Environmental Science at HippoCampus

Blog Archive

Rebekah K. Nix, Ph.D.
Rebekah's work centers on enhancing learning environments, with a focus on information technology integration and professional development innovation.

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Activities are available at https://sites.google.com/site/srcpage/
This page contains links to the currently available **SRC** (Science Reality Check) activities.

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WEDNESDAY, JUNE 1, 2011

Breaking the ice – and maintaining focus...

Environmental Science: what a timely, important, and interesting interdisciplinary topic; we can blog about anything and everything! As John Muir put it: “When we try to pick out anything by itself, we find it hitched to everything else in the universe.” That good news is also the 'bad' news if you have a targeted objective to achieve in this multimodal, multimedia society. Productive conversations build on common experience. Regardless of the group, I always introduce myself by way of a fun team-building activity. Quickly scan the Community Juggling activity detail.

In this case we have the topic. As facilitator I'll direct the focus to lifelong learners, our curious students of all ages and backgrounds.

Now take a good look at the CITES animation on HippoCampus. Notice how the arrows indicating the animal trade routes suggest the birds eye-view of the juggling pattern. Imagine 150 participants tossing 30,000+ objects in any which direction! This is the state of the world our students must be prepared to manage. Of course, there are many more examples of how people are teaming to work together as a global community to address today's environmental challenges.

You can see how this icebreaker is easy to focus on systems, a key concept in environmental science. I've used it as a diagnostic assessment to gauge student knowledge of system components and awareness of issues that bombard the system flow. Attempting to find
patterns and causal relationships is evidence of reflection – and a skill that can be developed from an early age; students often need to practice transferring that skill to other areas as they grow. They too can become overwhelmed with too much information and too many options.

As an educator, you know what's going to get your students from point A to point B. My goal is to point out some useful tools and to inspire innovation for creating new and different applications of them in your particular context. Via this blog, I'll link simple, targeted (and teacher-tested) activities to vetted, professional (and freely-available) NROC resources that you can weave into your lessons appropriately. As several textbooks are correlated to the Environmental Science course already, future posts will be organized by the topics detailed on the EPA website so you can incorporate breaking news.

No matter how many links I string together, I bring just one perspective to this on-going work. It's going to take more than that to make a difference in our classrooms, communities, and countries. So, fellow jugglers, how could/do you leverage the Environmental Science course content to support your practice?

POSTED BY REBEKAH NIX AT 5:44 AM  2 COMMENTS  

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LABELS: CITES, COMMUNITY JUGGLING, ENVIRONMENTAL SCIENCE, EXPERIENTIAL TRAINING, HIPPOCAMPUS, PATTERNS, RELATIONSHIPS
**Community Juggling**

**Topic**
Patterns (Relationships)

**Objectives**
- Establish, recognize, and repeat a pattern.
- Observe individual reactions and group interactions.
- Relate objects and processes to the chosen topic.

**Duration**
10-15 minutes depending on group size and topic complexity

**Assessment Type**
Diagnostic

*This is a great icebreaker/name game that builds teams and encourages individual reflection by providing a common experience. It also provides a terrific springboard for introducing complex inter-relationships or non-linear processes that often overwhelm easily-distracted novices.*

**Materials**
- Several (6-8) soft objects (koosh balls, beanie babies, etc.)
- Topic for discussion that can be described individually

**Instructions**

1. Ask everyone to form a circle, facing inward about elbow width apart, with their hands cupped in front of them. Tell them to keep their hands cupped in front until they have received and passed on an object. After that, it’s important they place their hands behind their back in this first phase.

2. Tell them to pay close attention to the pattern that will be established by tossing a single item around the entire circle. Clearly state that the two ‘rules’ are to be nice and play safe.

3. Call someone’s name and toss an object to him/her. Put your hands behind your back to indicate that you’re already a part of the sequence. Ask the recipient to say “thanks <your name>” and choose someone else to toss it to, emphasizing the importance of gaining their attention before throwing anything. Ensure that the first recipient places his/her hands behind the back now.

4. Repeat the process until all participants have received the first (single) object and it finally returns to you. This establishes the pattern.

5. Note that “things aren’t usually that simple, so let’s try it again and see what happens”. After the first object has been received and passed on to the second in the sequence, get the first person’s attention again and toss another object. (This will cause some surprise, so make sure the rules are followed each toss!) Several objects should be moving along the pattern; get as many going as you can before the first object is about to return to you. Continue until all objects have been returned to you.

6. After the group has settled back down – and while you’re all still in the circle – process the experience by asking the following questions:
   a. If you happened to look into the center of the circle, what did you see?
   b. As an individual, what did you do that worked or didn’t work?
   c. As a group, what did you all do that worked or didn’t work?
   d. With respect to the topic, what might these different objects represent?
7. Reverse the sequence! With an object in your hands and the group back in ‘ready position’, ask participants to think about how they each deal with things that come at them from unexpected directions. Remind them that the group established a pattern. Ask them to repeat it backwards this time! After you make a point of getting the attention of the person who tossed the objects to you, toss one, then additional, objects. Continue until all objects are returned to you again.

Notes

Try to vary the colors, textures, and shapes of the objects to make it more interesting and real. Including a few that make noises when caught can be a really fun addition.

It’s helpful to keep the objects in a shoebox. Placing the box at your feet allows you to quickly retrieve and replace items easily. It also adds an element of surprise as the students can’t see what’s coming next!

Participants will find a group rhythm; let it develop at its own pace. Hopefully you’ll have some mid-air object crashes that will make for some interesting discussion. Notice how the group reacts!

Discussion Questions

- What can you do to balance your various priorities and numerous tasks?
- How do you react when someone else ‘drops the ball’? How do you recover when you ‘drop the ball’?
- Can you think about situations where others might feel overwhelmed by multiple “items” being tossed their way from different directions?
- How do we deal with the great numbers of options available to us in this “information age”?
- What implications does this activity have for non-linear processing, for example, using the Internet?
- How would things go if everyone who handled an “item” focused on that specific issue, taking into account the others’ perspectives?

Reality Check! Evaluation

☐ Was each student included in the initial pattern?
☐ Did each student participate fully in the subsequent sequence(s)?
☐ Did students notice what they did to complete the patterns successfully?
  o Asked for names
  o Waited for attention
  o Picked up missed objects
  o Focused on source/destination
☐ Did students relate their individual experiences to the group experience?
☐ Did they identify similar processes/parts in a real-world example of a similar system?
☐ Did they grasp the implications for accomplishing a specific goal as a team?
Real solutions for real problems

Paraphrasing a classic line, ‘Humanity, we have some problems’. In terms of the environment, like any other system, one ‘solution’ impacts another and so on... so we must unravel things together with lots of communication, collaboration, and creativity to flourish. At least that’s what some who know how to ‘fix’ the educational system are saying right? I’m pretty sure that’s what most environmental scientists and exemplary environmental science teachers have been doing for decades!

Remember how the Community Juggling activity looked and sounded? That experience is one way we can identify stuck patterns of thinking and doing. If we give students a chance to exercise their own visualization skills along with the freedom to imagine possibilities, they’ll likely devise ingenious solutions that fit the complex situations faced today. Rope Trick is a diagnostic activity targeted at fostering that critical ability for any field; check it out!

Could you get loose? Click here to see how other teachers fared at a professional development workshop! Do your students build mental images of the concepts you cover? An oft-overlooked part of our job is to give students a frame of reference and conceptual understanding that naturally transfers to other contexts. Click here for an in-depth explanation of why Rope Trick really works.

That’s how collaborative problem solving happens in real-world
success stories as you can see in the UCLA Co-Generation Facility video at HippoCampus. And that’s how it’s happening in real student projects right now! For example, I was re-charged by the phenomenal work displayed at Catamount Institute’s Student Symposium this spring. Community leaders, parents, teachers, administrators, and students teamed on their own time to figure out what they would/can do to make unique contributions to solving global environmental issues. And they’re making it happen!

We tend to forget that it’s just as important to learn what doesn’t work as what does work. That’s called research. The inherent power of problem-based learning can be exponentially increased by building on personal relevance, attending to uncertainty, and developing student negotiation, critical voice, and shared control. These are the 5 scales of the Constructivist Learning Environment Survey on which I base my research. From another perspective, Shelly Blake-Plock shares her Thinking about Collaboration on the TeachPaperless blog. The only trick is in adapting (or replacing) current practice with practical accountability.

With unprecedented amounts of information at the fingertips of most of our students, our role as educators (no longer teachers) is made even more exciting with the power of digital media and electronic tools. The new HippoCampus site empowers even greater advances!

*How are you keeping pace with new technologies? More importantly, how do YOU set a proper pace for YOUR students?*

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**Posted by Rebekah Nix at 5:00 AM**

**0 Comments**

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**Labels:** Environmental Science, Experiential Training, Frame of Reference, HippoCampus, Problem-Solving, Rope Trick, UCLA Co-Generation Facility
Balancing Acts

Topic Systems (Homeostasis)

Objectives
- Construct a model of a balanced system.
- Explore effects of changes to a system.
- Explain the center of mass of a set of objects.

Duration 30-40 minutes

Assessment Type Formative

Students will operationally define center of mass by devising a balanced structure. The upright nail in the wooden base acts as a fulcrum. The complete system is comprised of many distinct, inter-related and inter-dependent, factors represented by the smaller nails. Students often overlook the fact that individual and collective, intentional and accidental, natural and catalyzed actions may change or even remove system variables. This shows how even though the model may maintain a stable form, it must respond to change to achieve overall equilibrium and that there is likely a critical limit in each case.

Set-up

In advance, prepare zip-bags of materials for distribution to each team.
Assign 2-3 students to a team.

