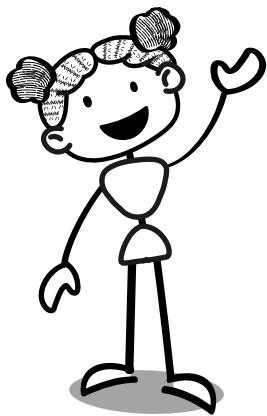


Discover!

A

PHYSICAL SCIENCE





Discover! Physical Science A

Published in Catasauqua, Pennsylvania by Learning Corp.

334 2nd Street

Catasauqua, PA 18032

edovate.com

Copyright © 2026 Edovate Learning Corp.

All rights reserved. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing by the publisher.

ISBN: 979-8-9994835-3-9

Printed in United States of America

2nd Edition

Discover! Physical Science A

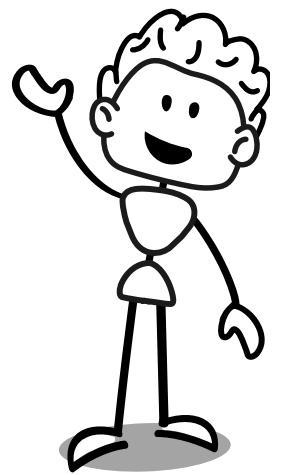


Table of Contents

Unit 1: Study of Physical Science

Chapter 1:	The Physical Scientist	9
Chapter 2:	Historic Foundations of Physical Science	17
Chapter 3:	Standing on the Shoulders of Giants.....	25
Chapter 4:	Scientific Theories and Laws	31
Chapter 5:	Methods and Processes	37
Chapter 6:	Models and Visualizing Data.....	46
Chapter 7:	Physical Science in Action	52
Chapter 8:	Unit 1 Review	58

Unit 2: Scientific Measurement Systems

Chapter 9:	The Metric System	64
Chapter 10:	Size and Distance	72
Chapter 11:	Area	80
Chapter 12:	Volume	89
Chapter 13:	Mass and Density	97
Chapter 14:	Using Graphs: Bar and Line	103
Chapter 15:	Using Graphs: Pie Charts and Pictographs.....	109
Chapter 16:	The Civil Engineer at Work	115
Chapter 17:	Unit 2 Review	121

Unit 3: Matter Structure

Chapter 18:	Matter Basics	127
Chapter 19:	States of Matter	133
Chapter 20:	Atomic Structure.....	139
Chapter 21:	Types of Molecules.....	147
Chapter 22:	Elements of the Periodic Table.....	153
Chapter 23:	The Physicist at Work	159
Chapter 24:	Unit 3 Review	165

Unit 4: Matter and Changes

Chapter 25:	Chemical and Physical Changes.....	171
Chapter 26:	Compounds and Mixtures	179
Chapter 27:	Solutions.....	187
Chapter 28:	Acids.....	195
Chapter 29:	Bases	203
Chapter 30:	Salts	210
Chapter 31:	Nuclear Changes	218
Chapter 32:	The Nuclear Engineer at Work	227
Chapter 33:	Unit 4 Review	233

Student & Instructor Books

Worktext

- The carefully preselected scope and sequence integrates an engaging storyline with direct instruction, practice, application, and extension activities.
- The curriculum provides direct instruction and assessment opportunities that allow the student to gain knowledge, reflect on it, and apply it.
- The curriculum correlates to national standards and integrates a variety of learning preferences (styles) to meet the unique needs of the student.
- The worktext is organized and divided into units and chapters. Each unit ends with a review and an assessment to help the student recall learned knowledge.

Instructor Guide

- The instructor guide is specifically structured to complement the worktext and lab book.
- The instructor guide provides suggestions for the instructor to facilitate, support, and extend student learning.
- Instruction and curriculum are differentiated with remediation, enrichment, assessment, and supporting activities suitable for a variety of learning styles.
- Answer keys for all activities are provided.
- The back of the instructor guide provides full support for all lab activities and is organized to mirror the lab book's table of contents.

Lab Book

- The lab book, when used alongside the worktext, serves as a dynamic tool to enhance student understanding of scientific principles and processes.
- Each unit has at least one lab experience. Each lab has five sections.
 - **Start!:** This section introduces the lab content and establishes a clear connection between unit content and lab application.
 - **Spark:** In this section, the student engages with the lab by making predictions and researching pre-experiment questions.
 - **Search:** In this section, the student completes the steps outlined to engage with the experiment. The section emphasizes recording observations and making critical notes.
 - **Synthesize:** In this section, the student takes the data collected during the experiment to report findings, make inferences, and/or suggest further research.
 - **Stretch:** This section invites the student to take the experiment further.

Assessment Booklet

- Traditional unit assessments and performance assessments are provided in the assessment booklet. A copy of each traditional unit assessment and performance assessment is also provided in the instructor guide, along with the answer key and rubric.
- Each unit assessment has two assessment options.
 - **Traditional unit assessment:** This is a traditional assessment with an answer key.
 - **Performance assessment:** This is a performance-based option with a rubric.



Planning & Chapter Organization

Planning

- Each course is designed to cover approximately 160 days of instruction, with each chapter taking roughly 2 days to complete. This does not include time spent on the enrichment activities provided in the worktext sidebars and the instructor guide. These materials allow the instructor to customize the learning experience and encourage the student to dive deeper.
- It is recommended that the student completes the **Explore** and **Read** pages on the first day and the **Practice** and **Show What You Know** pages on the second day.
- It is recommended that the student complete the unit lab(s) contained in the lab book prior to the completion of the unit reviews/assessment chapter. The student should be able to complete a lab in one day (or do half of the lab on one day and half on another day). Because of the nature of experiments, some labs may require the student to engage with the procedures over several days. Please be sure to read through the unit lab experiments in advance to adequately plan for each unit's calendar of activities.
- For unit review/assessment chapters, it is recommended that the student completes the **Review** pages and the first **Practice** page on the first day and the remaining **Practice** pages on the second day.

Chapter Organization

Chapter Overview

- The overview sets the student up for success with the chapter goals and objectives. The overview also facilitates the student's learning by identifying chapters they may need to review, highlighting relevant academic vocabulary, providing an optional extension activity and a big question that helps drive inquiry.

Explore

- The Explore section provides the student with an opportunity to discover new concepts within a real-world narrative.

Direct Instruction

- Direct instruction provides the student with the opportunity to read the content, write about it, and apply the concepts.
 - **Read:** The student reads informational text to gain knowledge about the chapter topic.
 - **Write:** The student reflects on what they have read by generating a written response.
 - **Apply:** The student practices what they have learned using various activities such as graphic organizers, matching, drawing, experiments, and other hands-on activities.
 - **Practice:** The student practices the objectives before moving on to the chapter assessment.

