



Properties of
Matter
Teacher Supplement



God's Design® for Chemistry & Ecology
Properties of Matter Teacher Supplement

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Book designer: Diane King

Editors: Gary Vaterlaus

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Welcome to GOD'S DESIGN®

CHEMISTRY & ECOLOGY



God's Design for Chemistry & Ecology is a series that has been designed for use in teaching chemistry and ecology to elementary and middle school students. It is divided into three books: *Properties of Matter*, *Properties of Atoms and Molecules*, and *Properties of Ecosystems*. Each book has 35 lessons including a final project that ties all of the lessons together.

In addition to the lessons, special features in each book include biographical information on interesting people as well as fun facts to make the subject more fun.

Although this is a complete curriculum, the information included here is just a beginning, so please feel free to add to each lesson as you see fit. A resource guide is included in the appendices to help you find additional information and resources. A list of supplies needed is included at the beginning of each lesson, while a master list of all supplies needed for the entire series can be found in the appendices.

Why Teach Chemistry & Ecology?

Maybe you hate science or you just hate teaching it. Maybe you love science but don't quite know how to teach it to your children. Maybe science just doesn't seem as important as some of those other subjects you need to teach. Maybe you need a little moti-

vation. Answer keys for all review questions, worksheets, quizzes, and the final exam are included here. Reproducible student worksheets and tests may be found in the digital download that comes with the purchase of the curriculum. You may download these files from GodsDesign.com/ChemistryEcology.

If you prefer the files on a CD-ROM, you can order that from Answers in Genesis at an additional cost by calling 800-778-3390.

If you wish to get through all three books of the *Chemistry & Ecology* series in one year, you should plan on covering approximately three lessons per week. The time required for each lesson varies depending on how much additional information you want to include, but you can plan on about 45 minutes per lesson.

If you wish to cover the material in more depth, you may add additional information and take a longer period of time to cover all the material or you could choose to do only one or two of the books in the series as a unit study.

If any of these descriptions fits you, then please consider the following.

It is not uncommon to question the need to teach your kids hands-on science in elementary school. We could argue that the knowledge gained in science will

be needed later in life in order for your children to be more productive and well-rounded adults. We could argue that teaching your children science also teaches them logical and inductive thinking and reasoning skills, which are tools they will need to be more successful. We could argue that science is a necessity in this technological world in which we live. While all of these arguments are true, not one of them is the real reason that we should teach our children science. The most important reason to teach science in elementary school is to give your children an understanding that God is our Creator, and the Bible can be trusted. Teaching science from a creation perspective is one of the best ways to reinforce your children's faith in God and to help them counter the evolutionary propaganda they face every day.

God is the Master Creator of everything. His handiwork is all around us. Our Great Creator put in place all of the laws of physics, biology, and chemistry. These laws were put here for us to see His wisdom and power. In science, we see the hand of God at work more than in any other subject. Romans 1:20 says, "For since the creation of the world His invisible attributes are clearly seen, being understood by the things that are made, even

His eternal power and Godhead, so that they [men] are without excuse." We need to help our children see God as Creator of the world around them so they will be able to recognize God and follow Him.

The study of chemistry helps us understand and appreciate the amazing way everything God created works together. The study of atoms and molecules and how different substances react with each other reveals an amazing design, even at the smallest level of life. Understanding the carbon, nitrogen, and water cycles helps our children see that God has a plan to keep everything working together. Learning about ecosystems reveals God's genius in nature.

It's fun to teach chemistry and ecology! It's interesting too. The elements of chemistry are all around us. Children naturally like to combine things to see what will happen. You just need to direct their curiosity.

Finally, teaching chemistry is easy. You won't have to try to find strange materials for experiments or do dangerous things to learn about chemistry. Chemistry is as close as your kitchen or your own body, and ecosystems are just outside your door.

How Do I Teach Science?

In order to teach any subject you need to understand how people learn. People learn in different ways. Most people, and children in particular, have a dominant or preferred learning style in which they absorb and retain information more easily.

