Science Connection

KENTUCKY DEPARTMENT OF EDUCATION

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In This Issue

Editor's Note

"If it is not tested, it won't be taught."

We have all heard this statement before. All too often it has been said that we teach to the test, yet in all actuality we should be teaching students to think critically so they can use their skills to solve problems. This is the year to make this statement a thing of the past. Because there will be no accountability for testing of 4.1 you have the opportunity to embrace the new science standards and shift your instruction. This year is the year to engage all students in authentic learning experiences related to the world around them. Best wishes for a wonder-filled year of learning for both you and your students. *Christine*

Clarification on Science Testing in 2015

With the adoption of the new Next Generation Science Standards (NGSS) incorporated in the Kentucky Core Academic Standards (KCAS) in June 2013*, all Kentucky schools are required to implement the new science standards in each grade K-12 beginning in the fall of 2014. Kentucky will embark on the development of a new science assessment system to match the standards. The new system will take time to build. Thus, staff of the Kentucky Department of Education (KDE) proposed to the Kentucky Board of Education in June 2014 to suspend the K-PREP science testing at grades 4 and 7 in the spring of 2015 since the only test available measures out-of-date standards. However, the United States Department of Education (USED), during the review of Kentucky's ESEA waiver extension submission, made it clear that there must be a science test at these levels administered in Kentucky in 2015. In order to meet USED requirements, the following will occur:

- Elementary and middle schools will administer at grades 4 and 7 a science Norm-Referenced Test (NRT). The Stanford NRT has been given for the last three years as Part A of the K-PREP science test. The NRT is 30 questions and takes 40 minutes of testing time. National percentile results will be reported, but scores will not be used in the state accountability system.
- The high school end of course model has not changed and will continue. In high school, the end-of-course science test (Biology) will be administered in 2015 and its scores will be reported and used in the accountability model.
- Alternate Assessment students will be tested in science in spring 2015 at grades 4, 7 and 11. Grades 4 and 7 will not be used in state accountability. The process for Alternate Assessment for grade 11 science is still under development.
- Science tests will continue to be part of the ACT EXPLORE (grade 8), ACT PLAN (grade 10) and the ACT (grade 11). For Alternate Assessment students, the Transition Attainment Record will continue. Results for all will be reported and used in accountability.

As the new science assessment system develops, educators will be kept informed of timelines and other important information.

*With the incorporation of NGSS into KCAS, the former standards including Core Content 4.1 for Assessment were completely eliminated.

by Christine Duke

NEXT GENERATION SCIENCE STANDARDS

Practice	DCI	Crosscutting Concept
Using Mathematics and Computational Thinking	LS3: Heredity: Inheritance and Variation Traits	Structure and Function

Teaching Earth and Human Activity - Are Students Getting It?

HS | Earth and Human Activity

William Thornburgh
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There are many opportunities for teachers to educate students about human activities and the impacts humans have on our planet. Whether it be within a unit in Biology, in Earth Science class, during an Environmental Science course, or maybe even an Agriculture class in certain schools, teachers can pass on valuable information and present students with real opportunities for critical thinking and problem solving. There are a number of questions we must ask ourselves when approaching this topic (and many other associated topics): Do we introduce and teach the material in an effective manner? Do the students truly understand the issues we are facing? How do you assess their understanding? Are students learning passively or actively? Are students free to discuss and debate the issues? Are we encouraging action to remedy the problems?

The NGSS for High School Earth and Human Activity includes six performance expectations, which are then broken down into the following Disciplinary Core Ideas:

ESS2.D: Weather and Climate

- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. *(secondary to HS-ESS3-6)*

ESS3.A: Natural Resources

- Resource availability has guided the development of human society. (HS-ESS3-1)
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary to HS-ESS3-2),(secondary HS-ESS3-4)*

As we examine the NGSS, it may at first feel like a daunting task to cover enough material so that students will meet all of the performance expectations. But do not be overwhelmed because you most likely already cover many of the items listed. A few tweaks and new approaches may be all you need to update what you already do. A few ideas that have been successful in my classrooms and will hopefully work for you, or at least provide you with a jumping off point for your own teaching, are presented below.

