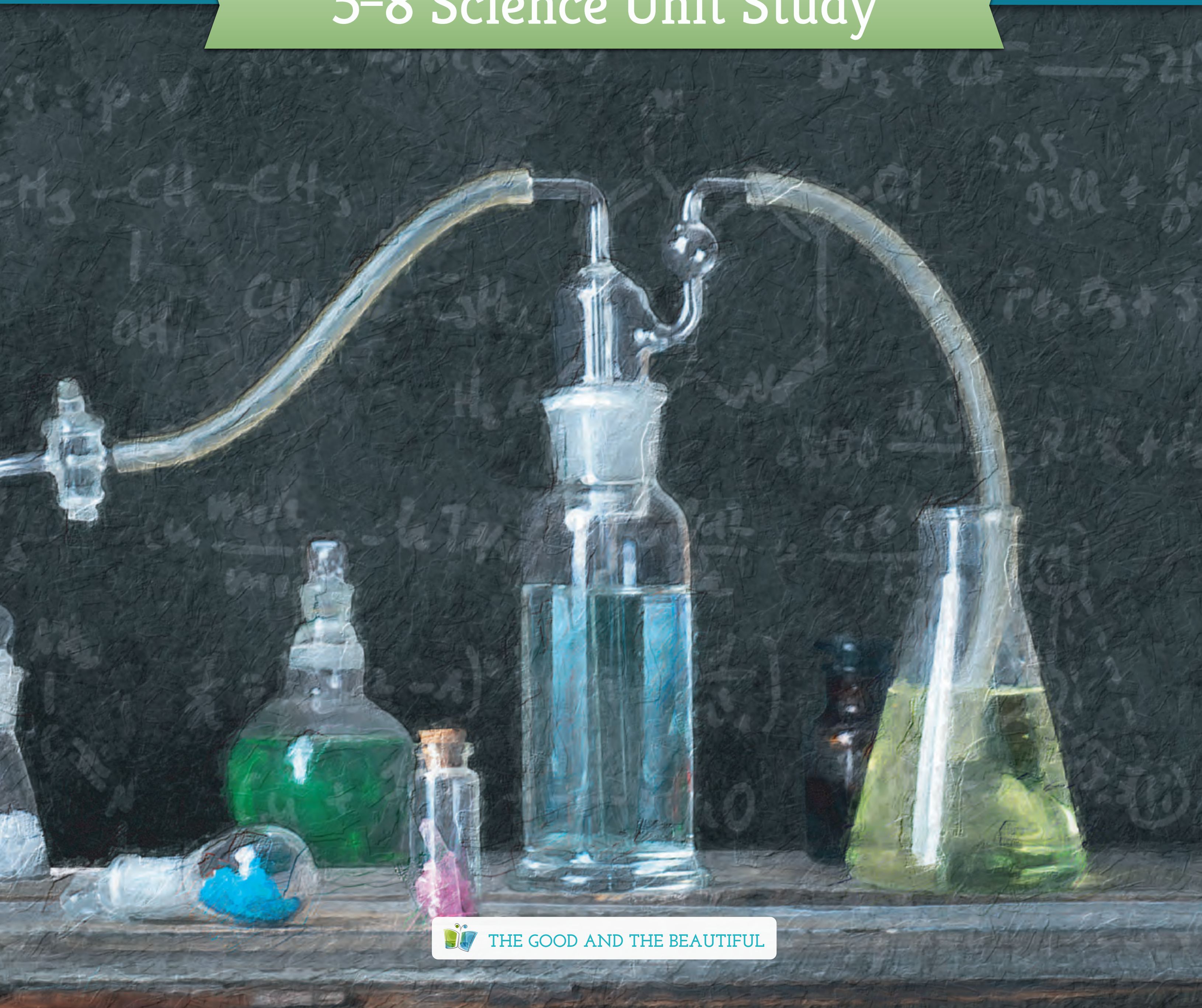
CHEMISTRY

5–8 Science Unit Study



THE GOOD AND THE BEAUTIFUL

Chemistry

CREATED BY THE GOOD AND THE BEAUTIFUL TEAM

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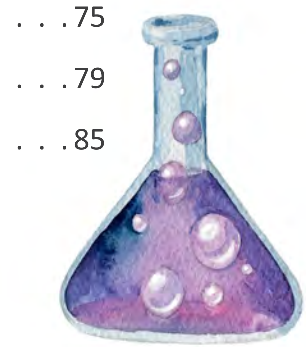


The Good and the Beautiful

Unit Information

Science Journal

All The Good and the Beautiful science units include activities in a student journal. This unit is different from other units because it is geared toward children in grades 5–8 and does not have a student journal for younger grades. Each child should have his or her own student journal, and the parent or teacher will direct the child regarding when to complete the activities as directed in the lessons. Student journals can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Chemistry* unit link.

Science Wall

All The Good and the Beautiful science units include vocabulary words to be placed on your science wall, which is a wall or trifold presentation board in your learning area on which you can attach the vocabulary words and other images. Cut out the vocabulary word cards at the beginning of the unit. The course will indicate when to place them on the wall.

Activities and Experiments

Many of The Good and the Beautiful science lessons involve hands-on activities and experiments. An adult should always closely supervise children as they participate in the activities and experiments to ensure they are following all necessary safety procedures.

Experiment Videos

Go to **goodandbeautiful.com/sciencevideos** and click on the *Chemistry* link or use the Good and Beautiful Homeschool app to see videos of experiments used in this unit. This is a convenient way to watch experiments that may be more complicated. Children often learn best through hands-on experience; therefore, this unit includes a supply list and instructions for all experiments, and you may choose to do as many as you wish.

Unit Videos

Some lessons include videos that were created by The Good and the Beautiful. Have a device available that is capable of playing the videos from **goodandbeautiful.com/sciencevideos** or from the Good and Beautiful Homeschool app.

Versions

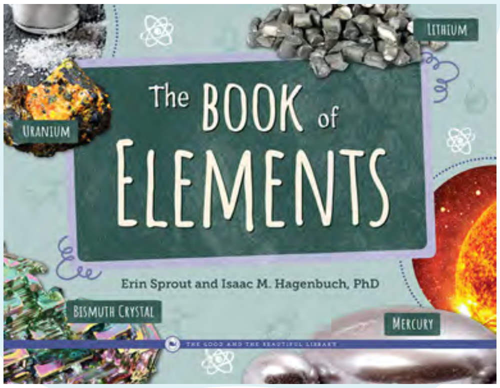
New discoveries are being made on an ongoing basis. This course is reviewed and revised periodically to keep information as up to date as possible. This version is the second edition of this unit.

Read-Aloud Book Pack

The books below are optional read-aloud books that complement this unit. These books can be purchased as a book pack by going to **goodandbeautiful.com/science** and clicking on the *Chemistry* unit link.

The Story of Alice Ball
By Jennifer Lerud

Marie Curie
By Robin McKown



The Book of Elements
By Erin Sprout and
Isaac M. Hagenbuch, PhD

CORRELATED BOOKS

The Good and the Beautiful Library has several books that correlate well with the *Chemistry* unit. It can be a wonderful experience for children to read books at their levels that are related to the subjects they are learning in science. The library includes both fiction and nonfiction books organized according to reading level. Find the correlated books by going to **goodandbeautiful.com** and clicking on the *Chemistry* science unit product page.

Supplies Needed

This section is divided into supplies needed for **activities** and supplies needed for **experiments**. If you would prefer to watch the experiments instead of perform them, you can watch all the experiments at **goodandbeautiful.com/sciencevideos** or from the Good and Beautiful Homeschool **app.** The activities, however, are not filmed.

