SPECTRUM

ISTA

Winter 2015, Vol. 40, No. 3

The Journal of the Illinois Science Teachers Association

In this Issue: **Engaging Students in Current Topics: Ecosystem Disruption**
What We Know About Preadolescents
Using Heart Models for Physiology Teaching and Learning

Plan Ahead:
NSTA National Conference on Science Education - March 12 - 15, 2015 in Chicago, Illinois
ISTA Annual Membership Meeting March 13, 2015, Noon, Regency A, Hyatt Regency Hotel

Illinois Science Teachers Association

Spectrum

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Volume 40, Number 3

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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: White Oak Mine. Photograph courtesy Marty Cox. See Science in the South on pages 7 - 9.

SPECTRUM

The Journal of the Illinois Science Teachers Association

Winter 2015 Volume 40, Number 3

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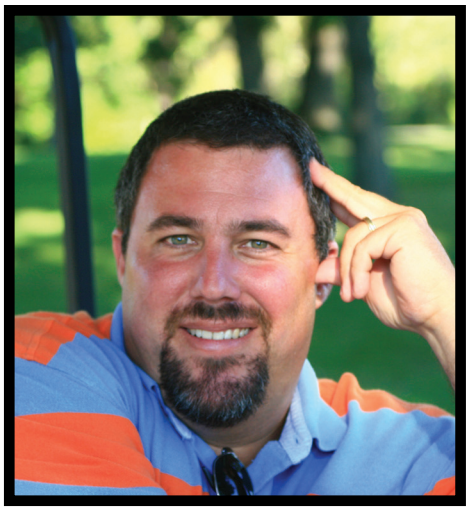
Paul Ritter



Dear Team ISTA:

Hip, hip, hooray, it's the new year. I love this time of the year. Resolutions, a new year, a new semester ... electricity in the air. Is it just me or does it feel like we just started school year? Where does time go?

I wish I knew. If you are like me there are so many things you would like to do, learn, try, or teach in your classroom.

Currently, I am working on setting up a project for my students to do a comparison study of the water in our local Vermilion River and a river in Nebraska. Equally exciting is that my students are going to be working with Dr. Alan Kolok and the students from a school system in Nebraska. You may remember Dr. Kolok from his groundbreaking research on ground water and the Lil' Miss Atrizine Project. It is an honor just to be able to speak with him, let alone have my students work alongside him. Another project that I want to do with my students is to conduct a comparison study using weather balloons to measure the concentration levels of carbon dioxide in our upper atmosphere. Hopefully, I will find the time and resources to make it happen.

As many of you have noticed by now, the ISTA website has had a major makeover. To echo this, ISTA is also changing how we send out communications to our members. We have done extensive research on how to maximize and modernize the way we can connect with you more effectively and efficiently. Emily Dawson, ISTA Director of Digital Presence, has worked diligently over the past few months to complete the make over and transfer our membership. One of the major goals behind our overhaul is to expand your access to valuable resources. To compliment her hard work, other ISTA leaders have been working on the new Illinois State Board of Education professional development requirements and the digital infrastructure that is needed to comply and serve our membership more effectively.

I am also excited to announce the debut of the ISTA Community News…a weekly compilation of news, professional development opportunities for our members, announcements about classroom resources, and updates on the new Illinois Learning Standards for Science and its associated materials, assessments, and so forth. The ISTA Community News will follow the model of the NSTA news e-blasts and will become our first line of communication with our members. It will replace our list

serve which has been hosted by our distinguished colleagues at the Office for Mathematics, Science, and Technology Education (MSTE) at the University of Illinois at Urbana-Champaign, Dr. George Reese and Mike McKelvey. The service provided by MSTE has served our organization wonderfully for at least eight years and our membership has enjoyed and valued the connections that have been made through our list serve under their expert guidance and oversight. We sincerely appreciate their dedication to help us promote excellence in science teaching and learning in Illinois. We are proud of our heritage with MSTE.

We truly hope that this new change will not only prove to be a more useful tool for our members but also a more effective way to communicate all of the great things that are going on around the State.

If you have notices for the ISTA Community News, please send them to TheHUB@ista-il.org. Upon receipt of such notes, we will apply our criteria for inclusion and post the information appropriately through our website, e-blasts, newsletters, Facebook, Twitter, and so forth.

In closing, I just want to say Happy New Year to each and every one of you from your family at ISTA. We truly hope that all your wishes come true in the New Year. Thank you so much for all you do for your students. Together we are making a positive change in science education. Together we are making a difference.

Yours for Education,

Paul

NSTA 2015

in Chicago

at McCormick Place

March 12 - 15, 2015

www.nsta.org

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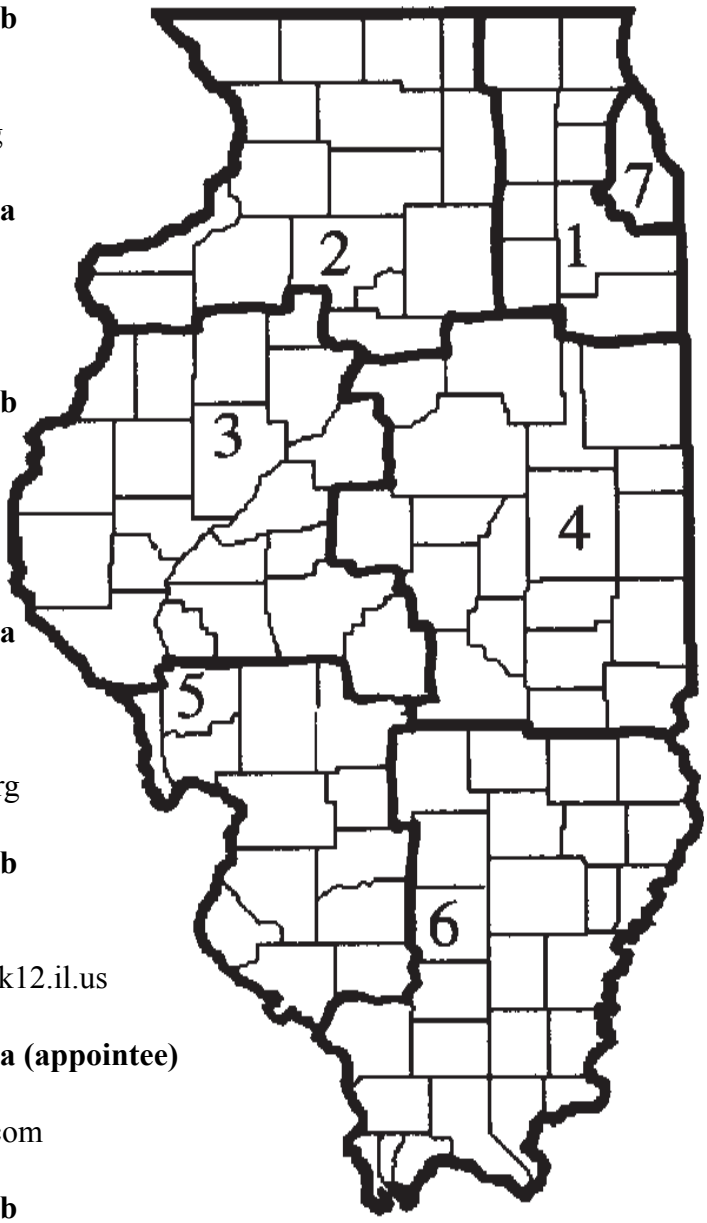

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According to ISTA bylaws, regional directors may serve only two consecutive terms. Directors noted with an "a" are in the first of a two-year term; those noted with a "b" are in the second consecutive two-year term.

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Career Development	Kendra Carroll
Code of Conduct	Tara Bell
Digital Presence	Emily Dawson
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Special Education	Maya Israel

Making Differences for You

ISTA Membership Benefits

- Discounted rates for conferences including 2015 NSTA Chicago
- Lifelong science education friends, connections, and resources
- Ability to participate in PEL hour-credit workshops that will connect with new Illinois science standards and the national NGSS standards
- Ability to collaborate with leading Illinois science teachers from kindergarten through college levels
- Access to discussion forums
- Professional development opportunities
- Access to ISTA's ListServ
- Free monthly e-mail newsletter or e-blast containing current science information and events of interest to attend in Illinois
- Additional memberships (by mail) for convenience, shared benefits, and savings for the below:
    - Fermilab Friends of Science Education, http://ed.fnal.gov/ffse
    - The Illinois Section of the American Association of Physics Teachers, http://isaapt.org/
    - The Illinois Association of Chemistry Teachers, www.iact-online.org/
    - The Environmental Education Association of Illinois, www.eeai.net/
    - The Council for Elementary Science International, www.cesiscience.org/
    - The Chicago Council for Science and Technology, www.c2st.org
- **Join ISTA or renew your membership at www.ista-il.org/membership**

Science in the South

Science in the South was held November 6 - 8, 2014 at Southern Illinois University at Carbondale. The luncheon keynote speaker was John Schwegman from the Illinois Department of Natural Resources. Conference participants enjoyed a variety of presentations, workshops, and exhibits to advance their STEM teaching and learning.

Science in the South goes one thousand feet underground to bring coal and the mining of natural resources to the surface of education!

On November 8, 2014, Science in the South offered a field trip to White Oak Mine Number 1 located in Hamilton county. With access to 1.3 billion tons of recoverable coal, attendees got a firsthand view of what is involved in safely and effectively recovering one of our region's most plentiful natural resources.

Tim Adkins, Director of Health, Safety, and Training at White Oak Resources, assisted by Benji Bowling, took the group through the safety training necessary, prior to going underground. The first line of defense is the self-contained self-rescuer (SCSR). Used for initial immediate need of air and protection from potential gases. This gives the miner time to reach the stored self-contained breathing apparatus (SCBA).

SCBA, a much larger unit that is both high tech and reusable, gives miners up to one hour of breathable oxygen before refilling is required. White Oak is invested in worker safety, stocked with the best equipment possible to help ensure a safe environment for their workers. White Oaks is the only mine in this area to employ such equipment. The SCBA allows miners to both communicate and refill their tanks, two very important components when time is of the essence.

Above, above right, and right: Cindy Birkner, ISTA Region 6 co-director and science teacher at Webber Township High School, along with Harry Hendrickson, ISTA executive director, don their safety equipment during training.

With training complete, the group head for the man lift to journey one thousand feet straight down into the coal mine.

Science in the South

Thanks

White Oak Mine president Scott Spears
for providing the mine tour and catering.

Tim Adkins and Benji Bowling for sharing their mining expertise with conference attendees.

Marty Cox for group and underground photos.

ISTA Annual Membership Meeting Friday March 13, 2015 Noon - 1:00 PM Regency A Hyatt Regency Hotel McCormick Place

Do *You* Know an Exemplary Science Student?

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

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

NSTA National Conference

Coming to Chicago!

March 12 - 15, 2015

McCormick Place

Want to Volunteer?
Assistance is needed from volunteering at the conference helping attendees, to supervising field trips, stuffing conference bags, and more. Volunteers may be eligible for waiver or partial waiver of registration fees, depending on the number of hours volunteered. Go to the ISTA website to sign-up.