If a student's dominant style is:

Auditory
He needs not only to hear the information but he needs to hear himself say it. This child needs oral presentation as well as oral drill and repetition.
Visual
She needs things she can see. This child responds well to flashcards, pictures, charts, models, etc.
Kinesthetic
He needs active participation. This child remembers best through games, hands-on activities, experiments, and field trips.

Also, some people are more relational while others are more analytical. The relational student needs to know why this subject is important, and how it will affect him personally. The analytical student, however, wants just the facts.

If you are trying to teach more than one student, you will probably have to deal with more than one learning style. Therefore, you need to present your lessons in several different ways so that each student can grasp and retain the information.

Grades 3–8

The first part of each lesson should be completed by all upper elementary and junior high students. This is the main part of the lesson containing a reading section, a hands-on activity that reinforces the ideas in the reading section (blue box), and a review section that provides review questions and application questions.

Grades 6–8

In addition, for middle school/junior high age students, we provide a "Challenge" section that contains

more challenging material as well as additional activities and projects for older students (green box).

We have included periodic biographies to help your students appreciate the great men and women who have gone before us in the field of science.

We suggest a threefold approach to each lesson:

Introduce the topic

We give a brief description of the facts. Frequently you will want to add more information than the essentials given in this book. In addition to reading this section aloud (or having older children read it on their own), you may wish to do one or more of the following:

- Read a related book with your students.
- Write things down to help your visual learners.
- Give some history of the subject. We provide some historical sketches to help you, but you may want to add more.
- Ask questions to get your students thinking about the subject.

Make observations and do experiments

- Hands-on projects are suggested for each lesson. This part of each lesson may require help from the teacher.
- Have your students perform the activity by themselves whenever possible.

Review

- The “What did we learn?” section has review questions.
- The “Taking it further” section encourages students to
 - Draw conclusions
 - Make applications of what was learned
 - Add extended information to what was covered in the lesson
- The “FUN FACT” section adds fun or interesting information.

By teaching all three parts of the lesson, you will be presenting the material in a way that children with any learning style can both relate to and remember.

Also, this approach relates directly to the scientific method and will help your students think more scientifically. The *scientific method* is just a way to examine a subject logically and learn from it. Briefly, the steps of the scientific method are:

1. Learn about a topic.
2. Ask a question.
3. Make a hypothesis (a good guess).
4. Design an experiment to test your hypothesis.
5. Observe the experiment and collect data.
6. Draw conclusions. (Does the data support your hypothesis?)

Note: It’s okay to have a “wrong hypothesis.” That’s how we learn. Be sure to help your students understand why they sometimes get a different result than expected.

Our lessons will help your students begin to approach problems in a logical, scientific way.

How Do I Teach Creation vs. Evolution?

We are constantly bombarded by evolutionary ideas about the earth in books, movies, museums, and even commercials. These raise many questions: Is a living being just a collection of chemicals? Did life begin as a random combination of chemicals? Can life be recreated in a laboratory? What does the chemical evidence tell us about the earth? The Bible answers these

questions, and this book accepts the historical accuracy of the Bible as written. We believe this is the only way we can teach our children to trust that everything God says is true.

There are five common views of the origins of life and the age of the earth:

Historical biblical account	Progressive creation	Gap theory	Theistic evolution	Naturalistic evolution
Each day of creation in Genesis is a normal day of about 24 hours in length, in which God created everything that exists. The earth is only thousands of years old, as determined by the genealogies in the Bible.	The idea that God created various creatures to replace other creatures that died out over millions of years. Each of the days in Genesis represents a long period of time (day-age view) and the earth is billions of years old.	The idea that there was a long, long time between what happened in Genesis 1:1 and what happened in Genesis 1:2. During this time, the “fossil record” was supposed to have formed, and millions of years of earth history supposedly passed.	The idea that God used the process of evolution over millions of years (involving struggle and death) to bring about what we see today.	The view that there is no God and evolution of all life forms happened by purely naturalistic processes over billions of years.

