Science Connection

KENTUCKY DEPARTMENT OF EDUCATION

A Collaborative Resource for Teachers **January/February 2015** Volume 1 Issue 12

In This Issue

Editor's note

Science is built up of facts, as a house is built of stones; but an accumulation of facts is no more a science than a heap of stones is a house. – Henri Poincaré, Science and Hypothesis, 1905

As we welcome in 2015 and the second half of the productive school year, I hope that you continue to see yourself as an powerful agent of change! You have the opportunity to empower students with skills that will enable them to solve problems and make responsible decisions that reach far beyond their classroom. Much work has been done related to the implementation of the new science standards in the past year as shared in a message by Karen Kidwell, director of the Division of Program Standards at KDE. I am sure that you will find her message informative. Along with the update on the new science standards work and the ongoing professional opportunities highlighted in this edition, you will also find great resources and lesson ideas from Kentucky colleagues. Your feedback on this teacher resource is welcomed, as are your contributions. Remember, the Science Connection is for teachers by teachers! You are the foundation on which this tool is built, so send in those stories to help build future editions!

Thank you,
Christine

A message from Karen Kidwell

Director, Division of Program Standards

It is not news that Kentucky continues to lead the nation in implementing new, more rigorous standards designed to support all students in attaining the knowledge, skills, and reasoning needed to be successful in the 21st century. We were the first to adopt, implement and assess new mathematics and English/language arts standards, and one of the first to adopt and fully implement new science standards.

What *is* news – especially exciting news – is that Kentucky is likely going to be the first state to implement a new *system* of assessment for science. Recognizing that standards alone are not likely to change results for students and that a single end-of-year test is not likely to provide key information that can transform teaching and learning in each classroom for each student, our state has taken up the challenge of creating a more balanced and informative system of assessment for science. This system concept is based on the following assumptions:

- A "high-quality assessment" means the assessment generates defensible evidence of student attainment of the standard – as the standard was intended.
- The focus is on what happens in the classroom: What teaching and learning practices promote student attainment of the standards as intended? What evidence is generated (and how is it generated)?
- "Assessment" is a process of collecting evidence all along a learning path – not the "test at the end of the unit" or the "test on Friday."
- In creating a "defense of student attainment or learning," just as in a legal defense, a collection of evidence will be required – not just one instance or example.

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NEXT GENERATION SCIENCE STANDARDS

Practice
Analyze and Interpret Data

DCI
PS1B Chemical Reactions

Crosscutting Concept
Energy and Matter

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- The newly adopted Kentucky science standards do not, explicitly or implicitly, prohibit any "item type" (e.g., selected response, constructed response, performance, or personal communication).
- Working collaboratively to plan learning experiences (including gathering evidence of learning) as well as to analyze lessons/units/assessment items/tasks will ensure more quality results for both teachers and students.
- The focus on engineering effective learning experiences (including gathering defensible evidence of student learning) must apply to *every grade level* if students are to gain the knowledge and skills intended in the new science standards.

This month, reviewers will look at proposals submitted to the Office of Assessment and Accountability for a "design vendor." This vendor's sole purpose will be to work with teacher leaders, science specialists and assessment/accountability experts to create a blueprint for this new system. They will outline specifications that will guide the development of the items and tasks that will enable an accurate, informative and learning-centered assessment system.

A review of the Board on Testing and Assessment's (BOTA) report: **Developing Assessments for the Next Generation Science Standards** has guided early conceptual ideas for this new system. While we still will need to create some type of "end-of-year assessment" that can be administered at least once in elementary, middle, and high school, the new system intends to build model lessons/tasks that can be used by teachers routinely in their classrooms to gauge student learning and provide feedback to students and teachers during learning; create some other tasks that would be required to be administered periodically – *not* for accountability, but as informative "through-course" tasks that will yield actionable information to teachers, students, schools and districts in time to support additional student learning and growth; and finally, to create some type of end-of-year assessment.

Do we know exactly what these will look like? No. Are we working with limitations, such as "only multiple-choice or open response items allowed"? No. We truly are blazing a trail of authentic, meaningful and congruent assessment. After the design vendor assists us in creating the blueprint/specifications, the KDE will seek proposals for a vendor that can create an operational assessment system that matches the plan.

