

pH Weird Science Experiment

- Pipettes
- Litmus paper or electronic pH testers
- Small containers each numbered (baby food containers work great)
- Any or all of the following listed below

Aspirin, Antacids (the white ones), white vinegar, baking soda, Sodium Bicarb IV, Citric Acid (can be purchased from hobby stores, pool shock (powdered form), distilled water, small amount of water with several drops of a clear soap stirred in to it, diluted bleach, etc..

Now have the students figure out, with litmus paper or pH testers, the chemical's pH and if it is an acid or a base. Encourage the students NOT to sniff or taste any of the chemicals. A snoot full of pool shock can damage mucous membranes!

Hints: Crush the solids into a powder so it isn't recognizable by the students. Don't forget to write down which chemical went in to which container so you will know the answers!

pH Weird Science

Please do not touch the used pH tester strips to the color charts on the packages.

This will ruin the whole guide.

Do not touch the pad on the end of the pH test strips. The acids on your skin will affect the test results from your solutions

*For the Dry Ingredients: Place a small amount (equivalent to a pinch) of powder in a clean plastic specimen cup and add about 1 tsp of bottled water. Swirl to combine and at least partially dissolve.

Step 1: Take a clean pipette and draw up a couple of drops of the solution and place on the colored pad on the end of the pH test strip. Wait 1-2 second and pour off the excess liquid onto your paper towel.

Step 2: Check the color against your color guide provided. Record the results below according to the number that was on the side of the container.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Respiratory Effort

- PVC pipe about 1 inch in diameter, about 8-12 inches long
- A coffee stirrer (the skinny straw kind, not the popsicle kind)

When I try to explain respiratory effort to my students, they don't understand why some patients have more trouble than others. This is especially true for those patients on ventilators. So I get a gullible volunteer to come to the front of the class.

The first thing I ask him/her to do is to breathe through the coffee stirrer. Of course, this is nearly impossible to do! It only takes a half a breath before they can't do it anymore without imploding their cheeks with inspiration or popping a vein in their forehead from trying to blow through one of those things.

Now, I have this same person breath in and out through the PVC pipe. Of course, this is so much easier !!! This gives the students an idea of what we need to do when making adjustments for our patients who are on ventilators.

You can also explain how albuterol works in this way too, with a respiratory distress breathing as if he/she is breathing through a straw and once albuterol/xopenex is given, their airways are dilated and breathing becomes easier.

Surface Tension & Atelectasis

2 pieces of food grade plastic wrap
spray adhesive or good quality hair spray
oil based cooking spray or spray bottle of water
2 glass microscope slides

Surface Tension

Place a drop of water in the middle of one of the microscope slides and put the other slide right on top, pressing gently to spread the water. If your drop was too big, the excess water will squeeze out the sides and that is okay. Now you will notice that you can slide the slides back and forth but you cannot pull them apart. This is surface tension and it is the same thing that happens to your lungs when you have good inflation and enough pleural fluid in between the lung and that lining of the lung called the pleura. You can use this example when explaining the need for surfactant in preemie babies. Only use dry slides to show how they DON'T slide against each other smoothly.

Atelectasis

Spray a thin layer of adhesive to one piece of plastic wrap and a thin layer of cooking spray and water to the other piece.

Wad up each piece of plastic wrap and try to pull apart and smooth out.

You notice that the adhesive sprayed plastic wrap is sticky and won't smooth out or pull apart easily. This is what happens when a lung collapses and doesn't get re-inflated for a period of time.

The plastic wrap that was sprayed with cooking spray or spritzed with water smooths out with a gentle "shake". This represents the moist healthy lung with the right amount of pleural fluid to allow the lung to contract and expand without difficulty. Those "crispy" lungs of people with COPD, Lung CA, etc don't do this.

A Visual Guide to Diabetes

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A can of Cola
A bottle of Corn Syrup
A bag of D5W

When teaching about diabetes and the hyperglycemic states, it is hard for some students to remember the difference between HyperOsmolar Hyperglycemic State (HHS) and Diabetic KetoAcidosis (DKA).

When explaining the different states, have your bag of D5W ready. Hold up your D5W and explain that this is “normal” blood sugar. D5W is isotonic (in the bag) and people tolerate this really well as long as they aren’t already hyponatremic (another lecture altogether).

DKA is a hyperglycemic/acidic state. The body cannot get the sugar from OUTSIDE of the cell to the INSIDE of the cell. The Cells begin to starve and the body begins breaking down fat cells for energy. A by-product of this process is fatty ACIDS. So, lots of sugar outside of the cell and a build up of acid? Hold up your can of Cola. Cola is high in sugar and it contains Phosphoric ACID. Another sign of DKA that is different from HHS is that because you are in an acidic state and your body is trying to compensate you become hyperkalemic and you develop Kussmaul Respirations. So... when you hold up your can of soda, your students should be able to recite “DKA-high sugar- acidic-high potassium- KUSSMAUL respirations!” (or something to that effect) I even make them mimic Kussmaul

respirations so they will recognize them when they see them. This lightens the mood of the class because when they do it all together it sounds like a group obscene phone call.