First, choose a few different topics that are current and 'hot button'. Allow the students to have some initial discussions and gauge their interest level, as well as their stance on those issues. Once you have a good feel, divide them up into debate teams and provide them with the rules of holding a debate. There are many options for the rules to use, or you may design your own, but here is a link to provide guidance, http://highschooldebate.org/rules/. You can give the students class time to conduct research, organize their thoughts, gather ammunition against the opposing side, and begin to understand the amount of information that is available to them. This activity also opens the door to teach them about credible and reliable sources, the proper citation of resources, sifting through the mass of information to find fine details, teamwork, public speaking and language, and the importance of scholarly debate.

If you are not sure about current or 'hot button' issues, here are some examples: Economic prosperity is more important than environmental protection. Developing countries should prioritize environmental protection over resource extraction. Construction of mass transit systems in established cities is needed. Recycling is too expensive and not as worthwhile as you might think. The United States needs a transition to another primary source of energy in the near future to save our planet. Some teachers still want

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to debate climate change, but it may be best to steer clear of this as a topic of debate because students may get the wrong impression. There is little to no debate among the scientific community, but if you are looking to provide more information to students, http://climatedebatedaily.com has many valuable sources that could be incorporated into individual student projects or research.

Second, allow students to do an urban planning and design project that will give them an opportunity to think ahead, build the city (or part of the city) from the ground up or work from an existing city, and use their creative side to create a unique presentation that incorporates what you have taught them, what they have researched, and even what they can imagine in the future. Yes, this project does take time. But do not let that be the reason for not doing it! The gains that students can make from this type of project are limitless and it will provide the classroom with some fancy decorations and points of discussion that you can return to throughout the year.

A variety of topics can be woven into student work, including urban agriculture, green ways, mass transit, brown fields, water use and recycling, electricity production, waste management, resource consumption, population density, green rooftops, connections to other nearby cities, and the list goes on and on. Additionally, if you allow students total autonomy in the construction of their project, they may draw it, build it (out of many different materials), they could use a computer program to design the city, or build it through certain games that are currently popular. You will be amazed at the students' ideas and effort into a project like this. Some examples of student work are included below (images taken from Google search).

No Scientific Method?

ALL General

David Grossman
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It's back to school time, and all across the United States, science teachers are pulling out those beginning of the year units on the scientific method. Then they look at their new copies of the Kentucky Core Academic Standards for science and find out that the scientific method didn't make the cut –it's not in the new standards. WHAT? We've been teaching the scientific method for 100 years. It's a staple of every good science classroom. All good science teachers know that. So we must decide, do we leave our comfort zone and delve into the new standards, or do we hold out, teaching that scientific method unit once again?

First, let's examine why the authors of *The Framework* and the new standards would leave out something so important. *The Framework* gives three reasons for the shift from scientific method or inquiry to the science and engineering practices. (see pages 43-44 in *A Framework for K-12 Science Education*)

1. Teaching the scientific method places too much focus on investigations to the exclusion of other practices that scientists engage in.
2. Teaching the scientific method leads students to believe that there is ONE universally accepted, linear approach that all scientist use. This simply isn't true.
3. The use of the term inquiry can be vague. Educators may define inquiry in many ways--which may or may not be the ways it is used by scientists.

So let's assume the authors of *The Framework* know what they are talking about (just look at the list of authors and you'll find a vastly qualified group). The next step is to carefully destroy that scientific method unit that you love so much. Make sure no shreds remain so that you won't be tempted to run back to it.

Now we enter the scary but exciting world of the new standards. Your first question might be, "So now that my favorite unit is gone, do I need to spend a few weeks lecturing on and modeling the eight practices?" I think the authors of *The Framework* would be quick to say "NO" to that ques-

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tion. The intent of the new standards is for an integration of the three dimensions, not for anyone to be taught in isolation.

My recommendation would be to introduce the students to a burning question that can only be answered by means of the practices of science, but one that doesn't require and extensive knowledge of the disciplinary core ideas I gave my students freaky fish- a cellophane fish that moves when held in the students' hands. They were curious about how the fish worked. They then used the practices on their own to investigate and then construct an explanation. From their initial attempts at these practices, I can add scaffolding and help the students become more proficient at each one.

The good news is that we aren't starting from scratch. Some of these practices are innate in students when they enter kindergarten. They are naturally good at asking questions; we just have to help them ask more scientific questions. They are good at carrying out investigations ("I wonder what will happen if I. . . ").

