Science Connection

KENTUCKY DEPARTMENT OF EDUCATION

A Collaborative Resource for Teachers **October 2014** Volume 1 Issue 9

In This Issue

Editor's Note

So many things are happening across the state related to implementation of the new Kentucky Academic Standards for Science. Teachers are creating learning experiences that provide students with opportunities to engage in the meaningful use of the science and engineering practices. Students are developing their understanding of science concepts through their involvement in authentic learning tasks that relate to engineering design challenges as well as those that address the Grand Challenges of Engineering.

Science Teacher Leadership Network meetings began in September in all eight regions of the state to support the implementation of the new standards and develop greater understanding of formative classroom assessment, 3D style. (*Be sure to ask who attends these meetings from your area so that you can ask questions of your representative -See map in September edition.*)

And there is a whirlwind of information and professional learning being shared through social media to support teachers as they shift instruction to reflect the vision of the Framework and the NGSS. This month, I'd like to share with you a special invitation from a group of our Kentucky teachers who used "outside the box" thinking to create another venue for you to deepen your understanding of the science standards (See invitation below.) This invitation is one of a few that will be shared with you in the months ahead. I hope you take some time to reflect, connect and share! Happy October!

Christine

An invitation to start a NGSS Blog

Reflect, Connect, Share

Submitted by Tricia Shelton

My guess is that you became a science teacher because you love learning, you love working with kids, and you love science. Loving science means you are probably a question-asker.

Today's question: "How do I grow as an educator and work to continually create improved classroom experiences to honor those students I love?

Today's Answer: Blogging

This is an invitation to consider joining us in a **#NGSSblogs Project** taking place on Twitter at #NGSSblogs and with our NGSS Peer Learning Network Google plus community throughout the 2014-2015 school year.

We would like to bring people together across states to share our thinking and learning around the Next Generation Science Standards. Great implementation will lead to great student achievement and progress towards the NGSS goal of depth of understanding through thinking and acting like a scientist. True integration of the 3 dimensions of the NGSS: disciplinary core ideas, science and engineering practices, and crosscutting concepts to explain phenomena and solve problems, will require a collaborative effort, collective conversation, and individual reflection. Blogging is one way to support this effort.

Why should we blog?

Reflective Thinking

Blogging gives you a platform for reflective thinking or writing that we do for ourselves

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NEXT GENERATION SCIENCE STANDARDS

Practice
Asking Questions and Defining Problems

DCI
PS3: Energy
PS4: Waves

Crosscutting Concept
Cause and Effect

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to think through things. This clarification of our thinking helps us improve our practice by what I call reflection into action. My reflections always move me forward in some way to the *next steps* mode, leading to my personal professional growth.

Collective Conversation

By sharing your blog, you are making your thinking visible to others, which supports them on the path of understanding, inspires reflection and revision of thinking. Sharing your blog enables you to get feedback, affirmation, and a new lens into your classroom from others. When you read and comment on the blog posts of others, you are also gaining great ideas and resources to enhance your own understanding and curate creative and innovative ideas for your classroom.

Getting Started Tips

Blogging is about the journey of reflection and collective conversation. **It is not about perfectionism.** Every teacher has amazing things to share from their experience as a learner and a classroom leader. Please consider sharing any NGSS reflections.

Some sample ideas:

- your classroom story
- your ideas and reflections
- resources you are finding useful in implementing the NGSS
- how you are utilizing technology to teach the NGSS your PLC or PLN story
- responses to something you have read or heard or conversed around (like in #NGSSchat :D)
- things you try that may or may not have worked
- ANYTHING you would like to clarify thinking around. **If it helps you, it will help others.**

Blog Posting Suggestions:

- Create a blog site using platforms like Wordpress.com or blogger.com
- Create a blog post and send the url link to #NGSSblogs on
  - Twitter and/or post in our NGSS Google community
- Commit to trying to post at least 1 blog per month.
- Commit to trying to comment and/or repost/retweet the blogs of others

Great website for teacher blogging tips
http://www.edutopia.org/blog/start-teacher-blog-tips-resources-matt-davis

Blogging is about being part of a conversation. Please consider becoming part of this global conversation around great science teaching and learning. Educator voices need to be shared and heard as we work towards shifting science education and preparing students for this 21st Century world.

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Interactive introduction to foundational characteristics of waves

Dr. Tom Tretter, University of Louisville

ALL

Teaching a somewhat abstract topic such as waves can be challenging, particularly for those working with our concrete-thinking elementary and middle school level learners. To introduce the topic, I've found that the interactive experiences described below are often helpful for students to build strong foundational understandings, upon which later instruction can then build. The set of experience below could be separated with other instruction or experiences inserted between portions to better support student processing of the ideas. For example, after the set of experiences targeting "amplitude" and "frequency," you may want to then take some time to include other student experiences of these same concepts (e.g. with shaking slinky or jump rope waves on tabletops) before having them go back a few days later to the human model of waves for the next concepts.

In addition to addressing the content domain of waves which has a stronger presence in our new science standards at all grade band levels, this particular set of experiences also offers a great opportunity to explicitly focus on the science & engineering practice of "developing and using scientific models." As recommended by Next Generation Science Standards, by being explicit with students about the science practice of modeling, students simultaneously learn both the practice and the content.

