

Make science easier to teach and exciting to learn.

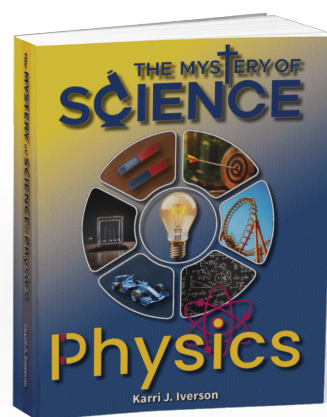
Open-and-go science curriculum for Christian homeschool families with students in grades 4 through 8.

Science should not take over your week. You want your children to learn well without spending every evening preparing the next lesson.

PHYSICS / LESSON 8

Slow Solids and Lively Liquids

Discover how familiar things like honey and water can help your child understand matter. Read both samples together and see how they fit your family.



Easy for you.

A clear plan for your homeschool week.

Fascinating for them.

Colorful lessons that invite discovery.

Grounded in truth.

Science through a biblical worldview.

Explore the Physics Curriculum

Includes selected Student Reader and Lab Manual pages; this is not the full curriculum.

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Science Editing: Dr. W. Brian Lane

Layout and Design: Tyler Hogan

Coloring Pages by David W. Taylor

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HOW TO USE THIS CURRICULUM

The main goal of elementary and middle-school science is to create joy in God’s creation and to prepare for next-level courses. Through reading and activities, students will become familiar with terms and processes that will equip them with skills needed for critical thinking in high school. They will understand the importance of a Christian worldview, observe the outside world through the lens of creation, and gain an understanding of a loving God who cares for us so greatly that He has designed life and the world to make sure all our needs are met and to show us the beauty in which we live.

This curriculum is designed for students in grades 4–8. However, it is easy to adjust expectations and adapt activities for younger or older students or to have siblings learn together. You’ll find suggestions for adaptation at the end of this section.

The *Student Reader* contains 32 lessons; each is designed to be completed in about 2–3 hours per week. We recommend splitting each lesson into 4 segments. Of course, this depends on the age and attention span of your students and the number of outside resources you use. If you teach science 4 times a week, plan for about 30–45 minutes each day. You have the freedom to choose what your students should complete in any week, according to your own schedule and plans.

Each lesson contains several components you’ll want to explore each week with your students. You’ll find a **vocabulary** section with words to define and a **Scripture Memory** section to help them hide God’s word in their hearts. Lessons also include a **Creation Corner** to point your students back to the unique creation designed by God for our care and enjoyment, as well as a **Meet the Physicist** section to introduce them to amazing scientists in the field of physics.

The Lab Manual

It is imperative that students use the *Lab Manual* with the *Student Reader*. The *Student Reader* contains information, but the *Lab Manual* reviews and reinforces the lesson material and encourages higher-level thinking as your students apply the information learned. The *Lab Manual* contains everything you'll need for recordkeeping; it provides a place for notes, sketches, research, and following the steps of the scientific method. You can easily adapt the *Lab Manual* to the age level and ability of your students.

Sketching: The goal of sketching is recordkeeping. Scientists frequently sketch and document their findings in their studies, and your students will do this throughout their educational journeys. However, if your students would rather find a picture or take a photo and tape or paste it in the *Lab Manual*, that can take the place of sketching. You're free to make a choice for each activity.

Suggested Daily Guide: A planning guide at the beginning of each lesson in the *Lab Manual* breaks down your week into 4–5 days. We recommend 4 shorter segments divided over a week rather than 1 longer session. The more frequently students are exposed to terms, concepts, and ideas, the easier it will be to retain information long-term.

Materials Needed: Students will need to have sketching tools available for almost every lesson. These include a pencil, colored pencils, a charcoal pencil, markers, etc. Students will also do research in almost every lesson. They'll need access to books, a science encyclopedia, and/or the internet (*with parental guidance*).

A complete list of all additional materials needed for the year is provided at the beginning of the *Lab Manual*. A list of materials is also provided in each lesson. Some of the materials are common items you'll have around your house; others will need to be purchased ahead of time from a science supply store or catalog. All experiments are designed to reinforce important lesson concepts and to prepare students for further study in science. It will be beneficial for you to familiarize yourself with the materials before each lesson.

You may notice that all the measurements in this book use the metric system. However, if you live in the U.S., Liberia, or Myanmar, you may be familiar only with the English or Imperial system. If so, this book is a great opportunity to become familiar with metric measurements! Virtually all scientists use the metric system, and it's important for aspiring scientists to be comfortable working with meters, liters, grams, and degrees Celsius. If your tools at home don't have metric measurements, we've included a conversion table in Appendix A for your convenience.