Any theory that tries to combine the evolutionary time frame with creation presupposes that death entered the world before Adam sinned, which contradicts what God has said in His Word. The view that the earth (and its “fossil record”) is hundreds of millions of years old damages the gospel message. God’s completed creation was “very good” at the end of the sixth day (Genesis 1:31). Death entered this perfect paradise *after* Adam disobeyed God’s command. It was the punishment for Adam’s sin (Genesis 2:16–17; 3:19; Romans 5:12–19). Thorns appeared when God cursed the ground because of Adam’s sin (Genesis 3:18).

The first animal death occurred when God killed at least one animal, shedding its blood, to make clothes for Adam and Eve (Genesis 3:21). If the earth’s “fossil record” (filled with death, disease, and thorns) formed over millions of years before Adam appeared

(and before he sinned), then death no longer would be the penalty for sin. Death, the “last enemy” (1 Corinthians 15:26), diseases (such as cancer), and thorns would instead be part of the original creation that God labeled “very good.” No, it is clear that the “fossil record” formed sometime *after* Adam sinned—not many millions of years before. Most fossils were formed as a result of the worldwide Genesis Flood.

When viewed from a biblical perspective, the scientific evidence clearly supports a recent creation by God, and not naturalistic evolution and millions of years. The volume of evidence supporting the biblical creation account is substantial and cannot be adequately covered in this book. If you would like more information on this topic, please see the resource guide in the appendices. To help get you started, just a few examples of evidence supporting biblical creation are given below:

Evolutionary Myth: Life evolved from non-life when chemicals randomly combined together to produce amino acids and then proteins that produced living cells.

The Truth: The chemical requirements for DNA and proteins to line up just right to create life could not have happened through purely natural processes. The process of converting DNA information into proteins requires at least 75 different protein molecules. But each and every one of these 75 proteins must be synthesized in the first place by the process in which they themselves are involved. How could the process begin without the presence of all the necessary proteins? Could all 75 proteins have arisen by chance in just the right place at just the right time? Dr. Gary Parker says this is like the chicken and the egg problem. The obvious conclusion is that both the DNA and proteins must have been functional from the beginning, otherwise life could not exist. The best explanation for the existence of these proteins and DNA is that God created them.

Gary Parker, *Creation: Facts of Life* (Master Books, 2006), pp. 20–43.

Evolutionary Myth: Stanley Miller created life in a test tube, thus demonstrating that the early earth had the conditions necessary for life to begin.

The Truth: Although Miller was able to create amino acids from raw chemicals in his famous experiment, he did not create anything close to life or even the ingredients of life. There are four main problems with Miller's experiment. First, he left out oxygen because he knew that oxygen corrodes and destroys amino acids very quickly. However, rocks found in every layer of the earth indicate that oxygen has always been a part of the earth's atmosphere. Second, Miller included ammonia gas and methane gas. Ammonia gas would not have been present in any large quantities because it would have been dissolved in the oceans. And there is no indication in any of the rock layers that methane has ever been a part of the earth's atmosphere. Third, Miller used a spark of electricity to cause the amino acids to form, simulating lightning. However, this spark more quickly destroyed the amino acids than built them up, so to keep the amino acids from being destroyed, Miller used specially designed equipment to siphon off the amino acids before they could be destroyed. This is not what would have happened in nature. And finally, although Miller did produce amino acids, they were not the kinds of amino acids that are needed for life as we know it. Most of the acids were ones that actually break down proteins, not build them up.

Mike Riddle, "Can Natural Processes Explain the Origin of Life," in *The New Answers Book 2*, Ken Ham, ed. (Master Books, 2008). See also www.answersingenesis.org/go/origin.

Evolutionary Myth: Living creatures are just a collection of chemicals.

