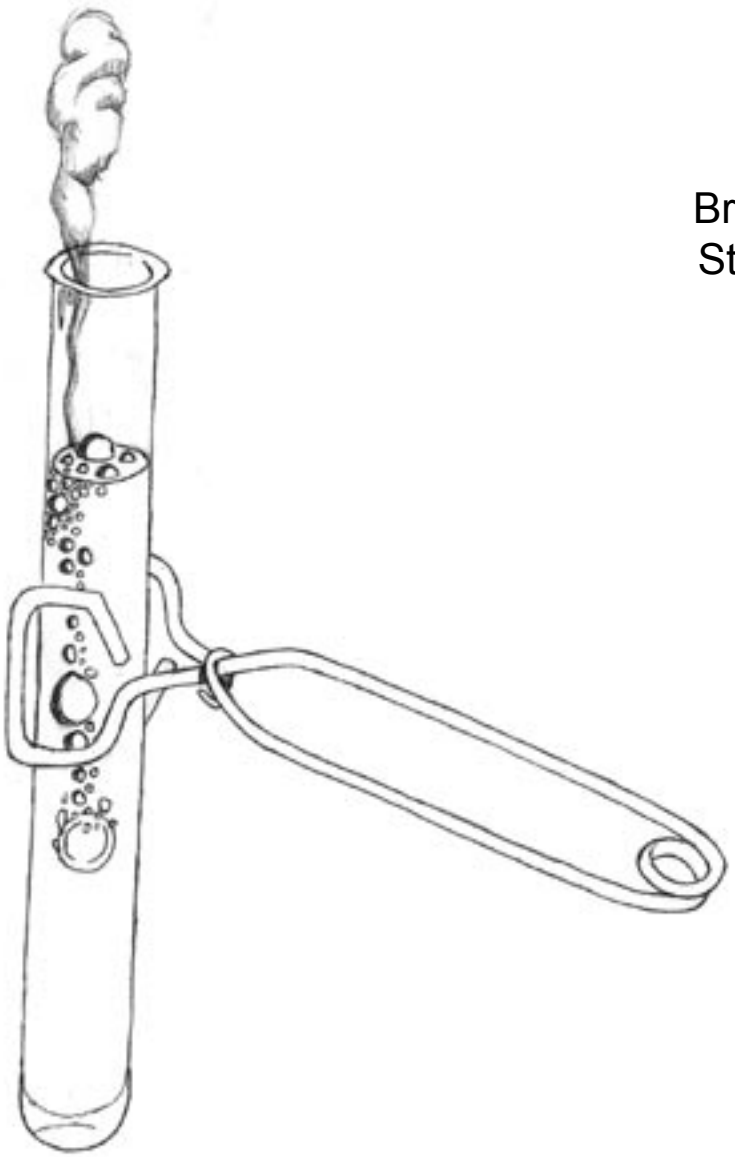
Reactions

Teacher's Guide
Middle School



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A Message from our Company. . .

Dear Educator:

Thank you for your interest in the educational videos produced by the Visual Learning Company. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and led Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome

National Standards Correlations

National Science Education Standards

(Content standards: 5-8, National Academy of Sciences, c. 1996)

Content Standard B:

Properties and Changes of Properties in Matter

As a result of their activities in grades 5-8, all students should develop an understanding of:

- Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals are an example of such a group.
- Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances we encounter.

Benchmarks for Science Literacy

(Project 2061 – AAAS, c. 1993)

4D The Structure of Matter

By the end of the 8th grade, students should know that:

- All matter is made up of atoms, which are far too small to see directly through a microscope. The atoms of any element are alike but are different from atoms of other elements. Atoms may stick together in well-defined molecules or may be packed together in large arrays. Different arrangements of atoms into groups compose all substances.
- The temperature and acidity of a solution influence reaction rates. Many substances dissolve in water, which may greatly facilitate reactions between them.
- No matter how substances within a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. The idea of atoms explains the conservation of matter: if the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

