**Name(s):** \_\_\_Dr. Kris Sherman\_\_\_\_\_\_\_\_

**Date/Time (start to finish)**

**Name of Course, Grade, and Level (Pre/AP, Honors, Advanced, Academic):** \_\_8th Grade Science\_\_\_\_\_\_

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| **Science Topic** | Evidence of a chemical change |

**Title of Lesson: (Creative title that will interest the students)**  How Do I Know It IS a Chemical Reaction?

**Concept Statement:**

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| * A chemical reaction involves the breaking of chemical bonds among atoms and formation of new chemical bonds among atoms. The formation of new chemical bonds leads to new substances with new properties that differ from the starting substances in the reaction.
* Evidence that a chemical reaction occurs includes (1) formation of a precipitate, (2) formation of a gas (smell or bubbles), (3) energy change (absorbed or released), and (4) a color change in the reaction mixture.
* Chemical reactions can be distinguished from physical changes by their irreversible nature.
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**Source of Lesson:**

Harrell, P., Subramanian, K. (2010). 8.5E: Chemical reactions. Simply Outrageous Science.

**List of appropriate TEKS:** Chapter 112.20. Science Grade 8

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| **TEKS #** | **Student Expectation** |
| 1.A & B |  The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:(A)  demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards(B)  practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials. |
| 2 C, D, E | The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:(C)  collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, **writing,** and graphic organizers;(D**)  construct tables and graphs**, using repeated trials and means, to organize data and identify patterns; and(E)  analyze data to formulate reasonable explanations, **communicate valid conclusions supported by the data**, and predict trends. |
| 4 A & B | The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:(A)  use appropriate tools to collect, record, and analyze information, including **lab journals/notebooks**, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, **thermometers**, calculators, **computers**, spectroscopes, timing devices, and other equipment as needed to teach the curriculum(B)  use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher. |
| 5E | (5)  Matter and energy. The student knows that matter is composed of atoms and has chemical and physical properties. The student is expected to:(E)  investigate how evidence of chemical reactions indicate that new substances with different properties are formed |

|  | **Objectives**Write objectives in SWBAT form. | **Evaluation Questions (at least one open-ended)**Each question should match the written objective. You may use one of your sample TAKS/STAAR problems as a guiding template for your evaluation questions. **Note**: these should be the SAME questions you are utilizing in the evaluation section. **Include *answers* to all questions.**  |
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| 1 | Identify the four types of evidence of a chemical change. | What are the four types of evidence of a chemical change? |
| 2 | Distinguish between chemical and physical changes using evidence. | Go **to DropBox and watch the video “Blazing Glory.”** What happens when glycerin is added to the container of potassium permanganate? Is this a chemical reaction or a physical change? Explain your answer with evidence from the video. |
| 3 | **Observe and record evidence for chemical reactions using cameras, thermometers, and video cameras.** | What stations showed evidence of color changes? **Attach evidence for ONE station by inserting a picture from your tablet into this document, then describe the reaction that took place under the picture.** |

**Resources, Materials, Handouts, and Equipment List in the form of a table:** for a class of 30 students working in pairs – Quantities of materials for lab activities in Explore can be adjusted based on number of students in the class and/or numbers of repeated stations for the Explore.

