"Gotcha" Activities

Short activities to grab the attention of your students…

GK-12 Down to Earth Science

Visit our website at: http://gk12.asu.edu/

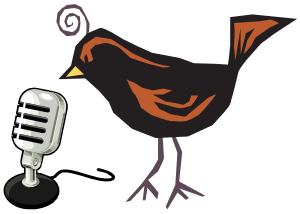
Authors: Arizona State University GK-12 Fellows 2009-2010:
Nathan Bakken, Erin DiMaggio, Sharon Kessler, Celena LeClair, Kaite Muto, Jonathon Oiler, Matt Rossi, Wandaliz Torres-Garcia

Program Directors:
Dr. B Ramakrishna & Jan Snyder, Ed.D.

Need and Purpose:
Students arrive to science class from various outside distractions. The purpose of our "Gotcha" activities is to GRAB the attention of ALL students and redirect them toward a single classroom learning objective.

Approach and Implementation:
Gotcha activities are short, engaging, and executed at the beginning of class. They are intended to be implemented within the first 15 minutes, can be tailored to grade levels and time constraints, are visually stimulating and/or relevant to "real-world" issues, and may serve as thought provoking activities to introduce complex concepts

Results and Conclusions:
These activities have been implemented in many of the Fellows' classrooms. We have observed success in the follows ways: 1) better in-depth understanding of the material; 2) overall positive feedback from students and teachers; and 3) increased student interest & interaction when introducing topics.



Activity 1: Knock Knock…Who's there?

Targeted Grade Level: any grade level depending upon the discussion that follows
Standards That Apply: adaptation, vocal tract anatomy, sound waves
Authors: Sharon Kessler (GK-12 fellow) & Trina Howard (teacher partner); Lowell Elementary School, Phoenix, AZ
Date: Fall 2009
Time Requirement: 10-20 minutes

Equipment/Materials:
- Download videos from Arkive.org:
    a. Howler monkey: http://www.arkive.org/mantled-howler-monkey/alouatta-palliata/video-13a.html
    b. Gibbon: http://www.arkive.org/white-handed-gibbon/hylobates-lar/video-13.html
    c. Indri: http://www.arkive.org/indri/indri-indri/video-13b.html
    d. Bat: http://www.arkive.org/greater-horseshoe-bat/rhinolophus-ferrumequinum/video-08.html
    e. Humpback whale: http://www.arkive.org/humpback-whale/megaptera-novaeangliae/video-03a.html
- Computer and projector

Procedure: (it is not necessary to play all of each video, short sections should suffice)
1. Play the videos without projecting them onto a screen so that the students can hear, but not see, the videos. Instruct the students to guess what animal it is and to guess its size.
2. Play the videos again, this time allowing the students to both watch and hear them. Point out to the students that the section of the bat video with the vocalizations has been slowed down to bring the sounds down into the human hearing range.

Explanation: This lesson can be used to introduce a variety of topics: the properties of sound waves, how animals are adapted to their environments, and how the vocal apparatus and respiratory systems produce sounds in different animals.

Activity 2: The confused Bottle Demo

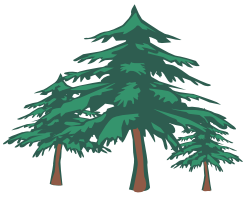
Targeted Grade Level: 9-12
Standards That Apply: Demonstrates convection
Authors: Celena LeClair (GK-12 fellow) & Kurt Ederer (teacher partner); Liberty High School, Peoria, AZ
Date: Fall 2009
Time Requirement: 10-15 minutes

Equipment/Materials:
-Four empty identical bottles (glass Starbucks frapuccino bottles work well)
-Food coloring
-A 3 x 5 card

Procedure:
1. Fill two bottles (A1 and B1) with cold and two bottles (A2 and B2) with warm water (do not reveal to students the temperature difference).
2. Color the water in bottles A2 and B1 with a few drops of food coloring and mix the color evenly.
3. Cover the bottles A2 and B1 with a small piece of the paper card, and place them upside down on the colored bottles (one finger on the card will keep the water from spilling while turning it upside down. Center the bottles A2 and B1 carefully over A1 and B2 and slip out the piece of card by holding the top bottle).
4. Let the students observe what is happening to the color

Questions to initiate discussion: (1) Why did the top bottle B get colored and not bottle A? (2) Do you think the temperature of all four bottles of water was the same? (3) Which of the four bottles were warmer? (4) Does bottle A2 ever get colored? If so, when? (5) What would happen to the color if the temperature of all four bottles were the same?