Show What You Know

- This assessment is carefully crafted to align with the chapter's objectives while providing the student with an opportunity to demonstrate their knowledge of the material.

Extension Activities

- **Create:** These activities require the student to construct something. Examples may include a drawing, song, poem, model, etc.
- **Online Connection:** These activities require the student to use technology-based solutions to research and investigate concepts related to the chapter or create artifacts demonstrating their understanding.
- **Closer Look:** These activities require the student to make observations about the world around them, allowing them to generate predictions, inferences, or conclusions based on those observations.
- **Mini-Lab:** These activities require the student to engage in quick experiments to apply relevant scientific concepts while utilizing common household materials.
- **In Focus:** These activities require the student to apply one element of the engineering design process to an activity relevant to the chapter's content.

Chapter 21

Types of Molecules

By the end of this chapter, you will be able to:

- identify and categorize different types of molecules, such as elements, compounds, and mixtures
- understand the difference between organic and inorganic molecules
- describe the basic types of bonds that hold atoms together in a molecule, specifically ionic, covalent, and metallic bonds
- explain simple molecular structures and understand the concept of polarity

Chapter Review

If you need to review elements and subatomic particles, please go to the chapter titled “Atomic Structure.”

Academic Vocabulary

Read the following vocabulary words and definitions. Look through the chapter. Can you find each vocabulary word? Underline the vocabulary word in your chapter and write the page number where you found each word on the blanks here.

- **covalent bond:** when two atoms share their valence electrons (p. ____)
- **elemental molecule:** a molecule with atoms of the same element (p. ____)
- **inorganic molecule:** a molecule that does not contain carbon (p. ____)
- **ionic bond:** a chemical bond that occurs when one atom loses a valence electron and the other atom gains an electron (p. ____)
- **macromolecule:** a long chain of atoms that make up the largest organic molecules (p. ____)
- **metallic bond:** when a metallic element bonds to another metallic element (p. ____)
- **mixture:** a combination of two or more substances that are not chemically bonded (p. ____)
- **molecule:** two or more atoms joined together (p. ____)
- **nonpolar molecule:** a molecule formed by a covalent bond with electrons evenly mixed within the molecule (p. ____)
- **organic molecule:** a molecule found in living systems that always has a carbon atom (p. ____)
- **polarity:** when the distribution of charges among atoms in a chemical bond is uneven (p. ____)

Materials Needed

- magnet
- plastic bag
- warm water
- whole wheat grain flakes

THE BIG QUESTION

What is the difference between elemental and compound molecules, and what types of bonds hold atoms together?

EXPLORE

As you sit and eat your lunch, you start to think about all the things Dr. Brown has taught you so far. You know about matter and all of the states of matter. You know about atoms and the subatomic particles that make them up. But what about valence electrons? That seems like a mystery! If atoms are gaining and losing electrons to become stable, how do atoms work together?

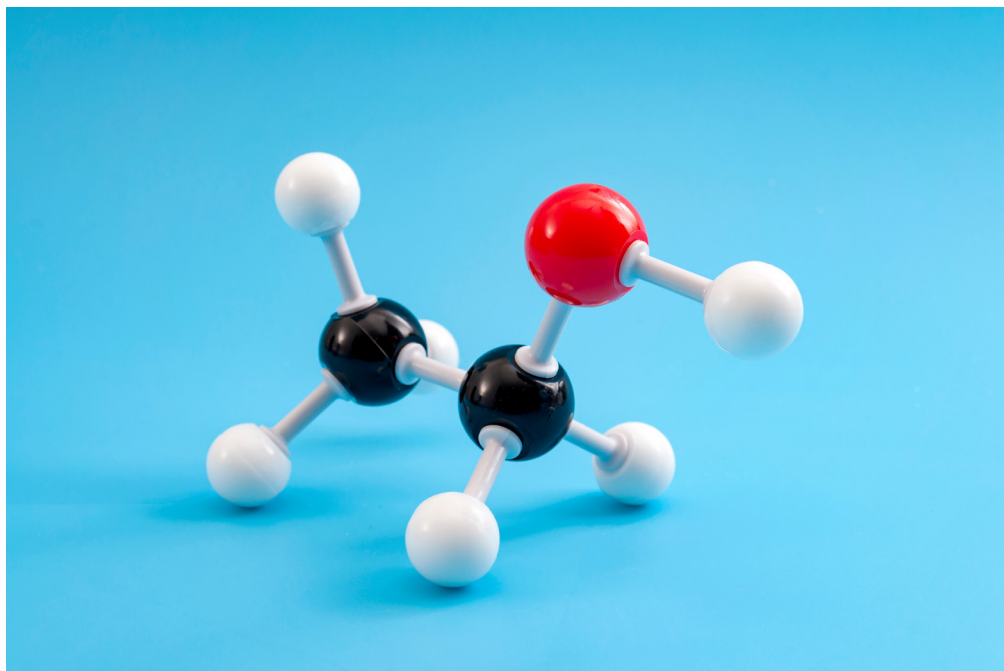
As you take another bite of your sandwich, you look around at the room. Up on a high shelf, you see these small statues that look like colorful balls with sticks holding them all together. What are these little statues? Are they some kind of model? What do they have to do with physics and chemistry?

Just when you begin to feel incredibly confused, Dr. Brown walks in with his lunch in one hand and one of those little statues in the other! You waste no time and immediately ask Dr. Brown what he is holding.

"This is an ethanol molecule," he explains. "You can see how the atoms are bonded together by the sticks. The stick between each ball represents a valence electron. Sometimes we use springs instead of sticks to show a double bond if two atoms share two valence electrons."

This makes you wonder: What exactly is a molecule? How are these atoms bonded together?

What elements are part of this molecule? You are eager to find out!

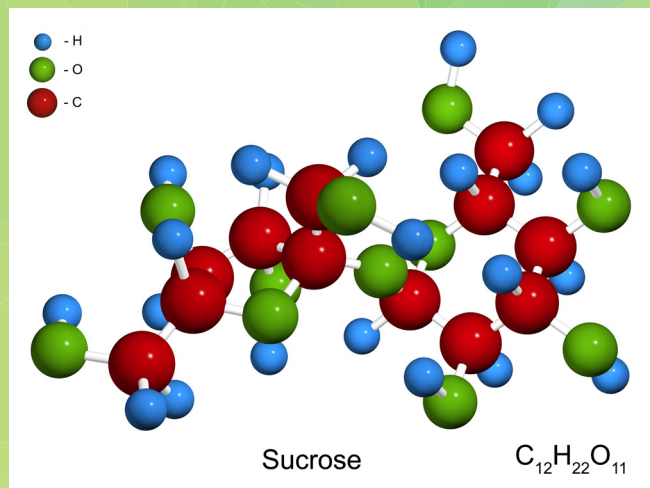


An ethanol molecule is made of two carbon atoms, six hydrogen atoms, and one oxygen atom.