- Describe a chemical reaction as the process by which substances undergo chemical and physical changes that form new substances with new properties.
- Provide some common everyday examples of chemical reactions.
- Identify some of the indicators of chemical reactions including a change in color, the production of a gas, the creation of a precipitate, and a change in temperature.
- Describe the chemical reaction of photosynthesis as the process by which plants take in carbon dioxide and water, and then produce sugar, oxygen, and water vapor using the sun's energy.
- Differentiate between reactants and products in a chemical reaction.
- Understand that a chemical equation is an expression which uses chemical symbols to represent a chemical reaction.
- State the Law of the Conservation of Mass which says that the overall mass of substances in a reaction does not increase or decrease. In other words, mass cannot be gained or lost in a chemical reaction.
- Identify the components in a chemical equation that are unbalanced.
- Use coefficients to correctly modify a chemical equation that is unbalanced.
- Explain that a decomposition reaction occurs when a complex substance is broken down into two or more simpler substances.
- Describe a synthesis reaction as a reaction in which two or more simpler substances combine to form a new complex substance.
- Provide an example of a decomposition reaction and a synthesis reaction.
- Generally describe the concept of replacement reactions. Differentiate between a single replacement reaction and a double replacement reaction.
- Describe what is meant by reaction rate.
- Explain some of the factors which influence reaction rate including temperature, concentration, particle size or surface area, and the presence of catalysts.

Assessment

Preliminary Assessment:

The Preliminary Assessment, provided in the Student Masters section, is an assessment tool designed to gain an understanding of students' pre-existing knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post Assessment:

The Post Assessment, provided in the Student Masters section, can be utilized as an assessment tool following completion of the video and student activities. The results of the Post Assessment can be compared against the results of the Preliminary Assessment to evaluate student progress.

Introducing the Video

Before showing the video, hold up a box of baking soda and a bottle of vinegar. Ask students if they have ever seen these substances in their home and if they know what they can be used for. Write the words “baking soda” and “vinegar” on the black board. Ask students to describe the observable characteristics of each substance. Write their responses under the words “baking soda” and “vinegar” on the board.

Next ask students what they think might happen if these two substances were combined. Write their predictions on the board. After doing this, take a few spoonfuls of baking soda and place them in a beaker or other glass container. Pour in some vinegar. Students should observe what they see and hear. Record their observations on the board.

Explain to your students that they have just witnessed a chemical reaction. The baking soda and vinegar went through a change which formed a new substance. Ask students what other examples of chemical reactions they may have witnessed.

Tell students to pay close attention to the video to learn more about the characteristics of chemical reactions and some different types of chemical reactions.

Video Viewing Suggestions

The student Master “Video Review” is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20 minutes in length and includes a ten question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher’s guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.

Video Script: Reactions

1. Have you ever wondered what causes a match to light?
2. Or have you ever thought about how the engine of a lawn mower uses gasoline to turn the cutting blades?
3. Have you ever thought about why salt melts the ice on a sidewalk?
4. Or have you ever wondered why certain metals, such as iron, rust over time?
5. Why do all these things occur?
6. These are all examples of chemical reactions in action!
7. What exactly is a chemical reaction?
8. How do chemical reactions start and finish?
9. And, what are some of the different types of chemical reactions?
10. During the next few minutes we are going to explore these questions…
11. …and others, as we explore the fascinating topic of chemical reactions.
12. **Graphic Transition – Evidence of Chemical Reactions**
13. Chemical reactions are all around us, even though we may not notice them.
14. A chemical reaction is the process by which substances undergo chemical and physical changes that form new substances with new properties. Let us take a look at an example.
15. When you cook an egg, you are witnessing a chemical reaction.
16. When you sit by a warm fire you are feeling the result of a chemical reaction.
17. And when you eat you are fueling your body for a series of chemical reactions that help you survive.
18. Even though chemical reactions occur in many places, they are not always easy to detect.
19. Here are some clues which may indicate the presence of a chemical reaction.
20. One indicator of a chemical reaction is a change in color.
21. For example, when grayish colored iron turns a brownish orange color it indicates that a chemical reaction called rusting is occurring.
22. Sometimes a chemical reaction produces a gas, as do these antacid pills when mixed with water.
23. Chemical reactions may produce a solid called a precipitate, which forms when two liquids react.
24. These large solid structures are precipitates formed underwater from chemical reactions when this lake was much higher.
25. Another good indicator of a chemical reaction is a change in temperature.
26. When the chemicals in this match tip are ignited, a chemical reaction is triggered that produces heat.
27. Magnesium when ignited also produces a great deal of heat.
28. These are just a few of the indicators which are clues to identifying chemical reactions.

