



Chemical Changes Stations

Type of Lesson:	1. <u>Content with Process</u> : Focus on constructing knowledge through active learning.	
IPC Content TEKS:	8A 8B	Students distinguish physical from chemical changes in matter. Students analyze energy changes and classify them as exergonic or endergonic.
Learning Goal/ Instructional Goal:	<p>General Objective Students investigate physical and chemical changes and learn the difference between the two changes.</p> <p>Instructional Objectives</p> <p>During this activity, the students will be able to:</p> <ol style="list-style-type: none"> 1. follow proper lab safety procedures and demonstrate their safety skills. 2. observe and describe the evidence and results of each experiment. 3. apply the concepts of physical and chemical changes to decide if each station's reaction shows evidence of a physical or chemical change 4. detect any temperature changes during reactions and classify them as exergonic or endergonic. 	
Key Question:	What evidence can be observed to classify changes in substances as physical or chemical changes?	
Related Process TEKS:	(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices	The student is expected to: (A) demonstrate safe practices during field and laboratory investigations; and (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials .
	(2) Scientific processes. The student uses scientific methods during field and laboratory investigations.	The student is expected to: (A) plan and implement experimental procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology; (B) collect data and make measurements with precision; (C) organize, analyze, evaluate, make inferences, and predict trends from data; and

		(D) communicate valid conclusions.
	(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions.	The student is expected to: (A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; (B) draw inferences based on data related to promotional materials for products and services; (C) evaluate the impact of research on scientific thought, society, and the environment; (D) describe connections between physics and chemistry and future careers; and (E) Research and describe the history of physics, chemistry, and contributions of scientists.
To the Teacher:	<p>Chemical reactions occur when the chemical bonds that hold atoms together are broken and new bonds form. During these reactions, new substances with new sets of properties are formed. By making careful qualitative and quantitative observations, chemical reactions can be detected when they occur.</p> <p>Physical changes occur when a substance changes size, shape, or appearance but still remains the same substance. For example, when paper is cut into four pieces, it is still the same substance and no new substance is created. If the paper is burned, then the paper is no longer paper but ashes. Once the original material becomes something different, a chemical change has occurred.</p> <p>During these experiences, students have the opportunity to observe different clues when a chemical reaction takes place. Safety is very important during these experiences. Each activity that follows has a brief TEACHER NOTES section for you to review prior to the investigations.</p> <p>Depending on your classroom set up and management style, the investigations can be set up around the room and student groups can rotate through each investigation. If this set up is used, each lab investigation can be copied for each station. Address the class as a whole with the safety precautions and needed information prior to their start.</p>	
Multiple Intelligences:	<i>Logical-Mathematical Intelligence—</i>	Consists of the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.
	<i>Linguistic Intelligence—</i>	Involves having a mastery of language. This intelligence includes the ability to effectively manipulate language to express oneself rhetorically or poetically. It also allows one to use language as a means to remember information.
	<i>Spatial Intelligence—</i>	Gives one the ability to manipulate and create mental images in order to solve problems. This intelligence is not limited to visual domains--Gardner notes that spatial intelligence is also formed in blind children.

Materials:

- Goggles
- Aprons
- Aluminum foil
- Metal spoon (one that can be placed in a flame)
- Candle/Bunsen burner/alcohol burner (flame source)
- Sugar
- Hot glove
- Baking soda
- Vinegar
- Pipette/medicine dropper
- Milk
- Test tubes
- Test tube rack



- Test tube cleaner
- Crackers
- Iodine
- Paper towels
- Citric acid (Fruit Fresh from the store)
- Ziploc bags – large sandwich size or quart
- Medicine cups/film canister – disposable



SAFETY NOTE:

Students will be working with flames, so it is important fire safety is addressed before the lab begins. Be sure to have proper fire safety equipment near in the event of an emergency. In addition, a large beaker of water may be placed next to the flame source in the event the sugar begins to burn. Instruct students to place the spoon in the water if a flame emerges from the sugar.

Be sure students are following proper lab safety procedures throughout the lab activities. Address any concerns from MSDS sheets so students are aware of any possible concerns. Most chemicals used can be found in the home but safety must be address to ensure student safety.

Engagement:

Set up a demonstration of an interesting physical change and an interesting chemical change. Some possibilities of physical changes are dry ice in a beaker, dissolving copper II sulfate in water. Possible chemical changes might include burning wood or steel wool. Another possibility of a chemical change is placing a large steel nail in copper II sulfate so iron and copper switch places to form Iron II sulfate and copper goes onto the nail.