The Truth: It is true that cells are made of specific chemicals. However, a dead animal is made of the same chemicals as it was when it was living, but it cannot become alive again. What makes the chemicals into a living creature is the result of the organization of the substances, not just the substances themselves. Dr. Parker again uses an example. An airplane is made up of millions of non-flying parts; however, it can fly because of the design and organization of those parts. Similarly, plants and animals are alive because God created the chemicals in a specific way for them to be able to live. A collection of all the right parts is not life.

Evolutionary Myth: Chemical evidence points to an earth that is billions of years old.

The Truth: Much of the chemical evidence actually points to a young earth. For example, radioactive decay in the earth's crust produces helium atoms that rise to the surface and enter the atmosphere. Assuming that the rate of helium production has always been constant (an evolutionary assumption), the maximum age for the atmosphere could only be 2 million years.¹ This is much younger than the 4+ billion years claimed by evolutionists. And there are many ideas that could explain the presence of helium that would indicate a much younger age than 2 million years. Similarly, salt accumulates in the ocean over time. Evolutionists claim that life evolved in a salty ocean 3–4 billion years ago. If this were true and the salt has continued to accumulate over billions of years, the ocean would be too salty for anything to live in by now. Using the most conservative possible values (those that would give the oldest possible age for the oceans), scientists have calculated that the ocean must be less than 62 million years. That number is based on the assumption that nothing has affected the rate at which the salt is accumulating. However, the Genesis Flood would have drastically altered the amount of salt in the ocean, dissolving much sodium from land rocks.² Thus, the chemical evidence does not support an earth that is billions of years old.

¹ Don DeYoung, *Thousands...not billions* (Master Books, 2005).

² John D. Morris, *The Young Earth* (Master Books, 2007), pp. 83–87. See also www.answersingenesis.org/go/salty.

Despite the claims of many scientists, if you examine the evidence objectively, it is obvious that evolution and millions of years have not been proven. You can be confident that if you teach that what the Bible says is true, you won't go wrong. Instill in your student a confidence in the truth of the Bible in all areas. If scientific thought seems to contradict the Bible, realize that scientists often make mistakes, but God does not lie. At

one time scientists believed that the earth was the center of the universe, that living things could spring from non-living things, and that blood-letting was good for the body. All of these were believed to be scientific facts but have since been disproved, but the Word of God remains true. If we use modern "science" to interpret the Bible, what will happen to our faith in God's Word when scientists change their theories yet again?

Integrating the Seven C's

The Seven C's is a framework in which all of history, and the future to come, can be placed. As we go through our daily routines we may not understand how the details of life connect with the truth that we find in the Bible. This is also the case for students. When discussing the importance of the Bible you may find yourself telling students that the Bible is relevant in everyday activities. But how do we help the younger generation see that? The Seven C's are intended to help.

The Seven C's can be used to develop a biblical worldview in students, young or old. Much more than entertaining stories and religious teachings, the Bible has real connections to our everyday life. It may be hard, at first, to see how many connections there are, but with practice, the daily relevance of God's Word will come alive. Let's look at the Seven C's of History and how each can be connected to what the students are learning.



Creation

God perfectly created the heavens, the earth, and all that is in them in six normal-length days around 6,000 years ago.

This teaching is foundational to a biblical worldview and can be put into the context of any subject. In science, the amazing design that we see in nature—whether in the veins of a leaf or the complexity of your hand—is all the handiwork of God. Virtually all of the lessons in *God's Design for Science* can be related to God's creation of the heavens and earth.

Other contexts include:

Natural laws—any discussion of a law of nature naturally leads to God's creative power.

DNA and information—the information in every living thing was created by God's supreme intelligence.

Mathematics—the laws of mathematics reflect the order of the Creator.

Biological diversity—the distinct kinds of animals that we see were created during the Creation Week, not as products of evolution.

Art—the creativity of man is demonstrated through various art forms.

History—all time scales can be compared to the biblical time scale extending back about 6,000 years.

Ecology—God has called mankind to act as stewards over His creation.



