Science Connection
KENTUCKY DEPARTMENT OF EDUCATION
A Collaborative Resource for Teachers **March 2015** Volume 2 Issue 1

In This Issue

Editor's note

Ah, the power of a growth mindset and the rewards of taking chances! Recently, my colleagues and I shared a must-see "inspirational graphic" with science network participants across the state. The graphic was called [DC-DoPS1] The Profile of a Modern Teacher. This infographic, created by Reid Wilson, sparked rich conversations about the growth mindset and the teacher dispositions that are needed as we continue to deepen our understanding of the Next Generation Science Standards (NGSS). The contributors to this month's Science Connection exhibit several of these internal dispositions, many of which Wilson captures in his work. These teachers stepped outside of their comfort zones to share their classroom experiences publicly, allowing themselves to be vulnerable among colleagues. Realizing that they don't have to wait until they are "experts" to share strategies, lesson ideas, or classroom experiences, these teachers took chances in order that we all might grow and improve as educators. I am grateful to each of them, not only for their willingness to collaborate, but for modeling the habits of mind that we hope to inspire in our students.

Read, reflect, and be inspired!

—Christine

Discourse leads to greater understanding

HS

By [Dr.] **Brett Criswell**, Clinical Assistant Professor, STEM Education University of Kentucky brett.criswell@uky.edu

Karina Kwiatkowski (Ms. K) opens a block period in her introductory biology class with a review, followed by an interactive lecture on cell regulation. After completing a check for understanding, she transitions into a new activity structure: The students will read an article on stem cells, write down individual questions from the reading, and then discuss those questions in their table groups. These small-group discussions will then be the fodder for conversations in a student-lead, whole-class discussion. Once sufficient time elapses for students to read the article, generate questions, and confer with the table group about what ideas / questions they wanted to share during the whole-class discussion, Ms. K marks the transition into this new activity by reminding students of some important norms. While it would be easy to interpret this action as a traditional classroom management strategy, it is in fact part of a larger framework for helping her students engage in productive discourse – a framework that shares many features with the Accountable Talk model (http://ifl.pitt.edu/index.php/educator_resources/accountable_talk).

Continued on Page 2

NEXT GENERATION SCIENCE STANDARDS

Practice
Obtaining, Evaluating and Communicating Information

DCI
LS1B Growth & Development of Organisms

Crosscutting Concept
Stability and Change

Continued from Page 1

Ms. K did one more thing before turning the reigns of the discussion over to her students: She queried, “Does anyone remember what three things we are asking ourselves [when other students are talking]?” In quick succession, three separate students responded, ‘Do I understand what they are saying?’, ‘Do I have anything to add [to their ideas]?’, and, ‘Do I agree with what they are saying?’ These three questions are another component of the framework that the teacher is using to structure the student talks. They are derived from the conditions that Bereiter (1994) established for what he labeled as progressive discourse in science: “Sometimes people with opposing views can engage in discourse that leads to a new understanding that everyone involved agrees is superior to their previous understanding” (p. 6). Bereiter viewed progressive discourse not only as the ideal of effective scientific inquiry, but as the ideal of meaningful science classroom talk. He suggested that achieving this ideal required upholding four commitments: (1) mutual understanding; (2) expansion; (3) openness; and (4) empirical testability (p. 7). By reminding her students of the three questions they were to be asking themselves as they listened to their peers talking, Ms. K was facilitating their participation in progressive discourse.

The outcome of the whole-class discussion that took place was very impressive, largely due to the significant structures Ms. K had put in place over the first few months of school. One exchange between a female (FS) and male (MS) student is worth highlighting:

> FS: Yeah, like, um once you … I think one of the reasons we have pluripotent cells as an embryo is because we don’t have any, like the organ systems and the tissues yet. And so, once we get enough of those, cells will like, start multiplying and dividing in their own special-, their specialization I guess. And so then, that’s why the adults, they don’t have, um, the stem cells.
> MS: So, like, you’re saying that, um, the pluripotent cells are only there to take up certain cells that aren’t going to divide and reproduce on their own.
> FS: Yeah, like … Okay, so like when you’re an embryo, you don’t have any of your body systems yet or anything, so like, they’re full of stem cells …
> MS: Yeah.
> FS: So, as they begin to multiply and as they develop into, as it develops into a fetus and stuff, the stems will then, they’ll start creating the body systems. Like, I guess … I think they sort of turn into the certain cells for the body system. And then once they do that, they can, those cells can multiply and divide at their own rate, and how they should.
> MS 5: And you don’t <need these blank stem cells to …> Yeah.
> FS 4: <You don’t need them any more.>

[The <> represent overlapping speech in the last two turns.]