Explanation: The water in bottle A1 and B1 was cold and that in A2 and B2 was warm. Warm water is lighter in weight or less dense than cold water and thus rises. Since the warm water in B2 was colored this water rises into the top bottle and the cold water sinks bringing with it convection currents. As the water in A2 is warm and already above the cold water in A1, no convection is occurring in this set of bottles and thus no coloring of the top bottle. When the water temperature of this top bottle gets to be equal to that of the lower bottle, diffusion of the color will occur, but convection does not. This process is much slower than convection and is caused by the constant vibration of molecules.



Activity 3: How many trees does it take to offset us?

Targeted Grade Level: 9-10
Standards That Apply: AZ Strand 4, Concept 5: Matter, Energy, and Organization in Living Systems
Authors: Katie Muto (GK-12 fellow) & James Jaeger (teacher-partner); Deer Valley High School, Peoria, AZ
Date: Fall 2009
Time Requirement: 15-20 minutes
Equipment/Materials: N/A

Procedure:

1. View one or more of these videos:
   - http://www.johnkyrk.com/photosynthesis.html
   - http://www.fw.vt.edu/dendro/forestbiology/photosynthesis.swf
   - http://www.brookings.k12.sd.us/biology/photosynthesis.htm

How can we use photosynthesis to our advantage?

Answer the following questions:

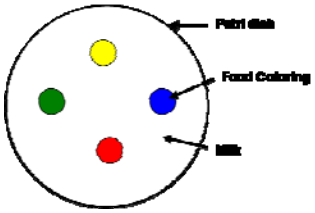
a. How many total acres of trees are needed on the earth to sequester the carbon produced each year?
b. How much total carbon is produced (industry, people, and cars)?
c. How many trees for that much carbon?
d. How many acres for the number of trees determined?
e. Is that a feasible number for the planet?

Givens: (1) The total carbon emissions (human, cars, industry) are 2.5×10^{13} lbs each year; (2) One tree sequesters or takes in 1lb carbon each year; (3) There are 20,000 trees/acre, there are 36,800,000,000 total acres on earth available for planting

Explanation: How can we apply the photosynthesis to real world problems, like global warming? Knowing how much carbon is produced each year, we can determine how many trees are required to offset that amount. We can then apply the number of known trees that occur in an acre to that figure in order to determine how many total acres are needed to offset the carbon emissions. In comparing that to the number of acres on the planet, we can determine if this is feasible or not.

Activity 4: The magical, mystical milk demo!

Targeted Grade Level: K-8
Standards That Apply:
Author: Erin DiMaggio (GK-12 fellow) & Charlie Kidder (teacher partner); Willis Jr. High, Chandler, AZ
Date: Spring 2010
Time Requirement: 20 minutes on day 1; 10 minutes on day 2 (optional)



Equipment/Materials:

- 200mL 2% Milk
- Food Coloring (Red, Green, Blue, yellow)
- 3 Petri Dishes
- Eye Dropper
- Dish soap

Procedure:

(1) This activity works the best if done on an overhead projector or a document camera that projects to a screen. On a sheet of paper have your students write the following headings, skipping 4-5 lines in between headings: Hypothesis, Observations, Results, and Conclusion. On the other side of the paper have them write: Variable changed: and New Hypothesis.
(2) Place 1 petri dish under the document camera. Fill the petri dish ~75% full with the milk. Place one drop of each food coloring color ~1cm away from the edges of the petri dish (see diagram). Tell the students that you will now use the eye dropper to add one drop of dish soap in the middle of the food coloring drops. BEFORE adding the soap, ask the students to write a hypothesis for this experiment following the format (If..., then..., because...). Select students to read their hypotheses to the class.
(3) Add 1 drop of soap to the middle of the food coloring drops and ask them to record qualitative and quantitative observations. The colors will begin to swirl in the milk and look really neat. In the "Results" section, ask the students to write 1-2 sentences explaining what exactly happened (example: When soap was added to the milk & food coloring...). Next, in the conclusion section, ask the students to write a sentence stating if their hypothesis was supported or unsupported based on the results of the experiment. (4) Discuss what the variables were in this experiment and ask each student think of one variable they would like to change (example: use different % milk, use water rather than milk, use different brand soap). Write a list on the board of all the variables students think of and have them vote on one. (5) The next day at the beginning of class ask the students to write their 'New Hypothesis'. Repeat the new experiment along side the exact milk experiment from the previous day (for control).