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| **ITEM****(Specify worksheets)** | **Quantity****(How many do you need?)** | **Source** **(Who is responsible?** | **List who this is for (teacher, student, group)** |
| **Android tablet with built in camera** | 30 | teacher | teacher and students |
| **Apps for tablet: Evernote, video edit, DropBox, graph, calculator, word processing program** | 1 of each per tablet | teacher | teacher and students |
| **DropBox account access** | 1 account – accessible by teacher and students | teacher | teacher and students |
| computer projector with either Bluetooth compatibility with tablet or wiring to connect computer to projector | 1 | teacher | teacher |
| lab activity directions in plastic sleeve protectors | 1 per station | teacher | student |
| baking soda/sodium bicarbonate (NaHCO3) | 1 large box | teacher | teacher |
| distilled white vinegar/5% acetic acid solution (HC2H3O2) | approx. 500 mL or 1 quart bottle | teacher | teacher & students |
| red cabbage | 2-3 leaves chopped or shredded | teacher | students |
| distilled water | 1 gallon | teacher | teacher & students |
| aqueous ammonia (NH3) – purchase ammonia cleaner from grocery store | 1 bottle | teacher | students |
| whole milk or half-and-half | 1 quart | teacher | students |
| green food coloring | 1 bottle | teacher | teacher |
| salt/sodium chloride (NaCl) | approx. 75 g | teacher | students |
| purple or blue glow stick | 1-2 | teacher | students |
| calcium chloride, powder (CaCl2) | approx. 75 g | teacher | students |
| phenol red indicator | approx. 150 mL | teacher | students |
| balloons | 1-2 | teacher | teacher |
| plastic spoons  | 1 box | teacher | teacher and students |
| safety goggles | 30 (one per student plus teacher) | teacher | teacher and students |
| splash apron | 30 (one per student plus teacher) | teacher | teacher and students |
| 250 mL beaker | 6 | teacher | students |
| 9 V battery or lantern battery | 1 | teacher | students |
| 14-gauge or 18-gauge wires – 12in. length | 2 | teacher | students |
| 50 mL beakers or small plastic Dixie-style cup | 3 | teacher | students |
| disposable graduated pipette | 20-30 | teacher | students |
| triple beam or electronic balance | 2 | teacher | students |
| alcohol thermometer | 1-2 | teacher | students |
| 150 mL beaker | 1 | teacher | students |
| quart-size zippered plastic bag | 15 | teacher  | students |

**Advanced Preparations:**

1. Prep Balloon demo by placing 2 spoonsful of baking soda (sodium bicarbonate) inside a large balloon. Wipe it clean. Pre-measure 20 mL white vinegar into a graduated cylinder.

2. Prep chemicals for Chemical Changes lab according to teacher page of handout.

2. Set up stations for Chemical Changes lab according to handout. Each station needs sufficient chemicals so that the entire class can work in pairs. Make signs to hang above each station so students know which station to go to. Set up the stations so that there is sufficient physical space between stations, and so that students can see the rotation pattern to complete the activity.

3. Assign students to lab pairs.

4. **Make sure that all tablets are fully charged and synced with DropBox so students can access lab handout**.

**Safety:**

1. Because chemicals and chemical solutions are being used in this lesson, students must wear safety goggles and a splash apron during the experimental procedure. Teacher should wear goggles and splash apron throughout the entire lesson.

2. Horseplay and improper use of chemicals and equipment in the lab will result in removal from lab.

3. All chemicals must be disposed of properly. The chemicals being used are household chemicals and of rather low concentration, so disposal in a waste container provided by the teacher will be sufficient.

**5E Lesson Plan**

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| **Objective Statement:** Students will investigate the different forms of evidence of a chemical reaction and use this evidence to correctly identify changes as being chemical or physical. |
| **ENGAGEMENT Time : Minutes 5 minutes** |
| **What the Teacher Will Do**  | **Probing/Eliciting Questions and Students Responses** | **What the Students Will Do** |
| *SAFETY: Teacher should wear goggles and splash apron throughout the demonstration.*Good afternoon! My name is Dr. Sherman.Hold up a balloon containing 2 spoonsful of baking soda inside (Students should not see baking soda in balloon. Balloon should have baking soda in it before beginning class.). Announce to the class that you have a new way to blow up balloons. Tell students to watch closely as you pour the vinegar into the balloon, then tie the balloon off. Once the balloon is tied, flip it right-side up so that the students can see the balloon expand and fill with gas.Ask students to describe what just happened, then ask them to explain why it happened.Say “What you just saw was a chemical reaction. Today, we are going to investigate chemical reactions. How do you know if you have a chemical reaction?” | What happened to the balloon?[After you tied the balloon, the balloon got larger and was filled with gas/air. There was a liquid still in the balloon.]Where did the gas come from?[the liquid, a chemical reaction]Do you think the liquid in the balloon is the same now as when I poured it into the balloon? How do you know?[No – the liquid is different because the formation of the gas caused it to change.]How do you know if you have a chemical reaction?[color changes, temperature changes/increases, makes a new substance, bubbles, etc.]  | What are students doing during the engagement activity? Students are watching teacher perform the demonstrations, then answering teacher’s questions about the demonstration and about chemical reactions. |
| **Transition Statement**  |
| Now that we have seen how a chemical reaction can inflate a balloon, let’s investigate other forms of evidence of chemical reactions. |

