Charlotte Teachers Institute
Collaborative Teacher Education

Curriculum Unit Title

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Davidson Elementary

This curriculum unit is recommended for:
5th Grade Science

Keywords: Matter, Solid, Liquid, Gas, Physical Changes, Chemical Change, Reaction

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit. (Insert a hyperlink to Appendix 1 where you've stated your unit's main standards.)

Synopsis:

Teaching science should be filled with magical experiences for your students! This unit teaches students how to identify physical and chemical changes through hands on experiences. The main objectives are identifying the three states of matter, comparing the mass of an object before and after a change, and identifying physical and chemical changes. The background information in this unit includes common misconceptions students have on the topic of matter. If this topic is new to your teaching standards it may be useful to read this information. Students keep an interactive notebook throughout the unit to record their thoughts, explanations, and lab reports. To begin the unit, two options are offered to activate prior knowledge with your students. Four demonstrations are included which cover the objectives of this unit. These magical demonstrations will allow teachers to have a meaningful experience to refer back to when emphasizing scientific points in their teaching. An experiment for students to conduct in groups is also included which gives students a chance to explore what happens to the mass and temperature of water as it melts. Lastly, an 8 rotation exploration is included which gives students a chance to think critically about physical and chemical change.

I plan to teach this unit during the coming year to 25 students in 5th grade science.

Changes that Matter: Physical and Chemical Change

Nicole Fraser

Introduction, Objectives, and Rationale

This unit takes the topic of physical and chemical changes and attempts to paint a picture of these changes through demonstration and small group experiments/lab work. My goal is to provide my students with opportunities that will leave a lasting impression. This lasting impression will embed the big ideas of science they need to know so as they continue with their education, giving their science teachers in the future a good foundation to build on. You can spend all day reading how to do something but it isn't until you try it out yourself that you really understand how or why something works the way it does. Science shouldn't be just reading a textbook, but trying out new ideas and reading the textbook to support the science you just experienced.

When I think of science, I imagine people asking why questions and conducting experiments. Unfortunately I do not always foster this thinking in my classroom. Last year, several new standards were added to the 5th grade science curriculum. With so many topics to teach and the pressure of getting all the material in for the test, I often rely on the textbook to get the required curriculum to my students. Even though the textbook offers a fast, easy to plan lesson, it is not the best approach in fostering the imagination of young scientists.

This unit has several objectives falling under the concept of matter. First I want my students to understand the material changes between the three states of matter. The water cycle will be used as a way to demonstrate water changing between the three states of matter. The students also should understand that the changes occur due to energy and in this case the energy input of the Sun. The students will be able to describe the changes using the words evaporation, transpiration, condensation, and precipitation.

The second objective explores the mass of a material before and after a material change. The students should learn that matter is neither gained nor lost in an interaction such as when an ice cube melts; the water will have the same mass before and after the change.

The third objective requires students to describe properties of a material and compare those properties to the material after a physical or chemical change has occurred. Properties will include state of matter, smell, color, shape, temperature, etc. To master this objective, students will first define what is meant by a physical and chemical change. They should be able to demonstrate an example of each kind of change and explain why the change was physical or chemical.

There are many ways to teach a science unit. In the next several paragraphs I will explain why I chose the teaching strategies and activities for this unit. It all begins when we first come into this world, and we try to make sense of the world around us. As children people are naturally curious and often ask the question, "Why?" Through this questioning adults often give us answers that are not completely true but convenient and the easiest way to explain the concept; an answer that will hold us over until we are finally old enough to "truly" understand the scientific meaning. We also come up with our own conclusions, which, often times are not correct. These well intended answers and conclusions often set up students to come to class with a set of misconceptions. Through my research of common misconceptions about physical and chemical changes, I have found that I myself am still guilty of holding these misconceptions. As educators we hold a responsibility to teach students the scientific reasoning's and not tricks and easy to remember sentences that at times can mislead students.

Today it is believed that people learn science through constructivism which means that we use our past experiences to make sense of new ideas[1]. With all students having a different set of experiences, we are faced with teaching a class with different preconceived notions dealing with science. Because of this, it is best practice to first find out what students know about a topic so you can determine what ideas may be at odds with the science you will teach[2]. If you know what students already assume is true, you can proactively plan demonstrations and activities that will prove the misconceptions inaccurate. We cannot assume that, because we teach an early level of science, we are teaching to a blank slate. As I mentioned earlier, as soon as we are born we are beginning to form our own answers to how the world works, which makes elementary science perhaps the most important time to make accurate explanations of science a priority so we build a solid foundation for students to understand complex scientific concepts later.

This unit will not necessarily work for every group of students so it may be helpful to learn a little about the group of students I designed this unit for. Even if your student demographics aren't exactly like mine, I hope that you can tweak the strategies and activities to fit your group of students!

