



Properties of Matter



God's Design® for Chemistry & Ecology is a complete chemistry and ecology curriculum for grades 3–8. The books in this series are designed for use in the Christian school and homeschool, and provide easy-to-use lessons that will encourage children to see God's hand in everything around them.

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Welcome to GOD'S DESIGN®

CHEMISTRY & ECOLOGY



You are about to start an exciting series of lessons on chemistry and ecology. *God's Design® for Chemistry & Ecology* consists of three books: *Properties of Atoms & Molecules*, *Properties of Matter*, and *Properties of Ecosystems*. Each of these books will give you insight into how God designed and created our world and the universe in which we live.

No matter what grade you are in, third through eighth grade, you can use this book.

3rd–5th grade

Read the lesson.



Do the activity in the light blue box (worksheets will be provided by your teacher).



Test your knowledge by answering the **What did we learn?** questions.



Assess your understanding by answering the **Taking it further** questions.

Be sure to read the special features and do the final project.

There are also unit quizzes and a final test to take.

6th–8th grade

Read the lesson.



Do the activity in the light blue box (worksheets will be provided by your teacher).



Test your knowledge by answering the **What did we learn?** questions.



Assess your understanding by answering the **Taking it further** questions.



Do the Challenge section in the light green box. This part of the lesson will challenge you to do more advanced activities and learn additional interesting information.

Be sure to read the special features and do the final project.

There are also unit quizzes and a final test to take.

When you truly understand how God has designed everything in our universe to work together, then you will enjoy the world around you even more. So let's get started!

UNIT 1

Experimental Science

1 Introduction to Experimental Science • 8

2 The Scientific Method • 11

3 Tools of Science • 15

4 The Metric System • 20

- ◇ Describe how the scientific method is used to study the world.
- ◇ Distinguish between qualitative and quantitative observations.
- ◇ Identify the proper tools and units used for measuring different properties of matter.



1

Introduction to Experimental Science

Learning about matter



How do scientists conduct experiments?

Words to know:

matter experiment

Challenge words:

operational science naturalism
origins science

Do you want to learn about science? I

hope so. Science can be very exciting. Why do you want to learn about science? Maybe you really like animals and want to learn more about them, or maybe you want to be an astronaut or an engineer and you know you need to learn a lot about science to do those jobs. Biology, astronomy, and physics are important parts of science. But this is a chemistry book, so why should you want to learn about chemistry?

Chemistry is the study of the material around you and how it reacts with other material. Scientists call this material matter. **Matter** is anything that

has mass and takes up space. Understanding what matter is and how it acts in different conditions is important to every other area of science. You need to understand chemistry to understand how plants and animals grow. You need to understand chemistry to understand what stars are and how they produce light. You need to understand chemistry to know how to build a computer, too. You even need to understand how one material reacts with another material to make a new recipe for dinner. So you can see that chemistry affects every area of your life.

So how do we learn about matter? One of the best ways to learn about matter is by conducting experiments. An **experiment** is a controlled test to see what happens in a certain situation. You will get to do lots of experiments in this book. Experiments will teach you what works, what doesn't work, and give you ideas of what to try next time.

Before you begin an experiment, you need to know the purpose: what are you trying to learn? You also need to know what you expect to happen. You can then design an experiment to test what you think will happen and see if you are right. Does this sound like fun? It is! So let's get started with your first experiment. ✨

What did we learn?

- What is matter?
- What do chemists study?
- What is an experiment?

Taking it further

- Why is it important to study chemistry?
- What are two things you need to know before conducting an experiment?

Chemistry is fun

Different kinds of matter act differently even under the same conditions because they have different properties. Today we are going to look at how well different types of matter conduct heat. If something is a good conductor of heat, it gets hot very quickly when it is near something hot. You might need to use pot holders to carry something that is a good conductor of heat. Something that is not a good heat conductor stays cooler for a longer period of time when it is near something hot. Most pot holders are made out of a thick cloth because cloth is not a good heat conductor. In the following experiment, you will test various substances such as wood, plastic, and metal to see which are the best conductors of heat.

Purpose: To understand how to conduct an experiment in a scientific manner

Materials: metal spoon, wooden spoon, plastic ruler, pencil, butter knife, butter, large cup, hot water, stopwatch, “Conducting Heat Experiment” worksheet

Procedure:

1. Think about what you know about different materials such as metal, glass, and wood. Which ones do you think conduct heat the best? Which ones do not conduct heat well? Place a metal spoon, a wooden spoon, a plastic ruler, a pencil, and a butter knife in order of which ones

you think would conduct heat the fastest to the slowest. Write these items on your worksheet.

