Supposed Driving Question – What Am I Made Of?
Activity 1
Substances (Mystery Powders)

Brief Description of Group to be Taught: Eighth grade, ~24 students per class (2 classes), varying ability levels, some students on IEP's

Name of Nationally-Validated, Standards-Based Curriculum: Full Option Science System (FOSS), Chemical Interactions – Teacher Guide, 2008

Relationship of this Lesson to the Unit: This lesson introduces the students to the unit on chemical interactions, a subdivision of physical science. Once this lesson has been completed the students will have an understanding that all matter is made up of different substances, having different physical and chemical properties, which are manifested in in physical and chemical changes, and that chemical changes occur when a reaction happens.

Massachusetts Frameworks Strand and Learning Standard (grades 6-8 framework):
· *Physical Science* 10 - Differentiate between physical and chemical changes.

· *Language Arts 1.3* – Apply understanding of agreed upon rules and individual roles in order to make decisions.
· *Language Arts 1.4* – Know and apply rules for formal discussions.
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Science Concepts:
· Day 1 - Students will be able to make a table which accurately reflects observations and tests they will make and perform.
· Day 2 - Students demonstrate an understanding that despite similarity in appearance, individual substances have different properties.
· Day 3 - Students will be able to understand the concept of a reaction, and that when a reaction happens, the original substances change into different substances. (reactants and products.)
· Day 4 - Students will be able to aptly model what they have done in the form of a flow chart.
· Day 5 - Students will be able to understand the concept of a physical and chemical property of a substance and the differences between the two.
· Day 6 – Students will begin to bring their understanding of physical and chemical properties and changes to the molecular/elemental level.

Process Skills:
· Day 1 – Forming Hypotheses
· Day 2 - Measuring
· Day 3 - Observing
· Day 4 - Modeling
· Day 5 – Interpreting Data
· Day 6 – Inferring

Science Habits of Mind:
· Day 1 – View science and technology thoughtfully, being neither categorically antagonistic nor uncritically positive.
· Day 2 – Recognize when comparisons might not be fair because some conditions are not kept the same.
· Day 3 – Be curious. Be careful and accurate in observations.
· Day 4 – Keep records of investigations and observations and do not change the records later.
· Day 5 – Open-minded, willing to change your mind in the face of reliable evidence, and respect another's point of view.
· Day 6 – Seek better reasons for believing something than "Everybody knows that"…or "I just know," and discount such reasons when given by others.

Session Length: Six 45-minute periods.

Activity 1 Materials Needed:
· sodium bicarbonate (baking soda) (100g)
· sodium chloride (table salt) (100g)
· cornstarch (100g)
· sucrose (sugar) (100g)
· plaster of paris (100g)
· acetic acid (vinegar) (25mL)
· iodine (25mL)
· small plastic cups (50)
· plastic spoons (50)
· aluminum foil (2 rolls)
· water (room temperature, hot or cold is fine, as long as it is consistent) (10 L)
· eyedroppers (2 – one for vinegar, one for iodine)
· paper products for cleaning
· large paper flip-chart (1)
· something to write with
· assorted hand-outs (see appendix to Activity 1)
· masking tape (1 role)
· markers (10)
· sticky notes (1 pack)

TIME	PROCEDURE
Day 1 Prep	1. Write the roles of getter, starter, recorder and reporter on large flip-chart piece of paper and tape to wall 2. Write 1, 2, 3, and 4 on one sticky note each, and put 1 next to getter, 2 next to starter, 3 next to recorder, and 4 next to reporter. 3. Write 1, 2, 3, and 4 on pieces of masking tape and tape one of each at a seat at a 4-person lab table x how many groups/tables there are.
Day 1 15 min	**Introduction** 1. Introduce chemical interactions, telling students that for the next week they are going to be scientists like the crazy ones they see on TV in white labcoats…that what they're going to be doing is similar to the process carried out in labs all over the world. That at times they will be frustrated, and in the end, discoveries will be made and new knowledge will be obtained. Tell them the moment they walked in today, they became chemists, and this is their laboratory. A crime has been committed…criminal had a white substance on their shoe, which in haste was left behind…they will test 5 substances which I have identified as bearing resemblance to that on the criminal's shoe. 2. Ask students what they would do determine the identity of a number of white powders if they were presented them? - will lead them through questions starting to outline physical and chemical interactions from which different results would begin to differentiate the powders. - testing conclusions: (which students will uncover themselves through my questioning) use vinegar, iodine, water, flame, and observation through sight, touch, smell (lead them through questions/answers which will bring students to the understanding that iodine is liquid being used as an indicator – what it is – what it MAY do – will be vague) (discuss vinegar as a liquid acid, which is reactive to certain substances – again, will be vague) 3. State that all of these things just happen to be available (and explain why other things they may have proposed are not – or work quickly to have them available for the next day) for their use the next day
Day 1 15 min.	**Lab Instruction and Roles** 1. Introduction to lab safety – wear goggles, do not taste anything, waft when smelling (benchmark) 2. Tell students to carefully record their observations as they are

	made, and ask them what they think a good way of planning the recording of information would be – (a table), model quickly a table on the flip-chart 3. Break students into groups of 4 and describe the 4 roles needing to be filled – a) getter b) starter c) recorder d) reporter Point to summary of these roles taped on large paper to the wall. Tell students roles will be assigned in this order according to the number they sit at when they move to their groups. Explain that each day they are to sit in the same seat, and the numbers will rotate positions, so after 4 days, they will have performed each role once. 4. Tell students to move into their groups, and that they will be given ~10 minutes to plan their testing, discuss with their groups, and build their observation tables
Day 1 10 min	**Groupwork** 1. Allow students to build their tables. Question students about their planned methods and observation. Lead them to conclude they need to have a planned method for introduction of the powders to each test (flame, water, iodine, vinegar, etc.) Try to lead them toward good lab practices such as labeling their materials so there is no confusion. (This was added as a response to carrying this out in Chad's classroom…kids were NOT very effective at keeping their powders and testing correctly labeled and consistent.) 2. Tell students to make sure to bring their tables to class the next day.
Day 2 Prep	1. Place 5 mystery substances into a container on counter labeling them with just the numbers as follows 1) Baking soda 2) Table salt 3) Cornstarch 4) Sugar 5) Plaster of Paris 2. Place cups, spoons, vinegar, iodine, candles, aluminum foil, and markers on counter next to 5 mystery powders (and anything else students thought of which I can make available) 3. Rotate groups roles down one position on paper on wall. (Make sure masking tape numbers are still on all lab tables.)