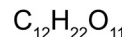
CLOSER LOOK

Molecular Sucrose

Look at the image. This is a model of a molecule of sucrose, or table sugar. What do you notice about this molecule? What atoms make up sucrose? How many atoms of each element make up sucrose?



Sucrose



A 3D model of sucrose helps you see how sugar is structured.

Molecules

Dr. Brown's model helps you realize that an atom is a single particle, but a **molecule** is made up of two or more atoms joined together. An element is made up of only one type of atom, but when atoms of the same element join together to form a molecule, it is called an **elemental molecule**. H_2 and O_2 are good examples of elemental molecules. A **compound molecule** is made up of two or more different elements joined together, such as methane (CH_4), carbon dioxide (CO_2), and water (H_2O). Elemental and compound molecules are chemically bonded, or joined together. These are different from mixtures of substances. A **mixture** is a combination of two or more substances that are not chemically bonded. For example, you could add water (H_2O) to sugar ($C_6H_{12}O_6$) and mix them together to make a substance that is sweet and delicious. However, it is only a mixture and not chemically bonded. The chemistry of the water and glucose molecules is still intact.

Molecules can also be discussed in terms of organic and inorganic. **Organic molecules** are found in living systems and always have a carbon atom. They can vary in size, but there are four main macromolecules that are essential to life: carbohydrates, lipids, proteins, and nucleic acids. **Macromolecules** are long chains of atoms that make up the largest organic molecules. Carbohydrates provide us with quick energy, such as sugar. Lipids like fats and oils provide us with long-term energy. Proteins send chemical signals such as hormones and enzymes. Nucleic acids, like our DNA, store and pass on genetic information. **Inorganic molecules** are molecules that do not contain carbon. Even though inorganic molecules are not found in living things, there are many inorganic molecules that living things rely on for survival, such as water, salts, and other acids and bases.

WRITE

Essay

Choose three of the following molecules, compare them, and give an example for each: elemental molecules, compound molecules, macromolecules, organic molecules, inorganic molecules.

MINI-LAB

Iron Extraction

Food supplies your body with essential elements. Iron is an element that is found in many common breakfast cereals. Try an experiment to see how cereal reacts to a magnet!

Materials: magnet, plastic bag, warm water, whole wheat grain flakes

Procedure:

1. Pour some whole wheat grain flake cereal into a bag so that it is a little more than half full.
2. Close the bag completely.
3. Crush the cereal with your hands.
4. Open the bag and fill the bag halfway with warm water.
5. Close the bag again and mix it for about 15 seconds.
6. Allow the bag to sit and soak for one hour.
7. Mix the bag again for one minute.
8. Place a magnet under the bag and move the bag around.

What happened? Why did it happen?

Pull out your Lab Book and record your answers and reflections in the space provided for the Mini-Lab or make the appropriate notes in a regular notebook and share with your instructor.

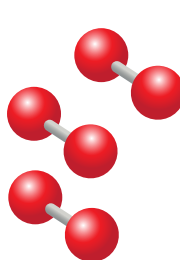
Bonds and Polarity

Atoms are always trying to become stable and reach their lowest state of energy. To do this, they have to bond together as molecules with one of the chemical bonds: ionic, covalent, or metallic. An **ionic bond** is a chemical bond that occurs when one atom loses a valence electron and the other atom gains an electron. This exchange provides stability for both elements. For example, sodium can give its one valence electron to fluorine, allowing its outer shell to be full and holding the sodium fluoride (NaF) compound together.

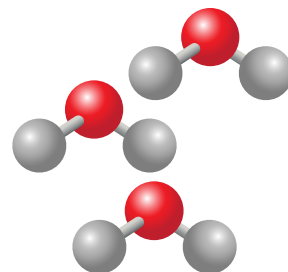
There are simple molecular structures that only have a few atoms. Carbon dioxide (CO₂), for example, consists of one atom of carbon and two atoms of oxygen. Water (H₂O) has two atoms of hydrogen and one atom of oxygen. Most simple molecules like these are held together with a covalent bond. A **covalent bond** is a bond where two atoms share their valence electrons. Water is an example of a covalent bond because the atoms are much weaker and much less stable on their own compared to when they are bonded together and share electrons. **Metallic bonds** occur when a metallic element is bonded to another metallic element, such as in a sheet of aluminum or copper wiring. The valence electrons in the outer shells overlap and form a lattice structure.

Polarity is when molecules are connected by a covalent bond and electrical charges are unevenly distributed throughout. Sometimes one end of a molecule may have more positive charges and the other side may have more negative charges. When this occurs, the molecule is considered to be polar. Polar molecules are usually V-shaped, like water, glucose, and Dr. Brown's ethanol model.

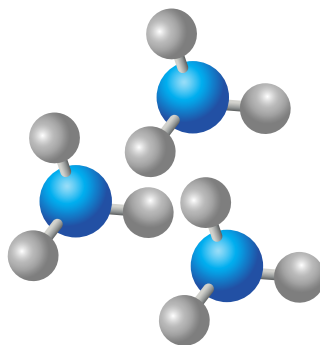
Nonpolar molecules are covalent bonds with electrons evenly mixed within the molecule. This usually occurs with molecules arranged in a line, such as ozone, carbon dioxide, and nitrogen gas.



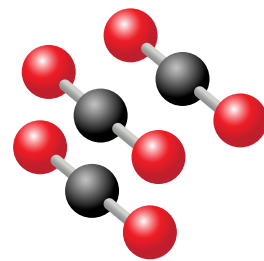
oxygen



water



ammonia



carbon dioxide

Basic molecules, such as these, are connected through covalent bonds.



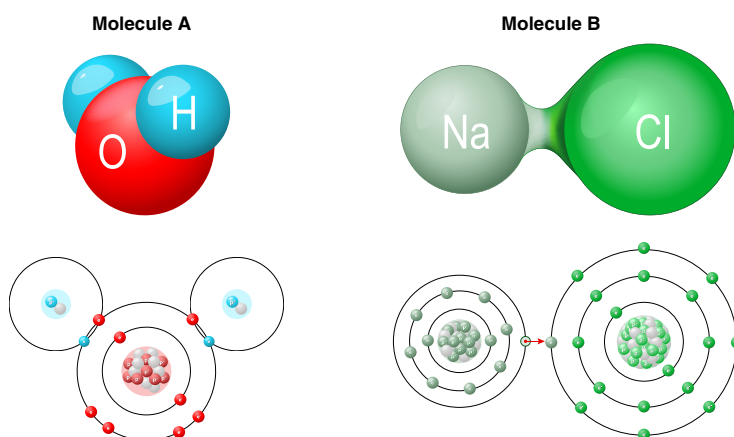
Polar Versus Nonpolar

Look at the four molecules in the image on this page. Based on the reading, which molecules are likely polar and which are nonpolar? How do you know?