When you read this exchange, it is clear that the students are co-constructing an explanation of how they believe stem cells function and change over time in certain organisms. Just as significant, though, is how they accomplish this. In the male student’s first turn, he begins with the words, “So, like, you are saying …” This is a well-known talk move called revoicing (http://inquiryproject.terc.edu/prof_dev/Goals_and_Moves.cfm) that is designed to ensure mutual understanding between participants in a conversation. The student used that move because Ms. K had modeled it for the class many times. And it is through this modeling, as well as the many structures she had put in place for science classroom talk, that her students are developing a great deal of proficiency with the science and engineering practice of obtaining, evaluating, and communicating information (Schweingruber, Keller, & Quinn, 2012, p. 53). Hopefully, these strategies from the classroom of a first-year science teacher can also serve as models for other teachers in Kentucky who want to similarly support their students in mastering this practice.

References:

Bereiter C. (1994). Implications of postmodernism for science, or, science as progressive discourse. *Educational Psychology*, *29*(1), 3–12.

Michaels S., O’Connor C., & Resnick L. B. (2008). Deliberative discourse idealized and realized: Accountable talk in the classroom and in civic life. *Studies in the Philosophy of Education*, *27*(4), 283–297.

Schweingruber, H., Keller, T., & Quinn, H. (Eds.). (2012). *A Framework for K-12 Science Education:: Practices, Crosscutting Concepts, and Core Ideas*. National Academies Press.

Continues on Page 3

Understanding Growth and Development of Organisms (LS1.B) Through the Lens of Science and Engineering Practice 8 – Obtaining, Evaluating, and Communicating Information

By **Sue Dillery** (Taylor County High School) and **Brian Womack** (Green River Regional Educational Cooperative)

HS

According to A Framework for K12 Science Education and Next Generation Science Standards, "Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs." One could contend that "all science begins and ends with obtaining, evaluating, and communicating information." - (NSTA, 2015)

Steve Metz, field editor for the National Science Teachers Association (NSTA), writes in the most recent issue of The Science Teacher (NSTA), "we think of practicing scientists and engineers working in labs or in the field but that reading and writing comprise of over half of their work. If science truly begins and ends with this practice, what are we doing with our students to make this more accessible? What experiences are we giving them so they can learn to critique by asking questions of their own work and the work of others? Developing this skill is inherent to developing others skills like engaging in argument from evidence".

For teachers, the task is to assist students in identifying primary text which are unique to the field of science- a genre unto itself. Science specific text can be heavy in vocabulary, charts, data tables, graphs, diagrams, and models. Metz suggest the use of "adapted primary literature" as a means to meet the needs of the students at their current reading levels (see Lexile level in resources below) while maintaining the established message of the source.

Students need to be critical consumers of information. They should have a comprehensive understanding of science related content but more importantly, a skill set of science literacy that allows them to evaluate the merit and validity of claims, methods, and designs. Once knowledge has been obtained and evaluated, students should be able to communicate their findings and understanding in a meaningful way. Like other science and engineering practices, this skill is developed progressively over time in grades K-12. Students that effectively communicate their understanding of information, ideas, and evidence demonstrate their level of their own learning. This can be achieved through multiple venues such as journal /science notebook entries, poster boards, slide show presentations, social media/blogs, video productions, and Socratic seminar discussions. Ultimately, science literate students should to be able to read and produce "domain specific text" related to science and engineering.

So what does this look like in the high school setting?

Most high school students can tell you they each started as a single cell, some can even use the term zygote, but few students can elaborate all the developmental changes that must occur for the transformation from a zygote to an "almost" adult being like themselves. Mitosis, notwithstanding, the growth of a single cell into a 30 trillion cell human with the myriad of cell structures and functions appears almost as if it were magic. How to facilitate experiences that help students to put together the ideas of DNA structure, replication, and gene expression with cell differentiation leading to growth and development is a daunting task. Questioning students about their DNA, gene expression and cell differentiation background knowledge frequently leads to the disappointing answer, "The DNA [within an individual] is different in different cell types". In the next breath students say, "Through mitosis one cell gives rise to two cells with identical DNA". Having students grapple with these two disparate ideas is key to building their understanding.

Hence the challenge for teachers (as well as students) is obtaining accurate information at an appropriate reading level/vocabulary level that is accessible for every student in a class. Most high school Biology textbooks provide little information on gene expression, college-level texts, such as Campbell's Biology, provide a more detailed account of the process but at a reading level beyond the grasp of many high school students. Journal articles tend to be too specific in this field and are frequently beyond the reading level of an average high school student.

Teachers may need to research content specific text or enlist the assistance of the school media specialist. A media specialist can assist with strategies that are often not inherent to science teachers. Adapting text (see resources below) to a student's level and/or differentiating the readings within a group of students is one such strategy which allows for greater exposure to a variety of texts within the classroom. While using Google Advanced Search, teachers and students can locate text through a

Continued on Page 4

Continued from Page 3

variety of filters including reading level. Also, websites like Newsela allows teachers to sign up classrooms and enable students to do searches on a variety of current science news related articles by subject and reading level. Simple English Wikipedia is another useful website to locate information on specific science subjects that could be more appropriate for limited English users or students below grade level due to its use of "simple English words and grammar." And by going to Achieve the Core website, teachers can locate and use the Academic Vocabulary Finder which allows teachers (and students) to plug-in up to 20,000 words of text to examine the reading level/text complexity as well as parts of speech, meaning (definition), and example.

