Title: Chemical Reactions **Subject/Course: Physical Science**
Topic: Chemical Reactions **Grades: 8**
Designer: Cory Redding

Stage 1 – Desired Results: What do I want my students to learn?

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Title: Chemical Reactions

Unit description:
In the first part of the chemical reactions unit, students will investigate the differences between chemical and physical changes by conducting a variety of hands-on, inquiry based experiments. Students will focus on identifying various characteristics indicating a chemical reaction has occurred such as the production of a gas or precipitate. Students will understand that when chemical reactions occur, new substances with proprieties different from the original substances are formed. The second part of the unit will focus on the enduring understanding that mass cannot be altered. The students will investigate this problem by conducting a series of five experiments in which they will analyze class data by creating histograms. Students will share results and report data utilizing graphing, communication and technological skills by role playing scientists from esteemed universities to their audience (classmates) at a science symposium. Students should demonstrate knowledge of chemical reactions and be able to prove though data they collected that mass cannot be altered.

Goals/Standards – Core Content Curriculum Standards
NJ 5.6 B
5.6B-1 Show how substances can chemically react with each other to form new substances having properties different from those of the original substances.
5.6B-2 Show that in most chemical reactions energy is transferred into or out of a system.
5.6B-3 Demonstrate that regardless how substances within a simple closed system interact, the total mass of the system remains the same.
5.6B-4 Illustrate how atoms are rearranged when substances react, but that the total number of atoms and the total mass of the products remain the same as the original substances.

Unit Enduring Understandings:	**Essential Questions:**
~ Substances react chemically in characteristic ways. ~Chemical reactions are like systems; although energy may be transferred out	Why do new substances form when a chemical reaction takes place? How can you tell if a chemical reaction has

of the system, the total mass of the system remains the same. ~ Students will understand that atoms are rearranged when substances react, but that the total number of atoms and the total mass of the products remain the same as the original substances.	occurred? Why do you think mass can or cannot be altered? Explain.
Students will need to know… • Students will know that signs that a chemical reaction may have occurred are gases being produced(bubbles), temperature change, or formation of a precipitate. • Students will know that mass (matter) and the amount of atoms are conserved in a chemical reaction. • Students will know that substances with different properties may chemically react with each other to form an entirely new substance with properties that are completely different that the original properties. • Students will know that in chemical reactions, energy is either transferred into or out of the system. **Vocabulary:** Products Reactants Reaction Properties Mass Atom Chemical Change Energy Transfer Conservation Bonding Precipitate	**Students will be able to (Skills students need)** • Measure correctly • Develop organized testing procedures • Communicate to lab partners effectively • Use the scientific method appropriately • Identify variables • Compare, analyze, infer and interpret data • Conduct laboratory experiment both safely and effectively. • Create charts, diagrams and data tables to organize their data

What do students typically misunderstand? Mass cannot be altered in a chemical reaction. A chemical reaction does not always occur when two substances are mixed together. Atoms are neither created nor destroyed; they are simply rearranged.	

Step 2 – Assessment Evidence: What will prove my students are learning?

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Science Symposium: Can Mass be Altered?

Performance Assessment:

Goal:
Your goal is to convince a group of scientists if matter is conserved during chemical reactions.

Role:
You are a chemist at a prestigious research university who has been investigating mass conservation.

Audience:
The audience is made up of scientists from throughout the world including India, Japan, Germany, Great Britain, and Australia who have also been conducting similar research.

Situation:
You have been asked to effectively communicate your scientific evidence to your colleagues in the form of a presentation at a science symposium. You will need to convince the audience of scientists that your conclusions regarding the alteration of mass are accurate by analyzing and organizing data that you have collected in the science lab.

Product Performance and Purpose:
You need to prepare a presentation that clearly states your conclusion to the question “Can mass be altered?.” You should cite evidence from the data you collected in the lab. In addition, you should also include a visual aid to utilize during the presentation that summarizes your results. This may include charts,

diagrams, data tables, etc.