How to Begin

To begin each new lesson, read the text of the *Student Reader* to your students or have them read it themselves. For very young students, you might read it on your own and then discuss the information at their level.

- Students should write down information they think is important in the **Student Notes** section of the *Lab Manual*. Remember that what they think is important might be different from what you think is important; that's completely acceptable at this age.
- Each lesson includes **Scripture Memory** because learning about God's Word is essential to understanding His character and His plan. Scripture memory cards are also included in the back of the *Lab Manual*. You can print them to aid in memorization or post them in your school area. They can also be used as flash cards for review throughout the school year.
- The **Define It** section of the *Lab Manual* provides a place for students to define the vocabulary words from each lesson.
- The **Write It** section of the *Lab Manual* is a guided review of the lesson's key concepts. Students will define words, answer questions, and sketch diagrams. They can compare what they determined was important when they read the lesson to the material reviewed in this section and add to their notes if needed.
- The **Apply It** section of the *Lab Manual* takes learning to the next level. It includes a variety of activities as well as labs—with an emphasis on following the steps of the scientific method—and a complete, step-by-step guide to writing a lab report (a necessity for high school and college). When students write their conclusions, they can choose which questions to answer; it could be all of the questions provided, some of them, or some of their own. It can be tempting to eliminate these activities to save time; however, we strongly advise using them to prepare for higher-level learning.
- The **Research It** section of the *Lab Manual* allows for further study. Students will use books, encyclopedias, and/or the internet (*with parental guidance*) to learn more about a topic. Younger students can write a couple of sentences or sketch a picture about what they learned. Older students can write 2–3 paragraphs about the researched topic.
- The **Review It** section of the *Lab Manual* provides a **quiz** on odd-numbered weeks and a **crossword puzzle** on even-numbered weeks. In addition, **semester tests** are included after lessons 16 and 32. You can use these components as tests, as another review, or not at all. Each quiz is worth 10 points, and a grade can be calculated by multiplying the number of correct answers by 10. Semester test grades can be calculated by dividing the number of points earned by the number of points possible, then multiplying that answer by 100.

Suggested grading scale:

