Discrepant Events

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To find ideas for discrepant events obtain the book “Invitation to Science Inquiry” by the late Tik Liem. It is full of ideas to get students thinking in all areas of science.

1. Magic Book: This I first observed with John Fortman from Wright State U in Dayton Ohio. David Katz (see “Chymist.com”) is also known for using this type of book. From Jeff Hepburn, Urbandale, Iowa, I found out this is a book used by magicians. [Not only is Jeff a great chemistry teacher he is also a magician and uses magic in his classroom.] The pages of the book are cut at different angles so that if you open the book by flipping the top, middle, or bottom pages, blank, colourless or coloured pictures are exposed. There is nothing in the beakers, flasks or bottles that make anything appear. But it still can be a great introduction to acid base indicators.
2. The floating and sinking ice cube. One ice cube is placed in water, the other in ethanol. Both colourless liquids look the same in the beakers [odour is not the same.] Great for introducing density or Archimedes principle. Many sources.
3. Magic sand, Magic sand was introduced to Chem Eders in 1999 at the signature demo night. What is interesting is that Al Delfiner, a research engineer with GE, followed that presentation. Al’s wife was a high school chemistry teacher and the two would do demos together. Al invented magic sand! He was asked to come up with something to put into the plug ins of electric frying pans, griddles, woks, etc. that would repel water since people would end up getting the do not place in water plug ins wet. He came up with a method of coating sand with silicone [Silicone coated silica. The two are not the same.] The silicone coating is hydrophobic so does not wet in water. Great for introducing hydrophobic and hydrophilic using magic and silica sand. Can be used to model a cell membrane. Float on water and drop water on top. Even though there are many parts it still holds as a film. It will, if too much water is placed on top break. Read instructions for more ideas.
4. Eight sided paper, from Jeff Hepburn. Arrows are at 90 ^{o} to each other. How the card is flipped determines direction the audience sees. Challenge students to make one and repeat the pattern. Does take practice.
5. Rice cylinder full, then not full. Why? Volume of the cylinder is $v = \pi r^2 h$. The larger radius by rolling the acetate to have the lower height gives it the larger volume. Both David Katz and Pat “Funky” Funk use this one.
6. Alka Seltzer in a glass pull out a towel. Compressed dehydrated paper towels can be purchased at dollar stores cosmetic section or camping

stores [which is less expensive?]. The towels are the colour and size of an Alka seltzer tablet. The Alka Seltzer comes in packages of two tablets. Carefully open a package, remove one tablet and replace it with a towel tablet. The remaining tablet will fizz and when finished the towel can be pulled out. I use this one for observing closely and safety.

7. The Think Tube. Jeff Hepburn introduced me to this but there are many places this can be found. The tube has two strings that go through a washer inside. As the washer moves from one end to another it appears all strings are connected. This is a black box demonstration that gives evidence of what is inside without being able to see inside. Ask students to design a tube with string that will do what the tube does. Now go on to Rutherford and the metal foil alpha particle experiment. Even though the atom is too small to see, why did they come up with the conclusions that they did? [Note: Philip Lenard did a similar metal foil electron beam experiment in 1900. Hantaro Nagaoki of Japan almost made the correct conclusions based on the results of that experiment in 1902. He even anticipated Bohr and tried to explain atomic spectra based on his Saturnian model of the atom.]
8. The non-existent bottle. {From Tik Liem] Place a block in front of a lit candle. Blow at the block the candle stays lit. Replace the block with a bottle and blow at the bottle. The candle goes out. The wind from your breath can flow along the sides of the bottle but are blocked and will not flow around the block. Shows aerodynamics. How to improve fuel efficiency, why airplanes stay up and birds can fly.
9. Balance a pool Q on your finger, heavy end up and heavy end down. Which is easier? To maintain angular momentum, heavy end up is easier. This is why circus performers will balance the tall chair with someone sitting in the chair.
10. Pink to blue, blue to pink hot and cold. I found this in the old Toon and Ellis chemistry text. In hot the solution turns blue in cold it goes pink. The solution is cobalt(II) chloride hexahydrate dissolved in ethanol with water dropped in to have the solution turn purple. [Caution, it is very easy to add too much water.] This is to illustrate Le Chateliere's principle, "A stress on a system at equilibrium will cause the system to shift to relieve that stress." The system is:

    $Co(H_2O)_6^{+2} + 4\ Cl^- = CoCl_4^{-2} + 6\ H_2O$

    Add heat and it will go to the side with fewer bonds,[endothermic side] the blue tetrachlorocobaltate(II) side and be blue. Remove heat and it will go to the side with more bonds, exothermic side, hexaaquocobalt(II) side and be pink. Also add chloride and more $CoCl_4^{-2}$ will form to use up the chloride, turns blue. Add water and more $Co(H_2O)_6^{+2}$ will form and the system turns pink.
11. Complete combustion of acetylene [ethyne, C_2H_2] [Helps illustrate Avogadro's Principle of equal volumes of gases have equal numbers of

molecules, and gases at the same temperature and pressure react in volume proportions just as the mole ratio shows. Shows complete and incomplete combustion of a hydrocarbon. Shows air is not the same as oxygen, but is 1/5 oxygen.]:
Fill beaker with water in a sink to the top. Mark a test tube into 7 equal portions. Fill this test tube with water and seal it with a piece of wet paper towel Invert the test tube into the beaker. Pour off some of the water and add a piece of calcium carbide. The reaction between the water and the calcium carbide produces acetylene gas. Collect two sevenths of the test tube full of acetylene.

The formation of acetylene:

$CaC_2 + 2\ H_2O \rightarrow C_2H_2 + Ca(OH)_2$

Complete combustion of acetylene:

$2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$

The ratio of acetylene to oxygen is 2:5, seven total volumes, hence the division of the test tube into 7 parts. Lift the test tube mouth down out of the water and place it on the lab bench. Let it stand for a few minutes. Acetylene is less dense than air and needs time to diffuse through the air for ignition. Ignite a wooden splint and lift the test tube, mouth down and ignite the acetylene. *What happens?* A black deposit fills the test tube. Incomplete combustion took place!

$2\ C_2H_2 + O_2 \rightarrow 4\ C + 2\ H_2O.$

There was not enough oxygen to completely combust the acetylene. *Why?* Air is only 1/5 oxygen. How much air is required? So take the final division of seven on an identical test tube and divide it into five portions. Fill only two of these 1/25 with acetylene in the same manner as before. Let the mixture sit, then once again ignite the gas. Watch for a clean burn with a blue flame and a loud pop as the mixture explodes.

The calcium hydroxide formed can be seen as only slightly soluble. Filter the mixture and you will have limewater. Test by blowing your breath through a straw into the limewater. It will turn cloudy as the calcium hydroxide forms calcium carbonate, [even less soluble] with the carbon dioxide from your breath. [Sulfur dioxide will also form a precipitate with the limewater which does not clear up as it does with carbon dioxide, but the odour of sulfur dioxide will identify it.]