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Ideas for enhancing primary and high school science education

Did you Know?

Each cubic kilometre of seawater contains about 4 kg of dissolved gold.

Science Story

Skin Colour Change

During the 1700's, women in some parts of the world used a preparation containing bismuth to give their skin a fashionable, chalk-white appearance. One young lady, so prepared, decided to bath at the spa town of Harrowgate, England. To her great surprise, her skin turned black! She reportedly shrieked and fainted, as did her gallant escort.

The problem was solved, though, by simply using soap with hard scrubbing. This removed both the black colouring and the lady's anxiety. The relevant chemistry may be written: $2Bi(OH)_2NO_3 + 3H_2S \rightarrow 2HNO_3 + 4H_2O + Bi_2S_3$.

Using Primers to Motivate Your Students

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Abstract

Primers are used to motivate and uplift your class. They come in many different styles and can be used in a variety of ways. Making primers relevant to students helps them to learn and makes them feel appreciated and knowledgeable when they participate. Using primers in the classroom to make students feel valued brings much success.

Imagine a classroom where the students were excited to learn and anxious to come to class each day, readily participating in discussions and sharing thoughts and ideas with one another. What if students were as excited to learn as the teacher was to teach? Wouldn't it be great if students even contributed to the lesson for the day, bringing materials to share with the rest of the class that are relevant to students at his/her age or ability level?

Does this sound too good to be true? It's not! We, as educators, simply need to find that "spark" for our students. We need to vary our approach to teaching and learning and involve students in any way we can. The learning has to be relevant to their lives and the world around them for students to see the need to learn the material we are teaching (Phillips, 2001). For our purposes, primers are defined as that which prepares or encourages future action or learning, and may be just what you've been looking for in your classroom.

Perhaps students are not a lot different to adults. Think about what gets you excited about learning when you enter a classroom. Is it a special experience you've had via a workshop, a life experience, or seminar? Is it what you see, feel, or hear? Is it the enthusiasm or expertise of the instructor or leader? Is it a demonstration or a "show and tell"? Is it because you're with friends or you have a lot of fun and challenging technology at your disposal? It's probably a combination of a lot of these, and more, for us as well as for our students! This article will address many of the various primers I use in my classroom and why I use them. My hope is that the reader can use these ideas to spark his/her own ideas for motivating his/her own students.

Ideas or activities for motivation include ice breakers, demonstrations, stories, Show and Tell, videodisc pictures or short video segments, microscope camera, Internet photos, articles, questions (teacher or student), share what you know, comments, brainstorming, and magic/tricks. Primers are used to break the ice, reach standards, motivate, change or bring different ideas, reach various learning styles, find out what they know, spark curiosity, get everyone involved, avoid boredom, make students feel good about what they know, and get students excited and ready to learn.

Icebreakers are especially good at the beginning of a new term because they allow students to meet each other and feel more comfortable in their new learning environment. They can be used with any grade level, and in any content area. I use several kinds in my high school biology classroom, depending on the group and time available. For example, in my cell biology class, I give students a diagram of a typical cell and we label the organelles together. This is followed with a discussion of treating others with respect - an important component of a successful classroom. Next, the students go around the room and make a positive comment to someone else, and ask if that person would be a cell organelle buddy. Each pair of students exchange names and write them next to an unsigned organelle, thus becoming

nucleus buddies, golgi buddies, and so on. Students continue doing this until they have one different name signed next to each organelle. After getting the required number of buddies, they return to their original seats and I explain that this "buddy" sheet will be used for future partner activities. If we do a lab the next day, I may say "use your nucleus buddy," giving students a random way of picking lab partners instead of always picking their friend(s). Students learn about the parts of a cell and the value of being positive toward others, and become more comfortable in their learning environment.