So this year, live dangerously. Throw out the scientific method (after all, scientists don't really use it). Start investigating with students. Build on the strengths that they bring to class. And most importantly, don't use the practices in isolation. (See my post on 3-Dimensional learning). Actually, the most important thing – enjoy the journey and have fun.

Communicating Evidenced-Based Thinking using Products: How Teachers Can Address the NGSS, CCSS, and ISTE Standards

ALL | Video Products as Evidence

Tricia Shelton, *Boone County Teacher Leader*

This article describes a framework developed through a partnership between high school students, their teacher, and a business partner to support the development of confident student thinkers. This collaboration is extending to other classrooms and the work is ongoing. Students, teachers, and partners are finding new ways to use video to support thinking, learning and sharing in the classroom and beyond the four walls while also preparing students for success in a 21st Century world.

Link to the Shelton Class Video Story Introduction
http://www.benchfly.com/shelton

A New Vision

The vision of the Next Generation Science Standards (NGSS) is not of a classroom of teachers filling students with facts for student learning, but instead, students reasoning to explain how and why phenomena occur .This focus on thinking is a commonality between the visions of the Common Core, the Next Generation Science Standards and the focus on 21st Century Learning. Video Thinking Products are a way for teachers to pull all three sets of national standards together as students obtain, evaluate, and share information and thinking with others.

Video Thinking Products

Video Thinking Products are 1-2 minute unedited videos students create to communicate understanding and share evidenced–based information. Video Thinking Products provide teachers with instant feedback about student understanding and misunderstanding in a learning progression. Coaching and critique provide opportunities for students to receive timely and specific feedback from teachers and peers to move learning forward. These Video Thinking Products classrooms are comprised of students actively constructing meaning, sharing evidenced-based findings, and coaching and supporting the work of their peers so all can develop confidence and skill for success.

Video Thinking Products support development of the following standards:

Next Generation Science Standards	**Science and Engineering Practices** SEP 8: Obtaining, Evaluating and Communicating Information SEP 6: Constructing Explanations and Designing Solutions. SEP 7: Engaging in Argument from Evidence
Common Core State Standards	**Presentation of Knowledge and Ideas** CCSS.ELA-Literacy.CCRA.SL4 Present information, findings and supportive evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. CCSS.ELA-Literacy.CCRA.SL5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
ISTE Standards	**Communications and Collaboration** Students use digital media to communicate and work collaboratively to support individual learning and contribute to the learning of others.

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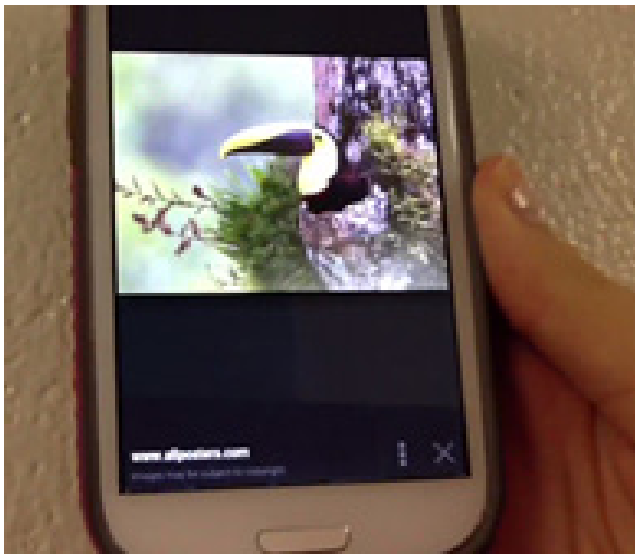
Obtaining, Evaluating and Communicating Information

One of the conceptual shifts of the new standards is the explicit connections between the NGSS and the CCSS, especially in the areas of reading, writing and speaking grounded in evidence. In the old science classroom model, students communicated understanding primarily through writing and summative assessments. Students often failed to connect learning and understanding between multiple class activities. In the new model, students construct meaning in the scaffolded class experiences of a learning progression and communicate a deep understanding by connecting those experiences in a communication of thinking. These communications are expressed through the multiple vehicles of writing, speaking and video. Thus, students are supported on the road to self-directed learning and problem solving with three vehicles that share a common foundation in evidence and reasoning. Video Thinking Products are the glue that binds together all of the essential elements of the current education landscape: Next Generations Science Standards, Common Core State Standards, and the 21st Century Skills in the ISTE standards.