Standards and Criteria for Success:
Your presentation to the scientists should include:

Presentation:
~Clearly state rationale of how your arrived at your conclusion
~Clearly state evidence to support your conclusion
~Clearly and effectively communicate your findings to the audience

Visual aid**:**
~Clearly states your position/conclusion
~Clearly depicts evidence in the form of data tables, charts, graphs, diagrams, etc.
~Incorporate into your presentation

Final research report for scientists to review:
~General purpose, original hypothesis, description of each investigation
~Total histogram
~Conclusion supporting your point of view (cite all evidence from data collected in the lab to support your conclusion)
~Design an experiment to address the question "Can mass be altered?" (title, purpose, hypothesis, materials, procedure)

Other Evidence (Performance Tasks, Academic Prompts, Quiz and Test Items, Informal Checks for Understanding):

Written tests
- Open ended
- Multiple choice

Preconception Assessment
1. A scenario is given to the students. They must identify what type of reaction occurred and give evidence to support their answer.
2. A scenario is given to the students. They must identify if mass increased, decreased or stayed the same and give evidence to support their answer.

Conduct formal laboratory investigations with accompanying lab reports
Research Paper
Quizzes
Homework/ class work assignments
Journal Entries
Portfolio Party
T-Shirt Presentation

Step 3 – Learning Plan: How will I have to teach to ensure students learn?

Learning Activities: W*H*E*R*E*T*O

Chemical Reactions:

W – Students need to know where they are going

Goals:

-Essential questions will be posted on the front board. A discussion will develop around the questions. Teacher will probe for prior knowledge to see what ideas and misconceptions students may already have.

- *Why do new substances form when a chemical reaction takes place?*
- *How can you tell if a chemical reaction has occurred?*

Diagnosis:

- Ask students what questions they may have involving chemical reactions. Consolidate questions throughout the day and write their questions on sentence strips. Post the strips on one side of a bulletin board that states "**What we want to know**." As the questions are answered throughout the unit, move the strip to the other side of the board that states "**Now we know**!." Have various students write the correct answers on paper to post under the sentence strips.

- Hand out and complete pre-assessment quiz to check for possible and probable misconceptions
  - A scenario is given to the students. They must identify what type of reaction occurred and give evidence to support their answer. (please see attached)

Relevance and Value:

- Discuss the relevance and value of learning about chemical reactions with students.
  - Discuss new technologies (how do you think someone was able to invent that I-Pod you use every day?!?!), career possibilities (researchers, chemists, etc.)

H – Hook

- "**Gummy Bear**" (teacher demonstration) Students are introduced to a gummy bear. They may pick the name of the gummy bear. A mixture of the chemical Potassium Chlorate is heated using a Bunsen burner. When it's heated, it will decompose into potassium chloride and oxygen. The oxygen will fill the test tube. If you add a gummy bear (sugar) you will have the 3 things needed for a fire: Heat, Oxygen, and a fuel source. A bright light and gases are produced. Students are asked to write down in their science journal what type of reaction they think may have occurred and some characteristics of that type of reaction. This is also relates to safety (*Why should you never look directly down a test tube? Why should you never point a test tube at another student?).*

E – Explore and experience the big ideas (enduring understandings)

Equipping students with knowledge

1. **Physical vs. Chemical Change Activities**

- Worksheet
  ~identifying the difference between a chemical and physical change
- Demonstrations
  Teacher will show various reactions and class will discuss if they are physical or chemical. (ex: cutting an apple in half, showing a brown apple) A t-chart will be used to record data in students' science journals.
- Website exploration: Stragematter
  http://www.strangematterexhibit.com/
  Students will utilize the website to identify the difference between a physical and chemical change.

2. **Chemical Changes Investigations** (Below activities are adapted from Kessler, James H., Galcan, Patricia M., Inquiry in Action: Investigating Matter Through Energy, American Chemical Society, 2005)

- Using chemical change to identify an unknown (Kessler, 2005)

~ Question: How can you tell similar –looking substances apart based on the way they react with different chemicals?
~ Students will be introduced to the concept that different substances react chemically in characteristics ways. They will use four different test solutions (water, vinegar, iodine, cabbage) to baking soda, baking powder, cream of tartar, laundry detergent and cornstarch to ultimately identify which of the five powders they have tested.

- Website exploration: Kitchen Chaos!
  http://www.sycd.co.uk/primary/kitchen_chaos/index.htm#

- Production of a gas (Kessler, 2005)

~ Question: How can you control the amount of gas produced in a baking soda and vinegar reaction?
~ Students will experiment with the amount of gas produced in the reactions between baking soda and vinegar. As students change the amount of the substances, the will evaluate the amount of gas produced based on the amount of foam (measured in a graduated cylinder).

