BIOLOGY FROM A CHRISTIAN WORLDVIEW

Devotional BIOLOGY

Learning to Worship the Creator of Organisms

KURT P. WISE, PHD

Biology from a
CHRISTIAN WORLDVIEW

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COMPASS classroom

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A NOTE TO TEACHERS

This text can be used in two ways. It can be read as a stand-alone book, or it can be used as a textbook alongside the Devotional Biology video curriculum taught by Dr. Kurt Wise (available for purchase at CompassClassroom.com).

A Unique Course

It is important for teachers familiar with traditional biology textbooks to realize this book is different.

It was written to look first at Christian theology as found in the Bible. It then applies that theology to what we see in living organisms. Finally, it examines what that means to how we live our lives. Each chapter will start with a section on God and His attributes, move into the scientific material, then end with a discussion about our responsibility to the creation.

The book also follows a different structure in terms of *when* certain topics are covered as well as *which* major topics are covered.

Finally, this book introduces many concepts that are simply not found in traditional biology textbooks. Many of these concepts are enlightening, but some can be a bit complex to understand on a first reading.

It is okay if a student does not comprehend everything: the goal of this class is to expand the way students think about God and His creation. Both are exceedingly complex. It is not a bad thing to struggle to understand; this is often where learning occurs.

Using Devotional Biology Video Lectures

If you are going to use this book with the video series, there are two ways to approach the material. You are welcome to try both to see which works better with your particular student:

1. Some students do better by watching the video lesson first, then reading the associated text.
2. Others may want to read the text first, then watch the associated video.

Either way, it could be useful to repeat the video or the text if a concept is difficult to grasp. This will help long-term retention, as well.

As you look over the Table of Contents, you will notice a small "play" symbol with a number after different sections, such as: "Creation and Revelation [▸ 1.1]."

This means Devotional Biology Video 1.1 "God Desires to be Known" is associated with the textbook section starting at "Creation and Revelation" and continuing until the [▸ 1.2] appears. You would thus stop reading when you reach the next symbol and number in the text, such as "Origin of Modern Science [▸ 1.2]." This section is associated with Video 1.2 "Christian Foundation of Science and Biology."

Please note that the video titles are not always the same as the chapter sections because some video segments cover multiple chapter sections. As you are taking the class, simply ensure you are matching the video numbers such as 1.1, 5.3, or 14.2 to the markers [▸ 1.1], [▸ 5.3], or [▸ 14.2].

Advanced Discussion Topics And Test Questions

If you purchased the Devotional Biology video curriculum, look for a Teacher's Guide that provides a scope and sequence for scheduling the class as well as answers to Test Questions. (The Teacher's Guide is also available at CompassClassroom.com.)

You will find Advanced Discussion Topics at the end of most chapters, and Test & Essay Questions at the end of every chapter.. Both of these sections were originally written for teachers using the textbook in a classroom environment. If, however, you would like to work from these lists, they could be incorporated in part or in whole as a discussion between parent and child, or as student projects.

Glossary and Index

Effort has been taken to enable the student and teacher to quickly locate key terms throughout the text. Definitions of terms appear in the margins as you read. Key terms have been collected in a Glossary at the end of the book.

Lab Manual and Lab Materials

Dr. Kurt Wise has written fourteen lab exercises to accompany Devotional Biology. These enhance the curriculum and provide one full credit for a high school lab science.

Purchase the available Devotional Biology Lab Materials and Lab Manual from CompassClassroom.com. Lab Materials include a microscope, DNA model kit, chromosome simulation kit, labware, microscopic slides, chemicals, and tools.

Questions?

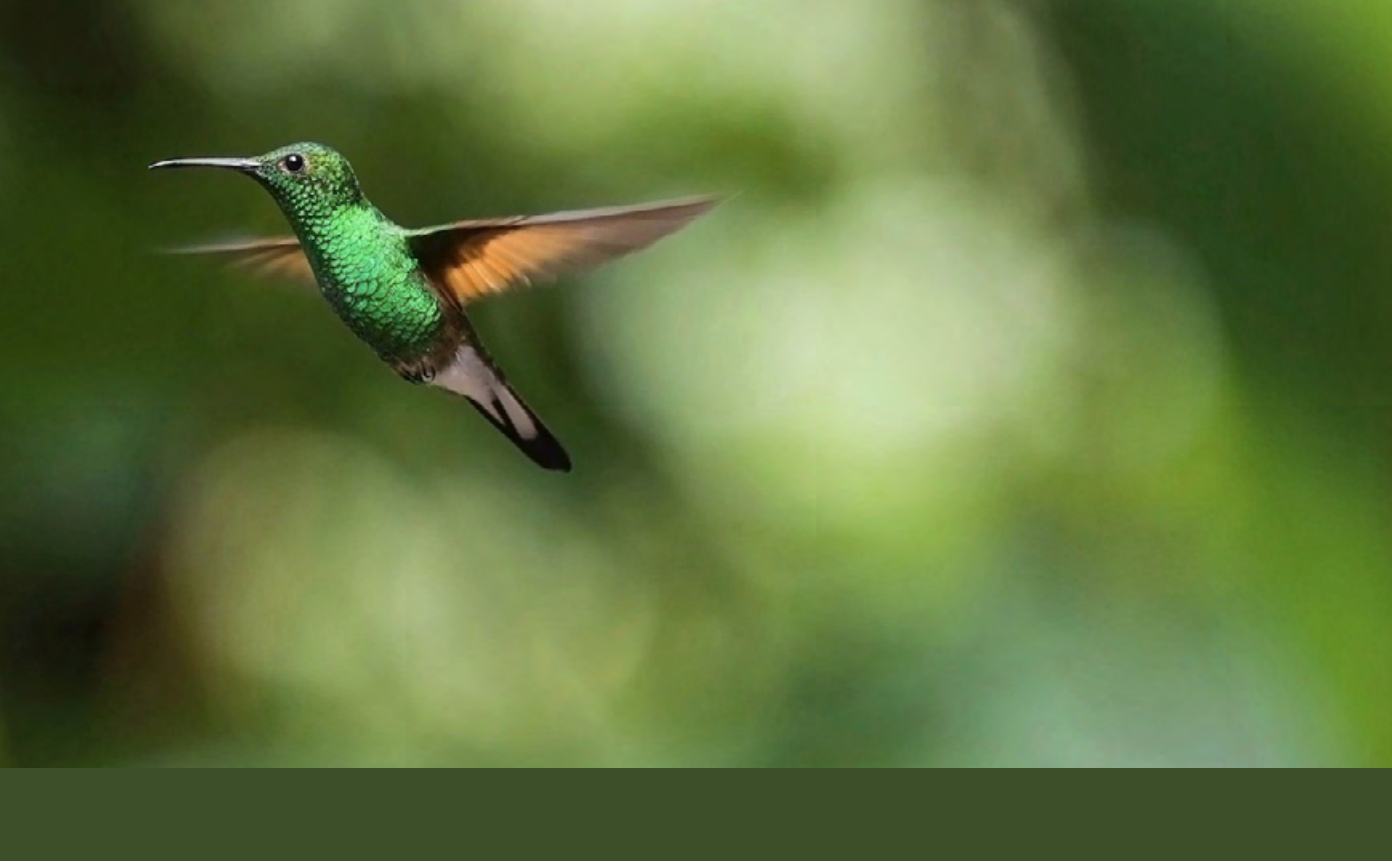
Visit us at CompassClassroom.com for support by joining our Devotional Biology group or through our email help system.

ACKNOWLEDGMENTS

Innumerable people and sources have contributed to the concepts, ideas, and even words of this text. Teachers and mentors, student peers and students of mine, textbooks and reference works, popular works and primary literature—I have borrowed from them all.

Perhaps nothing has taught me more about biology than the challenge of teaching college biology to hundreds of students over two decades before attempting this work. Then, as the first draft of this text was composed and subsequent editions were drafted, numerous students have functioned as guinea pigs in the development of the text. Their comments, tears, test answers, and groans have all made their mark on these pages. Then there are the near-whole-text reviewers in both theology and biology who devoted such a large chunk of their time and attention pouring over early versions of the text. They include (in the order of their review) Gregg Allison, Tom Hennigan, Brad Reynolds, Gordon Wilson, Joe Francis, Stephanie Hartz, and Leonard Brand. Many others reviewed smaller sections of the text.

As valuable as these many contributions have been, they should only be blamed for whatever might be good about the text. The shortcomings of the volume are, of course, entirely my fault.



INTRODUCTION

Why This Biology Text is Unique

“For in six days the Lord made heaven and earth, the sea, and all that is in them, and rested on the seventh day.”

Exodus 20:11, ESV

If you are a Christian and a student, this text has been designed for you. If you are typical of such students, you probably do not even like science, but must take a science class to fulfill the requirements of your academic program.

In fact, it is likely that you do not really know why a course like this is required. It may also be true that you chose Biology because it was the least undesirable of the science courses available. I pray that this text will convince you of the value of such a course. Even more, I hope that by the end of this course you even come to like science...at least a little!

0.1 | Christian Theism vs. Naturalism

Most college biology texts are written from the perspective of **naturalism**—the belief that only physical things[a] exist[b]. Since such a perspective or belief affects a person's view or understanding of all things—including the world—it is a **worldview**.

naturalism—a worldview that accepts the existence of only physical things (vs. Christian theism)

worldview—a person's perspective (set of beliefs) that colors or influences the way that person interprets everything that person perceives (e.g. naturalism; Christian theism)

Naturalism is more specifically the naturalistic worldview, or the worldview of naturalism[c]. According to naturalism there is no God, there are no angels, and nothing non-physical exists, such as soul, spirit, good, evil, or even purpose. Naturalism accepts the existence of only that which can be detected directly by human senses[d].

a Physical things are temporary, destructible things that can be detected in some way by our senses (touch, sight, smell, taste, or hearing) or by an enhancement of our senses (through microscopes and telescopes, rockets and satellites, amplifiers, etc.). Physical things not only include things made of matter (that takes up space and weighs something in the presence of gravity), but also includes physical energy (such as light), space, and physical time.

b Technically, there are two different types of naturalism. The belief that the physical is all that exists is known as 'philosophical naturalism', whereas the practice of studying the physical world as if the physical was all that exists (even if one believes non-physical things are real) is known as 'methodological naturalism'. However, whether the physical world is studied from philosophical or methodological naturalism, the description and explanation that results (*i.e.*, the science) is the same—a naturalistic description that excludes the non-physical. Consequently, this text will refer to both forms of naturalism by the simpler term 'naturalism' and apply to that term the definition of philosophical naturalism.

c Although a person who believes in naturalism is called a naturalist, the word 'naturalist' can also refer to a person who merely focuses his or her study on the physical things in the environment, without regard to a particular belief about whether non-physical things also exist. Because of this ambiguity in meaning, we will avoid the use of the term 'naturalist' and refer instead to 'naturalism' or 'naturalistic worldview'—both of which are unambiguously referring to the *worldview* of naturalism. Also, since philosophical naturalism accepts the existence of only physical or material things, it is sometimes referred to as physicalism or materialism. Unfortunately, 'materialism' more commonly refers to a desire to amass material things and 'materialist' to a person who hoards or strives to acquire material things. To avoid misunderstandings which might arise from the use of such terms this text will not refer to materialism, materialists, or the materialistic worldview.

d Included among things that can be detected directly by human senses would be those things that cannot be detected with unaided senses but must be detected by means of one or more of thousands of different physical

The author of this text accepts the existence of God, so this text adopts a theistic perspective. Then, among the various theistic worldviews that exist, the author not only accepts the existence of God, but more specifically the existence of the God described in the Bible. Consequently, the worldview of this text is **Christian theism** (or the worldview of biblical theism as opposed to the worldview of naturalism)[a].