Configuration

Arrange students in two long rows in chairs facing each other so that the students are shoulder-to-shoulder in their row. It is OK if the two rows are separated by a few rows of desks, and in fact this works better if the two rows are NOT immediately face-to-face but instead there is some distance so that each individual can easily see the entire facing row. The purpose for the two rows is that the students will be using themselves as key parts of the upcoming model, and when they are IN the model it is difficult for them to SEE the model. The two rows give each student the change to both 'be the model' as well as 'see the model.'

Explicit instruction on practice of modeling

Students will create a series of waves by waving their arms up and down.

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However, before beginning I recommend having an explicit but brief conversation that they are about to create a scientific model. Highlight that the purpose of scientific model is to serve as a tool for thinking about the science. Also include that all models have parts of them that tend to work well to help thinking, whereas other parts of the model may not help thinking and in fact could lead to incorrect thinking if they aren't careful. Alert students that after some of the experiences, you will pause and ask them to think about the model – how did it help your thinking, and how might it mislead or be weak. In other words, all models have limitations, but the goal is to develop models useful for thinking about the science while being mindful of the limitations.

Targeted wave characteristics concepts – transverse mechanical waves

Table 1 below summarizes a list of the concepts to be targeted with this human wave model, and are listed in the order they will be addressed. For this first set of experiences, the types of waves to be addressed include only transverse mechanical waves. Following this and related sets of small-group and whole-group experiences, subsequently longitudinal waves will be added, and then electromagnetic waves. This article, however, restricts itself to only transverse mechanical waves as the introductory focus.

The concepts underlying each term will first be developed conceptually with the model, and only after students have experienced and discussed them will they eventually be captured with the vocabulary term, including possibly having students summarize the concept in their own words in their science notebook.

Throughout each of the experiences briefly summarized below, the teacher will engage students in whole-group questioning and discussion, and can include other pedagogical strategies such as think-pair-share with classmate next to them.

Amplitude, medium, and transverse wave

For the very first wave, instruct students to imagine that they are observers in a large sports stadium and that you will be like a cheerleader who is orchestrating a wave among the fans. As you jog in front of one of the lines, you ask students to stand up and raise their arms high above their heads, and then sit back down. Do this a second time with the other row. Then indicate that you ask a row to do a wave by simply indicating a start time and do not jog in front. After each row has done a couple of waves, ask them questions along the line of "What is a wave?" and "Which direction did it move?" and "What exactly moved down the line?"

These question leads to conversation that the 'motion' or 'shape' moved down the line, but that the people didn't actually move across the room. Follow-up questions along the line of "So how did the people move?" then focuses attention on the individual as opposed to the wave. Finally, ask "What would the wave look like if no people were in the room?" (no wave).

Then do another series of waves, asking students this time to only raise their hands a tiny little bit (e.g. only moving the wrist while remaining seated). Do a few of these with each row, then add, "This time move your arms an average amount – about even with your head." NOTE: I avoid using 'medium amount' because soon you will be introducing the word 'medium' as a vocabulary term with very different meaning, and using 'average' avoids confusion of the same word used in two ways. You now have established waves that are 'large, average, or small' size (imprecisely using the word 'size' for now, to be formalized later) and can mix it up with the two rows, asking one row to do an average size wave, the next a small wave, then average size starting at the other end of the row, then large, etc.

Finally introduce some of the key vocabulary to capture the experience: *amplitude* = how high you raise your arms. What was necessary to carry the wave? (people). This is called the *medium* – the stuff that carries the wave. Without a medium, there is no wave. The motion of the wave (all point with one hand) and the motion of the arms (all point with the other hand) are perpendicular to each other (all students should have their arms now at a right angle by pointing these two directions). Put the label *transverse wave* to this perpendicularity.

At this point, it might be helpful to have students pull out science notebooks and document their thinking about these three wave characteristics in their own words. Encourage drawing of pictures or anything else that helps them think about these ideas. Can share with each other to both explore different ways to say the same thing and to use as a check that all students are conceptually correct with their thinking.

Revisit practice of scientific modeling

Also, while students have their notebooks out, revisit the scientific practice of modeling and have students document some key ideas about this practice (following NGSS recommendations to explicitly focus on teaching the "practices" dimension simultaneously with content). One approach could be to first give one definition of a scientific model – something to **help you think about the science. This could be followed by brainstorming with the students about possible types of models such as the list below.**

Examples of types of models:
Physical model (like this one)
Diagram or drawing
Mathematical formula
Analogical model
(others)

The discussion could then revolve around two questions that you pose for students to first discuss in small groups and then whole-class sharing:

How did this model help you think about wave properties? (i.e. what is good about it?)

What are limitations of this model? (i.e. where does it fall apart?)

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For the limitations, one key point to raise is that in our human model, each particle of the medium (the people) have free agency – they can each raise hands a different amount, or not be paying close attention and react slowly when it is their turn to 'wave'. However, in non-human materials (such as slinkies, ropes and water waves) the materials don't have free choice in action. This limitation will come up again throughout upcoming experiences, so highlighting this will be helpful. Other limitations also should be mentioned (e.g. that the 'people particles' in the medium are not really touching, unlike non-living substances to create waves with).