	4. Write: a) What does the getter need to get? b) What testing will be performed? c) Who is going to perform each test? on the flip-chart
Day 2 5 min	**Intro Groupwork** 1. Tell students immediately to sit with their groups assigned the previous day, and to brainstorm for 3 minutes the answers to the questions written on the flip-chart in Day 2 Prep #4.
Day 2 35 min	**Experimentation** 1. Tell getter to gather materials. 2. Students begin performing water, iodine, vinegar, flame and observation (and anything else they think of which is available e.g. weighing, black paper rub) testing on 5 substances. 3. As students are testing, question them about their measuring techniques, observation skills, curiosity, and accuracy skills. 4. After ~10 minutes, address inaccuracies in measurement by asking class if they were consistent. Were they inconsistent? (Most certainly.) Please repeat in a manner in which consistent measurement will be taken. Record observations. Were there any changes? What did we learn from this? - hard to know what to do the first time around, let's learn from this – it's always easier to do something right the first time – mention this is very applicable to the real world. Also address problems with the observation tables they are creating – readability, clarity, organization. Stress NECESSITY of testing consistently between the 5 powders. (Learned from teaching in Chad's class – they don't really <u>care</u> even when you do tell them…tell them it's imperative to test consistently to get correct answer – this seems to inspire them to listen…they want the correct answer…even though that's not the ultimate goal, but it's the only thing that got them interested.) Try to keep the burning/flame tests consistent and to a minimum. (Some groups got completely side-tracked using ineffective flame testing and wasted the whole period.) 5. Begin to question groups about what might cause different powders to react in different ways. Question them to figure out "each powder, though similar in appearance, has different properties."
Day 2 5 min	**Homework Assignment and Clean-up** 1. Tell students for homework to go over the observations they made and make sure everything makes sense to them – clarify anything that is unclear, then show their observation table to a

	parent/guardian and see if when they read the table, they describe what was actually seen. Tell students to have a parent/guardian write a short paragraph with possible suggestions/improvements and sign that this discussion occurred. 2. Ask one group who has not added too much water to their substances to leave their set of 5 mystery substances dissolved in water out on the counter for later use. 3. Allow for clean-up. 4. Tell students to make sure to bring their observation tables to class the next day.
Day 3 Prep	1. Place 5 mystery substances into a container on counter labeling them with just the numbers as follows 1) Baking soda 2) Table salt 3) Cornstarch 4) Sugar 5) Plaster of Paris 2. Place cups, spoons, vinegar, iodine, candles, aluminum foil, and markers on counter next to 5 mystery powders (and anything else students thought of which I can make available) 3. Rotate groups roles down one position on paper on wall. (Make sure masking tape numbers are still on all lab tables.)
Day 3 10 min	**Discuss previous day's results** 1. As students come in, tell them to sit with groups from previous day. Ask each group to describe one finding from the previous day's experiment – do not go into great depth, it is likely other groups may not have performed that test yet. (reporter for that day) 2. Ask what students' findings were when they went home to show their parents/relatives/friends/siblings their results. Was anything unclear? What advice do they have for the rest of the class moving forward making observations? See if any students have parent or self suggestion of drawing to clarify results. If not, bring this up and ask students to draw results of different tests.
Day 3 30 min.	**Continue Experimentation** 1. Groups will most likely need the rest of the class to finish the experimentation on all of the 5 mystery substances with CONSISTENT testing. (learned from Chad's class) 2. Walk amongst groups and monitor their observations as well as check to make sure their homework was done and signed off. Ask

	probing questions to make sure observations are accurate, precise, and detailed. Also ask probing questions to make sure that students grasp concept that everything in the world is made of substances, and that these substances, despite similar appearance, have different properties. (Review from day before.) E.g. What happened when you put powder 2 vs. powder 4 over the flame? Was there a difference or no? Why do you think that happened? Look for evidence that students have an open mind and are willing to discuss other points of view. (Again, keep the flame tests under control.) 3. Question students about <u>reactions</u>. What defines a reaction? How do you know a reaction occurred?
Day 3 5 min.	**Homework Assignment and Clean-up** 1. Tell students for homework they are to make sure, once again, that their observations are correct and cogent. Give them handout to fill out at home asking: 1) what would be a logical next step in the experimentation process, 2) what it is we're really trying to learn and 3) what they want to get out of this experiment. See Handout 1 in Activity 1 Appendix. 2. Ask one group who has flame test results that obviously show melting vs. burning to put all 5 tested powders on the counter for later use. 3. Allow for clean-up. 4. Tell students to make sure to bring their observation tables the next day.
Day 4 Prep	1. Make sure large pieces of paper (ideally 2x3') are available for student use. (Flip-chart paper works perfectly.) 2. Rotate groups roles down one position on paper on wall. (Make sure masking tape numbers are still on all lab tables.)
Day 4 20 min.	**Homework Collection and Review of Concepts** 1. (As students walk in, ask them to show you their homework. Observe that they have all questions filled in.) Ask students to look at the handout they filled out for homework. Go over what students think would be a logical next step, what they think the overall goal of the experiment is, and what they want to get out of it. Move questioning forward by asking students how they think these experiments relate to real life. Ask students what they think people are made of? Is it possible people are made of the same stuff in some of these powders? Direct them toward concept that all matter is made of combinations of substances with different properties. Introduce concept of a reaction, what changes before and after, examples of rx. When this is complete, walk around and collect

	homework. 2. Ask each group to share another observation that they found with the class (reporter). Ask if all groups obtained the same result. Ask probing questions about the melting specifically. (They will need precise observations of melting to discern what substances are in their mystery mixtures.) What does powder 2 vs. powder 4 do when heated by flame? How about powder 2 vs. powder 4 when iodine is added? Did anyone do any timed testing when heat was applied? Also – introduce concept of reactions. What happened when vinegar was added to mystery powder 1? Why did it fizz? Did anyone add more than a few drops to their aliquot of powder 1? Why did it stop fizzing? What was that fizzing? Gas released? Something changed? Evidence of a chemical reaction. Ask if any other experiment they did produced a chemical change. Discuss. Hopefully a student will introduce the idea of a reaction. Work with them on this concept. What defines a reaction? Which experiments produced a reaction? How do you know? (Reviewing concepts from Days 1-3) 3. Tell students that each group is going to be given a mystery MIXTURE of 1 or more of the mystery powders tomorrow in class. Leave it open-ended how many substances are in their mystery mixture. Could be just 1, could be 2, could be 3, 4, or all 5 substances in the mixture. As a forensic chemist, never know what the substance on the criminal's shoe could be. The original 5 powders will also be available in case any re-testing is necessary to gain more precise results. 4. Ask groups to, based on their recorded observations, make a flow chart of the experiments they are going to perform on their mystery mixture, and what each experiment will discern. Model a few steps of a flow chart on the paper flip-chart with input from students.
Day 4 15 min.	**Building a Flow Chart** 1. Give each group a large piece of paper. 2. Circulate amongst groups questioning them on the building of their flow charts, and provide necessary assistance. 3. While circulating, ask questions regarding chemical reactions, interpretation of data (incorporated into their flow charts) and the integrity of their data.
Day 4 5 min.	1. If time permits, hang up flow charts and have students critique them