PRACTICE

What Do You Know About Molecules?

Look at the two molecules in the image. Then, fill in the table.



	Molecule A	Molecule B
Bond		
Compound or Elemental?		
Organic or Inorganic?		
Name(s) of Element(s) in Molecule		

REVIEW

In this chapter, you learned:

- Compounds are molecules with different elements, an element only has one type of atom, and mixtures are physically added together, not chemically changed.
- Organic molecules are found in living systems and contain a carbon atom, while inorganic molecules do not contain carbon.
- Ionic bonds exchange electrons, covalent bonds share electrons, and metallic bonds are bonds only between metals.
- Polarity is determined by the distribution between the charges in a molecule. Polar molecules have unevenly distributed charges, while nonpolar molecules have an even distribution.

Can you answer The Big Question?

What is the difference between elemental and compound molecules, and what types of bonds hold atoms together?

SHOW WHAT YOU KNOW

Match each vocabulary word to its description.

- | | |
|----------------------------|---|
| 1. ____ compound molecule | A. a long chain of atoms |
| 2. ____ element | B. when a molecule is unevenly charged |
| 3. ____ macromolecule | C. contains different atoms joined together |
| 4. ____ elemental compound | D. contains a carbon atom |
| 5. ____ organic molecule | E. contains only one type of atom |
| 6. ____ polarity | F. has more than one atom of the same element |

Read each sentence. Circle True or False.

7. True or False All organic molecules contain carbon.
8. True or False The four macromolecules are inorganic.
9. True or False Water and salt are examples of organic molecules.

Choose the correct answer for each question.

10. When the charges in a molecule are unbalanced, containing a negative side and a positive side, what is this molecule considered to be?
- A. polar
B. nonpolar
C. organic
D. inorganic
11. The three types of bonds are:
- A. ionic, polar, and organic
B. ionic, covalent, and metallic
C. polar, covalent, and metallic
D. organic, inorganic, and carbon

Answer the following question.

12. What is the difference between ionic, covalent, and metallic bonds? Give an example of each.

IN FOCUS

Conduct Research

You want to be a chemist and work with molecules on a daily basis. What is the best way to see and study molecules? Using a reliable search engine, research the tools and programs chemists use to see molecules. Which tools work best? Which tools are excellent but are just too expensive to use all the time? Which tools need to be replaced with new technology?



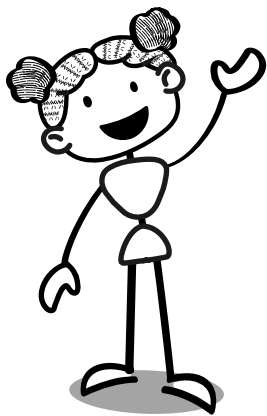
Chemists use various tools to study molecules.

Discover!

PHYSICAL SCIENCE

LAB BOOK





Discover! Physical Science Lab Book

Published in Catasauqua, Pennsylvania Edovate Learning Corp.

334 2nd Street

Catasauqua, PA 18032

edovate.com

Copyright © 2026 Edovate Learning Corp.

All rights reserved. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing by the publisher.

