

# exploring SCIENCE

FIFTH  
EDITION



**bju press**  
Greenville, South Carolina

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# USING YOUR TEXTBOOK

This textbook is just for you! We've designed it to help you learn. Flip through the following pages to see its features. We believe these will help you succeed in science. In the back of the book you will see other features, including a glossary and index. We've designed this textbook with you in mind. We hope it will help you appreciate the wonders of God's creation even more.

## ESSENTIAL QUESTION

Before you begin reading a lesson, take a few moments to think about the essential question found at the beginning of each section. Think about what you know and what you need to learn to find an answer. This will help you anticipate and recognize the key points as you read.

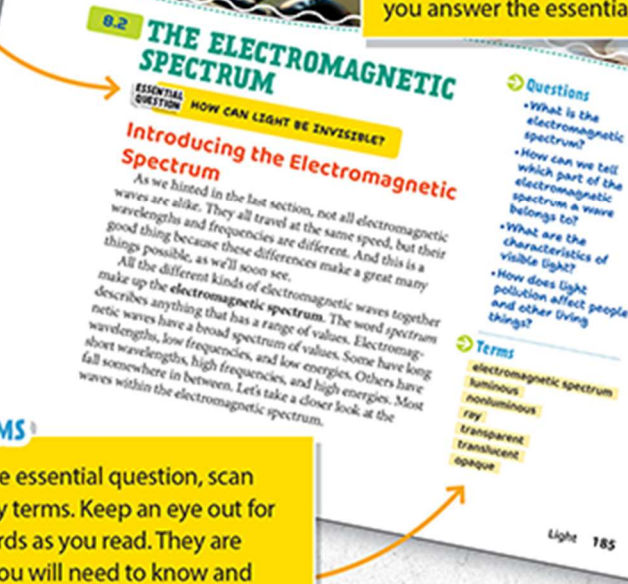
## BEFORE READING

## KEY QUESTIONS

The questions given at the beginning of each section are smaller questions that you can think about as you read to help you answer the essential question.

## VOCABULARY TERMS

After considering the essential question, scan the list of vocabulary terms. Keep an eye out for these boldfaced words as you read. They are the key terms that you will need to know and understand by the end of each section.



## DURING READING

### Boldface Terms

Vocabulary terms are printed in **boldface**. They are accompanied by a definition when they first occur in a lesson. You will find all these terms in the glossary at the back of the book.

### Italicized Terms

The *italicized terms* are terms that will be defined later or are other important terms that have been italicized for emphasis.

### MINI LABS

These short, hands-on activities will get you thinking and working like a scientist.

### CONNECTIONS

Connections features highlight examples of how science relates to other fields, such as technology, history, and even art.

#### Wanted: U or Your Element

#### HOW CAN WE USE INFORMATION FROM THE PERIODIC TABLE TO BUILD A MODEL?

There are ninety-four naturally occurring elements and twenty-four man-made elements. Elements hide in a lot of places. Your body, the sun, and even your food contain many unexpected elements. You would probably be amazed to know all the elements contained in a box of cereal in this mini lab activity you will select a "wanted" element and use your research skills to track down information about it. Your assignment is to prepare a case file on that wanted element. You will also learn about the element's structure, position in the periodic table, history, and uses. Of course, you will also need to create a model to help you understand your element.

#### PROCEDURE

- Choose one of the elements from Row 2 or Row 3 to learn about.
- Use your periodic table to determine your element's symbol and the number of its protons, neutrons, electrons, and shells. Record this information on the side or bottom of your poster.
- Choose one colored candy or cereal to represent your protons, another for your neutrons, and a third for your electrons. Draw an outline to represent a model of your element. Be sure to show where the nucleus is, along with the number of shells surrounding it.
- Create your model by gluing your colored candies or cereal to your poster board in the proper location.
- Research your element and answer the following questions.

#### QUESTIONS

- Describe the structure of your element.
- What characteristics does your element show?
- What are three ways that your element can be used to help people?

- Equipment**
- colored cereal or candies, 3 colors
  - poster board
  - markers
  - periodic table of elements
  - glue

### CONNECTIONS

#### Science and History: Isaac Newton

You know Isaac Newton's name from our discussions on force and motion. But he is known for much more than that. He was a famous scientist, mathematician, and inventor. He made many important contributions to the world. Newton studied forces and motion. He also helped invent a type of math known as calculus, wrote a book on light, and created the first reflective telescope. Newton's careful experiments and detailed notes helped lead to the scientific method. This revolutionized modern science.



Gravity explains the motions of the planets, but it cannot explain who sets the planets in motion. —Isaac Newton

There is no one who put the planets in motion. He believed that God was the one who put the planets in motion. He saw his scientific discoveries like the law of gravity as evidence of God's orderly nature. Newton's worldview and his belief in God helped him understand how the natural world worked, and his work inspired many generations of scientists.