What can you be doing? First and foremost: Engage students in the wonder of science! Implement the science standards in your classrooms and track the learning strategies, lessons, tasks that you use that generate truly defensible evidence that students are attaining the standards. We will be seeking those examples and models to inform the specifications. Also, track what doesn't seem to yield defensible evidence of student learning. That information will be just as valuable. We will be keeping everyone updated through this newsletter and other venues, such as *Kentucky Teacher*, the commissioner's weekly updates, and the District Assessment Coordinator (DAC) emails. You can access each of those on the KDE website.

The particulate nature of matter: Coordinating K-5 activities

Dr. Martin Brock, Chemistry, Eastern Kentucky University Martin.brock@eku.edu

ELEMENTARY

Overview. The Next Generation Science Standards (NGSS) are built on a framework of learning progressions. In other words, the best research, teacher classroom experiences and simple common sense all tell us that children have developmental sequences by which they are able to learn new concepts. Children begin even before their formal school age to make sense of their experiences in constructing an internal understanding about how the natural world is assembled. We know that this process can be channeled by best teaching practices to form more scientifically robust understandings.

A case in point is the development of chemistry-related content. Using the NGSS framework, the development of the idea of chemical reactions at the middle school level is highly dependent on a great many experiences of children in formal learning experiences at each level from K-5 in addition to middle school teaching. In addition, many of the standards in other domains (such as in life sciences and earth systems) are dependent on appropriate perspectives of chemical reactions. It is important to realize not only that one of the most overarching ideas in all of science is that chemical reactions consist only of rearrangements of atoms, but also that this is one of the most difficult concepts to internalize for all people, children and adults.

Disciplinary Core Idea from NGSS PS1:B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

To make sense of what is fully meant by chemical reactions, the following components must be in place before middle school, all learned at various stages during elementary school:

- Types of properties and their identification or measurement
- The particulate nature of matter (atoms)
- Distinguishing between chemical and physical changes
- Conservation of mass through all kinds of changes
- Gases have mass, even when they rise in the air

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- Ways to approach scientific investigation
- Use of math in reaching scientific conclusions
- The roles and limitations of models in scientific inquiry

What follows are four linked activities that can be done at the K/1 level, at 2nd grade, and again at grade 5, with suggestions for revisiting the issues at other grades to develop and reinforce the central ideas. These activities are described fairly broadly with an emphasis on the appropriate conversations to have with kids to help them make sense of their observations. If you need more specific details in setting up the activities, please e-mail me and I will provide additional information. Note that all the materials used here are easily and cheaply accessed.

1. **Properties, a sorting activity (K-1).** The principal learning outcome for this activity is for students to discriminate among ways to describe objects: learning types of properties, composition, shapes, uses, and the names of objects. For example, "button" is the name of an object, its use is to fasten things together, its shape involves holes through something, its composition may be plastic, metal, glass, wood or other substance, and its properties may include hardness, color, or size. It will be important for children to be able to tell that these are all different kinds of ways to differentiate objects. They may say that "wood" is a property, or that "button" is the use of the object. These kinds of confusion may lead to misconceptions down the road, and this activity will help to focus their vocabulary skills. Follow this link for the full activity**.** Sorting Activity (K-1)
2. **Paper Making (2nd grade).** This is a three-day activity. While the activity takes a long time, my experience is that it is one of the most enjoyable experiences of kids of any age and it can certainly reinforce the idea that good scientific investigation is a lot of fun. There is really only one learning outcome in this activity, but of critical importance in developing the chemical ideas to come: In mixing materials of different properties, you can tell that it is only a mixture because the observed properties of the new paper are the same as the properties of the substances that went into making the paper. Follow this link for the full activity. Paper Making (2nd grade)
3. **Conservation of mass (5th grade or earlier).** The learning outcome for students with this activity is that mass is always conserved in every situation. The activity described here is just one small aspect of this, and I encourage you to address the conservation of mass in as many science activities as you can. This is one of the big ideas that have central utility in all areas of science. There is also a second learning outcome, and that is that gases always have mass. A final learning outcome with this activity is that science often depends on appropriate use of mathematics. Because math is such a central part of the elementary curriculum, this (and the following activity) is a good place to reinforce math skills. Follow this link for the full activity. Conservation of Mass (5th grade or earlier)
4. Mixing Granular Materials (5th grade). This activity transitions students from direct observations of mass and volume to a very abstract idea that matter is composed of particles much too small to be seen. The learning outcome is that everyday observations can be used to show that such particles can be inferred. However, in doing this activity, it is best to not set the students thinking about atoms and such until after the activity is complete. Let them state that matter is composed of particles, and most of them will be able to develop that perspective themselves. Follow this link for the full activity. Mixing Granular Materials (5th grade or earlier)

And to help reinforce the ideas across science domains, remind students in their earth science and life science units that the movement of matter among the biosphere, atmosphere, hydrosphere, and geosphere occurs at the particulate level (5-ESS2), that the absorption of materials by plants from air and water occurs particle by particle (5-LS1), and the movement of matter among animals, plants, decomposers and the environment (5-LS2) is also a particulate process.