Lesson 1

- A bowl or basket
- White coffee filters, 3–6 per child
- 5 colors of washable markers, including black and brown
- Ballpoint pen
- Permanent black marker
- 3–6 cups per child, any kind
- Water

Lesson 2

- Glue or glue stick
- Game pawn or other small marker

Lesson 3

- Ruler with both inches and centimeters (one per child, or the group can share one ruler)
- Small piece of paper for each child
- Clear liquid measuring cup or graduated cylinder (indicating on the outside both cups and pints or quarts and milliliters)
- Packaged drink bottle (or any packaged container) that has the volume printed on the label in fluid ounces and milliliters
- Kitchen scale that displays grams along with ounces and pounds
- Object that can be weighed on the scale

Lesson 4

- Rock
- Drink in a cup with a straw, one for each child
- Empty cups of various sizes, one for each child
- Balloon

Lesson 5

- 4 paper cups
- Permanent marker
- 1-tsp measuring spoon
- Salt
- 1-cup liquid measuring cup or 250-mL graduated cylinder
- Warm water
- Spoon
- Candy thermometer
- Timer
- Play dough
- Short glass, cup, or jar
- Cup filled halfway with water
- Straw
- Food coloring (optional)

Lesson 6

- 3 colors of play dough (at least 5 oz of each color for each child)
- 8 toothpicks per child

Lesson 7

- Piece of paper for each child
- Cup of water (optional)
- Lighter or match (optional)
- Small dish (optional)
- 2 glasses filled with water
- 1 Tbsp sugar
- 1 Tbsp vegetable oil
- Graduated cylinder or measuring cup filled halfway with water
- Marble (or small, sinkable object)
- Kitchen scale
- Calculator
- 250-mL graduated cylinder or a tall glass
- Turkey baster (optional)
- ¼ cup honey

Supplies Needed, cont.

This section is divided into supplies needed for **activities** and supplies needed for **experiments**. If you would prefer to watch the experiments instead of perform them, you can watch all the experiments at **goodandbeautiful.com/sciencevideos** or from the Good and Beautiful Homeschool **app.** The activities, however, are not filmed.

- ¼ cup corn syrup
- ¼ cup dish soap
- ¼ cup water
- ¼ cup vegetable oil
- ¼ cup rubbing alcohol
- Food coloring (optional)
- Small objects found around house (raisin, safety pin, screw, etc.)

Lesson 8

- Gloves
- Tray lined with foil
- 250-mL graduated cylinder (or empty disposable water bottle)
- Dish soap
- Food coloring (optional)
- Hydrogen peroxide (at least 3%—see note at end of lesson)
- ½-cup measuring cup
- Funnel (if using a water bottle)
- 300-mL beaker (or a drinking cup)
- Kitchen scale
- 10 g of yeast
- 50-mL beaker (or a ¼-cup measuring cup)
- Warm water
- Spoon

Lesson 9

- None

Lesson 10

- 3 different colors of play dough
- Scissors or wire cutters
- Craft wire

Lesson 11

- 2 magnets (bar magnets, if possible)
- Tape

Lesson 12

- Vinegar
- 100-mL graduated cylinder (or an empty disposable water bottle with a narrow neck)
- 1-tsp measuring spoon
- Mini measuring cup (e.g., a plastic cup that comes with children's cough syrup)
- Kitchen scale
- Baking soda
- Balloon

Lesson 13

- Kitchen scale
- Small bowl
- Salt
- Small baking dish (about 8"x8")
- Warm water
- 50-mL beaker (or ¼-cup measuring cup)
- Spoon

Lesson 14

- Kitchen scale
- Calculator
- Tape
- Crayons or colored pencils

Note: Graduated cylinders and/or beakers are recommended, but completely optional, supplies that can be used in several lesson experiments and activities.

Vocabulary

Instructions: Cut out the vocabulary cards in this section. Place them on your science wall when prompted to do so in the lessons. Review the vocabulary words several times during this unit and, if desired, at various times throughout the school year.

Matter

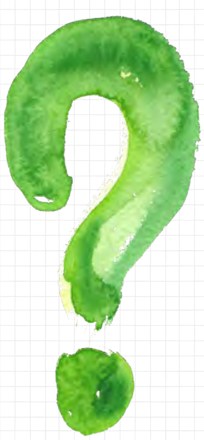
anything that has mass and takes up space

Chemistry

the branch of science that investigates the composition and properties of matter and how they interact

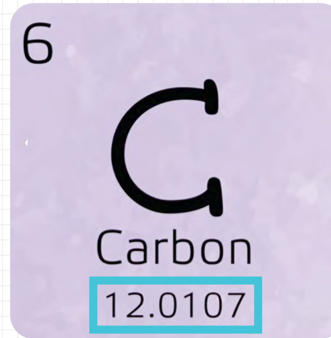
Hypothesis

an educated guess or proposed explanation for an occurrence that will undergo further investigation and testing; it is part of the scientific method



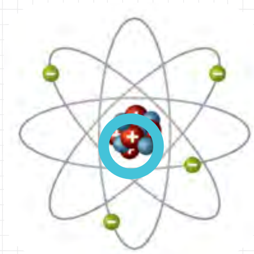
Atomic Mass

the weight of the number of protons plus the number of neutrons of an atom; it is an average of all the element's known isotopes and can be found on the periodic table



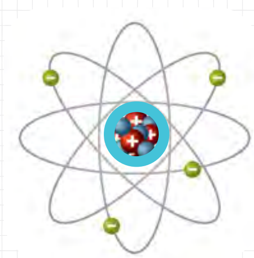
Proton

a positively charged particle found in the nucleus of an atom



Neutron

a particle with no charge found in the nucleus of an atom



CHEMISTRY
LESSON 1

Introduction to Chemistry

Objective

Help the children gain a general overview of and deeper interest in the study of chemistry.

Preparation:

- [ ] Cut out the boxes on the sheet titled "Chemistry Questions." Fold the papers in half and place them in a bowl or basket.

Activity Supplies:

- A bowl or basket

Experiment Supplies:

- White coffee filters, 3–6 per child
- 5 colors of washable markers, including black and brown
- Ballpoint pen
- Permanent black marker
- 3–6 cups per child, any kind
- Water

Introduction to Chemistry

Read to the children: In this unit you will be studying the exciting world of chemistry! Chemistry is used in so many important things that we experience in day-to-day life, such as when doctors make medicine, when engineers create electronics, or when farmers help their plants grow. Chemistry even happens when we cook food in our kitchen! Someone who works with chemistry is called a *chemist*. Through this unit you will get to become a chemist, too.

Chemistry: The Study of Matter

Read to the children: All of God's creations are made of matter. ***Matter*** is the word used to describe what everything around you is made of. Tiny particles of matter interact with each other to make the substances we can sense. ***Chemistry*** is the study of matter and how the tiny particles that make up matter interact with each other. Since everything around you is a part of chemistry, it is often called "the central science." Chemists also study the properties of matter. For example, color, weight, and the effect of temperature are all properties of matter. Studying chemistry will help you understand how the world around you works.

Science Wall

Place the vocabulary words MATTER and CHEMISTRY on your science wall. Read and discuss each word and definition.

MATTER

CHEMISTRY

Chemistry Questions

Have the children take turns picking "Chemistry Questions" from the basket or bowl. Have the children read the questions

Chromatography Experiment

Instructions

Supplies

Gather the needed supplies: white coffee filters (3–6 per child), five colors of washable markers (including black and brown), a ballpoint pen, a permanent black marker, 3–6 cups per child (any kind), and water.

Read through each step before starting. If you need to change the experiment in any way, be sure to record what you did differently. Part of being a good scientist is recording your data properly.

1. In the center of a coffee filter, draw a thick circle with a black washable marker. Your circle should be about 6.35 cm (2.5 inches) in diameter (the measurement from one end of the circle to the other). Do not fill in your circle with color. Using a ballpoint pen, label the far edge of your coffee filter with the type of marker you are using and your name or initials.

2. Repeat Step 1 with a new coffee filter and a black permanent marker. Repeat a third time with a new coffee filter and a brown washable marker. Repeat with as many other colors and/or marker types as you choose, labeling the edge of each coffee filter appropriately.

3. Fold each of your coffee filters in half three times, so as to form cone-shaped pieces.

4. Take a cup for each coffee filter and barely cover the inside bottom of the cup with water. You want the waterline to be below the marker ink. If the water is too high, remove any extra water so that it is below the marker ink, and then place the coffee filter point side down into the cup. Repeat this step for each coffee filter you are testing.