Script (cont.)

29. Graphic Transition – Chemical Reactions in Action
30. When you look at the forest in the winter, you see a much different scene…
31. . . . than looking at a similar forest in the summer time. What accounts for this difference?
32. The main difference is that in spring, leaves emerge from trees, shrubs, and other plants. . .
33. . . . Giving the landscape an overall green appearance.
34. You Decide! What vital chemical reaction is occurring in this leaf?
35. The important chemical reaction occurring in all these leaves is photosynthesis.
36. In the process of photosynthesis, plants take in carbon dioxide and water, then with the sun's energy, they produce oxygen, sugar, and water vapor.
37. In this chemical reaction, plants are able to take several substances and convert them into new substances…
38. …that help them grow and reproduce.
39. Other animals also benefit from this process. Their bodies use sugars which they obtain when they eat plants.
40. …and they also breathe in oxygen, which plants give off.
41. In chemical reactions, there are two main types of substances: reactants and products.
42. Let us take a look at a simple chemical reaction between baking soda, also called sodium bicarbonate, and vinegar, also called acetic acid. These are called the reactants. Reactants are substances that enter a chemical reaction.
43. When combined these reactants produce new substances called products.
44. The products in this reaction include sodium acetate, carbon dioxide gas, and water.
45. These are new substances that did not exist before the chemical reaction took place.
46. In a chemical reaction energy is either released or absorbed.
47. But, not all substances that are combined necessarily undergo a chemical reaction.
48. To make a fruit salad, different pieces of fruit are cut up and mixed together. The original kinds of fruit were not changed, and no new substances were formed.
49. When the fruit was mixed, the existing chemical bonds in the fruit were not broken, and so no new bonds were formed.
50. Graphic Transition – Chemical Equations
51. You Compute! How would you write out this numerical expression? Three times two equals six.
52. You would write this expression as a mathematical equation as follows: The number three times the number two equals the number six.

Script (cont.)

53. Reactions between chemicals can also be written in a similar manner.
54. Let us consider the very important chemical reaction occurring in this plant.
55. Photosynthesis is the chemical reaction in which plants take in carbon dioxide and water, and with the sun's energy produce sugar and oxygen.
56. Stating this reaction in words is a long, cumbersome process.
57. It is much easier and simpler to write it as a chemical equation. A chemical equation is an expression which uses chemical symbols to represent a chemical reaction.
58. A simplified version of the chemical reaction of photosynthesis is written like this: $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$.
59. In a chemical equation various chemical symbols and other symbols are used to represent the reaction.
60. Polished silver usually has a shiny appearance.
61. But when exposed to the air over time, silver turns a dull, dark gray color. This is the result of a chemical reaction between the silver and sulfur compounds in the air. This reaction produces a product called silver sulfide.
62. When chemical reactions occur, the overall mass of the substances reacting does not decrease or increase.
63. In a chemical reaction the change that occurs involves the rearrangement of atoms, not the production or destruction of matter.
64. This principle is expressed in the Law of the Conservation of Mass. This law states that mass cannot be lost or gained in a chemical reaction.
65. **Graphic Transition – Balancing Chemical Reactions**
66. As we discussed, the Law of the Conservation of Mass states that mass is not lost or gained in a chemical reaction.
67. Another way of looking at this law is that the number of atoms of each element must be the same before and after a reaction.
68. This stove in this kitchen burns natural gas to cook food.
69. Natural gas is made up mostly of a compound called methane. When combusted it reacts with oxygen to produce carbon dioxide and water.
70. The chemical equation can be written as follows: $CH_4 + O_2 \rightarrow CO_2 + H_2O$
71. On the left side of the equation there are 4 atoms of hydrogen, but on the right there are only 2 atoms of hydrogen.
72. This chemical equation is not balanced. We need to make it balanced by adding coefficients. A coefficient is a number written in front of chemical elements or compounds. A coefficient indicates the number of atoms or molecules of a substance present in a reaction.

Script (cont.)