Materials
- 1: 1-inch diameter dowel rod cut about 1 inch thick with a 16-penny nail hole in the center
- 3: 16-penny nails
- 16: 8-penny nails

Instructions
1. Make sure you have all of the necessary materials.
2. Insert one large nail into the center of the wood slice so that the nail stands upright.
3. Without using any other materials, balance all of the nails on the head of the nail in the dowel rod!
4. Sketch the arrangement of the nails when they are balanced.
5. Count how many nails can be removed (one at a time) before the structure collapses.
Notes

There are many ways to help students apply this experiential knowledge of center of mass. Using an ecosystem example, the two larger nails represent the key themes of population and sustainability. The numerous small nails represent different topics that impact on critical issues. Population is the overriding variable that most affects the system’s ability to sustain itself. In the model, the larger nail serves as the base of the canopy of smaller nails to be balanced.

If you don’t have stable, horizontal desks or tables, have students work on the floor to avoid accidental shaking.

*Timesaver!* Make sure that the vertical nail is solidly inserted in the dowel base before starting.

After one team solves the challenge, you may choose to have them demonstrate their solution so that the others have time to replicate success. Although there may be other possible solutions, the most common approach is shown here.

**Discussion Questions**

- Which nails were necessary for your structure to remain intact?
- Is there more than one possible solution to this challenge?
- Where was the balancing point (center of mass) in your solution?
- What real-world systems might this model represent?

**Reality Check! Evaluation**

- Did students ‘see’ a solution?
  - Was each team able to balance all 16 of the 8-penny nails on the post?
  - Did students work together to accomplish the solution?
  - Did teams appropriately share experiences (research collaboration)?
- Did students experiment with changing the structure?
  - Were they able to remove 2 or more nails from the balanced structure?
  - Did they conduct multiple trials to gain better results?
  - Did teams compare how many nails they were able to remove?
- Were students able to identify the balance point precisely?
  - Did they set up the activity properly (base nail)?
  - Did they recognize the balanced nail ‘canopy’ as a set?
  - Could they devise methods for removing more nails from the balanced structure?
**Education and the Environment: The same, but different**

We’ve talked a little about students and teachers and environmental science. As the *vet on the net*, I feel compelled to share my thoughts on being the *guide on the side*, so to speak, with respect to curriculum before we dive into content-specific labs. And be it known that I think our students desperately need to hear a *sage on the stage* from time to time. It’s just that what we more experienced folk ought to tell/show is different in this post-information revolution age. We are living in ‘interesting times’ indeed...

Anyone reading this blog is likely familiar with OERs (Open Educational Resources); HippoCampus is a great example of a rich environment that is keeping up with both new technologies and new directions for education. Being in higher education (and highly skeptical of this sort of significant change), I felt it was my duty to see how/if these new OERs might be useful. Having been an online learner as well, I am especially sensitive to maintaining a reasonable balance between my expectations for students and what all I could deliver via distance and face-to-face courses. I was happy to find that the licensed resources in the NROC Environmental Science course enabled the efficient development of and supported the effective delivery of an online *Integrated Earth Science for Teachers* course that I designed and taught. Visualize your own favorite teaching activities and supplements as you review the *Balancing Acts* activity.
Balancing Acts is a formative activity that helps students operationally define the center of mass. That's how you might integrate it into a constructivist Physics classroom. In an Environmental Science class, imagine how the bigger picture of an intricately related system, like a local habitat, an ecosystem, our planet, and perhaps even this universe ultimately, is easily transferred to the model. Think about the implications for your teaching practice! That's the power of experiential learning as we all know. Click here to explore various representations of this activity as it was presented in a professional development program.

Focusing its resources on several key issues where it believes it can have significant impact (Community Juggling), the William and Flora Hewlett Foundation has been a strong proponent of OER development. Its focus on education and environment programs provides another powerful application of Balancing Acts when considered from the perspective of the Global Warming & Environmental Law video at HippoCampus. Pay particular attention to the many aspects of the CLES scales introduced earlier with the Rope Trick activity and reinforced in this brief clip.

Today’s educators are challenged to provide hands-on experiences, inquiry-based activities, and problem-based labs with direct application to real world situations. Combining that with mobile learning technologies and social networking capabilities, the trendy pedagogical approach has been tagged as 'connectivist'. Like the many standards revisions underway, this re-focusing of educational priorities makes the role of the teacher even more critical. Innovative models for education are being designed with the intention of, as explained by James Zull (2002) in The Art of Changing the Brain, "creating conditions that lead to change in a learner's brain. We can't get inside and rewire a brain, but we can arrange things so that it gets rewired. If we are skilled, we can set up conditions that favor this rewiring, and we can create an environment that nurtures it" (p. 5).

The great news is that the reasons great teachers teach will not likely change in spite of the fact that the tools and techniques of the profession will transition continually. The exciting business of these 'interesting times' is that we can realize the goal of MOOCs (Massive Open Online Courses) by "re-defining the very idea of a course, creating an open network of learners with emergent and shared content and interactions" right now. The field of Environmental Science not only offers a personally relevant context for education, but also a practical preparation for 21st century leaders when one considers the opportunities for differentiating instruction based on the MOOC principles of content aggregation, remixing, re-purposing, and feeding
forward. *What is it that drives your practice? How are you managing such rapid change to maintain balance in your classroom? What advice would you give to new teachers?*

POSTED BY REBEKAH NIX AT 5:34 AM 0 COMMENTS

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LABELS: BALANCING ACTS, CENTER OF MASS, DIFFERENTIATED INSTRUCTION, ENVIRONMENTAL SCIENCE, EXPERIENTIAL TRAINING, GLOBAL WARMING AND ENVIRONMENTAL LAW, HIPPOCAMPUS

Home

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**Rope Trick**

**Topic:** Problem Solving (Visualization)

**Objectives**
- Devise alternate solutions to a problem.
- Check viability of different methods.
- Deconstruct success to document solutions.

**Duration:** 15-20 minutes, depending on group

**Assessment Type:** Diagnostic

*Students can be conditioned to think that there is a single ‘right’ answer to every question. This fun activity challenges them to see more than one way to solve a problem. We all sometimes forget that finding out what doesn’t work is as important as figuring out what does work! Typically, one group will let the others know they have completed the task, so the others will start to look their way… That’s not cheating; it’s called ‘doing research’ and is very much a part of how science really happens.*

**Set-up**

In advance, prepare ropes for distribution to each student. Cut sturdy, but soft, rope into 5 foot lengths and tie a slip knot at each end to make 2 loops.

Assign 2 students to a team; can be a group of 3 if there’s an odd number of participants

**Materials**

- 1 rope with loops per participant

**Instructions**

1. Place the loops of one rope over your partner's hands.
2. Hang the other rope over the one your partner is now wearing. (Refer to image at right).
3. Place the loops of the second rope over your hands.
4. Without cutting, untying, or removing the loops from your hands or your partner's hands and without untying the knots, get the ropes apart!

**Notes**

The method for getting free is very simple (see image at right).

Take the rope that is on top and make a loop.

Push this loop through the back side of the loop on your partner's opposite hand.

Move among the groups as you may need to give hints to help students visualize solutions.
Rope Trick

Slip knots allow the loops to be adjusted to fit comfortably and snugly around each wrist. **Timesaver! Keep your prepared ropes for the next faculty/staff development meeting or club celebration!**

If a couple of teams happen to figure it out before the others have a chance to explore enough, loop them together for an additional challenge. The solution is the same and this can be done with as many people as you can ‘rope’ together.

Although colorful and fun, most yarn is too flimsy for this to work well; different colors of the heavy yarn are good for younger students, but the activity may be too advanced for them to figure out on their own. Cotton clothesline is usually the best option in terms of weight and softness.

**Discussion Questions**

- What methods did you try at the beginning of this task?
- What method did you use to finally get the ropes apart?
- What could you have done to escape faster?
- How is this science?

**Reality Check! Evaluation**

- Did students follow the rules?
  - Did they properly set up the task?
  - Did they not tamper with the loops?
  - Did partners work together to find a solution?
- Did partners test several approaches for separating the ropes?
- Did teams share ideas to come up with additional possibilities?
- Could students explain how to solve the problem to others?
How a ‘half-life’ can impact a whole life...

In the aftermath of unexpected earthquakes in unlikely locales, in anticipation of the already interesting hurricane season, and in preparation for 10th anniversary remembrances of September 11, 2001, we start these content-focused blogs with the timely EPA issue of Emergencies. Addressing ‘uncertainty’ within the context of Environmental Science, we can empower students to be prepared for and respond more readily to natural disasters, hazardous spills, and the unexpected by helping them understand the basics. These future decision-makers may be able to safeguard against the rapid changes happening on a global scale and certainly cope better with the consequences with an understanding of the complete process.

Think back to last month’s Balancing Acts activity... often, seemingly unrelated subjects are tightly linked. For example, the nuclear emergency in Japan that most of us watched in real-time this spring was caused by a tsunami. In the event of a nuclear disaster, calculating the half-life of radioactive contamination will determine when an area is safe. We tend to dismiss radioactivity as a natural phenomenon; many people think that it only occurs in nuclear power plants or as the result of a nuclear accident. Radioactive rays are emitted when a radioactive atom decays. Nuclear radiation can be a good thing depending on how it is released. Nuclear medicine is a specialty that relies on the process of radioactive decay in the diagnosis and treatment of disease, for example.