### SCIENCE CAREER

#### Food Scientist

Have you ever seen a label on your packaged food saying that it's fortified with different nutrients? That means that nutrients have been added to the food, making it easier to get those things in your diet.

Nutrients are common on many packaged foods, including rice, orange juice, cereals, salt, and bread.

Food scientists help with this process of fortifying foods. In addition to making sure packaged foods contain certain nutrients, food scientists do many other interesting things. Some work in product development to create new flavors and types of foods. Others work to sample products to make sure that the food being produced is safe to eat and that every package is the same. They test many samples to make certain that every package has the right amount of food, is the same color, and has the same texture. Most importantly,

One way that food scientists can help others is by finding ways to help get nutrients to people who don't have enough food to eat. In many countries hunger is a big concern, and there are many who don't have enough to eat. Some organizations help by sending food to areas in need. But how can they be sure that they're sending the most helpful kind of food? Food scientists can help by testing food and figuring out how to fortify it with necessary nutrients. They can ensure that foods have plenty of calories to meet people's energy needs. They can also dehydrate food so that it lasts longer and allows more to be sent in a package. Dehydrated food is food that is preserved by having all the water removed from it. It's similar to...

wearing seat belts are anchored to the car and become part of the car. When the car stops suddenly, the seat belts lock as a force on the wearers, who now stop at a slower rate, along with the car. The seat belts will stop them quickly with a very large force.



### SCIENCE CAREERS

Science Career features will inform you about careers in science that you can pursue to glorify God and serve others.

## ETHICS

The work of science is bristling with ethical issues. Through the Ethics features you will learn a biblical model of ethical decision-making. You will also have opportunities to practice using it in considering real-world issues.

## Ethics Strategies

Think back to the discussion of ethics in Chapter 1. If your memory is a little hazy, review pages 18–20. We're now going to consider a strategy for evaluating ethical issues. Then we'll apply the strategy to evaluate responses to harmful emissions.

### THE STRATEGY

#### 1. What information can I get about this issue?

You may need to do some research on a topic before evaluating whether it's right or wrong. For this exercise you can find the needed information below, but in future chapters you will begin researching the topic on your own.

#### 2. What does the Bible say about this issue?

Read the Bible to see what it says about the issue. Sometimes God's word directly addresses an issue. Other times, you may need to infer a principle to learn how it applies to an issue. Consider the message of God in the Bible, and the

#### 4. What are the effects of the acceptable and unacceptable options?

Remember the biblical outcomes of human flourishing: a thriving creation, and God's glory? Some of the acceptable options may have effects that fit with the biblical outcomes. Others may not. Determine the effects of the acceptable and the unacceptable options. Reject the options that have results that are inconsistent with human flourishing, a thriving creation, and God's glory.

#### 5. What action should I take?

Suggest an action or form an opinion. Be prepared to justify your suggestion on the basis of your analysis.

Now that you know how to organize your research, let's see how we can use this strategy to solve an issue.

## Noise Pollution

### Introduction

Do you have loud neighbors who keep you up at night? Or maybe loud traffic outside your house that distracts you when you're trying to study? These distractions are forms of **noise pollution**, or sound pollution, which is unwanted loud noises that can have a negative impact on humans and animals.

Many cities and counties have noise laws to help reduce sound pollution. Some neighborhoods have rules as well. Are these laws and rules important? How do they help the people affected by sound pollution?

### Task

Several families in your neighborhood have been complaining about noise from a few sources. Some of these noises, like noise from traffic, can't be prevented, though rules can be created to help regulate them. Other neighbors have complained about sound from lawnmowers, trains, dogs, children, loud music, sirens, and cars. The neighborhood is meeting to discuss possible regulations and ways to reduce unnecessary noise. Your parents are planning on attending the meeting and have asked for your opinion. Research this topic using the guiding questions to

form an opinion on what steps you think your neighborhood should take.

### Procedure

1. Do an online search for sound pollution. The following questions can help guide your research.
  - a. What types of noise can be considered sound pollution? What volume of noise is usually considered sound pollution?
  - b. How does sound pollution affect human health?
  - c. How does sound pollution affect other living things (e.g., animals)?
  - d. What laws are in place to regulate sound pollution? How do they differ from one location to another?
  - e. In addition to regulations, what can be done to help reduce sound pollution? Research three ways that these noises could be reduced or lowered and see whether any of them may be effective for your neighborhood.

## CASE STUDIES

Case Studies give you a chance to investigate specific areas of science to apply what you have learned in a chapter.