A = 90–100

B = 80–89

C = 70–79

D = 60–69

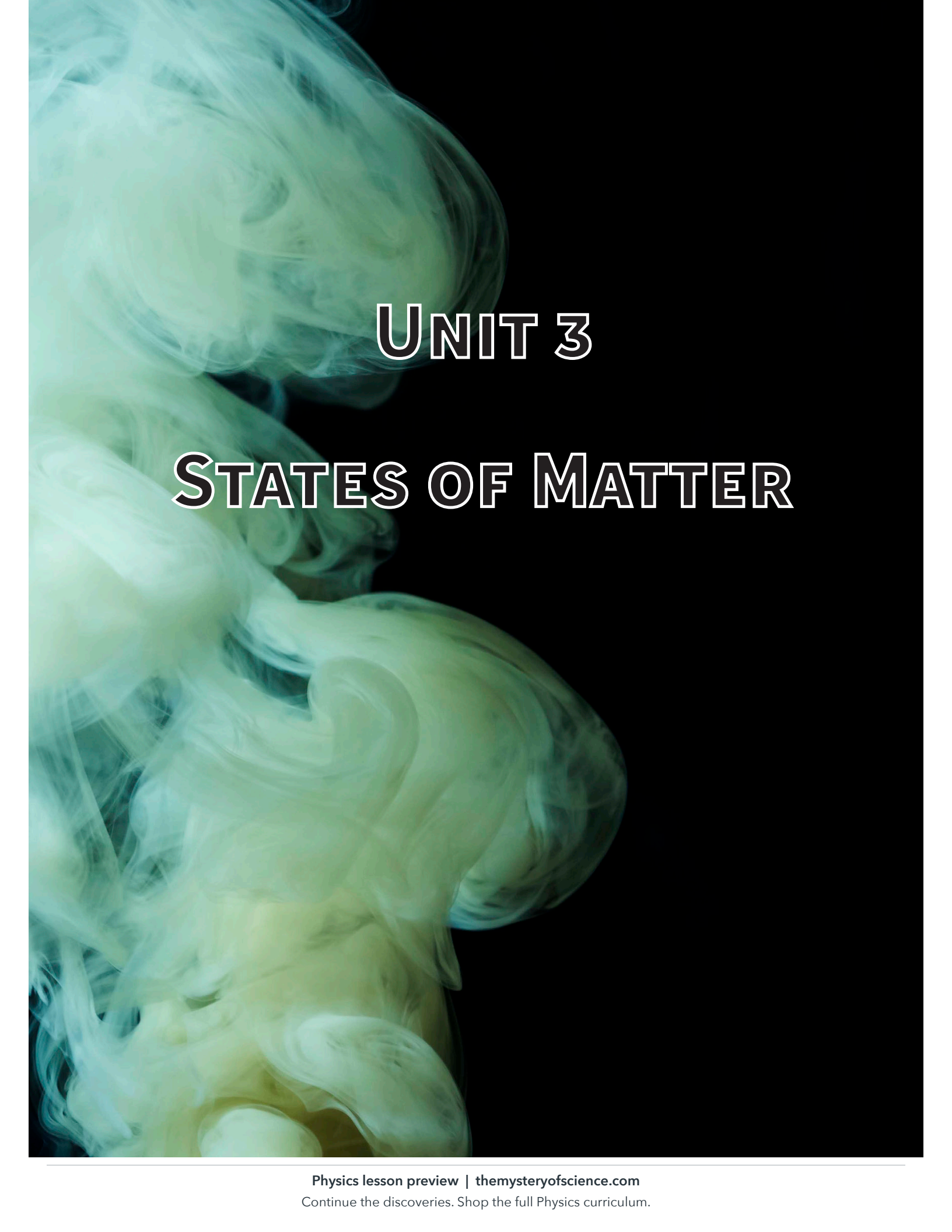
F = 59 and below

- Last, you’ll want to allow time for **outside reading**, perusing pictures, and researching topics of interest. We recommend that students keep track of important information in the blank pages in the back of the *Lab Manual*.

The *Lab Manual* will serve as an excellent reminder and record of what your students have accomplished and learned this year in science! It is also a great way to observe growth in their abilities from year to year.

As with the *Student Reader*, teachers may choose to adapt the *Lab Manual* for students of different ages and abilities. Younger students may answer the “Write It” sections orally, while older students may write their answers in complete sentences. Students of all ages will enjoy the “Apply It” experiments; the lab reports can be adapted as needed. A flexible approach to the curriculum will make learning successful for all ages.

Elementary and middle-school science is about discovery, following the model of other scientists, and taking joy in the journey. Have fun with it yourself, and your enthusiasm will carry over to your students!

The background of the page is a high-quality photograph of a fluid, likely smoke or ink, diffusing in water. The fluid is a pale, translucent green color and is captured in a state of dynamic motion, with intricate, swirling patterns and eddies. The movement is most pronounced on the left side of the frame, where the fluid appears to be rising and billowing upwards. The right side of the frame is mostly black, providing a stark contrast to the vibrant green fluid. The overall effect is one of organic, chaotic beauty, which is a common theme in physics education when discussing fluid mechanics and the states of matter.

UNIT 3

STATES OF MATTER

SLOW SOLIDS AND LIVELY LIQUIDS

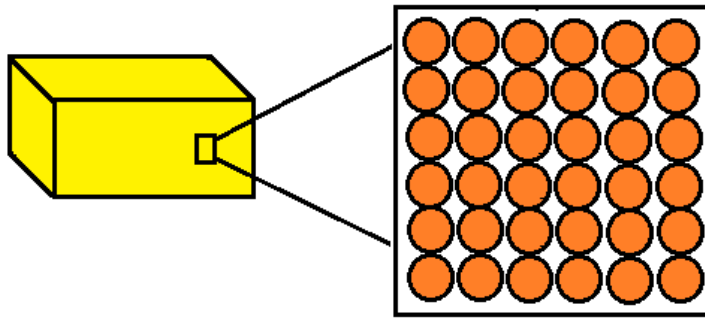
Goal: To understand the differences between solids and liquids based upon their shape, molecular movement, and volume.

Did you know that molecules are in motion? They do not just rest quietly but are always moving around, even if we don't see their motion. Just how much a molecule moves depends on its energy. The more energy it has, the more it moves around. This idea of molecules moving around is very important in understanding the differences between solids and liquids. Do you know the differences? One difference is that the molecules in a liquid move faster than those in a solid.