Sign-Up to Volunteer
https://docs.google.com/forms/d/1PMHmxhPXjN2DMpkMsZJ4W3ZAsYOaftQFEYH0rnxINmI/viewform?usp=send_form

Local Contacts

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Program Coordinator Natacia Campbell - natacia.campbell@gmail.com
Local Arrangements Coordinator Judy Scheppler - quella@imsa.edu

Conference Strands
Natural Resources, Natural Partnerships
Teaching Every Child by Embracing Diversity
The Science of Design: Structure and Function
Student Learning: How Do We Know What They Know?

NSTA 2015

Book Review

By Thomas Hansen

Engineering Essentials for STEM Instruction: How Do I Infuse Real-World Problems into Science, Technology, and Math? 2014. Pamela Truesdell. Alexandria, VA: Association for Supervision and Curriculum Development. 56 pages.

Pamela Truesdell presents, in this very brief book, a clear picture of what engineering does, what it consists of, and how it works. These basics are very important in providing a starting point for what is to follow in the text.

Another ARIAS book, this one shows lots of good definitions and uses an extended example of a project related to the environment. In this lesson, students must design and build a portable compost bin, and it has to work. The author shows how the students must employ the scientific method to the problem of coming up with a successful compost bin. Starting with defining the problem, students must go through additional steps and asks questions along the way.

This text is typical of the ARIAS series from ASCD - lots of important core information presented in a brief space with at least one long example to show how to use the basic key concepts presented. The book includes very clear steps of the engineering process and how to establish assessment strategies for monitoring student growth, complete with design of suitable rubrics (pp. 44-52).

The ARIAS series consists of several very brief books on a well-defined topic. The books are usually about fifty pages long, and most seem to include quite a few references to pursue for more information. These books will work well in a faculty lounge setting, where not only can they be read by subject matter teachers within their field, but they also can be read by teachers from other fields. Because they are so brief, these books can inspire quick understanding of other fields such that cross- and interdisciplinary units can easily be plotted out.

In Illinois, for example, teachers using the Illinois Foreign Language Goals in their units and lessons can draw upon the definitions and engineering methods spelled out in this book. Using the principles of the scientific method, and the questioning components of an engineering approach, we can forge links into other fields and classrooms - such as those developing language skills. In three benchmarks, we can see the connections between world languages and engineering:

30.A.5b Use the target language for math skills such as statistical analysis, estimating and approximating in experiments or research projects.

30.A.4c Use the target language to analyze the impact of human activity on the natural environment in areas where the target language is spoken.

30.A.5c Use the target language to analyze current science issues (e.g., ecology and the environment, space exploration, health) from the perspective of speakers of the language.

There are other good uses for this sort of brief book. For example, in a half-day or full-day professional development session, teachers of all fields can easily read this book quickly, and then work together on a theme or unit or lesson. The compost bin problem is a good one because it is so tangible. Looking at the national and state benchmarks for science, and the outcomes of the common cores for math and technical areas, we can readily come up with other ways to use the engineering components and strategies in other learning areas, such as English, language arts, reading, and fine arts.

I would recommend this book for a variety of uses, including open-library usage where teachers check out books on a regular basis as part of their professional development and reflection. This book could also be a great conversation starter at meetings.

Articles

Engaging Students in Current Topics: Ecosystem Disruption

Sarah O'Leary-Driscoll
Illinois Mathematics and Science Academy

One of the most compelling aspects of studying biology is that it has immediate relevance to the world around us. It is the study of life, which can give us amazing insight into how we as organisms work as well as our place in Earth's ecosystem. This second point is especially crucial for our students to understand, as the Earth is in many ways in a state of ecological crisis. Ecosystems across the globe are changing, often as the result of human influence, and an understanding of the causes and effects of these changes is essential for our students, especially those in high school, as they will not only be seeing the ripple effects and impact within their lifetime, but will also soon become the next generation of leaders, politicians, administrators, business leaders, and drivers of industry, putting them in a position to make positive change for the future.

Student Outcomes

The activity described below was designed to help students gain an understanding of how changes in biological diversity, both in terms of extinction and loss of population numbers, is impacted by and has an impact on human society, as well as to have them examine and share specific examples. It was used as part of Scientific Inquiries: Biology, the introductory biology course for sophomores at the Illinois Mathematics and Science Academy.

The lesson plan for this activity was divided into three parts. First, the students were given a short reading on defaunation and ecosystem disruption which led to a class discussion about the issues described. Then, the students were presented with the activity, and chose a topic from a list to research in collaborative groups. Students did some of their research work in class, allowing them to collaborate and to get feedback and guidance as they researched their topics. The topics were chosen for their relevance and currency, so most students were able to easily find basic information on their subject in news articles. From there they were encouraged to follow their line of research to more scientific sources, such as peer-reviewed journals and reputable websites. They were given several days outside of class to finish up their research, and to create and prepare to give their presentations. Finally, the students then gave these presentations in class and discussed each example. This activity addressed components of the science and engineering practices, disciplinary core ideas, and crosscutting concepts from the Next Generation Science Standards framework listed in Table 1.

Contextual Reading

This reading was given to students in order to provide them with some background information in regard to the current state of extinction and defaunation in our global ecosystem and the role of humans in ecosystem disruption. The reading was also the basis for a class discussion on these topics. This information was taken from: Dirzo et al (2014), Defaunation in the Anthropocene, *Science*, 345(401).

The Current Extinction: Defaunation and Ecosystem Disruption

Scientists estimate, conservatively, that there are 5 to 9 million different animal species on the planet. But that number is continually changing and, unfortunately, dropping, as we are likely losing 11,000-58,000 species annually, and evidence suggests that on average, there has been a decline of about 28% in terms of numbers of individuals within a species over the last four decades. Both of these statistics are vitally important. The critical nature of the first is perhaps more obvious, as total loss of a species is irrecoverable, but the second, a decline in population sizes of species, though more subtle, may actually have more immediate impact and represents an area where positive progress can be made.

The term defaunation (fauna being a description of wildlife diversity) is starting to be used by scientists to cover both the loss of species and declines in numbers within a species, in hopes that its similarity to the term deforestation, which represents an issue the public is highly aware of, will generate more public attention and support for this vital area of biological study and conservation. In fact, the topic and current research findings were the focus of a July 2014 issue of *Science* and conversations are ongoing in the biological community about the extent of current extinction rates. Some studies suggest that these rates are 100-1000 times higher than normal background extinction rates, which may mean that we are currently in the early stages of the next mass extinction for our planet.

So far, research into defaunation has given us important information about current trends, such as the knowledge that amphibians are among the most threatened vertebrates. Amphibians may not be the first organisms you'd identify as having a measurable impact on an ecosystem, or on human well-being, but they play an important role in maintaining balance in aquatic ecosystems. Without them, there can be an increase in algae and detritus, higher than normal nitrogen levels, and a disruption in the metabolic cycles of the ecosystem. Other consequences of defaunation are just as critical. Insect species, which are responsible for pollinating 75% of the world's food crops, are declining globally. A decrease in small vertebrate predators also has an impact on food production, as they normally help keep arthropod pests in check. These pests are responsible for up to 15% of the losses in major food processes.

Apart from food availability, one of the other major concerns for human populations is health, which, too, can be affected by loss of species diversity and decline in organismal populations. Specifically, research has linked defaunation to increases in disease transmission and prevalence due to changes in host abundance and behavior. Declining numbers can also have a significant impact in parts of the world where wild animals are a main source of food, and extinction of species means the loss of current or potential future sources for pharmaceutical compounds.

The critical nature of defaunation is clear, but why does it occur? Most of the causes, either directly or indirectly, stem from disruptions of the natural interactions and balance in an ecosystem, a phenomenon that can often be traced to human influence. Examples like habitat fragmentation or complete loss of habitat and introduction of invasive species directly result from human populations, while other examples like climate change represent how humans affect other aspects of the ecosystem that can then impact defaunation patterns. When we compare current extinction trends to historical data, especially of the past major extinctions, the human influence is obvious and a unique feature driving ecological changes, some of which were, unfortunately, preventable.

While these trends may seem somewhat depressing, the good news is that the more we understand about what is happening and the causes behind ecosystem disruption and defaunation, the better we, as a society, will be able to come up with solutions to slow down or in some cases even repair some of the damage that has been done. Already, scientists are using what they have learned to plan for the

Contextual reading on defaunation and ecosystem disruption.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
- Constructing Explanations and Designing Solutions - Engaging in Arguments from Evidence	LS2.A Interdependent Relationships in Ecosystems LS2.C Ecosystem Dynamics, Functioning, and Resilience LS4.C Adaptation LS4.D Biodiversity and Humans	- Cause and effect - Stability and change

Table 1: NGSS. Components of the NGSS Framework addressed by this activity.

Reading Discussion

After students read "The Current Extinction: Defaunation and Ecosystem Disruption," we held a class discussion to ensure that students had an appropriate contextual understanding for the activity and to provide an opportunity for them to share their responses to the reading. To begin the discussion, students were asked to brainstorm and share with the class what sorts of things came to mind when they heard the word extinction, prior to the reading. Many of the responses came in the form of some of the more well known endangered species, such as pandas, whales, and cheetahs. They were asked to think about why these were the sorts of animals that came to mind, and responded with: "They're impressive." "They are cute." "People like them." and other similar commentary. This led to a thoughtful discussion of both benefits and drawbacks of having these as focal points in society's view of what's happening to organisms as a result of ecosystem disruption, as they represent only one facet of a very complex problem. From there, students were asked to talk about what the differences between extinction and defaunation were, and how the loss of species and declines in numbers within a species could have ripple effects throughout an ecosystem and up through human society. When asked what they found most interesting or surprising about what they read, several students brought up how startling the statistics were in terms of how many organisms and species are being lost annually, and there were many comments like: "I never thought about why insects would be important." "I thought the push to save all the animals was more just because it was just the right thing to do, I didn't realize it could have a big impact on us." The real word applicability of this topic, as well as its connection to causes that are currently quite trendy, kept the students engaged, and they were eager to give their input. Overall the reading seemed successful in getting students to broaden their perspective on the risks we are currently facing, and why understanding ecosystem disruption is so important for our future.

Defaunation and Ecosystem Disruption Activity

After the discussion, students were given the below activity so that they were able to connect to a real world example of the phenomena covered in the reading. Examples of topics used can be seen in Table 2.

Your goal for this activity is to examine a specific example of ecosystem disruption and share what you have learned and ideas you might have for the future. With your partner or group, research one of the topics relating to ecosystem disruption and defaunation listed in Table 2, and then address the following:

- How is this topic an example of ecosystem disruption? What change has occurred? What was the normal state of the ecosystem and the place of the organism involved in it? How might this disruption contribute to defaunation or extinction or how is it caused by these phenomena?

Table 2: Examples of Ecosystem Disruption.

