Science Connection
KENTUCKY DEPARTMENT OF EDUCATION
A Collaborative Resource for Teachers **November 2014** Volume 1 Issue 10

In This Issue

Editor's note

It is the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed. –Charles Darwin

As I continue to grow in my understanding of the new science standards I realize how important it is to collaborate with others like minded professionals and informal educators. Last month an article was shared by Trish Shelton that suggested engaging in Twitter chats and NGSS Community blogs, both of which I would highly recommend. This month I would like to share with you an opportunity to collaborate on the development of another resource intended to support teachers and students.

Who do you reach out to when you have a question about science content that can't be answered by peers? What outings do you go on that provide support of your curriculum? Who has come to your classroom to provide enrichment opportunities related to your current unit of study? Are there informal educators who have helped you create learning experiences for your students beyond your classroom?

This is the information that I hope to collect and make available to you in the Kentucky Informal Educator Science Hub. The goal of the Kentucky Informal Educator Science Hub is to provide a pool of knowledgeable volunteers from a wide range of backgrounds that are willing to offer their time and expertise to work with local K-12 science educators as they implement the new Kentucky Core Academic Science standards. Please submit the person/organization that has supported you in science education. Once your submission is reviewed, a letter requesting their participation will be sent to the person or organization referred.

If you have any questions related to the Informal Educator Science Hub, please contact me at Christine.duke@education.ky.gov. Thank you in advance for helping to build this resource for all Kentucky teachers.

Fill out the form online by clicking here

'Super' Models: a powerful practice for learning and teaching science

Diane Johnson, PIMSER, Associate Director

Developing and using scientific models is a powerful practice that helps students build understanding of core ideas in science as well as an understanding of how knowledge in science progresses (Schwarz, et al., 2009), while making student thinking visible to guide instructional decisions (Lehrer & Schauble, 2000). In order to tap into the power of this practice in the classroom, educators will need to distinguish scientific models from the colloquial use of the word model, capitalize on how this practice progresses across grade bands, and scaffold students' developing understanding and use of modeling with a range of tools and strategies.

What makes a model scientific?

Step number one in implementing this practice is ensuring that when we use the term *model* in our science classroom, students are using a *scientific* definition of the term. According to the description of the practice in Appendix F of the NGSS, "[i]n

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NEXT GENERATION SCIENCE STANDARDS

Practice	DCI	Crosscutting Concept
Developing and Using Models	LS4: Biological Evolution: Unity and Diversity	System and System Models

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science, models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others… In engineering, models may be used to analyze a system to see where or under what conditions flaws might develop or to test possible solutions to a problem. Models can also be used to visualize and refine a design, to communicate a design's features to others, and as prototypes for testing design performance" (Achieve, 2013, pg. 52).

There are many types of scientific models:

- Mental models (tool for thinking with, making predictions about, visualizing, and making sense of experience);
- Physical models (may be made of similar or different materials, smaller or larger in size, same proportional scale or not);
- Conceptual models:
  - °Drawings and illustrations (of objects, places, processes, systems; are labeled and show relationships between components),
  - °Analogies (structural, functional, behavioral),
  - °Mathematical representations (graphs, equations);
- Simulations (computer, manipulatives);

That means that the only thing that is NOT a scientific model, is the real thing (Achieve, 2013; Mayer, et al., 2013; Krajcik & Merritt, 2012; Keeley & Tugel, 2009).

Mapping out the experience K-12

To support learners' engagement in scientific practices, teachers will need to create "an environment full of rich phenomena and meaningful data from which students build initial models" (Mayer, et al., 2013)

- The progression for practices stresses observations and explanations related to direct experiences in K-2, in which learners are asked to: distinguish between the model and the real thing, compare models to identify common features and distinctions, and develop and/or use models to represent amounts, relative scales (smaller, larger), and/or patterns in the natural or designed world.
- The grades 3-5 band introduces simple models that help explain observable phenomena and when microscopic entities are introduced there is no emphasis on understanding their size. Intermediate students are asked to revise simple models using evidence, identify limitations of models, use analogies or abstract representations to describe scientific principles, and describe/predict phenomena using models.
- A transition to more abstract and more detailed models occurs across grades 6-8 with an emphasis on atomic and cellular-level explanations. Middle school students will need to develop their ability to evaluate limitations of models, develop or modify a model based on evidence (to match what happens if a variable or component of a system is changed), and to describe, revise and/or predict using a model of unobservable phenomena or mechanisms.
- By the end of high school, students should be able to evaluate the usefulness of different models, test model reliability, develop and use multiple models to: describe and predict phenomena, generate data, support an explanation, analyze systems and solve problems (including mathematical and computational ones) at a sub-atomic/sub-cellular level (Achieve, 2013, pgs. 33-32, 56-59; Achieve, 2013, pgs. 52-53; Schwarz, et al., 2009).

