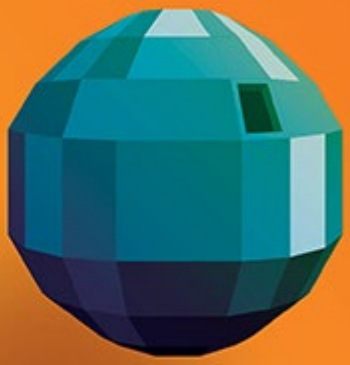


UNIT 1

THE STRUCTURE OF MATTER

CHAPTER 1

Modeling our Orderly World

SUPER SLEUTHING SCIENTISTS

Drops of blood under the table, beige powder dusting the countertop, and a footprint in the front hall. Each of these raises multiple questions for the forensic scientist. Whose footprint is that? What is that beige powder? Whose blood is that? Is this evidence related to the crime? What other trace evidence can I find?

Forensic scientists collect evidence and conduct investigations to determine what occurred during a crime. Their task is most difficult when there are no witnesses. Forensic scientists may gather evidence at the crime scene or analyze data in a lab or on computers. Whatever their task, they must be observant so that they don't overlook evidence. They must be meticulous in handling the evidence. They conduct tests and experiments to determine the evidence's significance. Finally, they come to conclusions about evidence, helping the police arrest the perpetrator of a crime.

The culmination of the forensic scientists' work occurs in the courtroom. They present their findings and provide expert opinions about what the evidence means. They have to be both accurate and precise in their testimony. They must be well spoken and have the ability to present their findings. Every day forensic scientists use scientific inquiry to see that justice is served.

1A | ORDER IN OUR WORLD

What is the source of order in nature?

1A Questions

- How does physical science relate to other sciences?
- What are some evidences of order in the world around us?
- Why is there order in our world?
- How can we use science to glorify God and help others?
- How can scientists make ethical decisions?