5. Wait approximately 5–7 minutes while the water spreads up the coffee filter into the ink.

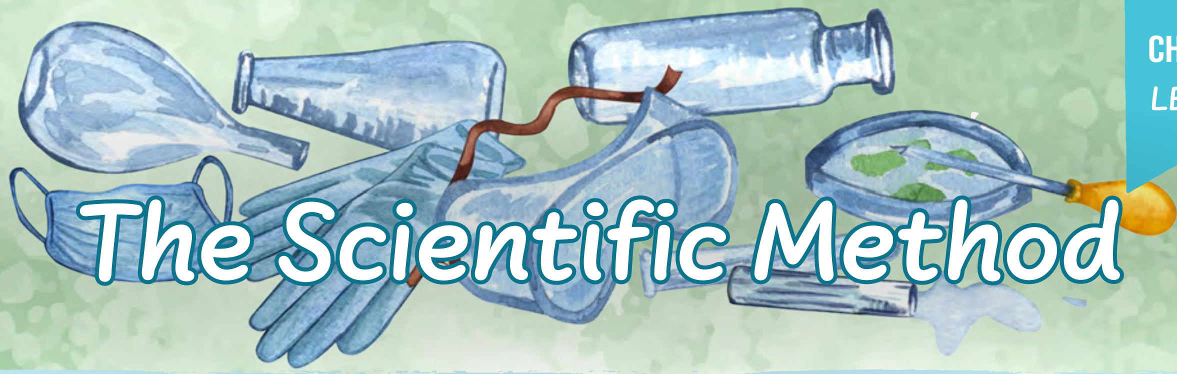
6. Slowly pull your coffee filter out, keeping it straight and waiting a few seconds for the excess water to drip back into the cup. Open the filter and set it on a dry surface. Record any noticeable color separation in your student journal. Be sure to record which marker and color you used.

7. Allow your coffee filters to dry completely. You may choose to move on to other things and revisit this experiment later. Once the filters are dried, record any other noticeable changes. Take time to be a good observer. Look for details in the colors. Some colors show up just on the outer edge of where the ink traveled, and some may be very light and not too visible.

OPTIONAL: Scientific minds are full of questions and wonder and seek to find understanding. You may choose to take this experiment one step further by experimenting with different color sources. See if this experiment would work on a different type of paper or if it would work with oil or rubbing alcohol instead of water. Another idea is to do the experiment again, but this time, fill in the circle or use a greater amount of ink.

Chemistry Questions

Why does sugar seem to disappear when it's mixed with water?	Why do bathroom mirrors get foggy during a warm shower?
How do cooking and baking involve chemistry?	What happens when you try to mix oil and water together? Do they mix or separate?
Why does putting salt on the driveway make the winter snow and ice melt? Does the salt mix with or separate from the snow and ice?	Why does ice float?



The Scientific Method

Objective

Help the children learn the scientific method and know the basic safety measures taken during an experiment.

Preparation:

- ☐ Cut out "PPE Used by Scientists" cards.
- ☐ Cut out "The Scientific Method Cutout" in each child's student journal by cutting along the dotted lines.

Activity Supplies:

- Glue or glue stick
- Game pawn or other small marker

☐ Optional Read Aloud

At any point in the lesson, you may read one of the books from the optional Read-Aloud Book Pack. *The Story of Alice Ball* by Jennifer Lerud is suggested with this lesson.

☐ The Scientific Method

Read to the children: Thinking like a scientist means that your mind asks questions and desires to find truth and understanding. In the Bible it says, "Ask, and it shall be given you; seek, and ye shall find; knock, and it shall be opened unto you: For every one that asketh receiveth; and he that seeketh findeth; and to him that knocketh it shall be opened" (Matthew 7:7–8).

<u>What do you think this scripture means?</u> [Pause for discussion.] God wants to help us in our learning and growth and has invited us to ask Him for help as we seek for truth and knowledge. After all, God is the Creator of this world; He cares about our efforts to learn more about His creations.

Scientists have developed a method for finding answers to questions; this is called the scientific method.

☐ The Scientific Method Video

WATCH ONLINE

Have the children watch the video "The Scientific Method" at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

☐ Scientific Method Journal

Have the children turn to "The Scientific Method" page in Lesson 2 of their student journals. Give each child "The Scientific Method Cutout" that you prepared.

Have the children glue only the center hexagon piece of "The Scientific Method Cutout" onto "The Scientific Method" page. Then have the children lift each flap and draw or write an explanation of each scientific method step. The children may rewatch the video referenced above if they need help remembering each step.

Measuring Equipment

The images below show types of equipment used to measure volume and weight in a science lab.

These types of glassware are used in chemistry laboratories and are called an Erlenmeyer flask (green), a beaker (red), and a graduated cylinder (yellow). They are all used to measure volume. (The Erlenmeyer flask is named after its inventor, Emil Erlenmeyer, a German chemist.)

This is an up close view of the measurements on a graduated cylinder. (The term "graduated" refers to the unit markings as they go up, or "graduate," in scale.)

Notice this scientist is wearing PPE! Also, notice there is a sliding glass door on this scale that will be shut once the scientist is done placing the substance on the tray. This door helps reduce air movement to ensure a more accurate reading.

Elements, Atoms, and Molecules

Objective

Help the children understand basic information about elements, atoms, and molecules and introduce them to chemical bonding.

Preparation:

- ☐ Cut out the “Making Molecules” strips.

Activity Supplies:

- 3 colors of play dough (at least 5 oz of each color for each child)
- 8 toothpicks per child

☐ Optional Read Aloud

At any point in the lesson, you may read one of the books from the optional Read-Aloud Book Pack. *The Book of Elements* by Erin Sprout & Isaac M. Hagenbuch, PhD, is suggested with this lesson.

☐ Building Blocks of Matter

“Perugia-Towers” by Benedetto Bonfigli (1420–1496), 1454

Have the children turn to the “Building Blocks of Matter” page in Lesson 6 of their student journals. Have them follow along and answer the questions at the bottom of the page as they discover the answers.

Read to the children: Examine the beautiful buildings in the painting. <u>What materials do you think were needed to build the structures in this image?</u> [Pause for answers.] Many different materials were needed to work together to build these towers, and all those materials were made of matter. <u>Have you ever built a tower of your own made of building blocks?</u> Let’s look

at the building blocks as we talk more about matter, atoms, elements, and molecules and how they would look as a block tower. Remember, matter is the “stuff” that makes up everything around you. So all of these blocks together are made up of matter. ***Atoms*** are the basic building blocks of matter. The word “atom” comes from the Greek prefix *a-* meaning “not” and *tomos* meaning “cut.” *Atomos* would then mean “not able to be cut.” If something is uncuttable, it must be extremely small. And so it is with atoms.

Point to any single block in your student journal. Each building block represents an atom. Just as not all blocks look the same, not all atoms look the same. In chemistry these different types of blocks or atoms are called ***elements***. Each element has only one type of atom and can look entirely different

Making Molecules

Have the children turn to the "Elements, Atoms, and Molecules" page in Lesson 6 of their student journals. Then give each child at least three colors of play dough, 5 oz of each, and have the children complete each step below as you read them.

- With one play dough color, form two small-sized spheres to represent hydrogen.
- With another color, form five large-sized spheres to represent oxygen.
- With the last color, form one large-sized sphere to represent carbon. The difference in sizes should not be great. (Notice the image of hydrogen peroxide—the blue circle is only slightly larger than the tan.)
- Use toothpicks to represent chemical bonds.

After the spheres have been formed, have the children choose one of the "Making Molecules" strips. Read the information, and then have each child create the molecule using toothpicks and the correct play dough spheres. In their student journals, have the children draw a picture of their creation and write the correct molecular formula for it. Have the children repeat this process for the two remaining molecules.