Finally, many of these particulate processes involve a fundamental change in the properties of the materials transferred; so many chemical changes had to take place.

Teaching chemical reactions using the three dimensions of the NGSS

William Thornburgh, Science education doctoral student, former chemistry instructor, University of Louisville

MS

Chemical reactions first appear in the physical science middle school grade band of the NGSS. Our goal is to engage students in a variety of learning experiences that reflect the three dimensions of the Next Generation Science Standards. Below are three MS physical science performance expectations as well as classroom activities intended to foster student understanding and mastery of these PEs.

PS1-2 – Analyze and interpret data on the properties of substances before and after the substances interact to determine whether a chemical reaction has occurred.

PS1-5 – Develop and use a model to describe how to the total number of atoms does not change in a chemical reaction and thus mass is conserved.

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PS1-6 – Undertake a design project to construct, test and modify a device that either releases or absorbs thermal energy by chemical processes.

Through limited lecture time, teacher demonstrations, student-led collaborative work time and an investigative laboratory activity, teachers will be delighted with the results of a student-centered unit on learning fundamental chemistry concepts. This condensed outline of ideas will allow teachers to retain control of the classroom but take on more of a facilitator role, by allowing students opportunities to generate their own questions.

Important concepts in a unit of middle school chemistry would include (but are not limited to) pure substances, mixtures versus compounds and physical versus chemical properties. Here is an idea for the next time you teach this content.

Materials:

3 sandwich bags (zip lock preferred), a large magnet, sulfur, and iron filings

Demonstration:

Prepare before class. Pour sulfur into one bag, iron filings into a second bag, and a mixture of sulfur and iron in a third bag.

Have students provide observations and ideas to test the two substances. Information we hope they identify or question includes the following: Where are they located in the Periodic Table of Elements? Are they metals or non-metals? Will they be attracted to magnets or not? What are the observable differences between sulfur and iron? Give the class time to think about each element and allow students to come to the answers you have targeted as essential understanding. Some prompting may be necessary to guide them, but hopefully they will work together to generate the aforementioned information.

Next, present a magnet and encourage students to make predictions about what will happen as the magnet is placed over each contained material. Continue by facilitating this experiment while students observe what happens. Follow up by having students explicitly state what they observed: Was either element attracted to the magnet? This can reiterate a definition from a previous class or act as an introduction to the fact that elements have unique properties.

Now ask students to predict what would happen when the sulfur and iron are placed in the same bag. Students should record their observations as they experience the magnet placed around the plastic bag. They will quickly notice that the magnet will separate the two components inside the bag. From this demonstration, students will glean that individual components in a mixture retain their original properties and that mixtures can be separated by physical means.

**If teachers want to challenge their students further, more discussion could follow on various separation techniques used in the sciences/industry for mixtures containing solids, liquids and solids-liquids.*

The final part of this demonstration is vital because it introduces students to how the products of a chemical reaction differ from the same components in a mixture.

******Important:*** *Be sure you read, understand and practice all safety regulations and evaluate your laboratory for the proper equipment.*

Place a small amount of iron filings and sulfur into a test tube and heat the test tube with a Bunsen burner. This should be done in a functioning fume hood away from students due to the production of a toxic gas. Once the reaction is complete, have the students make predictions on the interaction between the new compound and the magnet. Will the iron be attracted to the magnet as it was in the mixture within the plastic bag? Performing a similar demonstration using the magnet, students will observe that the magnet does not separate the iron from the compound. Students should be given time to discuss their thoughts on why this product is not attracted to the magnet.

This introduction to chemical reactions provides a valuable visual for students to learn that compounds cannot be separated by physical means and that the individual components in a compound do not retain their original properties.

******Note:*** The entire demonstration of mixtures and compounds or only the final part can be shown to students on YouTube videos here and here.

