First an elicitation phase is added to the cycle, second the evaluation process is made continuous, third we designate learning transfer as the exit of the circle, and fourth the cycle is reconfigured in a three dimensional structure. All the suggestions for improvement point to the creation of a revised learning cycle called a learning spiral (figure 2).

Integrating the Learning Spiral in Lesson Planning

Let us walk through a high school genetics (monohybrid cross) lesson to see how the different phases of the learning spiral are integrated. In the era of standard driven teaching, the first task we need to take care of is the alignment of the lesson to the state goals, the Illinois Learning Standards (ILS), and benchmarks in science. The lesson, though simple in nature, tightly integrates the knowledge and skills of the three Illinois state goals to prove the point that an effective lesson is seldom taught in isolation of any single goal. The goals, ILSs, and benchmarks connected to the genetics lesson follow:

State Goal, Standard, and Benchmark Alignment

State goal 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments, and solve problems.
Standard 11A: Know and apply the concepts, principles, and processes of scientific inquiry.
Benchmark 11.A.4c: Collect, organize, and analyze data accurately and precisely (early high school).
State Goal 12: Understand the fundamental concepts, principles, and interconnections of the life, physical, and Earth/space sciences.
Standard 12A: Know and apply concepts that explain how living things function, adapt, and change.
Benchmark 12.A.4a: Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms (early high school).
State Goal 13: Understand the relationships among science, technology, and society in historical and contemporary contexts.
Standard 13A: Know and apply the accepted practices of science.
Benchmark 12.A.4b: Assess the validity of scientific data by analyzing the results, sample size, similar previous experimentation, possible misrepresentation of data presented, and potential sources of error (early high school).

Lesson Objective Alignment

Ms. Smith teaches a lesson about the simple Mendelian genotype ratio of 1:2:1 for the offspring in the first generation produced by crossing two pure strains (state goal 12). She uses the hybrid crossing in dog breeding as a simple experiment simulation (state goal 11) to illustrate this phenomenon. To demonstrate the statistical nature (state goal 13) of the results obtained in the cross and the effect of dominant and recessive genes, Ms. Smith engages the class in a game of chance by drawing gene ping-pong balls out of a fish bowl.

The lesson objective defines the destination of the lesson and many teachers make it a point to write them on the board to help the class (and the teacher!) stay focused on what is to be learned. Robert Mager (Mager, 1997) once said, "If you do not know where you are going, you might end up someplace else." The learning objective of Ms Smith's class states, "At the end of the lesson the student should be able to predict the approximate proportions of each gene combination obtained with 100 trials of drawing the gene ping pong ball out of a fish bowl." The objective clearly states the three important variables of the objective. They are the expected outcome, the level of performance, and the condition of achieving the outcome.

The use of discrepant events and issue oriented problems are appropriate to engage students and motivate them to find out more.