Frequency

Returning to the human model, this time you will ask students to do a series of waves (e.g. five in a row) rather than one pulse – sometimes these are also referred to as *standing waves* since sending wave after wave can make it look like any one isn't moving, the same way that spokes on a turning wheel can sometimes look like they are standing still because your eye is seeing different spokes in the same location, making it look like the same spoke just is staying still in that spot. Connect the multiple pulses to the idea of vibrations – that in most cases waves are caused by vibrations (of something). You can indicate that all these next waves will be of average amplitude (remain seated – raise hands to about head height). The teacher will be the metronome who counts off the five waves for the first person, which then passes down the line. Do this at various speeds (slowly, quickly, average) starting at different ends of different rows. Question students about what is changing – something along the line of 'the rate at which the waves are coming' should emerge. This leads to formally labeling this characteristic as *frequency* and defining as 'number of waves per second' and introducing the unit of Hertz (Hz) for this.

At this point, it can be helpful to reinforce both amplitude and frequency by combining them in different waves and having students enact them. For example, tell one row that you will ask them to do a low-frequency wave but at a high amplitude. Give them adequate think time of what they will do, ask the other row to also think about what they expect them to do, then do it. Continue with multiple combinations of these two foundational wave characteristics to support student learning of the distinction and differences between these. Later, applications to sound (freq=pitch vs. amplitude=loudness) and electromagnetic waves or light (freq=color vs. amplitude=brightness) can refer back to these experiences about the difference.

Table 1. Wave Characteristics Target Concepts

• Amplitude
• Medium
• Transverse Wave - Motion of medium perpendicular to wave direction
• Frequency (and vibrations)
• Wavelength and Wave Diagrams
• Waves transfer energy [*bookmark-there is one other thing they transfer*]
• Wave energy related to frequency & amplitude
• Wave speed [dependent on elasticity of medium]
• Mechanical waves [needs a medium - *another category is coming*]

Wavelength and wave diagrams

At this point, you alert students that you are going to ask them to generate a series of wave pulses indefinitely (rather than stop after five cycles), and that at some point you will ask students to "freeze" their arms. Typically this works best for uncovering the concept of *wavelength* by asking for average amplitude waves at a relatively slow frequency (give the first person a cadence to work from, but tell them to continue at that speed even when you stop counting). As students do the wave and it has traveled all the way to the end of the row, say "freeze." At this point you highlight for students the updown pattern of people's hands (with caveat that the limitation of human free agency means that this won't likely be perfect, but the general pattern should emerge). Students should see in front of them something that looks very much like the traditional textbook wave diagram, and you can have them identify points on the diagram often labeled such as "crest", "trough", "resting position" (or centerline). And of course indicating the wavelength which would be measured from crest-crest or trough-trough. This experience helps students process typical textbook representations with what is really being illustrated – a 'frozen' pattern of repeated waves moving dynamically down the line.

Waves and energy

Refocusing student attention on the travel of waves across the room, through questions and discussions (and having the final person in the row hit a beach ball you are holding as the wave gets to you), rather than simply saying the wave 'motion' travels across the room, make the transition to the idea that waves transfer energy. Depending on where you are going with the curriculum, you may want to put a mental (or note in students' science notebooks) that waves also carry something else (information) that will be addressed later. Through revisiting both amplitude and frequency variations in different combinations, lead students to the concept that both higher amplitude (waving arms high and standing) and higher frequency (repeating waves at a high rate) transfer more energy. Certainly the situation of asking students to do a wave that is both high amplitude and high frequency will be experienced by students as most tiring, but it is important to combine opposites (e.g. high amplitude with low frequency) to underscore for students that amplitude and frequency are separate and distinctly different characteristics of waves. Because both high amplitude and high frequency are experienced by the students as more tiring, the link to higher energy becomes almost intuitive.

Wave speed

Once students have solidified these wave characteristics

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concepts – for example through further small group explorations with slinkies or ropes and connections to real-life examples and applications, such as sound and light, one additional wave characteristic can be explored. Wave speed is connected to the time it takes for one wave pulse to travel down the line to the other end of the room.

Have the human model go back to sending just one pulse down the line and observe the approximate time it takes. Then ask the other row to do the same wave (e.g. average amplitude) but with a faster or slower wave speed. After a few iterations, ask what part of the action determines the wave speed – students will be led to understanding that it is the 'reaction time' of one person to the one in front of her. At this point it will be important to have students distinguish between the two types of 'speed' that have been explored with waves: the wave speed (travel down the line) vs. the wave frequency (speed of vibrations). You can set up experiences with the distinction by asking for slow frequency but fast wave speed (lazy, slow movement of arms up-down but quickly reacting to the person in front by starting to move immediately after then begin). In fact, with this combination it may be that the wave energy quickly reaches the end of the line before the very first person has even completed the full up-down cycle.