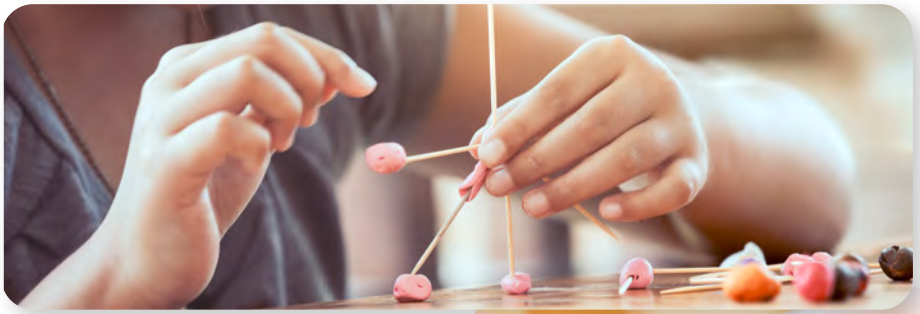
Optional: If you have more than one student doing this activity, have them hold up their water molecules and move them in a way that would best represent a solid, liquid, or gas state. For a solid, they can hold their molecules close together and barely jiggle them. For a liquid state, they can have the molecules slide by each other, staying close in range, moving at a moderate pace. For gas, they can zip their molecules around.

Read to the children: Atoms of specific elements can bond to form molecules. <u>What elements form the molecule for water?</u> [hydrogen and oxygen] <u>What elements form carbon dioxide?</u> [carbon and oxygen] <u>What elements form oxygen?</u> [oxygen] The models you made are a representation of the way these atoms would look. Isn't it interesting how these same building blocks can form completely different substances depending on which elements bond together?

It is important to remember that atoms and molecules are extremely tiny and can barely be seen with even the most powerful microscopes. To give you some idea of how small these molecules are, in one cup of water there are over 7,500,000,000,000,000,000,000,000 **[read as: 7 septillion, 500 sextillion]** water molecules!

Featured Element: Carbon

Turn to "Featured Element" on the following page. Read about the element carbon together.

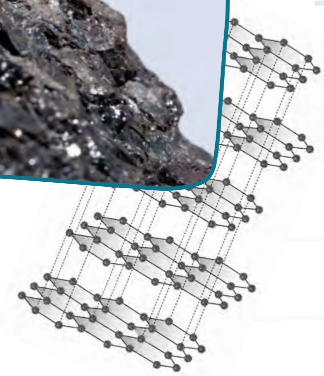


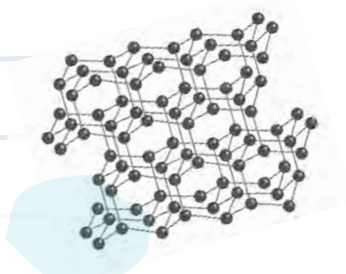
Featured Element

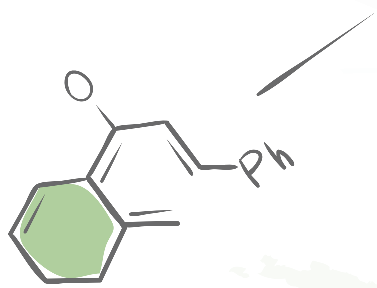
CARBON

6
C
Carbon
12.011

Carbon, a very common element, is found in specific kinds of molecules that make up about 18% of your body. Pure carbon can be found in different forms, including the brittle lead in pencils, which is actually not made out of lead but a type of carbon called graphite. While graphite may break under pressure, another form of carbon produces one of the strongest rocks found on Earth—diamonds!







CHEMISTRY
LESSON 9

Elements and the Periodic Table

Objective Help the children gain a greater understanding of elements and the historical figures who have added to our knowledge of elements and introduce them to the periodic table of elements.

Preparation:

- [ ] None

Activity Supplies:

- None

☐ Optional Read Aloud

At any point in the lesson, you may read one of the books from the optional Read-Aloud Book Pack. *Marie Curie* by Robin McKown is suggested with this lesson.

☐ A Quick Review

Have the children sit on the ground, allowing for individual space per child so they can move around without bumping into another child. Read the following information out loud. When you come to a blank, ask the children to jump up if they know the answer. Choose a child to answer, and if he or she answers correctly, the child may sit down. If the child does not answer correctly, other children may answer, or you can give them hints to help come up with the correct answer.

_________ [Atoms] are the basic building blocks of all matter. Atoms may chemically bond to other atoms to form particles called __________ [molecules]. A specific type of atom is called an _________ [element]. Atoms and molecules are extremely small and are in constant motion.

While everything is made of atoms, not everything is made of the same type of element or combination of elements. For example, you may be familiar with helium. Helium is used to _________ [fill balloons to make them rise]. Helium gas is composed of only _________ [helium] atoms. Another type of molecule, water, is composed of the elements _______ [hydrogen] and _________ [oxygen].

☐ The Periodic Table of Elements

Have the children look at the picture below while you read the following information:

Look at the column farthest to the right (group 18). Using the legend, what is the classification for these elements? [noble gases] Noble gases are naturally occurring gases and are the only elements in which one atom is completely satisfied being unbonded to another atom. Do you recognize any of the names of the elements in group 18? Neon is an element found in this period. Interestingly, neon signs are actually made of mixtures of neon gas or other noble gases and elements.

Have the children find the columns with alkali metals and halogens (groups 1 and 17). Notice how these groups are almost on opposite sides of the periodic table. These elements are most reactive with each other.

Have the children find the transition metals on the periodic table (green squares). Many of the element names in this section should be recognizable. **Have the children point out some elements they recognize.** Transition metals share similar properties. They are typically good conductors of electricity and are easily malleable (bendable).

Science Wall

Place the vocabulary words ATOMIC NUMBER and ATOMIC MASS on your science wall. Read and discuss each of the words and definitions.

ATOMIC NUMBER

ATOMIC MASS

Featured Elements: Chlorine & Sodium

Turn to "Featured Elements" on the following page. Read together about the elements chlorine and sodium.

Optional Element Study

Have the children turn to the "Optional Element Study" pages in Lesson 9 of their student journals. Note that this activity requires a parent's permission for children to do research online or at a library for an element of their choice. Children may repeat this activity for as many elements as desired.

The Atom

Objective

Help the children learn the basic structure of the atom.

Preparation:

- [ ] Cut out the "Element Structure Images" and "Element Cards."

Activity Supplies:

- 3 different colors of play dough
- Craft wire
- Scissors or wire cutters

Poetry Study

Read the poem below to the children.

Tiny Pieces
Chantelle Ivie

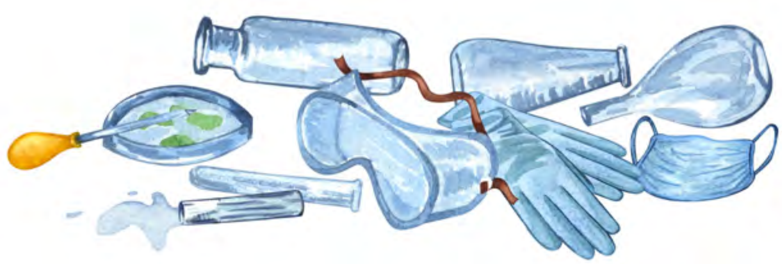
God made the world for us to see,
From every bush to every tree.
New scents and smells imbue the air,
Aromas wafting everywhere,
Melodious sounds for us to hear;
Our senses make it all seem clear.
Each tiny piece leaves us in thrall
Because for us He made it all.

Read to the children: What did you notice in the poem about the world around us? What do you think the "tiny pieces" could represent? [The tiny pieces could be atoms.] What senses are discussed in the poem? [sight, smell, and hearing] Even scents and sounds are created by the movement of atoms. Today we will learn more details about the tiny atoms that make up our amazing world. The ways elements interact and bond with each other form a multitude of different substances, creating everything around us. The periodic table reveals patterns in how atoms interact with each other. Atoms in one group of the periodic table are more likely to react with atoms of different groups. These properties are influenced by how these atoms are structured. Let's take a closer look at what an atom is.