After students have engaged with their chosen (or assigned) text through specific content reading strategies, scaffolded small group experiences can result in deeper understanding of the content. Students can further share their understanding by creating models of the process of gene expression and cell differentiation. Different student groups could focus on a specific aspect of development such as morphogenesis of human hands, organogenesis of a specific organ, hox genes and body plans.

Here the use of models (NGSS Practice 2) can be a powerful way to assess student understanding while engaging unique student work.

Being literate in science looks different than other academic areas. Ultimately, the goal is to move students forward in their thinking and understanding of science content. The stylized writing of science is unique, therefore, the attainment of concepts and skills will be as unique.

In order for students to be equipped scientifically, they will not only have to able to evaluate and communicate their own work but, perhaps more importantly, the work and research of others.

Resources:

- Achieve the Core – Academic Word Finder - http://achievethecore.org/academic-word-finder/
- Appendix F: Practice 8 – Obtaining, Evaluating, and Communicating Information – Progressions for Grades K-12 - https://www.dropbox.com/s/h8wdcn2nfl7nofx/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf?dl=0
- Google Advanced Search - http://www.google.com/advanced_search
- The Science Teacher - Vol. 82 Number 2 (NSTA)
- Lexile Reading Levels - https://www.lexile.com/using-lexile/lexile-measures-and-the-ccssi/additional-resources/
- Next Generation Science Standards, Appendix F: Science and Engineering Practices. Pp. 65-66 - http://www.nextgenscience.org/sites/ngss/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf
- Next Generation Science Standards, Appendix E: http://nextgenscience.org/sites/ngss/files/Appendix%20E%20-%20Progressions%20within%20NGSS%20-%20052213.pdf
- NSTA Webinar - Obtaining, Evaluating, and Communicating Information - http://learningcenter.nsta.org/products/symposia_seminars/NGSS/webseminar12.aspx
- Simple English Wikipedia - http://simple.wikipedia.org/wiki/Main_Page
- Teaching High School Science Using Adapted Primary Literature, University of Alberta - http://www.elementaryed.ualberta.ca/Centres/CCRL/StudiesandResources/TeachingHighSchoolScienceUsingAdaptedPrimaryLiterature.aspx
- Text Complexity and the Common Core (PPT) - https://www.dropbox.com/s/p0085s7am45iuy5/Text%20complexity%20in%20the%20CCS%20pptx2.ppt?dl=0
- YouTube – Bozeman Science - LS1.B – Growth and Development of Organisms - https://www.youtube.com/watch?v=rAe0LLWabY&index=31&list=PLllVwaZQkS2rtZG_L7ho89oFsaYL3kUWq

Clarity & Coherence Through Collaboration

By **Tricia Shelton**, Boone County HIgh School and **Ashley Hammond,** Berea Independent Schools

MS

A Framework for K 12 Science Education (National Research Council, 2012) presents an evidence-based vision for science teaching and learning that is grounded in decades of research. As states look to the *Framework* and NGSS to guide science education, it becomes evident that significant shifts in science teaching and learning are required to meet this new vision and provide meaningful and effective experiences for students.

One article describing these important shifts is that of Dr. Brian Reiser's: *What Professional Development Strategies are Needed for Successful Implementation of the Next Generation Science Standards* (2013). According to Dr. Reiser, ***"Central to the vision of teaching and learning articulated in the Framework and NGSS are three interrelated goals that affect how***

Continued on Page 5

Continued from Page 4

teachers need to support student learning: 1. Core Ideas: 2. Practices: 3. Coherence." The focus of the core ideas goal is depth over breadth, while goal 2 elevates the practices (acting and thinking like a scientist) to be equally important to content. Core ideas and practices intertwine with crosscutting concepts (the thinking tools) resulting in the 3 dimensionality of the NGSS where students develop understanding of key core ideas as they engage in the practices and apply the crosscutting concepts to explain phenomena or develop solutions to problems. This emphasis on 3 Dimensional learning has, and should, receive much focus in NGSS conversations. Equally important, however, is the third goal: **coherence**. Dr. Reiser describes coherence as "**Building explanatory ideas requires treating science learning as a coherent progression in which learners build ideas across time and between science disciplines**".

The following narrative offers insight into the power and potential of coherence through collaboration. Supporting students in 3D learning where each year is carefully designed to build on prior understanding will be an essential part of our work. This is just one example of a collaboration between two teachers.