By considering the modeling progression in general and the specific elements associated with a performance expectations in particular, teachers will be poised to map out experiences that will assist students in developing, revising, and deepening their understanding of core ideas and scientific models.

What are some strategies and tools that can be used to scaffold students' understanding of scientific models as they develop understanding of core ideas?

Every science discipline lends itself to the practice of students developing, sharing, discussing, and modifying models to explain and predict a broad range of phenomena (Mayer, et al., 2013). Challenges for learners with respect to models are understanding that: any model is an approximation, simplification, and is a flawed yet powerful tool for explaining and predicting phenomena; a model must be consistent with existing evidence; a model may change as new evidence is discovered; and different models are appropriate in different situations (Krajcik & Merritt, 2012). Knowing potential challenges with this practice allows teachers to scaffold instruction so that students develop, revise, and use models to progress their understanding of core ideas.

Tools

An analogy map

Part of the Model		Part of the Real World	They are alike because...	They are different because...
	is/are alike...			

From BSCS PDI 1, 2013

Students Share Models and Ask Questions

1. What similarities or differences exist between your models?
2. How do your models highlight difference aspects of the phenomenom or data?
3. Can we as a class come to an agreement on what to include in our models?
4. Which models best account for the data?

From Mayer, et al., 2013

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Strategies

Mark Windschitl and Jessica Thompson (2013) offer five classroom-tested strategies for making thinking visible with public representations of student models.

1. Small group models
   a. Before-during-after drawings
   b. Explanations elicited in drawing and writing
   c. For micro-level events, students are asked to "draw what you would see if you had 'microscope' eyes
   d. Avoid the pitfall of posterizing textbook representations and explanations
2. Whole class consensus models – single drawing or set of drawings worked on by the class as a whole
   a. Teacher constructs with input from students
   b. Student data is used as evidence
   c. Teacher adds labels that indicate students' hypotheses about underlying events or processes that influence the phenomenon.
      i. These hypotheses inform further testing.
   d. Use less often than small group models
3. Sticky notes and sentence frames as tools for changing models
   a. Color code by category: adding an idea, revising an idea, posing a question
   b. Use sentence frames as a guide for talking or writing
      i. We added _____, because _____.
      ii. We changed _____, because _____.
      iii. We used to think _____, but now we think _____, because _____.
      iv. We think _____ contradicts _____ in our original model because _____.
      v. We are wondering about _____, because _____.
   c. Allow time for students to act on suggestions.
4. "Gotta-have" explanation checklist
   a. Set of ideas that students think must be included in the final explanatory model
   b. List is developed overtime from activities, readings, and connecting to everyday experiences
      i. Teacher should modify if students miss key elements of final causal explanation.
   c. Checklist is NOT a list of vocabulary words but ideas or relationships important to the final explanation.
5. Summary Tables
   a. Running table throughout the unit that includes 4 columns (labels for columns in parentheses):
      i. Activities that were done (Activity)
      ii. Patterns or observations; what happened? (Patterns)
      iii. What do you think caused these patterns or observations? (Why)
      iv. How do these patterns help us think about the essential question or puzzling phenomenon? (Clues)
   b. Posted in the classroom
   c. May be used by students to construct their final explanatory model

Additional examples to those included in the article in the September, 2013 of *The Science Teacher,* can be found at: http://tools4teachingscience.org/pdf/primers/Public_reps_NGSX.pdf

Web Resources

Tools for Ambitious Science Teaching, University of Washington
http://tools4teachingscience.org/

A teacher progression for model-based inquiry http://tools4teachingscience.org/pdf/Learning_Progression.pdf

Modeling in the Classroom: How it's done http://tools4teachingscience.org/pdf/primers/Models%20and%20Modeling-%20An%20Introduction.pdf

Anchoring Events http://tools4teachingscience.org/pdf/primers/Identifying%20Anchoring%20Events.pdf

Public Representations of Student Thinking http://tools4teachingscience.org/pdf/primers/Public_reps_NGSX.pdf

Modeling Designs for Learning Science, Northwestern University
http://www.models.northwestern.edu/models/

Model-based Reasoning, UCLA
http://centerx.gseis.ucla.edu/partnerships-grants/tiip/showcase/animo-pat-brown/model-based-reasoning-understanding-the-world-like-scientists

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Modeling for Understanding in Science Education, University of Wisconsin-Madison http://ncisla.wceruw.org/muse/

MEA's: Model Eliciting Activities http://modelsandmodeling.net/MEA_Library_Directory.html (college-level but adaptable)

Case Studies for Kids, Purdue University https://engineering.purdue.edu/ENE/Research/SGMM/CASESTUDIESKIDSWEB/case_studies_table.htm

SGMM, Small Group Mathematical Modeling, Purdue University https://engineering.purdue.edu/ENE/Research/SGMM/MEAs_html (college level but adaptable)

Examples of MEA's from the University of Minnesota http://serc.carleton.edu/sp/library/mea/examples.html

CPALMS, State of Florida http://www.cpalms.org/Resources/PublicPreviewResourceCollection.aspx?ResourceCollectionId=59

Collection of Online Simulations (most are free) http://www.dianehjohnson.com/uploads/1/3/4/5/13452203/list_of_linked_simulators.pdf

Conclusion

The vision for K-12 science education, as described in *A Framework for K-12 Science Education,* includes preparing students "to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives" (pg. 9).