Once students have learned reactants versus products, the difference between coefficients and subscripts in an equation and the Law of Conservation of Matter, they are ready to move on to balancing chemical equations. Many teachers just explain the process and do examples on the whiteboard, while some teachers use modeling kits for students to have a hands-on experience. An inexpensive tool to accomplish a hands-on activity and allow groups of students to work collaboratively is to use bingo chips. Bingo chips come in a variety of colors (more reactions can be represented), they are easy to manipulate, and a classroom set can be purchased for little money in comparison to modeling kits.

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Image taken from: http://mrchips.net/catalog/34-inch-bingo-chips-bulk

Students could be given multiple opportunities to practice balancing equations in order to help build confidence. Talking through their thinking process while working collaboratively with other students is a proven technique. This is also a valuable activity for teachers because they can formatively assess students as they circulate through the classroom.

For additional practice and discussion: 1) Teachers could have students go to the whiteboard and diagram certain chemical reactions for the entire group to check, or 2) Each group could have a small whiteboard to diagram one problem. Once all groups do one example, the class will have access to all problems on the assignment. These whiteboarding techniques will allow students the opportunity to see more problems worked out and be given plenty of examples to improve in their ability to balance chemical equations. These techniques also provide students with an opportunity to express their thinking verbally and hear how others go through the process of balancing chemical equations.

*If teachers want to challenge certain students or groups, the idea of limiting and excess reagents can easily be incorporated into a discussion.

Science is all about "doing," and there is no better place for students to learn about chemical reactions than in the laboratory. There are so many reactions to choose from and so many considerations for teachers to take into account such as safety, time and materials. Regardless of whether this experience is carried out in pairs, small groups, or through teacher demonstration, "seeing and doing" are more valuable than telling students what happens when a chemical reaction occurs. The laboratory activity below is an example of exposing students to different types of chemical reactions and it could easily be adapted based on teachers' needs and resources.

Materials and Equipment

Bunsen burner
Crucible tongs
Mossy Zinc, Zn
Watch glass
Test tubes, small
Test tube clamp
Wood Splints
Litmus paper, Red
Evaporating Dish
Ring with Wire Mesh
Copper turning, Cu
Magnesium ribbon, Mg
Sodium carbonate, Na_2CO_3
0.1 M Silver nitrate, $AgNO_3$
3 M Hydrochloric acid, HCl
Isopropyl alcohol, C_3H_7OH
Methanol, CH CH_3OH
Hexane, C_6H_{14}
Cyclohexane, C_6H_{12}
Sodium hydrogen carbonate, $NaHCO_3$
Toluene, $C_6H_5CH_3$

Part A – Synthesis (Combination) Reactions:

1. Grasp a strip of magnesium ribbon in crucible tongs and ignite it in the burner flame. Hold it over a watch glass. Do not look directly at the flame!

2. Add a few drops of distilled H_2O to the ash. Stir with a stirring rod and place a drop of the solution on red litmus paper. Red litmus turning blue is evidence for the presence of a base.

3. Heat a piece of copper metal strongly in the Bunsen burner flame for about 30 seconds. Remove the copper from the flame and note the change in appearance. Discard the product in the solid waste can.

Part B – Decomposition Reactions:

1. Place about 1 scoopful of solid sodium hydrogen carbonate, $NaHCO_3$, into a dry test tube. Mass the test tube with the powder. Heat the sodium hydrogen carbonate in the test tube strongly for 2 minutes. Observe any changes that occur during the heating. Toward the end of the heating, light a wood splint and insert the flaming splint into the mouth of the test tube. Note what happens to the splint. Once the tube has cooled, mass the tube and contents again.

Part C – Single Replacement Reactions:

1. Place a strip of copper in a test tube with enough 0.1 M $AgNO_3$ to cover it. Set this test tube aside, then observe the surface of the metal after 5-10 minutes.

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2. Place a couple of pieces of mossy zinc metal in a test tube approximately 1/4 full of 3 M HCl. Place a stopper loosely in the tube. After a few minutes, light a wood splint and insert the flaming splint into the mouth of the test tube. Hold the test tube in your hand to feel if the temperature has changed.