Explanation: The purpose of this activity is to practice and familiarize students with the process of the scientific method, which is an objective in most science curricula. This activity can also be used as a full hour laboratory by having small groups of students conduct the experiment, rather than an instructor demonstration.

Activity 5: Blue Skies and Red Sunsets?

Targeted Grade Level: 7th grade, space science unit
Standards That Apply: keywords: Sunlight, atmosphere, blue sky, red sunset,
Author: Jon Oiler (GK-12 fellow) & Eric Nedow (teacher partner); Payne Jr. High, Chandler, AZ
Source: *CHEMICAL DEMONSTRATIONS: A Handbook for Teachers of Chemistry*, Volume 3, by Bassam Z. Shakhashiri, The University of Wisconsin Press: *http://scifun.chem.wisc.edu/HomeExpts/BlueSky.html*
Date: Fall 2009
Time Requirement: 10-15 minutes

Equipment/Materials:

- Large transparent container with flat/parallel sides
- Enough water to fill the container
- 1 cup of milk
- Flashlight

Procedure: Fill the container with water. Turn on the flashlight and aim the beam so that it shines through the container filled with water. Have the students view the container from the side and from the end looking back toward the flashlight. Ask them what colors they see from both locations? Try to observe whether you can see the beam in the container. It should be difficult to see the beam travel through the container. Now, add 1/4 c. of milk to the container and stir. Aim the beam through the container again. Record what color you see from the side view and what color you see looking into the beam, straight back toward the flashlight. From the side it should appear slightly blue, and looking toward the flashlight it should like yellow. You should also be able to discern the beam in the container. Add another 1/4 c. of milk and repeat observations. The side view should appear slightly more blue and the end view more orangish. Add the rest of the milk and observe. You should see yet bluer on the sides and more red from the end.

Explanation: When you added milk to the water, you added many tiny particles to the water. Milk contains many tiny particles of protein and fat suspended in water. These particles scatter the light and make the beam of the flashlight visible from the side. Different colors of light are scattered by different amounts. Blue light is scattered much more than orange or red light. Because we see the scattered light from the side of the beam, and blue light is scattered more, the beam appears blue from the side. Because the orange and red light is scattered less, more orange and red light travels in a straight line from the flashlight. When you look directly into the beam of the flashlight, it looks orange or red. What does this experiment have to do with blue sky and orange sunsets? The light you see when you look at the sky is sunlight that is scattered by particles of dust in the atmosphere. If there were no scattering, and all of the light travelled straight from the sun to the earth, the sky would look dark as it does at night. The sunlight is scattered by the dust particles in the same way as the light from the flashlight is scattered by particles in milk in this experiment. Looking at the sky is like looking at the flashlight beam from the side: you're looking at scattered light that is blue. When you look at the setting sun, it's like looking directly into the beam from the flashlight: you're seeing the light that isn't scattered, namely orange and red. What causes the sun to appear deep orange or even red at sunset or sunrise? At sunset or sunrise, the sunlight we observe has traveled a longer path through the atmosphere than the sunlight we see at noon. Therefore, there is more scattering, and nearly all of the light direct from the sun is red.