Christian theism—a worldview that begins with the existence of the Christian God, Creator of the physical world and its organisms as well as the non-physical world and its non-physical beings

Biblical theism believes in one triune God Who defines good and evil, provides purpose, and created both the spirit world (*e.g.* angels, souls, spirits) *and* the physical world (*e.g.* the universe, astronomical objects, the earth, organisms). I pray that this text will nurture your own biblical worldview and preserve you from any and all non-biblical worldviews you may encounter in the future.

Holism vs. Reductionism

Most college biology texts are also written from the perspective of reductionism—a logical consequence of naturalism. To understand something completely, a person who believes in naturalism does not believe he needs to consider purpose, or an unseen God, or in soul or spirit (because he does not believe any of these things exist).

reductionism—a perspective that seeks to understand something by looking at its component parts (vs. holism)

atom—an electrically neutral arrangement of proton(s) and an equal number of orbiting electrons(s)

molecule—atoms bound together by covalent bonds

cell—tiny, membrane-bound structures that make up all organisms; smallest unit of biological life

Since naturalism believes nothing exists beyond the physical, it should be possible to understand something completely by taking it apart and understanding its physical parts and how they fit together (*i.e.* 'the whole is the sum of its parts'). This belief is called **reductionism** and the perspective is reductionistic.

devices we have designed to amplify or extend our senses (such as microscopes, telescopes, magnetometers, seismometers, Geiger counters, infra-red cameras, x-ray machines, *etc.*, *etc.*).

a Note that although naturalism is the most common worldview found in biology textbooks, it is not the only worldview alternative to Christian or biblical theism. Many other alternative worldviews are advocated around the world, and each provides an alternative worldview of biology. As an example, many environmental activists almost deify organisms, seeming to believe that humans have done so much damage as to be considered an evil. Another category of increasingly popular worldviews in the West are the transcendental worldviews. These worldviews are closer to an exact opposite of the naturalistic worldview, for they focus on the non-physical, tending to deny entirely the existence of the physical world. With all their diversity, what all of these alternative worldviews have in common is that each was designed to challenge the worldview that God wishes us to adopt. Naturalism, for example, denies the biblical claims of the existence of God, the creation of organisms, and the special status of humans. Other worldviews deny these biblical truths or others—such as the personhood of God, the existence of the physical world, or the goodness of matter. Although this text contrasts biblical theism with naturalism, it does so only because naturalism is the most common alternative to biblical theism in biology, not because it is the only worldview out there. The student is encouraged to embrace a biblical worldview and beware of *all* false alternatives (not just naturalism).

Most biology texts are written from the perspective of naturalism, and thus tend to adopt a reductionistic perspective. Consequently, it is common for most biology texts to arrange their chapters from small things (the *micro*) to large things (the *macro*)—in a stepwise fashion dealing with **atoms** then **molecules**, **cells**, **organs**, **organisms**, and finally ecosystems.

The author of this text not only explicitly rejects naturalism, he also explicitly rejects reductionism, believing instead that the creation contains **emergent properties** (those that cannot be explained by the parts that make it up). He also believes that **life** cannot be understood without considering divine intent, or the 'big picture'. He believes that the biblical perspective is **holistic**, not reductionistic.

The Bible begins with God ("In the beginning God…"), then relates the creation of all things (Genesis chapter one), then relates God's interaction with mankind in general (Genesis 2-11), then with a chosen people group, and finally to us individually. The author believes a holistic perspective of biology is the proper one. He also believes it is a better teaching strategy to begin the study of biology with things you as a student are already familiar with—like the critters and plants themselves.

Consequently, the chapters in this text begin with the macro and deal with the micro when it is most appropriate to do so—namely when it actually does help understand the whole. This text starts with organisms and deals with molecules along the way. As a side benefit, the

organ—biological system of tissues in multi-cellular organisms; make up organ systems in large organisms

organism—an animal, plant, or single-celled life form

emergent properties—properties of an entity unaccounted for by the entity's component parts

life—non-physical source of vitality. Different types of life: divine life is part of the natural essence of God and creature life is created by God in spirit beings and organisms; biblical life is possessed by God, spirit beings, and living humans and animals; nephesh life is possessed by living humans and animals; biological life is possessed by all organisms.

holism—a perspective that seeks to understand something by looking at its larger context, and discovers more to something than is accounted for by a sum of its parts (vs. reductionism)

large-to-small approach is opposite that of the reductionist approach, so it implicitly reinforces a (holistic) biblical worldview[a].

Young-Age Creation vs. Evolution

Since a person who believes in naturalism rejects a creator God, he or she believes everything came into being without help (*i.e.* spontaneously or 'naturally'), changing—'evolving'—from previously existing physical things[b]. With a naturalistic worldview perspective, a person has no choice but to believe that everything came to be by some sort of **naturalistic evolution**—the idea that all physical things originate by spontaneous or natural change from previously existing physical things[c].

evolution, naturalistic—the belief that all things originate by spontaneous or natural change from previously existing physical things (vs. young-age creationism)

According to naturalistic evolution, life has been developing over billions of years, it has always been subject to **natural evil** (degenerative aging, animal **death**, suffering), and the diversity of human languages has been developed over thousands of years, and there never was a global flood on this planet.

natural evil—anything in the physical world that causes suffering of humans or animals

death, biblical—cessation of biological life in animals & humans as an evil-minimizing effect of the curse

However, since the God of the Bible is the Creator of all things (Ex. 20:11; Col. 1:16), the author accepts creationism[d] rather than evolutionism (*i.e.* he is a creationist, rather than an evolutionist, and

a Because there is no external organizer in naturalistic evolution, in many cases evolutionary theory also operates from the micro to the macro. Typically, subatomic particles are formed first, then atoms, and then molecules. Molecules are formed before cells, and single-celled organisms are formed before multi-celled organisms, organisms before species, and species before communities. Pursuing a macro-to-micro course also implicitly argues against naturalistic evolution.

b In naturalism this was true up until recent times. Because of the naturalistic belief that everything arose from previously existing physical things, most naturalists from the time of Aristotle to the middle of the 20th Century believed that the physical universe has always existed—that it did not have a beginning. Naturalists consistently believed that everything physical came from something physical that preceded it. It is only with the extraordinary success of the big bang theory in the 1960's that naturalists reluctantly accepted that the universe itself had to have had a beginning. Not only is this original belief of biblical theism a rather recent belief of science, but it stands as a substantial challenge to the naturalistic worldview.

c Many variations on evolution have been proposed, including forms of theistic evolution that involve God helping or accelerating the physical transformations. Since biology is dominated by naturalism, the dominant form of evolution in biology is naturalistic evolution, where physical changes are unaided, and are thus spontaneous or 'natural'. Consequently, the text will contrast creationism with *naturalistic* evolution. Unless otherwise indicated, when the text uses the word 'evolution' it is referring to naturalistic evolution, not any of the various forms of theistic evolution that have been proposed over the years.

d For philosophical clarity, note that 'creation' and 'evolution', 'creationism' and 'evolutionism', and 'creationist' and 'evolutionist' refer to claims about the *origin* and modification of things, not the on-going existence of things. Although there is a now unpopular theological theory that claimed that things were being continually re-created, most people today—whether creationists or evolutionists—accept that things continue to exist for reasons *other* than creation or evolution. They commonly believe either that physical things have an inherent property of continued existence or that they are being held together by a process unrelated to their origin or modification.

believes that ultimately, all physical things came to be *super*naturally). More particularly, the author believes that the Bible speaks with truth on all matters that it addresses, including its claims about the physical world[a].

As result, he affirms the creation of a complete, un-cursed universe in the course of six days (Gen. 1) only thousands of years ago[b], a curse in response to Adam's sin that introduced natural evil into the world (Gen. 3), a global **Flood** in the days of Noah a millennium and a half later that destroyed all living things on the land with the exception of those in the ark (Gen. 6-9), and a couple centuries later, a judgment on humans at Babel that was the source of the diversity of human language (Gen. 11:1-10)[c].

Thus, not only does this text present a creationist perspective of the world, it more specifically presents a **young-age creationist**

Flood—unique, global, year-long catastrophe that destroyed all land animals except those on Noah's ark

creation, young-age—the belief that God created the entire universe about 6000 years ago (vs. naturalistic evolution)

a An alternative perspective of Scripture that was first popularized by Galileo, suggests that the Bible speaks authoritatively on spiritual matters only. Various degrees of application of this concept to the Bible has generated a number of alternative perspectives of earth history, including a variety of old-age creationist views that accept the millions and billions of years of conventional science.

b As per the chronogenealogies of Genesis 5 and 11, the time from the creation to Abraham was approximately 2000 years. Since Abraham lived approximately 2000 B.C. (derived both from Biblical chronology and from conventional archaeology), the creation was roughly 6000 years ago. Alternative numbers (*e.g.* those of the Septuagint) and interpretations of Scripture can add as much as 1500 years to the pre-Abraham chronology, so young-age creationists accept an origin of the universe within the last 6000-8000 years.

c See Chapter 15 for more detail on the young-age creationist perspective of history.

perspective of the world[a]. Nearly every chapter relates the success of young-age creation and the failure of naturalistic evolution to explain some important aspect of biology[b]. The last chapter presents a summary of earth history from a young-age creationist perspective. Since the purpose of the text is to present a creationist perspective of the world, no systematic presentation or critique of evolution is presented in the chapters of the book, so it is offered instead in an appendix.

God-Centered vs. Biology-Centered

Biology is such an enormous field that authors of biology textbooks must select a few topics and ignore most of the others. Since most biology textbooks are written from the perspective of naturalism, it seems only natural that most biology textbooks include the things naturalistic biologists believe they understand about the biological world and avoid those things that continue to mystify them.

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a Note that the young-age creationist perspective of earth history is the position of a very small minority (<<1%) of scientists. It is even a small minority of college-educated evangelical Christians (perhaps <5%?). Of the hundreds of universities and colleges with accredited biology majors, less than ten accept a young-age creationist perspective of origins.

b Young-age creationism and naturalistic evolution are explicitly referenced in the text because the former is the perspective of the author and the latter is the dominant perspective of textbooks of biology. Other versions of creation and evolution are not mentioned in the text only because of lack of space (not, for example, because they are unimportant). Also, cases in the text where young-age creationism has been successful at explaining the biological world may also be cases where other variations on creation and/or evolution have been successful at explanation. And, conversely, cases in the text where naturalistic evolution has been *un*successful at explanation may also be cases where other variations on creation and/or evolution have been unsuccessful at explanation.

Consequently, most textbooks focus on the accomplishments of biologists, the nature of the biological world, and unify the topics with naturalistic evolution. As brilliant as scientists may be, as impressive as their accomplishments are, and as awesome as the biological world is, the author believes the focus of a textbook of biology should be on neither humans nor organisms, but rather upon the One Who created them. The chief end of man is to bring glory to God, so we ought to continually glorify and worship Him.

Scripture also tells us that God created the physical world to show us the invisible God and His invisible qualities or attributes (Rom. 1:20). It stands to reason that in some sense the obverse of this statement must also be true—that the attributes of God can help us better understand the creation. Consequently, this text focuses on how the major attributes of God illustrate the nature of God. Thirteen of the fifteen chapters open with a description of a characteristic of God and introduce that particular aspect of the biological creation that God created in order to physically illustrate that characteristic .

Christian Responsibility

Another distinctive feature of this text is its emphasis on personal responsibility. Most biology texts engage in very little discussion of ethics and personal responsibility, probably because of the wide diversity of opinions that exist in our society, and the fact that in strict adherence to naturalism there is no such thing as right and wrong. Christians, however, cannot avoid personal responsibility. We have an obligation to learn about the biological creation so that we grow in our understanding of how to know God more intimately, how to share God more effectively, and how to obey God's commands more completely. Then, once we have acquired that understanding we have a responsibility to use that knowledge wisely.