73. To make this equation balanced, all we need to do is add a 2 in front of the O_2 on the reactants side. And then add a 2 in front of H_2 on the products side of the equation.
74. The equation is now balanced with the same number of atoms of each element on either side of the equation.
75. **Graphic Transition – Decomposition and Synthesis Reactions**
76. There are thousands of different chemical reactions. As we mentioned, they are going on all the time around us.
77. Many chemical reactions are constantly occurring in the human body.
78. Scientists often classify chemical reactions to help make the different types easier to understand.
79. While chemical reactions all form products, they differ in the way the products are made.
80. One type of reaction is called a decomposition reaction. A decomposition reaction occurs when a complex substance is broken down into two or more simpler substances.
81. For example, calcium carbonate in this marble can decompose into calcium oxide and carbon dioxide.
82. The opposite of a decomposition reaction is a synthesis reaction.
83. In a synthesis reaction two or more simple substances combine to form a new complex substance.
84. For example, in the process of rusting, iron and oxygen combine to form iron oxide.
85. **Graphic Transition – Single and Double Replacement Reactions**
86. In a type of reaction called a single replacement reaction, one element replaces another in a compound. An example of a single replacement reaction occurred when the copper in this copper solution replaced the iron in these nails.
87. **You Predict!** What will happen when we place this copper wire in a solution of silver nitrate?
88. When a copper wire is placed in a solution of silver nitrate, over time the copper replaces the silver in the nitrate forming a blue substance called copper nitrate.
89. The chemical equation representing this single replacement reaction is: $Cu + AgNO_2 \rightarrow CuNO_2 + Ag$. Notice how the copper replaced the silver in the reaction.
90. In another type of replacement reaction, called a double-replacement reaction, different atoms in two different compounds replace each other.
91. When a solute is placed in a solution of silver nitrate, a chemical reaction takes place in which two different elements replace each other and a precipitate is formed.

Script (cont.)

92. Here $KCl + AgNO_3 \rightarrow AgCl + KNO_3$. Notice how both potassium and silver replace each other, forming two new compounds.
93. **Graphic Transition – Chemical Reaction Rates**
94. When you fry an egg a chemical reaction is taking place in the egg.
95. In which pan will the egg cook more quickly – the one in the sunny window or the one on the stove.
96. As you can see, the egg on the stove cooks much faster!
97. Temperature has a big effect on how fast chemical reactions occur.
98. Reaction rate is the speed at which a reaction takes place, or how quickly reactants change into products.
99. A chemical reaction is occurring in these glow sticks.
100. **You Predict!** Which one will be brighter – the one placed in cold water or the one in hot water?
101. After several minutes the one in the hot water is brighter than the one in cold water. This is because increased temperature speeds up or increases the reaction rate.
102. An increase in temperature makes particles move faster which forces reactants to collide and react more frequently.
103. Concentration, or the particles present per unit of volume, can also effect reaction rate.
104. For example, as the valve on this stove is turned the concentration of gas increases, and the combustion process increases.
105. In another example, the acid on the left has a lower concentration than the one on the right. When a piece of magnesium is dropped in each test tube, you can see that the one on the right with the higher concentration has a higher reaction rate.
106. **You Observe!** What fire is burning more vigorously – the one with one large piece of wood – or the fire with many small pieces?
107. The fire with many small pieces or many small particles is exhibiting a higher reaction rate. Why?
108. This is due to the fact that the many small pieces have a larger surface area.
109. Increasing the surface area increases the rate of a reaction.
110. When we chew food, catalysts in our mouth are actively promoting digestion.
111. A catalyst is a substance that increases reaction rate but itself is not consumed by the reaction.
112. Reactions in our body that might take years to occur are able to occur within seconds due to special types of catalysts called enzymes.
113. **Graphic Transition – Summing Up**
114. During the past few minutes we have explored some of the fascinating features of chemical reactions.

Script (cont.)