- Warm Weather in the Arctic
- Vulture Decline
- Aquatic Osteoporosis
- Phosphorous Pollution in Lakes
- Disappearing Bees
- Death of Sea Stars
- Reproductive Changes in Mosquitofish Related to Population Size
- Global Stilling and Wind Change
- Coral Bleaching
- Asian Carp as an Invasive Species
- Sumatran Rhino Decline
- Ocean Acidification
- Zebra Mussels as an Invasive Species
- Rabbits in Australia: Attempt at Control of Invasive Species Resulting in Coevolution with Virus
- Changes in Fish Size as a Result of Fishing Practices
- Geese Populations: Change in Habitat Range and Status as Nuisance/Invasive Species
- Niche Invasion by Fruit Bats as Results of Nipah Virus and Deforestation
- Warming Sea Surface Temperatures and Cholera Outbreaks

- Has human influence played a role in this ecosystem disruption directly or indirectly? How?
- How does this disruption impact other organisms in the ecosystem? Are there specific species interactions that have been affected?
- How might this change impact human society and well-being?
- What is currently being done to mitigate/reduce the impact of this disruption, if anything? What steps might be taken to avoid it in the future? Are there are any other ethical or societal issues involved (such as the balance between habitat destruction and necessity of crops)?
- With the information that you have gathered, prepare a 5-7 minute presentation on your topic. Include appropriate citations and a works cited section.

You will be assessed on how well you answer each question, and how you make connections between your specific example and the topic of defaunation and ecosystem disruption as explained above.

Student Assessment

Students were assessed on how well they answered the questions in the activity, including how well they were able to use the information in their sources, how clear their explanations were, and whether they put their subject in context in a meaningful way. Their visuals, usually PowerPoints, and verbal presentation were assessed separately, as indicated in the rubric presented in Figure 1. In addition, we offered an opportunity for students to earn extra credit by participating in a discussion after each presentation. Extra credit was awarded for asking good questions, differentiated as those that showed thoughtful attention and were extensions of what was presented and not merely clarification questions.

Discussion

One of the risks of employing current events in any classroom is that the information readily available for many of the "hot topics" does not have a sufficient basis in science. One of the successes of this unit was that although a quick google search could provide the relevance of the topics, the activity was designed to go beyond the easy answers, requiring students to make connections and provide context. They responded positively to this, and were especially intent on discovering what was currently being done to "fix the problems" that their topic discussed.

Likewise, most of the questions after each presentation focused on what was or was not being done in this regard and the discussions were often directed at problem solving, with many comments about what the students themselves thought would be helpful courses of action.

The presentations themselves varied in terms of quality, as might be expected, depending on the effort and attention that students paid to their creation, and how well they prepared to present their information. The most frequent mistakes students made were technical rather than in the content. They tended to include too much

Criteria	Fails to Meet Expectations	Meets expectations	Exceeds Expectations
Explanation of topic, including how it has been disrupted from its normal state, and how it contributes to or is caused by defaunation or extinction is clearly explained and supported by evidence from sources.			
Explanation of how human influence has played a role in this ecosystem disruption directly or indirectly is thoroughly explained and supported by evidence from sources.			
Explanation of how this disruption impacts other organisms in the ecosystem is clear, and any specific species interactions affected are included.			
The implications of how this example of ecosystem disruption or defaunation impacts human society and well-being is explained in a meaningful way and supported by evidence.			
What is currently being done to mitigate/reduce the impact of this disruption or prevent it in the future is included, along with any other ethical or societal involved concerns.			
Visual aspect of presentation is well organized and clear, with correctly formatted figures and captions.			
Works cited and in-text citations are present and formatted correctly.			
Verbal presentation was clear, with good pacing and appropriate volume. All group members participated in presenting.			
Presenters were able to address questions asked by instructor and peers.			

Comments:

Topic: _____ Group members:_____

Figure 1: Presentation Rubric.

What is Currently Being Done? Cont.

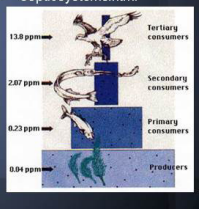
2. Prevent Spreading
   - Informing boaters
   - Setting down new rules and laws referring to zebra mussels (7)

Signs are placed near lakes to inform boaters of how to prevent spread of zebra mussels. http://commons.wikimedia.org/wiki/File:Zebra_mussels_sign,_Antrim_-_geograph.org.uk_-_1625378.jpg

Impact on Human Society

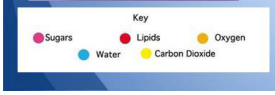
- Increase our exposure to organic pollutants (4)
- Pollutants 300,000 times greater than concentrations of area (4)
- Contaminants passed through food chain (4)
  - Fish consume pollutants, humans consume them (4)

Example of spread pollutants in food chain. https://seagrant.uaf.edu/nosb/papers/2004/seeuonline-septicsystems.html



Zooxanthellae and Coral Relationship

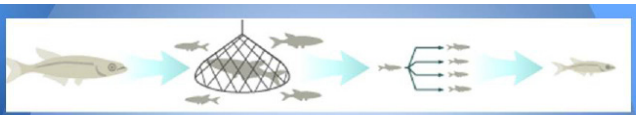
This is an animation that illustrates the mutualistic relationship between coral stomach tissue and photosynthetic algae-zooxanthellae. (9)



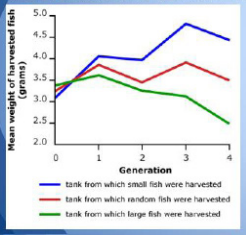
Close-up picture of a coral with zooxanthellae. (14)

Effects on Humans

- Fishing industry (9)
- Tourism (9)
- Medical breakthroughs (9)
- Food (5)
- Storm protection (5)
- Jobs (5)
- Billions of dollars (5)



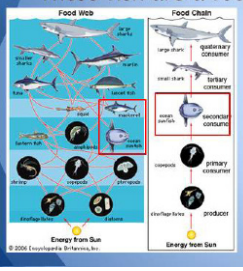
This picture shows the process and reflects the mechanisms present through the evolution of the smaller-sized fishes.(6)



This figure shows how body sizes changed in populations of fishes when certain sized fishes were removed in an experiment conducted by David Conover and Stephan Munch. These evolutionary changes happened in a mere 4 years after 4 generations!(7)

Effects of This Change

- These fish are a food source to many larger species(5)



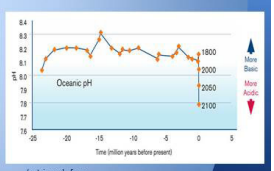
- A decrease in secondary consumers has ripple effects throughout the ecosystem.(5)
- It doesn't only affect organisms in the water.(5)

(5)

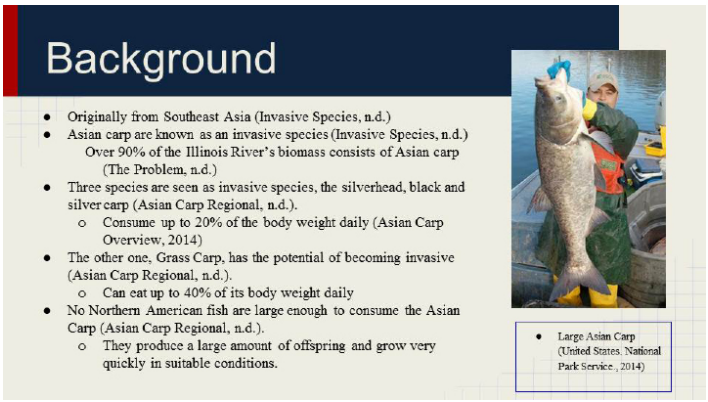
Top Row: Two PowerPoint slide examples for student presentation on zebra mussels.
Second Row: Two PowerPoint slides from the students' presentation on coral bleaching.
Third Row: Two example slides from the student presentation on changes in fish sizes.
Right: Powerpoint slide from the student presentation on ocean acidification.

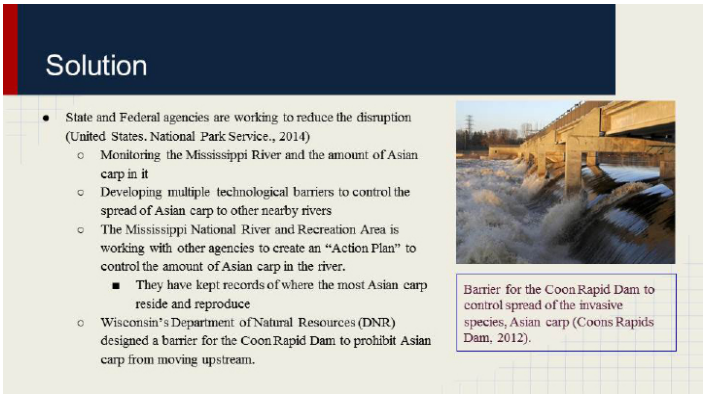
The Problem

- Humans contribute to ocean acidification through man-made machines powered by fossil fuels → CO_2 production (4)
- Decrease in Carbonate ions→ negative effects. A few examples:
  a. Calcifying organisms have difficulty building and maintaining calcium carbonate structures.
  b. Change in behavior of non-calcifying organisms.



(retrieved from http://www.newsecuritybeat.org/2012/10/vu...rable-ocean-acidification-warming/





Sample PowerPoint slides for presentation on Asian carp as an invasive species.

text on their slides, and to read from their slides, as is common when starting out in presenting complex scientific content. Overall the students were able to clearly communicate what they had learned and address questions from their peers.

This was a capstone activity to go along with our ecosystem and species interaction content, and the students were not going to be assessed on other groups' examples, but were expected to participate in discussion about the topics. Adding incentive in the form of extra credit for asking good questions was also a great success as students were more active in the discussion than we expected, and their questions helped to draw out more depth on the topics covered. It was a safe way for them to contribute, as it would not work against them if they were unsure of their question or were not comfortable enough yet with a topic to think of anything. Students indicated that this encouraged them to pay close attention during the presentations so that they could think of creative and interesting questions, especially ones that other people might not also think of.

Unfortunately there will continue to be more and more examples of ecosystem disruption, so the number of possibilities for examples that represent the depth and breadth of this issue will likewise continue to increase. The benefit, though, is that the activity can be easily updated in order to stay current, or altered to include examples that will have more direct relevance to the students. For example, many of the students in my class were from areas near Lake Michigan, the Mississippi river, or other smaller water systems, and recalled seeing signs warning boaters about zebra mussels and the risk of transferring them between waterways. After learning more about them in the presentation, they were able to understand the need for these signs, and were enthusiastic about how important it was for people to follow the guidelines presented to prevent the spread of this invasive species.

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What We Know About Preadolescents

Richard A. NeSmith
Branchville High School

Seldom does school reform consider the students or developmental needs of students.

We cannot expect to understand teenagers without understanding the stage of preadolescence. Here, we will equate preadolescents with that of middle school or middle schoolers. For educators, these two terms are fairly synonymous and though the former tends to address the teachers, the latter speaks of the students with implications for their parents. In addition, it provides more variety and is less redundant, and so, in order to provide a reasonably interesting text, the author will opt to use a number of synonyms to describe our growing students at this period of life who are leaving childhood and working towards adulthood. This will be somewhere between 11 to 15 years of age. Some of the terms used to describe this developmental period at the middle level, and thus, somewhere between fifth and ninth grades, are suggested, including terms having similar meaning, such as preadolescence, pubescence, transescence, and teenager. Thereby, the terms will be used rather loosely to describe those who are entering adolescence, the period of transition from childhood to adulthood. Because there are no clear lines of demarcation, I will often speak of the teenager in comparison to the pre-teen. In all cases, these are students who have yet to reach 21 years of age.