Behind the Scenes	
Ashley- ***4th grade teacher***	**Tricia-** **High school teacher**
In preparing my lessons related to sound waves, I spent time digging deeply into the intent of the corresponding performance expectations. I learned that these performance expectations will measure students' ability to develop a model of waves to describe patterns in amplitudes and wavelength. So I started planning and had a brainstorm! I recalled an informative and creative session I attended at last June's KEA Let's Talk Conference. The presenter, Tricia Shelton, inspired me as she shared her success in integrating technology in the classroom. I began thinking about all the possibilities that could become unique learning opportunities for my students that focused on the performance expectation dimensions. I contacted Tricia. It just so happened that Tricia was currently focusing on this same content at the high school grade band. What good fortune! We began collaborating via google hangouts and dissected the standards for sound waves across the progression to ensure that we had a feel for what is expected of students as they grow their understanding of this concept as well as the other dimensions. Tricia and I worked together to develop a lesson plan integrating common components of the standards in elementary and high school that includes the use of technology.	My class was really excited to connect with the 4th graders at Berea Community Elementary School. They were eager to take on this unique task to support the students as they learned about waves. We were finishing a learning progression in which I bundled several of the physical science performance expectations. My students were using their understanding of waves to make sense of digital and analog communication. Having pre-assessed my students on this content, I found that the high school students did not have a strong foundation in the middle school performance expectations about waves and their applications in technologies for information transfer. This was not a surprise since the new KCAS Science standards have only been implemented a short time. I knew that I needed to fill in the gap with foundational experiences using models to strengthen their understanding of those skills and concepts that are associated with the middle school grades. This provided the perfect opportunity to address the basic components that were similar to those being addressed by Ashley's students.

Continues on Page 6

The Berea /Boone Classroom Collaboration	
Our collaboration began by making a video of my 4th graders from Berea Community Elementary School discussing the topic “do sound waves move?” Students, armed with a dry erase marker and a small white board, shared their current understanding of sound waves as I captured their thinking on my iPhone. Some students drew detailed diagrams, some used their body to show me how sound waves move, and others were more comfortable sharing verbally. This activity engaged them and it was an opportunity for me to assess any misconceptions or if I needed to reteach and focus on certain aspects of sound waves. I uploaded the videos from my phone to iMovie and edited them. I then uploaded them to Youtube. The students viewed the video before I emailed it to Tricia. They had a chance to evaluate the video.	When the Boone County High School students in watched the 4th grade video, high school students loved connecting with their new 4th grade friends and were very interested in talking about sharing their thinking around this phenomenon. The older students were asked to view the video and provide feedback. Students suggested sending messages through Twitter and creating a student-produced video that would provide guidance and clarity on some of the younger students’ misconceptions. I was excited to provide an opportunity for my students to share their learning beyond the four walls. I projected the 4th grade Disciplinary Core Ideas, which fostered conversations and an awareness about the different grade level DCIs being in sync. The students went to work making videos to support the 4th grade students about waves. They were diligent in using correct terms and language of the NGSS.

Feedback Fuels Further learning

My students were thrilled to watch the video made by their Boone County friends and read the comments from Tricia’s students via Twitter. Tricia’s students sent us videos approximately a minute in length. Their video clips included the use of jump ropes, diagrams, their voices and body language to demonstrate patterns in wavelength and amplitude.The 4th graders loved watching the videos, and became excited about creating more videos. After watching their videos, my students broke into small groups and determine if they agreed with the evidence and reasoning provided in the video. Some students got jump ropes and replicated some of the videos clips we watched, and others compared diagrams in the video to ones they drew in their science notebooks. The videos coincided perfectly with what we are learning about waves. My students were very engaged and noted how they wanted to pursue science in high school like their new friends. My 4th grade students became more invested in the content as a result of the collaboration.They applied their new knowledge of waves as they provided feedback to Tricia’s students using a review	My students were motivated to engage with an authentic audience that would provide them feedback on their video products. In order to provide feedback to the high school students on their ability to communicate evidence-based thinking, the 4th graders used a “coaching” form. This Google form asked the reviewer to determine if the video creators addressed their audience, provided multiple pieces of evidence with reasoning in their thinking product, and used effective technique. Students in my class used the data from the “coaching forms” from their high school peers as well as from the Berea class to “Reflect into Action”. They analyzed the feedback provided and reflected on how to improve their future evidence-based video communications. With growth mindset dispositions, the students were mindful of the feedback as they shot new video thinking products to share with our 4th grade Berea friends as well as their connected classroom of high school students in Tennessee. Students constructing understanding and then sharing those evidence-based communications with the others to support the learning is a pow-

form for presentations (see www.benchfly.com). The provided questions required the students to look at evidence presented in the videos to reinforce the stated claims. Another question asked if the presenter provided evidence with reasoning, and if their claim was clearly stated. By using the feedback form and looking for evidence it required my students to use higher ordered thinking skills as they addressed misconceptions.	erful snapshot of what's possible in a 21st Century classroom immersed in the Next Generation

And the collaboration continues…
Collaboration continues as Tricia and I plan to engage our students in a new context: using patterns of light to transfer information and compare multiple solutions (NGSS 4-PS4-3). Our classes will use a code and engineer a light apparatus to act as a telegraph. My classroom will make observations, gather evidence from the patterns of light shared through the video and work collaboratively to decipher the code. After successfully deciphering the code and observing the lesson being modeled by Tricia's students, my students will then engineer a light apparatus and record a code that Tricia's class will then need to decipher. To master a subject is to be able to teach it, which is exactly what our students are doing. They are teaching the NGSS to their classmates and Tricia's class. By making videos, watching others on videos, and using physical models, my students have a clearer understanding about sound waves. They also have gained knowledge about technology etiquette and constructive criticism.