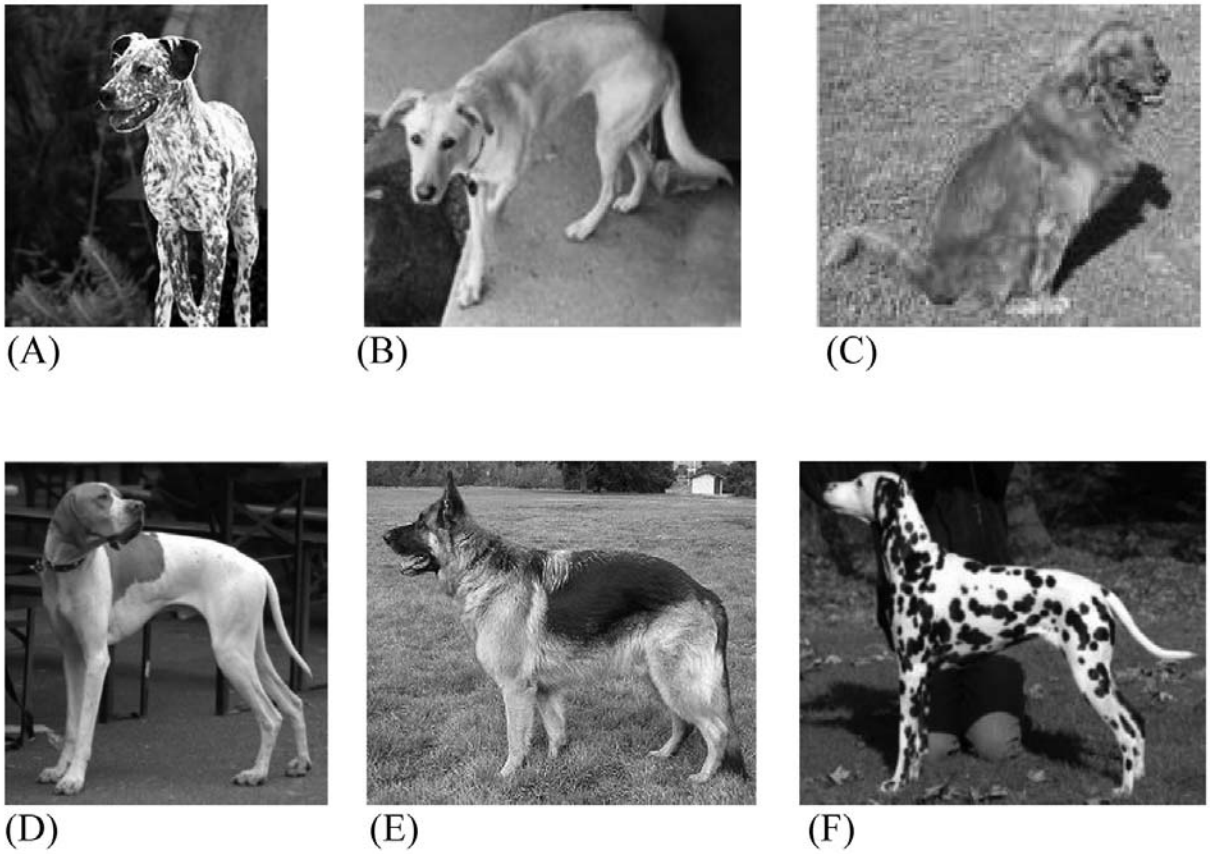

Figure 3: Dog Pictures

Applying the 6Es of the Learning Spiral

Teachers who are already familiar with the 5Es of the learning cycle will have no problems accommodating the 6Es of the learning spiral with only few adjustments. Let us examine how the 6Es are applied to teaching a monohybrid cross lesson.

Engagement

The purpose of engagement is to invite the interest of the students. This is the appetizer before the entree. The use of discrepant events (Wong 1989) and issue oriented problems are appropriate to engage students and motivate them to find out more. Ms. Smith uses a scenario based on personal interest and a societal issue of dog breeding. She shows two dog pictures (figure 3), A and B. Dogs A and B are mixed breeds. How do professional dog breeders cross different dog characteristics to produce new breeds? If A and B are the result of cross breeding, then what can one expect about the characteristics of their parents? Ms. Smith then shows four more dog pictures (figure 3). They are C, D, E, and F. If characteristics of the offspring resembles that of the parents, then who are the parents of A and B? A novice to the science of genetics initially takes only the external appearance into consideration. Students guess that F is one possible parent of A because dog F has spots, resembling dog A. Some may add that D is the other parent of A because of its body shape and short hair. At this point in the lesson the teacher introduces the term *phenotype*, knowing that students now have a knowledge base to assimilate the new term. The dog pictures prompted a number of questions regarding the possible offspring and parent characteristics. How do we know whether A is the offspring of D and F? How do we know that C and E are the parents of B? Toward the end of engagement students are stirred to find out more!

Elicitation

One student explains, "The phenotype of the offspring is the average of the two parents. If one parent has long hair and the other has short hair

	B	**b**
B	BB	Bb
b	Bb	bb

Figure 4. Punnett square of monohybrid cross.

than the offspring will have the average of the parents, which will be medium length hair." This obviously is correct if a gene is expressed as incompletely dominant. Knowing that this is a misconception in the situation of a gene that expresses itself as completely dominant or recessive, Ms Smith asks the student how is it possible for a tall offspring to have a tall parent and a short parent. At this point, Ms. Smith draws out the misconception of the student and offers the student a different (and better) explanation. During the clarification discussion, a wider concept is developed to include the use of *gene, chromosome, genotype, dominant, incomplete dominant, recessive,* and *incomplete recessive.* It is important to note that misconceptions have a tendency to turn off potential positive experiences down the road. Often times when the pieces do not fit together, the teacher must help the learner to break down old ideas and reconstruct them.

Exploration

Another student suggests that the different characteristic combinations in cross breeding may be tested by using a physical model. This particular student draws this suggestion from his experience of playing board games where dice are used to roll out a combination of numbers. A number of students agree to the model proposal due to their familiar experience with dice and board games. At this point, Ms. Smith introduces the game of chance by the use of four ping pong balls. Two balls are labeled "B" for black coat and two balls are labeled "b" for white coat. The four balls are placed in a deep bowl. Without looking, each student draws two balls from the bowl at a time. They record the ball combination such as BB, Bb, or bb, and record the results in a Punnett square displayed on the board. To achieve one hundred draws with a class of twenty-five students, each student draws four separate times from the bowl. The term *monohybrid cross* is explained and used in the discussion of crossing different traits of organisms.