Characteristics of Preadolescents

The concept of adolescence is relatively new in history as a psycho-developmental model. In the Victorian Age, children were looked upon as miniature adults. Most youth move from childhood to adulthood rather quickly, often centered on some rite of passage. There is, however, very little agreement as to what it is, when it begins, and whether it is simply a Western Society phenomenon or a global-wide transition. The biological aspects of puberty are best known and the most agreed upon. Most early theories on adolescence focused on the biological development from childhood towards adulthood. For instance, G. Stanley Hall, the father of adolescence psychology, was one of the first to focus directly on the growth patterns of children prior to adulthood. He prepared many of the norms used by previous generations in determining the maturation stages of development. It was also Hall who coined the concept of storm and stress. From his Darwinian perspective, Hall (1904) proposed that each person's psychological development repeats (i.e., recapitulates) both the biological and cultural evolution of human species (Snyder & Lopez, 2009, p. 150). In other words, ontogeny (the origin and development of an individual organism) is only a brief but rapid recapture of phylogeny (the evolutionary tree of development). Consequently, Hall saw adolescence as a tiny candid snap shot of a period in the history of the human race. This outmoded biological concept states that an organism, during development, reflects all the stages of its evolutionary past, in a step-by-step record[1]. Hall, accordingly, from this perspective, viewed adolescence as a volatile mirror reflection of the sturm und drang (storm and stress) of history of the human race.

Anthropologists Ruth Benedict and Margaret Mead both proposed that adolescence were more a social, cultural phenomenon (cultural relativism) than Hall had suggested. Mead saw the main task for this period to be one of searching for a meaningful identity. She proposed that adolescence, in fact, was possibly a concept or construct created by Western Society and not necessarily one that is recognized by all nations or people, including many of the pre-developing nations of the world where children move into adulthood by way of rites of passage (Vizedom & Caffee, 1960). Such social communal acts by-pass what Western society calls adolescence. Mead's work has faced critics. Her proposition seems to focus too much on the cultural aspect of rites of passage rather than recognizing the biological and psychological aspects of maturation. Adulthood involves taking on adult responsibilities, and typically is indicated by moving into that phase. However, one cannot, while doing so, mistakenly ignore the biophysical changes that are biologically DNA-controlled.

In Raising Emotionally Intelligent Teenagers: Parenting with Love, Laughter, and Limits, Elias, Tobias, and Friedlander (2000) noted that "Not only do raging hormones make everything more intense for teenagers, but they have their own special issues concerning identity, self-confidence, peer pressure, and responsibility, including individuating from their parents." Those hormones are influencing the brain as growth changes it. With these changes come some new traits that seem to be most applicable to the developing adolescent. These include egocentrism, an imaginary audience, personal fable, and feelings of confusion and inadequacy.

Egocentric

First of all, let me set the reader's mind at ease by acknowledging that, foremost, the changes in the brain for the preadolescent have accentuated some of the characteristics, and an inflammation of self-ego, self-interest, and selfishness, is an accurate description. However, as we consider the changes which have occurred in the early adolescent, especially that of significant brain growth. Then we must recognize that such changes have opened up new or restricted mental abilities of thought that were not extensively available to them prior to this period. Like a baby with a new toy, this new "age of thinking" includes propositional logic, the ability to think about thinking itself, the ability to consider "what if" situations, and a newly found enjoyment and ability to invent metaphors, similes, puns, and satire (Messick & Reynolds, 1992). This is why late middle schoolers can easily enter arguments for argument sake. They become argumentative, even if they really agree with what was said. With this (brain growth) comes such cognitive characteristics as sarcasm, abstract thinking, self-consciousness, and seemingly simple answers to all the world's problems. If that isn't enough, they experience feelings of ineptitude, moodiness, anxiety, and sometimes periods of depression. Though, as children, they were already self-centered, this perception heightens during this stage of brain growth. For teens, the world revolves around them.

The Imaginary Audience

Preadolescents believe that others are always watching and evaluating them. This has been called the imaginary audience, and is defined as the "belief that others in our immediate vicinity are as concerned with our thoughts and behavior as we ourselves are" (Elkind & Bowen, 1979, p. 39). The concept suggests that young adolescents are more self-conscious (concerned with, and uncomfortable with, what others think about them) than will be younger children or older adolescents. Preteenagers reach a stage where they are reluctant to reveal themselves to others, especially their own peers. Research seems to suggest that girls are more self-conscious than boys. With a mindset of being "onstage," preadolescents can be quite shy or quite melodramatic. This includes becoming overly emotional, sensational, or attempting to be entertaining. For most, the reaction to their "audience" is to conceal (Elkind & Bowen, 1979), coupled with an over-concerning fixation for how others react to them (Messick & Reynolds, 1992). When one factors in the rap-

id biological changes that are occurring to their body; rapid growth, multiple surges of sex hormones, growth of pubic and/or facial hair, clumsiness due to bones growing faster than muscle, then one can imagine how a preteen might feel that their bodies have betrayed them.

The Personal Fable

Whereas the imaginary audience tends to be a means of protecting oneself by hiding the inner feelings or acting in a manner to conceal the real self, the personal fable affects the outward behavior with less self-control. Elkind and Bowen (1979) define personal fable as "the belief that we are special and unique, will not grow old or die," and so forth (p. 38). Personal fable often influences a preteen or teenager to go where no man has gone before, or at least where no thinking person would go. It can lead to dangerous or risky acts, where either they failed to recognize the dangers or simply ignored them. It sometimes results in a teenager thinking that he or she is so unique that no one could possibly have the problems they have or face the issues they are facing. As one can see, the overlap between the personal fable, the imaginary audience, and the egocentric viewpoint of life creates much of the storm and stress that Hall proposes and that parents and teachers face with these individuals, or they, themselves, are facing. Walsh (2004), rightly, noted that adolescents, at times, do not even get along with themselves.

Feelings of Inadequacy

Prior to pubescence, preadolescents all pretty much have more characteristics in common than different. Girls are usually a few years ahead of the boys in maturity. However, pubescence begins to change all of that. Now, everyone seems to be facing multiple changes, and then, there are those who are feeling like they aren't changing so something must be happening that is keeping them dwarfed or hairless or from having any changes. Suddenly, it seems almost overnight, some preteens have shot up to become much taller, some with deeper voices, some touting near-beards, and some feeling like they haven't changed at all, and thus left behind. With the additional changes that are taking place in the brain, the teenager begins to have unusual feelings (many for the first time) that they are standing out from the crowd like a sore thumb. And, this occurs during a time when one's peers become very important in his or her life. If there is anything that a preteenager does not want to happen, it is to be different from the crowd!

Confidence can diminish. Skills can seemingly be lost, and fitting in becomes somewhat of a masquerade as the taller students enter the classroom in crouched-like ways hoping no one will notice them for their new-found height. Voices will unexpectedly shift in mid-sentence to sound like screeching or a bass tuba. The foot size of some of the boys' shoes will begin to look like water skis. To avoid the feeling of inadequacy, they begin to form cliques (safety groups) in which they feel protected from the emotions created by change, or from the hurtful words of others about such changes. Though these groups eventually include the opposite sex, in the early days of pubescence, they will still be forming buddies of the same gender. By the time they leave middle school many have expanded their groups, of which those of the opposite sex will be included. Some mid- to late-adolescents will begin to spend more time with the opposite sex than with their own gender as the dating drive develops. Feelings of inadequacy can be overcome, but are often dealt with by many teenagers through the formation and connectedness with peer group(s).

Preadolescent/Adolescent Needs

The very nature of the transformation that is occurring within the body and mind of a pre-teen creates scores of changes, and thus, establishes certain needs that were either not present between the ages of birth to ten or twelve years of age. In actuality, maturation (pubescence, to be exact) can occur as early as ten and as late as 16. The rise of hormones, such as gonadotropins, are followed by a rise in gonadal (sex organs; testis or ovaries) secretions. This is not the first time in the child's life that such hormonal surges

have occurred. The first surge creates a hormonal imprint which is foundational for future changes, whereas the second (at around age 7) targets the androgenic (male characteristics) zone of the adrenal cortex (Sizonenko, 1978). This third surge then begins to change both mind and body.

Many of these changes seem to catch the pre-adolescent off-guard, and this, itself, creates unique needs and problems. When those changes also catch parents off-guard, double trouble can result. In order to understand life as perceived by the preadolescent who is experiencing pubescence, we need to consider these changes and how they directly and indirectly affect the child who is on the journey to adulthood to be able to determine needs that may not have existed previously.

Abraham Maslow (1970, 1943) recognized what he believed to be five basic needs of humans (see Figure1). He considered these to be the lowest and the most basic need, which tend to be centered on physiological needs (breathing, food, water, shelter, homeostasis, excretion, and so forth). Once these needs are met (to some acceptable degree) then the next need in question as a main focus is safety. Safety can be defined as security of the body, resources, morality, family, health, property, and employment. Below we have made an application of Maslow's hierarchy of basic needs to the preadolescent/adolescent.

Physiological Needs

If Maslow's premise is correct, then the physiological needs are the most primitive and the ones most important in providing survival for humans. This means, for the pre-teen and the teenager, food, water (fluids to drink), sleep, and so forth. are first and foremost. In the classroom, a hungry student is not going to learn very much. One who is sleepy will gain little from being physically present. If a student needs a drink of water or has a need to use the restroom, denying those needs will only become hindrances to learning. The requirement in meeting those needs often begins in the home. Getting teenagers in the habit of getting a solid breakfast is not only a healthy practice, but a good educational one, as well. Seeing to it that these maturing youth get adequate sleep may

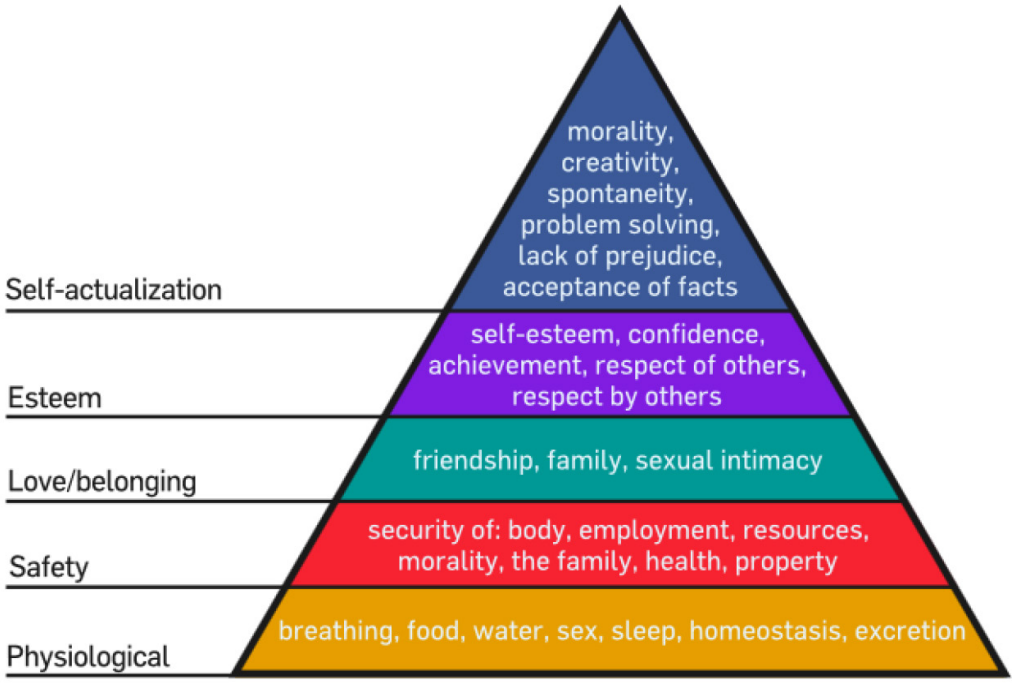

Figure 1. Maslow's hierarchy of human needs.

require having specified bed times, curfews, or some incentive to ensure that they get the sleep they need. One note of importance here is that the rapid growth spurts experienced intermittently during this age will be energy-consuming and not only create voracious appetites, but also require a great deal more sleep than at non-periods of rapid growth. In addition, one will find that as schooling becomes more academic that the brain will need extra periods of rest. Walsh (2004) has noted how these maturing ones can occasionally end up sleeping in all day. Since school attendance would not permit such, there needs to be some adjustments that permit or encourage some periods of extra sleep on weekends, holidays, or afternoons, as needed. However, parents should monitor this so as not to permit a teenager's sleep patterns to become displaced or dysfunctional.