Part D – Double Replacement Reactions:

1. Add 0.1 M $AgNO_3$ to a test tube to a depth of about 1 cm. Add a similar quantity of 0.1 M $CaCl_2$ solution. Observe the reaction.
2. Place a scoopful of solid Na_2CO_3 in a test tube to a depth of about 1 cm. Add a dropperful of 3 M HCl. While the reaction is occurring, test with a flaming splint as in part B.
3. Check to see if the temperature of the mixture has changed.

Part E – Combustion:

1. A small amount of the following compounds have been placed in an evaporating dish in the fume hood –

Isopropyl Alcohol, C_3H_7OH
Methanol, CH CH_3OH
Hexane, C_6H_{14}
Cyclohexane, C_6H_{12}
Toluene, $C_6H_5CH_3$

2. Your instructor will ignite them from the top of the liquid with a match.
3. Observe the appearance of the flame, the activity of the flame, the duration of the flame and the "fumes." Also, note the appearance of the evaporating dish once the flame goes out.

This activity introduces students to the importance of safety and following procedures, observing evidence for chemical changes, the Law of Conservation of Mass (part B), and it acts as reinforcement for the rearrangement of atoms they saw when working with their bingo chips. Not to mention, an activity such as this is exciting for students because they see the side of science and chemistry that they normally envision – fire and explosions (of course, the hydrogen is small scale and extremely safe in part C). Throughout each section of the activity, students will make predictions, make observations, record data and make note of any questions they have.

**If teachers want to challenge students or create an extension, this would be a good place to have students construct particle diagrams. They are making the 'macro' observations, but what is happening at the particle level? The idea of atoms and atom rearrangement have already been established, so having students put it all together and diagram the reaction is a logical next step.*

Hopefully these ideas for teaching middle school chemistry will excite and engage your students, as well as increase the amount of knowledge they have when they leave your classroom! Making minor tweaks to your classroom and completing (similar) activities in a chemistry unit will promote student understanding of the chemical reactions.

KCAS Connections

Analyzing and interpreting data through environmental education

Elizabeth Schmitz, Executive Director, Kentucky Environmental Education Council

ALL

From citizen science to schoolwide service learning projects, environmental education provides excellent opportunities to ground your science lessons in real-world contexts. All ages, from Pre-K through 12th grade, can benefit from these learning experiences.

Citizen science programs abound, and cover a range of topics that connect local scientific learning experiences to national data sets. These topics include earth, space, and biological sciences.

- *The Global Learning and Observations to Benefit the Environment (GLOBE) program* is a worldwide hands-on, primary- and secondary school-based science and education program. GLOBE students and other volunteer observers collect research-quality environmental measurements.

According to its website, the program "supports students, teachers and scientists to collaborate on inquiry-based investigations of the environment and the Earth system." GLOBE investigation categories include the Atmosphere, Earth as a System, Hydrology, Land Cover/Biology, and Soil (http://www.globe.gov).

- *Monarch Watch* (In the Classroom) provides opportunities for students to raise monarch butterflies in the classroom, tag monarchs, and much more (visit http://monarchwatch.org).
- *Project BudBurst* is dedicated to the changes in the seasons; the arriving of flowers, fruits and leaves; and other environmental shifts (http://budburst.org). The program

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has student and teacher resource pages and allows for students to input data on the "BudBurstBuddies.org" section of the website.

- *Journey North* tracks the migratory routes of about a dozen species. Students in classrooms across the world share field observations with one another and are linked with scientists who provide expertise directly to the classroom. Several migrations are tracked with satellite telemetry, providing live coverage of individual animals as they migrate. As spring sweeps across the hemisphere, students note changes in daylight, temperatures, and all living things as the food chain comes back to life. The Journey North program will feature live, interactive programming from Feb. 1 through June 30, 2015 (http://learner.org).
- The Kentucky Green and Healthy Schools program encourages students to collect data about water, energy, solid waste, transportation, green spaces, health and safety, and other topics. Students complete investigations of these categories, gathering data and reporting their findings, then developing a school improvement project to improve health, safety or environmental sustainability. Students have installed light and water sensors, led idle-reduction campaigns, and developed school-wide recycling programs. Along the way they investigate environmental topics, develop their math and engineering skills, use teamwork to solve problems, and communicate the results of their findings. (http://

Assessment

Formative assessment technique: Muddiest Point

Condensed from "Classroom Assessment Techniques" Angelo and Cross (1995)

Description and purpose

The *Muddiest Point* is one of the simplest classroom formative assessment techniques. It is efficient and provides a high information return for a very low investment of time and energy. The technique consists of asking students to jot down a quick response to the question: "What was the muddiest point in _____?" The focus of the *Muddiest Point* assessment might be a lecture, a classroom discussion, a laboratory investigation, a homework assignment, or a film.