Student Sample



Ecosystem Explanation
http://bit.ly/predictbench

Coaching feedback for student video:

This video product communicated the claim: "If a drought were to exist in a rainforest, the ecosystem would die off." The student provided three pieces of evidence: photosynthesis (diagram of a leaf performing photosynthesis with inputs and outputs), a water cycle diagram (with specific reference to transpiration) and an energy pyramid (with specific reference to the producer level). The student provided detailed reasoning communicating how each piece of evidence supported the claim and how all elements of the explanation connected back to the scientific principles of ecological interdependence. Additional evidence and reasoning was provided with a discussion of the additional roles trees can play in an ecosystem such as habitat for other organisms. Reasoning was provided around how a drought that would kill the producer (explained in the first part of the video) could also lead to the consequence of animal migration further impacting the ecosystem. The audience is provided with a website for more information about the effects of droughts. The student demonstrates strategic use of digital media by using a photograph on a phone as a piece of evidence in the video.

For more information on how to support Video Thinking Products in your classroom visit www.benchfly.com/shelton and click on the: "Download the ART of Video Material" button at the bottom of the page or contact tricia.shelton@boone.kyschools.us.

Globally Harmonized System of Classification and Labeling of Chemicals

ALL General

Sean Elkins, *Science Instructional Specialist (OVEC region)*

The Occupational Safety and Health Administration's (OSHA) of revision of its Hazard Communication standards required new training for anyone who works with potentially hazardous chemicals. The training is required for school personnel including custodial staff and science teachers, unless those teachers have no access or exposure to hazardous chemicals. The Hazard Communications standards have been changed as the United States moves to adopt the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Part of this change includes the requirement that **employers train workers by December 1, 2013, on the new labels elements and safety data sheets format** to facilitate recognition and understanding.

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In order to facilitate this training, the Kentucky Occupational Safety and Health program (KyOSH) created an online training course to train workers on the new label elements and safety data sheets. This course is titled *Hazcom 2012, GHS Overview* and is intended for participants who need training on the basics of the revised HAZCOM standard and GHS (Globally Harmonized System of Classification and Labeling of Chemicals). The training consists of a short interactive course followed by a quiz. Participants who receive a passing score on the quiz will have the option to print a Certificate of Completion for the course. The *Hazcom 2012, GHS Overview* course is available at: https://kylabor.adobeconnect.com/_a966381794/hcghssawc/ Background information for this requirement is available from OSHA's Hazard Communication webpage at http://www.osha.gov/dsg/hazcom/index.html If all personnel in your school who have access to chemical storage areas have not completed this training, please encourage them to do so as soon as possible.

School Laboratory Management and Chemical Cleanout

The Kentucky Department of Education occasionally receives inquiries from educators and school officials asking how to dispose of unwanted chemicals in school science labs. The Kentucky Department for Environmental Protection (KDEP) - Division of Waste Management (DWM) is the agency responsible for enforcing the statutes and regulations governing disposal of solid and hazardous wastes. KDEPs Division of Compliance Assistance (DCA) has created an informational document that provides a cursory overview of the responsibilities and hazards associated with chemicals/wastes associated with common school labs. The School Laboratory Management and Chemical Cleanout Manual is available at http://education.ky.gov/curriculum/sci/Documents/SC3SchoolLabManualFinal.pdf This manual provides information to help schools establish and maintain Best Management Practices for the selection, purchasing, storage, safe handling and proper disposal of chemicals used in schools. This will provide a safe environment for students, teachers and staff while simultaneously ensuring compliance with applicable regulations.

For each unwanted chemical the school must determine the category of waste (hazardous or non-hazardous) for the chemicals and then provide appropriate disposal for each chemical. Appropriate personal protective equipment (PPE) must be utilized and personnel using PPE trained in its proper use and limitations. There are a number of environmental contractors and disposal companies exist in Kentucky that provide disposal services. An internet search should find those contractors local to your area. For additional assistance you can contact the DCA at (502) 564-2150.