In my class there are 25 students in grade 5, ages 10 and 11. Our class community fosters a climate of working together as a family. My students express many different interests and ability levels and possess varying amounts of background knowledge and leadership skills. Together, the students balance each other and motivate one another to face the challenges presented to them. The students can benefit from each other when I strategically create groups taking into account their learning styles, interests, ability levels, and the motivations of each student.

My class has 15 students identified as gifted, and 3 students identified with exceptional needs. Two of these 3 students require extra guidance in the areas of reading and writing while one needs accommodations to cope with ADHD in the classroom. Within the 7 students not identified, lies a wide range of abilities and learning styles. The students I teach are high performing, with over 90 percent on or above grade level. The parents support their children in any way possible, and most of them hold college degrees.

For the subject of science I teach in a self contained classroom, so I use heterogeneous groups to establish an atmosphere that challenges all of my students. Each student offers a different perspective which takes the content to a variety of depths. I teach this class every other day for a period of 45 minutes and have three computers to use as a resource. This unit will be taught over a period of 4-5 weeks.

Background Information

Three States of Matter

Defining an object as a liquid, solid, or gas seems like a simple idea, however over time many misconceptions are developed concerning these concepts. When classifying objects, it is important to refer to them as materials. Often students think materials must be solid[3]. However, scientifically the definition of materials includes solids, liquids, and gases. First I would like to define the scientific properties of each state of matter[4].

Solid	Liquid	Gas
*Has its own shape. *Cannot change its volume. *Particles are very close together and are in a fixed position in a regular pattern.	*Can be spilled. *Takes the shape of the container. *Cannot change its volume. *Can flow. *Particles are very close together and are not in a fixed position.	*Fills its container *Volume can change (can be compressed). *Can flow. *Particles are far apart and are free to move randomly at high speeds.

As a side note there are two types of solids. Amorphous solids appear solid but the atoms or molecules are disordered and crystals are solids where atoms or molecules are arranged regularly in all three directions. An example of amorphous solid is glass which is made by rapidly cooling liquid and an example of a crystal solid is a diamond or copper.[5]

When working with states of matter, students should know that materials are not permanently solid, liquid, or gas but can change depending on temperature[6]. Pressure also effects state changes, but according to *Misconceptions in Primary Science*[7] this concept is best left to later years of learning. A material is generally given its state label at room temperature. Many times students find it hard to classify a material as solely a solid. Some confusing examples are items with air such as footballs and balloons. Materials that are soft solids also may throw students off such as candle wax, butter, and jelly.[8]

The material of powders such as sand and flour tend to create two misconceptions for students when dealing with the three states of matter. The first is that since powders can be poured, spilled, and take the shapes of their containers students classify them as liquids.[9] The second is that solids are lighter in powder form.[10] A material in powder form has air spaces which many people believe make it lighter than its solid form. However, if you take a solid piece and grind it into powder and weigh the two materials they will have the same mass.

As stated previously, materials can change state due to temperature changes. The changing of materials to different states comes with a few common misconceptions. One misconception is that if you melt a solid it becomes lighter[11]. An example of this is ice melting to water. When the ice melts the volume also decreases. With my experience with 5th graders, I think that the change in volume leads them to believe it must have less mass. They often equate the greater the volume the more a material will weight. Scientifically, when material melts there is a change in state, but the number of particles is the same assuming there is no loss due to evaporation.

The concept of boiling liquids is the heart of the next two misconceptions. The first is that boiling is an irreversible change[12]. An example of this is water steaming off of a boiling pot which students may think cannot be recaptured. The second misconception dealing with boiling liquids is those liquids that evaporate or boil disappear[13]such as a puddle evaporating on a hot day. What cleared this misconception up for me was the realization that there is a difference between boiling and evaporation. According to *Misconceptions in Primary Science* boiling is the state change that takes place when a liquid becomes a gas at its boiling point (water turns into steam). Evaporation is when a liquid becomes a gas below the boiling point (water turns into water vapor). Since water vapor is invisible this may be the source of why many students believe evaporated or boiling liquid disappear and are the same process.[14]

The water cycle lends itself as an effective vehicle for teaching the three states of matter and how materials can change states through temperature. Within this cycle are clouds which follow many properties of a gas and even look gaseous. Many students have the misconception that clouds are made from gas[15]. Scientifically, clouds are composed of microscopic water droplets that are so tiny they have a weight low enough that can be carried by the air currents. As more and more water droplets collide they become too heavy and fall to the Earth as precipitation. If visible, such as a cloud, then there must be liquid water present for the cloud to be visible, while water vapor and steam are invisible.