Students often associate ‘half-life’ with nuclear power, but do not understand always that it equally applies to other naturally radioactive elements - nor do they associate the dangers of the long-term ramifications of radioactive materials disposal with respect to nuclear waste management. Best used as a formative assessment, A Dating Game helps learners internalize what a ‘half-life’ really represents with a simple, fun, and safe activity that stimulates discussion. Click here to download the assignment details!
**HippoCampus Connections:** The ability to transfer knowledge across situations is a sure sign of understanding and mastery. The *Coral Age Dating* activity in *NOAA: Seamounts* is a real-life simulation of the concept presented to actually define and apply isotopic age dating of corals.

Because some students may not comprehend the drastic effects of natural disasters, the *before and after images* in *NOAA: Hurricanes* can help them appreciate the powers at play. And, in the case of natural disasters, we can show students a proactive aspect as early warning systems have been implemented to evacuate threatened areas, for example see the *Tsunami Warning System* in *NOAA: Ocean Waves*. Other predictions can be founded on historical scientific data and extensive monitoring as shown in volcanic activity detailed in *Composite Volcanoes*, *Cinder Cones*, and *Shield Volcanoes*.

**Instructor Notes:** As those of us who replay the vivid images of the 2001 terrorist attacks in our mind’s eye realize how ubiquitous communication networks can have equally positive and negative impacts that do not cancel out, but accumulate over time. Therefore, it’s important to identify, acknowledge, and possibly discuss the differences in perspectives among the many stakeholders who influence your students. Remember that most of today’s high school students were likely just 3-8 years old way back in 2001! I’m excited about the potential of leveraging new technologies for the betterment of the environment and its inhabitants – come whatever may…

*Challenge your students to make a difference right now! What Apps for the Environment might they propose?*
Radioactivity is a natural phenomenon; however, many people think that it only occurs in nuclear power plants or as the result of a nuclear accident. When a radioactive atom decays, radioactive rays are emitted. Nuclear radiation can be a good thing or a bad thing depending on how it is released (used). Students often associate ‘half-life’ with nuclear power, but do not understand always that it equally applies to other naturally radioactive elements - nor do they associate the dangers of the long-term ramifications of radioactive materials disposal with respect to nuclear waste management.

Set-up

Radioactive decay is the spontaneous transformation of one element into another. The only way this occurs is by changing the number of protons in the nucleus. A nuclear AND radiation accident, as defined by the International Atomic Energy Agency, is “an event that has led to significant consequences to people, the environment or the facility. Examples include lethal effects to individuals, large radioactivity release to the environment, or reactor core melt.” The Chernobyl Disaster (1986) is an example of a major nuclear accident; the reactor core was damaged and large amounts of radiation were released.

Assign students to small groups of 2 or 3.

Materials

Per team:

☐ Small box, with lid (either cardboard or plastic is fine)
☐ 100 black-eyed peas (or any small items with a unique directional mark)

Instructions

1. Mark the box on the inside by putting an ‘X’ on two of the opposite walls.
2. Place the ‘peas’ in the box.
3. Secure the lid and shake the box for a specific time, i.e. 10 seconds. Use the same method and time for later ‘shakes’.
4. Open the box and remove all the peas whose ‘eyes’ face the marked sides of the box. These represent atoms of the element that have decayed.
5. Record the number of remaining ‘atoms’ in the box. Repeat steps 3, 4, and 5 until all the atoms are gone.
6. Graph the data.
Notes

To change the ‘half-life’ of the element, mark an ‘X’ on just one or three sides of the box. While the overall data will produce an accurate representation of a half-life, individual groups or students may produce a variety of data.

*Timesaver!* Be sure to use beans or peas with a definite ‘eye’ so that students can see which way the pea is turned.

Discussion Questions

- Determine the half-life of your element (the point at which only 50 atoms are in the box).
- What is the half-life of your neighbor’s element?
- If the number of “decays” were in years (that is, one decay = 100 or 1000 years), what would be the half-life of your radioactive element?
- Why was it important to shake the box for the same specific time each trial?
- What is the average half-life for the class?
- What does ‘half-life’ mean?
- How is a half-life important to a geologist? How is it important to a medical doctor?
- How is radioactive decay important to the energy industry?

*Reality Check! Evaluation*

- Did students accurately graph their data across a series of trials?
  - Were they able to identify a pattern?
  - Did they draw a best-fit line?
  - Did students discuss what the shape of the curve means in terms of their experience?
- Did students identify and explain similarities or differences among other group results?
- Were students able to restate their experimental results in terms of radioactive decay, half-life.
Adapting to and surviving in new environments with infinite horizons

I truly am a digital immigrant. I like keeping one foot in the analog world while wiggling my toes in the digital world. They’re both quite real and uniquely wonderful – as well as complementary. ‘Home computers’ were introduced the year I graduated from high school. Realizing that was about as shocking as hearing my favorite songs on an ‘oldies’ station a decade (or so) ago… How dare they label my generation! If you read last month’s post, you may have returned to see if I was trying to shock unassuming readers: black-eyed peas? Seriously? Absolutely!

While some religiously champion digital evolution as the solution to the world’s problems, I maintain there is an urgent need for blending tools and strategies – especially in education. Existing and emerging technologies offer empowering tools for meaningful learning. Simply participating in this blog, actively or passively, is evidence that we’ve survived the information revolution. Technology has infiltrated the ranks of higher education even as explained in an enlightening Adobe whitepaper called The Silent Transformation. Eleven years into the 21st Century, what do your students really need to learn? What do you think is the best way to teach them? Both teachers and students must adapt to a changing environment if they want to survive!

Adaptation means survival in any environment on every level. Critical issues impacting our own physical development are detailed on the EPA's Health and Safety webpage: “children may suffer disproportionately from environmental health risks and safety risks; as we age, our bodies are more susceptible to hazards from the environment which may worsen chronic or life threatening conditions”. Although not as rapid as iPhone releases, the relatively contemporary story of the pepper moths provides a perfect example of how such change can happen in the real world. The Moth Mothers activity demonstrates why the pepper moth had to adapt to survive England’s
industrial revolution. Click here to download the 'analog' activity detail.

I typically use this activity as a summative assessment, but it’s equally useful as an introductory assignment. Because the effects of environmental changes often occur slowly and slightly over extensive time, students may not realize the link(s) to biological evolution. Few species can adapt quickly enough to survive the rapid impacts of human activity. Leveraging digital advances, I found a comprehensive Flash interactive that beautifully complements this hands-on physical simulation on Mr. Tevis' Class Web. Click here to review the Peppered Moths: Natural Selection in Black and White. This would be a great alternative accommodation for anyone who had to miss out on the lesson.

HippoCampus Connections: Additionally, the Global Warming video tells the same story of industrialization that triggered the pepper moth adaptation so it could survive. Air pollution is a similar story. Wilderness and Recreational Parkland is a broader look at making responsible decisions regarding human health and safety. Project Chariot is an example of how people took action to make a difference and avoid a possible repeat. The possibilities for integration are infinite!

Instructor Notes: Unfortunately, it’s probably pretty easy to make Moth Mothers personally relevant today. Fortunately, there are many instances of coordinated efforts to shift the balance of the systems involved. For example, because more kids have asthma and other environmentally induced diseases, regulations and policy are critical to our health and safety as global citizens.

Back to the realm of teaching and learning, I love that this ‘science’ lesson affords so many interdisciplinary opportunities. That’s the exciting part about these ‘interesting times’… Case in point: “The mission of the International Mind, Brain, and Education Society is to facilitate cross-cultural collaboration in biology, education and the cognitive and developmental sciences. Science and practice will benefit from rich, bi-directional interaction”. Hands-on, inquiry-based activities that simulate or model environmental issues and concepts are more than applicable than ever today… and the research says...
that “Action Based Learning” (friend 'em on facebook) is more critical than ever today. Seriously! See for yourself how well it works with any age learner!

POSTED BY REBEKAH NIX AT 8:00 AM 0 COMMENTS

Recommend this on Google

LABELS: ADAPTATION AND SURVIVAL, AIR POLLUTION, ENVIRONMENTAL SCIENCE, GLOBAL WARMING, HANDS-ON SCIENCE, PEPPER MOTH, PROJECT CHARIOT, SILENT TRANSFORMATION, TECHNOLOGY, WILDERNESS AND RECREATIONAL PARKLAND

Home

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**Moth Mothers**

**Topic**  
Adaptation (Pollution)

**Objectives**  
- Describe the changes in a population.
- Identify some of the factors leading to adaptations.
- Infer implications of a changing environment.

**Duration**  
25 minutes, if material ‘kits’ are ready - 40 minutes, if not

**Assessment Type**  
Summative

*This activity demonstrates why the pepper moth had to adapt to survive England’s industrial revolution. Because the effects of environmental changes often occur slowly and slightly over extensive time, students may not realize the link(s) to biological evolution. Few species can adapt quickly enough to survive the rapid impacts of human activity.*

**Set-up**

Tell (or have students research) the pepper moth evolution during the Industrial Revolution in England.  
Assign 2-3 students to a team: 1 = moth parent, 2 = hungry bird, 3 = recorder (optional)

**Materials**
- Newspaper (2 full spreads per team)
- Scissors (1 pair per student) or pre-cut moth sets
- Timer (clock with a second hand or stop watch)

**Instructions**

1. Using one of the sheets of newspaper, cut out 100 1½-inch ‘moth’ triangles.
2. Lay the other sheet of newspaper on the floor.
3. Moth Parent: While your partner is not looking, sprinkle 50 moths on the newspaper. This is the first generation of moths.
4. Hungry Bird: Your partner is now a bird. From a standing position, he or she has 10 seconds to pick up as many moths as possible by repeatedly swooping down, and standing all the way back up. **Moths must be caught one at a time.**
5. At the end of 10 seconds, count and record the number of moths collected. Subtract this number from the beginning number to figure the number of survivors.
6. Add as many new moths to the newspaper as there are survivors. The survivors have reproduced forming the second generation.
7. Repeat steps 4 through 6 three more times for each partner for a total of four generations each.
Notes

Timesavers! Save each group’s final materials (moths and habitats) in zip-bags for re-use. It can be fun to host a ‘moth-making session’ to cut out triangles and assemble material bags. A butterfly die punch (scrapbooking tool) makes really nice looking ‘moths’ quickly!