Corruption

After God completed His perfect creation, Adam disobeyed God by eating the forbidden fruit. As a result, sin and death entered the world, and the world has been in decay since that time. This point is evident throughout the world that we live in. The struggle for survival in animals, the death of loved ones, and the violence all around us are all examples of the corrupting influence of sin.

Other contexts include:

Genetics—the mutations that lead to diseases, cancer, and variation within populations are the result of corruption.

Biological relationships—predators and parasites result from corruption.

History—wars and struggles between mankind, exemplified in the account of Cain and Abel, are a result of sin.



Catastrophe

God was grieved by the wickedness of mankind and judged this wickedness with a global Flood. The Flood covered the entire surface of the earth and killed all air-breathing creatures that were not aboard the Ark. The eight people and the animals aboard the Ark replenished the earth after God delivered them from the catastrophe.

The catastrophe described in the Bible would naturally leave behind much evidence. The studies of geology and of the biological diversity of animals on the planet are two of the most obvious applications of this event. Much of scientific understanding is based on how a scientist views the events of the Genesis Flood.

Other contexts include:

Biological diversity—all of the birds, mammals, and other air-breathing animals have populated the earth from the original kinds which left the Ark.

Geology—the layers of sedimentary rock seen in roadcuts, canyons, and other geologic features are testaments to the global Flood.

Geography—features like mountains, valleys, and plains were formed as the floodwaters receded.

Physics—rainbows are a perennial sign of God's faithfulness and His pledge to never flood the entire earth again.

Fossils—Most fossils are a result of the Flood rapidly burying plants and animals.

Plate tectonics—the rapid movement of the earth's plates likely accompanied the Flood.

Global warming/Ice Age—both of these items are likely a result of the activity of the Flood. The warming we are experiencing today has been present since the peak of the Ice Age (with variations over time).



Confusion

God commanded Noah and his descendants to spread across the earth.

The refusal to obey this command and the building of the tower at Babel caused God to judge this sin. The common language of the people was confused and they spread across the globe as groups with a common language. All people are truly of "one blood" as descendants of Noah and, originally, Adam.

The confusion of the languages led people to scatter across the globe. As people settled in new areas, the traits they carried with them became concentrated in those populations. Traits like dark skin were beneficial in the tropics while other traits benefited populations in northern climates, and distinct people groups, not races, developed.

Other contexts include:

Genetics—the study of human DNA has shown that there is little difference in the genetic makeup of the so-called "races."

Languages—there are about seventy language groups from which all modern languages have developed.

Archaeology—the presence of common building structures, like pyramids, around the world confirms the biblical account.

Literature—recorded and oral records tell of similar events relating to the Flood and the dispersion at Babel.



Christ

God did not leave mankind without a way to be redeemed from its sinful state. The Law was given to Moses to show how far away man is from God's standard of perfection. Rather than the sacrifices, which only covered sins, people needed a Savior to take away their sin. This was accomplished when Jesus Christ came to earth to live a perfect life and, by that obedience, was able to be the sacrifice to satisfy God's wrath for all who believe.

The deity of Christ and the amazing plan that was set forth before the foundation of the earth is the core of Christian doctrine. The earthly life of Jesus was the fulfillment of many prophecies and confirms the truthfulness of the Bible. His miracles and presence in human form demonstrate that God is both intimately concerned with His creation and able to control it in an absolute way.

Other contexts include:

Psychology—popular secular psychology teaches of the inherent goodness of man, but Christ has lived the only perfect life. Mankind needs a Savior to redeem it from its unrighteousness.

Biology—Christ's virgin birth demonstrates God's sovereignty over nature.

Physics—turning the water into wine and the feeding of the five thousand demonstrate Christ's deity and His sovereignty over nature.

History—time is marked (in the western world) based on the birth of Christ despite current efforts to change the meaning.

Art—much art is based on the life of Christ and many of the masters are known for these depictions, whether on canvas or in music.



Cross

Because God is perfectly just and holy, He must punish sin. The sinless life of Jesus Christ was offered as a substitutionary sacrifice for all of those who will repent and put their faith in the Savior. After His death on the Cross, He defeated death by rising on the third day and is now seated at the right hand of God.