Physical and Chemical Change

A basic chemistry concept taught at the elementary school level is the determination of whether a change to a substance is physical or chemical. This topic was added to my science curriculum last year, causing me to research the concept so I could teach it to my students. I found myself giving my class a basic checklist to determine the type of change. This checklist included determining if the change was reversible, if there was the production of a new substance, and if there was heat involved. This checklist barely touched the surface for truly understanding the concept of physical and chemical changes. This simplified rubric also led to many unanswered questions that had my students and I "Google" searching for answers. One particular example involved determining the type of change if we were to mix paint colors. Being the over-analyzers that we are, we started wondering if there was some sort of chemical reaction when mixing the paint, if molecules were altered in some way, and if the color change pointed to a chemical change instead of a physical change. After reading an article from the journal *Science and Children*[16] I realized I led my students down a path of misconception! Let me share with you some of the big ideas from the article and give some depth to physical and chemical changes that I've learned.

The article defines physical change as a change to physical appearance and chemical change as a change that creates something new through a reaction between two substances. When analyzing whether a change is physical or chemical, it is crucial to have more than one piece of evidence to support our decision. The above definitions serve as a starting point to critically thinking about the change taking place.

A common misconception is that physical changes are reversible and chemical changes are not. This idea is usually true but there are exceptions such as the physical change of cracking an egg (the egg is now changed its physical appearance but not its chemical make-up) and the chemical change of mixing salt water which breaks apart to create ions (new chemical species) but when we evaporate the water we can get back the salt. If we dissolve sugar, we don't necessarily make new chemical species, thus this process would be better understood as a physical change.

Another misconception is that physical changes do not involve heat and all chemical changes do. Again the idea is mostly true but there are exceptions such as the physical change of popping corn, or melting ice which all involve heat, while the chemical change of metal rusting over a long period of time seems to involve no heat at all (in truth, this reaction does produce heat, but very slowly, thus not easily noticed). When giving examples of chemical change teachers often use cooking and burning which indirectly leads students to the misconception that only chemical change can involve heat. Adding in examples of physical changes, such as changes in state (ice, liquid, and steam for example) with heat can help show students, heat is not only for chemical changes.

No matter what the type of change, it is important for students to understand that matter is not lost or gained in any of these types of processes. One misconception is that when an object burns, part of it disappears and no longer exists such as when we burn wood[17]or when we burn a candle, the wax does not burn but melts[18]. Scientifically, when the wood or candle burns, carbon dioxide, carbon monoxide, and water escape as gases. The water produced immediately boils due to high temperatures of the reaction and escapes as steam at first, and then condensing somewhere else as it cools. In order to dispel this misconception you would need to burn one of the materials in a closed container where no matter could escape and weigh it before and after.

The misconceptions outlined in the *Science and Children* article basically highlighted the very checklist I was using in my teaching! No wonder we were all so confused. Being aware of these misconceptions and purposefully planning to use examples that address them will help students develop a more grounded understanding of physical and chemical changes. Providing opportunities for students to explore these changes and providing multiple pieces of evidence to support the changes will lead students to develop a more thorough thought process in correctly explaining what is happening to the substance. Through exploration and demonstration the goal should be for students to think of a physical change as changes in states of matter which rearrange the molecules and to think of chemical changes as not just mixing two substances but an interaction that makes new molecules.

With chemical changes, there are a few more misconceptions when dealing with specific examples. When burning paper shrinks to leave ash, part of it has evaporated[19]. Part of this misconception goes back to the basic idea in states of matter that only liquids can evaporate. The literary use of the words evaporate (to disperse or disappear) and melt (mysterious disappearance)[20] may lead students to misuse the words when talking about scientific changes of matter.

When teaching chemical changes, the reaction of rust often is used as an example. Here are three common misconceptions dealing with rust. One misconception is that rust is a type of decay caused by a fungus[21]. Since wet weather enhances the development of rust students often clump this with their understanding that organic materials decay in damp areas due to fungi, bacteria, and insects[22]. Scientifically, when iron or steel is exposed to prolonged moist conditions it helps the chemical change because it is the combining of oxygen and water from the air that produces the brown/orange iron oxide or rust. Another misconception is that rust is an impurity from within the metal that works its way to the surface over time[23]. They may believe that if you scrap away the top layer of metal you will find rust underneath. The third misconception is that when metal rusts, its mass decreases[24]. Scientifically the metal actually gains mass because more oxygen has been added to the material.

Chemical Changes	Physical Changes
*cooking an egg *toasting bread *burning wood *baking a cake *metal rusting *sun burning skin *copper turning green	*mixing Kool-Aid and water *popping corn *boiling water *melting ice *freezing water *add sugar to water *crack an egg

When teaching this topic, the following information may help build your own background on chemical changes. This information comes from the book *Understanding Chemistry* by CNR Rao[25]. Some general rules for identifying a chemical change are that a gas evolves, a solid precipitates out of solution, a color change, a substance disappears, and/or there is a new smell. In chemical reactions, the bonds of the molecules are either formed or broken, which results in the rearrangement of atoms, which requires energy. Often times in a chemical reaction, the energy is in the form of heat. A reaction where heat is produced is said to be exothermic such as when water freezes into ice. A reaction where heat is absorbed, such as when ice melts to water, is endothermic. The same chemical reaction can happen at different speeds depending on the conditions. The book explains many conditions that can affect the speed of a reaction, but the condition of temperature's effect on speed applies the most to teaching 5th grade students. The temperature doubles the reaction's speed for every 10 degree rise in temperature. This condition lends itself to two real life examples: we keep food in the fridge to slow decomposition and during heart surgery; patients are cooled to slow biological reactions.