Each team needs to log their results. The following table is a good arrangement to suggest if students are not well organized.

<table>
<thead>
<tr>
<th>Generation</th>
<th># Eaten</th>
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<th># of Offspring</th>
<th>Notes</th>
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Discussion Questions

1. Look at the number of moths in each generation. What can you say about the trend in this data?
2. What is the difference in coloration between the moths eaten and those that survived?
3. What would have happened to the moths if they were not adapted to their environment?
4. What would happen to the birds that ate the moths if the moths became extinct?
5. What would happen in Generation 8 if you used the Sunday comics as background for Generation 7?
6. What would happen in Generation 8 if you folded the newspaper page in half to simulate habitat destruction for Generation 7?

Reality Check! Evaluation

☐ Did students identify key factors leading to adaptations?
  o Did they recognize the importance of camouflage?
  o Did students infer factors leading to/preventing species extinction?
☐ Did students generate reasonable data?
  o Was the procedure followed closely?
  o Were the counts conducted accurately?
  o Was the data recorded practically?
☐ Were students able to draw conclusions from data?
  o Could students describe the changes in a population over time?
  o Did they realize the impact of habitat destruction?
Food webs offer serious food for thought!

I am just starting to recover from my summer 'vacation'… Having revised my Educational Technology course, I had to realign elements to the various standards: the TEKS, the NETS, the PPR, and so on… I’d need a 3D Microsoft Surface table to show you how each ties into the actual course – and over to the others – really. Because my course is cumulative across 15 weeks, the spiral design creates a fantastic interweaving of connections. I’d bet your practice produces a similarly intricate mesh when you take a step back from the general lessons and add in all of the IEPs. Representing such complexity is a challenge. My dream is to realize an interactive volvox model to literally connect the dots within and around the parts that make up the whole of education.

On a more practical note, the Oops, I Broke It activity provides a memorable way for students to dramatize a food chain. Hopefully you’ll have time to extend that simple linear model into a food web. Making the connection to energy, they sometimes forget that all food chains and webs begin with the sun. It’s also important that they realize how inter-dependent both chains and webs are when considered within an environmental context. As a formative assessment, I’ve found this to be a fun way to introduce the topic of food webs or to check for a thorough understanding of the importance of protecting endangered species. Click here to download the 'analog' activity detail.
Please refer to the EPA's website to learn more about the issue of **Pesticides, Chemicals, and Toxics** and incorporate that issue into your discussion of food webs. Their *Design for the Environment Safer Product Labeling Program* is one tool for empowering us all to help protect human health and the environment.

**HippoCampus Connections:** Depending on your curriculum needs, there are several wonderful resources to support this activity in the HippoCampus collection. *Hydrothermal Vent Food Web* in NOAA: **Chemosynthesis and Vent Life** provides a real-life simulation of a unique underwater food web. In **NOAA: Ocean Pollution**, the *Biomagnification* animation shows how toxins move into and through a food chain. *Dioxin* provides an environmental parallel for biomagnification with serious indirect health effects on humans. *Arsenic* shows how understanding environmental usage can lead to developing solutions for sustaining the food chain in Bangladesh.

**Instructor Notes:** Depending on your students, I was also pleased to find several interesting ‘games’ on the web that might offer additional assessments or appropriate remediation. Exercise your creativity to integrate this topic with geography and social studies! In *the food chain game* you drag the parts of the generic progressive food chains (from simple to full) to their correct places; when the chain is complete it ‘comes to life’! There are locale specific activities for meadow, arctic and pond chains, Canadian northern or forest food chains, and endangered animals in the Mexican ecosystem and/or you can learn about other animals by level then see complex webs for Australian or African Grasslands and Antarctic or Marine food webs. While the *Oops, I Broke It* activity targets a particular environmental science concept, you’re certainly not limited to addressing a single standard with such real-world examples!

An obvious benefit of new technologies is the ability to individualize teaching to accommodate different learning styles and special needs cases. With a slightly different tack, I try to design content that fosters individualized learning for everyone. (Yes, I am a true constructivist.) In fact, for my doctoral work I helped my graduate students weave their areas of interest into a single virtual field trip. The closest I’ve come to pursuing my *volvox* dream is an ancient, home-made project called the GEMweb. (Yes, I use it in my Science Education course each summer! The inter-relationships of ecology, geology, and humankind are basically the same still. Students help expand the site by contributing their own pages.) I’m eager to implement the playlist feature on the new HippoCampus site to let students to exercise a little more of that ‘shared control’ measured on the CLES. *How are...*
you empowering students to explore their interests within the scaffolding of our current educational system? How is that changing how you continue to learn?
**Topic**  
Energy (Food Webs)

**Objectives**
- Dramatize a food chain.
- Extend a food chain into a food web.
- Analyze the effects of breaking a food chain on a food web.

**Duration**  
40 minutes

**Assessment Type**  
Formative

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*Students sometimes forget that all food chains and webs begin with the sun and are inter-dependent.*

**Set-up**

Make a list of all the foods eaten by the students at a previous meal. Be sure that there are both plants and animals on this list. Discuss what people eat and what animals eat. Ask how plants get the food they need.

**Materials**

- ID tag per student: one ‘Sun’ and common plants and animals they know
- 4 different-colored skeins of yarn

**Instructions**

1. Give each student a tag with a plant or an animal on it. Make sure one student gets the ‘Sun’ and have him/her watch from the sidelines until called upon in Step 5.

2. Give four ‘animal’ students each a skein of yarn.
   a. Ask them to find one person with a tag that the animal on their tag might use for food.
   b. With the first students holding onto one end of the yarn, unravel it as they hand it to the selected ‘food’ person. Linked to the first student, the second student holds the skein of yarn.
   c. The second student repeats this process until the selected person’s tag has a plant on it.

3. Still holding onto the yarn, ask each group to form a straight line, with the plants at the front of the area and the animals toward the back.
   a. Remaining students may grasp the yarn next to the plant or animal they might use as food.
   b. Ask what they have formed: a food chain--a straight line of one organism feeding on another.

4. Ask students to find animals or plants in other lines their tag could use for food.
   a. If they find one, they may stretch the yarn from those students to themselves.
   b. Ask what they have formed: food web--intersecting lines from one food chain to another.

5. Ask them where the ‘Sun’ should stand.
   a. After several answers have been given, bring the Sun to the front of the lines and give him/her the end of each of the skeins of yarn.
   b. Ask students to watch where the yarn goes from the plants; then ask them what all plants need for food: sunlight.

6. Ask what would happen if some of the organisms were no longer part of the food web.
a. After several hypotheses are noted, ask them how they would test their guesses.

b. Follow the students' directions in testing their hypotheses. Make sure that they see that once an animal or plant leaves the food chain/web, other organisms are affected.

7. Have the very first students (the animals who started each chain) let go of the yarn and step away.

   a. Ask the students how losing them (animals at the top of the food chain/web) affects the other plants and animals. There is little or no effect other than possible over population of the prey of these animals.

   b. Allow the students to see that once an animal or plant leaves the food chain/web, other organisms are affected.

8. Next, remove a few students near the middle of the food chains/web.

   a. Ask the remaining students to change their eating habits to adapt to this change. Some students may not be able to adapt, so they must also leave the food chain/web. This lack of adaptation may affect still more students, who must also adapt or die.

   b. Ask students to explain what happened.

   c. Allow the students to return to the food chains/web.

9. Now, remove half of the plants from the food chains/web.

   a. Ask the remaining students to adapt. Those who can’t are also removed from the chains/webs.

   b. Ask the students what will happen if all the plants leave the food chains/web.

   c. Allow all students to return to the food chains/webs.

10. Finally, remove the sun from the food chains/webs.

    a. Ask the students what will happen to the plants and animals.

    b. Ask the students if any of the plants or animals can adapt to a world without sunlight.

    c. Return the sun to the food chains/webs.

Notes

Badge holders (light plastic sleeves with elastic neck bands) work great for this!

Be sure to start with carnivores when passing the yarn. Eventually, all yarn skeins should end at the sun.

Timesaver! You can limit this activity to food chains only, and not go on into food webs if needed.

This could be simulated on a whiteboard or other display, but students greatly benefit from the tactile role-playing aspect of acting it out and moving about the area.

Discussion Questions

- Where do plants get the food they need to grow?
- What would happen if you could no longer get your favorite food?
- Is this a system? What system is it and which parts could the system function without (if any).
- Why are some people so concerned about endangered plants and animals?

Reality Check! Evaluation

☐ Did the students successfully create a food chain?
☐ Could they extend it into a food web?
☐ Did they see the effects of breaking a food chain on a food web at the top? In the middle? At the end?
THURSDAY, DECEMBER 1, 2011

Seeing is believing… we are cramming to capacity.

Once again the seasons appear to have changed overnight! A couple of weeks before Thanksgiving Day, I was in Colorado where we’d already had 3 snows (8-9 inch accumulations each) and bitterly freezing temperatures. Just 12 hours later, when I arrived home in north central Texas, it was 80 degrees outside and spring green had replaced the chaff of an historically hot summer. According to the LCRA, “The 12 months from October 2010 through September 2011 were the driest for that 12-month period in Texas since 1895, when the state began keeping rainfall records.” My hometown is now enforcing Stage 3 Water Conservation Measures as the winter forecast does not hold much promise for relief. But the temperature has dropped and the leaves have changed to signal Fall, finally!