Thus, we have a responsibility to worship God, to share God with others, to guard and keep the creation He gave us, and to enhance the divinity-illustrating characteristics of the creation so as to bring God more glory. With this thought in mind the first chapter of the text focuses on what kinds of responsibility a believer has in regards to the biological creation. Nearly every chapter thereafter concludes with

comments about specific responsibilities that the believer has with respect to the biological creation.

In summary, this text opens with a chapter on Christian responsibility in the biological creation and ends with a chapter reviewing young-age creation earth history. Between those bookends are thirteen chapters devoted to the characteristics of God. Each chapter opens with a brief discussion of an attribute of God, then discusses that part of the biological world that God created to illustrate that attribute. This is followed in each case by a short discussion on how the origin of that aspect of the biological world is better explained by young-age creation than by naturalistic evolution. The last part of each chapter deals with our responsibility to that biological creation—first our responsibility to God (to worship Him), then our responsibility to others (to share Him), and finally our responsibility to the creation (to care for it and enhance it to His glory).

It is my hope that this text will change you. After reading and studying this book previous students have claimed it has helped them grow in their relationship with God. Biology has helped them better understand things they have long known about God but struggled to understand. They have come to see God in those things He made, to be awed by God in ways they have never been before, and to know God more intimately. Students have also commented that studying this material has helped them in their Christian walk. They learned new ways to worship, to share their faith with others, to stand for what they believe, and to glorify God.

Finally, students claim that issues in this text have changed their perspective on who they are. They have come to understand their purpose, recognized their roles as priests and rulers of the creation, and learned additional ways to do what is right. I pray all this for you. I pray that this course will initiate a life-long journey of worshipping and glorifying the One Who made all things and testifying that truth to others.

Kurt P. Wise, PhD
July 2015

CHAPTER 1

BIOLOGY FOR THE BELIEVER

What is Biology?

"Praise God, O heaven and earth, seas and all creatures in them."

Psa. 69:34, GNT

1.1 | Creation and Revelation

God identified Himself to Moses and Israel as 'I am' (Ex. 3:14) because it is part of His very nature to exist. It is impossible for God not to exist. Consequently, God is eternal ('the King eternal': I Tim. 1:17[a]). He had no beginning. He always was, is, and always will be. God and *only* God is eternal and uncreated. "…by Him were all things created…" (Col. 1:16). He created both the physical world (everything detectable, or potentially detectable, with our senses of sight, smell, hearing, touch, and taste) and the non-physical world (everything that is not detectable with our senses).

"God is spirit" (John 4:24). Therefore, unless He chooses to reveal Himself, human eyes cannot see Him, ears cannot hear Him, tongues cannot taste Him, noses cannot smell Him, and skin cannot feel Him. Unless He wanted us to perceive Him, God would be undetectable and unknowable. He would not have to 'hide' to be unknown to us. He would not have to do anything at all.

In fact, considering the awesomeness of God and how far we fall short of His glory (Rom. 3:23), we do not deserve to know Him. It seems only 'natural' that such a God *should* be unknowable to us[b]. However, astonishingly enough, this is *not* the God of the Bible. Instead, the God of Scripture desires to be known.

Before man's rebellion, God apparently made it a habit to walk and talk with Adam and Eve in the cool of the day (the implication in Gen. 3:8a). Even after the Fall of man, Enoch 'walked with God' until God took him directly into heaven (Gen. 5:24), Abraham 'was called the friend of God' (James 2:23), Moses spoke with God face to face 'as a man speaks to his friend' (Exo. 33:11), David was chosen by God as a man 'after His own heart' (I Sam. 13:14), Israel was cherished as the 'the apple of His eye' (Deu. 32:10), New Testament believers are adopted children who can call Him 'Abba' (Rom. 8:15), and the church is cherished by God in the way a bride is cherished by her bridegroom (*e.g.* Song of Solomon).

a Other references that God is eternal: Deu. 33:27 & Heb. 9:14.

b Thus, it is only reasonable that human reasoning would modify the Truth (as in modern Judaism), or create an alternative to the Truth (as in Islam), to envision God as distant and unapproachable. Such a god is too great to be known personally, and for a human to know such a god personally would be disrespectful, impious, or even sacrilegious. Although this might make sense to human reason, such is not the God of the Bible.

From the very beginning God has sought out man so that we could know Him. To do so, God has condescended to reveal Himself to man. Although He could create the entire universe and its components in an instant and still not need rest, He condescended to create over the course of six days and rested on the seventh day as an example to man (Mark 2:27; Exo. 20:8-11).

A couple thousand years ago "…the Word was made flesh, and dwelt among us…" (John 1:14). God went so far as to humble Himself and take on the form of a servant (Philippians 2:6-7)—all as an example to us. Jesus Christ even permitted a greater abasement than that. He allowed our sin to be placed upon Him, and He allowed Himself to take the full measure of punishment for our sin. He actually received on Himself His Father's anger towards our sin and paid for an eternity of suffering for the sins we committed. And He made Himself 'to be sin' for us, so that we might enjoy an eternal relationship with the Almighty Holy God (II Cor. 5:21).

He did so much for us that all we have to do in return is believe in what Christ has already done (Acts 16:31)—to trust that He has done all that is necessary for us to be acceptable in God's sight[a].

As part of the revelation of Himself to man, God created the physical world so that humans could see His invisible qualities and attributes (Rom. 1:20a). This was true of 'even His eternal power and Godhead' (Rom. 1:20b). According to the larger passage (Rom. 1:18ff), God has so convincingly used His creation to show His attributes that every person has actually already come to 'know God' (Gen. 1:21a). Every person did not just come to know *about* God; every person has come to *know* God. God's revelation through His creation is so effective that no person is left with an excuse. No one will be able to stand before God and say that he or she never knew God.

VIDEO **1.2**

1.2 | The Origin of Modern Science

Because He intended the creation to illustrate His attributes, God designed the creation—and humans—in a very deliberate and special

a If before this moment you have never trusted in what Christ did for you, would you like to? The Bible says that if we understand that we are sinners (Rom. 3:23), deserving judgment for our sins (Rom. 6:23), but that Jesus died on the cross to pay the penalty for our sins (I Cor. 15:1-4), then to receive eternal life we need only believe in what He has already done (John 3:16; Acts 16:31). If you have so trusted in what Jesus has done for you, then the Bible says you HAVE eternal life that no one can take from you (John 10:27-29)—otherwise, in fact, it would not be *eternal* life!

manner. A number of things had to be true about the universe and human beings for humans to recognize the illustrations and infer from them the nature of the invisible God. These might be called the 'knowability traits' of the creation, and they include the following :

The physical world actually exists. Although the existence of the physical world might seem quite 'obvious' to most of us in the Western world, many of the worldviews of the Eastern world believe the physical world to be an illusion[a]. Consequently, if people believe consistently with their declared worldview, a majority of the world's population rejects the claim that a physical world actually exists in some place other than the imagination of the human mind.

But, believers know the physical world exists because God created it to illustrate His attributes. An actual physical world not only allows inferences to be made from it, but also allows verification of those inferences.

a Even in the western world, Plato (c426-c348 BC) pictured the physical world as shadows dancing on the wall of a cave—mere silhouettes of those things which were truly real—the invisible world of perfect ideas, concepts, and forms.

Human senses are reliable. Even though we know of instances where our senses can lead us astray (*e.g.* with mirages) and we know that we can use the senses to lead others astray (*e.g.* as illusionists), human senses must be generally reliable so that humans can correctly perceive revelation from His creation. From this we can then conclude that the physical world that we perceive is the physical world that actually exists.

The creation is ordered. For the creation to illustrate something there must be some sort of structure or order to carry that illustration.

The order of creation is simple enough to be understood by humans and the human brain is complicated enough to understand creation's order. Although a full understanding of God would certainly be outside the capability of any finite being, God still wants us to understand something about Him. This means He chose to illustrate understandable things, created the universe in such a way as to illustrate those concepts in understandable ways, and constructed our brains in such a way as to comprehend those concepts.

We can thus conclude that the order we perceive in the creation is the actual order that is there, and not un-naturally imposed upon the creation by our minds.

Regularities of the creation can be detected and understood in the course of individual human lifetimes. Humans have long recognized that there are consistent patterns in the creation. It is almost as if there were rules or laws that things in the universe must obey. This actually seems quite

reasonable, for the God of Scripture is a personal God with reliable and consistent behavior, Who desires very consistent behavior of others.

If the creation mirrors God's nature, the creation might be expected to have regular behaviors of its own. And, since God desires for each individual human to know Him, it is reasonable to assume that He created at least some of that order and some of those regularities in such a way as to be detectable in the span of one individual's lifetime.

Regularities of the creation are consistent across the entire universe for all time. Since God is an unchanging God, creation's order and regularities should be consistent through time. And, since God desires to be known by all people, no matter where they are and no matter when they live, the law-like patterns of the creation ought to be true across all space for all of time.

The order of the creation, including all its regularities, is unified. Since God desires us to recognize the one true God in the creation, all its illustrations will point to the same God. Because there are many and various facets to God's character, there are probably many and various illustrations of His character in the creation. As our understanding of these illustrations increases, we would expect that they will weave together as threads in a tapestry into a coherent, interlocking picture of the God of creation.

We can gain truth and understanding by studying the creation. Since God has created the physical world to teach us something about Him, it is reasonable to assume that studying the creation will lead to truth and

understanding. At the very least we will gain truth and understanding about God.

There is intrinsic value in studying the physical world. There is perhaps no other endeavor as glorious and fulfilling as seeking God. The more we know of Him, the more awesome we realize Him to be, the more awed we are in knowing Him, and more benefited we are in becoming like Him.

Since He created the physical world to teach us about Himself, better knowing the creation leads to better knowledge of God. There is great value in studying the physical world to better know its Creator.

Truth is advanced by continual study of the creation. Since God is so much greater than we can understand or imagine, it is likely that He put enough truth in the creation to keep all humans challenged for all time. God has authored His word in such a way as to provide simple truths for children, deeper truths for those older in the faith, deeper truths still for those who diligently study, and even deeper truths to challenge those who spend lifetimes in study.

Likewise, God has designed His creation with simple truths for all, deeper truths for those who seek, deeper truths still for those who diligently study, and even deeper truths to challenge those who spend lifetimes in study of His creation.

Truth about the unseen can be inferred from the study of observable things. God created observable things so that we could understand those attributes of God that we cannot see. We infer from this that there is

probably much that exists that we cannot see, and we are justified in inferring the nature of those unseen things from the things we can see.

For every event there is a cause. God is a God of cause and effect. He wills and it occurs, He speaks and it is done, He promises and it is true, He redeems and we are His. The universe itself is an effect which resulted from His creation, and He has built the law of cause and effect into the creation as one of its regularities.

Just as we are supposed to infer the cause of the universe's regularities (as illustrations of His character), so also we are justified in seeking cause for effects that we observe in the creation.

Human language is capable of describing, understanding, and teaching truths about the creation. The same God Who created the creation so we could recognize His character in it, gave us language.

It is reasonable to assume that the language He gave us has been created in such a way as to make it possible to describe the creation and the attributes of God illustrated in that creation. It is reasonable to assume that that same language has been designed so that we can reliably pass on information about that creation to others.

Furthermore, the same God Who gave us language, spoke the universe into being by the word of His mouth. Not only should human language be capable of describing the universe, but human language itself should be similar to the structure of the creation. This would explain why mathematics—a language created by humans—has been so successful at approximating the very structure of the creation.

God's desire to illustrate His nature in those things He made yields quite an astonishing creation. Such a world is not the expectation of naturalism. Although our survival might suggest that our senses must be somewhat reliable, naturalism gives us no good reason to believe that the physical world's order just *happens* to be simple enough for us to understand[a] and our brains just *happen* to have evolved enough to be sufficiently complex to understand it.