Strategies

Interactive Notebook

During science instruction it is helpful if students have a notebook where they can record and process ideas. The book *Teaching Science with Interactive Notebooks* by Kellie Marcarelli[26] is a fabulous resource on information about using interactive notebooks in class. The following strategies all have elements that students could use when recording information in their notebook. For each unit I will have my students create a cover page for the unit where they write the title of the unit at the top, and throughout the unit, add pictures to the cover page to show the big ideas of the unit. Students will use the notebook throughout the year to review their work and study for tests.

Principles vs. Content

When planning a science unit, it is important to identify the key scientific principles and not to get weighed down by all the details. At the elementary level, students are not going to remember little details in a year from now. If we can teach the big ideas and scientific principles that go across science disciplines, we will be setting up the students for success through their scientific studies in future years. In this age of testing, it seems students must memorize a plethora of facts, but spending so much energy memorizing is not necessarily the best way to learn science. Once you identify the big ideas you want your students to walk away with, you can design your specific lessons so they always connect back to the big idea.

Determine Prior Knowledge

According to the book, *Misconceptions in Primary Science*[27] it is best for teachers to actively search for misconceptions by introducing activities that highlight them. Determining where your students are with a scientific concept will allow you to tailor your teaching to your students. As a result of this probing, you will not waste time teaching ideas they already understand and will not be making assumptions about what they know. There are several ways you can determine prior knowledge in the science classroom:

a. True/False Statements: Have students answer true or false to the essential questions in your unit. From analyzing this data you will be able to determine which ideas to spend more time on and which the students already know.
b. Pretest: Give students the end of unit test first and see what they already know. You could then create content groups based on the data so you do not have to teach concepts to students who already understand the material. Using center activities you could decide who will need to visit what center based on their test results.
c. Concept Cartoons: Have a picture of two people stating a science idea (it could be true or false) then have students discuss the picture and share their thinking. Through this conversation you could uncover misconceptions students may have about the concept.

Once the teacher has pinpointed the misconceptions of the class, the next step is to correct the idea. The prior knowledge can be used as a link to help students to a better understanding of the correct scientific idea. For example, you could use real life examples or familiar TV shows/movies that highlight a misconception.[28]

Demonstration

When planning demos they must have a point such as sparking interest, teaching/showing a concept, getting students to ask questions, or to tie ideas together. Demonstrations will create a lasting memory that you can always come back to throughout the year to revisit ideas or reinforce scientific concepts. Prompting the class with "remember when..." and then teaching the concept of interest will connect the students to the concept and give a concrete example of what you are teaching. Without demonstrations, memorizing vocabulary and answering textbook questions will lack an intuitive meaning and not have a hook to help students understand the scientific concepts. Demonstrations could still include student responsibility such as recording a hypothesis, observations, and conclusions in their science notebook. Drawing a picture of the demonstration may also be helpful for future reference to help them remember what happened.

Exploration Stations with Guiding Questions

According to *Misconceptions in Primary Science*[29] people learn best with hands on tasks where they are given the opportunity to plan, observe, record, interpret, and draw conclusions. For me personally, it can be a challenge to trust if I give my students total freedom to design and conduct experiments and still trusting what I want to happen will happen. However, when students are given some freedom to plan and perform an experiment through making a prediction and testing that prediction, the learning will naturally become more meaningful[30]. With a little creative thinking you can come up with ideas that make students think they have a lot of freedom but you have actually set it up to lead them in a certain direction. For example, you could give the students guidelines on the materials they are allowed to use or you could give students a few hypotheses and ask them to perform tests to see which one is true.

When providing the students with an experimental experience they should also record the process in their science notebook. The students should first write a hypothesis (an educated guess) of what they believe will happen. Next they should write out a step by step procedure, as well as a method for recording observations/data (chart). The students then can reflect on their hypothesis and their observations and write a conclusion. The conclusion also provides an opportunity for you to provide guiding questions that will help the students discover the purpose of the experiment. Finally, the students should write down any questions they might have had while doing the experiment and they now have answers for as well as questions that are still unanswered. For the first several experiments, the students will have to be walked through the proper way to write their lab report. However, after modeling it several times, your class should be able to set up their notebook and carry out the steps of the experiment on their own. The questions the students write down at the end of their report can serve as a tool in assessing what the students still do not understand, as well as a serving as a starting point for the students when creating their own experiments in an effort to answer their questions.