Day 4 5 min.	1. Assign homework Handout 2 in Activity 1 Appendix (review of concepts.)
Day 5 Prep	1. Mix 5 mystery mixtures (50:50) into 5 mystery combinations labeled A, B, C, D and E…one each for each of 5 groups in each class. A – baking soda and plaster of paris B – baking soda and table salt C – cornstarch and sugar D – cornstarch and table salt E – sugar and plaster of paris 2. Place 5 mystery substances into a container on counter labeling them with just the numbers as follows 1) Baking soda 2) Table salt 3) Cornstarch 4) Sugar 5) Plaster of Paris 3. Place cups, spoons, vinegar, iodine, candles, aluminum foil, and markers on counter next to 5 mystery powders (and anything else students thought of which I can make available) 4. Rotate groups roles down one position on paper on wall – students are now back to original day 1 roles. (Make sure masking tape numbers are still on all lab tables.)
Day 5 5 min.	**Introduction and Homework Collection** 1. Ask students to hand in homework. 2. Quick introduction asking if students have any questions, and re-iterate that today they will be testing their mystery mixture according to the flow charts they have designed. 3. Getter obtains the group's flow chart and necessary testing materials while instructor hands out different mystery mixture to each group.
Day 5 20 min.	**Experimentation** 1. Students perform testing according to their flow charts. Make sure students are adhering to their charts, and if not, ask why the deviation, and are they taking this into account in their lab notebooks (or wherever they have recorded their observations and results.) Be available to answer or clarify questions – groups will likely not be able to distinguish between sugar and salt unless careful observations of iodine and melting/burning results were kept. Suggest they perform tests side by side with individual mystery powders to compare results, if necessary.

	2. Ask students to clean up when they are done and have identified the two powders in their mystery mixture.
Day 5 20 min.	**Discussion** 1. Reconvene the class and ask each group to tell the class what their mystery mixture contained (powder 1 and 3, e.g.) and why they have definite proof of this (reporter). 2. (Trying to lead toward understanding of physical vs. chemical properties) Ask students to describe testing they did which did not seem to change the powders. Observing them by sight, smell, touch. Did dissolving them change them? Yes? No? Bring to light the saved samples of dissolved 5 substances (saved from Day 2), which now the water has evaporated off of, pass them around, and ask students if the powders have changed. Lead them to "no," they haven't. Possibly slight changes, salt's crystal structure is interrupted, but overall, if you scrape up the material, it is this same – show what powders look like when scraped off bottom – very similar to original. How about heating? Did it change the substances? Some yes, some no. If a color change is observed, it's good evidence that a chemical change has taken place. How about a <u>state</u> change? Introduce vocab. Just changing solid to liquid doesn't necessarily indicate a chemical change. What about ice melting? Is ice a different substance than water? No. Show students the melted/burned powders that one group saved at the end of day 3. Make sure physical vs. chemical property vs. change is defined by the end of this discussion. 3. Finally, ask students if they have an idea of what these 5 substances are, and say that 4 out of 5 of them are probably in most of their kitchens. Maybe they'll figure them out, maybe not…tell them what each of them are (if they don't get them), and say that these 5 substances are actually combinations of different elements.
Day 5 5 min.	**Homework** 1. Give students worksheet with questions "is it a physical or chemical change?" (See Handout 3 in appendix of Activity 1 Plan.) 2. Hand out periodic table worksheet and tell students to look for possible trends, and meanings of the different numbers associated with the table.
Day 6 **Prep**	1. Write the following on 8.5x11 pieces of paper: 9 Os (each on individual paper) 2 C 1 S 1 Ca

	3 H 3 Na 2 Cl 3 vinegar 2. Rotate groups roles down one position on paper on wall. (Make sure masking tape numbers are still on all lab tables.)
Day 6 15 min.	**Review of Physical and Chemical Change or Property Homework** 1. As students enter, check off that they have done their homework. 2. Go over "physical or chemical change" worksheet and refer to mystery powders experiment as much as possible when explaining answers (as necessary). 3. Make sure students understand the difference between a physical and a chemical property by creating a T-chart on the flip-chart. On the right, write physical property, on left, write chemical property. Have students fill in properties according to what they have learned from the mystery powders. (e.g. dissolving is under physical, burning is under chemical.) Discuss as necessary. 4. Make sure students understand the difference in stating a physical/chemical <u>property</u> vs. a physical/chemical <u>change</u>. Use examples from a text or website which lists physical and chemical properties and changes.
Day 6 10 min.	**Review of Periodic Table Homework** 1. Ask if anyone has any questions or comments about the Periodic Table. Ask students if they know what each individual box stands for. Introduce the concept of the element. Ask students how they think the Periodic Table relates to their mystery powder experiment. Ask if any student knows what "baking soda" and "table salt" really are. Introduce chemical names, chemical formulas, and common names. Make chart on the board of the 5 mystery powders common names, chemical names, and formulas. Also provide this for students as a hand-out (See Handout 4 in appendix of Activity 1). Tell them to familiarize themselves with it for homework. 2. Say that every basic unit of matter, the element, has a name. Talk about how some of them combine to form compounds, like the ones they have analyzed.
Day 6 20 min.	**Element/Compound Activity** 3. Tell students to stand up, that they are going to be named as elements for an activity. Give specific students names of the elements used to make up the 5 mystery powders. (Hand out elements to all kids in classroom – adjust # of Na, Cl, H and O –

	more or less salt and water so all kids are included.) Have Na and Cl stand up and hold hands. Have 2 H's and an O stand up and hold hands. Have H2O break in between Na and Cl – describe that this is the process of dissolving table salt, and because of it's inherent properties, this is easily done – thus the quick dissolution of salt. Have Ca, S and 4 O's stand up and hold hands – this is plaster of paris, or gypsum. They hold hands tightly, and have another 3 kids with H2O hold hands and bounce against, but not break up gypsum. Explain because of inherent properties of gypsum, it is insoluble in water, but it does for a suspension. Explain suspension as a removal of the individual molecules from the clump of powder so they float freely in water, but are not actually separated into component ions. Allow students to ask questions. Reiterate that suspensions and dissolution are physical properties, and are capable of returning to original state. Now show chemical changes by having Na, H, C and 3 Os stand up and hold hands. Have the vinegar or 2 or 3 stand up and bump into NaHCO3 from all sides…ask NaHCO3 what they think they should do to demonstrate what they saw when vinegar came in contact with them in the experiment. (Run in all directions to the outside of the room, keeping just CO2 holding hands – I will tell CO2 to stay together – they can run to a corner as well. Ask students if they know what CO2 is. (Carbon dioxide – a gas.) Ask them if this represents a chemical or a physical change, and why. (Not easy to return NaHCO3 to previous form…reactants different than products…gas released.)
Day 6 2 min.	**Homework** 1. Tell students they must bring in their mystery powders "common name, chemical name, chemical formula" worksheet to class the next day. 2. Tell students there are many websites which could help to enrich their understanding of the Periodic Table, and give them the following links, telling them to check them out over the next week. http://www.chemsoc.org/viselements/pages/pertable_fla.htm http://www.funbrain.com/periodic/index.html http://www.brainpop.com/science/matter/atomicmodel/ http://www.edumedia-sciences.com/m231_l2-3d-molecules.html