1A Terms

science, physical science, chemistry, physics, Creation Mandate, ethics

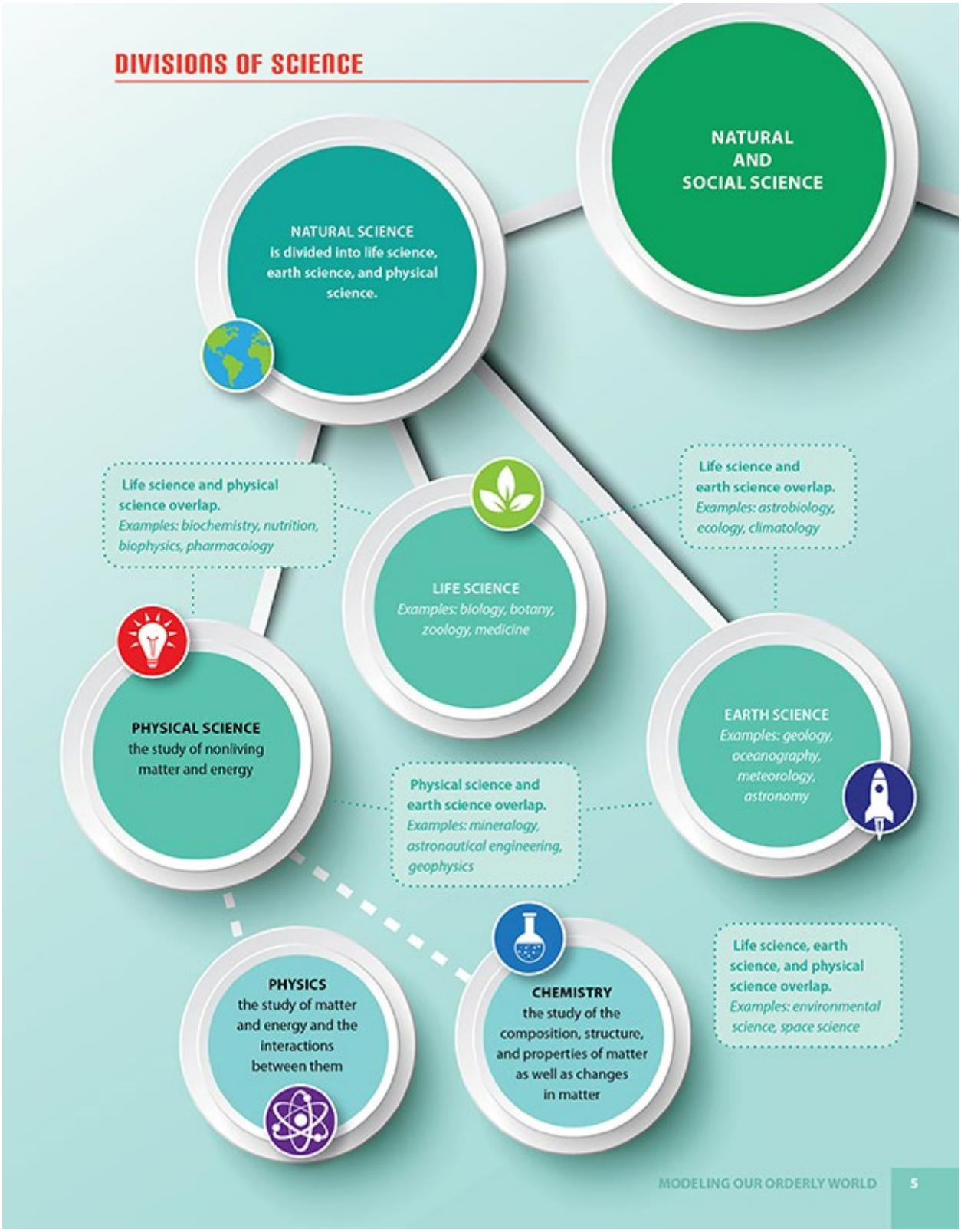
1.1 PHYSICAL SCIENCE

In the Chapter opener, you saw how forensic scientists are always asking and answering questions. This constant questioning is not something that only forensic scientists do. It is a characteristic of all scientists.

Scientists spend their careers asking questions and investigating events or facts called *phenomena* (s. phenomenon). They do this in an attempt to explain or describe the world around them. Some do this because they are naturally curious and want to learn as much as they can about the world around them. Others have a desire to use what they have learned to help other people. No matter their motivation, they all do science. But what *is* science?

Science is the systematic study of the universe to produce observations, inferences, and models. It also includes the products created through this systematic study. Science is initially divided into social science, the study of human societies and relationships, and natural science, the study of the natural world. We further divide natural science into numerous different fields. While we organize and describe these fields of study as if they were completely isolated from each other, they actually are very much interrelated.

DIVISIONS OF SCIENCE



1.2 WHY IS ORDER IMPORTANT?

Why can we study the universe systematically? If phenomena were completely random, we would have to accept just watching events happen, but investigating them would be impossible. However, our world is orderly, and order allows us to study the events that occur.

Evidence of Order

As we wake up each morning, the periodic changes of day into night, days into weeks, weeks into months, and months into years remind us of the order in nature. The cycles that we know as seasons have been guiding farmers in the planting and harvesting of crops since Creation. We see order in the repeated patterns of the chemical and physical properties of elements.

Order in the natural world is so evident that scientists even imitate it. Chemists arrange the elements in a *periodic table* by the repeated patterns in the structure and properties of those elements. Biologists have developed a system for classifying living organisms. This classification system uses the order found in nature to categorize the different species. Order is what allows us to do science successfully.

Result of Order

Watching something random, like the movement of flames in a campfire or raindrops on a pond, may be exciting and even entertaining. But if there is no pattern to the events, then we cannot identify causes, and we certainly cannot make predictions about these events. However, since order is a built-in part of the world in which we live, we can do science. With enough observations, we can even begin to make predictions about future events on the basis of the patterns that we have observed.

One key principle that allows us to study science is the *law of cause and effect*. This law states that every effect has a specific, identifiable cause, and for every cause, there is a definite and predictable effect. We can sum up the law this way: everything happens for a reason; nothing just happens. Therefore, scientists know that they can investigate a particular phenomenon to determine its cause. Similarly, after sufficient investigation, the scientist should be able to predict the effect of a given cause.

Another important aspect of our world is the *principle of uniformity* of nature. This principle declares that nature acts the same today as it did yesterday and that we can fully expect it to act the same way tomorrow. The uniformity in nature is what allows us to make predictions in science. But even the characteristics of uniformity and predictability had to be caused by something or someone.

Source of Order

Where does this order come from? Nothing left to itself becomes more orderly than it was before. According to the law of cause and effect, the *effect* of order in the universe had to be the result of a specific, identifiable *cause*.

Genesis 1 outlines the creation of the universe. God created all things out of nothing. The universe that He created is a reflection of His very nature. When He completed His creative work on Day 6, He evaluated everything and declared that everything was good (Gen. 1:31). Some will ask, didn't *God* need a cause? Remember, however, that the law of cause and effect relates to everything *in our world*. As mentioned in Genesis 1:1, God existed before the world He created and is therefore outside of it. And God created the universe with order because He is a God of order.