The common language and K12 coherence of the NGSS makes these collaborations possible across states and across grade levels. We hope this story encourages you to imagine the powerful stories and opportunities for teachers collaborating and supporting each other in KCAS standards implementation

Moving Forward… But Not There Yet

By **Cindy Combs,** National Board Certified Teacher, Gateway to Technology, Simons Middle School

MS

Any education in science and engineering needs to develop students' ability to read and produce domain-specific text. As such, every science or engineering lesson is in part a language lesson, particularly reading and producing genres of texts that are intrinsic to science and engineering. (NRC Framework, 2012, p. 76)

When transitioning to the Next Generation Science Standards, the realization hit me that not only do I have to shift the way I facilitate science instruction , I am also responsible for teaching students to read and write. I realized that the standards for English/language arts existed but it wasn't until I began to dig into the science and engineering practice of obtaining, evaluating, and communicating information that the connection became real apparent. This practice states that students need to develop the ability to read and produce domain-specific text. Reading and writing is the job of every science teacher, not just ELA teachers. So, I dug in and embraced the idea that I am a teacher of science who integrates ELA skills and strategies throughout science classroom instruction.

By engaging my students in an array of content-related text, they began to understand that science is not just experiments, labs, and observations, but that a vast amount of time is spent reading the thoughts of other science minded individuals and their understanding of the world around us. As I began to increase the amount of time my students spent reading and writing, the initial response was not positive. My students asked me questions and made comments such as, "Why are we reading articles? This is science class not English class." A different student commented, "You mean, I have to write in this class, too, and I have to make sure everything is spelled correctly.?" I couldn't believe what I was hearing from my students. I never realized the depth of the misconception my students had that reading and

Continued on Page 8

Continued from Page 7

writing should only happen in language arts. This epiphany led to a dramatic change for not only my school, but my district as well.

After many conversations in school and district PLC's, goals focused on literacy were adopted by all. Hence an immediate need to provide teachers with professional development targeted around content literacy strategies to enhance their instructional practice and engage students in the necessary 21st Century Skills. Goals related to integrating literacy skills in all classrooms were set and the journey to implement literacy into my classroom was no longer a battle I faced alone. We had a discussion in our building about the common misconceptions about literacy our students had and how we could address this issue. How were we going to support our students as they struggle with the multi-leveled text in a classroom with multi-level reading abilities?

With the assistance of the Morehead State University Writing Project staff, faculty members were trained on various close reading and scaffolding strategies that would support students with varying skill levels. We developed common posters with specific text-marking strategies that were introduced to all students at the beginning of the year. The strategies for annotating text were shared with students through modeling and students were encouraged to utilize these strategies to help make sense of the complex text. This does not mean that students annotate everything they read. Annotation is one of many strategies I introduced to my students to help them fill up their literacy skills toolbox. It is now January and many literacy strategies have become part of everyday instruction.

Having more confidence in my ability to provide students with relevant text related to science content, I ventured out of my comfort zone to engage my classes in a the practice of obtaining , evaluating, and communicating. I targeted the disciplinary core idea of Growth and Development of Organisms focusing specifically on how organisms reproduce sexually or asexually and transfer their genetic information to their offspring which connected to 08-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. I bundled this performance expectation into a unit with 08-LS4-5 which created a 3 dimensional learning experience for my students.

The focus question for this unit was "How do humans use technology to influence the inheritance of desired traits?" Students worked through several investigations on the difference between sexual and asexual reproduction and practiced using Punnett squares to model the outcome of reproduction. I provided articles related to different ways humans used technology to influence the inheritance of desired traits.

After a mini lesson on credible sources and utilizing the reading strategies they had been taught, students selected a topic of interest related to the unit and worked collaboratively to locate credible sources that would support their research. Once they located relevant, reliable text students engaged with the text using those strategies common throughout the school and those they found personally helpful.

Important points were shared out through a jigsaw strategy and charts were created that summarized the most relevant parts of the each article. This provided resources that could be used by the entire class when creating a poster that communicated their response to the burning question.

I believe my students developed their ability to obtain and evaluate information, but need ongoing practice in this area as well as in communicating.

While the quality of my students' presentations were more in line with my set expectations then in past years, I felt my students still weren't engaging deeply with text.

They were able to pull out key information but they struggled to make connections and synthesize the information presented in the text.

I wondered how I could create opportunities my students to engage in these high order skills.

Further research on my part has begun. Read next month's edition of the Science Connection and learn how I moved my students' thinking forward and well as my own!

References:

National Research Council, (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academic Press.

National Academies, (2013). Next Generation Science Standards: For States, by States. Washington, DC: The National Academies Press.

Science Connection

Continues on Page 9

Yes – Science in the Preschool Classroom!