ACTIVITY 1 APPENDIX

Assessment – Activity 1, Day 1

	Novice	Competent	Expert
Science Concept: Students will be able to make a table which accurately reflects observations and tests they will make and perform.	Table has one of the following properties: messy/unreadable, will not facilitate the recording of data in some manner, includes only 1-2 tests	Table will facilitate the recording of data, but may not be complete with tests which will isolate all 5 white powders, may inaccurately describe 1-2 tests	Table is neat, organized, readable, and will facilitate collection of data without any modifications – includes tests which will isolate all 5 powders
Process Skill: Forming Hypotheses	Thinks of 1-2 tests which may or may not be feasible or discriminatory	Thinks of 3 or more tests which are feasible and may or may not isolate all 5 white powders	Thinks of creative exclusive tests which will allow for isolation of all 5 white powders
Habit of Mind: View science and technology thoughtfully, being neither categorically antagonistic nor uncritically positive.	Thinks a few simple tests will give conclusive evidence of identity of all powders, reliance on "religion," not science	Thoughtfully ruminates on possible procedures, their downfalls, and their possibilities for producing results	Recognizes that results may be inconclusive at some junctures, does not show evidence that he or she thinks all results will be black and white

Assessment – Activity 1, Day 2-3

	Novice	Competent	Expert
Science Concept: Students demonstrate an understanding that despite similarity in appearance, individual substances have different properties.	Testing is solely appearance-based, when other classmates encourage physical/chemical change tests, does not recognize that powders melt/burn/dissolve/react differently to different stimuli – non-recognition of all but gross differences	Recognition that careful observations and controls must be put in place to observe differences in melting/burning/dissolving/reacting/appearance of white powders	Recognition that individual substances, though similar in appearance, have different properties, and these properties are attributable to microscopic differences
Process Skill: Measuring	Inaccurate/uncontrolled measurement	Some amount of effective control placed on measurement	All measurements/procedures are effectively controlled
Habit of Mind: Recognize when comparisons might not be fair because some conditions are not kept the same. Be curious. Be careful and accurate in observations.	Knows measurements should be controlled, but does not, or shows no evidence of understanding that measurements must be controlled to have usable results	Thinks about using accurate measurement and does it	Thinks about accurate measurement without teacher prompt, controls measurement, and controls procedure further (stirring dissolved powders, time of heat application, etc)

Assessment – Activity 1, Day 2-3

	Novice	Competent	Expert
Science Concept: Students will be able to understand the concept of a reaction, and that when a reaction happens, the original substances change into different substances. (reactants and products.)	Understands that something has changed	Understands that something has changed, and this is represented by a change in appearance somehow	Understands that the reactants are different than the products, and the change has to be basically irreversible, and the change is represented by color, texture, gas released, etc
Process Skill: Observing	Can point out obvious changes such as color	Makes sophisticated observations about slight changes such as texture, dissolving, melting/burning, color	Makes sophisticated observations and attributes them to a physical or chemical change
Habit of Mind: Be curious. Be careful and accurate in observations.	Shows interest in changes that occur	Shows effort toward understanding why the change had occurred, uses data to support these observations	Shows interest in understanding why change has occurred and explains a change in verbal or written form, uses data to support conclusion

Assessment – Activity 1, Day 4

	Novice	Competent	Expert
Science Concept: Students will be able to aptly model what they have done in the form of a flow chart.	Flow chart represents basic understanding of actions and reactions, may be missing some info or display faulty reasoning	Flow chart adequately models the process that will be performed the following day on the mystery mixture, and almost all of it is correct (1-2 mistakes or deletions)	Flow chart describes exactly the process that will lead to discernment of what the mystery mixture it without question (how sure are you? – 100% positive)
Process Skill: Modeling	Flow chart shows that student has basic understanding that it is a model of scientific process – model may be incomplete or erroneous	Flow chart shows evidence that student grasps abstract understanding of scientific process – (1-2 mistakes or deletions)	Flow chart is perfect abstract representation of lab procedures and will allow student to follow it exactly to determine correct results
Habit of Mind: Keep records of investigations and observations and do not change the records later.	Some changes may have been made to come up with "correct" results, some data may be missing	Fidelity is shown to results previously obtained, records were neatly and correctly kept	Nothing has been changed to original data because it was all recorded in enough detail that there are no questions

Assessment – Activity 1, Day 5

	Novice	Competent	Expert
Science Concept: Students will be able to understand the concept of a physical and chemical property of a substance and the differences between the two.	Shows no reflection on dissolving or melting as possibly a physical property, shows evidence of understanding appearance as physical, burning/fizzing/color change as chemical	Understands burning/fizzing/color change as chemical, thinks critically about dissolving and melting as physical or chemical, understands appearance as physical	Understands burning/fizzing/color change as chemical and melting/dissolving/appearance as physical and gives correct reasoning
Process Skill: Interpreting Data	Hypothesizes why certain properties are chemical or physical without referring to what happened in actuality	Uses data collected during experimentation to support hypotheses about chemical and physical properties	Uses data collected during experimentation to support correct hypotheses about chemical and physical properties
Habit of Mind: Open-minded, willing to change your mind in the face of reliable evidence, and respect another's point of view.	Largely does not incorporate results (science vs. religion) or classmates' explanations in his or her explanation of what makes a chemical or physical property	Reviews pre-conceptions about physical and chemical properties and offers explanations based on data and classmates explanations to try to find what defines chemical vs. physical property	Uses data and classmates' explanations to come to new and deeper understanding of definition of chemical and physical properties

Assessment – Activity 1, Day 6

	Novice	Competent	Expert
Science Concept: Students will begin to bring their understanding of physical and chemical properties and changes to the molecular/ elemental level.	Shows evidence of rudimentary understanding that chemical and physical properties are caused by something other than just "that's how they are"	Understands that chemical and physical properties can be attributed to something on the elemental/molecular level	Understands that chemical and physical properties can be attributed to something on the elemental/molecular level, and can begin to explain these differences on the microscopic level
Process Skill: Inferring	Shows rudimentary ability to understand that there is something very small which accounts for differences in larger things	Shows ability to think abstractly about things on a radically different scale (molecules vs. people)	Shows ability to picture and describe (either with formulas, pictures, or verbally) elements/atoms/molecules on a very small scale
Habit of Mind: Seek better reasons for believing something than "Everybody knows that"…or "I just know," and discount such reasons when given by others.	Largely unable to explain properties on a molecular level…easier to just say "because it is that way"	Makes an effort to try to explain properties on a molecular level	Is able to accurately describe molecular differences which would give rise to different chemical and physical properties

Handout 1 – Day 3 Homework Sheet

Name:_____ Date:_____

Answer the following questions:

1) What would be a logical next step in the experimentation process?