Transition back to discussion of the model, and that a limitation is human free agency. Ask students to consider what the property of material would be that determines wave speed. In effect, asking what is the equivalent to human reaction time? This property is *elasticity* of the medium – the ability of the medium to 'spring back' to its original resting position after being disturbed by a wave pulse. Material such as steel tends to have high elasticity (bounces back quickly) and so waves travel quickly in it (e.g. when a partner is tapping on the steel rail of a train track way off in the distance, your ear against that rail will hear the tapping faster than the other ear will hear the sound through the air, which has lower elasticity than steel). This is also related to why your own voice heard on a recording sounds weird to you – the sound traveling through the air (which you hear from the recording) sounds different from your own voice when heard through the bones and material of your head, which is primarily how you 'hear' your own voice when speaking since that solid material conducts sound better than air.

Mechanical waves

After students have developed a strong understanding of foundational characteristics of transverse mechanical waves, a next topic could be longitudinal waves introduced with a human model where each row of students now stands front-back and puts hands on the shoulders of the person in front of them with elbows locked. When the first person is pushed from the back, the pressure wave is transmitted through the arms-shoulders to the person at the end.

Upon completion of this category of mechanical waves, a next type of waves that could be targeted could be electromagnetic waves. A key distinction for these is that no medium is needed. A label that can capture this distinction is *mechanical waves* to refer to waves that require a medium, so one way to wrap up this set of experiences and explorations is to add the mechanical waves label to these with a medium, and as foreshadowing hint that a whole different type of wave exists that DON'T require a medium.

Questioning about energy

Parker Owen, Tates Creek Middle School Teacher

MS

Asking questions in science class should be easy, since the process of science itself is analyzing and answering questions. We all experience the typical questioning that students throw out in class; "What is. . ?", "Why is. . ?" They are basic, quick questions that generally require a basic, quick answer to satisfy an initial curiosity. The real task comes at trying to get the students to think deeper and pull out a question that would require a more complex answer. What I hope to address here is asking higher level questions about energy in all grades of middle school.

In the 6th grade, the students must be able to model what would happen to the particle motion, temperature, and state of a pure substance when you remove or add thermal energy. The first line of thinking should be about the states of matter and what causes them to change forms. Starting out, the teacher can have the students write down any questions they might have about states of matter, heat transfer, temperature, or thermal energy. This exercise gives the teacher a view of where the students are in their question asking process, as well as their conception of the standard. The best scenario for learning about the states of matter, because we are dealing with atoms and molecules and their respective levels of thermal energy, is through an exercise where students model the molecular structures of the states of matter. Given the time of year and weather conditions, this could best be done outside or, if possible, just move desks around to maximize space in the classroom. After an initial explanation of how the atoms move, the students would be grouped into the three "states". One group at a time, starting with solids, have the students move like the atoms would move. Then, given a minute to demonstrate, announce that you are "turning up the heat" and move to the next group. After the exercise, have the students write down any questions that came to mind during the exercise. Having a few teacher generated questions prepared ahead of time is a help to those who might need a hand in getting

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started. The last thing I do is ask my students why something happened. Why did the atoms of a gas shoot out all over the place? What happens to the thermal energy when water freezes into ice? This allows the students to address the cause and effect Cross Cutting Concept.

As the student move to 7th grade, the task changes to designing, constructing and testing a device that either maximizes or minimizes thermal energy transfer. This will still require a fair amount of guidance from the teacher, but allows for more independent student exploration within a set of parameters. One of the best ways to achieve this is Save the Penguin, devised by Christine G. Schnittka, Ph.D in 2009. In this lesson plan, the students take a detailed look at heat transfer, thermal insulation and temperature and how these topics play an integral part in their daily lives. They build cardboard houses lined with aluminum foil, and use different materials as insulators to try and cut down on the amount of temperature increase when the house is left under a heat lamp. From those results, the students will ultimately be given a variety of materials, and they must build an "igloo" designed to minimize the amount of heat transfer and save a penguin shaped ice cube from completely melting away. Throughout the process, the students must devise questions about the materials and how well they prevent heat transfer from the lamp to the inside of the igloo. They learn the cause and effect of which materials they choose and how the igloo is assembled.

In the 8th grade, the target is kinetic energy and how it changes with mass and the square of its speed. They are assigned to independently construct an experiment to test, collect data, and interpret data graphs to describe the relationships between kinetic energy, mass, and speed of an object. At this point, they should be able to ask the deeper knowledge questions, see their procedures as the cause of the energy level and what effect their manipulation of their generated variables (mass and speed of the object(s)) will have on that kinetic energy level. The only guidance I have given in this procedure is a sort of nudge one way or the other in terms of their initial question. "What do you think needs to be different and why?" Just enough of a bump to make sure they know how to analyze and revise on their own before they run the experiment.

Hopefully this has helped with bringing the new science standards into your classrooms. If you have any questions, please email me at parker.owen@fayette.kyschools.usDocument2.

Teaching our students to ask questions

Stephanie Harmon, Science Teacher, Rockcastle County High School

HS

"How can we investigate this phenomenon?" "Which solution is better and why?" There are a variety of questions that arise in our classrooms. As we look at the science and engineering practice of asking questions and defining problems, we know that ultimately we want students to be able to ask questions about what they read, what they observe and the conclusions they draw from investigations.