- Exploring baking powder (Kessler, 2005)

~ Question: Can you find a combination of powders that produces as much gas as store-bought baking powder?
~ Baking powder is a combination of substances will release carbon dioxide gas when mixed with water. Students will identify which substances are necessary for bubbling by testing combinations such as cornstarch and cream of tartar, baking soda and cream of tartar, etc.

- Color changes with acids and bases (Kessler, 2005)

~Question: How can you use the color changes of red cabbage indicator to help you compare the acidity of different substances?
~Students will investigate the color changes that occur when different substances are added to a red cabbage indicator. Based on results, they will categorize the substances as acid, base or neutral.

- Acids and bases website exploration: Alien Juice Bar
  http://sv.berkeley.edu/showcase/flash/juicebar.html

- Change in temperature (Kessler, 2005)

~ Question: How can you affect the temperature change in a reaction between calcium chloride and water?
~ Students will measure the decrease in temperature in a baking soda and vinegar

reaction. They will also measure the increase in temperature in a calcium chloride and water reaction and then explore how to increase the temperature of the reaction.

- Formation of a precipitate (Kessler, 2005)

~ Question: What happens when soap is added to hard water?
~ Students will investigate the formation of a precipitate (soap scum). Students will compare the bubbling of soap scum in water to soap in water to discover that they must be different substances.

- Electrolysis Demonstration

~ Teacher will demonstrate electrolysis of water using the Hoffman Apparatus.

- Electrolysis Packet
- Explore websites

~ Got Gas? (age appropriate)
http://www.tryscience.org/experiments/experiments_electrolysis_online.html
~ Electrolysis (extension)
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/electroChem/electrolysis10.html

R – Rethink, rehearse, revise and refine their work

Rethink:
Students will conduct research on how a chemical reaction played a part in a new technology or invention that was discovered. Students may choose any school appropriate technology/invention. Students will make a T-shirt depicting the technology/invention, and brief snippets of relevant information such as how it was discovered, uses, chemical involved, chemical make up, etc. Students will present to the class while wearing their T- shirt.

Journal reflections: Self Evaluation
What questions and uncertainties do you still have about chemical reactions?
How has what you have learned changed your thinking?
How does what you have learned connect to other subjects or topics?
What grade do you deserve for this unit? Why?

E – Evaluate their work and set future goals

Portfolio Party**:** Students will construct a portfolio of their research and activities that took place during the chemical reactions unit. They may organize in any manner they choose. The portfolios will be shared at a portfolio party. The portfolio should include a minimum of one self assessment piece in which they should reflect upon what they have learned or what misconceptions have been changed as a result of the investigations conducted. (ex: What was the most difficult concept you learned during this unit? How were you able to understand that concept? What were your strengths? What were your weaknesses?) In addition, students must have a minimum of three peer evaluations in which students write a one paragraph evaluation of a peer's portfolio. This may include a response to a journal entry, a "light bulb moment" as a result of looking at that student's portfolio, information on a lab, comments on the organization style, etc. (prompts may be given… see below journal entries)

Quiz- Chemical Reactions
Students will retake the original pre-assessment quiz (question #1)

Can mass be altered?:

W – Students need to know where they are going

Goals:
-Essential question will be posted on the front board. A discussion will develop around the question. Teachers will probe for prior knowledge to see what ideas and misconceptions students may already have.

- *Can mass be altered?*

Diagnosis:
- Hand out and complete pre-assessment quiz to check for possible and probable misconceptions
    - A scenario is given to the students. They must identify if mass increased, decreased or stayed the same and give evidence to support their answer. (please see attached)

Expectations:
- It is explained to the students that five investigations will be conducted to collect data to prove or disprove their hypothesis. The five investigations will involve either a physical or chemical change and the purpose is to observe if there is a change in mass. Each activity is briefly explained.

H – Hook
- Trip to the moon!

The teacher asks the students the difference between mass and weight. A discussion follows where the definitions are reviewed. A volunteer is asked to come to the front of the room. The class is told that he is going on a journey to the moon and he is bringing 12 bananas with him. The class will also be traveling but will only observe the student who will exit the rocket ship. The lights are turned out and the rocket ship takes off! Just a few seconds later, the ship lands on the moon. The students are asked to think about the mass and weight of the bananas. Do they change? If so, how do they change? A discussion follows and the example becomes one that is referred to throughout the rest of the school year. (*Who held the bananas on the moon? What did we say was affected by gravity?)*

Once the term mass is defined, the students are then presented with the driving question, *Can mass be altered?* The question is posted at the front of the room for the duration of the lessons and is referred to on a daily basis. The students are then told that they will be conducting research, as scientists in the real world do everyday, to find the answer to that question. In addition to their class, they will be gathering with the entire team at the end of the investigation for a science symposium where the results will be discussed and a conclusion reached.

