



## Basic Synthesis

### *Magnesium Hydroxide and Aluminum Hydroxide*

This lesson plan is a tool to use when teaching chemical reactions. Students will synthesize magnesium hydroxide and aluminum hydroxide using common household products. Teacher conclusions and review of lab will demonstrate the use of chemistry in society and how the products synthesized in this lab are used in everyday life.

#### Primary Learning Outcomes

Students will learn the difference between the four main types of chemical reactions: Synthesis, decomposition, single replacement, and double replacement. Students will observe chemical reactions taking place and determine the types of reactions that take place. Students will be able to define *precipitate* and observe the formation of precipitates. Students will determine a balanced chemical equation for each of the reactions.

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#### Assessed Georgia Performance Standards

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh6. Students will communicate scientific investigations and information clearly.

SPS2. Students will explore the nature of matter, its classifications, and its system for naming types of matter.

SPS6. Students will investigate the properties of solutions.

SC2 Students will relate how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.

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#### Background

In Part I of this lab, you will react *alum* with *ammonia*. These are both compounds that dissolve in water. Household *ammonia* contains *ammonium hydroxide*. The *hydroxide* part of the chemical reacts with the *aluminum* in the *alum*. In Part II of this lab, you will react *magnesium sulfate* (Epsom salt) with *ammonia*. These are both compounds that dissolve in water. Household *ammonia* contains *ammonium hydroxide*. The *hydroxide* part of the chemical reacts with the *magnesium* in *magnesium sulfate*.



## **Procedures/Activities**

*Step: 1 Duration: 10-15 minutes*

Introduce or review the types of chemical reactions with students. Overheads may be useful along with images or analogies. See included overheads for examples.

*Step: 2 Duration: 5 minutes*

Introduce lab and review directions as desired. Caution students about the use of household ammonia.

*Step: 3 Duration: 20-30 minutes*

Students conduct the two part lab as shown in student handouts at the end of this document.

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## **Materials and Equipment**

Per group:  $\frac{1}{2}$  teaspoon alum, 1 teaspoon magnesium sulfate (Epsom salt), 4 teaspoons household ammonia, tap water, plastic spoons, 100 or 250mL beaker

(Note: Alum can be found in most grocery stores on the spice isle. Epsom salt can be found at grocery and drug stores on the first aid isle.)

## **Total Duration**

35-50 minutes in class

## **Assessment**

Lab report and/or discussion questions. Discuss questions as a class to assess the students understanding and ability to communicate scientific concepts. Discuss the reactions and what common antacid relief products utilize the products synthesized in today's reactions. Discuss possible methods to purify the products (filtration, evaporation, etc.). Assess student understanding of concepts during the discussion and in post-lab report if desired.

Name \_\_\_\_\_

Date \_\_\_\_\_

## Chemical Reactions: Part I

### Background:

Some chemical compounds will dissolve in water, and some will not. Sometimes, two compounds that dissolve in water will react to form a new compound that is insoluble (does not dissolve). This new compound comes out of solution and is referred to as a precipitate.

In this lab, you will react *alum* with *ammonia*. These are both compounds that dissolve in water. Household *ammonia* contains *ammonium hydroxide*. The *hydroxide* part of the chemical reacts with the *aluminum* in the *alum*.

### Materials:

- ½ teaspoon alum
- 2 teaspoons household ammonia
- Water
- Plastic spoons
- Beaker

### Procedure:

1. Fill the beaker ½ full with water.
2. Add ½ teaspoon alum to the water and stir to dissolve the alum. Record observations.
3. Stir in 2 teaspoons of ammonia. Record observations.  
**CAUTION: ammonia has strong fumes, be careful not to breathe the fumes.**
4. Allow the solution to stand for 5 minutes. Record observations.
5. Dispose of solution down the sink. Rinse the beaker well.

### Results/Observations:

Step 2:
Step 3:
Step 4:

### Conclusions:

1. Was there a new compound formed? (YES/NO) Explain how you know.
2. What do you call this type of chemical reaction?
3. How would you propose to purify the precipitate?
4. Write the balanced chemical equation for this reaction.

Name \_\_\_\_\_

Date \_\_\_\_\_

## Chemical Reactions: Part 2

### Background:

Some chemical compounds will dissolve in water, and some will not. Sometimes, two compounds that dissolve in water will react to form a new compound that is insoluble (does not dissolve). This new compound comes out of solution and is referred to as a precipitate.

In this lab, you will react *magnesium sulfate* (Epsom salt) with *ammonia*. These are both compounds that dissolve in water. Household *ammonia* contains *ammonium hydroxide*. The *hydroxide* part of the chemical reacts with the *magnesium* in *magnesium sulfate*.

### Materials:

- 1 teaspoon magnesium sulfate (Epsom salt)
- 2 teaspoons household ammonia
- Water
- Plastic spoons
- Beaker

### Procedure:

1. Fill the beaker  $\frac{1}{2}$  full with water.
2. Add 1 teaspoon of magnesium sulfate to the water. Stir to dissolve. Record observations.
3. Add 2 teaspoons of ammonia to the beaker. **DO NOT STIR!** Record observations.  
*CAUTION: ammonia has strong fumes, be careful not to breathe the fumes.*
4. Allow the solution to stand for 5 minutes. Record observations.
5. Dispose of solution down the sink. Rinse the beaker and spoon well.

### Results/Observations:

Step 2:
Step 3:
Step 4:

### Conclusions:

1. Was there a new compound formed? (YES/NO) Explain how you know.
2. What do you call this type of chemical reaction?
3. How would you propose to purify the precipitate?
4. Write the balanced chemical equation for this reaction.