KCAS Connections

Earthquakes, Tornados, and Flooding, Oh, My! ESS3 and Young Learners

Elementary | Environmental Education

Vivian Bowles, *Kit Carson Elementary School*

The core idea for ESS3, Earth and Human Activity, is that students ask and answer this question: "How do Earth's surface processes and human activities affect each other?" (National Research Council, p 190), with subtopics including the dependence of humans on natural resources, the effects of natural hazards on individuals and societies, and the effects of humans behaviors on the earth's surface and climate. These behaviors include "activities in agriculture, industry, and everyday life (that) have had major effects on the land, vegetation, streams, oceans, (and) air…" (National Research Council, p196) Depletion of natural resources; air, land, and water pollution; and climate change are consequences linked to these activities.

A plethora of headline news stories, documentaries, and even leveled-reading materials attest to the causes and effects of local and global catastrophic natural hazards. Students not only practice earthquake, fire, and tornado drills in my school district, but shelter-in-place drills for (God forbid) nerve gas leaks. The challenge for primary and elementary teachers is less about providing students opportunities to obtain, evaluate, and communicate information on the impact of natural hazards, and more about providing authentic, developmentally appropriate learning experiences without breeding fear.

School campuses allow students to observe patterns and collect data for ESS3 learning experiences by investigating the question, "Where does water go on our campus? After a brainstorming session, take students on a tour of the school grounds to observe the paths water takes after a rain event. Discuss the effects of man-made (impervious surfaces such as parking lots and roofs on which water stands or runs off; and storm drains and gutters which move water) and natural features of the land (pervious features such as vegetation which absorbs and slows water, and slopes which carry water via gravity). The tour can assist third graders as they examine man-made and natural design solutions to reduce the impacts of flooding (3-ESS 3-1) (Kentucky Core Academic Standards). The tour also provides authentic

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observations of erosion and/or structures that prevent erosion and land shifts on the school grounds (2-ESS2-1 and 4-ESS3-2). Back in the classroom, providing spongy and hard materials allows students to investigate the effects of pervious and impervious surfaces on the movement of water and land. Satellite maps of the school campus copied onto graph paper allow fifth graders to compare the percentage of pervious to impervious surfaces. They can then conduct research, or you can invite municipal engineers to discuss and demonstrate how storm drains, rain gardens, and other structures protect the campus and community from flooding (5-ESS3-1).

David Sobel, an educator and advocate of place-based education, states that children need to have "an opportunity to bond with the natural world, to learn to…feel comfortable in it, before being asked to heal its wounds." (Sobel 1996, p.10) For primary and elementary students, observing local solutions to flooding hazards can help them gain a first-hand understanding of ESS3 concepts while avoiding the catastrophes of the evening news.

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Literacy Design Collaborative

ALL LCD

Academic Writing, Science and LDC

According to the NGSS Framework, the **overarching goal** for K-12 science education is to ensure that *all* students appreciate the beauty and wonder of science, possess sufficient knowledge to engage in public discussions, and become careful consumers of scientific and technological information. In addition, students should be able to learn about science outside school and develop the skills to enter careers of their choice. Given the enormity of this goal, can devoting time for writing be justified? The answer is an overwhelming, "yes."

Take a quick look at the science and engineering practices. What do you see? Appendix M provides multiple examples that include literacy skills critical to achieving the demands of the practices. Integrating these skills by asking students to use evidence, justify claims, and reason scientifically will have a positive impact on their conceptual understanding. But what distinguishes writing in science from other content areas?

Academic writing is typically used to describe the kind of writing students are asked to do at the college level. The genres differ significantly from one discipline to another but, Barrie Olson, in "Academic Writing across the Disciplines," identifies three traits of good academic writing:

1. ***Reason over emotion***. The student's claims are made with adequate supporting evidence and provide a clear line of reasoning to support his or her argument.
2. ***Evidence of being open-minded and disciplined***. The student includes a variety of credible sources and, where appropriate, acknowledges opposing views.
3. ***The written product assumes a rational reader***. The student offers a clear line of reasoning to address issues or questions the reader may have.