In order to do this, we must plan our instruction to model this process and provide students experiences to develop and refine these skills. In doing this, we must consider how questioning is conducted, what types of questions are being asked and whether or not all students are accountable for having an answer.

A learning culture must be established where students know that their questions have value and they will be provided an opportunity to seek out the answers. Students must know that it is okay to be wrong – that their thinking on the topic matters. This has to be modeled in how we deal with wrong answers so that students aren't afraid to share their responses.

The use of talking partners helps create this type of learning culture. Instead of a traditional question and answer session, the teacher can pose the question and then instead of calling on a single student the talk partners can discuss their thinking with each other. Talk partners provide students an opportunity to think, discuss and develop their own questions. Doing this makes everyone accountable for having an answer and provides the students an opportunity to articulate their thinking.

This can become a vital part of planning for scientific investigations. If we provide experiences that can have multiple approaches or even multiple solutions, then students must analyze the situation to determine the underlying questions that must be answered.

An example of this can be seen in how 11th grade students approach the problem of a clogged drain as part of a unit focused on chemical reactions. Students are given the scenario of a sink drain clogged with hair and toothpaste. Rather than use a commercial drain cleaner, they are asked to use a homemade drain cleaner made from baking soda and vinegar. Talk partners work together to identify questions that arise from this scenario. Some questions generated by students:

- What ratio of baking soda and vinegar should be used to that all the baking soda reacts (and none is left in the drain to add to the clog)?
- How effective is the homemade drain cleaner compared to the commercially produced drain cleaners?
- How much of the homemade drain cleaner must be used to clear the clog?
- How should the chemicals be added

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to the drain – should they be combined first then poured down the drain or should the baking soda be added followed by the vinegar?

Providing student an opportunity to develop their own questions allows them to take ownership of their learning.

Students are then given a section of a clogged drain, baking soda, vinegar and the opportunity to investigate their questions. From this investigation, other question arise:

- Is the homemade cleaner more effective than the commercial cleaner? What evidence do I have to support my claim?
- Is the homemade cleaner harmful to the drain pipe?
- Our model is just a section of pipe and we can see when the clog clears the pipe. In a real drain pipe, how will we know when the clog is cleared?

These questions lead to further class discussion that is student led. Students use their data as evidence to support their claims and talk about how other investigations can be structured.

Ultimately, this is why it is so important to teach our students how to ask their own questions. They must have experiences where their questions are valued and the opportunity to seek their own answers. The more students do this, the more refined they become at doing so.

References:

Clarke, Shirley. Formative assessment in action: weaving the elements together. London: Hodder Education.

Quinn, H., Schweingruber, H., & Keller, T. (Eds.). (2012). A framework for K-12 science education: Practices, crosscutting concepts and core ideas. National Academies Press.

Science for All

Academic Writing, Science, and LDC

Teresa Rogers, KDE Literacy Specialist

ALL

According to page 1 of 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 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:

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.

Evidence of being open-minded and disciplined. The student includes a variety of credible sources and, where appropriate, acknowledges opposing views.

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 a 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 this article is an example of how a blank template task is completed to become a teaching task:

When choosing a template task, you must consider several things. First, do the standards, texts, and experiences lend themselves to an explanatory or argumentative writing? Template tasks align to three main modes or categories of writing. However, 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)

You must also consider how students will develop their ideas. Within those writing types, "The 1.0 Guidebook to LDC" identifies nine important text structures. These structures are helpful as you define what students should be able

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to do in the template task 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)

Another consideration is the writing product you ask your students to do. In Barrie Olson's Academic Writing across the Disciplines," you'll find several suggestions. 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.

Writing an appropriate task is crucial first step to the development of a rigorous, content appropriate module. The planning time will be well worth the effort as you build the module. You can learn more about these tasks and explore the different templates on the LDC "What Tasks" page.

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.

KCAS Connections

Science from a 13 year old's perspective

Renee Boss interview with Ethan Boss

Renee Boss and her son, **Ethan**
NBCT/ Initiative Director, The Fund for Transforming Education in Kentucky

ALL

Since his toddler years, my oldest son (now age 13) has shown an interest in physical science, especially anything having to do with energy. From his earliest years, science books, gadgets, circuitry, and anything solar powered has fascinated him. He even spends spare time watching YouTube clips about science and Mythbusters. Now, before you get a mental picture of educators' son (My husband is an educator, too) being just a nerd, let me tell you that this child is an average teen interested in video games and computers like most other teens his age. The other trait Ethan has in common with average kids his age is a curious mind interested in exploring and learning. What's exciting to me about the Next Generation Science Standards is the push for greater exploration of scientific concepts and the opportunity for students to ask more questions. Since the goal will be for students to ask the questions rather than for teachers to create a lab experiment with step-by-step instructions, I recently asked Ethan about NGSS Standard PS3.C. (*Editor's note: Consider the overlap of this DCI with PS2.B at grade band 3-5*). His curious nature took hold as he explained to me how he would teach this standard if he were the teacher. Below is a portion of our conversation.