The 'super' practice of developing and using models provides students with experiences over time and in every science discipline that demonstrates how "ideas [in science] often survive because they are coherent with what is already known, and they either explain the unexplained, explain more observations, or explain in a simpler more elegant manner" (pg. 79) – just the kind of thinking needed by "critical consumers" in the 21st century.

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The Power of Student Driven Sustainability

Jiningnan Chen and Eric Xiong, Co-AuthorsBluegrass Youth Sustainability Council, Energy Audit Committee*, Math Science and Technology Center Magnet Program '15, Paul Laurence Dunbar High School, Lexington, KY

HS

More often than not, students are perceived as unmotivated. With studies such as the 2006 National Study of High School Student Engagement (Yazzie-Mintz, 2007) concluding that two out of three high school students are disengaged, lack motivation or are bored every day in class, this is not a completely ungrounded assumption. Yet, when students get passionate, they also possess the potential for unique efficacy that is unequivocal.

Beginning in fall, 2013, two students from Paul Laurence Dunbar High School in Lexington, Kentucky, set out to make an impact in their school system and community. Together with a team composed of Bluegrass Youth Sustainability Council members, the two students co-chaired the Energy Audit Committee, decreasing the energy usage of the Fayette County Public Schools "It's About Kids" Support Services (IAKSS) building by 5.8 percent in one yearly cycle. We – Jiningnan Chen and Eric Xiong – are those two students, and we would like to take a moment to share our experiences.

An organization less than 10 years old, the Bluegrass Youth Sustainability Council is a project-based, student-driven organization composed of environmentally passionate students from Lexington's five public and three private high schools. Students meet monthly to discuss collaborative outreach projects, partnership prospects, and leadership opportunities in all areas of sustainability from energy and

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waste management to water and air quality, the crux of our efforts lie in our dynamic sustainability committees.

The goal of the Energy Audit Committee was to decrease the energy expenditures of the IAKSS building and the Lexington-Fayette Urban County Government (LFUCG) Phoenix Building. With our Walk-Through Audits, we examined the facilities for day-to-day energy waste with visual inspection of the offices and community spaces. We provided same day, on site feedback through *Thank You* Tickets – reinforcing positive energy saving behaviors – and *Oops* Tickets – cautioning negative energy wasting behaviors and providing suggestions for improvement. By allowing building occupants to engage our committee, this strategy allowed us to play a role in increasing energy conservation by proliferating positive energy-saving behaviors.

The results from our efforts to raise awareness for energy conservation were both extremely significant and gratifying. By using the checklists that we created as tools to measure how efficiently energy was being used, we were able to quantify the improvements in the building occupants' sustainability while we interacted with them – providing them with constructive feedback during all three of our audits at both buildings. In LFUCG, we saw improvements throughout the year and almost every single office space was able to adjust their habits to accommodate the energy conservation tips we provided – turning off lights, monitors, computers, and consolidating office fridges to name a few . In IAKSS, we were able to access the energy usage of the building over five years. From this data, we ran statistical analyses and discovered the year we audited the building had a 5.8 percent decrease in energy usage, or 141,280 KWH – more than the previous three years' energy usage decreases combined.

However, since buildings in the United States account for more than 36 percent of our energy consumption and 30 percent of our total greenhouse gas emission, we did not just stop after the audits. Following the completion of our audits for the year, we presented our findings and conclusions to the leaders of IAKSS and LFUCG, including Fayette County Superintendent Tom Shelton and his cabinet. By doing so, we informed them of how impactful our initiatives could become in saving money and fossil fuels. We hope this will raise more awareness and bring about even more positive impacts for our community.

With increasing globalization comes increasing human impact on the environment. Today's human carbon emissions are at an unmatched peak and continuously compounding at an increasing rate. In light of this, we, along with the rest of the Audit Committee, plan to expand our efforts to more than just IAKSS and LFUCG. With each building we reach, we hope to steadily expand the amount of people that realize the simplicity and significance of daily energy conservation. Ultimately, by working together as a city, we can become more economically and environmentally sustainable, potentially saving millions of dollars while also reducing greenhouse gas emissions by making small changes to our habits.

***Committee Members:**
•Jiningnan Chen (Senior) and Eric Xiong (Senior) – Paul Laurence Dunbar High School, Co-Chairs
•Lucy Wan (Senior) and Alaap Patil (Senior) – Henry Clay High School
•Jakob Roney (Senior) – Lafayette High School
•Sam Waltman (Junior) – Sayre Upper School

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Yazzie-Mintz, E. (2007). Voices of students on engagement: A report on the 2006 High School Survey of Student Engagement.