How can LDC be used as a tool to meet those unique demands? The "teaching tasks" of LDC provide framework to develop these skills within the meaningful context of the science classroom. Teaching tasks are constructed from LDC "template tasks," a fill-in-the-blank sentence shell that allows flexibility to create high quality student assignments. Following is an example of how a blank template task is completed to become a teaching task:

Blank Template Task *(# 13 – Informational or Explanatory)*	**Completed Teaching Task**
After researching _____ on _____ write _____ in which you describe _____. Support your discussion with evidence from your research.	After researching **texts** on **Photosynthesis, The Law of Conservation of Matter, and The Law of Conservation of Energy**, write **an informational essay** in which you describe **how the photosynthetic process can be used to demonstrate both the Law of Conservation of Matter and the Law of Conservation of Energy**. Support your discussion with evidence from your research.

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Although there are three main modes or categories of writing, the first two align more closely to the discipline of science.

- ***Argumentation*** (KCAS for Writing, Standard 1)
- ***Informational or Explanatory*** (KCAS for Writing, Standard 2)
- ***Narrative*** (KCAS for Writing, Standard 3)
- Within those writing types, "The 1.0 Guidebook to LDC" identifies nine important text structures. These structures help to define what students should be able to do and include:
- ***Definition***: explaining the explicit and implicit meanings of a concept, topic or idea
- ***Description***: providing details that illustrate a character, place or event
- ***Procedural-Sequential***: relating chronological or sequential events in some order
- ***Synthesis***: summarizing; integrating important elements of an idea, concept or topic
- ***Analysis***: examining by breaking down the elements of an idea, topic, concept issue or theme
- ***Comparison***: contrasting similarities and differences
- ***Evaluation***: providing a point of view based on a set of principles or criteria; critiquing; recommending
- ***Problem-Solution***: examining a problem and proposing a solution(s)
- ***Cause-Effect***: identifying a cause for an event or condition and examining the effect(s)

Writing an appropriate task is crucial first step to the development of a rigorous, content appropriate module. You can learn more about these tasks and explore the different templates on the LDC "What Tasks" page. There you'll find a variety of resources to help you design a high-quality teaching task. Next month, we'll explore the different types written products, their purpose and connections to science and LDC to help you provide an authentic context for student writing.

Whole Class Questioning: Hearing From Many Student Voices

ALL ELA

Melissa L. Shirley, *Ph.D.*

Here we are at the last article in this series on using whole-class questioning to obtain data about what our students really know. I hope you have enjoyed thinking deeply about your questioning over the past few months and have gained some tools to enhance your practice!

This month, we're going to discuss strategies of getting more students involved in the questioning process. Since we started this series with the claim that whole-class questioning can provide us with valuable formative assessment information about our students, we're going to close with considering *which* students are being formatively assessed. When we give paper-based or electronic formative assessments, we can find out what each student knows. But with questioning, we run the risk of missing out on important information regarding *every* student's learning.

One common way in which this occurs is when we hold conversations with just a few target students or students who tend to dominate whole-class interactions (Tobin & Gallagher, 1987). Sometimes this is because we rely on the bright students to give the correct answers. Sometimes this occurs because one or two students are eager volunteers. Sometimes we focus our questioning on students who might otherwise misbehave or whose attention might drift if we don't keep them talking.

Whatever the reason, it's important to remember that the conclusions we draw about a class's understanding depends on how much data we have available to us. If the bright student responds and we move on, could we be leaving half of the class behind because we didn't ask them a question? Could some of our students feel ignored if they are not called on, thinking that "the teacher doesn't care if I respond or not"?

Another important reason to avoid focusing on target students is that the other students probably have some other interesting contributions to make. The entire class discussion will be enriched by hearing from more voices, and more of your class will feel involved if they have a chance to contribute. I'm going to close this series by giving you some ideas of what to look for in your questioning.