**THE NEXT SECTION INCLUDES OVERHEADS**

- I. Maalox and Mylanta product information (page 6)**
- II. Synthesis and Decomposition Reaction Definitions/Examples (page 7)**
- III. Single and Double Replacement Reaction Definitions/Examples (page 8)**



**Maalox**

**Indications:** For the relief of acid indigestion, heartburn, sour stomach, upset stomach associated with these symptoms, pressure and bloating commonly referred to as gas

**Active Ingredients:** Aluminum hydroxide (antacid), magnesium hydroxide (antacid), Simethicone (antigas)



**Mylanta**

**Indications:** For the relief of heartburn, acid indigestion, sour stomach, associated symptoms of gas and upset stomach, overindulgence in food and drink

**Active Ingredients:** Aluminum hydroxide (antacid), magnesium hydroxide (antacid), Simethicone (antigas)

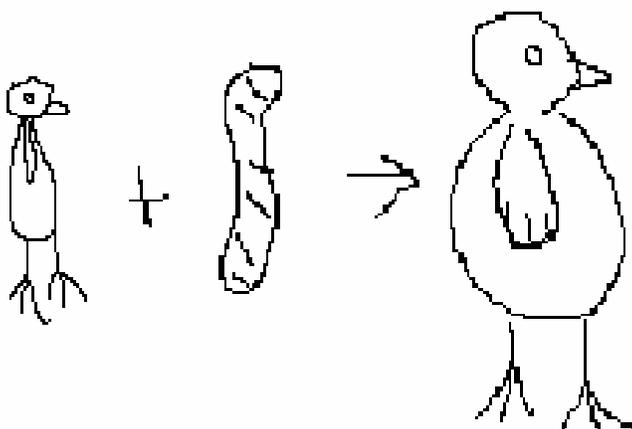
### How they contribute

**Aluminum Hydroxide:** Used in treatment of heartburn, gastritis, and peptic ulcer and sometimes to reduce absorption of phosphorus for people with kidney failure.

**Magnesium Hydroxide:** Used for short-term relief of stomach upset and as a laxative for short-term treatment of constipation.

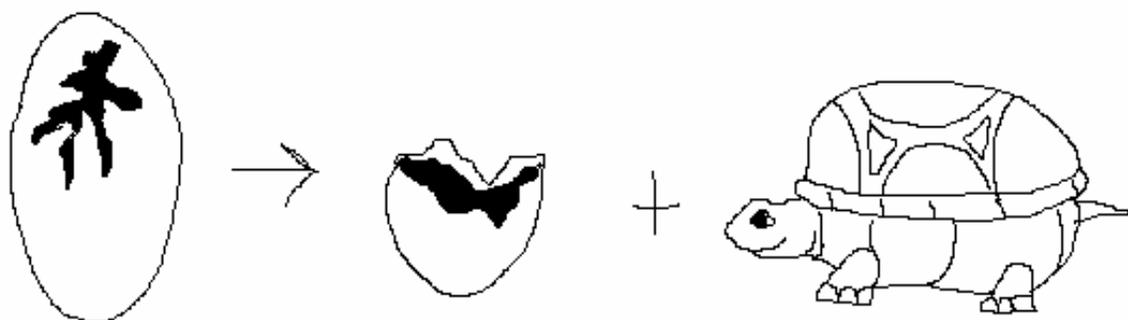
## SYNTHESIS REACTION

- Two or more substances combine to form a more complex substance.
- Two or more reactants yielding one product is another way to identify a synthesis reaction.
- Formation of a precipitate is a likely sign that a synthesis reaction took place.



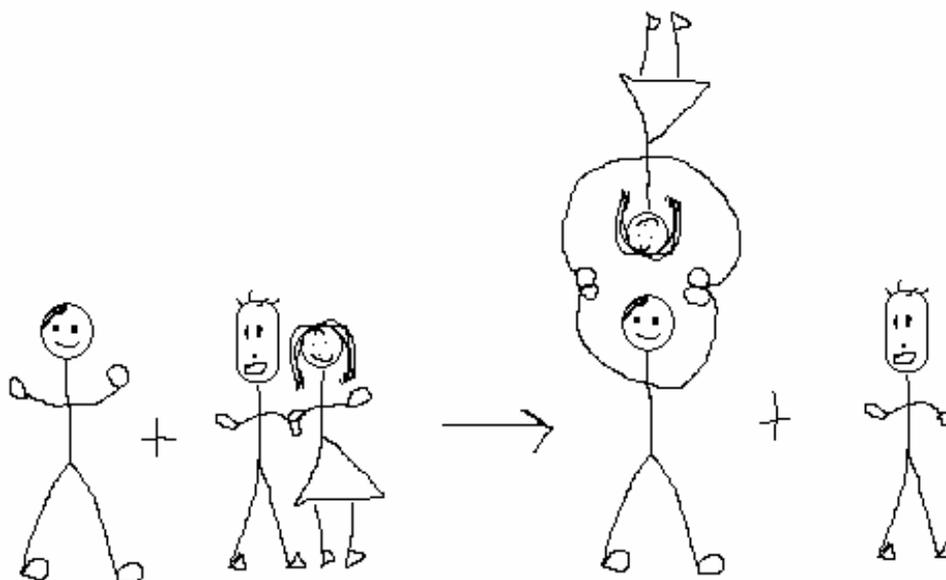
## DECOMPOSITION REACTION

- A complex substance breaks down into its simple parts.
- One reactant yields 2 or more products.
- **Synthesis and decomposition reactions are opposites.**



## SINGLE REPLACEMENT REACTION

- A single uncombined element replaces another in a compound.
- Two reactants yield two products.



## DOUBLE REPLACEMENT REACTION

- Parts of two compounds switch places to form two new compounds.
- Two reactants yield two products.