The Atom Video

WATCH ONLINE

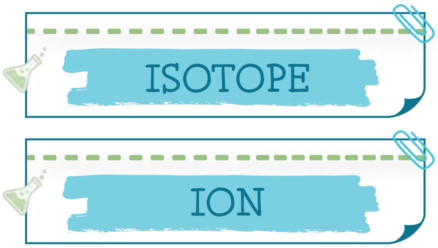
Have the children watch the video "The Atom" at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

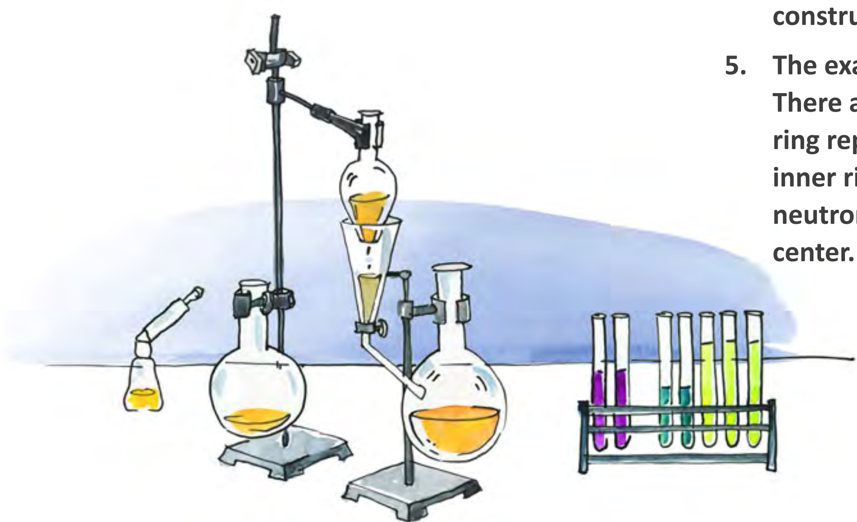


Atoms with a filled electron shell, like neon, are stable. Unfilled electron shells make atoms "unstable" and more reactive. In order to achieve stability, which depends on filling electron shells, atoms can gain or lose electrons. If an atom gains or loses an electron, an ***ion*** [EYE–on] is formed that has an electric charge. If an atom loses an electron, it has a positive charge because there are more protons than electrons. Likewise, if an atom gains an electron, it has a negative charge because there are more electrons than protons. **Show the children the Element Structure Image "Sodium Ion."** In this image of sodium, the outer electron is lost, forming a sodium ion and resulting in an overall positive charge. Sodium ions are found in the body and are essential for our survival.

Science Wall

Review the vocabulary words on your science wall. Then place the vocabulary words ISOTOPE and ION on your science wall. Read and discuss each of the words and definitions.





Featured Element: Helium

Turn to "Featured Element" on the following page. Read about the element helium together.

Making Atoms

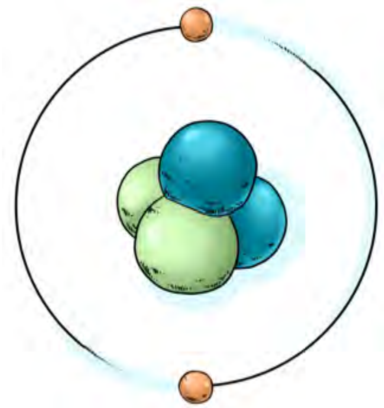
Display the cut-out "Element Cards." Have each child pick an atom to construct, and then have him or her complete the steps below:

1. **Choose one color of play dough to represent protons, a different color to represent neutrons, and the third color to represent electrons.**
2. **Form small balls of each color for the number of protons, neutrons, and electrons in the element you are constructing. Electrons should be made smaller than protons and neutrons. The number of neutrons indicated are those found in the most common and stable isotope of that element.**

3. **The protons and neutrons should be lightly pressed together as one unit and placed in the center of the atom.**
4. **Cut strips of craft wire and form rings by twisting the ends together. The rings will represent electron shells. The number and size of rings needed depends on which element is being constructed.**
5. **The example image above represents carbon. There are two rings of different sizes. The outer ring represents the second electron shell, and the inner ring represents the first electron shell. The neutrons and protons are grouped together in the center.**

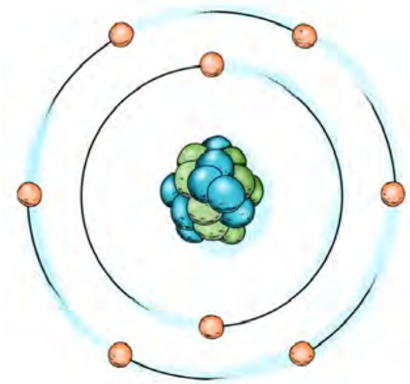
Element Structure Images

Helium



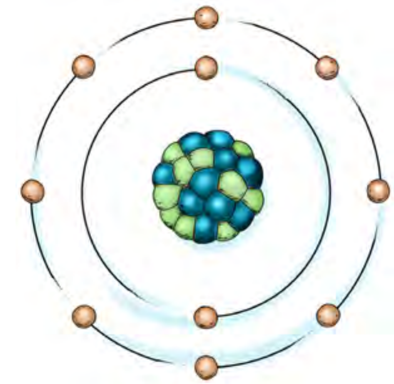
2 Electrons 2 Neutrons 2 Protons

Oxygen



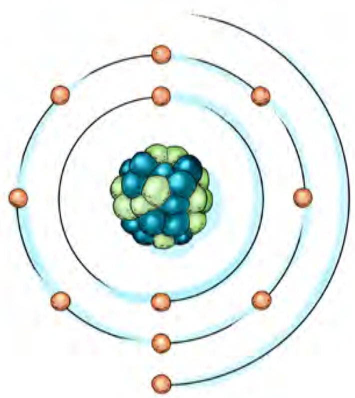
8 Electrons 8 Neutrons 8 Protons

Neon



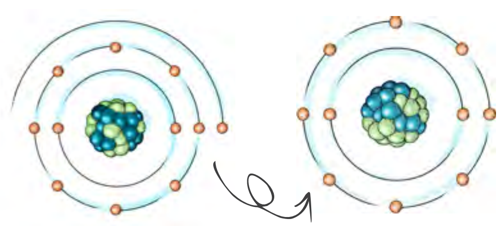
10 Electrons 10 Neutrons 10 Protons

Sodium



11 Electrons 12 Neutrons 11 Protons

Sodium Ion



10 Electrons 12 Neutrons 11 Protons

CHEMISTRY
LESSON 12

Conservation of Mass

Objective

Help the children understand the law of conservation of mass.

Preparation:

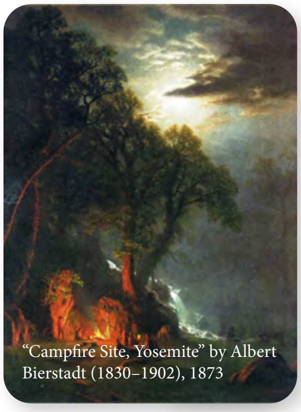
- [ ] None

Experiment Supplies:

- Vinegar
- 100-mL graduated cylinder (or an empty disposable water bottle with a narrow neck)
- 1-tsp measuring spoon
- Mini measuring cup (e.g., a plastic cup that comes with children's cough syrup)
- Kitchen scale
- Baking soda
- Balloon

Chemical Reactions Art Study

Have the children turn to the "Art Study" page in Lesson 12 of their student journals.


"Campfire Site, Yosemite" by Albert Bierstadt (1830–1902), 1873

Read to the children: As I explain chemical reactions, look at the painting and circle anything you think might be a chemical reaction.