The events surrounding the Crucifixion and Resurrection have a most significant place in the life of Christians. Though there is no way to scientifically prove the Resurrection, there is likewise no way to prove the stories of evolutionary history. These are matters of faith founded in the truth of God's Word and His character. The eyewitness testimony of over 500 people and the written Word of God provide the basis for our belief.

Other contexts include:

Biology—the biological details of the Crucifixion can be studied alongside the anatomy of the human body.

History—the use of Crucifixion as a method of punishment was short-lived in historical terms and not known at the time it was prophesied.

Art—the Crucifixion and Resurrection have inspired many wonderful works of art.



Consummation

God, in His great mercy, has promised that He will restore the earth to its original state—a world without death, suffering, war, and disease. The corruption introduced by Adam's sin will be removed. Those who have repented and put their trust in the completed work of Christ on the Cross will experience life in this new heaven and earth. We will be able to enjoy and worship God forever in a perfect place.

This future event is a little more difficult to connect with academic subjects. However, the hope of a life in God's presence and in the absence of sin can be inserted in discussions of human conflict, disease, suffering, and sin in general.

Other contexts include:

History—in discussions of war or human conflict the coming age offers hope.

Biology—the violent struggle for life seen in the predator-prey relationships will no longer taint the earth.

Medicine—while we struggle to find cures for diseases and alleviate the suffering of those enduring the effects of the Curse, we ultimately place our hope in the healing that will come in the eternal state.

The preceding examples are given to provide ideas for integrating the Seven C's of History into a broad range of curriculum activities. We would recommend that you give your students, and yourself, a better understanding of the Seven C's framework by using AiG's *Answers for Kids* curriculum. The first seven lessons of this curriculum cover the Seven C's and will establish a solid understanding of the true history, and future, of the universe. Full lesson plans, activities, and student resources are provided in the curriculum set.

We also offer bookmarks displaying the Seven C's and a wall chart. These can be used as visual cues for the students to help them recall the information and integrate new learning into its proper place in a biblical worldview.

Even if you use other curricula, you can still incorporate the Seven C's teaching into those. Using this approach will help students make firm connections between biblical events and every aspect of the world around them, and they will begin to develop a truly biblical worldview and not just add pieces of the Bible to what they learn in "the real world."

Experimental Science

1

Introduction to Experimental Science

Learning about Matter

Supply list

Wooden spoon	Butter knife
Metal spoon	Large cup hot water
Ruler	Butter or margarine
Pencil	Stopwatch
Copy of "Conducting Heat Experiment" worksheet	

What did we learn?

- What is matter? **Anything that has mass and takes up space.**

- What do chemists study? **They study the way matter reacts with other matter and the environment.**
- What is an experiment? **A controlled test.**

Taking it further

- Why is it important to study chemistry? **Chemistry is important to every other area of science.**
- What are two things you need to know before conducting an experiment? **The purpose and what you expect to happen.**

2

The Scientific Method

How do scientists do it?

Supply list

3 empty plastic bottles	Molasses
Masking tape	3 identical balloons
Yeast	Thermometer
Marker	Measuring cup and spoons
Sugar	
Cloth tape measure or string	
Copy of "Scientific Method" worksheet	

Scientific Method worksheet

- **Taste, color, and texture are all affected by the sweetener used, so even if molasses produces the most gas, you may not like the way it makes your bread taste or look.**

What did we learn?

- What is the overall job of a scientist? **To systematically study the physical world.**
- What are some areas that cannot be studied by science? **Morality, religion, philosophy, history.**
- What are the five steps of the scientific method? **Learn or observe, ask a question, make a hypothesis, design and perform a test, check the results, and draw conclusions.**

Taking it further

- Why was it necessary to have bottle number 1 in the experiment? **Bottle 1 had only water and yeast. This is called a control. It shows how much gas was produced without a sweetener, so you can tell exactly how much**