2) What it is we're really trying to learn?

3) What do you want to get out of this experiment?

Handout 2 – Day 4 Homework Sheet

Name:_____ Date:_____

Answer the following questions:

1) Why did powder #1 fizz when vinegar was added?

2) Why did iodine turn black when added to powder #3?

3) Was there anything different about what happened when powder #2 was added to water than when powder #4 was added to water?

4) What defines a reaction?

5) What do you think these powders are made of?

6) Is there any possible similarity between what the powders are made of, and what living things are made of?

Handout 3 – Day 5 Homework Sheet

Name:_____ Date:_____

Circle the correct answer.

Is each of the following statements an a) physical property b) chemical property c) physical change or d) chemical change?

1) Yeast acts on sugar to form carbon dioxide and ethanol.
a) physical property c) physical change
b) chemical property d) chemical change

2) Salt is dissolved in water.
a) physical property c) physical change
b) chemical property d) chemical change

3) Sugar is capable of dissolving in water.
a) physical property c) physical change
b) chemical property d) chemical change

4) Gasoline burns in the presence of oxygen.
a) physical property c) physical change
b) chemical property d) chemical change

5) The element/substance bromine has a red color.
a) physical property c) physical change
b) chemical property d) chemical change

6) Ammonia is a gas at room temperature.
a) physical property c) physical change
b) chemical property d) chemical change

7) Dry ice, solid carbon dioxide, is sublimed at room temperature.
a) physical property c) physical change
b) chemical property d) chemical change

8) Water boils at 100 degrees Celcius.
a) physical property c) physical change
b) chemical property d) chemical change

9) Vinegar will react with baking soda.
a) physical property c) physical change
b) chemical property d) chemical change

10) Diamonds are capable of cutting glass.
a) physical property c) physical change
b) chemical property d) chemical change

11) Wood is flammable.
a) physical property
b) chemical property
c) physical change
d) chemical change

12) Water can be separated by electrolysis into hydrogen and oxygen.
a) physical property
b) chemical property
c) physical change
d) chemical change

13) Iron rusts in a damp environment.
a) physical property
b) chemical property
c) physical change
d) chemical change

14) Aluminum has a low density.
a) physical property
b) chemical property
c) physical change
d) chemical change

15) Hydrogen peroxide decomposes to water and oxygen.
a) physical property
b) chemical property
c) physical change
d) chemical change

Handout 4 – Day 5 Chemical Names, Common Names, and Formula Sheet

	Common Name	Chemical Name	Formula
Powder 1	Baking Soda	Sodium Bicarbonate	NaHCO3
Powder 2	Salt	Sodium Chloride	NaCl
Powder 3	Cornstarch	A type of carbohydrate polymer	C6H12O6*
Powder 4	Sugar	Sucrose	C12H22O11
Powder 5	Plaster of Paris	Gypsum	CaSO4

*Polymers do not have a discrete formula

Supposed Driving Question – What Am I Made Of?
Activity 2
Periodic Table/Elements

Brief Description of Group to be Taught: Eighth grade, ~24 students per class (2 classes), varying ability levels, some students on IEP's

Name of Nationally-Validated, Standards-Based Curriculum: Full Option Science System (FOSS), Chemical Interactions – Teacher Guide, 2008

Relationship of this Activity to the Unit: This 4 day activity seamlessly follows Activity 1 – Mystery Powders. This lesson introduces the students to the Periodic Table and elements (following from Day 6 of Activity 1), combinations of elements, and their properties. This lesson will enforce Activity 1's purpose – that all matter is made up of different substances, having different physical and chemical properties, which are manifested in physical and chemical changes, and that chemical changes occur when a reaction happens, and anchor these in a tangible form – the Periodic Table. This activity also introduces the new concepts of the names of these individual elements, their combination into compounds, their common properties, and how these elements and compounds make up the human body (as well as all other living and non-living things) and certain elements/compounds are necessary for human survival. There is also a relationship to health, and taking good care of one's body by eating foods that supply these necessary basic elements/compounds.

Massachusetts Frameworks Strand and Learning Standard (all are grades 6-8 frameworks):
· *Physical Science* 5 – Recognize that there are more than 100 elements that combine in a multitude of ways to produce compounds that make up all of the living and non-living things that we encounter.
· *Physical Science* 6 – Differentiate between an atom (the smallest unit of an element that maintains the characteristics of that element) and a molecule (the smallest unit of a compound that maintains the characteristics of that compound).
· *Physical Science* 7 – Give basic examples of elements and compounds.

· *Language Arts 1.3* – Apply understanding of agreed upon rules and individual roles in order to make decisions.
· *Language Arts 1.4* – Know and apply rules for formal discussions
· *Language Arts 4.18* – Determine the meaning of unfamiliar words using knowledge of common Greek and Latin roots, suffixes, and prefixes.
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Science Concepts:
· Day 1 – Give basic examples of elements and compounds.
· Day 2 - Recognize that there are more than 100 elements that combine to make up everything in the universe (living and non-living). There is nothing else besides these elements.
· Day 3 - Differentiate between an atom and a molecule.
· Day 4 – Give basic examples of the uses of elements in every day life.

Process Skills:
· Day 1 – Interpreting Data
· Day 2 – Defining Operationally
· Day 3 - Classifying
· Day 4 – Communicating

Science Habits of Mind:
· Day 1 – Look at a matter from many sides before drawing a conclusion. Do not jump to conclusions or decide on the basis of one observation; deliberate and examine until you are as sure as you can be.
· Day 2 – Buttress statements with facts found in books, articles, and databases, and identify the sources used and expect others to do the same.
· Day 3 – Compare consumer products and consider reasonable personal trade-offs among them on the basis of features, performance, durability, and cost.
· Day 4 – Question claims based on vague attributions (such as "Leading doctors say…") or on statements made by celebrities or by any others outside the area of their particular expertise.

Session Length: Four 45-minute periods.