Chemical reactions produce chemical changes because atoms rearrange themselves to form new compounds. We can observe chemical reactions because we notice chemical properties. Recall from Lesson 7 that chemical properties include combustibility, flammability, reactivity, and corrosiveness. In a chemical reaction, you may notice things like gas being released, heat being absorbed or released, a spark, or solids forming in a solution (called a precipitate), among other occurrences. <u>What did you find in the painting that could be a chemical reaction?</u> [fire, cooking, or photosynthesis from the trees]

Growing Foam Experiment

Read to the children: In this experiment a chemical reaction will occur by mixing two common household substances—baking soda and vinegar. The two substances will be mixed inside a cylinder (or a bottle) covered with a balloon. The substances used in an experiment are called the *reactants*, and the substances produced are called the *products*. The reactants in this experiment are baking soda (sodium bicarbonate) and vinegar (acetic acid mixed with water). **Have the children fill out the Hypothesis section on the "Growing Foam Experiment" pages in Lesson 12 of their student journals.** Record observations during

Growing Foam Experiment

Instructions

Supplies

Gather the needed supplies: vinegar, 100-mL graduated cylinder (or an empty disposable water bottle with a narrow neck), 1-tsp measuring spoon, mini measuring cup (e.g., a plastic cup that comes with children's cough syrup), kitchen scale, baking soda, and a balloon.

Read through each step before starting. If you need to change the experiment in any way, be sure to record what you did differently. Part of being a good scientist is recording your data properly.

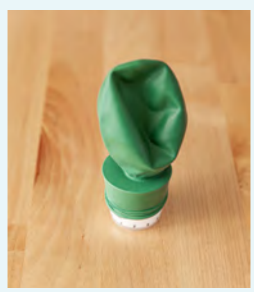
1. Measure 20 mL of vinegar into the 100-mL graduated cylinder or measure 4 tsp of vinegar and place it into the empty water bottle.

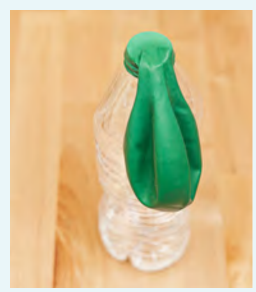
2. Place the mini measuring cup (similar to a child's medicine cup) on the scale. If your scale is digital, turn it on, be sure the units are set to GRAMS, and press the ZERO or TARE button so it is set to start weighing. Weigh out 10 g of baking soda with the measuring spoon by scooping out baking soda and placing it into the cup on the scale.

3. Stretch the balloon out by blowing it up and then releasing the air.

4. Place the graduated cylinder (or bottle) with the vinegar and the deflated balloon next to the measured baking soda on the scale. Record the beginning weight in the "Data Recordings" section in your student journal.

5. Carefully stretch the neck of the balloon over the top of the mini measuring cup containing the baking soda. Tip the mini measuring cup so the baking soda pours into the balloon.





6. Carefully remove the balloon from the mini measuring cup. Stretch the neck of the balloon over the top of the graduated cylinder or over the opening of the water bottle. Do not drop the baking soda into the vinegar yet. Rather, allow the baking soda to rest in the top of the balloon as it flops over the side of the cylinder. Place the mini measuring cup (empty) back on the scale. Check to make sure the measurement of weight is still the same.

7. Gently tip the balloon upward so that the baking soda dumps into the graduated cylinder or water bottle.

8. Watch the reaction and draw and/or write down your observations in the "Lab Notes" section in your student journal.

9. Touch the container to sense if there is a temperature change.

10. Record the final weight of the products in their containers in the "Data Recordings" section in your student journal. It may be helpful to remove and tie the balloon before setting it on the scale to observe the final weight. Complete the "Results" section in your student journal.

CHEMISTRY
LESSON 13

Mixtures and Pure Substances

Objective

Help the children understand the differences between mixtures and pure substances.

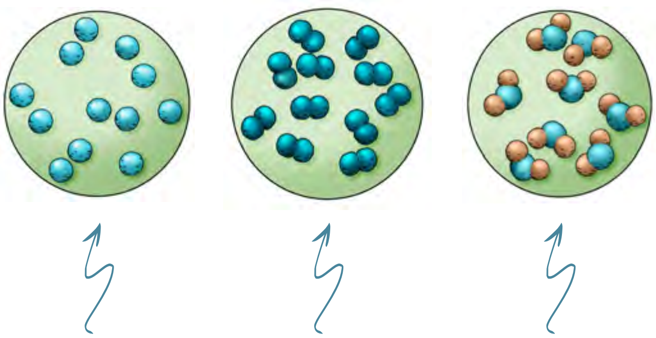
Preparation:

- [ ] None

Experiment Supplies:

- Kitchen scale
- Small bowl
- Salt
- Small baking dish (about 8"x8")
- Warm water
- 50-mL beaker (or ¼-cup measuring cup)
- Spoon

Mixtures and Pure Substances



Read to the children: Matter is anything that has mass and volume (takes up space) and can be grouped into two main categories—pure substances and mixtures. Pure substances are either made of only one type of atom (an element) or one type of molecule composed of different elements (a compound) and are the simplest forms of matter. They have special properties and are always the same in composition. This means that each pure substance will always react a certain way and will always have those elements present in the same ratio.

Copper is an example of a pure element. The tiny particles that make up a copper teapot are of the same single element.

Water is an example of a compound. There is no element named water, but we know the compound water is always made from the same elements—hydrogen and oxygen. Water has specific properties that we have already learned. For example, a specific property of water is shown in the way the molecules arrange themselves as a solid, liquid, or gas.

Most of the types of matter we see, use, or feel in our lives are mixtures, which means they are made of different substances. There may be mixtures made of the same components but with different amounts of each substance. For example, if you were to make saltwater, you could adjust the amount of salt or the amount of water—but it is still saltwater.

There are two types of mixtures. The first type is a *homogeneous mixture*, or solution. In a homogeneous mixture, a solute dissolves into a solvent. The substances are so thoroughly blended that you cannot distinguish individual substances. In

the example of saltwater, sodium chloride disassociates, or breaks apart, into sodium ions and chloride ions because water molecules pull them apart. This creates a uniform mixture. The term "uniform" and the prefix "homo" mean *same.*

Heterogeneous mixtures are the second type of mixtures. These mixtures are not uniform and can vary in texture or appearance. An example of this type of mixture is water and oil, which are substances that do not blend together. If you took a sample of one section, it could contain mostly oil, but another section would be composed of mostly water. The prefix "hetero" means *different*.

We often think of mixtures as liquids, but a mixture can be in the form of a solid, liquid, or gas. An example of a gas mixture is the air you breathe. Air is a homogeneous mixture because it's uniformly made up of nitrogen, oxygen, and other gases. Those gases would be the same anywhere you took a sample, and you could not easily see any separations. An example of a solid mixture is granite rock. Rocks are heterogeneous mixtures. The amount and types of compounds that make up rock are different and vary from one location of the rock to another.

Have the children look at the chart on the following page and notice the representations of the molecules. The copper is composed of only copper atoms. The baking soda is a compound of different atoms. Notice that the tea has an even mix in composition, while the water and oil mixture has an obvious separation in its composition.

☐ Saltwater Solution Experiment

Have the children turn to the "Saltwater Solution Experiment Instructions" at the end of this lesson and read through the instructions.

Have the children turn to the "Saltwater Solution Experiment" page in Lesson 13 of their student journals, read the information under the Hypotheses heading, and record their hypotheses.

Complete the experiment with the children as directed or have the children watch the video "Saltwater Solution—Part 1" at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

Please note: This experiment will be performed in this lesson, but the results will be observed in the next lesson. Allow 24–48 hours between this lesson and the next lesson in order for the water to evaporate.

After completing the instructions, read to the children: Salt is soluble in water. This means that salt dissolves in water to form a solution. In the solution of saltwater, salt is the solute and water is the solvent. The water molecules pull each sodium ion and chloride ion away from each other. <u>Is this solution homogeneous or heterogeneous?</u> [homogeneous] While it may seem that salt "disappears" in water, the solute is still there and a uniform mixture is created. If you taste the solution, you will sense the flavor of salt. Let's let the saltwater solution sit undisturbed for 24–48 hours.