ISBN: 979-8-9994835-7-7

Printed in United States of America

2nd Edition

Physical Science Lab Book

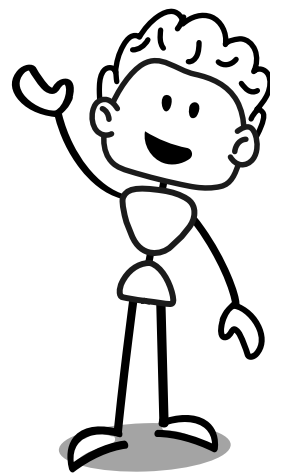


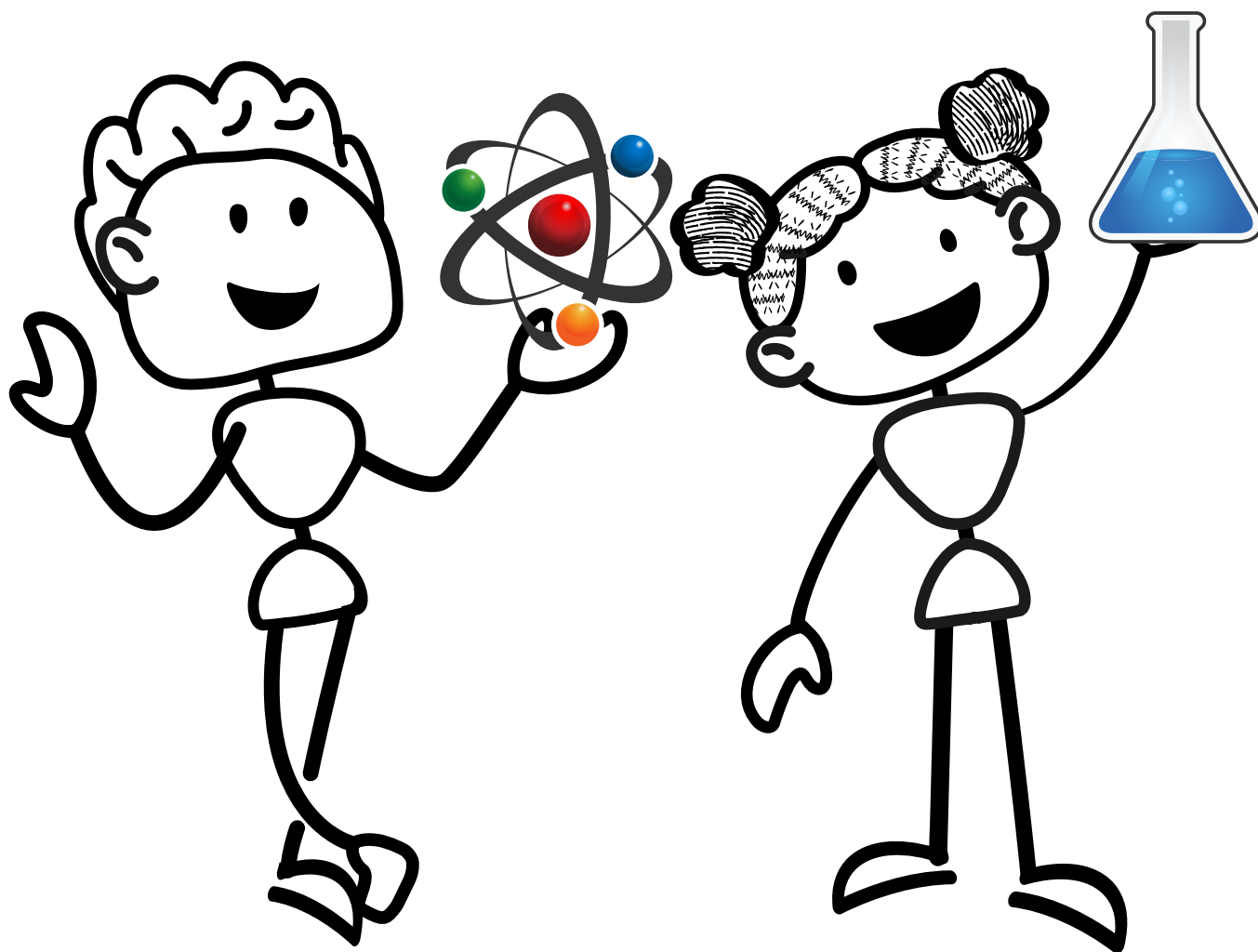
Table of Contents

Unit 1 Lab: Pendulums	5
Unit 2 Lab 1: Birdhouse Engineering.....	9
Unit 2 Lab 2: Dissecting Density	13
Unit 3 Lab 1: Bonding Bonanza.....	19
Unit 3 Lab 2: The Case of the Non-Newtonian Fluid	23
Unit 4 Lab 1: DIY Water Filtration System.....	27
Unit 4 Lab 2: Cabbage Chemistry	31
Unit 5 Lab 1: Spring Into Action.....	35
Unit 5 Lab 2: The Law of Thermodynamics	39
Unit 6 Lab 1: Magnetic Explorer	43
Unit 6 Lab 2: Cooking Up Sunshine	47
Unit 7 Lab 1: Newton's Hovercraft.....	51
Unit 7 Lab 2: Roller Coaster Rush	55
Unit 8 Lab 1: Power of Pulleys.....	59
Unit 8 Lab 2: Ramp It Up!	63

How to Use This Lab Book

Lab Book

- The lab book, when used alongside the worktext, serves as a dynamic tool to enhance student understanding of scientific principles and processes.
- Each unit has at least one lab experience. Each lab has five sections.
 - **Start!:** This section introduces the lab content and establishes a clear connection between unit content and lab application.
 - **Spark:** In this section, the student engages with the lab by making predictions and researching pre-experiment questions.
 - **Search:** In this section, the student completes the steps outlined to engage with the experiment. There is an emphasis on recording observations and making critical notes.
 - **Synthesize:** In this section, the student takes the data collected during the experiment to report findings, make inferences, and/or suggest further research.
 - **Stretch:** This section invites the student to take their experiments further.
- A page for lab notes is provided with each lab. The student is encouraged to record their hypothesis, experiment observations, and experiment results in this section.



Bonding Bonanza

Upon completion of the lab, you will be able to:

- describe the basic types of bonds that hold atoms together in a molecule, specifically ionic, covalent, and metallic bonds
- compare and contrast ionic, covalent, and metallic bonds
- explore solubility in different bond types
- observe the physical properties of different bond types

Key Concepts

- Matter is anything that has weight and takes up space.
- Matter exists in four states: solid, liquid, gas, and plasma.
- Atoms are sometimes joined together as a covalent bond, an ionic bond, or a metallic bond.
- Atoms can be organized into molecules, elements, and mixtures.
- Humans interact with many important elements daily.

Safety

Be cautious with the sharp edges of aluminum foil.

Materials

- | | | |
|--|---------------------------|-------------------------------|
| ■ table salt (sodium chloride, NaCl) | ■ two small bowls or cups | ■ magnifying glass (optional) |
| ■ sugar (sucrose, $C_{12}H_{22}O_{11}$) | ■ two spoons | |
| ■ aluminum foil (Al) | ■ stopwatch or timer | |

START!

When you return from your day with Dr. Brown, you are excited to share everything you learned with your family. You decide that the best way to do this is to show them.

You run to your kitchen to grab some essentials before setting up your experiment in the dining room. You call your family over, and they see your scientific setup.

“What is all of this about?” your mom asks curiously.

“The best way to explain my day is to show you how much you matter . . . get it?” you say, laughing loudly.

“Umm, sure,” your sibling says, still confused.

“Prepare to be amazed!” you say as you begin your demonstration.



Science can spark curiosity and learning.



Do you ever wonder what makes one matter different from the other? Matter is the basis of chemistry. The smallest particle of matter is an atom. Those atoms then combine through different types of bonds to create molecules: ionic, covalent, and metallic.

How do solutions or substances with different bond types differ?

Substances with different bond types have different properties. These differences happen because of how atoms stick together, which affects how they act in different situations.

You will observe three substances, then compare the similarities and differences between them.

Can you write a hypothesis? Use the Lab Notes page to record your predictions about this assignment.



Procedures:

Step 1: Pour one tablespoon of table salt into a bowl. Observe the physical properties and record your observations.

Step 2: Pour one tablespoon of table sugar into a separate bowl. Observe the physical properties and record your observations.

Step 3: Place one sheet of aluminum foil onto the counter. Observe the physical properties and record your observations.

Step 4: Pour a half cup of warm water into the bowl of salt. Time how long it takes to dissolve completely as you stir continuously. Record how long it takes.

Step 5: Pour a half cup of warm water into the bowl of sugar. Time how long it takes to dissolve completely as you stir continuously. Record how long it takes.

Step 6: Observe the solutions and record any differences.

Step 7: Crumple the foil into a ball. Observe its physical properties (malleability, ductility, color, state of matter, weight, etc.).

Step 8: Place the foil into a bowl of water. Observe how it interacts with the water compared to the solutions you created before.

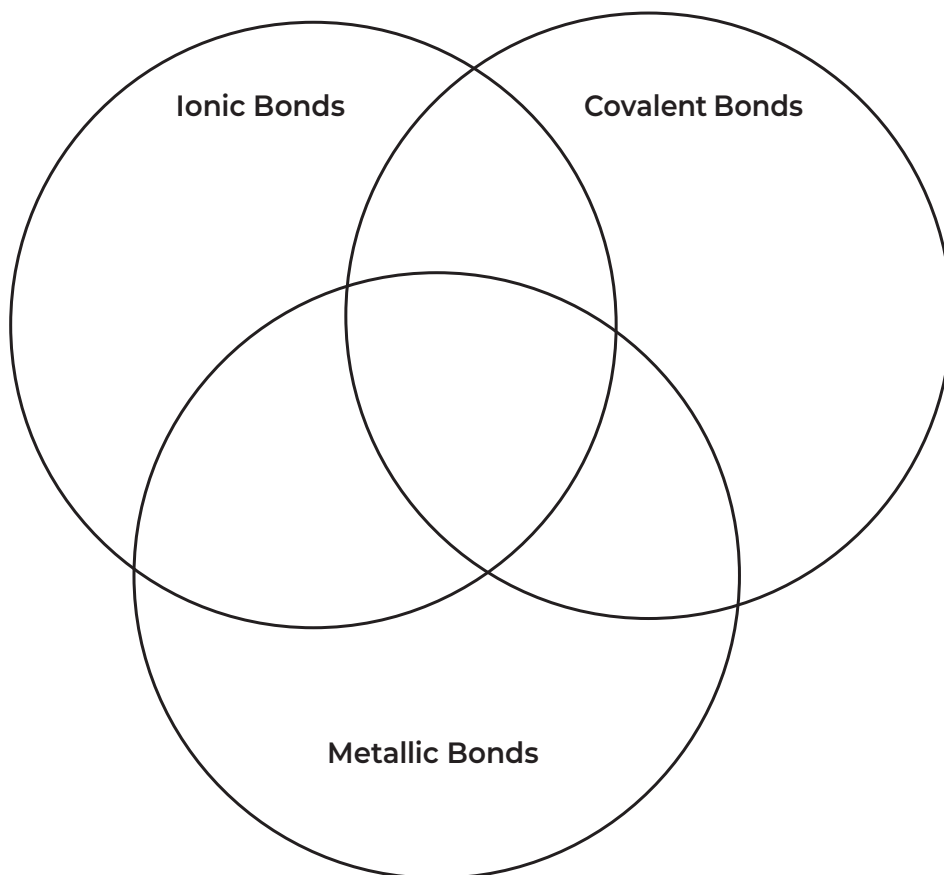
Substance	Bond Type	Time to Dissolve	Observations
Salt	Ionic		
Sugar	Covalent		
Aluminum Foil	Metallic		