Activity 2 Materials Needed:
· large Periodic Table to hang in classroom (1)
· something to write with (1 for each student and teacher)
· flip-chart (1)
· computers (at least 12, ideally 24)
· blank Periodic Table to fit 3x3" sticky notes (150)
· Periodic Table to fit 1.5x2" sticky notes (150)
· consumer product labels (at least 15)
· STC video "Properties of Matter"

TIME	PROCEDURE
Day 1 Prep	1. Put up large Periodic Table poster somewhere in the room (this will stay there for the rest of the week, if not the year. Consider it available from this point forward.) 2. As on Day 6 of Activity 1 - Make chart on the board of the 5 mystery powders common names, chemical names, and formulas. 3. Make sure extra Handout 4 from Activity 1 are available for those students who've forgotten theirs.
Day 1 20 min	**Question Set #1** 1. Tell students to get out their individual Periodic Table handouts. Ask them "how many of these elements do you recognize?" Discuss each element as it is named. Give interesting facts, see what students know about each. Make sure by the end of this, students are told/discover that "elements are the basic building materials of matter. Everything on Earth that has mass and occupies space is made of combinations of elements. All substances are made of elements – just as the mystery powders are. Each element has a name and is represented by a one or two letter symbol in the table." Provide interesting information about Greek vs. Latin nomenclature, and give background information e.g. about Na for Natrium, or Sodium, and the derivation of the word, relationship to water/pools in the Roman Empire, baths, etc. hydrargyros from Latin for "water and silver" and how it really looks, etc.
Day 1 20 min	**Question Set #2** 2. Ask students to get out their handouts showing the elemental composition of the 5 mystery powders. Give out worksheet with questions (See Handout 1, in appendix of Activity 2) – Which substance has greatest # of elements? Altogether, how many different elements are there in the 5 substances? Which element is found in the greatest # of substances? How many elements are in the substance carbon dioxide? How many elements are in the substance water? Which of the 5 mystery powders are made of 2 elements, 3 elements? Have them work in groups at their tables to answer these questions. Circulate and clarify anything necessary. Assign as homework anything that does not get completed.
Day 1 5 min	**Reconvene and Discuss** 1. Ask students what the difference between and element and a compound is. Make sure definitions are clearly stated.
Day 2 Prep	1. Reserve computer lab so students can work individually at computers. If not possible, arrange so enough computers are available that students can work in pairs. ~12 computers. 2. Make handout with following questions, "What element is the

	most abundant in the vicinity of Earth? What is the elemental/compound composition of air? Water? The Earth's crust? The human body? Universe as a whole?" (See Handout 2 in appendix of Activity 2.)
Day 2 3 min	**Brief Intro** 1. Allow for quick settling of the students and give out worksheet (Handout 2 in appendix of Activity 2) to be completed in computer lab, telling students they will be working in the computer lab the whole class on a "in silico lab." Explain that concept briefly. Tell them this worksheet needs to be done tomorrow, and should be completed in the 40 minutes allotted. They will be researching these questions on the computer.
Day 2 40 min	**Computer Lab** 1. Allow students to research the questions on the computer individually if possible, in pairs if necessary. Help them find reliable websites, critique sources. 2. Ask students questions about what is there besides these elements found in the universe. What is space made of? What is air made of? Make certain they are aware that there is NOTHING where there are no elements. 3. If this doesn't take them more than 30 minutes, come back to classroom and discuss answers to handout questions.
Day 2 2 min	**Homework Assignment** 1. Tell students it is necessary that each one of them bring in at least one consumer product with the nutrition info listed on it…as many as possible if they have more. Tell them to take a look at the backs of these products for recognizable elements and compounds that we've been discussing. Suggest vitamins, personal care products, cereal, canned soups, but say that anything with a product label stating ingredients is applicable. 2. Give students article "Elements in the Universe" and tell them to read it for homework. 3. Give students handout with the following questions, "What is an element? How are matter and elements related? How was Mendeleyev able to predict the existence of elements that had not yet been discovered? What is the Periodic Table of the elements?" (These are the questions they are responsible for from the reading – see Handout 3 in appendix of Activity 2.)
Day 3 Prep	1. Gather at least 15 consumer product packages for kids who have forgotten or had no access to them.

Day 3 10 min	**Discuss Element Reading and Questions** 1. As students are walking in, check off that they have completed their homework. Tell students to work in the groups of 4 that they're sitting with at their "home" table, and come to a consensus on their answers to the 4 questions on their homework handout. As they discuss, go around and listen for what students are "getting it," and which are not.
Day 3 5 min	**Introduction of Elements in Products** 1. Tell students that all matter is made of elements, and say that we all come in contact with a lot of different forms of matter every day. Ask students what elements do they think these products are made of, and why. Hold up a box of cereal and say that students may know the elements in some of the ingredients, such as water or salt.
Day 3 10 min	**Consumer Product Groupwork** 1. Tell students to work with partners (assign partners) and look at the labels of the products they brought in, and list the elements they see in their products, and the ingredients of their products (if they see a compound of which they know the elemental composition.) 2. Go around as students complete this groupwork activity and help those who may have things like "ascorbic acid" and "sugars" and "carbohydrates" in their products. Also help them with unfamiliar chemical symbols which may not have been discussed e.g. Phosphorus, Manganese, Fluoride, etc.
Day 3 10 min	**Reconvening of Class and Making Active Periodic Table** 1. Call on one group to name an element they found. Write the chemical symbol and its atomic number on a 1.5x2 in. sticky note and put it over Zn on the Periodic Table. Continue calling on groups, and as they name elements, write the symbol on the board, and tell representative from the group to write the symbol and atomic number on the sticky note and put it on the Periodic Table. Get groups doing this concurrently, because there could be up to ~30 elements.
Day 3 10 min	**Removal of Elements and Response Sheet** 1. Hand out sheet that accounts for the three main concepts the students are accountable for at this point. (See Handout 4 in appendix of Activity 2) Have students sit quietly and answer these questions on their own while you remove sticky notes from Periodic Table and put them in order by atomic number down a large piece of flip-chart paper. 2. Collect these sheets from the students and use as assessment. 3. Tell students to make sure to bring their answers from the computer lab (Activity 2, Day 2) to class the next day.

