Review and apply
Investigation 5

Let's review
Pages 311-312

1. **After you tested all the known powders with all the test liquids, describe what you did to identify the unknown powder.**
   Students should have tested the unknown powder with the 4 test liquids the same way they tested each of the known powders. They compared this set of reactions to the set of reactions for each of the known powders using their recorded observations on *Activity sheet 5.2—Using chemical change to identify an unknown*. Answers will vary as students describe the observations that led them to identify the unknown. If baking powder was the unknown, students might mention that the unknown powder bubbled with both water and vinegar the way that baking powder did. They should also notice that the unknown turned a foamy blackish purple with iodine and bubbled and turned purple to blue with the cabbage indicator. All of these reactions were like the reactions baking powder had with each of the test liquids; therefore the unknown must be baking powder.

2. **Baking powder contains baking soda, cream of tartar, and cornstarch. When water is added, two of these three ingredients react to produce carbon dioxide gas. Describe what you did to figure out what the two "active" ingredients in baking powder are.**
   Students should describe what they did during *Activity 5.3—Exploring baking powder*. Students should mention that they tested all the three different combinations of 2 powders with water. Since only baking powder bubbled with water, students knew that the combination that bubbled with water must contain the active ingredients in baking powder.

3. **If a chemical change occurs, there is usually a change in temperature. Some people think that when the temperature changes during a chemical reaction, it always *increases*.**
   Is this true? No

   Describe an experiment that you did that supports your answer.
   Students should remember that the temperature decreased when they combined baking soda and vinegar in *Activity 5.4—Change in temperature—Endothermic reaction*. In this experiment the temperature dropped about 12 °F or about 7 °C. Students may describe any other endothermic reaction they have conducted instead of the baking soda and vinegar reaction from the investigation.

4. **Acids make red cabbage indicator turn from blue to pink. Bases make red cabbage indicator turn from blue to greenish-blue. If you had two pink solutions and wanted to figure out which one contained more acid, how could you use a base to find out?**

   Describe what you would do below.
   Students will likely describe a process similar to what they did in *Activity 5.9—Comparing the amount of acid in different solutions*. Students should use three cups of red cabbage indicator. One will serve as the control (blue) while the other two (pink) will contain indicator plus some mysterious amount of acid. Students would then add single drops of a base to one of the indicator + acid cups, swirl, and count the number of drops needed until the solution returns to the blue color of the control. Then they should do the same thing with the other acid solution. The solution which needs more of the base solution (to return to the blue color of the control) is the one which contained the most acid.

   Below are some other ways in which students might test the two pink solutions to see which one contains the most acid.
   - Add a given measured amount (in a graduated cylinder) of each of the two pink solutions to the base solution. Which ever turns the blue solution pink first is the one that contains the most acid.
   - Add a given, measured amount (in a graduated cylinder) of blue solution to each of the two acids. Which ever is the closest color to the control blue solution is the solution with the least amount of acid.

5. **What would you do to find out if hard water affects detergent the same way it affects soap?**
   Students will need to obtain or make hard water the way they did in *Activity 5.10—Formation of a precipitate*. Then they should add the same amount of detergent and soap to 2 cups of hard water. They should stir each solution and look for a precipitate. Students could also test and compare the two solutions. They may test each for their cleaning ability, bubbling ability, etc.

Science in action!

Pages 313-315

1. **If an Alka Seltzer tablet is placed in red cabbage indicator, would you expect a gas to be produced?** Yes
   What makes you think that?
   Alka-Seltzer contains two acids and baking soda. Students should know from the activities in this investigation that adding an acid to baking soda causes bubbles of carbon dioxide gas to form. Students may mention adding vinegar to baking soda (Activities 5.2, 5.4, & 5.5) or adding water to cream of tartar and baking soda (Activity 5.3). Students may also cite experiences they have had with Alka-Seltzer in water in previous experiments or in everyday life.

2. **Would you expect a color change?** Yes
   What makes you think that?
   Because citric acid and aspirin are acids and baking soda is a base, a color change will occur. Acids make red cabbage indicator turn pink and bases make it turn green. Students might predict that the color will change like the following:
   - Because there are two acids and one base, the solution will initially turn pink.
   - Alka-Seltzer is used to settling upset stomachs (acids) so it might have more base turning the solution green.
   - The acids and base will react and neutralize each other making the color blue.

3. **Would you expect a change in temperature?**
   Answers will vary. Most students would predict that a temperature change will occur.
   What makes you think that?
   Students may remember that the temperature decreased when baking soda and vinegar were combined. Since vinegar is an acid like citric acid and aspirin, it is likely that the temperature will go down. However, the temperature increased when baking soda, water, and calcium chloride were combined. It is possible that the temperature will increase.