Safety

Once the physiological needs are met the main focus, according to Maslow, is that of feeling safe. In other words, the environment - the home, the school bus, the school, and the classroom - must not feel threatening or one where they will experience physical or emotional harm. All children and adults have a need to feel safe. This does not just denote safety, as in securing and ensuring that a campus is genuinely safe (venue security) from harms' way, but it also has implications about self-esteem.

Bullying has become an important problem and issue in schools and has come to national attention in the media. Bullying creates victims who have carried out their own terrorization of schools with guns and carnage. Environments that do not feel safe to students will hinder student learning and achievement. In some degree, inner-city schools have suffered from this issue for many years, and yet little has been done in the way of reform to change it. To multiply the problems, high-crime neighborhoods become deterrents for students to become academic achievers and getting to school only adds to the problem. Though we claim in America to provide all students with the opportunity to gain a free education, some truly pay more for less. That is not to say that the suburbs have not had their problems regarding safety issues, for most of the schools shootings tend to happen, not in the inner-city schools, but in middle class neighborhood schools.

As we continue to clutch our Second Amendment rights, which are taken out of context as intended by the Forefathers, we are going to see many more public massacres take place. These have lasting effects on survivors. It is important to note that it is not criminals who are shooting our children in these cases but, generally, people who legally own these weapons. One of my students (at the university) was a survivor of the Columbine shooting of 1999. Being in my class some thirteen years following that shooting indicates that some of those students do go on to successfully finish school and earn a university degree. He has earned several of them. However, he shared with me, personally, that every time a shooting occurs (such as the Aurora theater shooting of 2012, and the Newtown, Connecticut shooting on Dec. 14, 2012) how it truly sets him into an emotional tailspin as all the feelings, pain, losses, and fears return, only to be relived repeatedly. How unfair is that for our young people? Suffering trauma during one's most unstable/changing years, only to find that they will have to relive it over and over, is very unfair and unreasonable. "The massacre at Sandy Hook School was the deadliest elementary school shooting in the country's history" (Brown, 2013, para. 12). It truly is time that something was done to stop this. We may find that our next sub-point, "Love and Belongingness," directly relates to the victims who, themselves, have become perpetrators, and who believe they are instigators of self-justice and revenge.

Love and Belongingness

Everyone needs to love and to be loved. Once the basic physiological needs and the need for safety are met, then the human psyche has the room and freedom to focus on love and belonging. Humans are social creatures and require various levels of interaction. Maslow's concept can be approached from several angles. First, is the need to love and

be loved. In considering this important concept, we will consider it from the basis of the home and the school.

The Home

Love is not a concept that can be discussed apart from the home. The school is a secondary provider of love, and a growing provider of belongingness. From very young, children need to feel secure in knowing that their parents love them. It is rare that a parent doesn't love their child, but the point, here, is not whether one does or does not, for we assume that all do. The issue here is the child's perception and assurance of that love and acceptance. Unconditional love is sought by all, and when it is perceived that love is conditional then there is no true acceptance. This task needs to be developed before a child enters the teenage years, but continually maintained during the adolescent years. However, one must also recognize that the perceptions of one's relationship with an adolescent might seem more like a roller coaster ride than what was personally experienced by the child in childhood. Adolescents want to know that mom and dad and siblings do love him or her and accept them as they are (not as they want them to be or become). Many problems occurring in adolescence are a result of children being unsure, or unconvinced, that this type of love, especially from mom or from dad, is secure. Keep in mind, for the teen everything seems pretty unsecure.

Some teens do manage, in spite of lacking this assurance, to grow up to be adults who are always trying to please mom or dad. Deep down, adolescents want to know that they are loved by someone who loves them in spite of who they are or what they do. Love, however, is more than feelings or emotions; it is a commitment. Love is not carte blanche, nor is it a lack of rules, standards, or requirements. Actually, rules, standards and requirements are part of one's conveyance of love. There is no such thing as one loving their child so much that they allow them to do whatever they wish for that is not really love. In fact, that becomes a form of abuse. Love sometimes has to be tough, take a stand, enforce the rules, or carry out the consequences. Parents cannot convey the type of love that is needed by adolescents by being too soft or too strict. It really requires a balance, and it require the patience and persistence and faith to know that though one may question their present relationship with their teenager, things are better off than you may have feared.

Walsh (2004) shares a personal experience which seems to convey this period of shaky relationships with teenagers clearly. He explained how he had built a relationship with one of his classroom students who sometimes dropped by his guidance counseling office to share some of his inner concerns, which mostly, centered on his criticism of his parents. In class, however, Walsh had posed a question to his students as to what they would do if they were to win a million dollars. Instantly, this young man spoke up and said that he would buy his parents a house and would send them on a dream vacation to wherever they liked, for they worked so hard and took such good care of him. This surprised Walsh and he later shared with the young man about how surprised he was at his freeness to speak out and the answer he provided to the question regarding the million dollars, especially with some of the things he has shared with him in the counseling office. The young man replied that he, too, had surprised himself, as well, but still held to his answer. A few days later Walsh crossed the path of this young man's parents and in the discussion he shared what the student has said in class. His mom and dad were astonished, and his mother began to cry. She was so pleased that he had felt and spoke that way…for they had considered the relationship with their son to be in ruins for some months. This goes to show that we cannot always judge an internal relationship (especially with our children) by external responses. What is going on internally in the depths of the human psyche does not always reveal itself in a transparent manner. The teen obviously said some things to his parents that set them back, but deep down, he truly cherished what they had done for him and what they were doing.

For teens, the world revolves around them.

"People spend their childhood learning to be like their parents, and their adolescence learning who they are and how they are different from their parents" (Kaufman, 2006, para. 3). Separating from the parents to some degree is normal, and healthy. Parents must recognize this need, as hurtful as it may feel, and that the harm of students not becoming independent is far worse. As teenagers strive for identity, they seek more independence from their parents.

Application of Maslow's Hierarchy of Needs to Parenting

In consideration of Maslow's theory, some applications are noted below for parents and the home of adolescents.

- Pay attention. Consider how your teen's behavior is related to a particular need they might be trying to meet.
- Do everything you can to make your home physically and emotionally safe.
- Provide unconditional love and instill a sense of belonging in the family. A sense of belonging comes, in part, from being a contributing member. Find ways in which your teen can make an ongoing investment in the family.
- Learn about your teen's peer group. Talk about what it means to belong to that group. Group norms and values are typically shared and can guide behavior. You want your teen to see the link between how the group defines itself and the activities/behaviors it engages in.
- Help your teen reach his/her potential. Emphasize your teen's ability to make changes and control his/her future. Teach your teen to seek out the resources he/she needs to grow (Mahon, 2011, para. 7).

The School

The school also plays a valuable role and has a responsibility in meeting this natural need for students for they spend approximately 180 days in school per year. That's 1260 hours, or about 15% of their year. When one considers that it is nearly equal to the yearly amount of time sleeping, then it's a substantial amount, and, therefore, obligates the school to some level of responsibility in meeting those needs developmentally and socially. Research shows that "students' experience of acceptance influences multiple dimensions of their behavior but that schools adopt organizational practices that neglect and may actually undermine students' experience of membership in a supportive community" (Osterman, 2000, 323). This concern was shared by other educational researchers, as well. "One of the most fundamental reforms needed in secondary or high school education is to make schools into better communities or caring and support for young people" (Hargreaves, Earl, & Ryan, 1996, p. 77).

The concept of belongingness is explained as that of community (McMillan & Chavis, 1986). Community is defined as "a pervasive drive to form and maintain at least a minimum quantity of lasting, positive, and significant interpersonal relationships" (Baumeister & Leery, 1995, pp. 326-327). It describes the quality or character of human relationships and "is not present until members experience feelings of belonging, trust in others, and safety" (Osterman, 2000, 323). It is said to consist of four elements: 1) membership, 2) influence, 3) integration, and 4) fulfillment of needs, and shared emotional connection" (McMillan & Chavis, 1998). These are noted, for Schlechty (1997) argues that just as workers in businesses are affected by the working environment, students in schools are also affected by the school-working environment.

As a workplace environment improves, thus the workers improved. The same relationship exists among the students and their schools. When students' needs are not satisfied in a school environment, then the results will be *diminished motivation, impaired development, alienation, and poor performance* (Osterman, 2000; Deci, Vallerand, Pettetier, & Ryan, 1991; emphasis added). Herein lays an unexpected verity; meeting students' need to belong results in internal motivation, as well as revealing some of the possible reasons for student behavior and perfor-

mance (Osterman, 2000). However, this points profoundly to motivation, which requires a separate discussion and will not be addressed in this article.

School reforms often focus on the easy solutions or what might seem to be quick fix resolutions. This has included site-based management, fiscal accountability, learning standards, standardized test scores, teacher accountability, and even professional development programs. Seldom, however, does school reform consider the students or developmental needs of students. Researchers have, far and wide, pointed out the "scant attention to the socio-emotional needs of students, individually or collectively (Goodlad, 1984; Ryan & Powelson, 1991; Ryan & Stiller, 1991; Noddings, 1992; Anderman & Maehr, 1994; Hargreaves, Earl, & Ryan, 1996; Maehr & Midgley, 1996; Osterman, 2000; Roeser, Eccles, & Sameroff, 2000; Haynes, 2003; Zins, Weissberg, Wang, & Walberg, 2004).