Day 4 Prep	1. Make large Periodic Table in which to stick 3x3" Post-Its on each box where the element should go with the symbol, atomic number, and major use(s) of element. 2. Video "Properties of Matter" from STC curriculum
Day 4 15 min	**Discussion** 1. Hand out sheet with the questions below (see Handout 5 in appendix of Activity 2.) Discuss following questions with students: a) What element is among the five most abundant elements in the Sun, Earth, ocean, atmosphere, and organisms? b) What does it mean when people say everything is made of stardust? c) Why are the elements carbon, oxygen, nitrogen and hydrogen (CHON!) important to life on Earth? d) How can there be so many different substances in the world if there are only a few elements that are common? If they don't know, refer them to "Elements in the Universe" reading.
Day 4 15 min	**Show Video** 1. Show pertinent 15 minutes clip of "Properties of Matter" video – extension of understanding of elements/compounds to their uses in everyday living.
Day 4 15 min	**Element-Use Table Creation** 1. Point out newly-hung up blank Periodic Table. Ask students to get out their handout-sized Periodic Tables. Tell them to brainstorm in their groups at their table (name a recorder for the group who's job it is to make sure EVERYONE is writing down what they discuss) what the major uses are for elements, one by one. The video will have given them ideas, as will the mystery powders activity, as will their analysis of consumer product labels. Tell them they will be given 5 minutes, and name a time-keeper for each group as well. Tell them they will be filling in the blank Periodic Table with the uses they come up with. Name a reporter and the starter as well. 2. After about 7 minutes (always give them a couple minutes more than originally stated), get class's attention, and group by group, ask reporter to name an element, the uses of the element, then hand them a 3x3 sticky note and tell them to stick it to the blank Periodic Table in the correct location. If they don't know it, ask them what the atomic number of that element is. Refer them to their hand-out-sized Periodic Table if they don't know. Them tell them they can count across to where that number belongs. Continue this until ~2min before class ends. 3. With just a couple minutes left, ask the students to stop and

	quietly think about everything they have learned over the past two weeks. Ask them to think specifically about what everything in the world and universe is made of. Ask them to picture it on the atomic level. What does "space" look like vs. the air in the classroom? What does water look like vs. the table? What are the differences? What are the similarities? Tell them they've done an excellent job putting on the hat of a chemist.

ACTIVITY 1 APPENDIX

Assessment – Activity 2, Day 1

	Novice	Competent	Expert
Science Concept: Give basic examples of elements and compounds.	Can name elements from the Periodic Table	Can name elements from the Periodic Table and trace them to where they appear in their mystery powder formulas, understand the formulas in a basic sense	Can name elements, their uses, abundance, and demonstrate understanding of chemical formulas
Process Skill: Interpreting Data	Can name the elements in the chemical formulas for the mystery powders	From the chemical formulas, can generally assign abundance values to specific elements	Can assign abundance values for specific elements in the white powders as well as other unknown chemical formulas, and make prediction of properties based on formulas
Habit of Mind: Look at a matter from many sides before drawing a conclusion. Do not jump to conclusions or decide on the basis of one observation; deliberate and examine until you are as sure as you can be.	Routinely counts abundance values and learns some element symbols, but does not attribute meaning	Begins to learn element symbols and understands abundance in a formula. Questions these formulas.	Considers the meaning and implication of the chemical formula, asks probing questions about how these formulas were discovered

Assessment – Activity 2, Day 2-3

	Novice	Competent	Expert
Science Concept: Recognize that there are more than 100 elements that combine to make up everything in the universe (living and non-living). There is nothing else besides these elements.	Can repeat what is written under this "science concept," but cannot explain concept of "something vs. nothing"	Grasps concept of "something vs. nothing" in empty space vs. air in classroom, as well as everything being made of of these ~100 elements and NOTHING else	Shows deep understanding of "something vs. nothing" as well as that everything is made from the same ~100 elements (and nothing else)
Process Skill: Defining Operationally	May or may not understand "something vs. nothing" and everything from same ~100 elements, rudimentary recited definition	Can simply define the concept of "something vs. nothing" and everything is made from the same ~100 elements in a way in which it is obvious the concept is understood and not just recited	Can explain science concept through use of an analogy/metaphor, something meaningful which can be used by teacher to help explain to other students
Habit of Mind: Buttress statements with facts found in books, articles, and databases, and identify the sources used and expect others to do the same.	Does not refer to outside sources when explaining science concept	Refers to at least one article read or one online website reviewed when explaining science concept	When creating analogy for science concept, uses facts learned from online research, articles read, and other knowledge sources

Assessment – Activity 2, Day 1-3

	Novice	Competent	Expert
Science Concept: Differentiate between an atom and a molecule.	Can recite definition of atom and molecule	Can define atom vs. molecule using working definitions (examples from lab)	Shows deep relational understanding of atom vs. molecule and how the differences can be demonstrated in everyday life
Process Skill: Classifying	Has basic understanding of how atoms and molecules fall into different classes of "things"	Can cite 1-2 properties each of atoms vs. molecules	Can site multiple properties each of atoms vs. molecules and how this is significant to a life situation
Habit of Mind: Compare consumer products and consider reasonable personal trade-offs among them on the basis of features, performance, durability, and cost.	Makes basic numeric comparisons about amounts of elements/molecules in different products	Makes numeric comparisons about amounts of elements/molecules in different products and is able to root these in scientific data observed	Thinks critically about the nutritional content of packaged goods and can explain why certain content would be better or worse for a person or the environment

Assessment – Activity 2, Day 2-4

	Novice	Competent	Expert
Science Concept: Give basic examples of the uses of elements in every day life.	Able to name up to 5 elements and their properties/uses	Able to name up to 15 elements and their properties/uses	Able to name more than 20 elements and their properties/uses as well as elements which were not previously discussed
Process Skill: Communicating	Makes basic factual statements	Makes factual statements as well as scientifically supported inferences which can be easily understood by teacher and classmates	Makes factual statements as well as scientifically supported inferences, and seeks to explain other, yet un-discussed phenomena supported by data
Habit of Mind: Question claims based on vague attributions (such as "Leading doctors say…") or on statements made by celebrities or by any others outside the area of their particular expertise.	May repeat statements from other classmates or heard in advertising about elements and their uses…cannot explain phenomena with scientific data/backing	Does not just repeat rote statements about the uses of elements…shows evidence of individual research and interest in products	Does not just repeat rote statements about the uses of elements…shows evidence of individual research and interest in products, as well as scientific skepticism and further explanations of elements in daily life

Handout 1 – Activity 2, Day 1 Classwork Sheet

Name:_____ Date:_____

Answer the following questions:

1) Which substance has the greatest number of elements?

2) All together, how many different elements are there in the 5 substances? What are their names?

3) Which element is found in the great numbers of substances?

4) How many elements are in the substance carbon dioxide?

5) How many elements are in the substance water?

6) Which of the mystery powders are made up of 2 elements? 3 elements?

Handout 2 – Activity 2, Day 2 Classwork Sheet

Name:_____ Date:_____

Answer the following questions:

1) What element is the most abundant in the vicinity of Earth?

2) What is the elemental/compound composition of air?

3) What is the elemental/compound composition of water?

4) What is the elemental/compound composition of the Earth's crust?

5) What is the elemental/compound composition of the human body?

6) What is the elemental/compound composition of the universe as a whole?

Handout 3 – Activity 2, Day 2 Homework Sheet

Name:_____ Date:_____

Answer the following questions:

1) What is an element?

2) How are matter and elements related?

3) How was Mendeleyev able to predict the existence of elements that had not yet been discovered?

4) What is the Periodic Table of the elements?