Activity 6: Marbles Motion

Targeted Grade Level: 8
Standards That Apply: Strand 5: Physical Science; Concept 2: Motion and Forces
Grade 8: PO2.
Author: Wandaliz Torres-Garcia (GK-12 fellow) & Joe Corbett (teacher partner); Parkridge Elementary School, Peoria, AZ
Date: October 2009
Time Requirement: 5-10 minutes

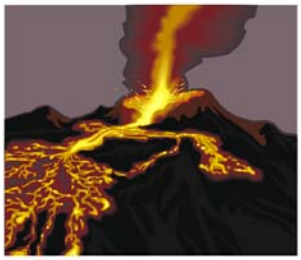
Equipment/Materials:

- 8 marbles
- 1 ruler with a long divot down the middle

Procedure: Place 5 marbles in the middle of the ruler. (The ruler canal will help the marbles stand and move when force is applied to it.) Place another marble at one of the ruler ends and roll it slowly towards the 5 marbles standing still in the middle. What happens as the marble touches the marbles in the middle? Repeat previous step rolling two and three marbles towards the 5 marbles in the middle. What happened? Why are they reacting in this way?

Explanation: This simple demonstration shows Newton's Laws of Motion (all the of them: Inertia, F=MA, and Action Reaction). One marble is rolled towards the 5 marbles in the middle of the ruler. When it touches the first one of the five the last marble standing should move away from the center. When two marbles are rolled towards the 5 marbles and touches the first one of the five the last two marbles standing should move away from the center. When three marbles are rolled towards the 5 marbles and touches the first one of the five the last three marbles standing should move away from the center. The three motion law's are

explained as followed: (1) Inertia: The marbles will stay still until a marble(s) with a force changes their current state; (2) F=MA: Increasing the number of marbles increases the mass and therefore the forces that acts upon the marbles in the middle; and (3) Action Reaction: The forced exerted from the rolling marble(s) is equal and opposite to the reaction force shown through the movement of the last marble(s).



Activity 7: Where does magma go?

Targeted Grade Level: 6-9 Earth Science

Standards That Apply: Strand 6: Earth and Space Science (Concept 1: Structure of the Earth (PO 3: Explain the following processes involved in the formation of the Earth's structure: erosion, deposition, plate tectonics, volcanis)

Authors: Matt Rossi (GK-12 fellow) & Alison Cambell (teacher partner); Paseo Hills Elementary, Deer Valley, AZ. Adapted from Nir Orion *(person. com...)*

Time Requirement: 10-15 minutes

Equipment/Materials:

- 500 mL glass beaker
- 1" melted paraffin wax
- 1" sand
- 300 mL of water
- Point heat source (Bunsen burner works best)
- Stand

Procedure:

1. Setup: Make a layered model of with the wax at the bottom, sand on top, and water. The water is very important for safety. Otherwise the heated sand may cause small explosions. --CAUTION: This demonstration requires an open flame. You can adapt this demonstration such that it is an experiment that student groups perform themselves depending on the setup and safety protocols of your classroom environment.—
2. Have students predict what they think will happen to the wax once the flame is applied. They will likely say that some of the wax will melt. Encourage them to think further. Suggested prompts: (1) Where will the melted wax go? (2) What will happen to the melted wax if moves?
3. You will want to apply the heat source underneath as small a portion of the solid wax as possible. The weight of the sand will prevent the melted wax from immediately rising to the surface. Instead, as the buoyant melted wax starts accumulating it will try to erupt at the surface. Some of the wax will eventually flow through pore spaces of the sand. At this point you may see any of five different kinds of phenomena:
    a. Very small wax 'blobs' escape the sand layer and quickly rise to the surface where they cool.
    b. Wax will 'erupt' through the sand and form a large 'island' at the surface. Often the path the wax took will also cool quickly enough that the wax at the 'island' of wax will be connected to the 'magma chamber' by a long 'neck.'
    c. Some wax will 'intrude' into the sand layer but cool down before it can erupt.
    d. Some sand will mix with the melted wax in the 'magma' chamber.
    e. Once the heat source is removed, the melted wax will re-solidify.

Explanation/Discussion: As with any physical model, you will want to probe students as to what the different parts of this model represent (wax—melted rock at depth; sand---overlying rocks). While the water is needed for this model to cool down the wax quickly and lubricate the sand, there is no physical analog on Earth. It not intended to represent the ocean!

This demonstration is useful for introducing: Igneous rock, Intrusive versus extrusive rock, Key words: magma, eruption, dike, magma chamber, volcanoes, volcanic neck, volcanic islands.