What is happening during the experiment? Use the Lab Notes page to record your observations about this assignment.

SYNTHESIZE

Each of the bonds reacted a different way in the water. The salt and sugar dissolved in water due to their ability to form interactions with water molecules, while the aluminum foil remained insoluble and floated on the water surface due to its metallic nature and hydrophobic properties.

Compare and contrast the three bonds (ionic, covalent, and metallic) and your observations from the experiment in the Venn diagram below.



Can you describe any results? Use the Lab Notes page to record your observations about this assignment.

STRETCH

Chemistry is an important part of biological science. Your body is made up of atoms that work together to make you, well, you! Start by researching elements that are used in the body. Once you do so, you may begin your initial research to prepare for the element. Be sure to answer the following questions in your research project.

- What element are you researching?
- What is the chemical symbol?
- What is a common compound that it is involved in making?
- What is the primary use in the body?
- What happens to the body if it is low in this element?
- What happens to the body if it is high in this element?

Predict

Before starting this lab, I predict . . .

Observe

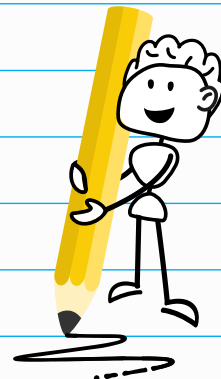
While completing the lab, I observed . . .

Explain

Upon completion of this lab, I learned . . .

Keep Going

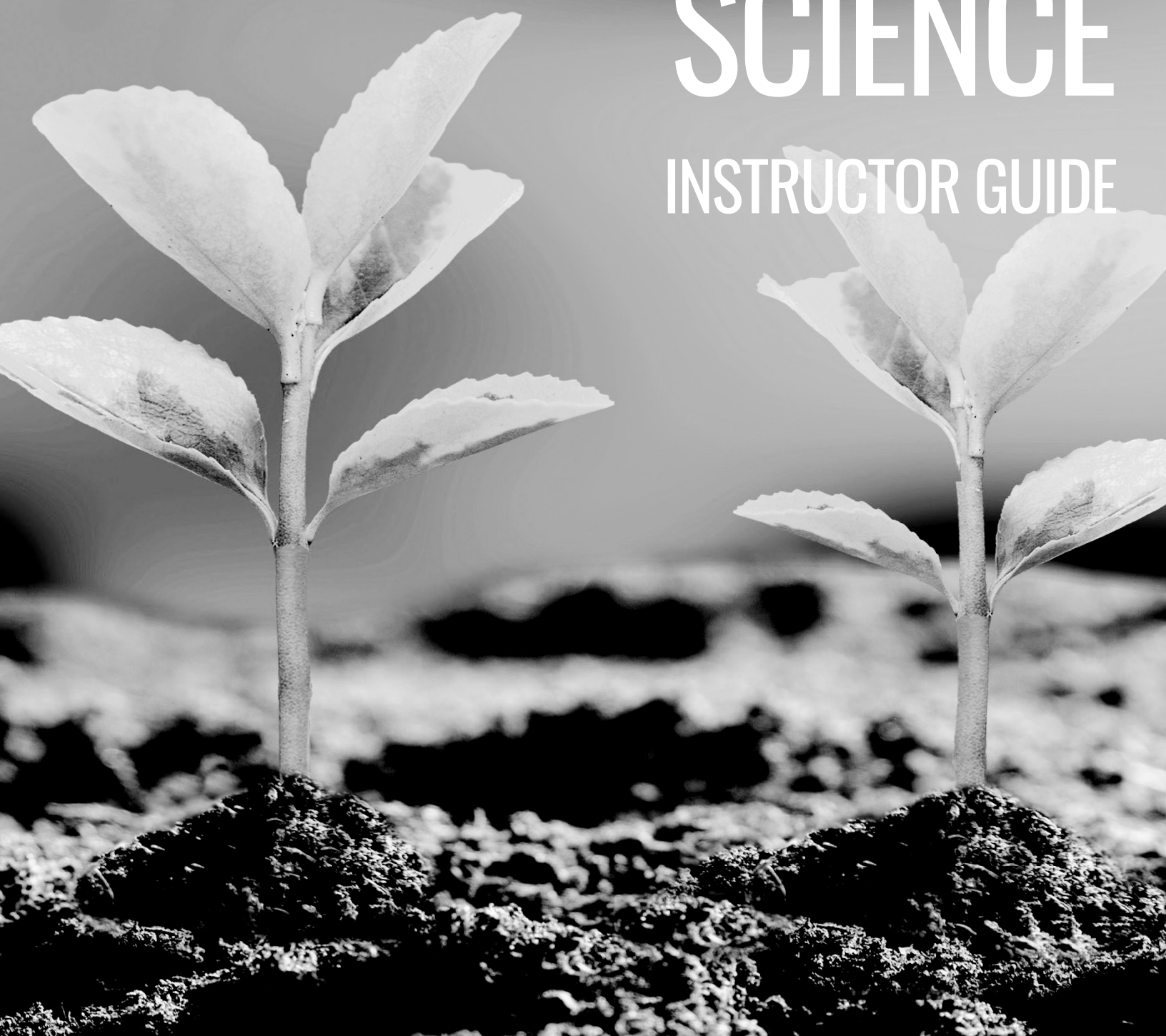
I still have questions about . . .