115. We learned that a chemical reaction is a process in which reactants undergo chemical and physical changes that form new substances called products.
116. We discussed some of the indicators of chemical reactions including a change in color, . .
117. . . . the production of a gas, . . .
118. . . . the formation of a precipitate, . . .
119. . . . or a change in temperature.
120. We also explored how chemical reactions can be represented by chemical equations.
121. The process of balancing chemical equations has also been demonstrated.
122. We discussed some of the different types of chemical reactions, including decomposition reactions in which a complex substance is broken down into two or more simpler substances.
123. We also discussed the opposite of a decomposition reaction, known as a synthesis reaction. In this reaction, two or more simple substances combine to form a new complex substance.
124. Single and double replacement reactions were also discussed.
125. And, finally we explored some of the factors which influence chemical reaction rates including temperature, . .
126. . . . concentration. . .
127. . . . surface area or particle size. . .
128. . . . and the presence of catalysts. . .
129. So, the next time you cook some food,
130. . . . see a roadside flare,
131. . . . or enjoy the warmth of a fire, think about some of the things we discussed during the past few minutes.
132. You just might think about chemical reactions a little differently.
133. **Graphic Transition – Video Assessment**

Fill in the correct word to complete the sentence. Good luck and let us get started.

1. This chemical reaction is showing a change in _____.
2. The new substances produced in a reaction are the _____.
3. In a reaction energy is either _____ or absorbed.
4. A chemical _____ uses symbols to represent a reaction.
5. The Law of the Conservation of _____ states that mass cannot be lost or gained in a reaction.
6. Coefficients can be used to _____ equations.
7. This is an example of a _____ reaction.

Student Assessments and Activities

Assessment Masters:

- Preliminary Assessment
- Video Review
- Post Assessment

Student Activity Masters:

- Reactions in Action
- The Law of the Conservation of Mass
- Vocabulary of *Reactions*

Answers to Student Assessments

Preliminary Assessment (pgs. 20-21)

1. chemical
2. precipitate
3. indicators
4. photosynthesis
5. released
6. equation
7. mass
8. decomposition
9. synthesis
10. increases
11. true
12. false
13. true
14. true
15. false
16. false
17. true
18. true
19. false
20. true

Video Review (pg. 22)

1. Photosynthesis is the vital chemical reaction occurring in these leaves.
2. You would write out this numerical expression as follows: 3 X 2 = 6.
3. When copper wire is placed in a solution of silver nitrate, the copper replaces the silver in the nitrate forming a blue substance called silver nitrate.
4. After several minutes the glowstick placed in hot water will be brighter than the one placed in cold water. This is because increased temperature speeds up or increases the reaction rate.
5. The fire with many small particles is exhibiting a higher reaction rate. This is due to the fact that the many small pieces have a larger surface area.

Video Quiz (p. 22)

1. color
2. products
3. released
4. equation
5. mass
6. balance
7. decomposition
8. synthesis
9. rate
10. increase

Post Assessment (pgs. 23-24)

1. released
2. chemical
3. increases
4. precipitate
5. decomposition
6. photosynthesis
7. indicators
8. mass
9. equation
10. synthesis
11. true
12. false
13. false
14. false
15. true
16. true
17. true
18. false
19. true
20. true

Answers to Student Activities

Reactions in Action (pgs. 25-27)

1. There were a couple of indicators for the reaction between baking soda and vinegar. The most obvious indicator was the production of a gas. The reaction also demonstrated a slight color change.
2. The chemical equation for the reaction between baking soda and vinegar is as follows: $NaHCO_3 + HC_2H_3O_2 \rightarrow CO_2 + NaC_2H_3O_2 + H_2O$.
3. The steel wool ignited and tiny sparks were given off.
4. The chemical equation for this reaction is as follows: $Fe + O_2 \rightarrow FeO_2$. This was a synthesis reaction.