In childhood, acceptance is essential; in adolescence, peer acceptance is unparalleled. "Peer acceptance is a key mental health variable for children" and "children with peer relation problems should be considered 'at risk'" (McCaslin & Good, 1996, pp. 49-50). Asher and Parker (1988) noted over 20 years ago that "low acceptance was most consistently predictive of later dropping out [of school]. In study after study, children identified as low peer acceptance dropped out at rates two, three, and even eight times as high as other children" (p. 18). Acceptance at school is a necessary and critical ingredient and the school atmosphere is either one of acceptance or rejection. A sense of belonging in a school meets the developmental needs of pre-adolescents and teenagers (Hamm & Faircloth, 2005). Schools should be able to ascertain to some degree how inviting their atmosphere is, for a team of research physicians have noted two important effects of belongingness in schools: 1) students become more involved/engaged in school activities, and 2) fewer non-academic risk behaviors such as suicide ideation, pregnancy, and violence occur (Resnick, Bearman, Blum, Bauman, Harris, 2005, et al). Feeling a sense of belonging/membership into the school requires shared values with other school-community members (McMillan & Chavis, 1986). They propose that a sense of community encompasses four elements:

- Membership: One has invested part of oneself to become a member and therefore has a right to belong.
- Influence: A bidirectional concept; the notion that for a member to be attracted to a group, he or she must have some influence over what the group does.
- Integration and fulfillment of needs: Reinforcement.
- Shared emotional connection: Group members identify with a shared history. (McMillan & Chavis, 1986, p. 4-8)

Feeling of belongingness with a school involves far more than just feeling that one fits in, but also an emotional attachment to, and a sense of security, in that environment that comes from feeling valued by and valuing of that community.

Schools, school boards, and all involved need to be more cognizant of the need students have to feel connected to the school they attend, and this must go further than just school spirit. Sports (for example, football and basketball games) and band does not attract the attention or meet the needs of all students. A better inclusion point are facilities for groups of all sizes to meet, hang out, or work on community projects. This would greatly enhance the little that most schools are presently doing. Rather than creating policies that keep students separated or restricted, more needs to be done to help them feel accepted and have some stake in the school. Scaffolding projects for students to work on that meet needs not only of the school community, but also those that seek to assist the community in which the school is located are required. Such would connect the students, as well as connect the school, to the community and the businesses within their area. There are numerous community projects - as many as there are needs or concerns - such that students could benefit from becoming involved in, as well as providing benefits for the community.

Environments that do not feel safe to students will hinder student learning and achievement.

McMillan and Chavis (1986) made some excellent proposals regarding the means of helping students to feel belongingness with their school through the use of neighborhood projects. Consider a community organizer, whose prime task is the creation of sense of community. First, he talks to people in an area to find out their problems and concerns, that is, what would reinforce them and motivate them to work together (integration and fulfillment of needs). When a common concern emerges (i.e., something they all seem to need, such as a safe neighborhood), the organizer begins to conceive of ways in which the residents can work together to meet their need (p. 11).

The Friends

For those parents with pre-teenagers, you already know how important friends are to your child. Elder (as cited in McCaslin & Good, 1996) noted that popularity and friendship were not only different but were sometimes antagonistic. Most teens would like to be popular but most know that they aren't and it doesn't truly bother them. Popular teens are often not liked. What matters to teenagers, however, is to have reliable reliances, referring to the security and strength that come with knowing another can be counted on; another is loyal (Weis, as cited in McCaslin & Good, 1996). This can be found in close friendships between individuals or small groups. Or, more likely, reliable reliances can be found among all of these including multiple small groups at various degrees. Loyalty becomes the key characteristic and trust holds such relationships intact. Trust is another one of those characteristics of which teenagers are seeking and grappling. "Friendships serve as a secure base and buffer that help adolescents to cope with the psychological challenges of the social ecology of high school. Through these relationships, adolescents develop a stronger sense of belonging to their schools." (Hamm & Faircloth, 2005, p. 61)

Since we are on the topic of school friends, let's address a need that is often policed right out the door: students talking! Students are going to talk. They are either going to talk to their peers/classmates while you continually correct them and tell them to stop talking, or, they can talk in carefully planned discussions or group work you have designed that encourages interaction and social communication, but in a more productive manner. It seems not only a better plan to include periods of talking during a lesson, but meets an innate human need, especially for middle school and high school students. Students need to be able to interact! If you build it into your lesson then you have met a need and you then have a right to request that there also is some time when there should be no talking. Teenagers have an elevated since of justice and if you give some, then they will give some. Structure your labs, small group activities, and so forth, in such a way as to ensure productivity and guided discussions. Do not fret over the trivial, but have high expectations and then hold them to the standards you have made known. Lewin (as cited in Forsyth, 2009), a Gestalt psychologist and the "father of group dynamics," justified group existence using the dictum, "The whole is greater than the sum of its parts." He theorized that when a group is established it becomes a unified system with supervening qualities that cannot be understood by evaluating members individually.

Esteem

This obviously addresses the self-esteem, but it also involves being esteemed by another or other. It is an innate, but often unspoken, desire to be respected, valued, a part of something intimate that is larger than one's self. This is a growing need for adolescents as they are already experiencing doubt, awkwardness, and self-consciousness about nearly everything they do. They gain confidence and can move beyond many of their barriers but the desire to be respected is one that will stay with them for many years. Those who

do not get this type of feedback often seek it in other forms; sometimes unhealthy behaviors, including sex, running with the wrong crowd, alcohol, or for young girls, seeking out older boys. One of the laws of nature is that if specific needs are not met properly, then those needs will be met improperly, even at the detriment or self-harm of the one facing those needs.

In addition to Maslow's hierarchy of needs, there seem to be other observed needs of the preadolescent/adolescent that we need to consider. Here are three such needs: the need for social activities, privacy, and short periods of self-chosen isolation.

Need for Social Activities

Implied in the last few paragraphs above, here we want to make it clear that teenagers need social activities. Schools, parents, youth clubs are excellent for being initiators of planned activities. If adults will proactively plan activities that youth like, then low-control forms of structure can be included that help teens to realize that they can still have fun living within the boundaries of rules. Without such planned activities, the students will create their own social activities, and they can lead to problems involving the typical teen troubled areas that we tend to read about and hear about on the six o'clock news.

Youth do not need something special every night of the week, but they do need adequate opportunities to meet, socialize, exercise, and even study. Yes, that is right. Consider helping your teenager form a study group in your home. Provide them some refreshments, or pizza, and room to meet, and they will, at times, be more effective than you might think. The money you spend will be worth the structure (and habits) you are helping them to form. And, it sure beats them sitting around watching too much television.

Need for Privacy

Teenagers want and need some privacy. They should not have the right to bring illegal substances or questionable materials into the home, but they do need to know that if they, for example, write in a diary, that mom or dad is not going to sneak in and read it. Parents might have to make a rule that the teenager cannot close the door if they have a guest visiting, but parents should respect a closed door if they are alone, unless of course, there is reason to believe they might hurt themselves. Most teens just need some space. They would not admit it but being around people all day can be a stretching process and spending time in their room listening to music, drawing, studying, or just hanging out is just a sign that they need some down time.

Need for Isolation

As mentioned above, teens do not always want to be around people, especially adults. There are some personality types that truly need time alone in order to recharge and rest their social batteries. Don't nag or mock a teenager who likes his or her time alone. Spending too much time alone might be a sign of depression and thus medical assistance might be called for, however, being alone is not going to warp them. Not all teenagers are social butterflies to the same degree. If you find your teenager too confined, then plan some outings or activities and do what you have to do to include them in it. Even telling Johnny to "come on and let's take a walk together" is a means of getting some fresh air, and it can open the doors to conversation.

Maslow's highest level of needs, and thus achievement, is that of self-actualization. Individuals who are self-actualizing (it is a process and not, generally, a single event) are motivated by the achievement of useful and contributing goals, and, accordingly, are internally motivated to see their goals fulfilled for the purpose and benefits of humanity. This does not really describe a teenager and probably very few would be near self-actualizing, but as a parent you can help teach your child develop principles and practices that might help them develop the habits of self-actualizers. There are many trade books available that can give parents (and teenagers) ideas on what type of goals to set in life and how to work towards meeting those goals. Teens can be very goal oriented if they believe the cause is just and worthwhile.

Deep down, adolescents want to know that they are loved by someone who loves them in spite of who they are or what they do.

Ginsberg (n.d.) provides a very useful list of preadolescent characteristics. Because of the excellent job in presenting this information and her gracefulness in her presentation, we present her full descriptions of early adolescence.

- Preteens often feel awkward and insecure because of the physical changes they are undergoing. And just when they most want to be like everyone else, their friends are all maturing at different rates. Typically, preadolescents become preoccupied with how they look. What made me realize Karen was an official preteen, says her Mom, was when she started spending so much time in front of the mirror - deciding whether to wear her shirt tucked in or hanging out, and fussing with her hair.
- Preteens rely on their friends and feel the need to belong. Their group gives them a sense of security - and, often, it seems as if friends replace family as the center of a child's life. But this can also be a turbulent time for friendships. As old friends drift apart, kids can feel hurt and parents worry whether or how to intervene.
- Preteens test limits and challenge rule. They have developed some strong opinions, often want to do things their way, and don't hesitate to state their case and argue with you. To assert their individuality and protect themselves against what they consider to be arbitrary rules, they have a tendency to deny anything that seems to put them in a bad light.
- Preteens are similar to toddlers in some ways. Eric wants to be independent, his Dad comments, but he still wants us to take care of him. He says things such as: “Why didn't you wake me up?” or “You forgot to remind me about my lunch money.” He wants us around, but at a comfortable distance, not hovering over him.
- Preteens want privacy. Debby doesn't want to talk to her friends on the phone where anyone can hear, her mom reports. She closes the door when she gets dressed. She doesn't ask me what she should wear anymore, and when she decides on an outfit or how to do her hair, she changes it a few minutes later because she's not sure how she wants to look.
- Preteens make excuses not to do chores or start projects that need to be done. Their planning and organizing skills are not well developed. In addition, their sense of time is fuzzy. If you ask a preteen to take out the garbage and he says, “Later,” don't count on it. He's likely to get involved in something else and forget; just as he forgets to bring home his jacket or hat from school.
- Preteens are beginning to have a social conscience. They are becoming aware of and interested in issues that affect society - and are often willing to take care of a baby, help out at senior citizens' center, or stuff envelopes for a cause.
- Preteens on the whole are quite wonderful. Despite being forgetful and sometimes moody and irritable, they are energetic, enthusiastic, and eager to learn new skills. Among other things, they are capable of playing complicated musical instruments, learning a second language and creating pieces of art and writing that are amazingly profound, says Judith Baenen of the National Middle Schools Association (Ginsberg, n.d., n.p.).

Adolescence can be a time of multiple changes, insecurity, and confusion. This has been described as searching for oneself. Pre-teens and teenagers are seeking their own identity; "Why am I here and what am I supposed to do?"

Need to Establish Identity

The need to establish identity is one of competency and raison d'être (reason for existence). Young adolescents will spend several years trying to determine who they are. This may, at a glance, sound rather unusual, but remember that their body has changed/is changing rapidly, their mind has changed/is changing, and now they have mental abilities that they were unaware of (or have greater access to) before this time. For them, it would seem that their body has betrayed them and who they thought they were is quickly

waning, and who they are becoming they do not know. What they may have thought they were good at before preadolescence, may well have changed, or that particular skill or field no longer interests them. How many children become proficient pianists during childhood only to drop it upon becoming a teenager? This need can put them beside themselves (viz. worried), and can lead to behaviors that parents and teachers might find alarming, especially since this often occurs simultaneously with the formation of the personal fable. For some teenagers, their unspoken slogan begins to sound like that of the television cartoon secret agent parody, Cool McCool, who always stated, "Danger is my business." Taking risk is the result of the cerebellum, the frontal lobe part of the brain that causes us to be cautious and to restrain our actions, not yet being fully developed. Ackerman (2007) noted the following: "Risk taking is a normal part of adolescence, most researchers agree. According to one school of thought, novel or slightly dangerous experiences stimulate the release of dopamine, bringing great pleasure through the circuits of the brain's reward system. As the chief neurotransmitter in the reward system, dopamine is also responsible for feelings of motivation. But thrill seeking and the love of novelty do not carry equal weight in every teenager; everal studies suggest that up to 60 percent of a person's tendency to act on impulse is inherited in the genes and may therefore exist to a similar degree in other members of a family" (para. 26).