Handout 4 – Activity 2, Day 3 In Class Assessment Sheet

Name:_____ Date:_____

Answer the following questions:

1) Eda studied the ingredients on a box of cereal. She made a list of the elements she found. She told her friend, “This cereal contains eight different elements. I wonder what the rest of the cereal is made of?”

   If you were Eda’s friend, what would you tell her?

2) What is the difference between an atom and an element?

3) Write down the name of three elements and three compounds.

Handout 5 – Activity 2, Day 4 Class Discussion Sheet

Name:_____ Date:_____

Answer the following questions:

1) What element is among the five most abundant elements in the Sun, Earth, ocean, atmosphere, and organisms?

2) What does it mean when people say everything is made of stardust?

3) Why are the elements carbon, oxygen, nitrogen and hydrogen (CHON!) important to life on Earth?

4) How can there be so many different substances in the world if there are only a few elements that are common?

Addendum

If I had time/extra enrichment:

Enrichment Field Trip/Experience:

Possibly integrate one day of class where a nutritionist came in and talked about why it is important to supply these different elements and compounds to our bodies through varied healthy food. Could get into biochemical pathways - not too in depth, but enough to make an impact on the science behind good eating. This would incorporate the following standards into my lesson plan:

Health – Growth and Development Standard 1.8 – Describe the influence of health habits on growth and development
Health – Growth and Development Standard 1.9 – Apply skills that increase immediate peak functioning of body systems (vigorous exercise, eating nutritious foods, adequate rest)
Health – Nutrition 3.1 – Identify the key nutrients in food that support healthy body systems and recognize that the amount of food needed changes as the body grows

(Explained further in Ch. 7 Questions)

Use of probes:

Many of the probes suggested during class and in the reading would have tangential use during the lesson plans I developed. If the students were so inclined, temperature probes could help define more accurately temperature changes occurring when different mystery powders/mixtures were dissolved in water. These temperature changes would be undetectable to normal human senses. As I said, this would be very tangential, but if students were so inclined, this technology could help enhance their understanding of the dissolving process. pH probes could be used in a similar manner – as students are dissolving their mystery powders/mixtures in water, they could use pH probes to measure a change in pH much more accurately than they could with pH paper.

(Explained further in Ch. 5 Questions)

Simulations:

On Day 6 of Activity 1 added in 4 websites which students could access for enrichment:

http://www.chemsoc.org/viselements/pages/pertable_fla.htm
http://www.funbrain.com/periodic/index.html
http://www.brainpop.com/science/matter/atomicmodel/
http://www.edumedia-sciences.com/m231_l2-3d-molecules.html

(Explained further in Ch. 5 Questions)

Evaluation of Unit Plans

Before making final edits to this plan, I taught for two days in Chad Pelton's eighth grade classroom in Brookline. He has two sections of eighth graders, one block after the next in the afternoon, and I taught both of these classes both days, because that way, according to Chad, they would be in the same place.

Because I only had two days in the classroom, I realized quickly that I would not have nearly enough time to complete the mystery powders lesson and bring the students to a complete understanding. This was unfortunate, and I would have liked to carry it through, or have Chad carry it through. Because of time constraints, however, Chad had to return to a different unit after I taught my two days, and I had to return to my full time job, so I had to have some semblance of a wrap-up at the end of the two days. Therefore, my lesson plans changed somewhat when I taught in actuality. I introduced four (instead of five) mystery powders on Day 1, and gave them the mystery mixtures as well as the physical/chemical properties handout on Day 2 (Handout 3, Day 5 of Activity 1). We also managed to have a short summary discussion on Day 2 about physical vs. chemical properties.

I could write about so many things, but since it would take pages, I'll discuss some major points about the content, as well as the behavior, and aspects that could have been improved.

First I'd like to say – I don't know how full time teachers do it. There is so much planning involved. I guess as a person becomes familiar with her students, and learns the tricks of the trade, it becomes easier. I spent a lot of time agonizing about whether I had all the materials available and ready, and of course, some parts still went wrong. I had to do a lot of preparation before class to get all of the powders out and labeled, however, the students used a lot more of the stock mystery powders, and between the first and classes on the second day of teaching, a couple of the powders ran out, and I did not have time to refill them. Secrecy about the identity of the powders was necessary, so it wasn't like I could just run over and pour more sugar into the pan. Chad was left trying to pour them hiding behind his desk. It wasn't ideal. Also, on the second day, I hadn't made two sets of the mystery mixtures: one for the first class, and one for the second. Luckily, the first class didn't use up all of their mystery mixtures, and there was just barely enough for the second class to get by.

These kids were messy. There was a lot of clean-up to do in not a lot of time. The students cleaned up somewhat, but Chad and I were left to do most of the dirty work afterward, and it was almost impossible to get cleaned up between the two classes, with only a couple minutes between when the first class left and the second one came in. Again, the time constraints, if I had my own classroom, would have been minimized because I wouldn't have had to cram everything into two days of lessons, but rather would have been able to use the ideal 2 weeks of the unit plan. That would have left a lot more time for preparation, clean-up, enhanced understanding, and discussion.

Something that struck me about the students' understanding was that many of them did not seem to grasp the concept of fidelity in testing. I didn't want to force a procedure upon them, but in the two days, for the most part, they did not come to the understanding that in order to have a fair test, the same amount of material has to be used, and the same test procedure must be performed. I would have liked more time to

discuss that with them. Some of their testing was so messy and poorly planned that despite having only four mystery powders, and me telling them that their mystery mixture contained exactly two of those four powders they had previously tested, some of them did not come to the correct conclusion. I know the "answer" is not the most important part, but I could see as they were doing their testing, because of their disorganized approach and messy habits, they were not coming to the correct conclusions. Most of them did understand the concept of process of elimination and analysis of results, and could give a decent explanation of why they thought their mystery mixture contained certain powders. The problem remained, however, that they often mislabeled their powders and did not keep track during experimentation, so even though it was powder 3 that turned blue/black with iodine, they told me it was powder 2 that turned blue/black. Obviously there had been some mislabeling.

In terms of classroom management, I have much to learn. The kids miraculously kept quiet and were respectful during discussion at the beginning and end of class, but during the middle of class, if I called for their attention, it took more than a minute for them all to give me their attention. I think it could have been chaos if Chad was not present. I came in one day previous to teaching and introduced myself. Chad said that his students tend to eat people alive if they are not introduced, and their authority not established, previous to teaching. That preliminary day, when I came in and introduced myself, the first question I was asked was "Is Mr. Pelton going to be here when you teach?" I translated that as "Are we actually going to have to behave and do work, or is it going to be a free for all where we intimidate you and eat you alive?" Chad answered that one, saying he would be present.

Overall, it was a great experience to be able to try out my lesson in practice. This was made possible by Chad's generosity. I learned that teaching is tiring, takes a lot of planning and effort, but can be very rewarding and fun.

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