Classroom Activities

Activity One: Activating Prior Knowledge
Materials: Interactive White Board (optional), Why Can't You Unscramble an Egg? By: Vicki Cobb

As stated in the strategies previously, there are many ways to activate prior knowledge with your students before beginning a unit. Here are two options that apply to the topic of physical and chemical changes of matter.

A. True/False Statements: These types of questions could be presented to the class in a variety of ways. You could transfer the following statements to a document that you will pass out to your students, display the questions on an interactive white board and have the students write their thoughts in their science notebook, or orally read the questions to your class. Here are 12 statements which address the objectives of this unit. I have put the correct answer in parentheses for your reference. Since students have a 50% chance of guessing the correct answer, it may be helpful to require students to also include an explanation for their answer, especially the false responses

1. When a balloon is heated or cooled, the mass changes (F)
2. Water can change its state of matter to either a solid, liquid, or gas. (T)
3. A material changes its state because of temperature changes. (T)
4. Jelly is an example of a liquid. (F)
5. When you melt ice into liquid water, it gets lighter. (F)
6. A puddle of water disappears on a hot day due to evaporation. (T)
7. Once water evaporates, it stays as a gas forever. (F)
8. Clouds are in the gaseous state. (F)
9. Water freezing to ice is a physical change. (T)
10. Burning wood is a chemical change. (T)
11. Burning a candle is a physical change. (F)
12. Blowing up a balloon is a chemical change. (F)

B. Concept Cartoons: The book *Why Can't You Unscramble An Egg?* by Vicki Cobb[31] includes 8 questions related to matter. For each question the author has included a concept cartoon and several pages of scientific explanation. There are two questions that apply most closely to the objectives in this unit. The first is "How Does Wood Burn?" on pages 32-35. The concept cartoon is on page 32 and could be presented to the students to get them discussing what exactly happens when wood burns. It is one of those questions many students have not thought about more deeply, they just know that it does! Pages 33-

35 could be read aloud in class after discussing the cartoon. The second question in the book is "Why Can't You Unscramble an Egg?" and is on pages 36-38. There are two concept cartoons with this section (page 36 and 38). The first cartoon will get students thinking and wondering if some changes are irreversible. The second cartoon will get students thinking about the chemical reactions in our own bodies. Pages 37-38 also could be read aloud in class after discussing the cartoons. Each of these cartoons shows three students observing a real life scenario such as wood burning. The students have speech and thought bubbles which would provide the points of discussion with your class.

Activity Two: Demonstrations
Materials: 2 large clear containers, water, electric kettle, access to refrigerator, ice cubes, cabbage, blender, vinegar, laundry detergent, several glasses, flash paper, lighter, baking soda

As stated above in the strategies, demonstrations help to paint a picture for the remainder of the unit. These demonstrations are meaningful because you can keep coming back to them throughout the unit to reinforce the concepts. Here are 4 demonstrations that focus on the objectives in this unit.

A. Objective: State Change
Demonstration: Cloud in a Cup
Prep: Before class use an electric kettle to boil water. Place another large container that you can place upside down on the first container in the freezer for several hours.
Demonstration: For the demonstration pour the boiling water into a large container. Take the other large container and place upside down on the first container. These containers should be see-through so students can observe what is happening. Place ice cubes on top of the upside down container to make it colder. A cloud should form inside of the cup! This demonstrates the state changes of water due to temperature changes. As a side note you can also show your students a video clip by Steve Spangler where he uses pressure to create a cloud in a bottle and also reverses the effects highlighting how pressure change also causes a state change.[32] http://www.youtube.com/watch?v=msSVQ903T8k.

B. Objective: Chemical Change, Color Change
Demonstration: Cabbage Indicator
Prep: Before class take a few large cabbage leaves and put them in a blender that is about half filled with water. Blend the cabbage until you have cabbage juice. In an earlier class ask the students to bring in various liquids to test in this experiment. These could include baking soda, lemon juice, soda, fruit juice, sports drinks, or anything else your students think of!
Demonstration: For the demonstration, fill three glasses with cabbage juice. In the first, add some vinegar and stir. The color should change to a red to indicate an acid. In the second, add laundry detergent. The color should turn to a green to indicate a base. The third glass should have water added to it. The color should not change to indicate a neu-

tral substance. Use other glasses filled with cabbage juice to test the liquids brought in by students. Use the original three glasses as references to determine if the liquid is acid, base or neutral. The main purpose of this demonstration is to show the students that a color change usually means there has been a chemical change. The information concerning acids and bases is more of a side note, but a great way to introduce students to an idea they will learn within the next few years of their education.