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| **EXPLORATION Time: 30 Minutes** |
| **What the Teacher Will Do**  | **Probing/Eliciting Questions and Student Responses** | **What the Students Will Do** |
| Instruct students to open the file \_\_\_\_\_ in **DropBox** on their tablet. This file is instructions for their lab activity.Instruct students to create a new **EverNote notebook**. This file is for gathering evidences of chemical reactions that occur throughout the lab activity. All notes, pictures and videos related to the lab are kept here.Instruct students to obtain a pair of safety goggles and an apron, and to put them on correctly. Model this behavior, if necessary.Instruct students to be careful with the tablets as they are working in the lab: Avoid getting them wet or getting chemicals on the tablet, keep the screen covered when you are not using the tablet.Teacher will direct students to start at a specific lab station, complete the lab activity as described in the handout file, **record data using their camera and video camera**. All data will be kept and organized in the **EverNote notebook**. Questions will be answered within the electronic file for the student lab handout.Lab stations include:1. acetic acid + ammonium hydroxide [Universal indicator added shows color change with change in pH. A distinct odor is produced, ammonia gas. Direct students to waft the gas toward their nose and not to inhale it directly.]2. half-and-half + acetic acid [white fatty clumps form]3. sodium bicarbonate + acetic acid colored green [bubbling of mixture and color change]4. water decomposition with battery and wires [bubbling of gas]5. diphenyl oxalate + hydrogen peroxide [light energy released as fluorescence of diphenyl oxalate occurs]6. acetic acid + calcium chloride + phenol red [color change and temperature change]7. citric acid + sodium bicarbonate + water [bubbling and temperature change] | Why do we need to wear safety goggles and a splash apron today?[to protect our eyes and our clothes from chemical splashes in our face and on our clothes]Where do we dispose of our chemicals when we are done with an activity?[put the chemicals in the designated waste container]What do you notice as \_\_\_\_ and \_\_\_\_ are mixed together?[color changes, bubbles form, the test tube becomes hotter/colder]When the mixture ‘bubbles,’ what is actually happening?[A gas is being formed.]Where does the gas come from?[The gas comes from the reaction mixture]What did you notice about the temperature after you mixed the two substances together? Why did the temperature change?[The temperature rose/dropped after the two substances are mixed. The temperature rose because the reaction mixture released energy, or the temperature fell because the reaction mixture absorbed energy.]Is this change a chemical or physical change? How do you know? | In their new **EverNote** notebook, students will write a note in complete sentences that predicts whether the changes they see at each station are chemical or physical. This note is called “Hypotheses for Each Station.”Students will wear safety goggles and aprons properly to protect their eyes and clothing.Students will complete the lab activity and record all pertinent observations and data as instructed in the lab handout. Students will use tablet to record **videos of gas formation**, **photos of color changes** (before 🡪 after), written data in file throughout the lab activity. Graphs of temperature changes will be completed using **graphing app**.Students will dispose of all used chemicals properly and clean all equipment when they are finished with the experiment before moving on to the next experiment.Students will organize their photos, videos, and other data neatly in their **Evernote file**.  |
| **Transition Statement:** |
| Now that we have investigated and collected evidence that chemical reactions take place, let’s put this evidence together and draw some conclusions about all chemical reactions. |

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| **EXPLANATION Time: 10 Minutes** |
| **What the Teacher Will Do**  | **Probing/Eliciting Questions and Student Responses** | **What the Students Will Do** |
| Ask questions about each of the stations. Have students **share photos with instructors from their tablet for the teacher to project on the screen.** After discussing the experiments, the teacher will explain the terms *precipitate, gas production, exothermic, and endothermic*.The teacher will then have the students generalize their results to apply to all chemical changes.The teacher will then further distinguish chemical and physical changes by discussing how color changes are expected in physical changes (like making Kool-Aid) and unexpected in chemical changes (like the reaction in Station 1).  | What did you see happen at Station 1?[The red acetic acid was mixed with the blue ammonium hydroxide forming an unexpected greenish solution.]What did you see happen at Station 2?[As half-and-half was added to the acetic acid, white clumps formed and fell to the bottom of the container.]What did you see happen at Station 3? [Adding sodium bicarbonate to green acetic acid resulted in bubbling – gas production.]What did you see happen at Station 4? [Tiny bubbles form on both wires. More bubbles are on one wire than on the other. Gases produced]What did you see happen at Station 5?[Adding hydrogen peroxide to diphenyl oxalate made the mixture glow. Temperature did not change, but energy released as light.]What did you see happen at Station 6?[Adding acetic acid to calcium chloride + phenol red resulted in an unexpected color change to clear and temperature increase. Heat is released.]What did you see happen at Station 7? [Mixing citric acid and sodium bicarbonate in water produced a gas and temperature decrease. Heat is absorbed.]What are the types of evidence we have for chemical reactions?[unexpected color change, formation of a precipitate, formation of a gas, energy being either absorbed or released]When does a color change not indicate a chemical reaction has taken place?[when it is expected]When doesn’t bubbling indicate a chemical reaction has taken place?[when it is a part of a physical change like boiling water or opening a soda] | Students will answer probing questions when called upon, **share photos, videos, and graphs through DropBox** **with the teacher directly from their tablet to the teacher’s computer/tablet for projection**. |
| **Transition Statement**  |
| Now that we have investigated the different forms of evidence of chemical reactions and determined what those general forms are, let’s take a look at some different changes and identify those as being chemical reactions or as physical changes. |