E – Explore and experience the big ideas (enduring understandings)

1. **Can Mass be Altered?**

- The Mass of Dissolved Salt

~Students will investigate if mass is altered when salt is dissolved in water.

- The Mass of Ice and Water

~ Student will investigate if mass is altered when an ice cube melts.

- The Mass of Gas

~ Students will investigate if mass is altered when a gas is produced in a liquid.

- The Mass of Mixed Solutions

~ Students will investigate if mass is altered when two liquids produce a solid (precipitate).

- The Mass of Copper and Sulfur

~ Students will investigate if mass is altered when two solids are heated and a new substance is formed.

R – Rethink, rehearse, revise and refine their work

Journal reflections: Self Evaluation
What questions and uncertainties do you still have about chemical reactions?
How has what you have learned changed your thinking?
How does what you have learned connect to other subjects or topics?
What grade do you deserve for this unit? Why?

E – Evaluate their work and set future goals

Take the role of a scientist: Science Symposium Performance Assessment
(see GRASP)
Students will retake the original pre-assessment quiz (question #2)

CAN MASS BE ALTERED???

Final Research Paper

Include:

Cover:

- ✓ Title and your name

Page 1

- ✓ Purpose/ Problem
- ✓ Original Hypothesis (science journal)
- ✓ Description (short paragraph) of each investigation
  - o Salt
  - o Ice
  - o Gas
  - o Precipitate
  - o Copper Sulfide

*** Results are not to be included in this section.

Page 2

- ✓ Total Histogram
  - o All investigative data from each class combined into one histogram

Page 3

- ✓ Conclusion Paragraph
  - o Follow the conclusion format
  - o Refer to histogram for all 5 classes
  - o No % error (increase/ decrease) needed

Page 4

- ✓ Design an Experiment!
  - o Design an experiment to answer the question: Can mass be altered?
  - o Include:
    - Title
    - Purpose
    - Hypothesis
    - Materials
    - Procedure

CAN MASS BE ALTERED?
"A" HALL SCIENCE SYMPOSIUM

The program:

1. Prior to the symposium, prepare a research paper.
2. Ticket into the symposium...
   - Research paper
   - Pen/Pencil
   - Best conduct
3. Introduction
4. Purpose
5. Description of five investigations
6. Class speakers present data
   - A Hall
   - B Hall
   - D Hall
7. Description of experimental errors
8. Conclusion
   - Based on school wide data ... an answer to Can Mass be Altered?
9. Closing Statements

Performance Assessment: Can Mass be Altered?
Classroom Science Symposium

Goal: Your goal is to convince a group of scientists why mass can or cannot be altered.

Role: You are a chemist at a prestigious research university.

Audience: The audience is a group of scientists from throughout the world including India, Japan, Germany, Great Britain, and Australia.

Situation: The challenge involves convincing skeptical scientists from around the world that your conclusions regarding the alteration of mass are accurate.

Product Performance and Purpose: You need to prepare a presentation that clearly states your conclusion to the question "Can mass be altered?". You should cite evidence from the data you collected in the lab. In addition, you should also include a poster or PowerPoint presentation that summarizes your findings (evidence). This may include charts, diagrams, data tables, etc.)

Standards and Criteria for Success: Your presentation to the scientists should include:

Presentation:

- A clearly stated rationale of how your arrived at your conclusion
- Clearly state evidence to support your conclusion
- Clearly and effectively communicate your findings to the audience

Visual aid:

- Neat
- Clearly states your position/conclusion
- Clearly depicts evidence in the form of data tables, charts, graphs, diagrams, etc.
- Incorporate into your presentation

Final research report (see reverse side)