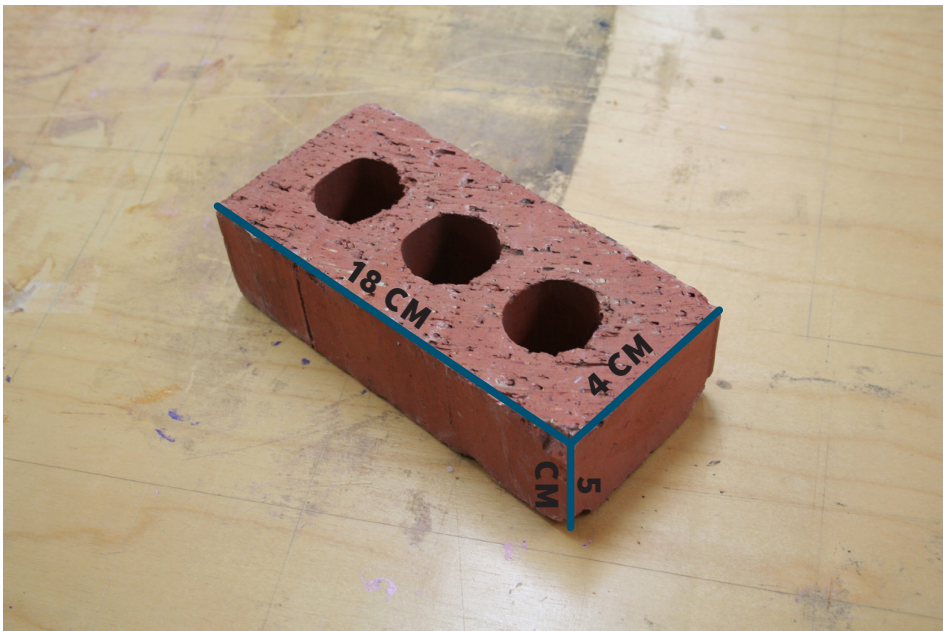
Water is a liquid at room temperature. When it gets cold enough, it becomes a solid; and when it gets hot enough, it becomes a gas.

Any kind of matter that has a definite shape and definite volume is a **solid**. Definite shape means that the shape doesn't change. Consider a piece of gold. It has a definite shape. If it is a piece of jewelry, it may be shaped like a ring. When you place it on your finger, it keeps its shape. A chair, a leaf, and your foot are all solids. There are thousands of examples of solids God created. A solid's molecules move—but so slowly that it keeps its shape.



In a solid, all of the molecules vibrate, but they don't move about. That is what makes a solid keep its shape.

Another important characteristic of solids is that they have definite volume. **Volume** is the amount of space something occupies or how much space there is inside it. Let's think about a brick—the kind you might find in a building or a sidewalk. We can measure its length, width, and height to find its volume.



By multiplying these 3 dimensions, we can figure out the volume: $18\text{ cm} \times 5\text{ cm} \times 4\text{ cm} = 360\text{ cm}^3$.



VOCABULARY

solid
volume
liquid
state of matter



SCRIPTURE MEMORY

John 7:38: "The one who believes in Me, as the Scripture said, 'From his innermost being will flow rivers of living water.'"

The molecules of a **liquid** move much faster than a solid's molecules because liquids have more energy. They have a definite volume that flows freely. One way to identify a liquid is whether it can be poured. The volume of a liquid is definite and can be measured. If you put some water into a measuring cup, you can look at the marks on the side of the cup to see how many milliliters of a liquid you have.

Although a liquid has a definite volume, its shape changes based upon the container it's in. For example, when you pour a glass of water, the water doesn't fall out of the pitcher in a chunk; it takes the shape of your glass. If you pour water into a flower vase, the water takes the shape of the vase. Even though the shape changes, the amount of liquid obviously stays the same.

A **state of matter** is one of the forms in which matter can exist. Matter that is solid is said to be in a solid state. When it is liquid, it is in a liquid state. The difference between states of matter is the amount of energy the molecules have. We know that the molecules in a liquid move much faster than the molecules in a solid, and as we will see in the next lesson, the molecules in gases move even faster.



The volume of this water is approximately 40 ml. If you poured the water into a container with a different shape, its volume would still be the same.

CREATION CORNER

ICE AND WATER

Have you ever walked on a frozen puddle or pond? Normally when a liquid is frozen, the solid it creates is denser than the liquid was. One exception to this rule that shows the incredible forethought of our Creator is water. When water freezes, its solid (ice) is less dense than liquid water. You can imagine the effect of this on our world when you picture what happens when a pond freezes.