RB: Ethan, I'm looking at the Next Generation Sci-

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ence Standards being implemented in schools around the country, including Kentucky, and I'm looking specifically at a standard for middle school that says "when two objects interact, each one exerts a force on the other, and these forces can transfer energy between them." What do you think?

Ethan: Yeah, what about it?

RB: If you had to teach that standard to kids, how would you do it?

Ethan: Well, there are several ways you could do it. You could use magnets, or plastic combs or balloons, but you should really let kids explore and see what might happen before you tell them anything.

RB: What do you mean?

Ethan: So, take the plastic comb idea. I would gather the students around a sink, give them all plastic combs and tell them to make the water bend.

RB: What if they don't know what to do?

Ethan: That's okay. They'll figure it out probably if you give them a chance.

RB: But how would I give them a chance and still teach them anything? What if they just stand there?

Ethan: Mom, these are middle schoolers standing near a sink, they're not going to just stand there. They're curious and they will want to play around.

RB: OK. But what if they don't figure it out?

Ethan: Well, after you wait a bit, you might have to start giving them hints.

RB: What kind of hints?

Ethan: Well, you could ask them questions or get them to ask you questions.

RB: What kind of questions?

Ethan: More than likely, the students will start asking questions and trying things out. They might ask—what will happen if I put this water under water? What will happen if I run the comb through my hair and then put it in water? If they don't ask those questions or try out those things you might ask them how they think they could make static electricity with the comb.

RB: So, more than likely they will have some experience with combs and their hair having static electricity, right?

Ethan: Yeah, then you could start explaining stuff to them like electrical charge happens when objects are rubbed together, so you will have charge when you run the comb through your hair.

RB: Tell me more.

Ethan: Negatively charged particles move from your hair to the comb. This makes the comb negatively charged. Electrons repel other electrons. If the negatively charged comb (from rubbing it in your hair) is near the water, it repels the electrons in the water. The water near the comb has a positive charge. The attraction between the positive charge and the negative charge bends the water.

RB: So how do you know this? Is this an experiment you did at school?

Ethan: No, I tried it in the bathroom sink one time. Plus I watched a YouTube video about it. It works the same way with strong magnets. But really, mom, you should try it and read about it, too.

And, there you have it, a science lesson from my 13 year old, and I would guess most science teachers already know this experiment, so the purpose of our sharing with you was not so much to tell you a cool experiment kids might enjoy. Instead, the purpose of our sharing this exchange and idea with you is to help you see just how curious kids are on their own, if we let them be. We don't have to provide step-by-step instructions for how to do the experiment, and it seems the NGSS don't want us to do that anyway.

Some sites Ethan suggests for learning about bending water (just make sure you don't provide kids the step-by-step instructions).

http://www.sciencebob.com/experiments/bendwater.php
http://scifun.chem.wisc.edu/homeexpts/BENDWATER.html

If you'd rather teach the standard using balloons, check out this resource--

http://www.physicsclassroom.com/class/estatics/Lesson-1/Charge-Interactions

Can I do a cookbook lab when I switch to the Next Generation Science Standards?

David Grossman, Science Teacher, TK Stone Middle School, Elizabethtown, KY

ALL

According to the Next Generation Science Standards (NGSS), students are supposed to be able to plan and carry out investigations (Science and Engineering Practice number 3), and they are supposed to be able to analyze/interpret data and construct explanations (practices 4 and 6). If students are going to be proficient at these skills, the science teachers cannot continue to assign cookbook labs, right? (Cookbook labs are labs where each step of the investigation is laid out for the students. All they have to do is follow the directions--thinking is optional.) With the new standards, the students will have to be planning every lab, right? We should just lead them toward a burning question

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for them to research, give them some materials, and turn them loose. That could be a recipe for disaster; maybe we should take a deeper look at this question.

First let's remember that the standards are goals--targets that students should be able to meet after instruction. While they will never become successful at planning and carrying out investigations without adequate practice, they also need models to see what quality experiments look like. Just as a person must first cook with recipes before becoming a chef, a student must have some pre-designed experiments to use before he/she can become proficient in planning his/her own investigation.

Perhaps then we should ask how we can best modify a cookbook lab for use in an NGSS classroom. What shifts are necessary?

In my classroom, I've often done labs and then brought the students together to tell them what they were supposed to have learned in the lab. If they had done a cookbook lab and then heard from me what they were supposed to learn, they didn't have to do any work. I outlined the steps of the lab and told them their conclusion. I even did the hard work of backing up the conclusion with data from the lab. In an NGSS aligned classroom, one where students are expected to do the hard work, I might give the students the directions for the lab (the cookbook), but I would shift the hard work of constructing an explanation and backing it up with evidence onto the shoulders of the students.

In summary, here are a few tips for designing labs in an NGSS-aligned classroom

Let students plan and carry out the investigation whenever possible and practical.

When it isn't possible or practical, give the students specific directions for the lab.

Have students construct explanations from the results of the lab. Don't tell the students what they should have discovered. You may want to hold a class discussion and draw the conclusions collectively from the students.

Discuss possible reasons for error with the students.

With just a little work, you can transform labs where students do little cognitive work into next-generation labs where students do the heavy-lifting (even if they don't plan the investigation themselves). Good luck.