- Do students have the opportunity to truly discuss among themselves, or do you mediate all conversations? This can be referred to with the analogy of "volleyball versus ping-pong" (Keeley, 2008). In ping-pong questioning, the teacher verifies all responses and calls on specific students. In volleyball questioning, students take ownership of the discussion and respond directly to one another. This can cause classroom management issues if you're not careful, so you may want to look into some other suggestions so you are prepared!
- Do you call on specific target students? If so, you might try a strategy to help randomize your selections. There are a lot of tools to help you. I prefer ones that don't make it obvious to students that you are drawing random names – you can lose a lot of valuable instructional time by using complicated name randomizers. Try index cards or popsicle sticks with names written on them – these are both cheap and easy techniques that

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allow you to decide whether to replace the name so the student might still have to answer, or you can choose to leave a name out until all students have been called on.
- Do you call on girls and boys equally during whole-class discussions? Many teachers have an unconscious bias that leads them to treat boys and girls differently in the classroom – read this online article (Scantlebury, 2009) for some interesting points!
- Do you use calling on students as a mechanism to keep students quiet and attentive? If we want students to share their thinking with us, it's important to refrain from making being called on a punishment.

The major point to remember in whole-class questioning is that it can provide teachers with valuable data on all students' learning. Effective questioning is an essential tool for us to use to find out what our students really know and think about science concepts. Over the past months, we have examined several components of effective questioning – starting with cognitively demanding questions, encouraging deep student responses, following up with probing questions to ensure deep thinking, and making sure we hear from many student voices. These areas are interrelated, and enhancements in any aspect will benefit your ability to learn from your students and carry out effective formative assessment through whole-class questioning.

I hope that this series has given you a way to consider your own questioning strategies and some ideas for what you might like to examine more closely. If you found this helpful, or interesting, or even thought-provoking, I would love to hear from you at melissa.shirley@kstf.org.

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Science and Engineering Practices in a Preschool Classroom
Asking Questions and Defining Problems

Early Education | Engineering

Kendra Rutman, *Ashland County Schools*

Children have a natural curiosity to learn and explore. In a preschool classroom, we strive to encourage this curiosity and foster a child's growth through exploration and play. Children create experiments on a daily basis. If you step back and watch a child, you will most likely observe their curiosity at work.

- What will happen if I mix these colors?
- Why did this leaf fall off the tree?
- How did the ice melt?

It is our belief that following children's interests leads to more meaningful classroom experiences for children. When setting up a classroom for exploration, I begin with what children know. I ask open-ended questions and encourage conversations to find out what their interests are and what they know about a particular topic.

Next, we explore what children would like to learn. We focus on finding out why this is important to the child. Following the child's interest builds confidence, allows them to feel a part of the group, and shows that their ideas have meaning. A child-centered classroom encourages higher level thinking and develops problem solving skills.

It is important to encourage children to make a plan to find the answers they need. Together, teachers and children can gather the necessary materials so they may begin to explore and investigate. Exploration provides children with the opportunity to take the lead and experiment so they can find answers to their questions.

- What will we need to solve this problem?
- Where can we look for the answers?
- Who can help us?

Learning is hands on. Setting up a classroom that facilitates exploration provides children multiple opportunities for investigation and learning. After all, authentic learning involves trial and error. We invite experts and take trips (on or off site) so that the experience is meaningful to the child. Teachers support and scaffold the student's attempts at problem solving, as well as check for understanding through conversation and demonstrations. Skills learned through science curriculum can also be linked back to other curriculum areas such as; cognitive problem solving, communication, vocabulary,

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math, social skills, and literacy.

The concept of creating a child driven learning experience, hit home for me during one particular classroom activity. One year in my class, we were studying buildings. We discussed many different features of buildings, took a trip to the library to discover more about buildings in our community, charted features of our classroom building, etc. I noticed that the study was only meaningful to a handful of students. I was considering moving on to a new interest, and then one day a student noticed that our classroom guinea pig had torn up its home. We talked about it as a group, and decided that the guinea pig needed a new building for a home. Suddenly, the entire class was involved, because it was meaningful to them. Our classroom guinea pig, Kisses, needed a new home. We talked about different options:

- What will be strong enough to use for a home?
- How can we make the home "stick" together?
- How big does the home need to be?

Through investigation, the children discovered that paper was not a good option for a home because it fell over easily. Next, the children suggested using Popsicle sticks to make a home. One child suggested we use tape to hold the pieces together. The children tried the tape, but after repeated attempts, they decided tape wasn't strong enough to build an entire home. Another child suggested we use glue. I assisted the children in cutting out a template from cardstock. They then began gluing the wood pieces together. The children made suggestions along the way

"We need a door!" "It needs to be taller." Before long, Kisses had a brand new home, and the children in the class learned how to problem solve through asking questions and defining problems.