By **Krystal Barker**, Prestonsburg Elementary

Pre-School

For years our nation has been focusing its efforts to improve reading and math scores in elementary schools across the country, and as a former elementary school teacher, I too felt the need to emphasize math and reading skills with my students. However, I knew it was just as important to set aside adequate instructional time for other content areas - especially science, so I devoted as much time as I possibly could to science-related topics. Now in my preschool classroom I continue these practices, setting aside as much instructional time as needed for science exploration.

You, like many of my colleagues that teach other grades, may be pondering the same question: You do science in your preschool classroom? Of course, I focus on science skills with my preschool students. Why wouldn't I? Young children are naturally budding scientists, with their inquisitive approach to the world around them. They have a desire to find out answers, as evidenced by their continuous questions, and we as educators should capitalize on this innate characteristic by fostering a love for science in our students. So obviously the next question for many is – How do preschool teachers teach science? Well the only requirement to be an effective preschool science teacher is to think of yourself as a facilitator of learning; and if you begin with this mind-frame, it's easy!!!

My students are given the opportunity daily to come up with their own topics to investigate. Of course, I continue to follow our curriculum map, but within the realm of these topics, my students are always coming up with ideas they want to explore, and that's exactly what I encourage them to do. The students decide upon what they want to learn / find out, and I urge them to become better thinkers by engaging them in conversations about the topic they have chosen to investigate. This includes higher-order questions and quality feedback to guide their thinking. These strategies boost student learning and help to keep students engaged, which really isn't that difficult since the learning is already meaningful because they selected the topic.

One excellent example of my class' scientific thinking this year happened during our "Down on the Farm" unit. While my class was engaged in a group discussion about how long foods would last that were fresh, frozen, or canned, the students came up with a question they wanted to answer.. They wanted to place an apple in a sealed container and see how long it would take it to "rot." This simple experiment sparked many interesting conversations among our students and with visitors/ guests to our classroom as well. It has even generated further explorations to explain what was happening to the apple and why: asking questions, searching through books, exploring the internet for answers, and even prompting other experiments like – will an apple outside of the jar take as long to rot as the one inside the jar? These types of experiments have also gotten my students to evaluate what they have discovered, to see if it was correct or not and even to connect it to new learning experiences.

One last question you may still be curious about is: How can preschool students communicate the information they have learned? Throughout the entire process of our "apple in the jar" experiment, my students have consistently communicated the information they have gathered about the apple's transformation. The majority of my students have verbally shared the information they have learned during this experiment and some have even chosen to illustrate / write about their learning. In addition, I have also seen evidence of learning from my students with language difficulties as well through their actions / body language during conversations pertaining to the apple.

The photo is of one of my students holding the "apple in the jar." My students are still mesmerized by the changes the apple has gone through and is still continuing to go through. I foresee a lot more opportunities to learn from this apple; and yes – Teach Science in The Preschool Classroom!

Assessment

Kentucky's Next Generation Science Assessment System

UPDATE by **Karen Kidwell,** Division Director, Office of Next Generation Learners

The Kentucky Department of Education recently awarded a contract to WestEd to serve as a 'thinking partner' for the design of a new Next Generation Science Assessment System for our state. Specifically, WestEd is tasked with working with Kentucky to create an assessment framework for KCAS Science, along with item and test specifications that ensure congruence to the intent of the new standards.

Senate Bill 1 (2009) requires that a "balanced assessment system" is created across schools, districts and the state to support student learning of new standards that emphasize critical thinking within the content areas. A balanced assessment system* that meets the needs of all stakeholders involves:

· Considering the student as the most influential user of assessment information;

· Ensuring on-going, accurate classroom assessments FOR and OF learning;

· Developing interim, short-cycle, or benchmark assessments (also sometimes called common assessments) not for accountability purposes;

· Administering annual accountability testing.

(*adapted from ETS Assessment Training Institute "Leading Professional Development" Workshop, 2009)

To that end, Kentucky is working to develop a system that is informed by and aligns to what happens in classrooms—since that is where the student is actually learning and growing in their attainment of the standards. The conception of the key system components originates from the National Academies of Science's Board on Testing and Assessment's report: Developing Assessments for the Next Generation Science Standards (http://sites.nationalacademies.org/DBASSE/BOTA/DBASSE_090259).

The desire is to create specifications to inform classroom and common, or 'through-course' assessments (assessments FOR learning) that are created wholly to provide actionable information for students and teachers as science teaching and learning is happening, and that would not be used for state accountability. Additionally, specifications will be developed for summative assessments (assessments OF learning) that align to and complement the classroom and through-course and that would be used for accountability.

The consistency between all components of the 'balanced' system would ensure that teachers and students alike would be clear on the expectations for demonstrating attainment of the standards—and that everyday teaching and learning would be all the necessary 'test prep' needed.

WestEd specialists in both psychometrics and science will be visiting –either in person or electronically –the Kentucky Science Teacher Leadership Networks in the spring of 2015 to hear from teacher leaders what the most important considerations and expectations are for the framework and specifications. Their ideas and priorities will help shape the final system design and specifications.