Assessment

Just in case you missed this important information in the August edition of the Science Connection, please take note of this statement provided by Dr. Holliday regarding the most recent information on science testing for 2014-15.

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

Kentucky will embark on the development of a new science assessment system to match the standards. The new system will take time to build. 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.

If you have questions on this matter, contact Associate Commissioner Ken Draut at (502) 564-2256, ext. 4728 or via e-mail at ken.draut@education.ky.gov.

Be In The Know

CIITS Update

The 10-minute-a-week tool that's making a difference in Kentucky's STEM learning

Edivation—the new PD 360—helps you reach your STEM professional learning goals

What's **Edivation**? It's an intelligent professional learning platform that delivers a highly personalized learning experience for all educators. It's the only resource proven by independent research to actually work. It's provided by KDE, and is available to all Kentucky educators.

Edivation supports your STEM professional learning goals by giving teachers targeted resources based on their individual needs

Edivation comes with:

Hundreds of STEM-related, classroom best-practice videos featuring the most talented teachers from around the country demonstrating classroom best practices

Thousands of award-winning professional learning videos to help improve pedagogy

Content from leading experts such as Heidi Hayes Jacobs, Robert Marzano, Jay McTighe, Harry Wong, Rick Smith, and many more

Ready-to-use lesson plans

Pedagogy instruction in every grade and subject covering today's most important PD topics, including classroom management, differentiation, teaching strategies, stimulating learning and thinking in students, project-based learning, technology in the classroom, and many more

Common Core- and state standard- specific resources, including videos, ready-to-use standards-aligned lesson plans, crosswalking tools, a standards roadmap, and more

Research shows that using **Edivation** for as little as 10 minutes a week makes a significant impact on student achievement—and on schools as a whole

When educators use **Edivation** for just 10 minutes a week, almost everything about their classroom improves. It starts with increased teacher-student engagement, which leads to higher student achievement, fewer discipline issues, and more. And, more often than not, these effects spread to the entire school.

Independent research published in the *Journal of Instructional Psychology* found that when teachers used **Edivation** for at least 10 minutes a week, student proficiency on standardized tests increased by an average of 18% in a single year. The study also found that dropout rates went down by 20%, discipline issues decreased by 33%, and 10% more students indicated an intention to go to college.

Get to **Edivation** by logging in to CIITS.

Go to CIITS (ciits.kyschools.us).

Enter your username and password.

Scroll down to the School Improvement Network section and click the **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**.

Enter the desired subject in the search bar at the top of the **Edivation** page. Press ENTER and select a video from the search results. That's all there is to it!

For assistance, please call the Kentucky Support Hotline at 855-597-4638 (855-KY-SINET).

Welcome to the Kentucky Core Academic Standards (KCAS) Challenge!

The department is seeking specific input on the English/language arts and mathematics standards adopted in 2010.

While stakeholders had an opportunity to provide feedback during the development and adoption process, this will give P-12 teachers, higher education, parents, students and others who are interested the chance to perfect the standards based on their experience over the past 4-5 years.

The KCAS Challenge has two primary goals:

1. increase awareness and understanding of the Kentucky Core Academic Standards in English/language arts and mathematics

2. solicit actionable feedback on the standards as part of the Kentucky Department of Education's regular review process of academic standards that have been implemented. If you would to provide input, go to http://kentucky.statestandards.org/

Professional learning modules now available from PGES website

The Kentucky Leadership Association (KLA) in conjunction with the Kentucky Department of Education (KDE) has com-piled an extensive set of professional learning modules that can be used for staff professional learning surrounding TPGES and PPGES. The modules can be downloaded as zip files from the right-hand sidebar on the PGES website. They come in three folders: PPGES Modules, TPGES Modules Part A, and TPGES Modules Part B. It is important that you download both Part A and Part B of the TPGES Modules. Because the modules are in zip file format, iOS devices will not support their download.

A crosswalk of the TPGES and PPGES Modules with the new Kentucky Professional Learning Standards is also available.

Mark your calendars for the PGES webcasts

The PGES webcast takes place on the third Wednesday of every month at 9:30 a.m. ET. A survey of districts showed this to be a better time for most than the mid- to late afternoon slot used last year. You may view the PGES webcast at the following link: mms://video1.education.ky.gov/encoder3a.

KDE also will continue to record the webcast (the archived copy is accessible from the main PGES webpage) and send out the questions and answers that come up each month.

Professional Learning Opportunities

Annual Conference & Professional Development
November 6, 7 & 8, 2014
The Lexington Center and Lexington Hyatt Regency

The implementation of new science standards has encouraged science education professionals to seek help from one another and science ed experts as they strive to make the transition as smoothly and effectively as possible.

For the past 41 years, the KSTA annual conference has provided the most comprehensive array of professional development offerings packed into an intense three day period. That tradition continues this year on November 6, 7 and 8 at the Lexington Hyatt Regency and Lexington Center. As the conference program develops and finalizes, you'll be able to view the sessions being offered by visiting the KSTA website: www.ksta.org and choosing the conference schedule link. Also be sure to Like the KSTA page on Facebook as daily previews of conference sessions will be posted along with helpful updates for attendees.