C. Objective: Chemical Change, Heat/Light
Demonstration: Flash Paper.
Prep: Flash paper is a chemical compound that ignites quickly and seems to disappear into thin air. You can make your own flash paper and a quick internet search will give you several sources on how to create your own. A more convenient option is to buy the flash paper. Many magic stores sell this item and you can also order it online on www.amazon.com.
Demonstration: Just light the paper and toss to see an intriguing light show! This demonstration will show students that heat and/or light is another indicator of a chemical change.

D. Objective: Chemical Change, New Substance
Demonstration: Vinegar/Baking Soda
Prep: Take a large container and place a cup of baking soda inside.
Demonstration: For the demonstration, pour vinegar into the container and watch the bubbles form! This demonstration shows students that during a chemical change a new substance is formed. In this case, the new substance is carbon dioxide gas.

Activity Three: Scientific Method, Mass of frozen vs. liquid water.
Materials: Each student group will need the following materials: balancing scale, metal weights, cup, ice, water, and thermometer.

In this activity, students will follow the scientific method as described in the teaching strategies. Students should work in groups for this activity and each student should complete a lab report in their notebook as described in the teaching strategies section. Students will take a cup of ice and balance it on the scale. They will also take the starting temperature of the ice water. Every five minutes students should record the temperature of the water. This experiment does not end until the ice has completely melted. You may choose to setup this experiment and have your students work on another task and stop to record the temperature every five minutes. This experiment should lead the students to a few conclusions. First, the balance should not change from the beginning to the end of the experiment; highlighting that mass does not change with a state change. Second, the temperature of the water should not change because all of the energy is going into melting the ice.

Activity Four: Exploration Stations (Physical and Chemical Changes)
Materials: All materials are needed for each student group unless otherwise noted: egg, cup, salt, spoon, water, popcorn, access to a microwave, computer paper (per person), scissors (per person), vinegar, baking soda, orange juice, cracker (per person), two paint colors, and cup.

In this activity there will be 8 stations that students will rotate through. Students will spend 5-10 minutes per station so you will need about 1 1/2 hours to complete this activity. This activity could be split up over more than one class period if necessary. See appendix page 2 for a chart that students could use during these rotations to record their work. Students should work in groups of 3-4 for each rotation. Here is a list with brief description of each rotation.

A. Crack an Egg: Students will crack an egg into a bowl. (Physical)
B. Mix Salt and Water: Students will pour salt into a cup of water and stir. (Chemical)
C. Pop Corn: Students will use a microwave to pop corn kernels. (Physical)
D. Paper Snowflake: Students will cut a piece of paper into a snowflake. (Physical)
E. Vinegar and Baking Soda Bag: Students will put 1 tablespoon of baking soda into a sandwich bag, then students will pour one fourth of a cup of vinegar into a snack size bag. Students will put the sealed snack bag into the sandwich bag and seal it as well. Students will bang the bag until the vinegar bag pops. Eventually the sandwich bag will pop too as it fills with gas. If possible, have this rotation outside! (Chemical)
F. Orange Juice and Baking Soda: Students will pour orange juice into a cup of baking soda. (Chemical)
G: Eat a Cracker: Students will chew a cracker and keep it in their mouth until they notice a taste change. (Chemical)
H: Mixing Paint: Students will mix together two different colors of paint in a cup. (Physical)

After students complete the rotation and chart you may want to provide them with some guiding questions to discuss in their groups. Here are some examples of questions.

1. According to your observations, what kind of change was cracking an egg? Would you change your answer if you had scrambled it with a fork? Explain.
2. How could you separate salt and water?
3. What is the difference between producing heat and using heat?
4. What chemical reactions take place in the human body?
5. When you mixed the paint, was a new substance created? Explain.

When disposing of chemicals it is always important to follow the proper disposal guidelines. If you decide to use other materials that are not everyday food items make sure to research the correct way for disposal. For the above materials paint is the only material that may pose a problem. Finger paints and water colors can be disposed down the sink.

If you use latex paints let them dry out until they turn solid. Then you can put them in the trash. You could also use a drying agent such as kitty litter to speed up the process. If you have more questions on how to properly dispose of items contact your local trash organization.

Conclusion

The above activities are not exhaustive of what you could do with this unit. Teaching chemical and physical changes has many demonstrations and experiments involving food that may fit your needs more effectively. Below are the books I used to gather my ideas and could be a starting point if you are interested in seeing what other experiments are out there. By the end of the unit the students should have the big idea that changes are happening all the time. They also should have a grasp on the big idea that chemical changes create new substances and physical changes only change the appearance.

Bibliography

Teacher Books

Allen, Michael. *Misconceptions in Primary Science.* Berkshire, England: McGraw-Hill :, 2010.
This book covers common misconceptions found in early science education. The book has four sections including an introduction which covers how people learn science. The scientific sections are life processes and living things, materials and their properties, and physical processes.