From there, a new search for an "operational vendor" that will assemble the new through-course and summative assessments following the framework and specifications will begin (likely, early this fall).

To summarize:

1. Work is taking place to define a framework for a balanced science assessment system.

KDE-ONGL/OAA March 2015 kk

2. WestEd has been selected to be the 'thinking partner' to deliver the framework and item/test specifications based on KY educator input.
3. WestEd is NOT creating the assessments themselves—just the specifications.
4. A new vendor will be sought to create operational assessments that meet the specifications developed.
5. KY teachers' voices matter and are being sought to inform the specifications.
6. It is the intent to broaden the discussion of science assessments to include the high school model, but we are starting with the K-8 first. With that in mind:
   - The focus is on building a framework for a system of assessment that begins in the classroom, focusing on generating information that enables teachers to adjust instruction and students to track their learning and focus on growth and improvement—for all levels/courses.
   - The process of identifying defensible evidence of student understanding goes beyond the bounds of any particular assessment.
   - The information the vendor will provide can be extrapolated to all science levels/courses.

Continues on Page 11

Watch plants grow and develop on KET!

By **Mary Duncan**, Director, KET P-12 Instructional Resources

Looking for media to help your students visualize the life cycle of plants? Kentucky Educational Television can help! Engaging KET-produced instructional resources—two for preschool through grade 1 and two for grades 3-5—show students how seeds sprout into plants, bloom, produce fruit, and more.

Both sets of resources are available free at PBS LearningMedia, a searchable online service that offers tens of thousands of standards-based videos, interactives, lesson plans, and more from KET and other public broadcasters throughout the country.

The first set of resources is a matching video and interactive entitled "From Seed to Fruit." They are part of KET's *Everyday Learning* collection for Kentucky's youngest students, accessible at http://ket.pbslearningmedia.org/collection/everyday-learning/. These two resources depict the life cycle of a cherry tomato plant, as the seed sprouts roots, grows into a plant, blooms, and produces tomatoes. Like all the resources in *Everyday Learning*—which include 22 *Everyday Science for Preschoolers* videos and interactives—they are accompanied by suggested activities and background essays to help you incorporate them into instruction.

The second set of resources come from KET's *Think Garden* collection for grades 3-5, available at http://ket.pbslearningmedia.org/collection/thnkgard/. One is "A Year in the Garden," which follows the process of growing food, from choosing locations, to growing plants from seeds, to harvesting and getting the garden ready for winter. The other is "Plant Structure," which describes the root and shoot system of plants and how pollination allows the plant to reproduce new seeds and begin the process of growth and development all over again. Both of these resources offer background essays and discussion questions to help you use them effectively in the classroom.

These four resources are only a tiny percentage of the thousands of STEM-related resources available at PBS LearningMedia. To sign up for the service, go to the KET EncycloMedia login page at http://www.KET.org/encyclomedia. Click on the link in the PBS LearningMedia panel in the center of the page where it says, "Not yet a member, Sign Up for FREE now!"

If you need further assistance regarding PBS LearningMedia or any of KET's instructional, professional development, or distance learning services, including free onsite trainings for your faculty, please contact your regional KET education consultant. Here is a link to a page with a map showing which consultant works with your school plus his or her contact information: http://www.KET.org/contact/education.htm.

Effectively Teach NGSS Science Practice #8: Obtaining, Evaluating, and Communicating Information

By **Todd Franks**, School Improvement Network

Did you know that reading and writing makes up over half of the work of scientists and engineers? It's true. (See NRC 2011;Tenopir and King 2004). Whether it's creating tables and graphs, sketching diagrams, writing for scholarly journals, or giving presentations to the public, the communication skills of scientists and engineers help facilitate cooperation and understanding with the public as well as with colleagues.

That's why the Next Generation Science Standards (NGSS) include **Obtaining, Evaluating, and Communicating Information** [link if needed: http://www.nap.edu/openbook.php?record_id=13165&page=74] as one of the eight key practices for students to learn as they progress through their science studies.

NGSS-Aligned Lesson in Action: Tapeworms

There are as many ways to help students obtain, evaluate, and communicate information as there are scientific concepts to teach. One example of effective teaching of these skills can be seen in a video on Edivate (formerly known as PD 360)—a professional learning resource available to all Kentucky educators through CIITS.

In this video, students learn about kinds of worms. After watching this video, you'll understand how to help your students by:

- Communicating learning objectives
- Assessing their progress toward meeting those objectives
- And engaging your students cognitively and physically in rigorous activities

Watching videos in Edivation is simple. Just follow the instructions below:

1. Go to CIITS (ciits.kyschools.us).
2. Enter your username and password.
3. On the home page, scroll down to the School Improvement Network section and click the green Edivation logo

(shown here). This should automatically log you into Edivation.

Note: If nothing appears to happen when you click the logo, check your browser's pop-up blocker and disable it for the CIITS website. This will get you into Edivation.