Mixtures and Pure Substances Chart

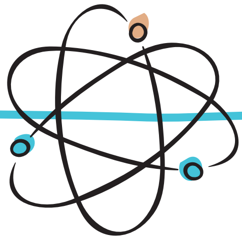
CHEMISTRY

Grades 5-8

STUDENT JOURNAL

This journal belongs to:

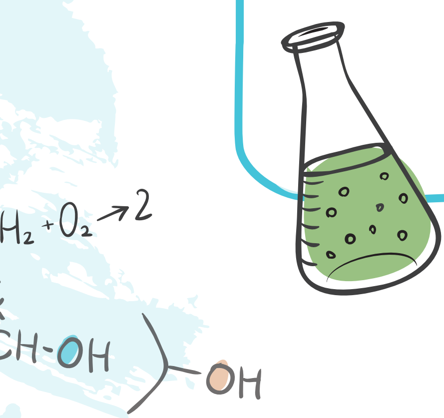
THE GOOD AND THE BEAUTIFUL



INSTRUCTIONS

This student journal accompanies *The Good and the Beautiful Chemistry* science unit. It contains all the worksheets and journal pages that are needed to complete the unit. Each child will need his or her own copy of the student journal.

Have each child take his or her time to create high-quality work as the activities and worksheets are completed. The children may enjoy looking back on their past discoveries when they've finished.



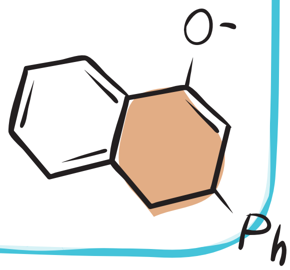
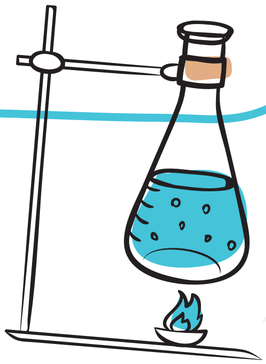


TABLE OF CONTENTS



THE PERIODIC TABLE OF ELEMENTS

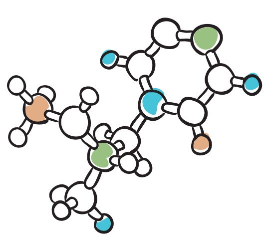
atomic number → 26
chemical symbol → Fe
name → Iron
atomic mass → 55.845

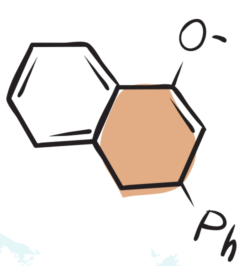
STATE OF MATTER
SOLID GAS
LIQUID UNKNOWN

☢ radioactive elements

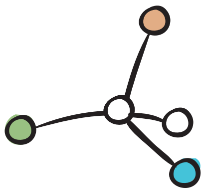
	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB
1	1 H Hydrogen 1.00794								
2	3 Li Lithium 6.941	4 Be Beryllium 9.012182							
3	11 Na Sodium 22.98976	12 Mg Magnesium 24.3050							
4	19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.95591	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9962	25 Mn Manganese 54.93804	26 Fe Iron 55.845	27 Co Cobalt 58.93319
5	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Vr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.96	43 Tc Technetium 98.907 ☢	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055
6	55 Cs Cesium 132.9054	56 Ba Barium 137.327	57 - 71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9478	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217
7	87 Fr Francium (223) ☢	88 Ra Radium (226) ☢	89 - 103	104 +4 Rf Rutherfordium (261) ☢	105 +5 Db Dubnium (262) ☢	106 Sg Seaborgium (266) ☢	107 Bh Bohrium (264) ☢	108 Hs Hassium (277) ☢	109 Mt Meitnerium (268) ☢

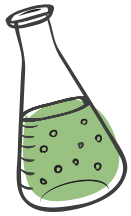
lanthanoids	57 La Lanthanum 138.9054	58 Ce Cerium 140.116	59 Pr Praseodymium 140.9076	60 Nd Neodymium 144.242	61 Pm Promethium (145) ☢	62 Sm Samarium 150.36
actinoids	89 Ac Actinium (227) ☢	90 Th Thorium 232.0380 ☢	91 Pa Protactinium 231.0358 ☢	92 U Uranium 238.0289 ☢	93 Np Neptunium (237) ☢	94 Pu Plutonium (244) ☢





nonmetals
alkaline earth metals
alkali metals
transition metals

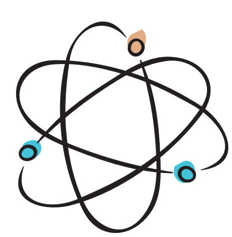




10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
								2 He Helium 4.002602
			5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.998403	10 Ne Neon 20.1797
			13 Al Aluminum 26.98153	14 Si Silicon 28.0855	15 P Phosphorus 30.97696	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.441	49 +3 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.9044	54 Xe Xenon 131.293
78 Pt Platinum 195.084	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium 208.982 ☢	85 At Astatine 209.987 ☢	86 Rn Radon 222.018 ☢
110 Ds Darmstadtium (271) ☢	111 Rg Roentgenium (272) ☢	112 Cn Copernicium (285) ☢	113 Nh Nihonium (284) ☢	114 Fl Flerovium (289) ☢	115 Mc Moscovium (288) ☢	116 Lv Livermorium (293) ☢	117 Ts Tennessine (294) ☢	118 Og Oganesson (294) ☢

63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.9253	66 Dy Dysprosium 162.500	67 Ho Holmium 164.9303	68 Er Erbium 167.259	69 Tm Thulium 168.9342	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
95 Am Americium (243) ☢	96 Cm Curium (247) ☢	97 Bk Berkelium (247) ☢	98 Cf Californium (251) ☢	99 Es Einsteinium (252) ☢	100 Fm Fermium (257) ☢	101 Md Mendelevium (258) ☢	102 No Nobelium (259) ☢	103 Lr Lawrencium (262) ☢

- metalloids
- post-transition metals
- halogens
- noble gases
- lanthanoids
- actinoids



THE SCIENTIFIC METHOD CUTOUT

H_2SO_4

$2H_2 + O_2$

Ask a Question

Results & Conclusion

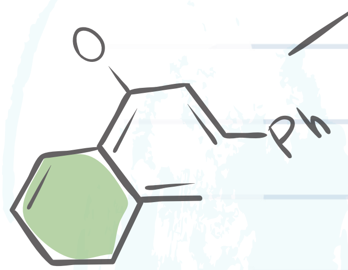
Form a Hypothesis

The Scientific Method

Record Observations

Plan an Experiment

Test the Experiment

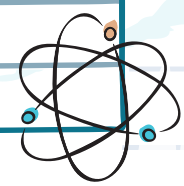


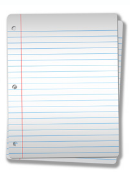
WHICH UNIT WOULD YOU USE?

Using the chart below, draw a line to match the object with its correct unit of measurement.

Common Metric Units of Measurement

Length		Volume (liquid)		Weight	
UNIT	ABBREVIATION	UNIT	ABBREVIATION	UNIT	ABBREVIATION
Nanometers	nm	Microliters	uL	Micrograms	mcg
Millimeters	mm	Milliliters	mL	Milligrams	mg
Centimeters	cm	Liters	L	Grams	g
Meters	m				



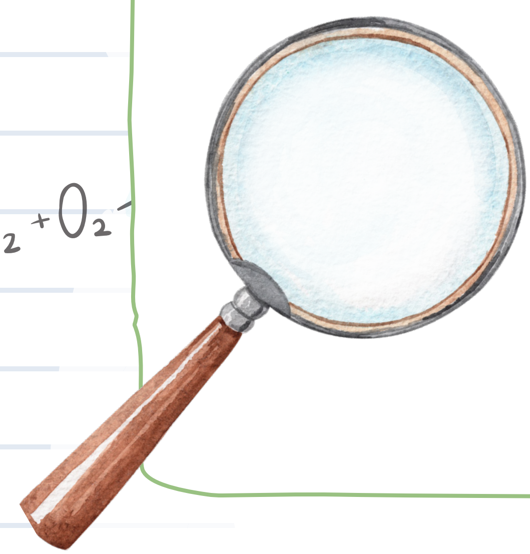
	the liquid in eye drops	milligrams (mg)
	powdered medicine measured in a pharmacy	liters (L)
	the weight of a single human cell	milliliters (mL)
	length of a line on a sheet of paper	micrograms (mcg)
	orange juice in a carton	grams (g)
	weight of a bag of sugar	centimeters (cm)