Nor in naturalism is there reason to believe that the order of the universe should be comprehensible in the course of a single human lifetime, or that the order is unifiable. In naturalism there is no good reason to believe that the regularities of the physical world are unchanging—let alone consistent across all time and space. For naturalism it is even more incredible—or even presumptuous—to

a Einstein is said to have said "The most incomprehensible thing about the universe is its comprehensibility."

believe that language humans invented happens to correspond with the structure of the entire universe.

Yet, after centuries of studying the physical world, it does seem as if the universe is understandable. It does seem as if the regularities of the universe are consistent across time and space. And more and more of the regularities of the universe have been unified. And it does seem as if mathematics comes astonishingly close to mimicking the very structure of the universe. The universe seems to be designed just as the Bible intimates—in such a way as to illustrate the very nature of its Creator.

In fact, belief in such a universe led to the origin of science itself. When people acknowledged that the universe not only existed, but was understandable and worthy to be understood, and, additionally, that humans were capable of understanding it, humans began studying the universe in order to understand it. This was the birth of what is called 'modern science'.

It is no accident that this occurred in the wake of the Reformation in Western Europe, among people who were freshly re-acquainted with the truths of Scripture. No worldview aside from a Christian (or biblical) worldview generates such an understanding of the physical world as to spawn the birth of modern science. It is unlikely that modern science could have been birthed in any other worldview. In fact, the birth and subsequent success of modern science is implicit confirmation of the truth of the biblical worldview[a].

VIDEO **1.3**

1.3 | What is Science?

A Challenge to Define

Most people are under the impression that science is easy to define. After all, the word has some sort of a definition in the dictionary and even grade school textbooks offer definitions. Furthermore, since the word is used somewhat commonly, one might infer that it should be easy to determine whether something is science or not a science. Finally, since most of the definitions floating around in our society—

a The characteristics of the universe that permit it to illustrate the nature of God turn out to be what philosophers of science call the 'presuppositions' of science. Presuppositions of science are those things that are assumed so that science can be done and those things that must be true for the pursuit of science to be reasonable. The biblical worldview is the only worldview known to provide reason to believe the presuppositions of science.

especially those which students are called upon to memorize—link science to 'the scientific method', there must be a procedure that all scientists use and no one outside of science uses.

In fact, none of these things are true. First of all, science is *not* easy to define. Even experts[a] struggle to define it, and thus far no single definition has been agreed upon. Secondly, it is not always clear whether or not something is a science. There are certain things that everyone is satisfied labeling as science. There are many other things that everyone agrees should not be labeled as science. But there are still other things that some people label as science and other people label as non-science. Finally, there is, in fact, no single 'scientific method' that all scientists use, and most of the methods that are used by scientists are also commonly used by people outside of science.

The whole story on how our society came to confuse the definition of science is long and complicated. Some of the confusion comes from the rather typical changes that occur in language, where words change meanings and words assume additional—often figurative—meanings. Some of the confusion also comes from the nature of science itself. After all, such a large variety of things are studied by science, and such a huge variety of people are scientists, that a simple definition might not be possible.

I suspect that the single most important cause for the confusion, however, has to do with the fallen nature of man, rather than the

a Philosophers of science are those whose job would include creating a definition of science.

nature of science itself. In our society, scientists are held in very high regard. Many people find the esteem that comes with science to be an irresistible temptation. Some outside of science want the esteem for themselves, so they stretch the definition of science so they can call themselves scientists. Some within science want to preserve or increase the esteem they already receive, so they modify the definition of science in such a way that science is even more respectable than it really is. Some even want to exclude others from the esteem of science, so they modify the definition of science so that those other people fall outside the definition and can then be called *non*-scientists.

All this has produced a variety of inaccurate definitions of science. Not only has this led to overall confusion about the nature of science, but our society has come to cultivate (and teach our young people) an inaccurate understanding of the true nature of science[a].

The Nature of Science

Simple definitions of science are probably not possible. After all, scientists come from a wide variety of cultural backgrounds and they study many different things (*e.g.* from the structure of the universe to the makeup of electrons, from minerals of rocks to the workings of the human brain, from the behavior of extinct dinosaurs to the cause of polio, from the cause of gravity to the process of evolution). Furthermore, there might actually be human activities that lie on the

a In most educational materials (at all grade levels) science is defined improperly. Since students are often required to memorize these inaccurate definitions, most people have adopted inaccurate definitions of science.

edge of science, being (validly) defined as science by some and excluded from science by others.

On the other hand, though the fringes of science might be difficult to define precisely, the vast percentage of science is universally accepted as science. And, though science is a broad discipline, there are characteristics that seem to be found across its entire breadth. Let us now consider what seems to be the most important of the characteristics found across all of science.

Science is something humans do to understand the physical world by proposing tentative truths as theories of explanation and valuing fit with the physical world.

Science is a human activity. One implication of this statement is that science is done by humans. Chimpanzees do not do science. But neither does God… nor angels. Chimpanzees do not do science because they are incapable of doing so. God does not do science because He does not have to. Angels do not do science because it is not what they are called to do. Humans invented science and humans do science[a].

A second implication of the statement is that science is an activity. Many students might think of science as a bunch of things a person has to memorize. In contrast, scientists themselves tend to understand science as something scientists *do*—almost as if 'science' was a verb. A third implication is that since science is performed by humans, human nature plays an important role in science. For example, in our society, scientists are commonly portrayed as emotionless, unbiased seekers of truth. In fact, science is done by humans, and emotions are an essential element of being human.

Furthermore, bias has also been a part of every human who has ever lived. A person's bias might be a correct one or an incorrect one, but there is no way that any human can have no bias at all. Scientists are not only emotional beings, they are also fallible and fallen. Scientists do make mistakes. And, although it would be nice if every scientist was seeking the truth, human nature being what it is, a fair bit of science is done for less than the best motives.

Science is something humans do to understand the physical world by proposing tentative truths as theories of explanation and valuing fit with the physical world.

a As shall be discussed later in the text, humans invented and do science in order to fulfill the task that God assigned humans in the creation.

The purpose or goal of science is to understand the physical world. One implication of this is that pure science[a] does not generate anything useful. Unlike many in our society may understand, science did not provide us with light bulbs, air conditioners, or cars. It is *not* used to build bridges or computers or cure disease. Pure science only attempts to understand *how* the physical world works. Inventions, engineering feats, and medical cures are examples of applied science. The applied sciences seek to modify the physical world for the benefit of humanity. The applied scientist may or may not base his or her inventions on knowledge derived from the pure sciences.

A second implication is that science focuses its attention on the physical world. Whereas another discipline, theology, seeks to understand God; science seeks to understand the physical world. This does not mean that science rejects the existence of anything else—even

a Pure science is also known as 'natural science', or even 'modern science'.

though naturalists (and many scientists) do believe that the physical world is all there is. It merely means that science focuses its attention on the objects of the physical world, many times ignoring everything else. Thus, whereas understanding is the *purpose* of science; the physical world is the *object* of science—or said another way, the physical world is what science studies.

Science is something humans do to understand the physical world by proposing tentative truths as theories of explanation and valuing fit with the physical world.

A common *misconception* of science is that it has something to do with proof and certainty[a]. Rather, a better motto for science would be 'you never know for sure'. In an effort to understand the physical world, a scientist makes an educated guess called a scientific theory. Any attempt to *understand* the physical world cannot be known for sure. We'll never be able to test theories in every possible situation and at all possible times[b].

Furthermore, you can never know for sure that something might be discovered which shows the idea to be wrong. As the late paleontologist Stephen Jay Gould (1941-2002) used to say, honest scientists must always fear the 'mouse in Michigan'—that apocryphal mouse (that lived in the backyard of an elderly gentleman from Michigan) which falsified a highly celebrated theory about mouse behavior and humiliated the scientist who proposed it.

Reinforcing the idea of the tenuous nature of scientific theories is the turnover rate of scientific theories. New and better scientific theories are being suggested all the time, replacing older theories that are not as successful at explaining the world. Very few theories survive this process of modification for more than a few decades. None have survived for more than a few centuries. These short life spans for scientific theories suggest that every *current* theory of science may be wrong—in large or small part—and every scientist knows it. It may not be too far from the truth to say that every scientist prays that his or her theory is not shown wrong before he or she gets famous for proposing it… and if the theory *is* disproved that he or she will be the one to

a The commonness of the phrase 'proven by science' illustrates the association of science and proof.

b It is possible for a scientific theory to be shown to be false (if data of the physical world is contrary to the theory), but since a theory cannot be tested everywhere, at all times, under all circumstances, a scientific theory cannot be *proven* to be true.

show it wrong and become famous for its replacement theory! As a result of this, scientific theories of all types (*e.g.* hypotheses[a], historical scenarios, mechanisms, laws[b]) must be accepted as only *possible* truths.

Theories remain theories for their entire existence—science itself cannot finally declare any scientific theory to be certainly true. Although a given theory might actually be true, there is nothing in science that alerts the scientist that that particular theory is actually true[c].

Science is something humans do to understand the physical world by proposing tentative truths as theories of explanation and valuing fit with the physical world.

Any process seeking to discover truth requires some standard to determine which ideas should be held onto and which ideas should be rejected. In conservative Christianity, for example, the Bible is considered absolute truth because the God of Truth authored it.

Consequently, anything which does not compare favorably with the Bible is considered untrue. In science, the physical world is the standard of evaluating scientific theories. Scientific theories are created in an effort to explain the physical world. So, if a particular scientific theory is correct, or nearly correct, then the physical world should 'behave' in the particular manner expected by that theory.

Other ways this might be described is that the theory should 'fit' the physical world, or align with the physical world, or 'explain' the physical world. If the physical world is not the way the theory expects (*i.e.* the theory does not fit the physical world), then the theory

a Whereas it is commonly taught that a 'scientific hypothesis' is an untested theory, the term 'scientific hypothesis' is rarely used by scientists, and when it is used it is not restricted entirely to untested theories. Actually, hypothesis and theory are used interchangeably by most practicing scientists.

natural law—a regularity of the universe

b Whereas it is commonly taught that a scientific theory becomes a 'scientific law' with enough testing, scientific (or 'natural') laws are actually one very specific type of theory. A **natural law** is a regularity of the universe—something that is supposed to operate across all space and time. A theory that suggests no regularity for the entire universe can *never* become a law. Furthermore, a claim about a regularity of the universe is especially impossible to test over the entire universe for all of time. Natural laws cannot be proven and must always retain the status of tentative truths. Scientific or natural laws are thus nothing more than a particular type of scientific theory and must always remain a particular type of scientific theory.

c It is even questionable whether scientific claims can be legitimately arranged in order of increasing likelihood of being true. It is often believed that theories that have successfully survived many tests are somehow more likely true. For example, it is commonly taught that a scientist first makes an educated guess known as a scientific hypothesis, which, upon successfully testing, becomes a scientific theory, which in turn, upon more successfully testing, becomes a scientific law. There is an implicit suggestion that hypotheses, theories, and laws have increasing likelihoods of being true. However, if one 'mouse in Michigan' can prove a theory wrong, then just before the mouse was discovered was the theory more likely to be true just because the theory had successfully survived many tests before that? No, testing does not make a theory more or less true. It is either true or false and testing will not change that.

should be considered *un*true. Some scientists may consult additional standards of truth (Christians, for example, may consult Scripture), but the physical world is the standard that scientists accept across all the disciplines of science.

To restate our definition,

Science is something humans do to understand the physical world by proposing tentative truths as theories of explanation and valuing fit with the physical world.

When multiple theories are available to explain something in the physical world, theories are *preferred* that match the physical world best. Theories that explain more of the physical world are preferred over theories that explain less. Theories that can be tested (in other words, compared with the physical world) are preferred over theories that cannot be tested. Theories that have 'passed' more tests or more severe tests are preferred over theories that have only a few or easier tests.

Theories that fit better with other accepted theories are preferred over those that do not relate to anything else or conflict with other theories. Theories that have fewer internal problems (*e.g.* logical problems) are preferred over those with more. Even theories that lead to further research into the physical world are preferred over those that do not lead to other investigations.