Similarly, in my Aquatic Ecology Class, I use an icebreaker called "Raining Cats and Dogs." Students pick a water-related phrase such as sink or swim, wet your whistle, sandbagging, get your feet wet, and so on, and then have to draw a picture on an index card that reflects the phrase they chose. The teacher has to ensure that no two students use the same phrase. When everyone has finished their drawing, students walk around the room with a copy of the phrases and their picture, share what they drew, and guess which phrase the other student is trying to depict. They write the name of the person who drew the phrase on their paper in the blank next to the phrase. This allows them a chance to get to know each other and usually stimulates many questions about water.

Primers can also initiate effective discussions. For example, one day I had two adult mice that had babies, and the next day students had to close their eyes and hold their hands open. I put a baby mouse in each student's hand and they had to figure out what it was without looking. They loved it and it led to a huge surge of questions. "How many babies do they have? What do they weigh? How often do they have babies? How much damage do mice cause? Where is the hair? Won't they die if I touch them?" Students are motivated without realizing it. One day a curious student brought in a fat perch (I ask students to bring things in all the time to share or ask questions) and wanted to know why it was so fat. We squeezed it and milt (fish sperm) came out. We put a sample on a slide and showed the entire class live fish sperm swimming around under the microscope camera. Wow, did this ever bring a wave of discussion! With the help of my students, I have collected well over 500 different kinds of specimens, which I put on display in my room. Collected specimens include over 50 preserved skulls, several preserved organisms including fetuses, hundreds of seashells, beehives, feathers, hair, skins, pelts and more. Students love bringing in what they have found in nature. At the beginning of a lesson I may grab a piece from my "specimen collection" and have each student write down a comment or question, from which I then choose at random to answer. These are all great Show and Tell items, sometimes from our own "backyard."

There has been a tremendous amount of educational research done on learning styles and it has been found that no two students learn in exactly the same way (Jenson, 1998; National Research Council, 2000). This can be addressed nicely by varying the

primer activity. For example, ask students to draw a picture of photosynthesis, or write down what they know about a starfish. Ask them to tell what you could find in a cigarette, or play a song and have them write down how it is relevant to what we are doing. To reach every student you must change and do different things everyday. You may spark the interest of a deeply abstract creative type of brain without reaching the visual, kinesthetic type of mind. By changing and adapting everyday you will reach all learning styles.

I do not believe that primers have to coincide with a specific lesson you are presently teaching. Good teachers never let a teaching moment escape. One of my students totaled her car in a drinking-related accident and wanted to pass the message on to her classmates not to drink and drive. We had a heartfelt discussion and then I showed some graphs and charts off a videodisc specifically related to what happens biologically when you drink. This led to discussions on blood alcohol levels and much more. Again, I probably didn't reach every student, but maybe I saved a life. Have you ever wondered if anything you've told your students has been life saving? I think about it all the time and really believe we make a huge difference in the life of a student. Primers can be related to the seasons. Why do fall leaves turn colors? What makes snowflakes different? Capitalize on students' curiosity.

Make use of current events in your primers. Students often wonder about the world around them and what they hear in the news. For example, the attacks of September 11th provided an example of a teachable moment. We discussed decaying bodies, search dogs, building materials, DNA identification, and much more. I sometimes also will use date-specific primers such as Earth Day or Arbor Day to remember a famous scientist or major event. Many primers are also lesson specific. For example, I may walk around the room with an open container of perfume to demonstrate diffusion. I may show a model of something we're going to make that day, or perhaps I'll have a student read a poster related to our topic. The possibilities are endless!

Many times teachers get into a routine where they do the same kind of thing from day to day without thinking about what the students are getting from it. By doing various kinds of primers, it forces you to do different things. It tends to keep you "sharp" as you prepare and deliver each and every lesson. I have found that my enthusiasm for the topic is often contagious with the students, especially when the topic is made relevant to the lives of the student(s). Sometimes I'll even ask students to write about how some topic we discussed was relevant to them. This may be especially relevant when dealing with a sensitive topic such as the lesson on drinking, or when reading an article on anorexia or bulimia. It is good to let students give you ideas for primers or deliver them themselves. Students may bring in deer antlers, and we discuss nutrients, genetics, and so forth. This is a good chance for extra credit and many times students will let you know what is relevant to them. It

gives you more ideas. Many of the primers lead to curiosity and a lot of discussion and follow-up questions.

