Interactive Notes-"Physical and Chemical Change"

Student Materials (per group of 4 students):

Demo 1	1-250mL beaker 2/3 full of tap water 1-zipper-seal baggie with 3 spoons of salt; labeled "Salt" with marker 1-plastic spoon 1-raw egg
Demo 2	1-pair of goggles 1-test tube with zinc pellet in the bottom (item # WW94390M06 at sciencekit.com); stoppered and standing in a test tube rack
Demo 3	1-zipper-seal baggie with 3 spoons of baking soda ($NaHCO_3$); labeled "Baking Soda" 1-400 or 600 mL beaker with ~50mL vinegar 1-tealight candle sitting in the bottom of an empty 250 mL beaker
Demo 4	1-beaker or vial with about 5ml Luminol solution (item #WW9459800 at sciencekit.com)
…and	4-note sheets (see p. 7)

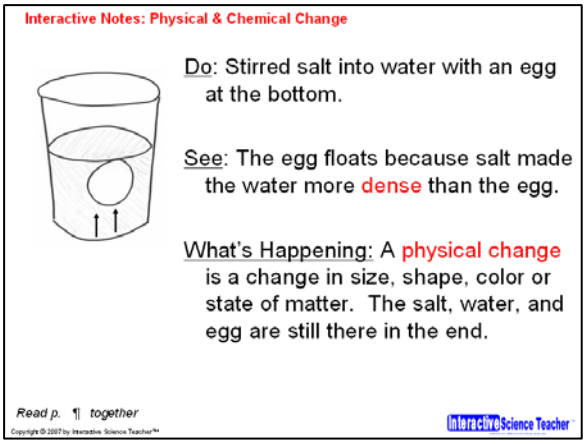
Additional Teacher Materials:

PowerPoint (see p. 7)
Hydrochloric acid and pipet/dropper (see demo #2)
1-lighter- the automatic clicker kind is handiest
Chlorine bleach (or another oxidizer that works with your Luminol solution); and pipet/dropper

Beforehand:

- Close blinds before class. There will be two times today when darkness is needed (demos 2 & 4).
- If you have enough materials you should prepare all 30 sets of what you will need all day for demos 2-4 ahead of time. That means putting zinc pellets into test tubes, pre-pouring Luminol into vials, and scooping your first batch of salt and baking soda into baggies. It might take you (or a student helper) about an hour or two to do all this, but imagine trying to get that done during class the next day with everything else going on!
- Try these demos out for yourself well ahead of time so you're familiar with them. They each have their own personalities.
- Insert page and paragraph numbers from relevant pages in your textbook at the bottom of slides 1 and 2 if you choose to have the class read from it together. This is a good way to connect with your textbook as well as transition into the next demo. You can also delete these page inserts, or Copy and Paste them onto later slides if needed.
- Print extra copies of the notes pages on paper for yourself, students that are slow writers or can't see well, and for absentees. Click "File" → "Print" → then where it says "Print what:" select "Handouts" → and then "OK".

1.



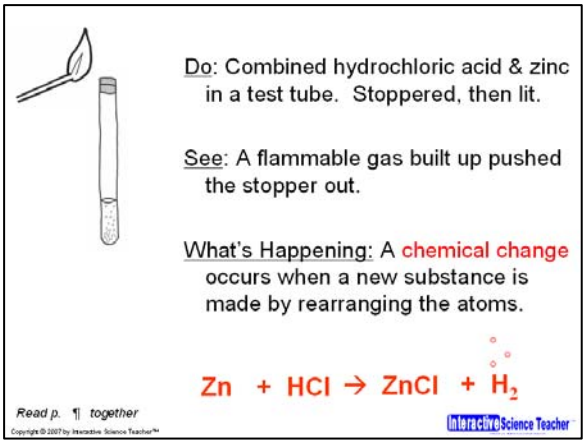
Have student #1 (of the 4) put the egg in the water and see what it does (sink). After removing it, have them pour in the salt from the baggie and stir, stir, stir for about 30 seconds. When the egg is put back in, it floats.

The change in the water can be related to your classroom. This morning at 5 am your room was empty. Now there are 30 students and their things in it. More "stuff" in the same space, making it more full. By adding salt to the water, we filled the spaces in the water with more stuff. That little bit of salt made it full enough that now it's more dense than the egg.

The salt and baking soda are in zipper-seal bags today for the sake of ease- 1. baggies take up much less room than do beakers, 2. when sealed they won't spill, and 3. when refilling them it's tons easier and quicker to just say "put 3 spoons of salt in the baggie" than to have them measure 25 grams of it.

As a side note, it is possible to squeeze a raw egg in your hand without breaking it… so long as the egg is snug in the ball of your hand with the fingers wrapped all around, applying equal pressure to all sides at once.

2.



After student #2 goggles up (and you do too) have them bring their test tube to you. After you pour in/squirt some hydrochloric (until it's about 1/4 full), have them stopper the test tube and put it in the test tube rack to observe. Back at their seats, make sure no one is holding their test tubes because within a minute or two corks will be popping all over the place.