What is Biology?

In modern science there are many different natural sciences, distinguished by studying different aspects of the physical world. Biology, for example, is one of the natural sciences. Derived from the Greek words *bios* ('life') and *logos* ('word' or 'discussion'), 'bio-logy' was originally understood to be the discussion or study of life and is often defined as 'the study of life'. And, if you believe that the physical world is all that exists (the worldview of naturalism), this would be an accurate definition of biology. If, however, the biblical worldview is true, then there is more to the world (and more to organisms) than the physical.

God is called the living God (*e.g.* Jer. 10:10; Matt. 16:16), but He is also spirit—not physical. Since biology is a natural science and can only study the physical, God is at least one living being Who cannot be studied by biology. Consequently, biology does not study *all* of life—but only living beings with physical bodies. The Bible also refers to life itself as something different from the physical—or at the very least something more than physical. For example, God first formed man from the dust of the earth (Gen. 2:7a). It would seem that man's complete physical being was formed at this time. But it was only after God breathed into man's nostrils the 'breath of life' that 'man became a living soul' (Gen. 2:7b).

Our physical body is an essential part of being human (after all, God creates physical bodies even for believers in heaven). But the body alone is not alive. Adam's body needed enlivening, so God gave it 'life', just as He did for all of us and even does for all animals (Psa. 104:29-30). Since it enlivens physical bodies (and is not itself the physical body), life involves something beyond the physical. And if life is non-physical, or something more than physical, then biology, as a natural science, may not be able to study life itself—at least not completely[a].

Thus, although the nature of the word itself would suggest 'biology' is the 'the study of life', the science of biology may not actually be able to study life! At best, science can study only organisms—the bodies of those physical things that possess life. So, rather than say that biology is the study of life (a common definition and an acceptable one in naturalism), it would be more accurate to say that **biology** is the study of organisms (physical beings having life).

biology—a science that studies organisms

a More discussion on the non-physical nature of life is found in Chapter 2.

CHAPTER 3

THE GLORY OF GOD

Biological Beauty

"...worship the Lord in the beauty of holiness."
I Chr. 16:29, KJV

3.1 | The Beauty Of God

beauty—the attractive holistic fit of an entity's attributes; deep beauty is beauty at multiple scales

When the word is correctly applied, **beauty** is a holistic concept. Something is said to be beautiful when, upon considering it, one is struck by how all its characteristics fit together in a compelling way. It is not just that something is pretty—a type of one-dimensional aesthetic appeal—but also that it fits together well and that it is somehow good. We have trouble labeling a person as beautiful who is physically attractive but who is also artificial, cruel, miserable, devious, unclean, or lazy.

Beauty involves a sort of multi-dimensional aesthetic appeal. A beautiful person is attractive in their *whole* being—physically, emotionally, and morally. This is something of the sense in which Scripture refers to the beauty of God. Not only is any one of God's attributes (like mercy or love) attractive to us, but each of His other attributes like grace and patience and kindness and omniscience (and so on) are also attractive. And, these attributes are interwoven and fit together in an awesomely compelling way.

At the same time, we need to realize that God is not simply the addition and remarkable integration of a bunch of amazing attributes. No amount of addition can reach infinity. Each of God's attributes is infinite and a necessary part of God Himself. All of them are fully realized at the same time in a perfectly unified whole—so awesomely appealing (beautiful) as to compel us to worship.

In this way God's 'beauty of holiness'—the wholeness of the awesomeness of all His interwoven attributes—encourages worship and praise ('worship the Lord in the beauty of holiness': I Chr. 16:29 & Psa. 29:2 & 96:9; 'praise the beauty of holiness': II Chr. 20:21). When the psalmist writes "One thing have I desired of the Lord …to behold the beauty of the Lord…" (Psa. 27:4), he seeks the entirety of God's being—all of His attributes together. Consequently, the greatest blessing that can be bestowed upon a people is that God Himself is their 'crown of glory' or their 'diadem of beauty' (Isa. 28:5), for this means God dwells in, on, and among His people in all His fullness and being.

Because God is spirit, that awesome beauty of God cannot be seen by mortal eyes. But God desires that we know Him and that we know Him in His fullness, including His beauty. Therefore, God illustrates

that beauty that cannot be seen by physical beauty that we *can* see. For example, He creates physical beauty and 'clothes' Himself with it (Job 40:10).

From time to time He has demonstrated His presence with something the Bible refers to as 'the glory of God'—something so filled with manifestations of God's nature that it is overwhelming to man. It is described as so bright, brilliant, and shining as to 'fill' the area around it, such as the temple (Eze. 10:4; 43:5; 44:4)[a].

In fact, in eternity, the glory of God provides the light for all of heaven (Rev. 21:23)—a light that even seems to pass through objects and walls as if the glory of God cannot be hindered by anything created. Prior to our glorification, however, the glory of God is fearsome to sinful man (*e.g.* "…the glory of the Lord shone round about them, and they were sore afraid.": Luke 2:9[b]). This is because God's glory includes His holiness, and we fall so very short of that (Rom. 3:23). It is because of this, that after Moses spent just a short amount of time on Mount Sinai in the presence of God's glory, his face shone so brightly that even his brother was afraid to approach him (Ex. 34:29-30). Yet, as

a And that glory will shine on even larger areas in future events (*e.g.* Hab. 2:14; 3:3-4; Rev. 18:1).

b Other examples of human fear in response to the glory of God: (1) Moses being unable to enter the tabernacle (Exo. 40:34-35); (2) priests being unable to enter the temple (I Ki. 8:11; II Chr. 5:14; 7:1-3); (3) "… the sight of the glory of the Lord was like devouring fire… in the eyes of the children of Israel" (Exo. 24:17); (4) "Behold, the Lord our God has showed us His glory… Now therefore why should we die? For this great fire will consume us if we hear the voice of the Lord our God any more…": (Deu. 5:24-25).

intense as these physical manifestations of His glory were, they are still a dull image of God's true beauty.

When God chooses to reveal Himself, He often does so in beautiful form. For example, when Ezekiel sees Christ (Ez. 1:25-28), Ezekiel seems to struggle to describe what he sees. He refers to sapphire, amber, fire, and rainbow. Each of these items is visually stunning when considered alone; together they must have been beautiful indeed.

We see His glory illustrated in the beauty of His sanctuary (Psa. 96:6)—and (by illustration) by adornments of the places where He chooses to reveal Himself. Eden, for example, where God first dwelt with man, was a garden. Only locations of beauty are called gardens—much more so the 'garden of God'. In fact, God placed in Eden 'every tree that is pleasant to the sight and good for food' (Gen. 2:9; 3:6). He chose trees attractive to both the sense of sight and the sense of taste. At least one of the beings in the garden, the 'anointed cherub', was described as having 'beauty and brightness' and decked with precious gems and gold (Eze. 28:13-16).

Beautiful is also the description of the New Jerusalem (Psa. 48:2), the final, eternal home of man living with God. It is 'prepared as a bride for her husband' (Rev. 21:2). Its foundations are made of 12 gemstones, its walls are made of jasper, its gates of pearl, its streets of transparent gold, and it is lit with 'the glory of God' (Revelation 21). Any place God Himself creates for His own abode is a beautiful place[a]—a physical manifestation of the even greater beauty of God Himself.

When God instructed man to build a temporary abode for God, He gave meticulous detail to its beauty (Exodus 25-27). There were sweet aromas (spices for incense), luxurious textures (fine linen), and deep-grained wood (acacia) with beautiful carvings. There were shiny metals (gold, silver, and brass), translucent stones (onyx), and colorful dies (blue, purple, scarlet). The tabernacle was designed to stimulate the senses of sight, feel, and smell. Another chapter (Exodus 28) is devoted to the description of the garments of the high priest, God's

a The incarnation might be considered an 'exception' to this rule. Jesus, though not unattractive, was not of such compelling appearance as to draw people toward Himself because of His beauty (Isaiah 53:2). Instead, the Word (John 1:1-3, 14) condescended from His exalted state and took upon the humble form of a servant (Philippians 2:6-7) so as to touch man. In this case He is not seeking to illustrate His glory, rather He *chose* to taken on a less awesome form *so that* He could touch us, we could touch Him, and He could example how we are to live. It was done to connect with us. It is also true that even now the Holy Spirit chooses to reside in believers, even though those temples are less than beautiful. In those cases, it can be argued that that same Holy Spirit is perfecting those saints, so as to 'make them beautiful in His time' (Eccl. 3:11).

chosen representative among the Israelites. These garments involved linen, embroidery, lace, gemstones, and gold—all 'for glory and beauty' (Exodus 28:2, 40).

To orchestrate the construction of the tabernacle, such as its furnishings and priestly garments, Bezaleel and Aholiab were 'filled with the Spirit of God' (Ex. 35:30-36:2). God gifted these men to accomplish the necessary cutting, carving, engraving, molding, spinning, weaving, and needlework. And all of this, we were told, was done as a pattern of heaven itself, and the things in heaven (Heb. 9:23-24). In a similar manner, Solomon's temple was beautiful as well (I Kings 6-7; II Chr. 3-4). And when the temple was rebuilt in the days of Ezra, God put it in the king's heart 'to beautify the house of the Lord' (Ezra 7:27). God wishes His habitations to be beautiful as a testimony to the beauty of God Himself.

Yet, in spite of the beauty of things made by man, according to Jesus, the beauty of God is pictured even more powerfully in His creation—in fact, in His biological creation. Jesus claimed that Solomon in all his glory was not arrayed as beautifully as a single lily (Matt. 6:29).

VIDEO **3.2**

3.2 | Biological Beauty

As an illustration of His awesome glory and beauty, God infused His entire creation—including the biological portion of His creation—with extraordinary beauty. Because that beauty is bestowed upon a

finite creation, the beauty of the creation is limited, but it is nonetheless breathtaking. There is not just a lot of beauty, the beauty itself has an appealing array of qualities. There is, if you will, a beauty to the creation's beauty. What follows is an attempt to describe some of the amazing qualities of the beauty God placed in His biological creation.

Deep Beauty

God created beauty at every scale of the universe—infusing it into the smallest unit, the largest structure, and every entity between—including organisms. In contrast, the beauty of things made by humans is shallow—typically beautiful at only one scale[a]. An oil painting examined too closely amounts to unimpressive individual brush strokes; an oil painting far enough away is not seen as beautiful at all. A striking set of watch components examined too closely amounts to a set of ugly cogs. The most beautiful things made by humans lose their beauty when we get too close or back up too far.

In contrast, the creation's beauty is found at every scale. The beauty of a 'purple mountain' observed closer becomes a stunning mountain vista draped with a soft, green blanket. Closer yet it is a warm forest scene. Even closer, one can be struck by a bird's colorful feathers. At a smaller scale is the iridescence of a single feather, and smaller still is the repeating symmetry of microscopic interlocking barbules.

a The observation of the scale-independent beauty of God's creation in contrast to the single-scale beauty of human creations was first pointed out to me about 1990 by Dr. David Mention.

Even closer one finds the ordered arrangement of specially designed cells, and closer still are the intricate components of a single cell. The depth of beauty is not even limited by the bounds of biology. Stunning arrangements of molecules and atoms and subatomic particles are found at scales many times smaller than the smallest organisms. At the opposite end of the size spectrum, when all of biology gets too small to see, there is still beauty in the awe-inspiring scenes from satellites and spacecraft, and even beyond to stars and galaxies.