One of the standards in the National Science Education Standards (National Research Council, 1996) reads: " The program of study of science for all students should be developmentally appropriate, interesting, and relevant to students' lives; emphasize student understanding through inquiry; and be connected to other school subjects" (p. 45). By adding primers you certainly meet that standard as well as many more. Many times we reach so many standards that it's impossible to keep track of all of them. With primers, you're generating and encouraging curiosity, as well as challenging students to accept and share responsibility for their own learning. As a matter of fact, the students are usually having so much fun that they don't even recognize they're learning! The bottom line is, no matter what you do, you are going to reach students and you are going to address the standards.

It is critical to get everyone involved in the primer activities, and there are some important things to remember. When you ask a question, give plenty of wait time. Have all students write a question down, or write a comment, or let all of them see something up close rather than just standing in front with a small specimen and talking about it. Walk around with the specimen, or have them get up for a closer look. If appropriate, allow students to touch the specimen. Perhaps the students could team up with a neighbor or two to discuss something relevant to the topic. There are many ways to involve all students, but the bottom line is that you need to figure out a way to get everyone involved. It is important to acknowledge and use student comments in the discussion, even if they're not especially insightful ones. This makes a student feel valued and that they're a part of something. We all know that there are too many kids today who do not get the support they need outside of school. It's up to us to make every attempt to bring out the positive things students have to offer, and in turn they will respond much better and take more ownership and pride in what they do. If we want students to succeed, we have to make them feel good about what's important to them. Primers will often help students realize they know more than they thought.

On the last day of each class I ask students to fill out an evaluation of the course. One thing that continuously rings out on these evaluations is that they love the primer activities. They tell me these activities motivate them to come to class. Some say they're really excited because they don't know what they will see or hear in class the next day. If all educators can use some sort of primer, even if it takes just a few minutes, you will motivate your students, increase their excitement about learning, bring relevancy to the curriculum, and promote higher student self-esteem. You will make them feel better about themselves and what they know. You will help foster success in their lives. These primers can come from almost any source, and many can be made up on the spur of the moment. You could tell a story, use the Internet, a

demonstration, or Show and Tell, or do just about anything to get a student excited about learning. What could be more important than getting all your students involved in your class, and making them feel appreciated and valued? By using primers, you will “raise the bar” for both your teaching and your students’ learning.

References

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Demonstrations

The Falling Cards

Needed. A deck of playing cards and a draft-free room.

Invitation. Hold a playing card in front of you, with the card in the vertical plane and its longer edges at the bottom and top. It is best to hold the card using your thumb and forefinger near the top corners of the card, so the card does not stick to them. Invite a student to come out, hold the card (engineer things so that he holds the card the same way you did, but without making a big deal of it), and drop it so that the card lands on the floor directly in front of him. This will be impossible. Give him a few trials, and try a few other students also.

Exploration. Tell students that it is possible to drop the card so it behaves as required, and invite further students to try. If necessary, hint that it may be productive to hold the card in some different way. The only way to achieve this feat will be to hold the card horizontally before releasing it. Ask students why the vertical orientation will not work.

Concept introduction. When the card is held vertically, it is impossible to release it in a perfectly vertical plane. The card is always slanted slightly one way or the other, and as it falls, one side of the card gets pushed harder by the air than the other side, causing the card to rotate to one side. When the card is held horizontally, the air flows evenly around it and it falls straight down.

Concept application. Invite students to devise a method for sorting cards, in this way, into three different piles. Each student in the class could even be given a card with which to experiment. They must be able to predict where a card will land before