Lott, Kimberly, and Anita Jensen. "Changes Matter!." *Science and Children* 50, no. 12 (2012): 54-61.
This article summarizes ideas found in the chapter titled Chemical Changes in Materials found in the book above. The article's authors also add some of their own insight into common misconceptions of students on this topic.

Marcarelli, Kellie. *Teaching Science with Interactive Notebooks*. Thousand Oaks, Calif.: Corwin Press, 2010.
A great resource on using interactive notebooks in the classroom. The book begins with an introduction, explains how the notebooks promote learning, gives guidance on giving student's ownership of their notebooks and shows how the notebooks can be used in the classroom.

Rao, C. N. R.. *Understanding Chemistry*. Singapore: World Scientific Pub. Co., 2010.
A basic college textbook that is written in an easy to understand format. Chapters of interest include Chemistry in a Capsule, Chemical Energy, and Chemical Reactions.

Teacher Websites

Helmenstine, Anne Marie. "Make Ice Cream in a Baggie - Freezing Point Depression." About.com Chemistry - Chemistry Projects, Homework Help, Periodic Table. http://chemistry.about.com/cs/howtos/a/aa020404a.htm (accessed August 18, 2013).
This website gives a materials list and step-by-step directions on making your own ice cream. It also provides a scientific explanation of the chemical change.

"Royal Society of Chemistry | Advancing Excellence in the Chemical Sciences." Royal Society of Chemistry | Advancing Excellence in the Chemical Sciences. http://www.rsc.org/ (accessed September 15, 2013).
From the main site click on the education link which will lead you to information for teachers and students. There are many videos on this site of demonstrations that you could use in class when you do not have the materials to conduct the demonstration yourself.

YouTube. "Cloud in a Bottle - Cool Science Experiment." YouTube. http://www.youtube.com/watch?v=msSVQ903T8k. (accessed November 21, 2013). This website is a demonstration of Steve Spangler creating a cloud in a bottle using air pressure.

Student Books

Cobb, Vicki, and Ted Enik. *Why Can't You Unscramble an Egg?: and other not such dumb questions about matter.* New York: Lodestar Books, 1990.
This book contains 9 chemistry based questions that students may ask. It then offers a few page explanation including illustrations of children discussing the concept. These illustrations could be used as discussion points with your students to see what they think about each topic.

Coelho, Alexa, and Simon Field. *Why is Milk White? & 200 Other Curious Chemistry Questions.* Chicago: Chicago Review Press, 2013.
This book is divided into ten sections: people and animals, plants, household chemistry, health and safety, things that catch fire or go bang, things that stink, color, chemistry in the world, chemists, and food. Some of the sections also feature a project students could complete.

Cooper, Christopher. *Matter.* New York: DK Pub., 1999.
This book provides information on 29 subtopics of matter. Each subtopic has two pages devoted to it including pictures and scientific explanation.

Gardner, Robert, and Jeff Brown. *Kitchen Chemistry: Science Experiments to do at Home.* New York: J. Messner, 1982.
This book offers experiments students could perform at home. Many of the experiments require a sink, refrigerator or stove. Depending on your classroom resources you could use many of these in the classroom as well.

Loeschnig, Louis V., and Frances W. Zweifel. *Simple Chemistry Experiments with Everyday Materials.* New York: Sterling Pub. Co., 1994.
Each experiment in this book includes a purpose, materials list, procedure, and an explanation of what should happen and why. It also includes pictures that show each step in the experiment.

Newmark, Ann. *Chemistry.* New York: Dorling Kindersley, 2000.
This book features 29 big ideas of chemistry. Each idea has two large pages devoted to it and includes scientific explanations and pictures to explain the ideas.

Spangler, Steve. *Naked Eggs and Flying potatoes: Unforgettable Experiments that Make Science Fun.* Austin, Tex.: Greenleaf Book Group Press, 2010.
This book includes experiments in five categories: the power of air, kitchen chemistry,

dry ice, gooey wonders, and don't try this at home...try it at a friend's home. Each experiment includes a materials list, step-by-step procedure, and a scientific explanation. Some experiments also offer ideas for how to take the experiment one step further.

VanCleave, Janice Pratt. *Janice VanCleave's A+ Projects in Chemistry: Winning Experiments for Science Fairs and Extra Credit.* New York: Wiley, 1993.
This book includes 30 projects from various aspects of chemistry. These experiments offer step-by-step directions and scientific explanations. These would be useful to give students for an extra credit assignment or if your school offers a science fair. The experiments could be used in class but go beyond the scope of this unit.

VanCleave, Janice Pratt. *Step-by-Step Science Experiments in Chemistry.* New York: Rosen Pub., 2013.
This book offers experiments in six categories: what's the matter Air, H2O, and other things, here's superman but where's Clark, salty solutions and sweet success, it's crystal clear, kitchen alchemy, and the lab: CO2 and you. Each experiment includes a thought to ponder, materials list, what to do, what happens, and why.