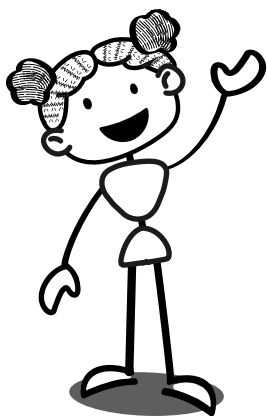


Discover!

PHYSICAL SCIENCE

INSTRUCTOR GUIDE





Discover! Physical Science Instructor Guide

Published in Catasauqua, Pennsylvania by Edovate Learning Corp.

334 2nd Street

Catasauqua, PA 18032

edovate.com

Copyright © 2026 Edovate Learning Corp.

All rights reserved. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing by the publisher.

ISBN: 979-8-9994835-5-3

Printed in United States of America

2nd Edition

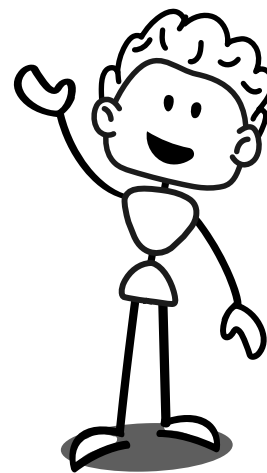


TABLE OF CONTENTS

Physical Science

Unit 1: Study of Physical Science

Chapter 1: The Physical Scientist.....	7
Chapter 2: Historic Foundations of Physical Science.....	10
Chapter 3: Standing on the Shoulders of Giants.....	13
Chapter 4: Scientific Theories and Laws.....	16
Chapter 5: Methods and Processes	19
Chapter 6: Models and Visualizing Data	23
Chapter 7: Physical Science in Action	26
Chapter 8: Unit 1 Review	30
Unit 1: Assessment	34

Unit 2: Scientific Measurement Systems

Chapter 9: The Metric System	39
Chapter 10: Size and Distance.....	42
Chapter 11: Area.....	46
Chapter 12: Volume.....	49
Chapter 13: Mass and Density.....	52
Chapter 14: Using Graphs: Bar and Line.....	56
Chapter 15: Using Graphs: Pie Charts and Pictographs	59
Chapter 16: The Civil Engineer at Work.....	62
Chapter 17: Unit 2 Review	65
Unit 2: Assessment	68

Unit 3: Matter's Structure

Chapter 18: Matter Basics	76
Chapter 19: States of Matter	78
Chapter 20: Atomic Structure	81
Chapter 21: Types of Molecules	84
Chapter 22: Elements of the Periodic Table.....	87
Chapter 23: The Physicist at Work.....	91
Chapter 24: Unit 3 Review	94
Unit 3: Assessment	97

Unit 4: Matter and Changes

Chapter 25: Chemical and Physical Changes	102
Chapter 26: Compounds and Mixtures	106
Chapter 27: Solutions	109
Chapter 28: Acids	115
Chapter 29: Bases.....	120
Chapter 30: Salts.....	123
Chapter 31: Nuclear Changes.....	128
Chapter 32: The Nuclear Engineer at Work	133
Chapter 33: Unit 4 Review	137
Unit 4: Assessment	140

Unit 5: Energy

Chapter 34: Energy Basics	145
Chapter 35: Waves.....	149
Chapter 36: Mechanical Energy	153
Chapter 37: Potential Energy	157
Chapter 38: Chemical Energy	160
Chapter 39: Atomic Energy.....	163
Chapter 40: Basics of Thermodynamics.....	166
Chapter 41: The Mechanical Engineer at Work.....	170
Chapter 42: Unit 5 Review	173
Unit 5: Assessment	176

Unit 6: Electromagnetism

Chapter 43: Electricity	181
Chapter 44: Electrical Circuits	184
Chapter 45: Magnetism.....	187
Chapter 46: Electricity and Magnetism	189
Chapter 47: The Future of Energy	192
Chapter 48: The Electromagnetic Systems Designer at Work.....	195
Chapter 49: Unit 6 Review	198
Unit 6: Assessment	201

TABLE OF CONTENTS

Physical Science

Unit 7: Force, Distance, and Work

Chapter 50: Force	206
Chapter 51: Force Vectors	211
Chapter 52: Motion and Distance	214
Chapter 53: Measuring Motion and Distance	217
Chapter 54: Work	221
Chapter 55: Energy and Work	224
Chapter 56: The Physicist at Work in the Field of National Defense	227
Chapter 57: Unit 7 Review	231
Unit 7: Assessment	234

Unit 7 Lab 1: Newton's Hovercraft	294
Unit 7 Lab 2: Roller Coaster Rush	296
Unit 8 Lab 1: Power of Pulleys	298
Unit 8 Lab 2: Ramp It Up!	300

Unit 8: Simple Machines

Chapter 58: Friction Basics	239
Chapter 59: Friction Types	243
Chapter 60: Levers	246
Chapter 61: Wheel, Axle, Pulley, and Gears	250
Chapter 62: Inclined Plane, Wedge, and Screw	254
Chapter 63: The Construction Engineer at Work ...	258
Chapter 64: Unit 8 Review	262
Unit 8: Assessment	266

Lab Support

Unit 1 Lab: Pendulums	272
Unit 2 Lab 1: Birdhouse Engineering	274
Unit 2 Lab 2: Dissecting Density	276
Unit 3 Lab 1: Bonding Bonanza	278
Unit 3 Lab 2: The Case of the Non-Newtonian Fluid	280
Unit 4 Lab 1: DIY Water Filtration System	282
Unit 4 Lab 2: Cabbage Chemistry	284
Unit 5 Lab 1: Spring Into Action	286
Unit 5 Lab 2: The Law of Thermodynamics	288
Unit 6 Lab 1: Magnetic Explorer	290
Unit 6 Lab 2: Cooking Up Sunshine	292

Student Books, Instructor Guide, and Planning

Instructor Guide

- The instructor guide provides chapter-by-chapter guidance to facilitate your instruction.
- For your convenience, the objectives are provided at the beginning of each chapter.
- Each chapter provides suggestions for supporting your student with worktext activities and adapting the content to your student's learning preferences.
- Booster activities are provided for some chapters which provide your student an opportunity for repeated practice toward mastery of specific skills or concepts.
- Co-op activities are provided for many chapters and allow you to tailor the instruction with creative ideas for collaborative and group learning.
- Each chapter contains extension activities to enhance or extend the content for your student.
- Answer keys for all activities are provided in each chapter.
- The back of the instructor guide provides full support for all lab activities and is organized to mirror the lab book's table of contents.
- The unit assessments are included with each unit review as well as in the assessment booklet. Each unit has two options.
 - **Traditional unit assessment:** This is a traditional assessment with an answer key.
 - **Performance assessment:** This is a performance-based option with a rubric.