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Excerpt from Teaching DNA and Inheritance with a Hands On-Minds On Approach

MS/HS

William Thornburgh, Science Education Doctoral Student, University of Louisville

In classrooms across the nation, middle school and high school educators are teaching their students about genetics - Punnett squares, the structure and function of genetic material, the inheritance of traits, and so many other important concepts and processes. Hopefully, teachers find this to be an exciting unit of study; after all DNA is the basis for life. What is as important as the content though, are the instructional methods we use to teach our students.

Our goal as science educators should be to teach for understanding and to improve conceptualization of ideas. In order to do this we must keep our practices up-to-date and use new tools for the appropriate age group. At the middle school and high school level, the Science and Engineering domain of the NGSS identify developing and using models to describe, predict, ask questions, analyze and interpret data, all from the use of models and/or simulations.

Here are some interactive and engaging learning experiences. First, instead of just showing them that old model you have had on the shelf for years, have students construct their own model of DNA. While doing this activity, you could have a set of questions to foster critical thinking guide them along, or provide further learning opportunities for advanced students. Two

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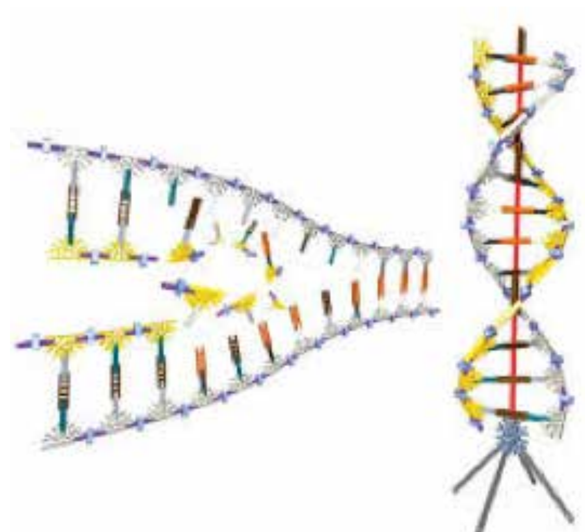
examples that are inexpensive and easy, but provide students with gratification upon constructing their own model and working through the sometimes tedious process of base-pairing, are by using paper clips or K'NEX to make DNA. -



Of course, there are pros and cons to each of these activities. Therefore, individual teachers have to decide what would be best for their budget and best for their students.

Activity	Materials	Pros	Cons
Paper Clip	Multi-colored paper clips (5 colors, 1 for each base) Lab hand out	Extremely cheap Visualization Easy manipulation for replication & transcription	Does not take the shape of double helix
K'NEX	K'NEX DNA Replication/Transcription Kit Lab hand out	Forms a double helix Visualization Easy manipulation for replication & transcription	$55 per set (can make 2 models per set at the same time)

Visit these links for examples and assistance for each of these activities. Please remember, the use of either activity can be tailored from middle school through high school AP science depending on the level of content you want to teach.

http://www.tiemanbiology.com/uploads/6/3/2/3/6323843/dna_replication_paper_clip_activity.pdf (directed toward a typical high school classroom)

http://tandem.bu.edu/knex/knex.pdf (directed toward higher level learning and shows possibilities beyond the basics)
http://www.knex.com/shop/16790/dna-replication-transcription/ (information about kits and ordering your K'NEX)

Helping students understand genetics usually begins with an introduction to Punnett squares. These can pose many potential issues for students –vocabulary, genotype vs. phenotype and heterozygous vs. homozygous confusion about alleles and others.

Teachers can use a variety of activities to get students moving and working together to learn the important aspects of inheritance.

Students can make Reebops, Dragons, Botheads, or even do a Face Lab to learn many important concepts: genotype/phenotype, homozygous/heterozygous, dominant/recessive, sexual/asexual reproduction, and probability. Teachers can adjust the number of traits that parents pass on and even include mutations to add realism to the activity. Once completed, teachers and students can analyze the results of each parent pair and the offspring produced. For more information on each activity, visit the links provided and make the appropriate adjustments so the activity suits your needs.

Reebop Labs

http://www.mpsaz.org/stapley/staff/clewis/sc08assignments/files/baby_reebop_lab_update.pdf
http://www.ccitonline.org/ceo/home/content_images/BCM-Reebops_s.pdf

Dragon Genetics Labs

http://mysite.cherokee.k12.ga.us/personal/kasey_miller/site/Group%20B%20Documents/1/Dragon%20Genetics.pdf

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http://biologica.concord.org/webtest1/web_labs_genophenotype.htm (online)

Bothead Labs

http://cmiller4jma.weebly.com/uploads/2/1/0/9/21094238/_botheads_lab_activity.pdf
http://east.lapeerschools.org/UserFiles/Servers/Server_3099604/File/Fidler/Bio%20I/Botheads.pdf

Face Labs

http://kenpitts.net/bio/genetics/face_lab/face_lab.htm
http://sciencespot.net/Media/gen_smilewkst1.pdf
https://teacher.ocps.net/theodore.klenk/vcc/labs/newfacelab.pdf

If you have not had your students do any of these activities, you will be amazed at the level of engagement and creativity from your classes. Why not make this unit more fun and allow students a chance to learn from you, their peers, and through a variety of opportunities?