STATES OF MATTER

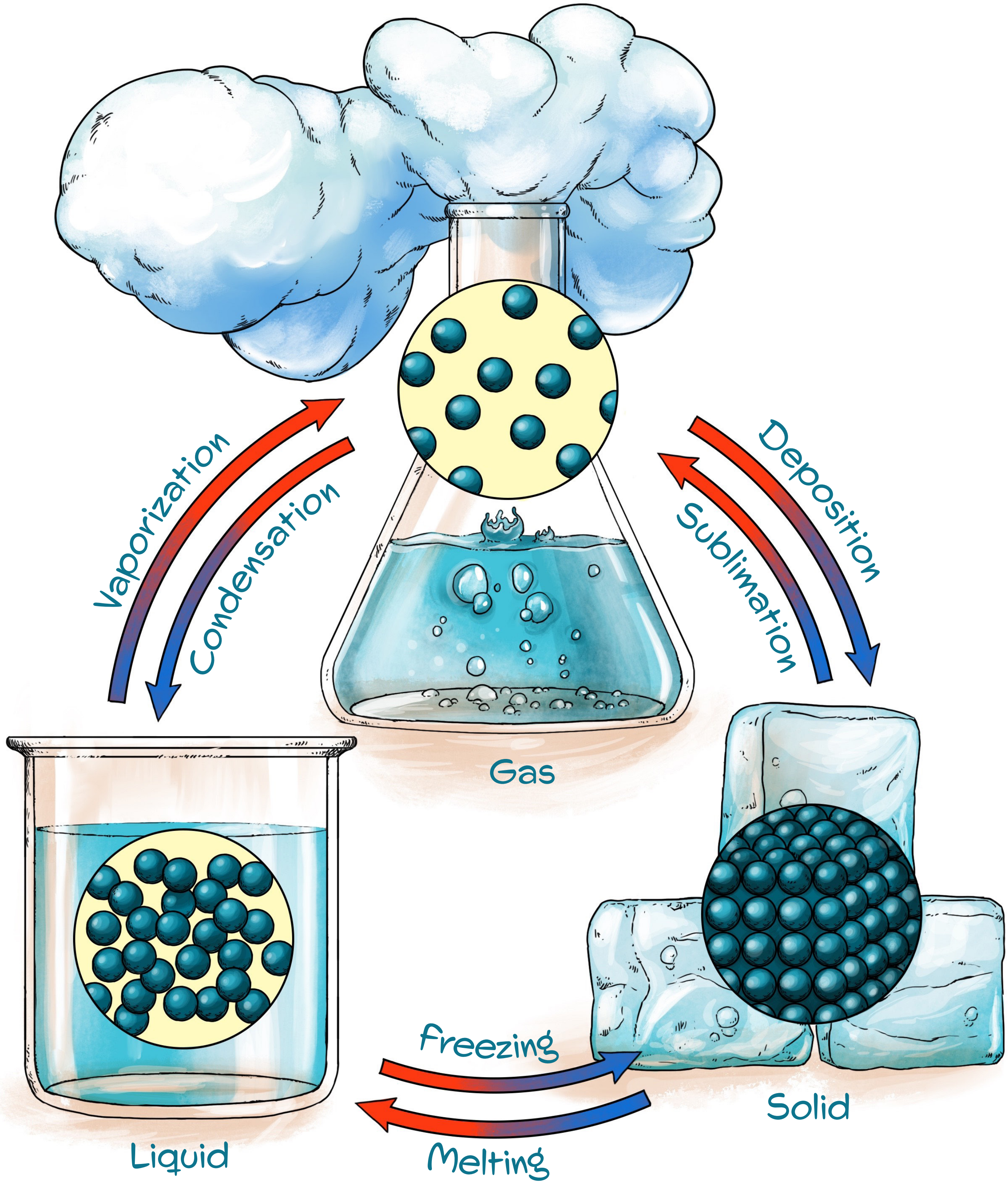
Write or draw at least 2–3 observations for each state of matter.

SOLID	LIQUID	GAS

Draw what the particles would look like for each state if you could see them up close.

Solid	Liquid	Gas
		

TYPES OF PHASE TRANSITIONS



The Freezing Point of Water Experiment

Hypotheses

How do you think salt will affect water when we freeze it? Which do you think will freeze faster, pure water or saltwater? Which will require a lower temperature to freeze, pure water or saltwater?

Notes during my experiment:

Data Recordings

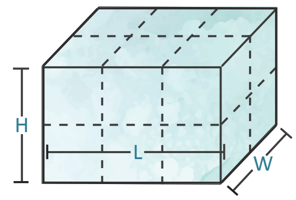
When recording data, be sure to include units: a.m., p.m., °C, or °F.

	Water	Water + 1 tsp Salt	Water + 2 tsp Salt	Water + 3 tsp Salt
Start Time:				
Time:				
Time:				
Time:				
Time:				
End Time:				

Physical and Chemical Properties

Solubility Data

	Sugar	Oil
What happens when we add this solute to water?		



Volume Data

Volume of a Rectangular Prism = Length x Width x Height

	Length	Width	Height
Rectangular Prism Volume			

The volume of your object (don't forget to write the unit): ______________________

Volume by Displacement Data

Volume by Displacement = Water level with object - Water level without object

	Volume of Water	Volume with Object	Volume of Object
What is your object? ____________			

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Density Data

	Mass of the Object	Volume of Object (from the previous experiment)	Density
What is your object? ____________			

OPTIONAL ELEMENT STUDY

With your parent's permission, do research online or at a library on an element of your choice. In the square box, write the element symbol, full name, atomic number, and atomic mass, similar to the elements on the periodic table. On the lined spaces, write fun facts about your element. In the rectangular box at the bottom of the page, you may write more information, draw a picture, paste a printed picture, or glue items into this area that represent your element. If desired, repeat this activity for another element using the following page.

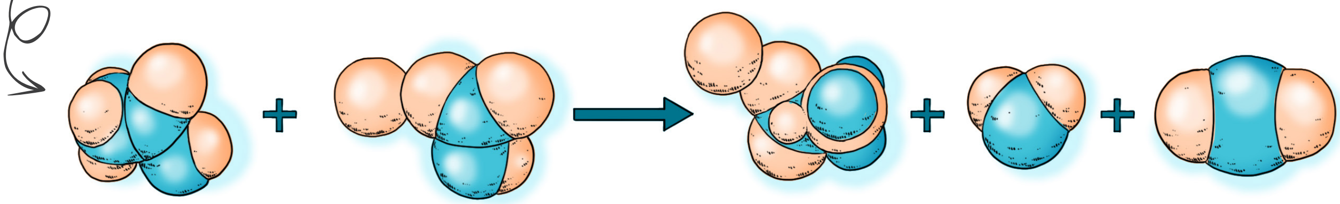
ART STUDY

"Campfire Site, Yosemite" by Albert Bierstadt (1830–1902), 1873

Circle any chemical reactions you see in the painting.

Growing Foam Experiment

What happened?



$HC_2H_3O_2$	$NaHCO_3$	$NaC_2H_3O_2$	H_2O	CO_2
acetic acid	sodium bicarbonate	sodium acetate	water	carbon dioxide

Exploring the Law of Conservation of Mass

Total Number of Atoms							
Reactants				Products			
H	C	O	Na	H	C	O	Na

The formula below represents the reaction and is called a chemical equation.

$$HC_2H_3O_2 + NaHCO_3 \longrightarrow NaC_2H_3O_2 + H_2O + CO_2$$

When the number of atoms of each element is the same on both the reactant and product sides of the arrow, the chemical equation is balanced.