Planning

- Each course is designed to cover approximately 160 days of instruction, with each chapter taking roughly 2 days to complete. This does not include time spent on the enrichment activities provided in the worktext sidebars and the instructor guide. These materials allow the instructor to customize the learning experience and encourage the student to dive deeper.
- It is recommended the student completes the **Explore** and **Read** pages on the first day and the **Practice** and **Show What You Know** pages on the second day.
- It is recommended that the student complete the unit lab(s) contained in the lab book PRIOR to the completion of the unit reviews/assessment chapter. The student should be able to complete a lab in one day or do half of the lab on one day, and half on another day. Because of the nature of experiments, some labs may require the student to engage with the procedures over several days. Please be sure to read through the unit lab experiments in advance to adequately plan for each unit's calendar of activities.
- For unit review/assessment chapters, it is recommended the student completes the **Review** pages and the first **Practice** page on the first day and the remaining **Practice** pages on the second day.

Types of Molecules

Chapter Objectives

By the end of this chapter, your student will be able to:

- identify and categorize different types of molecules, such as elements, compounds, and mixtures
- understand the difference between organic and inorganic molecules
- describe the basic types of bonds that hold atoms together in a molecule, specifically ionic, covalent, and metallic bonds
- explain simple molecular structures and understand the concept of polarity

Supporting Your Student

Read (*Molecules*)

As your student is reading, encourage them to stop and discuss each of the vocabulary words. This will help to clarify and clear up any misconceptions. Also, consider having your student take notes or even draw pictures as they are reading. Then, they can refer back to their notes to complete any of the practice activities. Remind your student that the elemental molecules contain atoms from the same element. Organic molecules contain carbon, but inorganic molecules do not. This is a clue for when your student has to look at the chemical formulas of molecules and decide what molecules they represent.

Apply (*Polar Versus Nonpolar*)

If your student is struggling to complete this activity, refer them back to the reading. One tip in the reading is about the shape of the molecules that are bonded. If they are bonded in a V-shape, they are likely polar, and if they are bonded in a line, they are likely nonpolar. Remind them that this is not always the case, with several exceptions. However, it is a good rule to use when beginning to investigate molecules.

Practice (*What Do You Know About Molecules?*)

To complete this activity, have your student look at the image closely and see what they notice right away. Have them write down anything they notice in the table. Then, have them go through one molecule

at a time and fill in the table. Remind your student that it is fine if both molecules have the same answers. Refer them back to the reading if they have any questions.

Learning Styles

Auditory learners may **enjoy** hearing descriptions of molecules and determining what molecules they are based on their descriptions.

Auditory learners may be **challenged** by using household objects to build their own molecules to improve their kinesthetic learning skills.

Visual learners may **enjoy** looking at different molecules and explaining how they are bonded together.

Visual learners may be **challenged** by listening to descriptions of molecules and determining what elements make up the molecules and what their bonds are to help their auditory learning skills.

Kinesthetic learners may **enjoy** using household objects to build their own molecules.

Kinesthetic learners may be **challenged** by naming simple compounds from pictures to help their visual observation skills.

Booster Activity

Milk Polarity

Polarity means that the charges within the molecule are unevenly distributed. Water is a polar molecule, but fat is a nonpolar molecule. The following activity uses milk, which has both water and fat in a mixture. Pour some whole milk onto a thin plate or tray. Have your student add a few drops of food coloring near the middle of the plate. Then, they should dip a cotton swab into some dish soap. Finally, have your student carefully touch the cotton swab in the middle of the milk plate. The food coloring should zoom to the edges of the plate. This is due to the differing polarities of the fat content and water in the milk and the unique properties of the dish soap, which clings to fat but repels water.

Extension Activities

Marshmallow Molecules

Many students imagine molecules like balls on sticks in different shapes. Try to build these molecules out of marshmallows and toothpicks instead. Use the multicolored marshmallows and assign a color to represent each of the following elements: oxygen, carbon, hydrogen, and nitrogen.

Challenge your student to make some flashcards of common chemical formulas (water, methane, carbon dioxide, ammonia, octane, sugar, acetic acid, ethanol, caffeine, and graphene). Have them write the name of the molecule on one side and its chemical formula and how it is bonded together on the other side. Once the flashcards are complete, have your student randomly choose a card and build the molecule (such as oxygen) using marshmallows and toothpicks. Double bonds are represented with two toothpicks, and single bonds are represented with one toothpick.

Who Am I?

Have your student use a reliable search engine and find a particular molecule they want to write about. They should then write a paragraph as if they are the molecule, giving information about themselves in the form of clues. Then, a partner, family member, or instructor can try to guess the molecule they are describing.

Answer Key

Closer Look (*Molecular Sucrose*)

Answers will vary. Possible answer: The molecules are in little V shapes. There are three different atoms in the molecule: hydrogen, carbon, and oxygen. There are 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms.

Write (*Essay*)

Answers will vary. Possible answer: An elemental molecule (such as oxygen) has two or more of the same atom, while a compound molecule (such as sodium chloride) has two or more atoms of different elements. An organic molecule (such as carbon dioxide) has a carbon atom, but an inorganic molecule (such as water) does not. Macromolecules (such as

nucleic acids) have large numbers of various atoms, whereas elemental molecules usually only have two or three atoms of the same element.

Mini-Lab (*Iron Extraction*)

Answers will vary. Possible answer: The iron in the cereal was extracted and attracted to the magnet because iron is magnetic. The warm water and the physical crushing of the cereal broke the bonds and freed the iron so that it moved toward the magnet.

Apply (*Polar Versus Nonpolar*)

Explanations will vary. Answers with possible explanations: Polar: water and ammonia; the atoms aren't lined up. Nonpolar: oxygen and carbon dioxide; the atoms are lined up.

Practice (*What Do You Know About Molecules?*)

	Molecule A	Molecule B
Bond	covalent	ionic
Compound or Elemental?	compound	compound
Organic or Inorganic?	inorganic	inorganic
Name(s) of Element(s) in Molecule	hydrogen, oxygen	sodium, chlorine

Review (*The Big Question*)

Answers will vary. Possible answer: An elemental molecule has two or more of the same atom, while a compound molecule has two or more atoms of different elements. An ionic bond is a chemical bond that occurs when one atom loses a valence electron and the other atom gains an electron. A covalent bond is when two atoms share their valence electrons. Metallic bonds are when metals are connected to other metals.

Show What You Know

1. C
2. E
3. A
4. F
5. D

Types of Molecules

- 6. B
- 7. True
- 8. False
- 9. False
- 10. A
- 11. B
- 12. Answers will vary. Possible answer: An ionic bond is a chemical bond that occurs when one atom loses a valence electron and the other atom gains an electron. Example: sodium fluoride (NaF)
A covalent bond is when two atoms share their valence electrons. Example: water
Metallic bonds are when metals are connected to other metals. Example: copper wiring

In Focus (Conduct Research)

Answers will vary. Possible answers:

- ZC model
- transmission electron microscopy (TEM)
- crystal x-ray