When things have settled and students have noticed the fizzing going on, turn the lights off and ignite the gas inside each test tube. Do this by holding the flame right next to each test tube then have them un-stopper it, releasing the flammable hydrogen gas. If the stoppers keep popping off, they can hold it down with their thumb. They'll see a streak of light and hear a squeal as the extremely flammable gas (which is used as rocket fuel) burns.

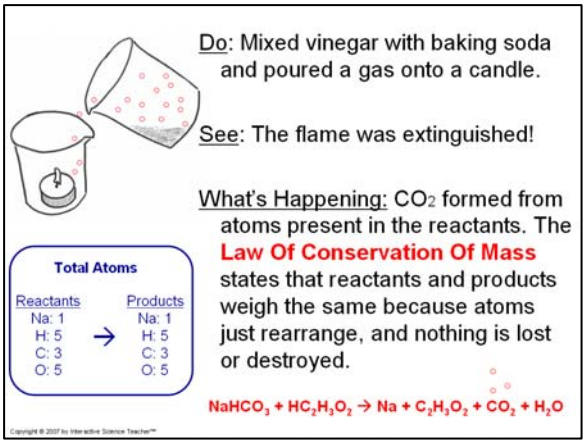
Mix the HCl in this demo to about 1.0 molar. You want it weak enough that putting a little bit on your hand does not hurt (better you get a little sting than students, right?). Immediately rinse off. But you also want it strong enough that stoppers pop after a minute or two.

Caution: Hydrochloric acid is very hazardous to eyes and skin. Require any student handling the test tube to wear goggles (don't forget later during clean up too). Immediately rinse it off any skin that's been exposed to it.

Zinc pellets- if you need to pick some up, the 500 gram one called *mossy* is what you want. Don't get zinc powder- it will react too quickly.

The reason the stoppers pop off goes back to your chapter on solids, liquids, and gases. A gas takes up about 50x more space than a solid or liquid. So when you see the hydrogen bubbles forming inside the test tube, imagine them squeezing harder and harder into the space between the top of the liquid and the stopper. Eventually the pressure becomes greater than what the stopper can hold, and it's pushed out. And the tighter the stopper is, the more pressure can build, since the hydrogen gas bubbles longer…..and that can cause a stopper to launch into the ceiling. (This is the perfect time to warn you about the possibility of hitting and breaking an overhead light. Keep an eye on competitive students that might try this.)

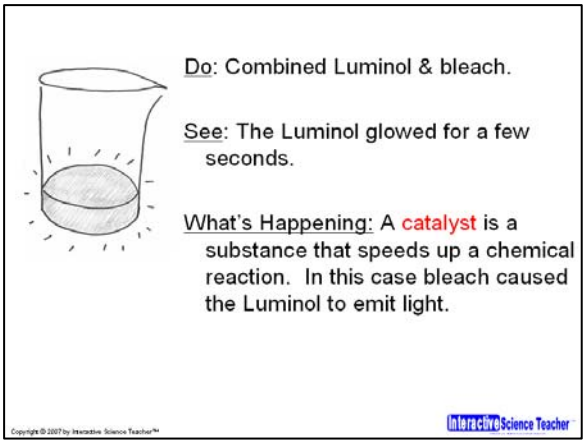
3.



Light the tealight candles in the bottom of the beakers. Then have student #3 slowly pour the baking soda powder into the large beaker with vinegar (too fast then the solution will bubble over). Ask them not to move the large beaker while the reaction is going (you want to keep any CO_2 gas from spilling out). Also have them notice that the beaker now feels cold, evidence of a chemical reaction (endothermic in this case). After waiting about 30 seconds, ask them to pour the invisible gas that has formed in the large beaker onto the candle sitting in the smaller one. The candle will go out!

Definitely practice this one a few times beforehand. That will help you notice little things that help it work better- like holding the larger beaker very close to the smaller one with the candle when pouring so that enough CO_2 gets directed inside and extinguishes the flame. Timing is also crucial- pour within a minute of combining the baking soda and vinegar.

4.



With lights low or off, have student #4 bring the vial of Luminol to you so you can squirt some bleach into each one.

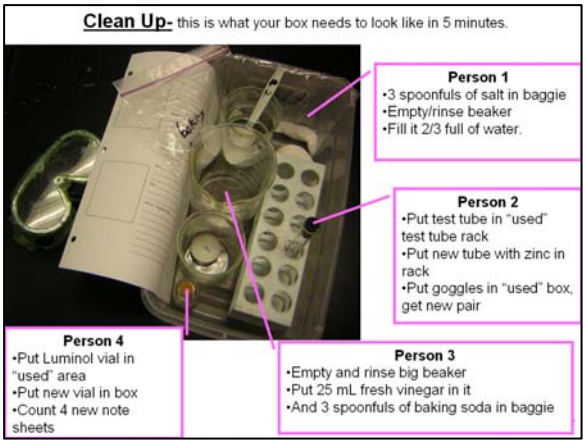
If you're a good story teller and want to play a trick on them, have them first line up in front of the room and announce that what they're holding is actually truth serum. "It's in the experimental stage, but it seems to be more reliable than polygraph tests. Here's how it works- you hold the truth serum to your right temple while answering a yes/no question in your mind. Since the right side of the brain is more active when you are truthful, those neurons are firing more electrical impulses, and the serum becomes energized. We'll use an indicator to see if you told the truth. Ready? Hold it to your right temple right now- When you were 5 years old, did you believe in Santa Claus?"