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| **ELABORATION Time: 10 Minutes** |
| **What the Teacher Will Do**  | **Probing/Eliciting Questions and Student Responses** | **What the Students Will Do** |
| Teacher will walk around and monitor student access to video files and ask about the videos:“Marshmallows in a Syringe”“Frying an Egg”“Zinc and Muriatic Acid”“Dissolving and Evaporating” | What did you see happen in the “Marshmallows in a Syringe?” Is this a chemical or physical change? Why?[The marshmallow expanded when the plunger was pulled, then the marshmallow shrank to a much smaller, squished, size when the holder’s finger was released from the hole. This is a physical change because there was no color change, no gas produced, no precipitate, nor a temperature change. The marshmallow’s size and shape changed.]What did you see happen in the “Frying an Egg” video? Is this a chemical or physical change? Why?[The egg changed color as it was frying from clear to white and from an orangey yellow to a light yellow. This is a chemical change because energy was absorbed (Heat is applied, not produced!) and the color of the egg changed.]What did you see happen in the “Zinc and Muriatic Acid” video? Is this a chemical or physical change? Why?[The zinc began to turn black, then small pieces break off the larger chunk of metal. The acid bubbles and the temperature rises. This is a chemical change because the color of the zinc changed, a gas was produced, and energy is released.]What did you see happen in the “Dissolving and Evaporating“ video? Is this a chemical or physical change? Why?[The person poured salt into water, stirred, and the salt disappeared. After heating the mixture for a few minutes on a slide, the mixture bubbled and a white crusty residue was left on the slide. This is a physical change because no color changes occurred unexpectedly, and the gas produced was a result of boiling.]  | Students are instructed to go to **DropBox** and watch several videos uploaded by teacher:“Marshmallows in a Syringe”“Frying an Egg”“Zinc and Muriatic Acid”“Dissolving and Evaporating”Based on these videos, students will classify the processes shown as either chemical or physical. They will create a new note in **Evernote** called “Applying What I’ve Learned” where the students record their classifications and justifications based on what they saw in each video. |
| **Transition Statement**  |
| Now that we have looked at some different changes, let’s summarize our findings.  |
| **Closure Statement**  |
| Today we have studied different chemical changes. We have determined what evidence we need to prove if a change is either chemical or physical and applied that knowledge to new changes. |

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| **EVALUATION Time: 5 Minutes** |
| **What the Teacher Will Do** | **Probing/Eliciting Questions** | **What the Students Will Do** |
| The teacher will direct the students to write a conclusion about the four types of evidence of a chemical reaction **referencing the photos and videos in their Evernote notebook** into the conclusion where it is appropriate. This will be a new note in their notebooks. Then, the students will be directed to **share their Evernote notebooks with the teacher in Dropbox.**The teacher will ask the students to complete “What I Learned Today” **on their tablet and save the document in the class’ folder on DropBox**. Students should not save the quiz on their tablet. |  | Students will write a conclusion that summarizes the four different types of evidence of a chemical reaction and write a description of one lab station that illustrates this evidence with **references to photos and/or videos within their Evernote notebooks**. This will be a separate note in **Evernote** called “Conclusions.” Students will organize their work in **Evernote**:1. Pictures and videos are titled with the station name. 2. Notes and pictures are arranged in a logical order with the hypotheses at the top/beginning, data in the middle, lab questions, “Applying what I’ve learned”, and “Conclusions.” Students will upload their Evernote file into their class’ folder on **DropBox**.Students will access and complete “What I Learned Today” on their **tablet** and save the document in the **class’ folder on DropBox.** |