Using the modeling practice in the classroom – An enduring skill

Patrick Goff, 8th Grade Science, Beaumont Middle School

MS

Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Although models do not correspond exactly to the real world, they bring certain features into focus while obscuring others. All models contain approximations and assumptions that limit the range of validity and predictive power, so it is important for students to recognize their limitations. (Appendix F of NGSS)

Using modeling in the science classroom should be happening on a near daily basis. As the Science and Engineering Practice states above, there are multiple types of models that are can be created or analyzed.

This enduring skill was what I chose as my student growth goal area, specifically the limitations/merits. Using rubrics developed in my district, I selected three specific capabilities of models that are appropriate for the grade band: limitations, evaluate the limitations and describe the merits of the models. I then asked the students to consider these when analyzing models.

Upon analyzing student work it became apparent that my students were not proficient in this area, which lead me to ask why? I asked my students the next day and the answer I primarily got back was that they had not been asked to think like this before.

Now, I had to develop a plan of how to help them. I decided that whether students were completing a labor assignment that contained a graph or if students were creating a model, they would include in their conclusions the limitations and merits of the models. Classroom discourse would also relate to the merits and limitations observed throughout classroom experiences.

Our first few discussions have been very slow and deliberate, purposely allowing student time to process the overall intent of the model. The class has engaged in a few discussions since I only introduced this plan a short time ago, but I have already observed an improvement in their thought process. The students are getting better at identifying the limitations (moving from basic ideas to more complicated ones). The next step in my plan will be to engage students in the evaluation of the model limitations.

Communicating as Scientists

Teresa Rogers, ELA Consultant

ALL

Learning how to produce scientific texts is as essential to developing an understanding of science as learning how to draw is to appreciating the skill of the visual artist.

This analogy from the Framework for K-12 Science Education (pg. 75), illustrates the significance of writing in the realm of science. The writers continue by boldly stating “Science simply cannot advance if scientists are unable to communicate their findings clearly and persuasively.” This communication spans the gulf of formal texts, including peer-reviewed articles and books, to informal texts, such as newspapers and magazines. Technology has progressed to provide additional means of sharing information, such as email, webinars, blogs, and websites. Now, more than ever, the ability to communicate one’s findings clearly, to a

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diverse audience through multiple formats, is critical for today's science students.

Given the enormity of the task, how do you choose an authentic writing product that will allow your students to demonstrate their understanding of the world around them? Before you make that choice, take a few moments to consider the broad spectrum of writing in science. What are the unique traits of each? How will you help your students develop these in their writing?

FOCUS -- *To whom is the text written…and for what purpose?*

The audience and purpose set the tone and directly influence the style of writing. Formal texts, including scientific articles and proposals, are written for members of scientific community who possess a deep understanding of the topic and read to gain information in order to answer questions or solve problems. On the other hand, informal texts, such as science articles found in newspapers and magazines, are written for the lay audience. Their purpose is to entertain, inform, or persuade the public about science topics. These two traits, audience and purpose inform the language, structure, and conventions of the writing.

LANGUAGE – *How does the author choose their words?*

Compare an article on childhood diabetes from USA Today and another from the Journal of the American Medical Association. You'll notice a significant difference in the language of each. The audience and the intended purpose determine the style of language. Formal texts use concise, objective technical language as scientists describe observations, clarify their thinking, and justify their arguments. Descriptions are highly detailed, attending to precise measurements, times, and variability. The language is dense, explicit and unambiguous. On the other hand, informal texts use a conversational tone, defining, or replacing difficult vocabulary to increase the readability. Writers summarize detailed explanations to highlight the resulting conclusions. Figurative language such as analogies, similes, and metaphors, are often used to create a picture in the reader's mind and make the writing more interesting.

STRUCTURE – *What determines how the paper is organized?*

Formal texts have unique structural features that may challenge even the most gifted students. Depending on the audience and purpose, most adhere to a strict organizational structural, such as IMRaD (Introduction, Methods/Materials, Results and Discussion) or Goal – Action – Outcome, and follow an expository, rather than narrative, format. Scientific texts often use the passive voice, which can lead to awkward and confusing sentence structures. Nominalization, or changing verbs into nouns, creates an abstract and formal tone. By comparison, writers of informal texts do not face to the same level of constraints. A newspaper editorial may follow a traditional structure in order to persuade the audience, while the author of an article in National Geographic may use a narrative structure to describe the plight of the African elephant's struggle in a dwindling habitat. Sentence structure may consist almost entirely of simple sentences

CONVENTIONS – *What is considered correct?*

The basic rules of spelling and grammar are applicable in both formal and informal texts. However, formal texts typically adhere to discipline specific rules. Most discourage the use of contractions such as don't or isn't and run-ons such as "etc." or "and so on". In addition, rules for the use of verb tenses, abbreviations, italics, and naming structures may hinder student comprehension.