4. Once in Edivation, come back to this article and click on the link below, or copy and paste the video title in the Search window.

9th Grade Biology - Secondary: Learning About Worms

(13:01)

In this segment, you'll observe students in a 9th grade biology class being taught about tapeworms. You'll notice how the teacher effectively communicates her learning objectives, conducts formative assessments throughout the course of the lesson, and engages her students in rigorous learning activities.

https://www.pd360.com/#resources/videos/6943

If you need any assistance accessing these videos, please call the Kentucky Support Hotline at 855-597-4638 (855-KY-

Professional Learning Opportunities

Kentucky Academy of Science

Kentucky Junior Academy of Science welcomes Middle and HS Students doing Science Research

Encourage your students to present their research at the 2015 Annual Meeting of the Kentucky Junior Academy of Science (KJAS) on Saturday, April 11 (8.30 a.m. – 5 p.m. ET) on the campus of the University of Kentucky in Lexington.

Any Kentucky high school or middle school student may present his or her research findings at the Kentucky Junior Academy of Sciences Annual Meeting.

Do you have a science fair project that is being presented in a poster format? Would you like to practice giving a 10 minute scientific talk about this research project? Would you like to meet up with your fellow student scientists from across Kentucky?

Details here: http://kyacademyofscience.net/junior-academy/

Registration will be open soon. Deadline for registration is March 13, 2015.

For inquiries about a coach to help students & teachers, Contact Amanda Fuller, KAS Executive Director, executive-director@kyscience.org, 859-227-2837

Science Connection

Continued on Page 13

BLUEGRASS CENTER
FOR TEACHER QUALITY

Please join Alltech and Bluegrass Center for Teacher Quality on April 18 to participate in a day devoted to STEM and the future of education. This highly interactive day will feature:

- Dr. John Nash, director of the Laboratory on Design Thinking in Education (dLab), an initiative of University of Kentucky College of Education P20 Innovation Lab
- Trainers from Bluegrass Center for Teacher Quality Master Teacher Network
- KEA onsite to answer NGSS question
- Breakout sessions with scientists from Alltech

This event is FREE and open to teachers across Kentucky!

More information is available at www.bgteacherquality.org

The University of Kentucky STEM Education Department and
College of Agriculture, Food and Environment
Present
2014 SUMMER TEACHER INSTITUTE
Project-based Explorations Investigating
the Kentucky River Watershed
Grades 6-8
Teacher Summer Institute Tentative Schedule

For more information call 859-257-1993 or visit http://enri.ca.uky.edu/outreach/KRWatershed

Earth Science and Archaeology Outreach Programs in Your Classroom

While the Falls of the Ohio State Park Interpretive Center is closed for renovation and new exhibit installation, the park interpretive services will offer hands-on labs for classes from February through May 2015. The cost is only $2 per student. Outside Clark and Floyd Counties, a small transportation fee will apply. Labs run 45 minutes and accommodate up to 30 students at a time. See http://www.fallsoftheohio.org/OutreachLabs.html for additional information, including learning objectives. Call (812) 280-9970 or email park@fallsoftheohio.org to schedule or to answer your questions about our programs.

2015 NGSS Short Courses
Presented by PIMSER

Our most popular trainings! New courses added for K-12 teachers. Check out the list below - over 20 days of training available! For complete descriptions, dates, and registration, visit our website at www.uky.edu/pimser. NGSS Short Courses (Grades K-12)

Courses are designed to strengthen content understanding and/or understanding of science and engineering practices at the designated grade bands. All sessions will examine misconceptions and naïve conceptions that might hinder concept and practice development, and participants will learn how to design experiences to help students change these misconceptions. Participants will experience activities as a learner that promote concept and practice understanding, and discuss implications for best practice and highly effective teaching with other professionals. Teachers will leave each session with examples, resources, and a deepened understanding of how to implement the NGSS.

Elementary	Middle
Properties of Matter	Developing and Using Models
Forces and Interactions	Waves*
Light	Energy*
Constructing Explanations and Engaging in Argument from Evidence (grades 4-8)*	
Waves	
Life Science: structure, function, and information processing*	**High**
Engineering Process and Design*	Developing and Using Models including Data Analysis and Mathematics and Computational Thinking*
Earth Systems: processes that shape the earth*	
Planning and Carrying Out Investigations*	

*New courses

Science Connection

Continued on Page 15

Please help populate 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 by working with local K-12 science educators as they implement the new Kentucky Core Academic Science standards.

Please submit the name of a person/organization that has supported you in science education. Once your submission is reviewed, an invitation to become a participant in the KDE Informal Educator Hub will be sent to the person/organization you have named in this form. Thank you in advance for helping to build this resource for all Kentucky teachers.

The Kentucky Informal Educator Science Hub submission form can be accessed here.

Thank you in advance for your support in the development of this resource and for your submissions! Christine

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

April	Asking questions and defining problems	ESS 1B Earth and Solar System	Cause and Effect
May	Engaging in argumentation from evidence	PS2 B Types of interactions	Patterns

Please send 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.