Questions:

1. How do your observations give you a clue as to whether you are looking at a physical or chemical change?
2. What are examples of physical changes that you have observed at home?
3. What are examples of chemical changes that you have observed at home?
4. What is exergonic and endergonic? How can you know whether a reaction is exergonic or endergonic?

Explore:

Students will complete each of the activities to make observations and decide what evidence is needed to determine if a chemical change has occurred. A safety discussion should take place prior to students start the investigation. It may be helpful to the students if a brief verbal description of each activity so the students know what to do as they complete each activity. Remind students to record observations during each investigation in their journal. Have them write as many details as possible to help determine if a chemical reaction has occurred. In addition, have them write a brief summary of the steps so they can review them when doing their final project because these investigations cannot be used as the final project piece.

PART A PROCEDURES:

Read the procedures below. Write a brief summary in your journal of what you will be doing. Make a prediction of what will happen or what you might observe. Conduct the investigation below.

1. Use a small piece of aluminum foil to line the inside of the metal spoon. Do NOT line the bottom of the spoon.
2. Put a very **small** amount of sugar in the spoon on top of the aluminum foil. Use your finger to spread it out and make a thin layer.
3. Wearing protective eye goggles and apron hold the spoon over the flame. One person should record observations as you watch changes occur. Continue to heat the spoon until you are sure the reaction is complete. Try not to burn your sugar but if your sugar starts to burn and flame, carefully place the spoon in the beaker of water to extinguish the flames. DO NOT DROP THE SPOON OR WAVE AROUND.
4. OBSERVE AND RECORD ANY EVIDENCE THAT WOULD INDICATE THAT A CHEMICAL REACTION HAD OCCURRED.

Students' observations should indicate a color change to black, bubbling and an odor.



PART B PROCEDURES:

Read the procedures below. Write a brief summary of what you will be doing. Make a prediction of what will happen or what you might observe. Conduct the investigation below.

1. Place one small spoonful of baking soda in a test tube (it should be less than $\frac{1}{4}$ full).
2. Add 20 drops of vinegar. Be sure to feel the bottom of the test tube. OBSERVE AND RECORD IN YOUR JOURNAL ANY EVIDENCE THAT WOULD INDICATE THAT A CHEMICAL REACTION HAD OCCURRED.
Students should write that they observe bubbling and a temperature change. It should get slightly colder.
3. Clean out test tube and leave upside down in the test tube rack. Wipe up any mess that occurred and leave the area clean.

PART C PROCEDURES:

Read the procedures below. Write a brief summary of what you will be doing. Make a prediction of what will happen or what you might observe. Conduct the investigation below.

1. Pour 20 drops of milk into a small test tube.
2. Add 20 drops of vinegar to the milk. Allow the mixture to set for 1-2 minutes.
3. OBSERVE AND RECORD ANY EVIDENCE IN YOUR JOURNAL THAT WOULD INDICATE THAT A CHEMICAL REACTION HAD OCCURRED.
Students should observe a white solid made. The students should be able to name this as a precipitate.
4. Clean out the test tube and leave upside down in the test tube rack. Clean the area and leave it neat for the next group

PART D PROCEDURES:

Read the procedures below. Write a brief summary of what you will be doing. Make a prediction of what will happen or what you might observe. Conduct the investigation below.

1. Place a small piece of cracker on a paper towel.
2. Place 2 drops of iodine on the cracker.
3. OBSERVE AND RECORD ANY EVIDENCE IN YOUR JOURNAL THAT WOULD INDICATE THAT A CHEMICAL REACTION HAD OCCURRED.
Students should observe that the color turns black.
4. Dispose of the cracker and paper towel.

PART E PROCEDURES:



Read the procedures below. Write a brief summary of what you will be doing. Make a prediction of what will happen or what you might observe. Conduct the investigation below.

- Place ½ spoonful of baking soda and ½ spoonful of citric acid into a zip-loc bag.
- Place 10 ml of water into a medicine cup/film canister. CAREFULLY place the cup of water into the bag with the solid without dumping the water. With the help of a partner, seal the bag while trying to remove as much of the excess air as possible. One person can press the sides of the bag together while the other presses the seal.
- RECORD ANY OBSERVATIONS AT THIS TIME BEFORE DUMPING THE WATER INTO THE SOLID.
- Turn the bag to the side dumping the water. You may need to hold the bag with your fingers and press together to mix the water and solid. DO NOT OPEN THE BAG. Feel the mixture and observe.
- OBSERVE AND RECORD ANY EVIDENCE THAT WOULD INDICATE THAT A CHEMICAL REACTION HAD OCCURED.

Students should observe bubbling and a dramatic temperature drop.

- Dispose of the bag without opening it up.