CLASSROOM PRACTICE – *How can I support my students to communicate their findings?*

So how do you help students apply these characteristics in their own writing? The Framework (pg. 76) explains that students need sustained practice and support to develop this ability. The LDC module provides the instructional framework to develop these skills by combining authentic texts and carefully constructed tasks and mini-tasks. This structure provides an effective tool to scaffold student ability to advance scientific reasoning through clear and persuasive communication. Although there is no one-way to teach science, LDC can be instrumental in achieving the overarching goals of the Framework.

For more information, check out the following resources.

Uni-Learning. University of Wollongong. A detailed site with information about academic writing and writing-related skills, including scientific reports. http://unilearning.uow.edu.au

Writing in Science. Language and Learning Online. Monash University. Detailed descriptions of multiple forms of scientific writing, including literature reviews and poster presentations. http://www.monash.edu.au/lls/llonline/writing/science/index.xml

Fulwiler, Betsy R. *Writing in Science. Portsmouth: Heineman, 2007. Although written for K-5, strategies may be applicable through middle school with modification.*

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KCAS Connections

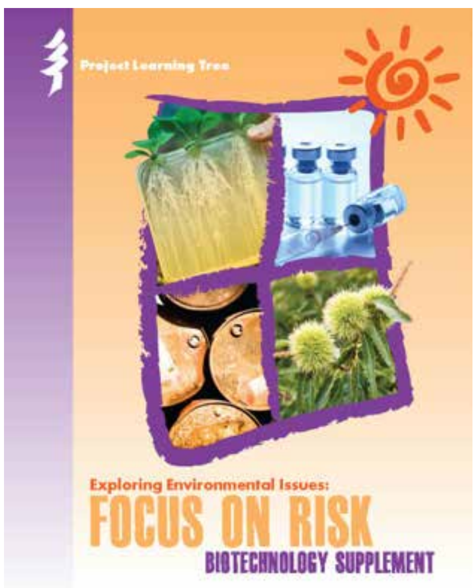
Michelle Shane, Kentucky Environmental Education Council

ALL

Project Learning Tree Secondary Modules offer Tools for Learning

Project Learning Tree (PLT), a well-known international curriculum, provides learning tools for Pre K-12. PLT uses hands-on, interdisciplinary activities, helping young people learn how to think, not what to think, about complex environmental issues. To accomplish this, the PLT Pre K-8 Activity Guide curriculum uses a variety of activities focusing on ecosystems and the forest. However, less known are the PLT Secondary Module Curriculums, which provide more in-depth units on forests as well as units with expanded focus on prominent issues like biotechnology, biodiversity, municipal solid waste, risk, and sense of place.

The PLT Secondary Modules *Exploring Environmental Issues (EEI): Biodiversity* and *EEI: Focus on Risk, Biotechnology Supplement* offer an incredible wealth of material ready to unpack for your students. The *Biodiversity* module topics include invasive species, the importance of species diversity in protected areas, and how pesticides impact biodiversity. In the *Biotechnology Supplement,* topics covered include artificial selection, genetic engineering, bioremediation, infectious diseases, vaccinations, edible vaccines, transgenic plants, and forest biotechnology.



The PLT modules are supported by hands-on activities, student worksheets, labs, discussions, and in-depth case studies. The materials offer out-of-the-box readiness so teachers can immediately integrate the lessons into required learning for the KCAS for Science.

- **MS-LS4-5.** From the *Biotechnology Supplement* , Activity 1, Parts A-C. During three 50-minute learning periods, explore how humans have been genetically modifying organisms for thousands of years. Students will experiment to understand the distinction between artificial selection and genetic engineering, mimic the process of genetic engineering, and evaluate risks and benefits associated with genetic engineering.
- **HS-LS4-6.** From the *Biodiversity* module, Activity 1, Parts B-C. During two 50-minute learning periods, investigate invasive species and the various economic and ecological problems associated with them. Students will come to understand some of the issues and conflicts surrounding invasive species control, as well as how these global invaders spread, what their affects are on the environment and the economy, and how these species affect local biodiversity.

As students work through different perspectives on issues, they will develop critical thinking skills. The PLT modules offer assessment opportunities and extension activities with each lesson, helping teachers gauge understanding and comprehension.