This technique provides information on what students find most confusing about a particular lesson or topic. The feedback can be used to discover which points are the most difficult for students to learn or the least clear. Teaching decisions about which topics to emphasize and how much time to spend on each can then be made. In response to the classroom assessment technique, learners must quickly identify what they do not understand and articulate those muddy points. Even though the technique is extremely simple to administer, students are required to engage in some higher-order thinking when responding.

Suggestions for use

The assessment can be used in any setting. Student responses usually consist of a few words or phrases that can be read by the teacher in minutes. The *Muddiest Point* should be posted at the end of a lecture, at the close of a discussion, or immediately following the activity being assessed. This should be used sparingly so that students do not focus on what they do not know.

Example from chemistry

From the first week of class, students had been responding to the *Muddiest Point*. Now, several weeks into the course, the teacher used this formative assessment strategy to assess the students' understanding of entropy and enthalpy. The most commonly mentioned muddy point concerned the difference between enthalpy of formation and enthalpy of activation. These responses let the teacher know that the students had not firmly grasped the differences between entropy and enthalpy and that many of them probably did understand the principle of isolation. In looking back on her class presentation, the teacher realized that she had probably put too much emphasis on detail and not enough emphasis on the differentiation of concepts.

Step-by-Step Procedure

1. Determine what you want feedback on: the entire class session or one self-contained segment? A lecture, a discussion, a laboratory investigation?
2. If you are using the technique in class, reserve a few minutes at the end of the class session. Leave enough time to ask a question, to allow students to respond, and to collect responses by the usual ending time.
3. Let students know beforehand how much time they will have to respond and what use you will make of their responses.
4. Pass out slips of paper or index cards for students to write on.
5. Collect responses as or before students leave. Stationing yourself at the door and collecting "muddy points" as the students file out is one way; leaving a "muddy points" collection box by the exit is another.
6. Respond to students' feedback during the next class meeting or as soon as possible afterward.
7. Keep data analysis simple. Quickly read through at

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least half of the responses looking for common types of muddy points. Go back though the responses and sort them into piles – several piles containing groups of related muddy points, and one "catch-all" pile made up of one-of-a-kind responses. The responses in each pile can be counted or they can be grouped together by those muddy points that concern facts and principles, those that concern concepts, and those that concern skills.

Ideas for extending

Let students know that some of your exam questions will concern the muddy points that you have responded to in class.

Considerations

- The *Muddiest Point* is quick and simple to administer. It requires little preparation and can be used on the spur of the moment.
- For students who are hesitant to ask questions in class, this technique provides a safe alternative. For students who are lost, it can be a "lifeline."
- This technique allows teachers to see material through their students' eyes and serves as a reminder of the range of intellectual and perceptual diversity present in the classroom.
- The technique promotes introspection. Students can easily internalize, making self-assessment a regular part of classroom and study routines.
- Don't become angry or disappointed if students identify something as a "muddy point" that you're positive you presented with absolute clarity.
- Don't spend so much time responding to "muddy points" from past sessions that forward momentum is lost.

Be in the Know

KET has the right 'chemistry' to teach about reactions!

Larry Moore, KET Education Consultant

ELEMENTARY

Students making observations about events occurring in the natural world sometimes need a "virtual mediating bridge" to help them understand the scientific concepts behind what they are observing. Kentucky Educational Television's instructional media resources can provide that bridge.

This article highlights two KET-produced instructional resources, one for grades 3-5 and one for 6-12, that will help students better understand the science of chemical reactions. Both are available free at PBS LearningMedia, a searchable online repository that includes thousands of standards-based videos, interactives, images, documents, and related resources from KET and other public broadcasters and providers nationwide.

The first of these resources is a short video titled "Photosynthesis" from KET's Think Garden collection for grades 3-5. This collection consists of 18 video "learning objects" that use the lens of gardening to focus attention on a variety of natural science concepts. All these videos use fun and sometimes rhyming narration presented by child narrators along with colorful graphics and a combination of live action plus computer and stop-motion animation.