We believe there is no more affordable and valuable way to enhance the professional growth of science educators than by attending the KSTA annual conference. Register for the conference by using the online form below -or- click this LINK to download the mail-in registration and membership form for 2014.

KySTE Fall Training Event: Digital Transformation
Tuesday, October 21, 2014,
Lexington Convention Center

For 2014, KySTE will be partnering with the University of Kentucky College of Education for the Fall Training Event. This year›s theme is Digital Transformation. There will be other content as well -- stay tuned for more conference announcement details.

General registration is $75 and includes a KySTE membership. Current KySTE members and UK Alumni are eligible for a $50 discounted registration rate.

The conference also includes convenient access to Kentucky's most active vendors.

Sessions
To see a matrix of confirmed sessions, click here.
Registration
To register for the event, visit this website to use the online or PDF form.

NGSS Short Courses for Teachers

Lexington

"The NGSS focus on a deeper understanding of the content as well as application of content" (Achieve, 2013). In order to begin to develop units of study, applications, and assessments, teachers will need to deepen their understanding of the disciplinary core ideas. These short courses are designed to strengthen content understanding of fundamental physical science concepts.

$125 per session

Lunch is on your own

9:00 am to 4:00 pm EST

Sign-in Time: 8:30 am to 9:00 am EST

Contact

Jessica Eaton

jessica.eaton@uky.edu

Where

UK/Lexmark Center for Innovation in Math and Science Education

PIMSER Training Room 105D

1737 Russell Cave Road

Lexington, KY 40505

Former Kentucky Gov. Martha Layne Collins will keynote the Project Lead The Way (PLTW) Kentucky State Conference on Oct. 17. PLTW master teachers from around the state will help to provide a conference that will allow existing PLTW teachers to collaborate and receive update training. There will also be breakout sessions for administrators, counselor, and teachers. The conference also is open to non-PLTW schools and districts interested in STEM education. It will be held Oct. 17 at Elkhorn Crossing School in Georgetown. Cost is $50, and 6 hours of EILA credit is available to those who attend. Click to register, see the program layout of the conference, and recommend a teacher for the PLTW teacher of the year. A registration-only link is here.

SCIENCE CONNECTION *Continues on Page 14*

Science & Art Discovery Field Trips & Outreach Programs

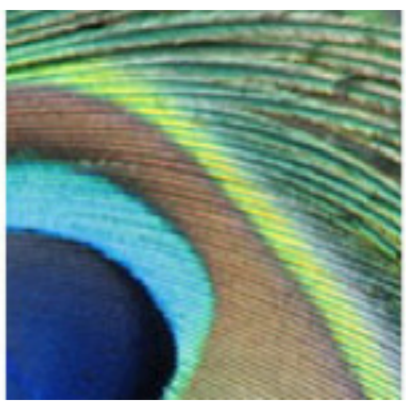
Our Field Trips and Outreach Programs are interactive and stimulating ways to reinforce art and science curriculum!

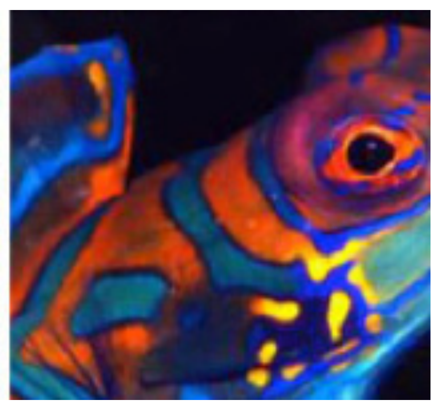
New! 2014-2015 Science Discovery Exhibit:
The Nature of COLOR

Students will embark on a visual and scientific exploration of COLOR in our new, interactive exhibit through:

- Uncovering the mystery of light and color with hands-on physics experiments!
- Mixing colored light, making colored shadows, bending light with prisms, and learning about optics!
- Exploring the biology of color and amazing animal adaptations in the natural world through interactive experiences and live animal observations! LIVE animals will include fluorescent salamanders, poison dart frogs, fire bellied toads, and even a chameleon!
- Creating unique optical designs while learning about light and refraction with the LASC's jumbo kaleidoscope!
- Delving into the world of chromatography while learning how to separate mixtures and find hidden colors in chemistry!
- Uncovering how pigments are made while learning about natural items used to create amazing colors!
- Experimenting with color and temperature – from star color to heat sensitive, color changing films!
- Becoming a light and color sleuth while learning about how humans and animals see and perceive color!
- And more…. Come join the COLOR exploration!

For more information about this new exhibit and much more go to www.LASCLEX.org





SCIENCE CONNECTION *Continues on Page 15*

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

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

Dear Colleagues,

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

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

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

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

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

For any questions, please contact the AEF Program at sc.einstein@science.doe.gov.

U.S. Department of Energy, Office of Science

View this announcement online.

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.

November	Developing and Using Models	LS4: Biological Evolution: Unity and Diversity	System and System Models
December	Planning and Carrying out Investigations	ESS1 B Earth and the Solar System	Scale, proportion and quantity

E-mail your contributions to christine.duke@education.ky.gov. All submissions are needed by the 25th 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.