The beauty of God's creation is so much greater than the most beautiful things made by man in part because the beauty of God's creation is scale independent. How very deep indeed is the beauty of God. One can imagine that every brushstroke of His original creation must have been spectacularly beautiful. Not a single one was out of place and not a single one was unessential for the beauty of the whole. Even now, with the creation fallen and marred, God is interested in bringing out more glory to Himself by increasing its beauty. He seeks to make all things beautiful in His time (Eccl. 3:11), so that everything glorifies God to its fullest potential. This includes every imperfection of our lives—from a small, seemingly insignificant scratch to the very largest, seemingly insurmountable ugliness. Each one of us is an essential component of the beauty and the tapestry of the creation of God.

Ubiquitous Beauty

Beauty is found throughout His creation—not just at every scale, but in every location. This beauty is found in every corner of the universe. Even that portion of His beauty that He chooses to reveal through biology is found across the entirety of the earth. Organisms with beauty are found in the air, the land, and the seas.

Nearly every body of water and every landscape—no matter how harsh—is adorned with organisms. From the tops of the highest mountains, to the ice on the coldest pole, to the baked surface of the driest desert, biological beauty is found across all the continents. Organisms thrive from boiling hot springs, to seething cauldrons of acid, to springs at the bottom of the deepest oceans, and even between grains of sand under crushing pressures miles beneath the earth's surface. Biological beauty is ubiquitous across the planet.

Even when something makes His creation ugly, God begins a process that replaces that ugliness with a new beauty. In the 'natural' course of events, healing comes to landscapes devastated by pollution, war, or catastrophe. God built a remarkable facility into His creation that keeps its beauty in balance and restores beauty when beauty is lost, similar to how our bodies repair themselves after injury. Stinky, lifeless oozes become clear streams teaming with life. Stark landscapes dotted by fallen logs become vibrant forests. Drab underwater shipwrecks become colorful reefs. Land stripped of vegetation and deeply rutted

community succession—a sequence of communities in a particular area leading to the climax community in that area, each community altering the environment for the community to follow

community—(biological) system of plant, animal, and biomatrix species found in a particular location

climax community—the stable community for a particular area; the last in community succession

pioneer community/ species—the first organisms (in community succession) to settle in an area

with erosion becomes reclaimed again by rain forest. Sometimes it takes weeks or months and sometimes it takes centuries or millennia. Sometimes it even requires a replacement of what was there with something new[a]. But, no matter how marred, God can make the fallen beautiful.

In the biological world this is accomplished in individual organisms by means of biological processes of repair and healing. On a larger scale, this is done in communities of many species of organisms by the process of **community succession**. In community succession, the species found in a particular area change over time as organisms at a given time prepare the area for another **community** of organisms to follow. Each such community alters the environment in such a way as to effectively phase itself out. Over the course of time, what results is a series of different communities, each replacing the previous one, finally resulting in a stable **climax community** that can persist more or less indefinitely at that location.

Community succession usually begins with the arrival of **pioneer species**. Pioneer species are specially designed for these situations. Photosynthesizers, like cyanobacteria, lichens, and plants, will usually be the first to arrive on a barren landscape because they can harvest their energy from the sun. Animals will come in later. If the environment is dry and without soil, the lichens will be the first because they can get

a Such as He does when He creates in believers a new spirit (*e.g.* Eze. 11:19; 36:26), and as He will in the future when He creates a new heaven and a new earth (Isa. 65:17; Rev. 21:1).

the water they need directly from the atmosphere, even in the driest of deserts. Lichens also erode rocks to produce soil for plants that follow after. The first plants that appear will usually be those that can fertilize the soil because they carry nitrogen-fixing bacteria.

Some plants are even designed to come in after a fire (*e.g.* lodgepole and Jack pine cones that open after being heated up in a fire). An example of community succession would be the development of communities following the retreat of Alaskan glaciers. Pioneer species, such as lichens, mosses, and nitrogen-fixing annuals build up a fertile soil. Other plants germinate in that soil and eventually a community dominated by nitrogen-fixing alders and willows and cottonwoods takes over. This community is replaced by one dominated by western hemlock and spruce, and finally that community is replaced by the climax community dominated by Sitka spruce.

God restores such communities for His own glory, to make sure His own beauty is always well pictured in the creation. If He is so interested in restoring the beauty of plants, animals, and the earth itself, how much more is He interested in restoring our own beauty and the beauty of our lives.

Profound Beauty

Beauty is not just everywhere at every scale, it is also intense. The beauty of the biological creation is awe-inspiring. Whether it is the bioluminescent sparkling of dinoflagellates on the waves of the ocean

at night, or the flurry of a flock of migrating butterflies, or the fiery brilliance of a maple tree in the fall, or the vibrant color of prairie flowers, or any of millions of other scenes, biological beauty has the power to stop us in our tracks. It strikes us with awe and convinces us again and again of the beauty of the Creator.

Biological beauty has inspired poets, painters, sculptors, composers and artists of all types and in all cultures. No one has matched it or fully captured it, though many have tried. Countless lifetimes of talented artists have been committed to sharing that beauty with others. As awesome as the creation's beauty is, how much greater is the beauty of the Creator.

Multifaceted Beauty

There are many different types of biological beauty in the world. Different sources of beauty can stimulate different senses. Our sense of touch reacts to a cool carpet of grass, a velvety cluster of mimosa leaves, the smooth scales of a boa, the sandpaper roughness of a shark, the soft fur of a chinchilla, and myriad other textures. God has designed organisms to stimulate our senses of smell, taste, sound, and sight in thousands and tens of thousands of different ways.

The same biological scene can not only be perceived with different senses, but also from different vantage points. We examine it from above and below, from the north and the south and the east and west. We can even examine it at different scales, with our own eyes and with aids from lenses and microscopes. And that same biology yields a distinct beauty in each case—from every perspective.

When God gifted humans to appreciate beauty, each person was graced with an appreciation of a unique type of beauty—giving rise to the phrase 'beauty is in the eye of the beholder'. Yet, God fashioned the biological creation in such a way as to stimulate each unique perspective. When a person shares the beauty he or she sees, others are given the privilege to appreciate a beauty they would otherwise have missed. When the perspectives of all people are combined biology is seen to be a magnificent tapestry of interwoven beauties. Like a well-cut diamond, the beauty of biology is multi-faceted. In a similar manner, God is uniquely beautiful in every situation and seeks to illustrate His beauty in all situations.

Sparkling Beauty

Finally, creation's beauty is not boring. It is diverse and it is ever-changing. The same highway turnout never manifests the same vista, for biology is always changing. Every stunning view changes because different organisms are active at different times of the day and different seasons of the year. Organisms also change shape and size as they grow, change color and form with the seasons. And movement characterizes most organisms—sometimes the movement of the whole organism, but always the movement of its components.

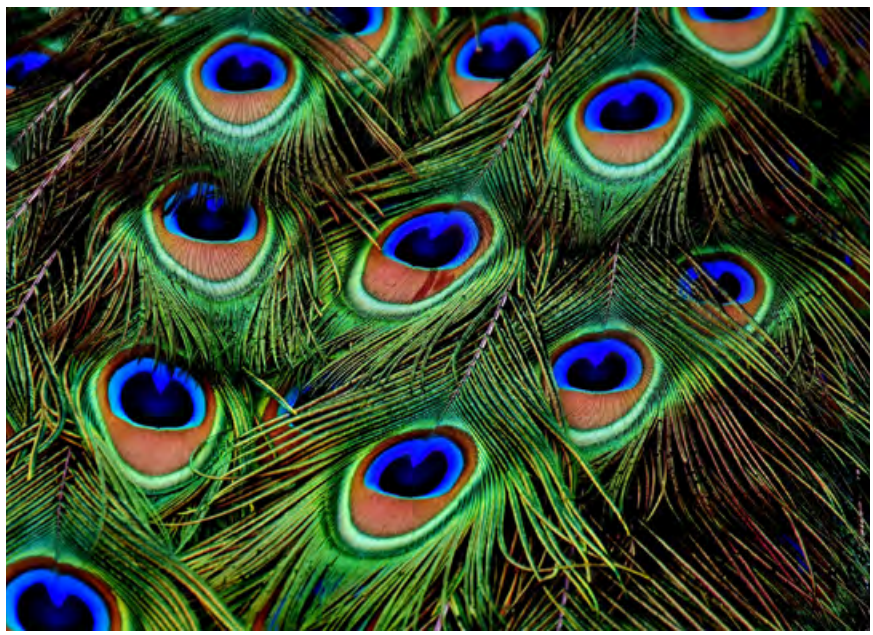
Creation's beauty is vibrant. It sparkles, if you wish, and that sparkle has its own beauty. The beauty of the creation is always surprising and always refreshing. God is an unchanging God—in the sense that He will always have an unbounded quantity of each of His attributes. He will always have unbounded holiness, power, beauty, and so on. For example, He will always and forever have unbounded love toward us, but every moment of every day we realize the impact of that love in a new and fresh way. It is as if His love 'sparkles'. Each of His attributes sparkles. God Himself—His nature and His beauty—is always surprising and always refreshing. God's beauty sparkles, and that sparkle has its own beauty.

The Origin Of Beauty

The ancient Greek philosophers were fascinated by beauty. They marveled at its splendor, speculated on its true nature, extrapolated to its perfection, and wondered about its origin. Millennia later, the origin of beauty is a puzzle to modern evolutionists because natural selection (thought to be the primary mechanism of change in naturalistic evolution) should select survival or efficiency over beauty. If organisms refocused the energy they currently use to 'be beautiful' in order to outcompete the organisms around them, they would be better survivors. They would be better players in the struggle for the survival game known as evolution.

If peacocks had shorter tail feathers they could fly better and more readily escape from predators. Charles Darwin (1809-1882) suggested that peacocks have beautiful tail feathers because peahens mated only with beautiful peacocks. But then, why did peahens do that? Their young would have survived better if they had chosen peacocks that could fly better[a]. In like manner, if butterflies did not stand out so well, fewer of them would be eaten by birds.

a Evolutionists have devised explanations (the most common of which is that beauty is an indication of health, so when peahens choose beauty they are implicitly choosing the desirable quality of health). Although many of these theories seem reasonable, none of them work well upon testing (*e.g.* there is little relationship between the 'beauty' of peacock feathers and the health of the peacock; peahens do not consistently choose either the most beautiful peacocks or the healthiest). Evolutionary theory continues to struggle to explain the origin and maintenance of biological beauty.



If natural selection was truly the source of biological variety, then we would expect there would be little to no beauty in the world. And, as long as natural selection has operated in the world (since the Fall of man), it has systematically taken beauty out of the world. Yet, there is still a profound amount of beauty in the world. Imagine how much beauty there must have been in the beginning! A God of beauty infusing the creation with beauty is the only reasonable explanation for the deep, profound, ubiquitous, multi-faceted, sparkling beauty we see in this world. Creation's beauty testifies of the Creator and stands as a substantial argument against naturalism and evolution.

Human Appreciation of Beauty

Humans appreciate beauty. Even though different humans appreciate different types of beauty, every human appreciates some sort of beauty, and that beauty is found in God's creation. Every human being is awed by biological beauty. The ability to appreciate beauty, and to be awed by it, are as God-given as beauty is itself. Freezing in awe at the beauty of His creation is not the best survival tactic in a savage world. Natural selection would tend to take out the appreciation of beauty. It would especially rid the world of the tendency to be awed by beauty. Consequently, the ubiquitous appreciation of beauty in humans and the tendency to be awed by beauty also testify of God's creation.

Consider, for example, how sensitive we are to beauty. If survival was our only reason for existence (which is more or less what is true in

naturalistic evolution), we would not need our senses to be as sensitive as they are. Humans, for example, could get along quite well without seeing color. We could also get along with recognizing fewer tastes and smells. But God gave us these extreme sensitivities so that we could recognize beauty in biology. He desires for us to recognize biological beauty so that we can better understand the beauty of the unseen God. God has given us the capacity to see color—and to hear and taste and feel and smell to the extent that we can—as a blessing. They are a gift from the God Who desires us to perceive God's invisible nature from those things that were made.