Explain:

- In which of the experiments did you observe a chemical reaction? Support your answer with evidence. *All experiments were chemical reactions. The evidence includes gas produced, temperature change, precipitate formed, color change.*
- In Part A, you burned sugar. Sugar is made up of carbon, hydrogen, and oxygen atoms that are bonded together. The heat from the flame broke apart the bonds and changed the hydrogen and oxygen into water vapor (H₂O) that was bubbled away into the air. What kind of atoms formed the black residue that was left in the spoon? **Carbon is the black residue on the spoon.**



- In Part C, you added vinegar to milk and a precipitate formed. Based on your observations, what is a precipitate? **A precipitate is a solid that forms during the chemical reaction between liquids.**
- In Part E, what type of observations indicated a chemical reaction? The prefix ex- means to leave like the word exit. The prefix en- means to come in like the word enter. The suffix -gonic means energy. Using this information, which word would best describe this chemical reaction, endergonic or exergonic? Support your answer. **Students should answer endergonic since heat entered the compound sugar in order for the reaction to occur. The heat was used to give energy to break the bonds holding the compound together. Water and carbon are released.**
- Create a list of observations you can use during any lab investigation to determine if a chemical reaction has occurred. **The students' lists should include color change, a gas produced, bubbling, temperature changes, new substance with new properties produced.**

Elaborate:

Have students research other reactions that demonstrate chemical and physical changes for the final project the chemistry show. They can use books or the Internet as resources.

Evaluate:

POINTS	Scientific Accuracy	Reasoning	Communication	Collaboration
4	All questions and observations are correct.	Conclusions showed great thought and application of concepts.	Team discussed observations in great detail and lab was completed with very clear and complete answers.	Team members worked very well together and showed excellent safety skills.



3	Most answers and observations are correct.	Conclusions showed good thought and application of concepts.	Team discussed observations in good detail and lab was completed with clear and complete answers	Team members worked well together and showed good safety skills.	
2	Some answers and observations are correct.	Conclusions showed average thought and application of concepts.	Team discussed observations in some detail and lab was completed with somewhat clear and complete answers.	Team members worked fairly well together and showed fair safety skills.	
1	Few answers and observations are correct.	Conclusions showed little thought and application of concepts.	Team discussed observations in little detail and lab had unclear and incomplete answers.	Team members worked poorly together and showed poor safety skills.	
	Subtotal: ____	Subtotal: ____	Subtotal: ____	Subtotal: ____	

Sample TAKS questions:

Which of the following is an example of a physical change? (TEKS 8A)

- A wood burning
- B ice melting
- C sodium reacting with water
- D iron rusting

During a laboratory investigation, a student combined three chemicals in a plastic bag. After mixing the chemicals for a minute, they noticed the bag increased in size and it felt very warm. Without knowing the chemical formulas, the increase in temperature is an example of which of the following? (TEKS 8B)

- A endergonic reaction
- B exergonic reaction
- C single replacement reaction
- D double replacement reaction

Which of the following is evidence of a chemical change? (TEKS 8A)

- A the liquid evaporated
- B the solid expanded
- C a gas is produced
- D the density changed

During a simple laboratory investigation, an IPC student combined two chemicals in a test tube. The student felt the test tube and it felt very cool. The decrease in temperature is an example of which of the following? (TEKS 8B)

- A endergonic reaction
- B exergonic reaction
- C single replacement reaction



- D double replacement reaction

Which of the following is a difference between physical and chemical changes? (TEKS 8A)

- A In chemical changes, the mass before the reaction is greater than the mass after the reaction. In physical changes, the mass never changes.
- B In chemical changes, new substances with new properties are made. In physical changes, the substance is still the same but in a different form.
- C Chemical changes happen more often than physical changes.
- D Chemical changes always involve a change in state of matter while physical changes always involve a change in size.

Which of the following is a physical change? (TEKS 8A)

- A Magnesium burns brightly in a flame and becomes magnesium oxide
- B A rock is cracked by the water inside freezing and expanding during a cold winter.
- C Digestion of food in the stomach
- D An acid is poured into a base and forms salt and water.

Which of the following is an example of a chemical change involving water? (TEKS 8A)

- A Salt dissolves in water until the extra settles to the bottom.
- B Liquid water freezes to become ice.
- C Ice can change from solid to gas.
- D Using electricity, water can be broken up into hydrogen and oxygen.

References/Resources/Websites:

<http://www.visionlearning.com/library/science/chemistry-1/CHE1.8-equations.htm>

<http://www.usoe.k12.ut.us/curr/science/sciber00/8th/matter/sciber/intro/htm>

<http://www.chem4kids.com>

<http://thinkquest.org>

<http://www.chemtutor.com/react.htm>