On a grander scale, climate changes naturally over a long period of time. This gradual progression usually allows plants and animals to balance the carrying capacity of their environment. Whether or not you ‘believe’ in global warming, the impact of human activity is causing rapid changes in our shared environment. Adults have actually seen the changes manifest: we know that the current local weather patterns are different from what seemed relatively predictable when we were kids; we see the impact of that on flora and fauna, not to mention the domino effects of continued habitat destruction. Today’s students, however, often have difficulty connecting our need for the same resources as other organisms with the amount of life the planet can support. Many times they also fail to associate changes in climate with the earth’s ability to sustain life. That’s why the No More Room activity is designed to provide a tangible representation of carrying capacity from the bottom of a food web up!
HippoCampus Connections: Several HippoCampus resources might fit into your lessons to support this activity. For example, the Microclimates video shows how not only landforms but also vegetation affect climate. The Range of Tolerance video further establishes that organisms are dependent upon a band of climatic conditions to flourish. The Greenhouse Effects video explains how the earth’s energy balance is managed so we can figure out how our choices might impact it overall. And the Methane Clathrates simulation illustrates an indirect consequence of the slightest climate change as ocean temperature.

Instructor Notes: This activity can be used as a summative assessment to see if students really grasp the fact that climate change is a problem that is affecting people and the environment – and that they can take action to make a difference right now. There’s a lot of great information in A Student’s Guide to Global Climate Change on the EPA website, which is available in the Learn the Issues section on Climate Change. In addition to a virtual field trip around the world to explore the effects of climate change, students can calculate their impact on the environment and learn about specific ways to help solve this global challenge. Please share your ideas for incorporating the interactive Global Warming Effects Map too!

Somewhat related to this topic, I am a visual learner, always have been and hopefully always will be. I suppose that’s part of the reason I so love to ‘watch’ the seasons change. Regardless of my preference, experts say that over 80 percent of what a child learns in school is presented visually. And sadly, up to 25 percent of schoolchildren may have vision problems that can affect their ability to learn. The good news is that many of those roadblocks can be reduced if not eliminated with rehabilitation or therapy! The COVD website is a great starting point for finding out more about vision development and vision therapy – and vision and learning. Please review their Symptoms Checklist of common signs and symptoms of conditions to look for that may indicate a vision problem. They can occur at any age and typical eye exams and school screenings do not check for these critical functions, unfortunately.

As we continue to leverage new tools and technologies to track global climate change and to assess neuro-sensory diagnostics, teachers have exciting opportunities to incorporate new techniques and
strategies for more meaningful learning for an increasingly diverse audience. For example, Environmental Science is a wonderful topic for exploring ways to use infographics as creative assessments. As explained on Wikipedia, “information graphics or infographics are graphic visual representations of information, data or knowledge. These graphics present complex information quickly and clearly”.

When checking the forecast for my recent drive from CO to TX, I was naturally and immediately drawn to the GraphiCast (graphical short term forecast) produced by the National Weather Service.

In *Teaching with Infographics*, the New York Times acknowledges that it’s becoming increasingly important for students to be able to read and interpret visual representations of information. I started my explorations with 10 Awesome Free Tools to Make Infographics and The Anatomy of an Infographic: 5 Steps to Create a Powerful Visual.

*What changes in teaching and learning are you noticing? What ideas could you develop to inspire your students to share facts and figures about their place in the changing environment?*

**POSTED BY REBEKAH NIX AT 6:00 AM**

**LABELS:** CARRYING CAPACITY, ENVIRONMENTAL SCIENCE, GREENHOUSE EFFECTS, HIPPOCAMPUS, INFOGRAPHICS, METHANE CLATHRATES, MICROCLIMATES, NO MORE ROOM, RANGE OF TOLERANCE, VISION THERAPY

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**0 COMMENTS:**

**POST A COMMENT**
Environmental Science: Seeing is believing… we are cramming to capacity. http://hippocampusenvironment.blogspot.com/2011/12/seeing-is-believing...
No More Room

**Topic**  
Population (Carrying Capacity)

**Objectives**
- Categorize what plants and animals need to survive.
- Estimate the chances of survival based on resource allocation.
- Judge the results of management strategies in terms of consumption versus resource availability.

**Duration**  
30 - 40 minutes

**Assessment Type**  
Summative

*Students have difficulty connecting our need for the same resources as other organisms with the amount of life the planet can support. They also fail to associate changes in climate with the earth’s ability to sustain life.*

**Set-up**

Carrying capacity is a measure of the biomass of a population that can be supported by the ecosystem. The carrying capacity changes over time with the number of predators and resources (breathable air, food, water, shelter and habitat). Climate change is a large scale, long term process. Studies have shown a strong connection between climatic variables and carrying capacity. All organisms need food, water, shelter, plenty of space to gather these materials, and air. Animals and plants that do not get these materials in sufficient quantity and frequency will become endangered, and eventually, if the scarcity becomes a trend, will become extinct. In general, extinction is sped along by the impact of humankind on the environment. This impact is, more often than not, on the amount of space the plants and animals have in which to live. As space becomes scarce, so do food, water, and shelter. Air may also become polluted as a result of our intrusion into the organisms’ space.

**Materials**

- Five colors of construction paper cut into one-inch squares to represent food (green), water (blue), shelter (brown), space (orange), and air (white)
- Opaque sack or bowl or similar container for distributing paper squares
- Blank sheets of paper (tabloid size is ideal, but letter size will work)
- Glue or tape

**Instructions**

1. Ask students to reach into the ‘sack’ and pull out five squares. *You may want to go around the room 5 times or draw out the squares yourself, depending on the age of the students.*

2. On the blank sheet of paper, have students set up a grid with column heading for the necessities (food, water, shelter, space, and air). For each trial, they will make a new row.
   a. Have the students sort, then glue, the color squares into each associated column.
   b. Once the squares are glued down, tell students that they must have at least one of each color square for their plant or animal to live comfortably.

3. Repeat these two steps, twice more.
Notes

If the same element is missing three times, the organism is considered endangered. If two elements (for example food and space) are missing three times the organism will become extinct.

_Timesaver! Before students glue down the first trial, make sure they grouped their data in rows by year and columns by color!

You may also want to have students compare data or add their data together to see a more complete picture of a single ecosystem.

If students are very young, you may want to take elements around to each student so that he/she can save the plant or animal from extinction.

Discussion Questions

- Ask students if their plant or animal is getting enough of each of the five things they need to live comfortably.

- _If time allows, repeat the drawing and gluing twice more._ Examining each year, ask students which of the essential elements were missing from the animal or plant's environment. Ask them what will happen if their plant or animal cannot get the essential elements that it is missing.

- Ask students with endangered or extinct cases to show their data and tell about what happened to their plant or animal at the critical point in their data collection.

- Ask students to analyze their data and project what will happen to their plant or animal if the trend they see continues.

_Reality Check! Evaluation_

- Were students able to recognize what plants and animals need to survive?
  - Food
  - Water
  - Shelter
  - Space
  - Air

- Using information from the data they collect, could students estimate the chances of survival based on the random resource allocations?
  - Did they examine the columns to explain what the lack of particular resources mean in terms of the likelihood of the environment's ability to support life?
  - Did they examine the rows to explain what the changes in particular resources over time mean in terms of the likelihood of the environment's ability to support life?
  - Were they able to see the ‘big picture’ of how the two aspects impact the environment?

- Could students reasonably judge the results of management strategies in terms of consumption versus resource availability?
  - Did students consider setting aside parkland or national park areas?
  - Did they propose solutions based on using products that are not from endangered plants or animals?
Taking Ownership of Environmental Protection

A big part of this season's holiday joy, for many, centers on family anecdotes from years past that are remembered as we write the stories for future generations to recall. For some reason this year I thought about how my dad – who coached my community sports teams – told us how to win. He said there were only two things that mattered: scoring more points than the other team and not letting them score more points than we did! Yes, it's _just that simple._

As many of us ponder likely familiar resolutions for 2012, I decided to build on my dad's advice to plan my personal goals this year. I aim to do more things that are 'good' for myself and fewer things that are 'bad' for myself. The same trade-off works for this month's blog post topic. Paraphrased in terms of sustainability, we simply need to use more alternative energy and not use as much from sources that negatively impact our economy, safety, and environment.

Unfortunately, it's not such a simple task to actually implement either challenge. _Need some energy?_ Just flip a switch and the lights come on, or the computer boots up, or the washing machine starts to run. Many students think that electricity comes from the wall; they do not consider what had to happen for that electricity to be produced and to get to that wall socket. Further, they have no idea about the amount of energy they are using. The summative _Energy Watchers_ activity is all about making the abstract more concrete – and putting all of that into a personally-relevant context.
Yes, this activity was inspired by the Weight Watchers program success! From their homepage, “Weight Watchers works because it’s not a diet. You’ll learn how to eat right and live healthy.” Fortunately, quantifying energy consumption and production along with comprehensive cost-benefit analysis for each option is becoming a lot easier and far more interesting thanks to new technologies that have recently made it to market. Adding an increased awareness of the causes and effects of our pre-information revolution lifestyles to that growing knowledge base is catalyzing exciting collaborations that reach across the political and peculiar boundaries for positive change.