1.3 WHY WE DO SCIENCE

Order in nature allows us to do science, but what makes it worthwhile? The answer to this question depends on your understanding of the world. We all view the world on the basis of assumptions we have about the world. This is called our *worldview*. As you can imagine, every decision we make is affected by our worldview.

There are many divergent worldviews, some religious and others secular. People who hold to secularism are not necessarily atheistic. Secularists simply believe that we should exclude religious beliefs from the public sphere of discourse.

Secular scientists believe that they can explain the universe and all that is in it by solely naturalistic means. There is no room for the supernatural. According to their worldview, everything began from nothing in the big bang and slowly formed over billions of years. Man is the product of evolutionary changes driven by natural selection over millions of years. Man's purpose is to understand the world around him to help him improve his life.

People with a religious worldview see the world through the lens of the teaching of a particular teacher or text. Christians develop their worldview from the teaching of the Bible. According to a biblical worldview, the world is relatively young and is the product of Creation as outlined in Genesis 1. God created the universe and all that is in it from nothing and for His good pleasure. Everything was created to glorify God. People are a special creation—made in His image.

SERVING AS A FORENSIC SCIENTIST: SILENT WITNESS

Forensic anthropologist Clea Koff has given a voice to the victims of genocide around the world when entire populations have been murdered with no witnesses. There is often no justice in cases of genocide because it is carried out during civil wars or by the dominant group in a region. Fear of the dominant group often causes these cases to go unreported. Even when reports surface, few witnesses are available or willing to testify. In these situations, teams of forensic scientists from the United Nations get involved.

Clea Koff used the remains in mass graves in Rwanda and Yugoslavia to build cases for genocide in those countries. After concluding her work there, Koff turned her attention to the United States. She used her anthropology skills to help families of missing persons. She also founded the Missing Person Identification Resource Center in Los Angeles.

Crime is a fact of life in a fallen world. Through forensic anthropology, Clea Koff has helped others find closure after loved ones had disappeared.

An artist involved in forensic anthropology works on 3D facial reconstruction.

A Christian's purpose in science is the same as his purpose in life. We were created to love and glorify God (Ps. 86:9; Matt. 22:37) and to serve others (Matt. 22:39). In fulfilling our purpose in life, we can accomplish a crucial aspect of a biblical worldview—redemption. Creation was very good, but man damaged it by introducing sin into the world at the Fall. Each of us needs personal redemption, the forgiveness of our sins. But our thinking also needs to be redeemed (Rom. 12:2), as does the physical world (Rom. 8:22), because every aspect of the Creation was adversely affected by the Fall.

Our purpose in life and science stems from the Creation Mandate. The **Creation Mandate** (Gen. 1:26, 28) directs us to fill the earth and have dominion over it. God's command to humans is to exercise wise and good dominion over His creation for the glory of God and the benefit of their fellow humans. How can we accomplish this as scientists?

We do this by studying and caring for God's creation. We observe and then replicate in our models and understanding of nature the order created by God. We use science to meet the needs of other people, God's image bearers. We imitate God's creative work through inventing and engineering products to benefit people. All that we do in science should honor and glorify God while caring for His creation.

1.4 SCIENCE AND ETHICS

Scientists don't work in isolation; the science they do affects people around the world. As we do science, we must decide what is right and wrong. These decisions can become complicated very quickly. While science can tell us that a person's brain is not working, it cannot tell us whether we should disconnect the person from life support. So how do we decide whether a particular use of science is right or wrong?

What we are talking about is **ethics**—a system of moral values or a theory of proper conduct. Our worldview plays a key role in making ethical decisions. Christian ethics should be based on the three-element foundation of *biblical principles*, *biblical outcomes*, and *biblical motivations*.

Biblical Principles

God created the world and everything in it. He created man as His special creation and gave us His Word to guide our lives. While the Bible doesn't specifically address everything that we might face in life, His Word gives us enough guidance to make right decisions. God tells us what is good and evil. By studying Scripture, we can understand general principles that we can use in all situations. So the first thing that we should ask when we encounter an ethical issue is, "*What does God's Word say?*" The three biblical principles that lead to right thinking are people as God's image bearers, the Creation Mandate, and God's whole truth.

Biblical Outcomes

We also must think about what we want to achieve. God tells us in the Bible the goals that He has for us. Ethical decisions must include striving for right outcomes. A second question we must ask when faced with making an ethical decision is, "*What results are right?*" Clear goals follow from the biblical outcomes of human prospering, a thriving creation, and glorifying God.

Biblical Motivations

When God saves us, He intends for us to be changed to be more like Him. We better reflect His image as we grow. A Christian should do right because it contributes to his growth, not just because the rules tell him to or because he wants good results. A Christian should want to be more like the Lord. So the third and most important question is, "*How can I grow through this decision?*" Three biblical motivations follow from Scripture: faith in God, hope in God's promises, and love for God and others.