HHS is a hyperglycemic/non-acidic state. The body has just enough insulin of its own to let in enough sugar to keep the body from having to resort to fat breakdown. BUT the glucose level of someone in HHS is a lot higher than that of DKA. So get your bottle of corn syrup. Corn syrup is THICK from so much sugar (fructose). This is a good way of thinking about how the blood of someone is like. HHS patients' blood is almost syrupy. But corn syrup doesn't contain any acid and because there isn't an acidic state the potassium level will be normal and there won't be a need for the body to go into Kussmaul respirations. You can address the "little tiny baby breaths" as a possible respiratory pattern but seriously I haven't even seen it. So... hold up your bottle of corn syrup and your students should be able to recite "HHS-REALLY high sugar-normal potassium-normal respirations!"

Throughout your day, periodically at random hold up one of your containers and have your students recite the characteristics of whatever state of hyperglycemia your container represents. By the end of the day, they should be very familiar with each state and have a better understanding.

Cucumbers and Salt

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Cucumbers

Salt

Cutting board and knife or chopper

Bowl

Spoon

2 Wire mesh strainers (sink strainers work great)

Small food scale with measuring device

2 liquid measuring cups of the same size

Cut and chop a portion of cucumber to measure about a cup. Chop to “relish” consistency. Divide the cucumbers into 2 equal portions by weight.

Put one part of the chopped cucumber in the wire mesh strainer and place over the liquid measuring cup.

Take the other part of the chopped cucumber and mix liberally with salt. (about 1 tablespoon) Pour this mixture into wire mesh strainer and place over the other liquid measuring cup.

You will notice that the salted cucumbers give up more fluid. This confirms the old saying, “water follows salt”. You will also notice that the cucumber pieces are smaller than the unsalted cucumber pieces. This is cellular dehydration and it occurs when you infuse a hypertonic solution, or eat too much high sodium foods.

While this doesn't apply to the new standards of PALS and the new terminology of ITLS 7th Edition, it is still a great acronym (if I do say so myself) to go by when dealing with an airway. This acronym can be in any order because they all have equal importance when taking care of any airway. And it works with BLS as well as ALS skills.

Seal – you need a good one when bagging a patient. You also need a good seal when you inflate the balloon on an ETT or a Combitube (or equivalent device)

Suction- have it on and ready. The last thing you want to do is to bag someone and have beer and pizza on the return. Most of us have been guilty of needing suction NOW and then there is a scramble to turn it on, find the yankuer, etc. But it is a mistake you only make once, right?.... right?

Supplemental O2- have you ever bagged someone and their saturations weren't rising like you wanted? Well let's go back to the basics and check our equipment. Is the oxygen ON? Is it flowing? Or did your d-tank run dry?

Sellicks - PALS no longer recommends this practice but it is due mostly to the fact that most people don't know how to do it right. Stand back and let us EMS folks show you how it is done! And ITLS 7th Edition has renamed our beloved Sellick's maneuver, "External Laryngeal Manipulation (ELM)" But if it quacks like a duck and sounds like a duck.... It's is like the Heimlich maneuver, it isn't politically correct to call it that anymore but we all know good and well that it will be called the Heimlich until a our grandkids are old enough to work in EMS. Then they will make fun of us for using such a funny word.

S eal

S uction

S upplemental 02

S ellicks

Cell Permeability

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Coffee filters

Tulle (the material ballerina tutu's are made of)

Pantyhose

- Salt, sugar, cinnamon, finely ground black pepper, mustard seed, whole peppercorns, curry powder, little cupcake sprinkles, poppy seeds, etc
- Bowls, jars, spoons, etc. Not much is needed, just something to mix and pour with.

Mix together 1 quart of water, $\frac{1}{4}$ cup of salt, $\frac{1}{4}$ cup of sugar, and 2 tsp each of the spices/sprinkles. Stir to combine. Remember to stir before pouring over each membrane to get an equal amount of the little stuff and bigger stuff.

Line a small colander or funnel with the coffee filter. Place over a bowl or jar.

Cut the leg off of the pair of pantyhose and place in a jar. Secure the leg of the pantyhose with a rubberband.

Line a colander or funnel with the tulle. Place over a bowl or jar.

Pour 1 cup of the liquid into each of the membranes. Note what passes through each of the membranes and what is trapped.

Salt and sugar represent electrolytes. These pass through each of the membrane types once they are dissolved in the water. These electrolytes have become **solutes**.

Cinnamon, very tiny pieces of the finely ground black pepper, and the curry powder are able to pass through the pantyhose. The pantyhose are the capillaries when they have increased their permeability.

Mustard seed and some of the smaller cupcake sprinkles may pass through the tulle. This is cellular permeability that occurs in many conditions including burn patients losing their plasma and cellular proteins because of the damaged skin.