Interested in bringing PLT Secondary Modules to your classroom? Join PLT facilitators Michelle Shane, of the Kentucky Environmental Education Council, and Jennifer Hubbard-Sánchez, of the Kentucky State University, for a Secondary Modules workshop in early 2015 near Jenny Wiley State Resort Park. Learn how to use PLT's Secondary Modules. These modules help teach the standards outlined above, as well as but not limited to HS-LS2-7, MS-ESS3-3, HS-ESS3-4, HS-ETS1-2, and HS-ETS1-3. You'll receive copies of two modules to take back to your classrooms, and get the information you need to use any of PLT's seven comprehensive Secondary Modules. Class size is limited to 25 participants. For more information and how to sign-up for the workshop, please email Michelle.Shane@ky.gov or check out details at keec.ky.gov.

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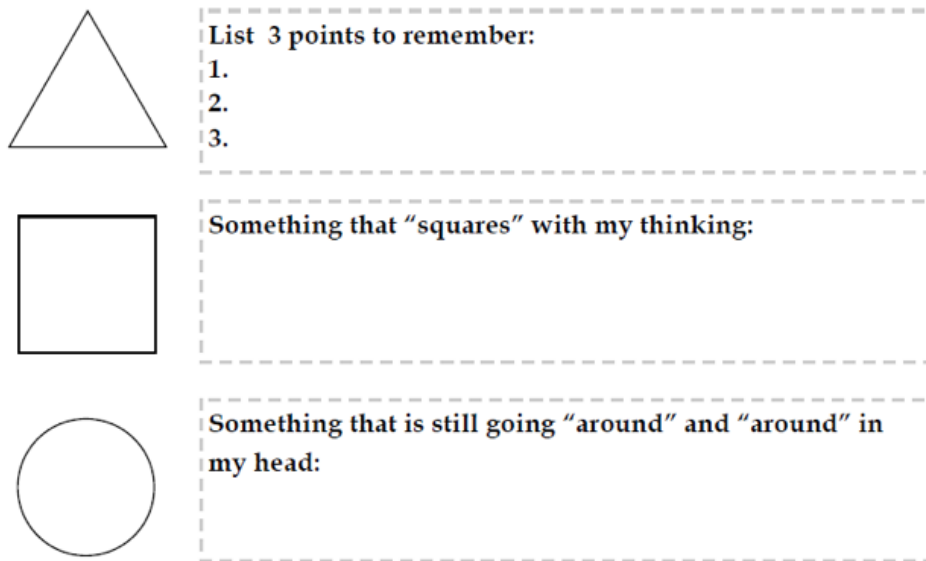
Assessment

Give me your shapes!

Lisa Antoniou, Science lisa.antoniou@clark.kyschools.us

In my 6th grade science class, I try to mix things up a bit by having variety in the way I formatively assess my students. One of the first things I teach them to do at the start of the school year is to, "Give me your shapes!"

I use the following format to assess learning in a few different ways: end of lesson review, after reading a content-rich passage, or after a discussion with a partner in class on an activity.



To begin teaching students this strategy, I give them an actual copy of the above format and they complete it on the paper. Then, I gradually teach them to write the shapes on their paper and record the necessary information beside each shape using a poster in my room (made out of a large Post-it chart paper) for guidance. Eventually, I can ask them to "Give Me Your Shapes!" and each student takes out a piece of notebook paper or even scrap paper and knows what to do.

This is a quick, fun way to assess and lets me gauge whether or not any re-teaching needs to occur. Kicking off the year teaching my students this foundational skill for assessing is a true teacher time-saver.

Professional Learning Opportunities

Opportunity to Blend Arts, Technology, and Environmental Education

KET School Video Project Challenge — Arts! is an opportunity to integrate multimedia technology while supporting the Kentucky Arts and Humanities Curriculum Documents for fun project-based learning. All Kentucky public, private, and homeschools who upload a video to us by Friday, November 21, 2014 will be automatically entered in a prize drawing held on Monday, November 24, 2014 for a greenscreen lighting kit! ket.org/education/svp/arts.php

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PIMSER NGSS Short Course: Waves, for 1st and 4th grade teachers

Wednesday, December 3

Courses are designed to strengthen content understanding of fundamental physical science concepts while addressing multiple aspects of the PGES Framework for Teaching. Examine misconceptions and naïve conceptions that might hinder concept development, learn how to design experiences to help students change these misconceptions.

Experience activities as a learner that promote concept understanding, and discuss implications for best practice and highly effective teaching with other professionals during these 1-day courses.

- Understand key ideas underlying the concepts of waves and information transfer; become familiar with the connections between sound, light and waves
- Learn how to develop student understanding of waves in lessons where the Science and Engineering Practices are embedded in instruction, following the vision of the NGSS

$125

For more information and registration, visit www.uky.edu/pimser

Check out this great resource for amazing wildlife connections!

Journey North engages citizen scientists in a global study of wildlife migration and seasonal change. Use this search engine to find resources on the Journey North website. Report your observations with the new mobile app or web or contact us. Journey North is presented by Annenberg Learner.

Seeing Hummingbirds? Let Us Know!