Go up to each student and have them hold it up high (and away from themselves so you don't spill bleach on them) while you put a dropper-full of bleach in each. If you're especially devious you can plant a vial of plain water instead of Luminol, and that student has some explaining to do when theirs doesn't light up, indicating they're lying.

Luminol isn't cheap, but it is most economical when mixed on your own. There are many Luminol formulas, but the easiest to prepare calls for 0.2g Luminol (yes, that's *point 2* grams), 10.0g Na_2CO_3 (sodium carbonate), 180mL of distilled water, and 180mL of 3% H_2O_2 (pharmacy grade over-the-counter peroxide). Mix all together in a 600 mL (or larger) beaker. Use chlorine bleach as the oxidizer to set off the gorgeous blue chemluminescence. Make it fresh every year- after a year of sitting on the shelf it will be almost completely non-reactive.

Pour 5 mL into little vials, then *loosely* stopper when done- the degrading peroxide will pop stoppers all over the place if you don't. If you can pre-pour all 30 or so vials the day before, you'll be really glad you did on notes day. It's worth the trouble!

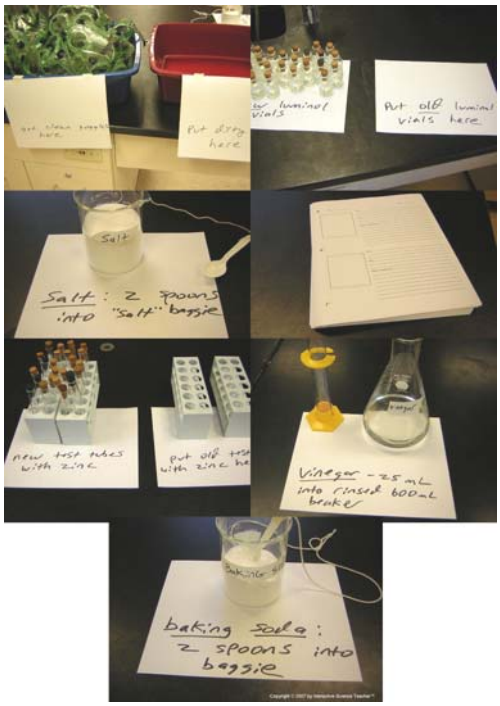
Use caution when working with Luminol powder- it can irritate mucous membranes and the respiratory tract.



You'll need at least 5 minutes to reset everything for the next class.

Leave refills of everything (shown right) in different parts of the back of your room so students don't all crowd one spot:

- Big box/beaker of salt (4 lb.) for demo #1
- New test tubes with zinc, and a place to put the old ones-demo #2
- Goggles- demo #2
- Box/beaker of baking soda- demo #3
- New vials of Luminol, and a place to put the old ones- demo #4
- Note sheets



Make a sign for each station to spell out exactly what to do. That makes cleanup much simpler, which is what you're all about. For the salt and baking soda stations attach a plastic spoon to the beaker with a string, and you won't be looking for it all day.

Check student boxes closely before each class leaves- there are many things that need to be done that you don't have time to do for them.

If you don't want the cleanup slide, right-click on the slide and select "Hide Slide".

To help you with clean up, have your last science class take everything out of the boxes and put them in like piles in the back of your room, and give beakers a good rinse for you.

Your homework

What is the difference between a physical and chemical change? Answer with 3 sentences:

1. The definitions
2. One example of physical
3. One example of chemical

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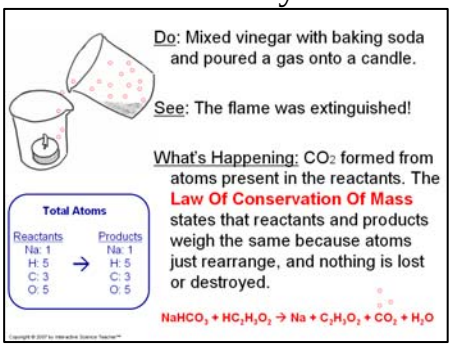
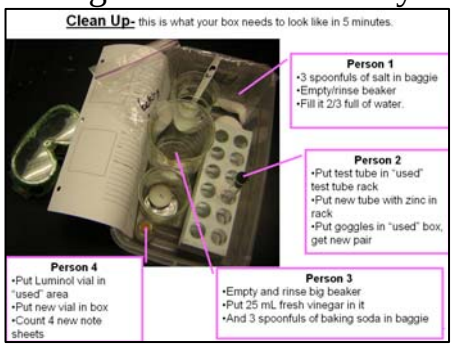
PowerPoint- lead your students through the lesson click-by-click





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Student Handout