**HippoCampus Connections:** Even though this was the topic for last month’s post, the Carrying Capacity video explains the significance of our various environmental footprints and sets the stage for global comparison. You might then use Economic Factors to relate US consumption to other items and population growth. As a lead into breaking advances, the Renewable and Non-Renewable Energy video provides an overview of energy sources so that students can make informed hypotheses about sustainable options. Following on that description of the environmental impacts of energy use, several items afford exploration of alternative renewable energy sources: see Solar Heating System, Photovoltaic Cells, Hydroelectric Power, and NOAA: Ocean Waves. Last, but certainly not least, Sustainable Environment demonstrates how regulations can stimulate this exact type of necessary change to restore a healthy environment by reducing vehicle emissions with a variety of energy sources.

**Instructor Notes:** Many new homes are equipped with ‘smart meters’ that send electricity consumption data to the utility. Smart meters can also record the energy fed back into the distribution network from co-generation sources, such as wind turbines and solar panels. An internet search will also return ‘Home Energy Management Software’ apps to gain valuable insight into energy use. To gain a broader perspective, take a look at Chevron’s **Energyville.** While it’s called a game, it is a powerful simulation tool for controlling the energy mix of a virtual city. It can be played individually or as teams. You might set up class challenges! Even if you don’t use the gaming component, a wealth of information on energy sources and demands is nicely presented on the well-designed site.

Hoping to ‘score more points than the other team’, I am thrilled to be a part of the first community solar project in Colorado Springs. This innovative plan offers an affordable way for me to utilize solar energy – thanks to many people who worked together to figure it out. The city
council unanimously approved the idea of a solar garden in September 2011. SunShare negotiated a working relationship with the local utility company to make it all possible. I leased my option in October to leverage attractive government incentives. The governor attended a groundbreaking ceremony when the first panels were installed in November. And I should see a credit for the energy piped into the local grid on my January 2012 electric bill! Perhaps someday soon I'll need to map my CO to/from TX route on the Alternative Fuels and Advanced Vehicles Data Center site to make sure I can refuel my next vehicle as needed!

We all need to take ownership of environmental protection in whatever ways we can. Encourage your students to seek out other ways to reduce their environmental footprints today – at home, at school, in the garden, and in the community! The EPA's Green Living page includes many great ideas and current information and a link to their Sustainability site. How will you measure your students' success this year? It all adds up to a win-win for a healthier and happier future.
Need some energy? Just flip a switch and the lights come on or the computer boots up, or the washing machine starts to run. Many students think that electricity comes from the wall; they do not consider what had to happen for that electricity to be produced and to get to that wall socket. Further, they have no idea about the amount of energy they are using.

Set-up
Discuss the amount of energy used in different countries as compared with the United States. See the World Population web site (http://www.worldpopulationbalance.org/population_energy) for example. Student need to track their energy usage for 24 hours to prepare for this activity.

Materials
- Student energy usage log (24-hour)
- Calculator (optional)
- Access to the Internet

Instructions
1. For the next 24 hours, log each time you turn on or off energy for each device used.
   a. For example, when you enter a room, you may turn on a light, so you’ll enter Overhead Light on your log and the time. When you leave the room, you’ll enter the Time Off.
   b. This does not include things running on battery power, but does include the times you re-charge those batteries. You might enter iPod Recharger under equipment and the time; then enter the time you take the iPod off the recharger.
   c. Make a log on your own paper with the following headings:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Time on</th>
<th>Time off</th>
<th>Total time</th>
</tr>
</thead>
</table>

   You’ll probably need at least 40 entry lines in your log.

   The very last line should only have a grand total.

2. Calculate the total the time of your energy usage.
3. As a crude measure, each person in the US consumes about 27 kWh of energy per day (or 1.13 kW per hour). Multiply your total time of energy use by 1.13 kW. Does that equal the average US consumption? Is this the total amount of energy used at your home?
4. What energy was used in your household that was not on your log (dishwasher, refrigerator, washing machine, clothes dryer, TV, computer, heater, air conditioner, water heater, etc.)?


6. The pie chart shows all of the sources used to produce electricity. Remember that 60% of electric consumption is residential. Do we use more non-renewable or renewable resources?

[Image: Fuel Mix for U.S. Electricity Generation]


7. One gallon of crude oil can produce about 17 kWh. There are 42 gallons of oil in a barrel. How long would that barrel of oil last for your personal energy usage?

8. Multiply the number of people in the US (http://www.census.gov/population/www/popclockus.html) by 27 kWh (average amount of energy usage per day) to find out how much energy we are using right now. Now multiple that number by 1.4 gallons and divide by 42 gallons. That's how many barrels of oil we are using right now!

Discussion Questions

  - How does your energy use (lightbulb symbols) compare to people in China?
  - What about other countries with a greater consumption that population?
  - Why is the information from the two previous questions important?

- Energy in Texas has variable time-of-use rates. Electricity is more expensive between 1 and 6 p.m. on weekdays in summer and fall. These are the times with highest electric demand, largely because of air conditioning usage. Demand peaks earlier in the day during the winter; between 7 and 10 a.m. When is the best time to run your dishwasher or clothes dryer?

- Assume it is the year 2020. The non-renewable energy in the US now accounts for 30% of our available energy. We can still purchase 0.10% of our energy, but the rest must come from the other sources on the pie chart. Go back to your log. How would you change your energy consumption and still maintain your life style?

Reality Check! Evaluation

- Did students reasonably identify and log their personal energy use? (at least 10 complete entries)
- Did students translate personal usage into per capita national consumption statistics?
- Were students able to formulate a practical exchange to lessen dependence on non-renewable energy sources? (examples of changes in energy consumption)
A Sustainable Frontier Ethic: Reclaiming Non-Renewable Energy Sites

This month's blog topic, Land & Cleanup, is far more personally relevant than I expected! Beautiful spring-like weather coerced me to do my annual yard cleanup much earlier than usual. Even though I've xeriscaped significantly, non-native invasive vines and saplings commandeered a good bit of physical energy each season.

Speaking of energy, the previous post focused on one kind of renewable energy: solar. The Great Buffalo Shortage activity helps students learn how to weigh the trade-offs of mining operations, a common way of extracting non-renewable energy sources. Like the buffalo, that almost became extinct, without proper management, we may lose the environment itself. Click on the image below or right here to review a truly hands-on model that offers a fun formative assessment!

Many students tend to believe that mining always produces a profit. They may not know about the regulations governing mining and requirements for land management or how to weigh the yield. As detailed on the EPA's abandoned mine lands site, AMLs present serious threats to human health and the environment… not to mention often extreme scarring of the land. I think it's well worth your time to scroll way down NASA's remote sensing tutorial page to see satellite images of long term changes in resource use, such as strip mining and
Instructor Notes: It's sadly easy to relate real-world stories of energy-related environmental destruction back to almost every activity I've shared to date! Think about the implications of mining operations in terms of systems (Balancing Acts), adaptation (Moth Mothers), food webs (Oops, I Broke It), and population (No More Room), for starters. That's why I was so happy to see a new Fact Sheet added to the EPA resource site just this past December. Directly related to the Energy Watchers activity, Shining Light on a Bright Opportunity: Developing Solar Energy on Former Mine Lands provides a great summary of solar energy – and how abandoned mining areas can serve as 'renewed' sites for renewable energy production.

HippoCampus Connections: Several excellent resources on HippoCampus support an understanding of why the revitalization and reuse of damaged land – and protection of land in general – is important to each of us. The Mining for Borax video shows a real-world success story of managing this balance. Unsustainable Frontier Ethic simulation shows why it's critical we find and maintain a balance by explaining desert encroachment. Tree Harvesting explains how we can mechanically remove a renewable resource in a sustainable way. The Fight to Preserve the Bollana Wetlands presents a case study of how citizens took action to save a local environment from over-development. Other related items of possible interest include: Mine Restoration and Area Strip Mining.

FYI: I've set up playlists on myHippo page at the new HippoCampus site to match all of these blog activities for your convenience.

Even though your students may not have direct exposure to mining operations, other than the many historic towns that come to mind initially (Leadville, CO for example), there are many active operations globally. See what's closest to home on the USGS Mine and Mineral Processing Plant Locations map – and then see if your students agree with the practices and policies in place there today!
**Great Buffalo Shortage**

**Topic** Resources (Restoration)

**Objectives**
- Show the cost-benefit determination of a mining operation.
- Analyze environmental impact of prolonged mining on profitability.
- Justify decision to continue old methods or to develop new options.

**Duration** 35-45 minutes depending on depth of discussion

**Assessment Type** Formative

*Students tend to believe that mining always produces a profit. They may not know about the regulations governing mining and requirements for land management or how to weigh the yield.*

**Materials**

- Large box (1m x 50cm)
- Styrofoam packing materials to fill the box
- 20 household sponges cut into 2cm cubes

**Set-up**

Materials taken from the earth are only designated as ‘ore’ if the mining operation is profitable. The environment is not destroyed by modern and responsible mining practices. The land is simply altered for another use. In fact, the future use of the land is designed and planned prior to mining; the government requires contractors to establish an Environmental Protection and Enhancement Program before mining begins in order to protect the environment. In this activity:

- the box filled with Styrofoam represents the earth;
- the sponges represent nuggets of the target ore;
- 10 seconds represents 1 year;
- it takes 10 nuggets of ore per year to make a profit; and
- miners who are careless about ecology (as indicated by the mess on the floor) will be assessed a damage tax of 20% of their total production for that year.

**Instructions**

1. Each miner has 10 seconds to get as much ore as possible using his/her non-dominant hand.
2. In the first year there is one miner. Be sure to record the number of nuggets mined on your graph. *Do not return the nuggets to the earth.*
3. The second year, there are two miners. Graph their total production.
4. The third year, there are four miners. Graph total production for each year.
5. The fourth year, there are 8 miners.
6. Continue doubling the number of miners until the total production rate drops to about what it was the first year. For example, the fifth year, there would be 16 miners.
Notes

Depending on the size of the miners 16 or even 8 miners may not be able to reach around a box. You may want to assign a ‘scribe’ to each miner to collect and count the ore. You can also designate students to play the part of the EPA official to make sure that the amount of destruction is accurately noted.