So how should a Christian make ethical decisions?

BIBLICAL PRINCIPLES

What does God's Word say?

God's Image Bearers. Foundational to our ethical decision-making is the understanding that we all bear God's image. Therefore, we must make decisions out of respect for all people and for their protection (Gen. 1:26–28).

Creation Mandate. God's first commandment to us is to have dominion over the world that He created. Therefore, we must wisely care for God's creation. We must balance the appropriate use of the world's resources with the needs of people around the world. Nothing belongs to us; we are stewards of God's world (Gen. 1:26–28).

God's Whole Truth. God's image in people and the Creation Mandate touch on many ethical issues. But other parts of Scripture also give us helpful insights into what God wants us to do. Part of making wise ethical decisions requires that we understand what His Word teaches. We cannot live any part of our lives separated from God and His Word (2 Tim. 3:15–16).

BIBLICAL OUTCOMES

What results are right?

Human Prospering. As soon as God created mankind, He blessed him (Gen. 1:28). Throughout Scripture (Ps. 1; Matt. 5), we see that God's desire is for all people to be blessed and to prosper. Jesus came to give us life and to have us live that life abundantly (John 10:10). Our ethical decisions must align with God's will to maximize human development.

A Thriving Creation. Part of our obligation to the Creation Mandate is to ensure that creation thrives (Gen. 1:28; 2:5, 15). We wisely use and develop the earth's resources to ensure that it flourishes.

Glorifying God. Just as Jesus came to glorify God, everything we do should glorify God (Matt. 5:16; 1 Cor. 6:20; 10:31). Our decisions should show God that we love and honor Him. This obligation includes every aspect of our lives: school, work, and play. So it is not enough that our decisions help others or that creation thrives. Our decisions must always give God the honor that He is due.

BIBLICAL MOTIVATIONS

How can I grow through this decision?

Faith in God. The Bible discusses works versus faith (Jam. 2:14–26). The passage concludes that we are to live out our faith in God through our works. We are motivated to act because of our faith in God. Good works can stem only from our faith in God (Rom. 14:23; Heb. 11:6).

Hope in God's Promises. In the Bible, hope is not something that we wish for; it is something that God has promised. Biblical hope is confident expectation. The promises of God allow us to take action without fear (2 Tim. 1:7–9). Scripture teaches us that God can never lie, so we can act with the assurance that God will follow through on His promises.

Love for God and Others. As stated in 1 Corinthians 13, our greatest motivation for doing right is love. We have the love of God in us, and we do right when we are motivated by our love for God and our love for others. John 13:34–35 teaches that love is the outward sign of a transformed life.

1A | REVIEW QUESTIONS

1. Define *science* in your own words.
2. Graphically display the relationship between social science, natural science, physical science, chemistry, and physics.
3. Give an example of orderliness in nature.
4. Why does order imply a Creator?
5. What is the Creation Mandate?
6. Give two examples to show how we can fulfill the Creation Mandate.
7. Define *ethics*.
8. What are the three questions that guide Christians in making ethical decisions?

1B | MODELING OUR WORLD

How do scientists do science?

1B Questions

- Why are models important in physical science?
- What models are important in physical science?
- How do hypotheses, theories, and laws compare?
- How do we do science?
- Why do we approach science systematically?

1B Terms

model, theory, law, workability, scientific inquiry, hypothesis

1.5 MODELING IN SCIENCE

As we mentioned, scientists seek to explain or describe the world around them. Scientists use models to help them do this. A **model** is a workable explanation or description of a phenomenon. A model may be physical, conceptual, or mathematical.

Two major categories of models in science are theories and laws. A **theory** is a model that *explains* a related set of phenomena. It can be used to predict unobserved aspects of the phenomena. On the other hand, a model, often expressed as a mathematical equation that *describes* phenomena under certain conditions, is called a **law**. It does not attempt to explain the phenomena.

So what is the benefit of using a model? Models allow scientists to focus on a particular portion of the world around them. A model helps them understand and communicate their understanding of the phenomenon being studied.

Types of Models

Because of the complexity of physical systems, scientists use various models in physical science. Physical models are quite common, including atomic models, models of waves, models for the behavior of gases, ball and stick models of molecules, and scale models of vehicles. Conceptual models can take as many forms as there are scientists. Scientists typically use conceptual models for thinking about ideal systems. Mathematical models show up everywhere in physical science. They include equations or computer modeling (virtual models) of weather, atmospheric changes, water flow, or any computer simulation.