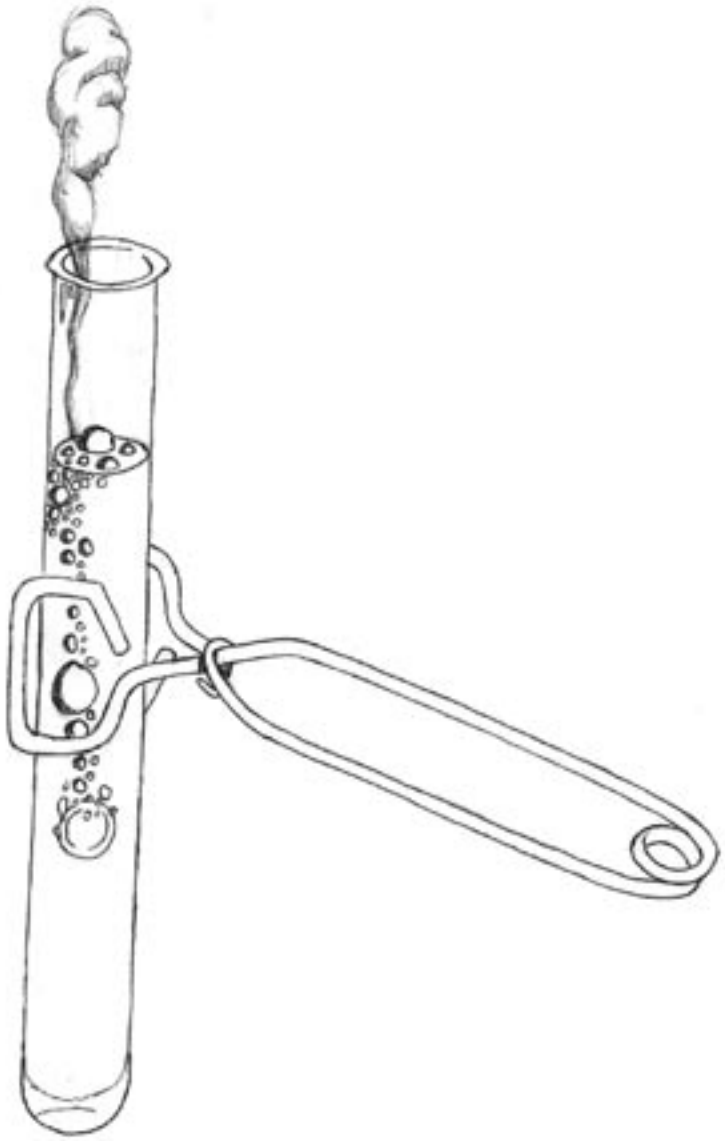
The Law of the Conservation of Mass (pgs. 28-29)

1. The weight of the reactants (vineagar and baking soda) before the reaction was the same as the weight of the products following the reaction.
2. The weight of the reactants (antacid and water) before the reaction was the same as the weight of the products following the reaction. This supports the Law of the Conservation of Mass which states that the mass of the reactants equals the mass of the products in a reaction.
3. Answers will vary.

Vocabulary of *Reactions* (p. 30)

1. j - coefficient
2. h - reaction rate
3. f - replacement reaction
4. d - synthesis reaction
5. g - decomposition reaction
6. i - chemical equation
7. e - reactants
8. b - products
9. a - chemical reaction
10. c - indicator

Assessment and Student Activity Masters



Name _____

Preliminary Assessment

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. When you see fire you are witnessing a _____ reaction.

2. Sometimes when two liquids react a solid _____ forms.

3. _____ are clues which identify a chemical reaction.

4. _____ is the process by which plants produce their own food from the sun's energy.

5. Energy is either _____ or absorbed in a chemical reaction.

6. $H_2O \rightarrow H_2 + O$ is an example of a chemical _____.

7. In chemical reactions the overall _____ of substances reacting does not decrease or increase.

8. A _____ reaction occurs when a complex substance is broken down into two or more simpler substances.

9. In a _____ reaction two or more simpler substances combine to form a new complex substance.

10. An increase in temperature most often _____ the reaction rate.

chemical	mass
decomposition	photosynthesis
equation	precipitate
increases	released
indicators	synthesis

Preliminary Assessment

Directions: Decide whether the statement is true (T) or false (F).

11. A change in color is sometimes an indicator of a chemical reaction. T F

12. Chemical reactions rarely occur in living things. T F

13. Reactants are substances that enter a chemical reaction. T F

14. In a chemical reaction energy is either released or absorbed. T F

15. All substances that are combined undergo chemical reactions. T F

16. This equation is balanced: $Fe + O_2 \rightarrow 2\ FeO_2$. T F

17. This is an example of a single replacement reaction: $Cu + AgNO_2 \rightarrow CuNO_2 + Ag$. T F

18. A decomposition reaction involves a complex substance being broken down into two or more simpler substances. T F

19. A decrease in temperature usually increases the reaction rate. T F

20. An increase in concentration of one or more of the reactants often increases the reaction rate. T F

Name _____

Video Review

Directions: During the course of the program, answer the questions as they are presented in the video. At the end of the video, answer the Video Quiz questions.