Students Websites

"Chemistry for Kids - Fun Experiments, Free Games, Cool Projects, Science Online." Science for Kids - Fun Experiments, Cool Facts, Online Games, Activities, Projects, Ideas, Technology. http://www.sciencekids.co.nz/chemistry.html (accessed October 13, 2013).
This site includes experiment ideas, videos, games, images, facts, lessons, science fair projects and quizzes.

"Rader's CHEM4KIDS.COM - Chemistry basics for everyone!." Rader's CHEM4KIDS.COM - Chemistry basics for everyone!. http://www.chem4kids.com/ (accessed October 13, 2013).
This site includes information on matter, atoms, elements, the periodic table, reactions, and biochemistry. It also has quizzes on the information presented on the website.

"The Science Spot: Chemistry - Matter, Atoms, & more." The Science Spot. http://sciencespot.net/Pages/kdzchem.html (accessed October 13, 2013).
This is a collection of websites that fall under the topic of chemistry, atoms, and more. There are at least 50 links on this site that could be valuable in teaching chemistry.

"ZOOM . kitchen chemistry . home | PBS Kids." PBS KIDS. http://pbskids.org/zoom/games/kitchenchemistry/ (accessed October 13, 2013).
This site gives a virtual experience of using a cabbage indicator. It uses common household items as the test materials. You virtually poor cabbage juice into each one to deter-

mine if it is an acid or a base. There are other sections to the website to explore as well that connect to the PBS program ZOOM.

Notes

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[6] Allen, Michael. *Misconceptions in Primary Science.* Berkshire, England: McGraw-Hill :, 2010. Page 101.
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[16] Lott, Kimberly, and Anita Jensen. "Changes Matter!." *Science and Children* 50, no. 12 (2012): 54-61.
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[30] Allen, Michael. *Misconceptions in Primary Science.* Berkshire, England: McGraw-Hill :, 2010. Pages 11-12.
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[32] YouTube. "Cloud in a Bottle - Cool Science Experiment." YouTube. http://www.youtube.com/watch?v=msSVQ903T8k. (accessed November 21, 2013).

Appendix 1

North Carolina Essential Standards

Matter: Properties and Change

Essential Standard:
Understand the interactions of matter and energy and the changes that occur.

Clarifying Objectives:
5.P.2.1 Explain how the sun’s energy impacts the processes of the water cycle (including evaporation, transpiration, condensation, precipitation and runoff).
5.P.2.2 Compare the weight of an object to the sum of the weight of its parts before and after an interaction.
5.P.2.3 Summarize properties of original materials, and the new material(s) formed, to demonstrate that a change has occurred.

Appendix 2

Name______________________________________

Directions: As you move from each rotation complete the chart below. Remember your main focus is to determine if the change that occurs is chemical or physical. You must record the properties **before** you complete the change! If you forget then you will not be able to accurately go back and complete that column.

For the last column you must include two pieces of evidence to support your answer. Here is a list of examples for each type of change.

Chemical: produces a gas, color change, substance disappears, new smell, heat, light
Physical: state change, change to appearance, chemical bonds did not change

Rotation	Properties Before (state, smell, color, shape)	Properties After (state, smell, color, shape)	Chemical or Physical? Must include at least two pieces of evidence!
Crack an Egg			
Mix Salt with Water			
Pop Corn			

Rotation	Properties Before (state, smell, color, shape)	Properties After (state, smell, color, shape)	Chemical or Physical? Must include at least two pieces of evidence!
Paper Snowflake			
Vinegar with Baking Soda Bag			
Orange Juice with Baking Soda			
Eat a Cracker			
Mix Paint			

Higher National Unit specification General information for centres Unit code: F3S3 34 Unit purpose: The Unit is intended for candidates who are employed in an early years and childcare setting or have.Â Download "Unit title: Curriculum and Assessment in an Early Years and Childcare Setting". Error: Download Document. Author title pub date note pub type edrs price descriptors. Identifiers. Barca, Deborah "A Changing Planet: Cultural Worldviews and the Environment". A Curriculum Unit for Grades 5 and 6. 1997-05-00. 71p. Guides Non-Classroom (055) MF01/PC03 Plus Postage.Â A Curriculum Unit. for grades 5 and 6: "A Changing Planet: Cultural Worldviews and the Environment". Each curriculum unit provides examples about implementing Primary Connections guided-inquiry teaching and learning approach. When units are brought to life by teachers, students engage in hands-on activities, opportunities for representation using multiple modalities, collaboration, reflection, self and peer assessment. Learning activities embedded in units are rich and offer great scope for teachers to learn from students, with students and about student learning of science. Search by unit title or keyword: Filter by