In "Photosynthesis," students learn an easy-to-remember rhyme about how plants produce their own food plus life-giving oxygen for humans and animals through the chemical reaction of H_20, chlorophyll, and CO_2 powered by energy from the sun. To see this video and the others in the collection, go to this link within the PBS LearningMedia service.

The second resource highlighted here is actually a set of several resources from KET's Water Solutions collection. This resource consists of two subsets of eight videos that explore how to prevent and mitigate non-point source water pollution. The first set (for grades 4-12) focuses on Bernheim Arboretum and Research Forest, located near Louisville, and how its "green" visitor center and other environmental initiatives help protect and conserve water. The second set of videos (for grades 6-12) focuses on the problem of acid drainage from abandoned Kentucky coal mines.

Viewed in the order they are listed, each group of videos provides an overall story about water pollution and its prevention. Used individually, they can help students understand specific concepts related to green building design, ecosystems, the chemistry of acid mine drainage, stream restoration and more.

The eight videos in "Acid Mine Drainage" provide visual representations related to the science of chemical reactions. Students learn about the geology of coal formation and how the pyrite in high-sulfur coal deposits in abandoned mines oxidizes when it comes into contact with water. This oxidation process creates ferric ions and sulfate salts, which in turn react with the water to greatly reduce its pH. As a result, the water flowing from the mines into streams and rivers is very acidic in addition to containing dangerous

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heavy metals.

Along with the eight videos, "Acid Mine Drainage" offers a number of PDF resources including background essays, discussion questions, lesson plans and graphic handouts.

Here, more specifically, are some of learning targets that can be addressed through "Acid Mine Drainage." In the videos and related materials, students will:

- Learn about the geological processes that formed Kentucky's coal deposits.
- Learn about the chemistry of high sulfur coal pyrite oxidation and see a demonstration how it causes acid mine drainage.
- Understand what pH and the pH scale are and how the scale is logarithmic.
- See the remediation system of treatment ponds that Kentucky environmental technologists put in place to raise low pH and clean the heavy metals from the water flowing out of the mines.
- Understand the negative effects of mine runoff to aquatic organisms and habitats.
- See the results of remediation and the positive impact it has on Kentucky streams.
- Learn from the accompanying PDF handouts both general background information about acid mine drainage and remediation and, for more advanced students, information about the chemical processes that underlie the problem of acid mine drainage including detailed equations.

To go directly to this collection of resources click here:

Keep in mind that the resources highlighted in this article are just a few of the thousands of STEM-related resources to be found within the PBS LearningMedia service. To gain the full benefits of this instructional repository, teachers and students should create their own PBS LearningMedia account by going to the KET EncycloMedia login page. 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!"

Professional Learning Opportunities/ Information/Resources

Kentucky Paleontological Society

The Kentucky Paleontological Society was founded in 1993 for the purpose of promoting interest in and knowledge of the science of paleontology. It is intended that the Society be a network for the exchange of data between professionals and serious amateurs in the field. Teachers are welcomed. Consider attending the upcoming KPS meeting.

WHO – The Kentucky Paleontological Society (KPS)
WHEN – 7:30 p.m. Friday, Jan. 30
WHERE – Mines and Minerals Resources Building, Room 101, Rose Street, University of Kentucky campus, Lexington
SPEAKER – Dan Phelps, KPS President
TOPIC – "The Geology of Antarctica and the Natural History of the Antarctic Peninsula." Dan will discuss Antarctica and his recent trip to the Antarctic Peninsula and Tiera del Fuego, Argentina (just a few days after his return).

FOR FURTHER INFORMATION: DANIEL J. PHELPS (859) 296-4870

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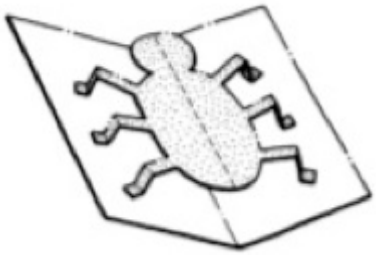
Children's Council Paper Engineering Contest



The Children's Council of the ITEEA (www.tecchome.org) is sponsoring a paper engineering contest for all PreK-6 students in the United States. The contest supports two of the council's goals: to promote children's creativity, ingenuity, and design-based problem-solving skills and to promote the study of technology and engineering as a vital aspect in every elementary school.

Paper engineering contest guidelines

1. The contest will consist of four divisions: PreK-K, 1-2, 3-4, 5-6
2. The paper engineering design must have at least one movable part (a pop-up, a linkage, or other mechanism).
3. The design must represent, model or relate to some aspect of the student's curriculum.