This, seemingly, recklessness is not necessarily because of an adolescent's belief that he/she is immortal, as may have been held in the past. Rather, it seems probabilistic that it is the gap between knowing and their experience, which is filled in during late adolescence, factored in with the development that is taking place in the front lobes of the cerebellum. Whatever the exact explanation, it is of great relief to all when the teenager begins to recognize the true fragility of life and the need to practice caution and restraint.

Finding one's identity is about trying on different personalities, styles, music, jobs, interests, roles, friends, and skills. It is truly a search for identifying what the teen is best at, what they like and dislike, and most importantly, how it all fits together to make up the real person they think they are or wish to be. As they experiment, they begin to become more at ease and less alarmed. Life has a way of showing one that everything is not going to happen overnight, and success is one step at a time. And probably the best lesson a parent or teacher can share with teenagers is to see life as the result of decisions made, perseverance, and to take life one step at a time. To learn this lesson is to become a resilient well-adjusted, well-adapted adult. But, the adults in an adolescent's life will need to be patient and supportive, and remembering one's own teenage years can help to see the world through that young person's eyes.

Footnote

1) See http://evolution.berkeley.edu/evosite/evo101/IIIC6aOntogeny.shtml

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Using Heart Models for Physiology Teaching and Learning

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Over the last few decades, there has been a shift in the classroom from a teacher-centered learning environment, with its emphasis on content delivery, to a student-centered environment focused on inquiry learning (http://www.nsta.org/docs/PositionStatement_ScientificInquiry.pdf). With the Next Generation Science Standards (NGSS, 2012) being adopted by many states, students are no longer passive listeners, but actively participate in and initiate class discussions (Weimar, 2013). Additionally, recent technological advances have allowed students to acquire information from sources such as the internet which no longer necessitates the teacher giving lectures (Silverthorn, 2006). The more student-centered learning environment allows students to better comprehend and articulate their understanding.

My Physiology and Disease course at the Illinois Mathematics and Science Academy requires that students be able to articulate their understanding of anatomy and physiology to disease conditions caused by abnormal functions of organs and organ systems. They then use their understanding to solve real life case studies. What I have observed over the years is that the students often struggle more with understanding physiology than anatomy. To help students with the more challenging concepts of physiology, students design and build a model of the human heart. In doing so, students have to think about the different parts of the heart and how they work together, as well as the reason for the different sizes, shapes, and placements of the structures in the heart. A useful resource on building a non-life size, working model of the heart is Brock (2009). This activity addresses the Next Generation Science Standards LS 1.A: structure-function relationships (NGSS, 2012).

The goal of the heart model activity is for students to gain a greater understanding of the physiology of the heart. The students are required to work in groups of two. The minimum expectation is a heart model that shows the major parts of the heart and the pathway of blood circulation. All the parts of the heart involved in blood circulation are required to be clearly labeled and the circulatory pathway clearly marked. The model is required to be life size. A working heart model is given extra credit.

Students build the model out of low-cost materials. A model design report (see Figures 1-5), including calculations of dimensions, is required and must be approved before students beginning making their models. The purpose of this report is for students to think practically about building the model and also to factor in the greater thickness of the aorta and arteries compared with veins. Since they are making the model lifelike, students need to think about this. After approval of the model design report, students have two to three weeks to build the model and present it to the class. Examples of student heart models are shown in Figures 4 and 6.

Models are assessed based on accuracy, creativity, and adherence to design specifications. Students then write a reflection report (see Figure 7) on what they learned during the construction of the model, and how their understanding related to other heart laboratories and activities (heart rate, blood pressure, lung capacity). Students also reflect on how their understanding of the workings of the heart fit in with the principles of physics such as gravity, resistance, and capillary thickness. This project is a huge success in my course. Students take more responsibility for their learning and I see that the previous need to reiterate information is unnecessary given their newfound comprehension. This activity would be appropriate for other areas of physiology as well, such as the respiratory system. For the more visual learners, as well as those that take a longer time to comprehend material, building models gives students a goal to work toward while learning at the same time.

Figure 1: Heart Model Design Report. Use these questions as a guide to create your heart model design. Make sure you answer these questions in your model design report. Please note that the model design report is different from the final reflection report.

1. Describe how the human heart works to circulate blood throughout the body. Include your thoughts on how cardiac fitness and high blood pressure affect heart function.
2. Show calculations to find lengths of arteries or veins, portrayed by tubes, strings, or other materials, depending on what you use. If you are making your model work, explain what modifications you are using to make "blood" flow through your heart model.
3. Make sure that your model is the same size as a human heart and when you put the parts together, be aware of measurements of the blood vessels. There may be an element of trial and error in your design. For example, you may have to cut several pieces before you decide upon the size of blood vessels; it may not function the first time.
4. Now that you know the lengths of your elements (strings, tubes, and so forth), show a drawing of what your model will look like. Include the overall dimensions - length, width, depth - as well as the dimensions of the elements.
5. On the drawing, specify the materials that you will use.
6. Describe your procedure for how the model will be built.

Cite your references using APA style, both in-text and at the end of your report. Reports without in-text citations and a bibliography will not be scored. Use at least two scholarly references.

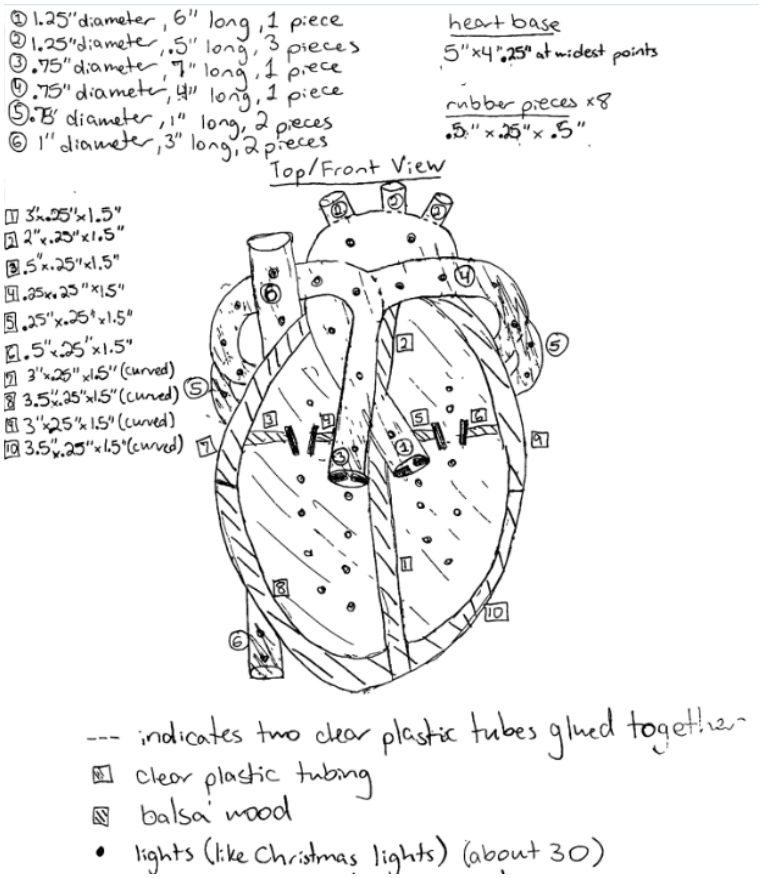

Figure 2: Heart model design. Drawing of a design of a heart model submitted prior to making the working model.

Figure 3: Excerpt From a Heart Model Design Report, Question 1.
Describe how the human heart works to circulate blood throughout the body. Include your thoughts on how cardiac fitness and high blood pressure affect heart function.

In order to circulate blood throughout the body, the heart uses two things: the intrinsic conduction system, and a blood pressure gradient. The intrinsic conduction system of the heart allows for the heart to pump blood. It is our body's own natural pacemaker. An impulse starting at the sinoatrial (SA) node goes through the atria to the atrioventricular (AV) node. This tells the atria of the heart to contract. That impulse is then carried to the bundle branches and the Purkinje fibers to tell the ventricles to contract. While the ventricles contract, the atria relax. While the ventricles relax, the atria contract, and so on and so forth. This is the cycle the heart muscle goes through to allow blood to be pumped throughout our body.

However, once the blood leaves the heart, a blood pressure gradient allows for the blood to get from one location to another. As the blood moves away from the heart to the capillaries, blood pressure is decreased, due to loss of energy. Gravity, breathing, and the contraction of skeletal muscles all also play a role in affecting blood pressure. This differing blood pressure gradient allows for blood near the heart that has a high pressure to reach the areas of the body that have a lower pressure.

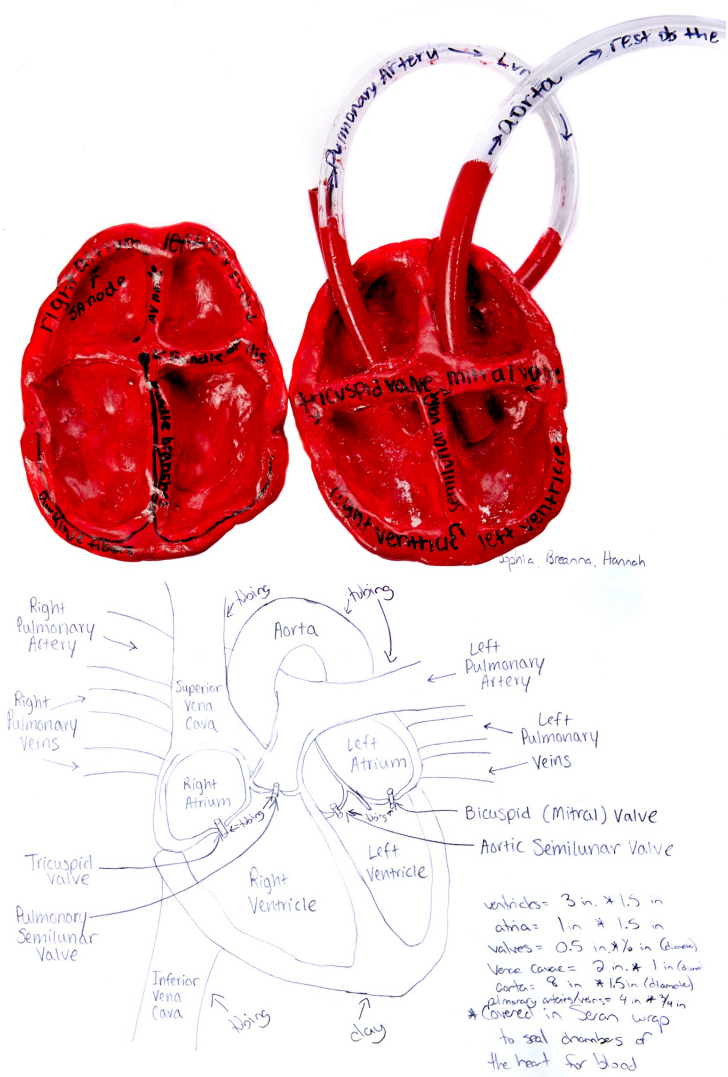

Figure 4: Model and diagram. A heart model made of clay, with the corresponding submitted design.