If ice were denser than water, it would freeze and then sink to the bottom of the pond, killing pond life with it. Or, depending on the temperature, it would freeze from the bottom up, also killing organisms. An ocean freezing would be even more devastating than a pond, possibly causing worldwide flooding. However, because ice floats in water, it creates insulation, protecting marine life underneath. Ice in the Arctic also provides a place to live for animals like polar bears and seals. Because ice floats, these cold-weather creatures can easily travel across it for miles to find food. The next time you observe ice floating in your cold drink, consider the design our Creator put into why your ice cubes float.

.....

MEET THE PHYSICIST

ROBERT BOYLE (1627–1691)

Robert Boyle was born in Ireland to a very wealthy family. When he was 12, he and his brother began a tour of Europe, including Italy, where Boyle learned of Galileo, whose studies interested him. As an adult, Boyle sold much of his family land, allowing him to focus on his love of science. His greatest contributions to science were his work with gases and the law named after him, Boyle's law. Without this law, scientists would not understand how weather changes due to pressure, how our lungs work, or why our ears pop when we climb a mountain. Boyle also studied the physical qualities of a gas all around us—air—and wrote many books about how matter changes physically into different states. He also wrote extensively about his worldview, explaining that God created the universe according to definite laws.



See the lesson come together.

The Mystery of Science: Physics

Lab Manual - Lesson 8

Slow Solids and Lively Liquids

The following pages show the matching Lab Manual lesson. Use this preview alongside the Student Reader pages to see how the weekly plan, activities, and reviews fit together.

Prefer a printed Lab Manual?

Choose the Reader-and-Manual set, or add a Printed Lab Manual separately. The Student Reader also includes access to the printable digital Lab Manual.

[Explore the Physics Curriculum](#)

Lesson 8: Slow Solids and Lively Liquids

Goal: To understand the differences between solids and liquids based upon their shape, molecular movement, and volume.

Materials Needed

- ☐ measuring cup with metric markings (milliliters or ml) that will measure at least 500 ml
- ☐ 3 rocks approximately the size of ping-pong balls or golf balls
- ☐ water
- ☐ laundry marking pen or crayons

Suggested Daily Guide

Day 1:

- Read through the “Define It” terms and “Write It” questions.
- Read the lesson in your *Student Reader*.
- Work on Scripture memory.

Day 2:

- Read through the lesson again.
- Write the definitions or say them out loud.
- Complete the “Write It” section.
- Work on Scripture memory.

Day 3:

- Complete the “Apply It” section.
- Work on Scripture memory.
- Record the physicist’s information in Appendix B.

Day 4:

- Complete the “Research It” section.
- Work on Scripture memory.
- Complete the “Review It” section.

Scripture Memory

John 7:38: “The one who believes in Me, as the Scripture said, ‘From his innermost being will flow rivers of living water.’”

Write It

Give 5 examples of liquids and 5 examples of solids, remembering our definitions for each.

Liquids

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

Solids

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

.....

Apply It

Lab: Measuring Volume

Materials Needed

- ☐ measuring cup with metric markings (milliliters or ml) that will measure at least 500 ml
- ☐ water
- ☐ 3 rocks approximately the size of ping-pong balls or golf balls
- ☐ laundry marking pen or crayons



Observation and Question

We can easily measure a brick and figure its volume, but not every object is that easy to calculate. For example, a golf ball or any other sphere is round, so we can't use the formula $L \times W \times H$, but it can be calculated using a special formula. What things can you think of that might not be measured so easily? What do you know about a solid's shape?



Hypothesis

If we want to know the volume of something like a rock with an irregular shape, the calculation can get complicated. Even if the shape of the rock is very irregular, it is still a solid and therefore has a definite shape. In this activity, we are going to measure the volume of rocks indirectly as a method of determining the volume of irregularly shaped objects. How do you think this will work?



Experiment

1. Using the crayon or laundry marker, mark each rock with a different letter (*A*, *B*, or *C*).
2. Fill the measuring cup with exactly 300 ml of water.
3. Add the rock marked *A*, then record the measuring cup reading in the “Rock Measurement” table in the “Data and Analysis” section. It is sometimes necessary to interpolate (or read between the lines) when measuring.
4. Remove rock *A*, letting all the water drip back into the measuring cup.
5. Check to be sure the water level returns to the 300 ml mark. If it doesn’t, then carefully add a little more water until it is exactly 300 ml.
6. Repeat using the rocks marked *B*, then *C*.
7. Record the readings in the table.