You may choose to have one graph per miner. You can then combine the individual graphs so that students can see all the data.

Discussion Questions

- Explore the components:
  - What type of resource were the nuggets, renewable or non-renewable? *How do you know?*
  - If each year the nuggets had been replaced in the earth, what type of resource would they be? *How do you know?*
  - If oil is like the nuggets, what will happen if we all use as much as we want?

- Examine the data:
  - What was the largest number of nuggets per person mined?
  - What was the smallest number of nuggets per person mined?
  - What is the relationship between number of miners and available resources?

- Should you keep mining in that way at the locale?
  - List the costs.
  - List the benefits.
  - Adjust for any fines.

- If there had been no environmental damage tax, what would have happened to the environment?

*Reality Check!* Evaluation

☐ Did students correctly determine the cost-benefit of their individual mining operations (boxes)?
☐ Did students reasonably analyze the environmental impact of prolonged mining on profitability?
☐ For each of the scenarios, could students justify their decisions
  - to continue old methods?
  - to develop new options?
  - to shut down the operation?
Internalizing “the Worth of Water”: Human Hydration and Water Conservation

If you drive over 800 miles across Texas (west to east) along Interstates 10 and 20 and 30, you can’t help but notice the differences between ecoregions as you move from the Chihuahuan Desert of El Paso to the Piney Woods of Texarkana. Having experienced that continuum of increasing annual precipitation (and being a native Texan), I’d almost bet my brother’s pickup truck that you’d find an almost direct and inverse correlation of location to attitude toward water conservation. I don’t even want to think about the real numbers for actual action at present.

As Benjamin Franklin said way back in 1746, “When the well is dry, we know the worth of water” (Poor Richard's Almanac). Depending on where and how your students live, they may not appreciate the critical importance of fresh drinking water - and I mean critical as in life-support. Most of the water on our planet is contained in two areas that most people can’t readily access or use. And on top of that, all of the water that is on this planet is the same water that we’ve always had! The Water, Water Everywhere! activity shows how very limited the water that we have to use is relative to the total supply.

Used as a diagnostic assessment, this hands-on exploration adds an urgent perspective to protecting and conserving our precious water – and all natural – resources. And since March 11-17 is National Groundwater Awareness Week this year, the EPA's Learn the Issues
page on Water is a terrific place to start all sorts of investigations that ought to have a great deal of personal relevance to your students! With activities for all ages, students can find out how water is stored in an aquifer, how groundwater can become contaminated, and how this contamination may end up in their drinking water!

**HippoCampus Connections:** You can also incorporate these resources from the HippoCampus site in a variety of ways! The **Water Cycle exploration** in NOAA: Water Cycle graphically shows where water accumulates in the water cycle – and how it moves through the cycle. The **Global Impact video**, also in NOAA: Water Cycle explains how water pollution threatens our relatively scarce fresh water supply. Similarly, **Water Resources** illustrates what happens to fresh water within a watershed. The **Water Distillation** video shows how pond water, sea water, and tap water can be purified. And the **Wastewater Treatment** video describes how we are reclaiming reusable water resources.

**Instructor Notes:** Click here to see how Dr. Fred Fifer helped Texas science teachers learn how to integrate the **Water, Water Everywhere!** activity into their classroom teaching. He goes on to show how this experiential training activity can lead to discussions on how this experience can help all understand the term ‘variable’ and the importance of water conservation.

Researchers estimate that half of the world's population is chronically dehydrated. And in America, that level is thought to be even higher at 75 percent of the population. According to WebMD, “Dehydration can occur in anyone of any age, but it is most dangerous for babies, small children, and older adults.” Check out the **Hydration Calculator** to figure out how much water your body requires to function properly. To see how much your students have internalized, challenge them to create an ‘infographic’ of the benefits of hydration – along with the percentage of water in their own bodies! Here’s an example to help sustain your flow of creativity…

**Posted by Rebekah Nix at 5:00 AM 1 comments   ▶ 2012 (3) ▶ March (1) Internalizing “the Worth of Water”: Human Hydratio... ▶ February (1) ▶ January (1) ▶ 2011 (7)**

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Most of the water on our planet is contained in two areas that most people can’t readily access or use. All of the water that is on this planet is the same water that we’ve always had! This activity shows students how very limited the water that we have to use is relative to the total supply. It adds an urgent perspective to protecting and conserving our precious water – and all natural resources.

Set-up

In advance, prepare ‘distribution cards’ with six areas (large enough to accommodate one container) labeled as indicated in the figure.

Materials

- 6 small containers (i.e. plastic condiment cups)
- distribution card
- dropper
- water supply

Instructions

1. Place one container in each of the six areas on the distribution card.
2. Use the dropper to count 100 drops of water into the "Total Supply" container. Each drop is proportional to one percent of the earth's water.
3. Your task is to remove each drop from the total supply and place it in one of the location containers. When you are finished you will have a representation of the world distribution of water.
   a. Hypothesize on what percentage of the earth’s water (number of drops) is stored in each location.
   b. Use the dropper to move that many drops of water from the total supply to each category.
   c. Indicate your estimated values on a bar chart as shown below.
4. As instructed, use another color to mark the actual percentages of water in each location.

Notes

Students may also perform this activity using 1000 drops in the "Total Supply" rather than 100 drops. This changes the math slightly, but allows more accurate allocation of resources.

Timesaver! For the total supply, instead of counting out 100 drops students can measure 100 mL and simply show the relative amounts in each area (without the impact of the depleted total supply).

Actual percentages are generally reported as follows: Glaciers = 2%; Lakes/Rivers = 0.02%; Air = 0.001%; Groundwater = 0.6%; and Oceans = 97%. Have students display/share their data prior to revealing the actual numbers. This allows students to confront their misconceptions.

Discussion Questions

- For which area was your guess closest to the actual?
- Which of these locations contain that water that we use for drinking?
  - Why are these the only sources of fresh water?
  - How do you think modern technology affects our water supply?
  - What steps must we take to protect these supplies?
- What are some methods that could be used to make fresh water more accessible?
- Although water is a renewable resource, why should care be given to avoid polluting any water source?

Reality Check! Evaluation

☐ Did student’s estimates of earth's water distribution sum to 100%?
☐ Did they reasonably compare their hypotheses to the actual allocation of earth's water?
☐ Were water resource management strategies discussed in terms of meeting local demand with the projected supply?
Raising the proverbial bar: Upcycling ‘waste’ with technology-supported design

Good educators are experienced designers. The research shows that the teacher is the single most important variable in any classroom! Among so many other distractions, you are responsible for the learning environment in which you teach and your students learn. No need for any qualifiers there… they are always learning something; hopefully that new life experience includes something from your lesson plan.

Great educators have mastered the magic of minimizing ‘waste’ in terms of time, tools, and especially, non-essential effort. (That’s why it’s not at all surprising that we share this common interest in HippoCampus!) Engaging today’s students in yesterday’s classrooms can be a challenge indeed. In fact, it’s an uphill battle at times! But thankfully recent trends in teaching and learning are encouraging creativity in the classroom – for both teachers and students finally! Problem-based learning centered on real-world issues is one of the ways we can challenge learners to maximize their unique potential.

I was fascinated by the universal implications of upcycling as explained in Cradle to Cradle: Remaking the Way We Make Things (2002) by William McDonough and Michael Braungart. Far beyond the relatively simple recycling practice we ‘boomers’ practice, the goal of upcycling is to prevent wasting potentially useful materials by making use of existing ones. Of course, recycling is still a key component of modern waste reduction; however, students may not realize that it does not provide a long-term solution.

In contrast to the third component of the "Reduce, Reuse, Recycle" waste hierarchy, upcycling is a process that can be repeated in perpetuity of returning materials back to a pliable, usable form without degradation to their latent value – moving resources back up the supply chain. Upcycling requires innovative design and is likely critical
to maintaining a balance between consumption and availability in our current system. Hence, the new activity *Cycling Up Hill* was designed as a summative assessment! Click on the following image to download a copy.

I’m certainly not suggesting that reducing and reusing and recycling are a waste! There are many excellent tools and resources on the EPA’s Learn the Issues page on Waste. For example, *Individual Waste Reduction Model (iWARM)* is the consumer version of the *Waste Reduction Model (WARM)* created by the EPA to help solid waste planners and organizations estimate the energy and greenhouse gas emissions reductions from several different waste management practices. Extending the *Energy Watchers* activity, it explains the energy saved by recycling small quantities of common household products, rather than landfilling them.

**HippoCampus Connections:** As you’d expect, the HippoCampus site also includes relevant resources you can design into your lessons in a variety of ways! *A Modern Landfill* shows how landfills are created and illustrates the lasting change to the natural environment. The next option for garbage disposal is detailed in *Incineration*, which also contributes to landfills. The *External Costs* video explores relates the cost of pollution clean-up to private production costs and the overall economic and environmental impacts. The *Superfund* animation tells the story of Love Canal – and how waste dumping resulted in long-term health problems and government action.