How did the temperature change during the reaction?	
Start temperature	70°F or 21°C
Lowest temperature reached	62°F or 16°C
Change in temperature	8°F or 5°C

Answers will vary. The temperatures listed in the chart are given as a basic guide.

4. **In addition to a temperature change, what other evidence of chemical change did you observe?**
   Students should observe a color change and a gas released.

5. **Describe the color changes as the tablet dissolved.**
   At first the tablet turned bright pink. As the tablet continued to dissolve and react, the solution become purple. Once the tablet dissolved and the reaction seemed completed the solution turned blue.

6. **Use the words “acid”, “base”, and “neutral” to explain the color changes…**
   - **when the Alka-Seltzer tablet was first placed in the indicator solution.**
     When the solution turned bright pink, it meant that it was very acidic.
   - **while the reaction was taking place.**
     When the solution turned purple, some base neutralized some of the acid making the solution less acidic than before.
   - **after the reaction was complete.**
     When the solution turned blue, it was neutralized.

Think about it!

Pages 318-319

1. **Photosynthesis uses energy from the _____ to make food for the plant.**
   a. earth
   b. sun
   c. plant's leaves
   d. bacteria

2. **What fact might the author want you to remember most?**
   a. All living things depend on chemical reactions.
   b. Photosynthesis makes food for plants.
   c. Burning wood is a chemical process.
   d. Cell Respiration gets energy from glucose.

3. **When wood is burned, the process is exothermic. What does the word *exothermic* mean in this sentence?**
   a. Energy released from the sun.
   b. Fire breaks down the wood into ashes.
   c. Energy is released.
   d. Oxygen is produced.

4. **Living things are able to get energy out of glucose during cell respiration. Glucose is…**
   a. the sun's energy.
   b. a sugar molecule.
   c. a water molecule.
   d. carbon dioxide.

5. **During photosynthesis, energy from the sun is trapped as…**
   a. water and carbon dioxide.
   b. chemical energy in the glucose molecule.
   c. cell respiration.
   d. oxygen.

6. **No matter what food you eat, you can always trace the source of energy back to…**
   a. the sun and photosynthesis.
   b. fertilizer
   c. the heat from the center of the earth
   d. oxygen and carbon dioxide

7. **How are photosynthesis and cell respiration similar and different?**
   Photosynthesis and cellular respiration are similar because both reactions contain water, carbon dioxide, glucose, oxygen and energy. They are different, because the reactions are opposites of each other. In photosynthesis, water, carbon dioxide, and energy are part of the products. With cellular respiration, water, carbon dioxide, and energy are part of the reactants.

8. **In a way, everything we eat depends on photosynthesis. Describe how a breakfast of bacon and eggs depends on photosynthesis.**
   Bacon comes from a pig or turkey. Pigs eat plants and meat. The plants they eat get their energy from photosynthesis, but the meat they eat (such as insects) also get their energy from plants. Turkeys get their energy from plants such as seeds and grains. All of the breakfast depends on photosynthesis, either directly or indirectly.

9. **One of the reasons plants are important to us is because they reduce the amount of carbon dioxide in the atmosphere and increase the amount of oxygen, which we need to breathe. Explain how this statement relates to the chemical equation for photosynthesis.**
   During photosynthesis plants take in *carbon dioxide* gas along with water. Plants use energy from sunlight to produce *glucose* and oxygen. The oxygen is released into the air for us breathe.

10. **We need to eat food and breathe in oxygen to stay alive. We also breathe out carbon dioxide gas. Explain how these statements relate to the chemical equation for cell respiration.**
    Cell respiration changes glucose and oxygen from the food we eat into carbon dioxide, water, and energy. We exhale carbon dioxide, use and excrete water, and get energy from our food.
    Note: Cell respiration is different from breathing. “Lung” respiration, or breathing, takes in air and releases the carbon dioxide from it as a waste product. Breathing depends on cellular respiration for the energy that is produced.

What's going on here?

Pages 321-322

1. **What is the difference between *reactants* and *products* in a chemical reaction?**
   Reactants are the atoms, ions, or molecules that are combined with one another.
   Products are new substances that are formed when the atoms, ions and molecules of the reactants rearrange themselves during the reaction.

2. **What is the difference between an *element* and a *compound*?**
   An element is only made of one type of atom. A *compound* is a substance made of all the same molecules, but these molecules are made up of more than one type of atom.

3. **In chemical reactions, one or more new substances are created. Are new *atoms* created?** No
   Use one of the examples of a chemical reaction described in this article to justify your answer.
   Students may select any one of the 4 chemical reactions used in this article as an example. In these reactions, all atoms on the left side of the equation also appear on the right. There are no new or extra atoms. For example, in the chemical reaction to make water there are a total of 4 hydrogen atoms and 2 oxygen atoms on both sides of the equation. The atoms on each side are arranged to make up different molecules.