Beauty: Our Responsibility

Our Responsibility to God

As priests of the creation (see Chapter 1) we have a responsibility to know God, worship God, make the creation a house of worship, and bring the creation into the worship of God. What we learn about biological life can help us do that. A study of biological beauty gives us insight into God's very nature. Even a casual acquaintance with the awe-inspiring beauty of the biological world ought to remind us—at the very least—that our God is a God of awesome beauty.

A closer look at biological beauty gives us even further insight. For example, God created a spectrum of perfection of beauty. God created some things that appear to lack beauty altogether. He garnished other

things with stunning beauty, and still others with various levels of beauty between these extremes. There is, in fact, a complete spectrum of things from the non-beautiful to the strikingly beautiful. In the sky, for example, such a spectrum exists: "one glory of the sun, and another glory of the moon, and another glory of the stars, for one star differs from another star in glory" (I Cor. 15:40-41).

Even among humans there is a spectrum of perfection of beauty. Some of us are not so attractive—in fact, some of us might be just downright ugly! Others are stunningly beautiful. Most humans, of course, find themselves somewhere on that spectrum between these two extremes. Beyond humans, as Christ indicated (Mat. 6:29), even a simple plant (such as a single lily) has been graced with more beauty than is found even among the most beautiful of humans and the most beautiful of human creations. Organisms, then, create another spectrum of perfection of beauty. There are organisms that appear quite ugly to us, and others that are ugly (or is it cute?) in a homely sort of way. Other organisms are tolerably pleasant to perceive and still other organisms are truly gorgeous. The millions—in fact, millions of millions—of organisms make up quite an impressive spectrum of perfection of beauty.

In our mind's eye, we can follow that spectrum from the most unattractive to the most beautiful, and project beyond, imagining even greater beauty than we observe in all the creation. We can extrapolate towards the existence of infinite beauty—God Himself. Even though our brains cannot fully grasp it, through this process we can get a bit of a glimpse of the boundless beauty of God. He is the source of all beauty, the sustainer of all beauty, and He Who makes all things beautiful in His time. His beauty is without bounds, infinitely greater than all the beauty we see about us. The awesome spectrum of perfection of biological beauty—whether found in landscapes, or butterflies, or birds, or flowers—ought to aid us in understanding a bit of His beauty and ought to cause our hearts to lift up in worship towards the Source of all beauty.

Scripture indicates that God is active, everywhere present, creative, and desirous of relationship with us. Biological beauty reinforces these claims and gives further insight into their meaning. The sparkling nature of biological beauty, for example, is consistent with God being an active, dynamic, living God, and provides insight into what it means

for God to be a living God. The ubiquity of that sparkle suggests that God is active over us, among us, and within us—even in those things we sometimes consider too mundane or lowly to concern the great God.

Beauty informs our understanding of the ever-present, on-going care by God of every aspect of our lives. The deep and ubiquitous nature of beauty is consistent with His omnipresence. God's presence at all places and all times is suggested by the beauty we see everywhere, at all times, at all scales—even when we are otherwise unaware of His presence. The multi-faceted nature of beauty impresses upon us the creativity of God. Providing each of us a beauty fitting our individual appreciation of beauty, reinforces the sense in which He interacts with us as individuals and cares about our individual needs.

The fact that we have been given the tools to appreciate the beauty of the creation when those are not 'necessary' for our survival is consistent with God's desire for a relationship with us. This reminds us of how He loves us so much that He steps down from His worthy greatness so that we can understand and know Him. Finally, the mechanisms He has put in place to make sure that biological beauty is restored when it is marred, reminds us of how He is able, willing, and even desirous of restoring the ugliness of our lives and 'make all things beautiful in His time'.

When we allow the Holy Spirit to reveal these aspects of God to us through the beauty of His creation, how can we not explode in worship? As you then acknowledge the origin of that beauty—in the person of

God—you glorify God. As you continue your study of the beauty of organisms and the greater beauty of His being, your worship increases, you then fill the creation with His worship. You cannot then help but share that wonder with others and bring them into His worship with you. In this way you fulfill your role as priests of the creation.

Our Responsibility to the Creation

Preserving Beauty. In our responsibility as kings over the creation (see Chapter 1), we should serve God, and serve and protect the creation. After God infused beauty into His vast creation, he handed it over to us to 'guard and keep it'. We have a responsibility to preserve the beauty of creation and pass that beauty on to the next generation. Some activities mar the beauty of the creation in an obvious and direct sense (*e.g.* clear cutting, strip mining, burying trash in landfills, polluting).

More generally, though, human development (such as the construction of new homes, highways, factories, office buildings, schools) often replaces the natural beauty of creation with something substantially less beautiful. It should be noted that many of these changes are *necessary*, because being in the image of God, the needs of humans have a higher priority than even preserving the beauty of the creation. We often *must* reduce the beauty of His creation so as to meet the needs of others.

However, it is often possible to replace the beauty that was there with another beauty that is at least as honoring to the God Who created it. In those locations where beauty has already been reduced, we should strive to re-infuse beauty so as to restore the glory that God receives for it. In those cases where we are planning to develop an area, we should include designs that generate at least as much beauty as we will have to destroy in the process of construction.

Enhancing Beauty. Although God created an enormous amount of beauty in the creation He created the *potential* for even more beauty. He also gave humans the ability to reveal that beauty—to 'create' beauty. He gave us the opportunity to bring God even more glory by bringing out more of the beauty than was evident in God's original creation.

One of the simplest ways to enhance creation's beauty is by rearranging the organisms of God's creation, thus creating more beautiful combinations of organisms. The 'Garden of Eden' was created

by God (Gen. 2:8). God apparently selected a number of organisms, arranged them in a beautiful pattern, and placed them in the area He had set aside to be the 'Garden of Eden'. God then placed man into the Garden 'to dress and keep it' (Gen. 2:15).

It is likely that from that moment on throughout human history, in the pattern established by their Creator, humans have been active in what is sometimes called **'artificial selection'**[a]—selecting organisms and arranging them in beautiful patterns. Given that the organisms themselves were created by God, the beauty of such rearrangements is appropriately ascribed to God. Consequently, through gardening and landscaping we can glorify God by creating beautiful arrangements of organisms.

selection, artificial—human choice of some available organisms (e.g. for use or breeding)

A second method of enhancing the beauty of God's creation is by **breeding**—where humans select what organisms are to be bred (mated or crossed) with what other organisms. Breeding can be used to make a desired characteristic more common or it can be used to combine characteristics of two organisms in a unique fashion. Changing the frequency of characteristics and creating new combinations of characteristics can produce beauty that was not recognized before.

breeding—human activity of controlling what sorts of organisms are produced in the next generation by selecting which parents are mated (or 'crossed')

Breeding can also reveal characteristics not seen in either parent, thus displaying beauty hidden in the organisms ('gifts of glory' placed there by God). Breeding is an ancient practice which may date back as far as the Garden of Eden. It is certain that it goes back at least to the time of Jacob, for God blessed Jacob by breeding livestock for him—and revealing to Jacob how He did it (Gen. 31:8-10). Breeding has produced hundreds of thousands of varieties, breeds, and cultivars of organisms, including hundreds of varieties of dogs, scores of varieties of pheasants, horses and cattle, roses, apples and peaches, and tens of thousands of varieties of orchids. Breeding new varieties of plants or animals that are cheaper to raise, or easier to keep healthy, or easier to get to market, or better-tasting or more attractive, *etc.*, is an enormous industry in our modern world.

Yet it is also clear that breeders are merely revealing designs that were already present in the parent organisms, something God probably placed within those organisms at their creation. Such breeding has increased the beauty that is actually manifested in the creation, thus directly bringing more glory to God. To whatever extent it is then

a It is termed 'artificial' because it is done by humans and not by the 'natural' world.

acknowledged that the new breeds were not actually created by humans, but put there by God, God receives even more glory.

Finally, beauty can also be enhanced by creating more fundamental rearrangements of God's creation. Entire human professions have been created to enhance the beauty in God's creation in this very manner. Interior decorating, cosmetology, the culinary arts, the fine arts—these are all examples of entire disciplines devoted to *increasing* the beauty in the world. Properly executed, practitioners of these activities can glorify God in profound ways.

Summary of Chapter

A. Beauty is a holistic concept where multiple attractive characteristics are woven together in a compelling manner. Because the various attributes of God are attractive and woven together into a compelling whole, God is beautiful. And, given that the attributes of God are infinite, God's beauty is infinite.

B. Because God is invisible and He wishes us to know Him, He made Eden, the tabernacle, the temple, and heaven beautiful and He infused the creation with beauty (including the biological world).

C. God also created things with different measures or perfections of beauty (e.g. ugly things, less ugly things, mildly beautiful things, stunningly beautiful things). Humans have been created in such a way that they take this spectrum of perfection of beauty and extrapolate through the spectrum of beauty that we can see towards the infinite beauty of God Himself.

D. Biological beauty is deep (i.e. found at every size scale in the universe), ubiquitous (everywhere on earth), profound (intense, awesome), multi-faceted, and sparkling.

E. God created natural processes that restore biological beauty when it has been lost or damaged. These processes include healing processes in organisms and community succession in groups of species. Community succession (from a pioneer community to the climax community) is a series of communities of organisms, each modifying the environment to make it suitable for the community to follow.

F. The only reasonable explanation for the origin of biological beauty and the human ability to appreciate and be awed by beauty is that God infused beauty into the creation so that we could see illustrations of His infinite, but invisible, beauty.

G. Modern evolutionists believe natural selection is the process that makes evolution possible. Yet, in principle, natural selection selects efficiency over beauty—thus systematically reducing the beauty in the biological world. Natural selection would also tend to select against the human ability to appreciate beauty. Since evolution is the logical consequence of the naturalistic worldview, naturalism has no adequate explanation for how biological beauty came to be nor how human developed the ability to appreciate beauty, let alone how biological beauty could be so abundant, so deep, so ubiquitous, so profound, so multi-faceted, and so sparkling.

H. The abilities humans have to perceive beauty and to be awed by it are gifts of God given so that we could grow in our understanding of His infinite, but invisible beauty.

I. Studying biological beauty allows us to be better priests of the creation by

   a. giving us greater insight into Who God is (His beauty, the infinite nature of His beauty, He as the source of beauty, His continuous activity, His care for the details of our lives, His omnipresence, His creativity, His desire to be known, His desire to make our lives beautiful) and giving us cause to

   b. worship God, and

   c. bring others and the creation into the worship of God.

J. Our kingly responsibility to biological beauty is

   a. to preserve the beauty of the creation (e.g. prevent pollution, replant logged areas, design parks and landscaping in new construction),

   b. to restore creation's beauty wherever it has been marred by human sin (e.g. clean up pollution), and

   c. to enhance creation's beauty to the glory of God. We can enhance creation's beauty

      i. by rearranging organisms of the creation into beautiful new communities of organisms (e.g. gardens),

      ii. by breeding organisms to generate plants and animals with new combinations of characteristics, and

      iii. by breeding organisms to reveal beauty that God hid inside organisms.

Advanced Discussion Topic

Some argue that beauty is an illusion because 'beauty is in the eye of the beholder'. Develop a response to this argument. Consider the following: the number of people who believe beauty does not exist at all; the existence of things that everyone finds beautiful; and the difference between the existence of beauty and types of beauty.