**Instructor Notes:** If you have the time and resources, I think the *Cycling Up Hill* activity is a perfect fit for graphic animation as an alternative project outcome! Mashable offers a good summary of *Free Animated GIF Creators You Can Use Online*. I’m always looking for innovative ways to integrate new teaching techniques into the online learning environment, which adds the title of ‘instructional designer’ to my ever-growing list. If this aspect interests you too, you might want to check out *Design for How People Learn* by Julie Dirksen. In addition to practical information that can be applied immediately, she models a visually-rich presentation style that fits my classroom.
Sometimes seemingly off-task topics demand/deserve your attention. Leveraging those rare ‘teachable moments’ is never a waste of time. Knowing we made a unique contribution makes all the difference. Somehow, how we chose to orchestrate the physical, intellectual and emotional aspects of the learning environment makes having to deal with the tedious tasks of academic politics is worthwhile – and on occasion, priceless. **Thank you for the great work you do in putting together great lessons for our future problem-solvers!**
Cycling Up Hill

Topic  Design (Upcycling)
- Design a useful product from recyclable materials.
- Construct a prototype of the upcycled product.
- Compare and contrast upcycling and recycling.

Duration  2-3 class periods
Assessment Type  Summative

Recycling is a key component of modern waste reduction; however, students may not realize that it does not provide a long-term solution. In contrast to the third component of the "Reduce, Reuse, Recycle" waste hierarchy, upcycling is a process that can be repeated in perpetuity of returning materials back to a pliable, usable form without degradation to their latent value - moving resources back up the supply chain. Upcycling requires innovative design and is likely critical to maintaining a balance between consumption and availability in our current system.

Set-up
Explore current recycling programs in the local area.
Define upcycling and give a simple example.
Students should work in groups of 4-5 on this project.

Materials
- Variety of tools (scissors, shears, hammers, pliers, etc.)
- Variety of fastening materials (glue, tape, staples, etc.)
- Access to recyclable materials (plastic bottles, paper, aluminum cans, etc.)

Instructions
As a team,
1. Decide on a material to upcycle.
2. Collect as much of that material as possible.
3. Use the engineering cycle to create a useful item from those materials.
   a. Design
   b. Prototype
   c. Test
   d. Evaluate
Notes

If you explain the difference between upcycling and recycling then the students really don’t have to think about now to compare/contrast. So it’s better to simply give the definition of upcycling and an example of a material that has been upcycled (using a soup can for a pencil holder, for example). Once the students have actually developed a product, then in their evaluation of that product will determine if they have actually upcycled or recycled. At that point they can compare/contrast.

Our current handling of aluminum cans is close to a true upcycling model in that the aluminum can be melted down and turned into brand new cans, thus saving more than 90% of the energy needed to make new cans from the raw materials.

Timesaver! Ensure that teams can acquire sufficient recyclable materials or that you give students strict limits of the amounts of materials they may use.

Address technology standards in the reporting step by having students produce an infomercial or take a digital picture of their upcycled product and describe it for publication!

Discussion Questions

- How did your team come to consensus on what to create?
- Why is your upcycled product better than commonly recycled products made of the same material?
- What other non-recycled materials did you need? Could they be replaced?
- What did you need to alter from your original design to create a prototype?
- How did the changes you made from your original design impact your anticipated results?
- When should upcycling always be chosen over recycling?

Reality Check! Evaluation

☐ Students designed a practical product from recyclable materials.
  - At least 80% of the product is made from recyclable materials.
  - The new product is useful (justified from the team's perspective).
  - All stages of the design process were fully executed.

☐ Students constructed a prototype of the product.
  - The prototype is functional - or a reasonable 'fix' is provided for the next generation product.
  - The prototype provides useful information about the product design.
  - The team worked together to make a final presentation of their project.

☐ Students can compare and contrast recycling and upcycling.
  - Relevant examples of upcycled are noted.
  - Relevant examples of recycled items are noted.
  - Each member of the team can explain the difference between recycling and upcycling.
Ah, sweet Spring… that marvelous seemingly magical time of year when the trees leaf out overnight, the bulbs and bushes burst into full bloom, and everything awakens to a fluorescent yellow stickiness that makes many folks suffer miserably through the welcoming season. We tend to sense the air around us more this time of year because we can smell the fragrant aromas in the breeze and see the bright pollen that entices the insects to do their important work. In my area, the pollen count leads the weather segment most evenings this month. The other time of year we focus on air quality is fast-approaching. As increasing heat commands weather patterns, we will likely hear even more about critical ozone warnings while spectacular, yet bittersweet, sunsets intensify thanks to summer pollution.

Found all over the United States, particulates and ozone are just two of the six common air pollutants for which The Clean Air Act requires the Environmental Protection Agency to set National Ambient Air Quality Standards. Realizing that air is a critical resource that most of us take for granted, I decided to learn more. Virtually invisible, it is a difficult concept to master and a challenging topic to teach. As part of a Community Grant Program Award from the North Texas Clean Air Coalition, I created the A-I-R website to support the integration of hands-on, inquiry-based activities with current tools and resources to create a positive, technology-infused learning environment. The Air Lift! activity is one way we helped lifelong learners kinesthetically test the force of air pressure. Download the instructions by clicking here or on the image.
Your students can find out about current air quality trends on the EPA's *Where You Live* page.

**Instructor Notes:** The *Air Lift!* activity could be leveraged as a cross-disciplinary link to physics or even technology when it comes to measuring air pressure and quality. The first thing I did at those summer workshops was to set up a CO2 probeware experiment to measure a cricket's respiration. Like in a magic show, I made it ‘clear’ that there was ‘nothing’ in the stoppered bottle but the cricket. After our lunch break, we studied the resultant graph that definitely indicated something more was happening!

A few years later, I used that same ‘trick’ to get the attention of a diverse crowd at the Texas Aquarium and Zoo Educator annual meeting one year where we focused on ‘measuring the invisible’ in terms of educational research. FYI, in each case, we celebrated the cricket’s release back into the wild before any harm came about to any of the participants.

**HippoCampus Correlations:** There are several excellent resources on the HippoCampus site too! Among others, *Photochemical Smog* illustrates how air masses can become inversion layers and trap air pollution in an area. *Earth’s Atmosphere* describes the varying layers and air pressures surrounding our planet. *Air Movement* describes how air pressure and temperature differentials affect wind patterns. *Climate Systems* explores the potential regional effects of changing water and air currents.

*Remember that you can use the activity-based playlists on my Hippo page for quick access to each of the media files referenced in these posts!* Also, you can use the links on the SRCpage archive to access the PDF activity files directly.

The A-I-R on my website stands for *Action-Interaction-Reaction*: **YOU are THE key!** Environmental action begins with environmental literacy. By providing teachers with the content knowledge, pedagogical skills, and technology tools needed to make a positive impact in their classrooms, we can encourage action – interaction – and reactions to air quality issues. Focusing on ecological knowledge, and social and political knowledge, and sustaining environmental resources in a personally-relevant context will develop the critical foundation required for action. Coming round full circle to the good/bad news noted in my first post, as John Muir put it: “When we
try to pick out anything by itself, we find it hitched to everything else in the universe.” The Wind Map project (which will blow you away) is one way to visualize the interconnections that flow throughout this wonderful topic of Environmental Science. *How do you cleverly teach critical concepts so that your students internalize them today?*

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Although air is generally invisible, it has mass. This mass, being pulled to the planet by gravity, gives air weight, allowing it to press on the earth. The weight is referred to as air pressure. Air also has density, which is determined by temperature. For example, cold air is denser than hot air. Weather changes with air pressure. A barometer is designed to measure air pressure and predict the weather. Students cannot feel air pressure on their skin, thus may not realize that air has mass.

Set-up

Assign 2-3 students to a team.

Materials

- Small plastic bowl
- Sandwich bag
- Rubber band
- Ruler

Instructions

1. Make sure that your bag has no holes in it.
2. Put the bag into the bowl so that it covers the entire inside and bottom. The edges should hang slightly over the edges all around the top.
3. Put the rubber band around the top of the bowl so that it holds the plastic in place securely.
4. Predict:
   a. What will happen when you grab the plastic on the bottom of the bowl and pull up?
   b. Will the plastic pull up easily?
   c. Will it stick to the bottom of the bowl completely?
5. Try gently lifting the plastic off of the bottom of the bowl. Be careful not to tear the plastic.
Notes

For this to work properly, all of the air must be pressed out from between the bag and the bowl. It helps to use a soft cloth (i.e., hand towel or sweater) to press the bag into the bowl. Provide bowls with a rim if possible as it’s easier to position the rubber band along the edge.

Calculating the exact amount of air pressure on the plastic on the inside of the bowl is a rather complicated matter, since you must account for the bowl shape. However, for a rough calculation, consider only the bottom of the bowl. Measure the area of the bottom of the bowl, then multiply by 14.7 lb/in² (or 1 kg/cm²).

Discussion Questions

- What happened when you pulled on the plastic? Why did this happen?
- Can you actually see the air when you pull up on the plastic? What do you see?
- Does air have weight? How do you know?
- If air pressure is about 15 pounds per square inch, about how much air is pressing down on the plastic?
  - How could you calculate the amount of pressure on the plastic?
  - What does this have to do with lifting the plastic?
- What adjustments would we have to make in our lifestyles if air were weightless?

Reality Check! Evaluation

- Did students actually test the force of air pressure?
  - Did they create a pseudo-vacuum seal with the rubberband?
  - Did they compare their predictions to their results?
  - Were they able to repeat their results for each team member to experience?
- Did students understand that air was exerting pressure onto the bag?
  - Could they give examples of how air pressure on the plastic could be calculated?
  - Did they reasonably estimate the amount of pressure on the plastic?
  - Did they accurately measure the bowl?
  - Did they correctly calculate the air pressure exerted on the area?
- Were students able to speculate on changes in lifestyles as a result of weightless air?
  - We might need to live in an atmosphere enclosed area.
  - We might be able to run (fly, drive, etc.) faster since there would be no air resistance.
  - We might have to wear a breathing apparatus because the air was not held to the surface of the earth.
  - We might not use air!

Note: These are speculations ~ there are no wrong answers!