A big dip in sightings signals a slowdown in the journey south. This week brought just half the number of reports and almost 60% fewer hummers than last week. Most reports are single-bird sightings, and many people are reporting their latest hummingbirds ever

KAEE | Project Learning Tree Kentucky | TOYOTA | KENTUCKY TOYOTA MOTOR MANUFACTURING, KENTUCKY, INC.

The Earlier, the Better for Environmental Education in Kentucky

KAEE Funded for Early Childhood Programs by Toyota Motor Manufacturing of Kentucky

In support of our efforts to strengthen early childhood environmental education throughout the state, the Kentucky Association for Environmental Education (KAEE) was recently awarded more than $8,000 from the Toyota Motor Manufacturing of Kentucky, Inc (TMMK). KAEE provides professional development opportunities in environmental education (EE) for nearly 1,000 Kentucky educators annually, and the TMMK support will allow for a greater focus on pre-kindergarten learning environments.

"With Toyota's generous support, KAEE can now offer training opportunities to 300 early childhood educators," explained Ashley Hoffman, KAEE's Executive Director. "Additionally, we plan to target this program in Kentucky's rural areas, where professional development opportunities for teachers are often not readily available."

Early childhood educators participating in the program will attend a workshop in the use of Project Learning Tree (PLT) Environmental Experiences for Early Childhood. This curricula is specifically designed for educators who work with children age three to six and has been correlated to national standards for preschool education. Participants will receive a copy of the PLT Early Childhood guide and CD for use in their classroom or workplace and will be connected to an array of resources and support available to them from a diverse professional network of environmental educators throughout the Bluegrass and nationwide.

In addition, they will have the opportunity to participate in the development of National Project Learning Tree's early

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childhood green schools program. This initiative is modeled on PLT's existing GreenSchools! program with a focus on how to engage younger learners in creating a healthier learning environment.

"Our goal is to assist educators," Hoffman said, "in providing education that ensures the development of problem-solving skills, builds an interest in and appreciation for the natural world, and develops an environmentally-conscious consumer citizenry and workforce in Kentucky."

For more information on the Early Childhood Project Learning Tree Program, please visit plt.org.

If you are interested in setting up a workshop for your early childhood school or center, please contact Ashley Hoffman at director@kaee.org.

Since 1976, KAEE has worked to build a sustainable environment through education. KAEE is committed to ensuring that all Kentuckians have the opportunity to learn about and connect with the environment where they live and to actively participate in building healthy, sustainable communities.

KAEE serves as the statewide membership-based nonprofit organization for environmental education in Kentucky. Learn more at kaee.org

Albert Einstein Distinguished Educator Fellowship Program now accepting applications for 2015-2016 Fellowship Year

Applications are due by 5:00 pm EST, November 20, 2014.

Dear Colleagues,

The Albert Einstein Distinguished Educator Fellowship (AEF) Program provides a unique opportunity for accomplished K-12 educators in the fields of science, technology, engineering, and mathematics (STEM) to serve in the national education arena. Fellows spend 11 months working in a federal agency or U.S. Congressional office, bringing their extensive classroom knowledge and experience to STEM education program and/or education policy efforts. Program applications are due November 20, 2014, and must be submitted through an online application system.

To be eligible, applicants must be U.S. citizens, be a current employed full-time in a U.S. public or private elementary or secondary school or school district, and must have taught full-time in a public or private elementary or secondary school for at least five of the last seven years in a STEM discipline.

Federal sponsors have included the Department of Energy (DOE), the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA). The DOE sponsors up to four placements in U.S. Congressional offices.

The AEF Program is managed by the DOE Office of Science, Office of Workforce Development for Teachers and Scientists, in collaboration with the Triangle Coalition for STEM Education and the Oak Ridge Institute for Science and Education.

Information about the Albert Einstein Distinguished Educator Fellowship Program, including eligibility requirements, program benefits, application requirements, and access to the online application system can be found at http://science.energy.gov/wdts/einstein/.

For any questions, please contact the AEF Program at sc.einstein@science.doe.gov.
U.S. Department of Energy, Office of Science
View this announcement online.

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Collaboration and Connections:

The Science Connections Newsletter offers a forum for science professionals across Kentucky to collaborate and share classroom experiences. You are encouraged to share instructional strategies, resources and lessons that you have learned with colleagues across the state. Note that your entries should relate to one, or all, of the topics for the next month as noted below.

Below are the upcoming SCN focus dimensions:

December	Planning and Carrying out Investigations	ESS1 B Earth and the Solar System	Scale, proportion and quantity
January	Analyze and Interpret Data	PS1B Chemical Reactions	Energy and Matter

E-mail your contributions to christine.duke@education.ky.gov.
All submissions are needed by the 20th of the month.

If you want to subscribe to KYK12SCI or others LISTSERV for the Kentucky K-12 Science Teachers, go to http://www.coe.uky.edu/lists/kylists.php . Please share this link with your colleagues.