2. Smear a small amount of cold butter on the end of each item.
3. Place the items, buttered end up, in a large cup.
4. Fill the cup with hot water; be sure that the butter is not in the water.
5. Use a stopwatch to time how long it takes for the butter on each object to begin to melt. Record this time on your worksheet.
6. Compare your results with your predictions.

Questions:

- Did the butter melt fastest on the item you expected to conduct the heat the best?
- Which items actually conducted heat the best? Which ones conducted heat the slowest?

Conclusion: By using your knowledge to make good predictions, following a careful plan, and checking your results, you learned about the heat conductive abilities of several materials. You will learn more about how to conduct experiments when you learn about the scientific method in the next lesson.

Operational science vs. origins science

You just learned that chemistry is the study of how different materials react with each other. This is a form of observational science. You can observe what happens when you do an experiment. Observational sciences is what you normally think of as science. A scientist can measure how far away a star is. A scientist can cross-pollinate two plants and observe what

kind of flowers or fruit they produce. Scientists test the strength of new metals or measure how much energy is in a particular sample of coal. Observational or **operational science** can be repeated and reproduced by other scientists. This is an important part of discovering how things work.

However, there is an area of science that is not observable. This area of science tries to answer

questions about the past, such as where all of the matter and energy in the universe came from. This area of science is often called **origins science** or historical science. Origins science does not deal with repeatable experiments like observational science does. Origins science looks at what we see today and tries to explain how it got here.

There are basically two views of origins. One view says there is a powerful God who created everything we see. The other view says there is no God, but only what we are able to see. This view is called **naturalism** and only accepts explanations of origins that exclude any supernatural being.

Experiments cannot be used to prove the ideas of origins. We cannot go back in time and observe the universe before there were planets. We cannot observe matter being created. In fact, all of the experiments that have been conducted in the past have shown that matter cannot be created or destroyed. This has been shown by so many experiments that it is called a scientific law. Because questions of origin cannot be tested or repeated, these areas must be accepted on faith. Either God created everything, or nature is all there is and everything developed by random, natural processes. God is the only eyewitness to creation and He has revealed in His Word that He created everything in six days (Genesis 1; Exodus 20:11).

It is important to recognize when someone is talking about operational science or origins science. When you read about scientific discoveries, you need to ask questions that will help you decide if it is observational science or origins science. Here are a few questions to help you get started in evaluating scientific claims.

1. What is this scientist claiming? What is the purpose of his investigation?
2. Is this claim based on experimentation that can be repeated, or is it trying to explain something that may have happened in the past?
3. What assumptions is the scientist making?
4. Does this claim contradict what the Bible says?

If a scientist claims to be able to show how something happened in the past, he is not dealing with observational science, but is dealing with origins

science. This is the area where creationists and evolutionists often disagree. If a scientist claims to be able to show how something works today, then she is dealing with observational science, and others can test this claim to prove whether it is true.

Below are several scientific claims. Ask yourself the questions above and try to determine if each claim represents observational or origins science.

1. The bones of an ancient ape-like creature show the evolution of man.
2. Carbon nanotubes have great potential in electronics because of their semiconducting properties.
3. The rocks in this area are millions of years old.

The first claim is origins science. The scientist observes some bones. He sees that the bones are similar to apes that can be observed today. But the scientist has not done, nor can he do, any experiments to show how that creature evolved into another creature. The scientist is making assumptions about what the bones show without supporting experimentation. The claim contradicts the Bible's claim that God created man.

The second claim is observational science. The semiconducting properties of carbon nanotubes can be tested. Whether this potential is ever fulfilled remains to be seen, but the properties can be tested today, so this is observational science.

The age of the rocks may appear to be observational science as well. Scientists perform many tests to try and determine the age of a rock. However, these tests only give them relative amounts of elements in the rocks. The ages they assign to rocks is their interpretation of the evidence. These tests rely on assumptions that are not always true; therefore, the scientists get unreliable answers. Because this claim contradicts the Bible, it is worth investigating further. You can find more information about rock dating by going to the God's Design for Science Online Resource Page at answersingenesis.org/go/godsdesignlinks.

The theory of evolution deals with origins and is not operational science. Be a wise scientist and ask questions to help you understand the claims of other scientists.