You Decide!

1. What vital chemical reaction is occurring in this leaf?

You Compute!

2. How would you write out this numerical expression? Three times two equals six.

You Predict!

3. What will happen when we place this copper wire in a solution of silver nitrate?

You Predict!

4. Which one will be brighter - the one placed in cold water or the one in hot water?

You Observe!

5. What fire is burning more vigorously - the one with one large piece of wood - or the fire with many small pieces?

Video Quiz:

1. This chemical reaction is showing a change in _____.
2. The new substances produced in a reaction are the _____.
3. In a reaction energy is either _____ or absorbed.
4. A chemical _____ uses symbols to represent a reaction.
5. The Law of the Conservation of _____ states that mass cannot be lost or gained in a reaction.
6. Coefficients can be used to _____ equations.
7. This is an example of a _____ reaction.
8. In a _____ reaction, two or more simple substances form a new complex substance.
9. Reaction _____ is the speed at which a reaction occurs.
10. An increase in temperature tends to _____ the reaction rate.

Post Assessment

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. Energy is either _____ or absorbed in a chemical reaction.

2. When you see fire you are witnessing a _____ reaction.

3. An increase in temperature most often _____ the reaction rate.

4. Sometimes when two liquids react a solid _____ forms.

5. A _____ reaction occurs when a complex substance is broken down into two or more simpler substances.

6. _____ is the process by which plants produce their own food from the sun's energy.

7. _____ are clues which identify a chemical reaction.

8. In chemical reactions the overall _____ of substances reacting does not decrease or increase.

9. $H_2O \rightarrow H_2 + O$ is an example of a chemical _____.

10. In a _____ reaction two or more simpler substances combine to form a new complex substance.

chemical	mass
decomposition	photosynthesis
equation	precipitate
increases	released
indicators	synthesis

Post Assessment

Directions: Decide whether the statement is true (T) or false (F).

11. In a chemical reaction energy is either released or absorbed. T F

12. Chemical reactions rarely occur in living things. T F

13. This equation is balanced: $Fe + O_2 \rightarrow 2\ FeO_2$. T F

14. A decrease in temperature usually increases the reaction rate. T F

15. This is an example of a single replacement reaction: $Cu + AgNO_2 \rightarrow CuNO_2 + Ag$. T F

16. Reactants are substances that enter a chemical reaction. T F

17. An increase in concentration of one or more of the reactants often increases the reaction rate. T F

18. All substances that are combined undergo chemical reactions. T F

19. A decomposition reaction involves a complex substance being broken down into two or more simpler substances. T F

20. A change in color is sometimes an indicator of a chemical reaction. T F

Reactions in Action

Background:

Chemical reactions are all around us. When we cook things, eat things, and breathe we are experiencing chemical reactions. Without chemical reactions life would not exist. What exactly is a chemical reaction? A chemical reaction is the process by which substances undergo chemical and physical changes that form new substances with new properties.

If chemical reactions are all around us then how do we know when they occur? There are some clues which indicate the presence of a chemical reaction. One indicator of a chemical reaction is the production of a gas. A change in color can also indicate a chemical reaction. Other indicators include a change in temperature and the production of a solid precipitate when two liquids react. These are just a few of the more common indicators identifying chemical reactions.

In this activity you will create a chemical reaction and observe its characteristics.

Materials:

Protective eyeglasses or goggles, baking soda, vinegar, a beaker or glass container, a spoon, a small amount of fine steel wool, matches and tongs.