One of the most important jobs as an educator is to help students reach the next level. By keeping it child directed, you set them up for a lifelong love of learning. Meaningful classroom experiences occur when students have a vested interest in what they are learning and begin to take responsibility for their education. Science and exploration instills a love for learning at an early age. So why not go explore and see what you learn today?

Be in the Know

NARST

The National Association for Research in Science Teaching (NARST), an NSTA affiliate, recently published a series of position papers addressing the network of changes needed to successfully implement the Next Generation Science Standards (NGSS). The papers address eight key topics, including accountability, assessment, curriculum materials, engineering, equity, informal science education, pre-service teacher education, and professional development. According to NARST's introductory statement, "the position papers are intended to provide a thoughtful, policy-oriented response to the NGSS from the standpoint of science education researchers, but aimed at the general public, science educators and policymakers."

To access a PDF versions of position papers please click on https://www.dropbox.com/sh/blwxpb4ihisrtfa/AAAepzdeK74GC74cir-ODrbda or go to http://www.narst.org/NGSSpapers/index.cfm

UK UNIVERSITY OF KENTUCKY College of Agriculture, Food and Environment

The Department of Plant and Soil Science at the University of Kentucky wants to get involved and come visit YOUR classroom!

In the past 50 years the world population has doubled and there is an entire industry that exists to feed, clothe and provide for them. Approximately 54,000 jobs a year are available in agriculture with approximately 29,500 graduates per year trained to fill them. Help us spread the word by inviting someone to speak to your classroom.

Our department is currently trying to coordinate high school classroom visits for the fall 2014 to educate students interested in the sciences of the career opportunities in agriculture, specifically in plant and soil sciences. Schedule an appointment to have a UK representative come visit your classroom to speak with your students.

Please contact, Amber Harris, Academic Coordinator in the Department of Plant and Soil Sciences by email, amber.harris@uky.edu or phone, (859) 257-3214. We look forward to hearing from you.

Real Scientist... Real Research... for Real Students!
Check out the *Natural Inquirer* and *Investi-gator*

The *Natural Inquirer* is a middle school science education journal. Scientists report their research in journals, which enable scientists to share information with one another. This journal was created so that scientists can share their research with middle school students. Each article tells you about scientific research conducted by scientists in the USDA Forest Service. Find out more about the USDA Forest Service.

All of the research in this journal is concerned with nature, trees, wildlife, insects, outdoor activities and water. First students meet the scientists who conduct the research. Then students read special information about science, and then about the environment. Students also read about a specific research project, written in a way that scientists write when publishing their research in journals. Students become scientists when they do the Discovery FACTivity, learning vocabulary words that help in understanding articles." (http://www.naturalinquirer.org/)

"*Investi-gator* is a free science journal for grades 4 through 8. This journal is created in partnership with the USDA Forest Service and the Cradle of Forestry Interpretive Association. The journal focuses on contemporary, Forest Service research and is written in the format of a scientific article." (http://www.scienceinvestigator.org/)

*As with all resources, be sure to review documents for alignment with the 3 dimension learning of the NGSS. Refer to the NGSS EQuiP Rubric for guidance.

Any person in the Commonwealth of Kentucky with a plan to educate young people about the birds of Kentucky may apply for up to $250 project funding from the ***The Kentucky Ornithological Society Anne L. Stamm Avian Education Fund.*** Applicants must be at least 21 years of age. Teachers at public and/or private schools within Kentucky are especially encouraged to apply for funding of projects related to their classroom/teaching activities. The application form can be found at http://www.birdky.org/.

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:

Coming up:	Science and Engineering Practice	Disciplinary Core	Crosscutting Concept
October 2014	Asking Questions and Defining Problems	PS3: Energy	Cause and Effect
November 2014	Developing and Using Models	LS4: Biological Evolution: Unity and Diversity	System and System Models

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

KDE Revised Consolidated Compliance Plan for Non-Discrimination Available

Please be advised that the Kentucky Department of Education has revised its Consolidated Compliance Plan for Non-Discrimination. The revised plan has been posted on the Legal and Legislative Services page on KDE's website and includes a Discrimination Complaint Form that can be filled out by anyone alleging discrimination against KDE staff and/or KDE program areas.