## CASE STUDY

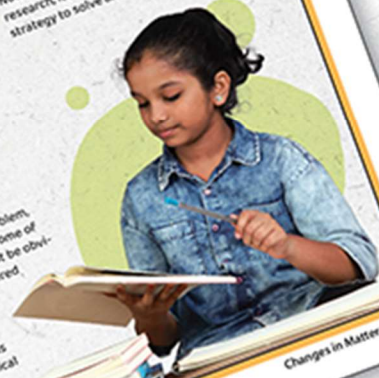
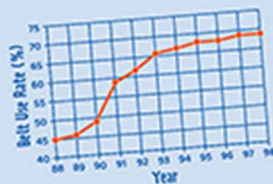
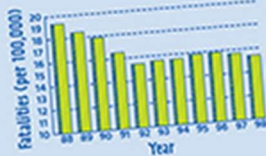
### Car Safety Stats

Newton's first law tells us why seat belts can prevent and reduce injuries in an accident. But just how much do they help? Let's look at some safety statistics.

The graphs on the right show how accident fatalities change as seat belt use changes. The number of people killed is shown in green, and the number of people wearing seat belts is shown in red.

#### Questions to Consider

1. What percentage of people wore seat belts in 1988? How many fatalities happened that year?
2. What percentage of people wore seat belts in 1998? How many fatalities occurred that year?
3. What happens to the number of fatalities as seat belt use increases?
4. How does the number of fatalities change as the percentage of seat belt wearers changes?
5. What does this information tell you about the importance of wearing a seat belt?



Changes in Matter 73

## WORLDVIEW INVESTIGATIONS

These investigations help you think through controversial areas of science through the lens of Scripture.

## CHAPTER REVIEW

## 8.3 Using Waves in Technology

- Electromagnetic waves are used in many everyday applications, including cooking, medicine, imaging, and communication.
- Radio broadcasting encodes signals in two bands of waves: the FM band (88.0 MHz to 108.0 MHz) and the AM band (530 kHz to 1600 kHz).
- FM radio relies on frequency modulation to encode signals. AM radio uses amplitude modulation.

## Terms

analog signal



- An analog signal encodes information by modifying some property of the medium. An analog signal consists of a continuous range of values.
- A digital signal encodes information in the form of discrete values. Digital signals are less prone to interference.

digital signal

## RECALLING FACTS

- How are electromagnetic waves like mechanical waves? (Select all that apply.)
  - They are caused by disruptions in electric and magnetic fields.
  - They have both amplitude and frequency.
  - They require a medium to move through.
  - They transfer a medium to move through.
- Electromagnetic waves travel as bundles of electromagnetic energy called \_\_\_\_\_.
- (True or False) Electromagnetic waves travel at the same speed in any medium.
- Electromagnetic waves with high frequencies have \_\_\_\_\_ wavelengths.
- Order the types of electromagnetic waves from longest wavelength to shortest.
  - (True or False) The visible light portion of the electromagnetic spectrum consists of a broad range of wavelengths and frequencies.

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## CHAPTER SUMMARY

The chapter summary gives you quick bullet points for each section. Use these summaries to check your understanding of the main points of each section.



Now suppose the red team begins to tire. Suddenly the forces acting on the rope are no longer balanced. We say that the forces are unbalanced. The red team now exerts less force,  $R$ , on the rope, so its vector on the free-body diagram shortens. There is now a nonzero net force acting in the direction of the blue team. The  $B$  arrow is now longer than the  $R$  arrow since the blue team is pulling harder than the red team and thus is applying a larger force. Unless the red team can add some force, the blue team is going to win!

## 4.2 SECTION REVIEW

- Which type of force, contact or field, can be exerted if two objects are not touching?
- Describe two forces acting on a cat sitting on a bookcase. Identify the sitting in which each force acts and whether it is a contact or field force.
- A rider on a bicycle gently applies the brakes as she rolls down a hill. Which type of force occurs between the brake pads and the wheel?
- Fish are designed to move easily through water. Which type of force does the design of their bodies reduce?
- Refer to the setup of the three spring scales described in the mini lab on page 88. Draw a free-body diagram of the three forces at work in that scenario. Label the single force as  $A$ . Hint: Think carefully about the lengths of the vector arrows!
- Imagine two forces acting on an object, each with 5 N of force. The  $U$  force is exerted upward. The  $L$  force is exerted to the left. Draw a free-body diagram for the two forces.
- Will the forces described in Question 6 change the object's motion? If so, in what direction will the net force be exerted?

Forces

## REVIEW QUESTIONS

Each section and chapter includes a set of review questions. Use these review questions to check your ability to recall facts, understand concepts, and develop critical thinking about the content. Problem-solving and extra-thought questions are marked with a blue box—you may need to think a little harder or do some research to answer these questions.