For more information, please download the flier at this link.

Kentucky Space and Higher Orbits are collaborating to bring Kentucky's first Mission Discovery Camp to Louisville. This is a four-day weekend space camp Feb. 21-22 and Feb. 28-March 1 at the Kentucky Science Center. This camp is available to 8th grade-undergraduate level students and availability is limited to 250 campers. Some age exceptions can be made on a case-by-case basis. Science teachers can attend for free if they volunteer as a mentor.

The flier and brochures are attached. Scholarships are available, and we are looking for more sponsors as well!

For more information go to http://www.mission-discovery.us

or email epuckett@spacetango.com.

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Sally Ride EarthKAM (**Earth K**nowledge **A**cquired by **M**iddle school students) is a NASA educational outreach program that enables students, teachers, and the public to learn about Earth from the unique perspective of space. During Sally Ride EarthKAM missions (periods when the Sally Ride EarthKAM camera is operational), middle school students around the world can request images of specific locations on Earth. The entire collection of Sally Ride EarthKAM images is available in a searchable Sally Ride EarthKAM image archive. This image collection and accompanying activities are extraordinary resources to engage students in Earth and space science, geography, social studies, mathematics, communications, and art. https://earthkam.ucsd.edu/about

You are invited to take part in the next Sally Ride EarthKAM Mission, scheduled to take place Jan. 27-31. To sign up, please visit: http://earthkam.ucsd.edu

#KySTE15 Open for Registration

"Welcome to the Future!" KySTE 2015, the conference of the **Kentucky Society for Technology in Education,** invites you to attend. Join nearly 2,000 information technology leaders, technicians, tech resource/integration specialists, classroom teachers, administrators/district leaders, library media specialists, vendors/exhibitors, and other education professionals at the largest education technology conference in the south-central United States.

Session topics

There will be sessions on a variety of important education technology trends and tools, including:

- Using Google Drive and Google Classroom,
- Getting the most out of Office 365,
- Integrating Gaming and Coding into your Classroom,
- The Best Apps for your teaching area,
- Getting Flipped Instruction Right,
- ...and many more!

Click here for a current list of approved sessions.

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NGSS Short Courses

For Elementary, Middle, and High School Teachers

Our most popular workshops are back for Spring and Summer 2015!

- **Designed to strengthen content understanding and/or understanding of science and engineering practices at the designated grade band**
- **Addresses multiple aspects of the PGES Framework for Teaching**
- **Examine misconceptions and naïve conceptions that might hinder practice and concept development, and learn how to design experiences to help students change these misconceptions**
- **Experience activities as a learner that promote concept and practice understanding, and discuss implications for best practice and highly effective teaching with other professionals**

Course / Grade Level	Spring Date	Summer Date
Light / 1, 4	March 20	
Properties of Matter / 2, 5	February 18	
Developing and Using Models / 6-8 *Elizabethtown	February 18	
Waves / 1, 4	February 24	July 9
Constructing Explanations and Engaging in Argument from Evidence / 4-8	February 25	July 6
Engineering Process and Design / K-5	February 26	July 24
Developing and Using Models including Data Analysis and Mathematic and Computational Thinking / 9-12	March 10	June 29
Forces and Interactions / K, 3	March 18	
Waves / 6-8		July 10
Energy / 6-8		July 13
Earth Systems: processes that shape the earth / 2, 4		June 15
Planning and Carrying Out Investigations / K-2		June 22
Planning and Carrying Out Investigations / 3-5		June 30
Life Science: structure, function, and information processing / 1, 4		July 17

$125 per session

Unless indicated, all trainings held in Lexington

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

COLLEGE OF EDUCATION

PIMSER Partnership Institute for Math & Science Education Reform

UK UNIVERSITY OF KENTUCKY

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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. **Many thanks for your support of this resource and for your submissions!**

Collaboration and Connections:

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

Below are the upcoming SC focus dimensions:

2015	Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
March	Obtaining, Evaluating and Communicating Information	LS1B Growth & Development of Organisms	Stability and Change
April	Asking questions and defining problems	ESS 1B Earth and Solar System	Cause and effect

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 other LISTSERVS for the Kentucky K-12 Science Teachers, go to http://www.coe.uky.edu/lists/kylists.php. Please share this link with your colleague