Data and Analysis

Rock Measurement			
Rock Sample	Water-Level Measurement (without rock)	Water-Level Measurement (with rock)	Volume of Rock Sample <i>(Subtract 300 from the measurement with the rock.)</i>
Rock A	300 ml		
Rock B	300 ml		
Rock C	300 ml		



Conclusion

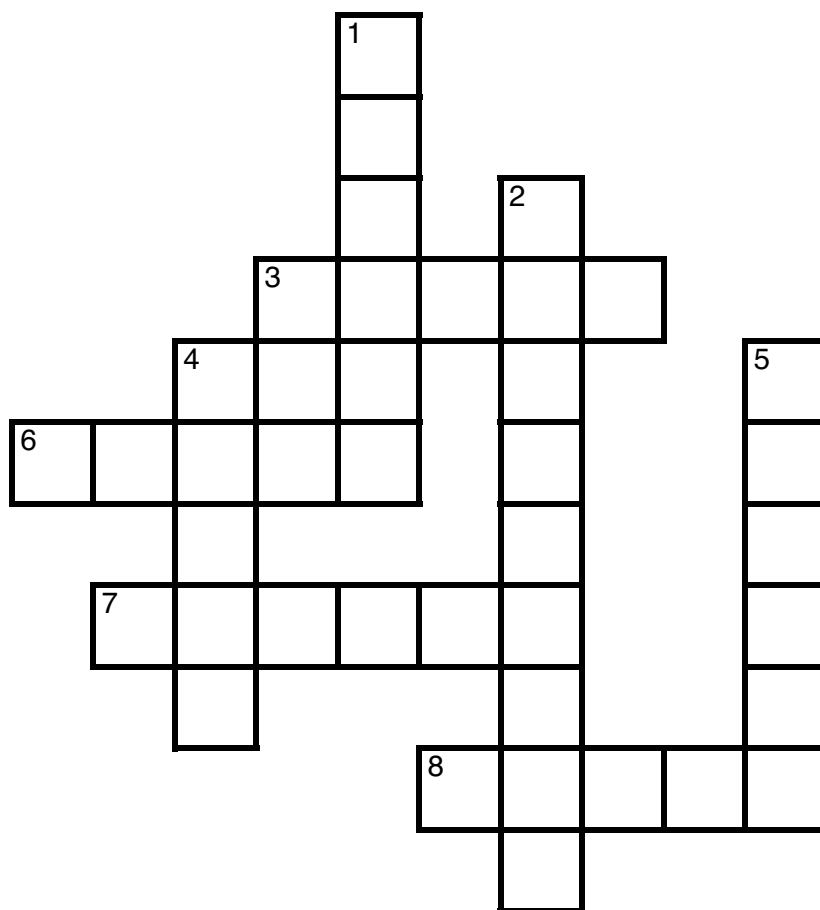
Were you surprised by how easy it is to determine the volume of a solid that has an unusual shape? Could this technique be used to figure out the volume of a person? Explain how you would do that.

Research It

BMI stands for “body mass index.” It is one way for doctors to determine a person’s physical fitness. What is used to determine a person’s BMI? How is this formula different from hydrostatic weighing? Which do you think would be more accurate? Write a short paragraph about your findings.

.....

Review It



Across

3. An ancient measure of length
6. What liquids cannot keep
7. Goes with length and width
8. The state with the least energy

Down

1. What a solid definitely has
2. What happens with the molecules of a solid
4. A liquid we drink to survive
5. Always takes the shape of its container

Less time preparing. More time discovering.

If this lesson sparked curiosity, keep it growing. The full Physics course gives you a plan to follow so science can become a regular part of your homeschool week.

Continue with Physics

32 colorful lessons to keep discovery going. The Student Reader includes access to the printable digital Lab Manual.

The Lab Manual organizes your weekly plan, activities, and reviews. A Printed Lab Manual is available separately or as part of the set.

1 Choose your course

Choose Physics for your next science course.

2 Follow the plan

Use the weekly guide and gather lab materials.

3 Discover together

Help your child explore God's creation.

Explore the Physics Curriculum

Printable Lab Manual access included with the Reader. Printed manual optional.
Experiment supplies not included.

Still deciding? Keep learning with Karri.

Join Teaching the Curiosities of Creation for practical ideas each month to teach science with more confidence, curiosity, and less preparation.

Get monthly teaching ideas at [themysteryofscience.com](https://www.themysteryofscience.com)

Created by Karri Iverson, homeschool mom of five and science educator.