"Can Mass be Altered?" Investigation Rubric

Salt, Ice, Alka-Seltzer, Precipitate, Copper Sulfide

Lab Sheet			
Hypothesis	Clearly stated 2 points	Included, but not "if/then" 1 point	Not included 0 points
Data	Included 2 points	Partially included 1 point	Not included 0 points
Interpretations	Demonstrates sound understanding 10 points	Incomplete answers that do not demonstrate sound understanding and/or answers were not written in complete sentences. 5-9 points	Incomplete answers that do not demonstrate sound understanding or not completed 0-4 points
Histogram			
	Titled, labeled, and numbers planned correctly, represents class data accurately 10points	Missing a key piece of information such as title or labels, or does accurately represent class data 5-9 points	Incomplete histogram or histogram not included 0-4 points
Conclusion Paragraph			
Problem	Clearly stated 2 points	Unclear 1 point	Not included 0 points
Hypothesis	Clearly stated 2 points	Included, but not "if/then" 1 point	Not included 0 points
Class Data Analysis	Includes thorough explanation and analysis of class data including experimental error. 5 points	Includes explanation of class data, but missing key points in analysis or does not mention experimental error. 1-4 points	Not included 0 points
Percent Error	Included and work is clearly shown. 2 points	Included but work is not shown. 1 point	Not included. 0 points
Concluding Statement	Clearly stated and is based on class data. 2 points	Unclear or not based on class data. 1 point	Not included

Total: _____/36 points

"Can Mass Be Altered?" Rubric for Final Research Paper

Cover	Included, neat and incorporates title, name, date, class period 2 points	Included but missing information 1 point	Not included 0 points
Problem	Included 2 points	Partially included 1 point	Not included 0 points
Hypothesis	Clearly stated 3 points	Included, but not "if/then" 1 point	Not included 0 points
Lab descriptions	Paragraphs accurately describe each of the five investigations 18-20 points	Does not include all five paragraphs or inaccurate description 9-17 points	Does not include all five paragraphs and inaccurate descriptions 0-8 points
Histogram			
	Titled, labeled, and numbers planned correctly, represents team data accurately 10points	Missing a key piece of information such as title or labels, or does accurately represent team data 5-9 points	Incomplete histogram or histogram not included 0-4 points
Conclusion			
Problem	Clearly stated 2 points	Unclear 1 point	Not included 0 points
Hypothesis	Clearly stated 2 points	Included, but not "if/then" 1 point	Not included 0 points
Class Data Analysis	Includes thorough explanation and analysis of class data including experimental error. 5 points	Includes explanation of class data, but missing key points in analysis or does not mention experimental error. 1-4 points	Not included 0 points
Relate Back to Hypothesis	Clearly stated 2 points	Included but statement is unclear. 1 point	Not included 0 points
Concluding Statement	Clearly stated and is based on class data. 2 points	Unclear or not based on class data. 1 point	Not included
Designing an Experiment	Problem, hypothesis and procedure are clearly stated. The experiment is deeply rooted in science content and shows sound understanding of the law of conservation of mass. 10 points	The experiment is included but does not demonstrate sound knowledge of the law of conservation of mass. Problem, hypothesis or procedure are not stated or the experiment does not relate to the law of conservation of mass. 5-9	The experiment is not included or does not show sound understanding of the law of mass. 0-4

Total: _____/ 60 points

CATEGORY	4	3	2	1
Rationale	The rationale is clearly identified and stated.	The rationale is identified, but is stated in a somewhat unclear manner.	The rationale is partially identified, and is stated in a somewhat unclear manner.	The rationale is erroneous or irrelevant.
Graphs and Charts	Graphs and charts are included and make the experiment easier to understand. Graphs and charts are labeled neatly and accurately.	Graphs and charts are included and are labeled neatly and accurately.	Graphs and charts are included and are labeled.	Needed graphs and charts are missing OR are missing important labels.
Scientific Concepts	Presentation illustrates an accurate and thorough understanding of scientific concepts underlying the investigations.	Presentation illustrates an accurate understanding of most scientific concepts underlying the lab.	Presentation illustrates a limited understanding of scientific concepts underlying the lab.	Presentation illustrates inaccurate understanding of scientific concepts underlying the lab.
Analysis	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends or predictions are made based on the data.	The relationship between the variables is not discussed.
Visual Aid	Visual aid clearly 1. states your position/ conclusion 2. depicts evidence in the form of data tables, charts, graphs, diagrams, etc. 3. incorporated into the presentation.	Visual aid does not include one of the three major components.	Visual aid does not include two of the three major components.	Visual aid does not include any of the three major components.
Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, experimental evidence and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.
Summary	Summary describes the procedure utilized, the information learned and a possible application to a real life situation.	Summary describes the information learned and a possible application to a real life situation.	Summary describes the information learned.	No summary is written.

Can Mass be Altered Performance Assessment: Presentation