Directions:

1. In the first part of this exercise you will initiate a chemical reaction between baking soda and vinegar. These are the reactants.
2. Before starting the activity obtain safety glasses or safety goggles. **Wear the safety goggles over your eyes throughout the entire experiment!**
3. Obtain a sample of baking soda from your teacher. Baking soda is also called sodium bicarbonate ($NaHCO_3$). Also obtain a sample of vinegar, also called acetic acid ($HC_2H_3O_2$), from your teacher. You'll probably need about 3 g of baking soda and 5 ml of vinegar.
4. Place the baking soda in a small beaker or glass container. Observe its properties and record your observations in the data table.
5. Observe the properties of the vinegar and record your observations in the data table. Next slowly pour the vinegar onto the baking soda.
6. Observe what occurs when the vinegar comes into contact with the baking soda. Record your observations.
7. The next part of the experiment will be conducted by your teacher. Make sure your teacher wears protective eye glasses or goggles. Your teacher will hold a piece of fine steel wool with tongs and ignite it with a match.
8. Watch closely to see what happens to the steel wool when it is ignited. Record your observations.
9. After the steel wool has burned record any changes you see in it.

Name

Reactions in Action (cont.)

Baking Soda and Vinegar Data Table

	Chemical name	Obervations before reaction	Observations during reaction	Observations after reaction
Baking soda				
Vinegar				

Steel Wool Data Table

Steel wool before reaction	Steel wool during reaction	Steel wool after reaction

Reactions in Action (cont.)

Questions:

1. What indicators led you to believe that a chemical reaction occurred between the baking soda and vinegar?

2. Write out the chemical equation for the reaction between the baking soda and vinegar.

3. Describe the reaction you observed in the steel wool.

4. Write the chemical equations for the steel wool reaction and state what type of reaction it is.

Name

The Law of the Conservation of Mass

Background:

When chemical reactions occur, the overall mass of the substances reacting does not increase or decrease. In a chemical reaction the change that occurs involves the rearrangement of atoms, not the production or destruction of matter. The principle that expresses this concept is the Law of the Conservation of Mass.

The Law of the Conservation of Mass states that mass cannot be lost or gained in a chemical reaction. In this activity you will observe two reactions which illustrate this important law.

Materials:

Protective eyeglasses or goggles, baking soda, vinegar, a stirring rod, a beaker, water, and a balance.

Directions:

1. **Put on protective eyeglasses or goggles and wear them throughout the duration of the activity.**
2. Pour 20 ml of vinegar into a beaker. Weigh the beaker and record the weight in the data table.
3. Obtain 10 grams of baking soda. Weigh the baking soda and record the weight in the data table.
4. Carefully pour the baking soda into the beaker with vinegar.
5. Stir with a stirring rod and observe. Look for the presence of a chemical reaction.
6. Place the beaker on a scale and record the weight.
7. Think of other types of chemical reactions which would exhibit the Law of the Conservation of Mass.

The Law of the Conservation of Mass

Baking Soda and Vinegar

	Observations
Weight of beaker with vinegar	
Weight of baking soda	
Total weight of baking soda, vinegar, and beaker before reaction	
Weight of beaker containing mixture after reaction	

Questions:

1. What was the weight of the reactants before the reaction, and what was the weight of the products after the reaction?

2. Describe how the measurements support the Law of the Conservation of Mass.

3. Describe another chemical reaction you have seen and how the Law of the Conservation of Mass relates to it.

Vocabulary of Reactions

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

____ 1. fenoftcecii _____

____ 2. eraitcno tera _____ _____

____ 3. rclanepemet eraitcno _____ _____

____ 4. ysnehtssi eirontca _____ _____

____ 5. eondipitosmco teirnoca _____ _____

____ 6. hcceiaml qnoetuita _____ _____

____ 7. rcatnstea _____

____ 8. rsopcutd _____

____ 9. hcceiaml areitcno _____ _____

____ 10. nroaticid _____

a. the process by which substances undergo chemical and physical changes that form new substances with new properties

b. the substances which are the result of a chemical reaction

c. a clue which helps identify a chemical reaction

d. a type of reaction which occurs when two or more simpler substances combine to form a more complex substance

e. the substances which enter a chemical reaction

f. a type of reaction in which one element replaces another in a compound

g. a type of reaction which occurs when a complex substance is broken down into two or more simpler substances

h. the speed at which a reaction takes place, or how quickly reactants change into products

i. an expression which uses chemical symbols to represent a chemical reaction

j. a number written in front of chemical elements or compounds which indicates the number of atoms or molecules of a substance present in a reaction