Explanation

A Punnett square (figure 4) is a simple graphical way to explain how the genes from each parent might combine to produce an offspring. The Punnett square duplicates the observation that the reproductive cells (eggs and sperm) get only half the normal number of chromosomes. This cross yields three possible genotypes in the offspring: BB, Bb, and bb. In addition to showing the possible genotypes of offspring, the Punnett square also indicates how likely a particular offspring of this cross is to have a given genotype. In this case, there is a one in four (25%) chance that the offspring would be BB, two in four chance (50%) that it would be Bb, and one in four chance (25%) that it would be bb. This is like throwing a four sided die, with BB written on one side, Bb written on two sides, and bb on the last side. This die gets thrown once for each offspring. If the cross produces several offsprings, each gets one toss of the die (except identical twins). Thus on average, about 25% of the children of this cross should have a genotype of bb. A Punnett square, illustrates the results of a cross between two F1 heterozygous individuals. The result is a 1:2:1 genotypic ratio and a 3:1 phenotypic ratio.

Figure 5. Punnett square of dihybrid cross.

	RY	**Ry**	**rY**	**ry**
RY	RRYY	RRYy	RRYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
rY	RrYy	Rryy	rrYy	rryy

Elaboration

Students and teachers can assess the depth of understanding of the newly formed ideas. The new knowledge/skill learned then becomes familiar knowledge (for example, the monohybrid cross) on which to connect new learning (for example, the dihybrid cross) – where the cycle reaches the ready stage of learning transfer. A dihybrid cross is a cross between two individuals identically heterozygous at two loci for example: RrYy/RrYy. A dihybrid cross is often used to test for dominant and recessive genes in two separate characteristics. Such a cross has a variety of uses in Mendelian genetics. In the pea plant, two characteristics for the peas, shape and color, will be used to demonstrate an example of a dihybrid cross in a Punnett square. "R" is the dominant gene for roundness for shape, with lower case "r" to stand for the recessive wrinkled shape. "Y" stands for the dominant yellow pea, and lower-case y stands for the recessive green color. By using a punnett square (the gametes are RY, Ry, rY, and ry) you observe the results (figure 5).

Evaluation

Evaluation is an on going process that allows the teacher to determine if the learner has attained understanding of concepts and knowledge. Evaluation and assessment need to occur at all points along the continum of the learning process.

Conclusion

The learning spiral invites learners to the exciting experience of inquiry learning and to help them to achieve an elevated height of achievement. As classroom teachers we need to remember that based in the cognitive learning principle of assimilation, the learning spiral implies that learning cannot be imposed on the learner. Instead, it is developed progressively by the learner, beginning with a curiosity to learn, and progressing to conception and internalization. Let learning be student centered. Give students the experience to engage, elicit, explore, explain, eloboarate, and self evaluate their own learning. Use the learning spiral and take your students to a new level of academic success.

References

Carin A., et al. (2005). *Teaching Science as Inquiry*. Upper Saddle River, New Jersey.

Dewey, J (1938). *Logic: The Theory of Inquiry*. New York: MacMillan.

Karplus, R., et al. (1977). *Teaching and the Development of Reasoning*. Berkeley: University of California Press.

Kolb, D. A. (1984) *Experiential Learning*, Englewood Cliffs, NJ.: Prentice Hall

Mager, R. (1997). *Preparing Instructional Objectives: A Critical Tool in the Development of Effective Instruction.* Atlanta: the Center for Effective Performance.

Swan, M.B., (2001). *Dealing with Misconceptions in Mathematics*. In: Issues in Mathematics Teaching. pp. 147-165

Wong, O. (1989). *Is Science Magic?* Childrens Press, Chicago

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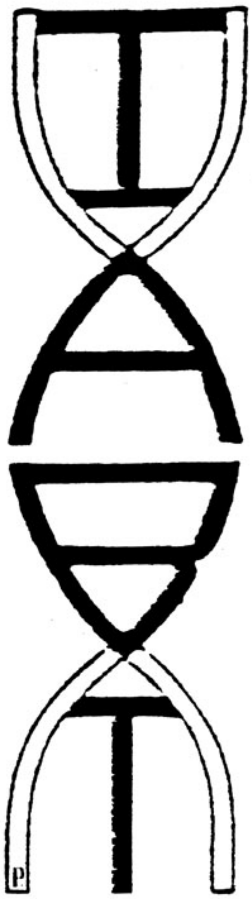

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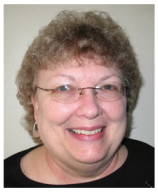





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