Figure 5: Excerpt From a Heart Model Design Report

We will use 3" of ¾" diameter clear plastic tubing for both the superior vena cava and inferior vena cava, to indicate where they flow into the heart. We will use 7" of 1 ¼" diameter clear plastic tubing for the aorta because it will cover 4" of the front of the model where it connects to the left ventricle, and we will allow 3" for it to wrap behind the top of the heart.

From the top of the aorta, we will attach three separate ½" long pieces of the same diameter tubing to indicate the branches of the aorta located above the heart. For the pulmonary vein/artery tubing, we will use 16" of ¾" diameter clear plastic tubing, 7" for each pulmonary circuit from the right ventricle to the right lung, 5" to the right lung and 2" for the additional branch on each side that empties into the left atrium.

We will make our model work by drilling holes in the wood back of the heart model and in the clear plastic tubing and inserting small lights that light up in the order of blood flow through the heart. The whole actual heart will be 5" long and 4" wide at their widest points. We will make the 3D heart walls 1 ½" tall. We will connect the pieces of wood, plastic tubing, and lights with hot glue/super glue. We will tilt the heart forward for easier viewing with a 2" wood stilt behind it, both sitting on a wooden 6"x6" base.

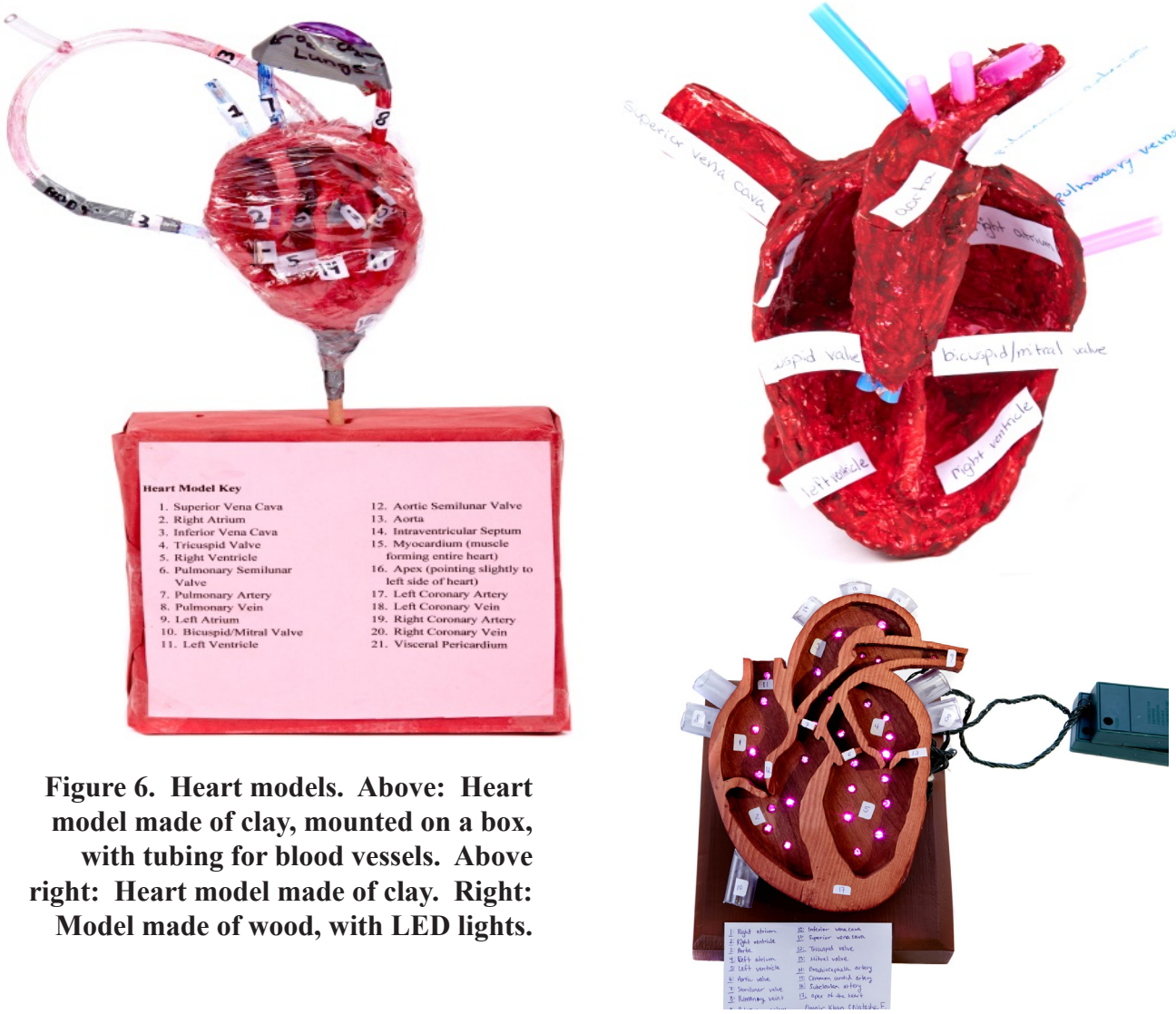

Figure 6. Heart models. Above: Heart model made of clay, mounted on a box, with tubing for blood vessels. Above right: Heart model made of clay. Right: Model made of wood, with LED lights.

Figure 7: Excerpt From a Heart Model Reflection Report

To replicate the human heart, my partner and I decided to "think out of the box" and create a working heart model out of wood. We decided to make a cross section of the heart that would work by flashing lights, indicating the blood circulation in the heart. If one looks at our original design, it can be seen that there are some differences in our actual model and the design. First and foremost, it can be seen that the actual model is bigger than an actual human heart. There are very good reasons for this. When trying to make a heart model that small, carving out intricate details such as the mitral and tricuspid valve was very difficult and it actually cracked the wood. Although we understand that our model is a blown up version of a real human heart, the fine attention to detail that we achieved with making the bigger heart was more valued to us, for it was more accurate in displaying the unique characteristics of a human heart. I also personally think that by making our heart bigger, it made the final piece tidier and cleaner. Also, we changed the fact that our pulmonary artery and aorta were made out of wood in the final model. ….. If I was to change anything for the next time, I would definitely try to make the entire piece out of wood without the use of plastic tubing. Additionally, I would do this from a thinner wood slab, because the one we used was way too thick, and had to be sanded down so that the saw would cut through it. Furthermore, I would more carefully carve the left pulmonary artery because in the current model, it is not very distinguishable that the pulmonary artery splits up into the left pulmonary artery as well, not just the right one. I would also get smaller bulbs for the lights because putting the lights on the back of the heart proved to be difficult because of their size. Moreover, I would change the lights so that they synchronize with the actual heartbeats of the heart. And lastly, in the future, I would start staining the wood early in the day. This is because it took 7 hours for the wood to completely stain to the desired color; I should have not started at 4 pm, because it took up my whole day!

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(tentative)

ISTA
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Fall 2015

Watch for upcoming details

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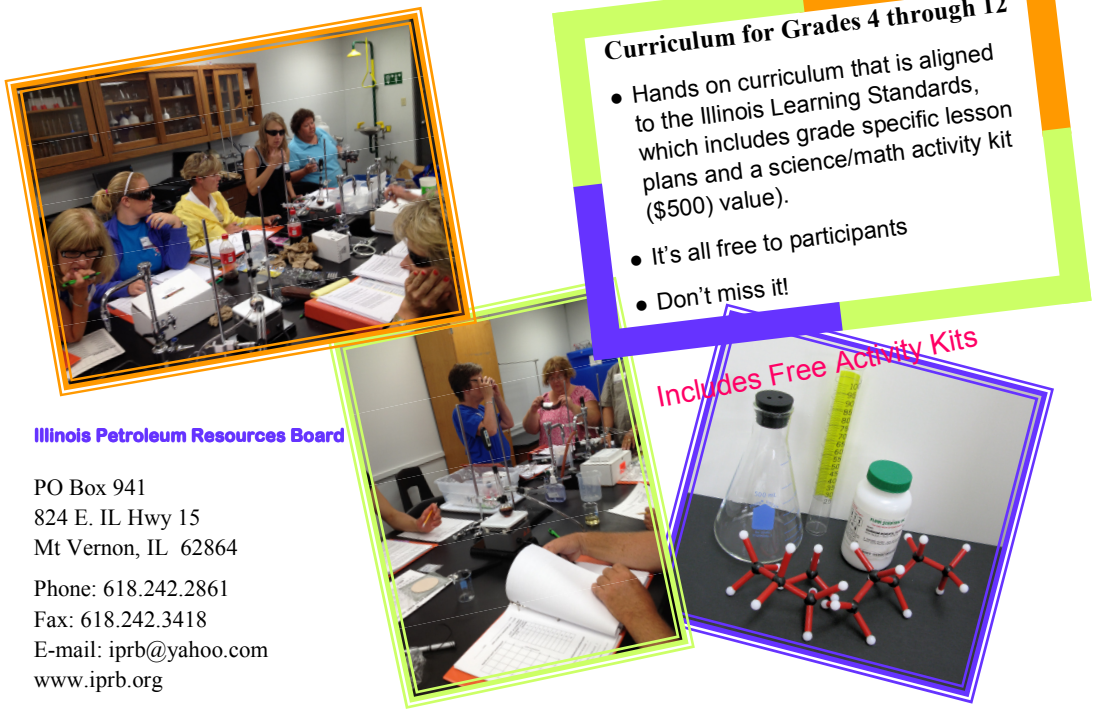

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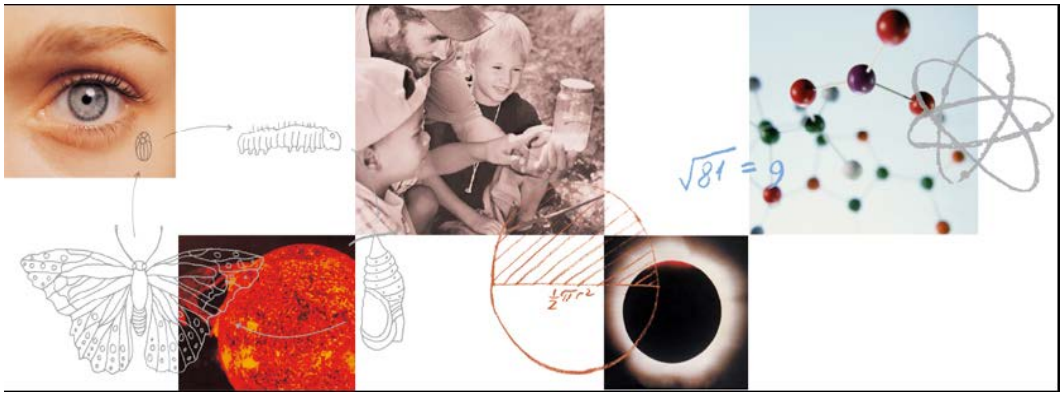

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