Test & Essay Questions

1. Define deep beauty / ubiquitous beauty / community succession / climax community / pioneer species / profound beauty / multifaceted beauty / sparkling beauty / spectrum of perfection of beauty / artificial selection / breeding.
2. Compare and contrast deep beauty and the beauty of human creations, and then the origin of biological beauty in the naturalistic and Christian worldviews.
3. Short Essay: In what sense can an invisible God be beautiful? (Not how does he *show* His beauty, rather how *is* He beautiful when He cannot be seen?)
4. Why did God make the biological world / New Jerusalem beautiful? // Why did God specify that the tabernacle / temple be beautiful?
5. Short Essay: What does it mean for biological beauty to be deep / ubiquitous / profound / multifaceted / ever-changing and what does this suggest about God's nature?
6. Short Essay: What is the spectrum of perfection of beauty, and what are we supposed to deduce from it?
7. Short Essay: How is the origin of biological beauty / human appreciation of beauty better explained in the Christian worldview than in the naturalistic worldview?
8. Short Essay: Why should we preserve / enhance biological beauty?
9. Short Essay: Why did God hide potential for beauty in the creation?
10. Short Essay: How can interior decorating / landscaping / cosmetology / the culinary arts / the fine arts be used to glorify God?

CHAPTER 14

FULLNESS OF GOD

Biological Reproduction

"'I fill all of heaven and earth', says the Lord"
Jer. 23:24, NCV

Christ "...fills everything in every way."
Eph. 1:23, NCV

14.1 | Fullness of God

God is an infinite God. He has every good attribute and He possesses each attribute fully, completely, and perfectly. He is everywhere, *filling* the heavens, the earth, and all things (Jer. 23:23-24; Eph. 4:10). Consequently, he wishes to *fill* our mouths (Psa. 81:10), *fill* the land with fruit (Isa.27:6), and provide *fullness* of joy (Psa. 16:11). God is *abundant* in goodness (Exo. 34:6), truth (Ex. 34:6), forgiveness (Isa. 55:7; Titus 3:5), grace (Rom. 5:17), and mercy (I Pe. 1:3). He *abounds* with blessings and grace (Pr. 28:20; II Cor. 9:8). He gives *abundantly* (Deu. 28:47; Psa. 36:8; 132:15) and not just more life, but more *abundant* life (John 10:10). He is *rich* in mercy (Eph. 2:4) and gives *richly* (I Tim. 6:17). God is *perfect* (Mat. 5:48) and desires us to be *perfect* (Deu. 18:13; Mat. 5:48; II Cor. 13:11) and to be *perfected* (Eph. 4:12-13; Col. 1:28; II Tim. 3:17; Heb. 6:1; 13:21; James 1:4).

To emphasize His fullness, completeness, and perfection, God delights in giving a lot, then giving even more, so that He has given abundantly, and then when we think no more can be given, He gives again (*e.g.* Mal. 3:10).

The biological creation also illustrates his fullness. When God created the animals of the sea and the air, He did so *abundantly* (Gen. 1:20-21), and then He commanded them to 'be fruitful and multiply'! God intends for organisms to be found everywhere on this planet, and everywhere they are found they are to abound.

God's blessing and presence is demonstrated by the abundance of organisms, and His judgment and absence by the paucity of organisms. But God's mercy often replaces judgment with blessings, so that even after the earth's greatest judgment of life (the Flood), God blessed Noah's family, and the animals, to multiply abundantly and fruitfully (Gen. 8:17).

"Be Fruitful"

One of the most impressive characteristics of the biological world is its ability to reproduce. Non-living materials cannot reproduce. What we observe across the creation is that even though energy can take on different forms, the total amount remains the same (the First Law of Thermodynamics). Atoms and molecules cannot reproduce either. Their components can be broken down or built up as they rearrange

themselves into different atoms, molecules, and compounds, but this is not reproduction.

Organisms are unique in being able to increase the numbers of their *kind*—one bacterium becomes two bacteria, two foxes become three, *etc.* Reproduction is producing another of the same kind. In reproducing, organisms are uniquely designed to illustrate God's fullness and completeness, because by reproducing, organisms alone can *abound*.

Genesis 1:21 indicates that when created, the sea creatures were abundant. Being abundant, animals were a physical illustration that God is an abundant God. He abounds in each of His attributes. He abounds in His ability, and He abounds in demonstration of that ability. The abundance of life points to God. The abundance of life glorifies God. Even so, the next verse implies that although abundant, the sea creatures had not yet filled the seas, so He commanded the sea creatures to 'be fruitful and multiply and fill the waters in the seas' (Gen. 1:22).

Increasing in numbers suggests God is vibrant and active. He is not asleep, unconcerned, bored, or boring. It suggests that God is more than abundant. Whatever amazes us, He exceeds. When we think that He can do no more, He does even more. Increasing beyond abundance physically illustrates the infinity of God. God does not just abound in His attributes. He is perfect, complete, and infinite in each and all of His attributes. Animals were commanded to reproduce and multiply

and fill the earth in order to bring glory and pleasure to the God Who created them.

Cellular Reproduction

Cell theory claims that organisms are composed of cells. Some organisms spend their entire lives as single cells. Such organisms are referred to as **unicellular**. The remaining organisms are **multi-cellular**. Yet, even multi-cellular organisms begin their life as a single cell. Even organisms *capable* of developing from multi-cellular fragments, like a rose generated from a cutting or a sea star developing from an amputated arm, do so as an alternative form of reproduction. They usually develop from a single cell. Ever since the Creation Week, multi-cellular organisms begin their life as a single cell. And, since each of these cells was generated from another cell, the reproduction of every organism begins with **cellular reproduction**. Whether speaking of the reproduction of bacteria, redwoods, or humans, they all begin with cellular reproduction.

unicellular—organism that is made up of only one cell

multi-cellular—organism made up of more than one cell

cellular reproduction—cell process that divides a (parent) cell into two or more daughter cells.

Cellular reproduction usually involves one ('parent') cell dividing into two smaller ('daughter') cells. This involves four steps:

1. Getting two full sets of DNA into two different parts of the parent cell and—in the case of eukaryotes, developing a nucleus around each set (**karyokinesis**);
2. Getting two sets of the remaining cell components in two different parts of the parent cell;
3. Dividing the parent cell into two daughter cells (**cytokinesis**); and
4. Growing each daughter cell to full size and restoring a full complement of cell components.

karyokinesis—nuclear division; eukaryotic cell process that divides a cell nucleus into two nuclei

cytokinesis—cell process that divides a cell in two

In eukaryotes there is often more than one organelle in the cell (*e.g.* mitochondria and chloroplasts). For these organelles, some end up in one daughter cell and the rest end up in the other. Less well-defined plasma membrane organelles, like the endoplasmic reticulum and Golgi bodies, are divided along with the cytoplasm. A portion ends up in one daughter cell while the remaining portion ends up in the other. In all cases, it is *after* cytokinesis that the organelles are restored to the normal cell quantity in each daughter cell.

In the cellular reproduction of eukaryotes, the most significant challenge is the dividing of the DNA and nucleus in such a way that each daughter cell ends up with both a nucleus and a complete copy of the DNA. This process is called karyokinesis or nuclear division, and the process occurs *before* cytokinesis. Nuclear division itself involves three steps:

replication—cell process that makes a copy of the cell's DNA

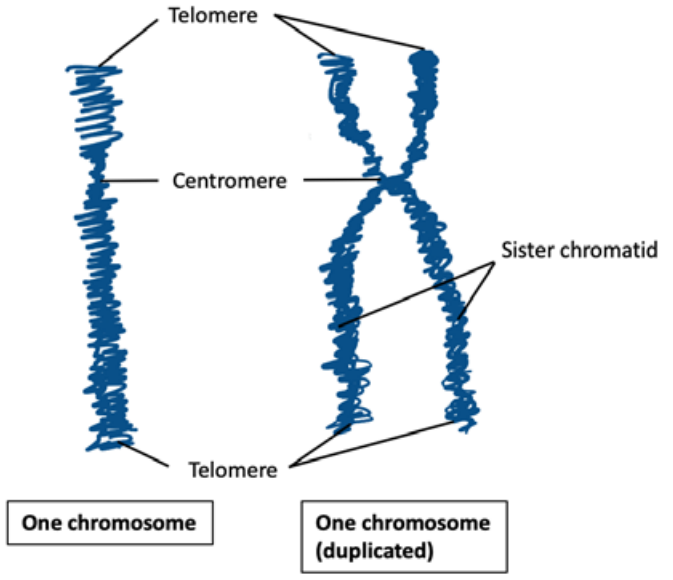
sister chromatids—(following replication) two identical DNA molecules attached at their centromeres

centromere—section of a chromosome containing proteins for attachment

condensation—the dense packing of a chromosome that occurs at the beginning of mitosis or meiosis

chromosome—(in a eukaryotic cell) a linear segment of DNA and its associated proteins

1. **Replication** makes a copy of the DNA so that each daughter cell will have a complete copy of its own. In replication, each piece of DNA is unzipped and a complement is built off each half. For each piece of DNA, this generates two identical DNA molecules (called **sister chromatids**). As the cell enters the next stage, each pair of sister chromatids remain attached to each other at a site known as a **centromere**.
2. **Condensation** packages DNA in such a way as to make it easy to separate into different parts of the parent cell. When it is functioning normally, DNA has to be fully extended, allowing for portions to be untwisted, unzipped and copied. But in its extended form it is an extremely long molecule (a total of about a yard long in the case of the DNA in single human cell). As such, it is extremely difficult to move around (rather like trying to separate or move several very long strands of yarn). To make it easier, each DNA molecule is 'condensed'—that is, carefully wrapped up in a compact form known as a **chromosome** (rather like wrapping up



yarn in a skein to allow it to be transported, sold, and used for knitting).

Whereas DNA cannot be seen under a normal microscope when it is in its extended form, condensed DNA is stubby enough to show up. And, since the proteins that help form the chromosome stain rather easily, condensed DNA shows up under the microscope as a 'colored body' ('chromo': colored; 'some': body).

3. When chromosomes first show up under the microscope, the cells are said to enter mitosis or meiosis, depending upon the type of reproduction that is occurring. If the parent cell is making an exact copy (clone) of itself, the cell nucleus goes through mitosis. This type of division occurs when a unicellular organism (*e.g.* a yeast) reproduces by asexual reproduction. It also takes place in multicellular organisms when they grow by increasing cell numbers or when organisms repairing themselves by replacing damaged cells.

   The result of mitosis is two daughter cells with DNA identical to each other and to the DNA of the parent cell. If, however, the parent cell is producing sperm or egg cells for sexual reproduction, the cell nucleus goes through meiosis (pronounced 'my-ōsis'). Meiosis yields four daughter cells, each with half the amount of DNA the parent has, and each with unique DNA.

As impressive as the process of cellular reproduction is, it is not the 'normal' part of cell life. Through the entire process of mitosis or meiosis, DNA is condensed, and while it is, the information on the DNA cannot be accessed. Furthermore, until the quantity of cell components reaches that of mature cells, a cell usually cannot fulfill the optimum functions for which it was designed. Consequently, most of the lifetime of a given cell is spent *between* divisions—in other words after the cell has fully grown from the previous division and before it begins replicating its DNA for the next division.

It has become traditional in biology to label the stages in the life of a cell as the **cell cycle**. The **interphase** is that portion of the cell cycle when the nucleus is not dividing. It includes three substages. The first substage of the interstage is labeled G1, which includes the growth of a cell following the previous division as well as the 'normal' part of the cell's life when the cell carries on its normal operations. The second and third substages are short in duration and prepare the cell for

cell cycle—stages and substages in the life of a cell. Stages: interphase when the nucleus is not dividing; mitosis or meiosis when the nucleus is dividing

interphase—stage in the life of a cell when the cell is not dividing

dividing the nucleus. The second substage is the S (Synthesis) substage when replication occurs. During the third substage, G2, the DNA is double-checked for copy errors and the DNA begins to condense.

Mitosis

When an exact copy of a eukaryotic cell is needed (such as when a unicellular organism reproduces asexually, or as a multi-cellular organism grows, or replaces cells) mitosis is how a cell divides its nucleus and DNA. There are four substages to mitosis:

prophase—first mitosis substage, when chromosomes, centrioles, and spindle fibers appear and nuclear envelope and nucleoli disappear; see prometaphase

metaphase—mitosis substage when chromosomes align and attach to centrioles via spindle fibers

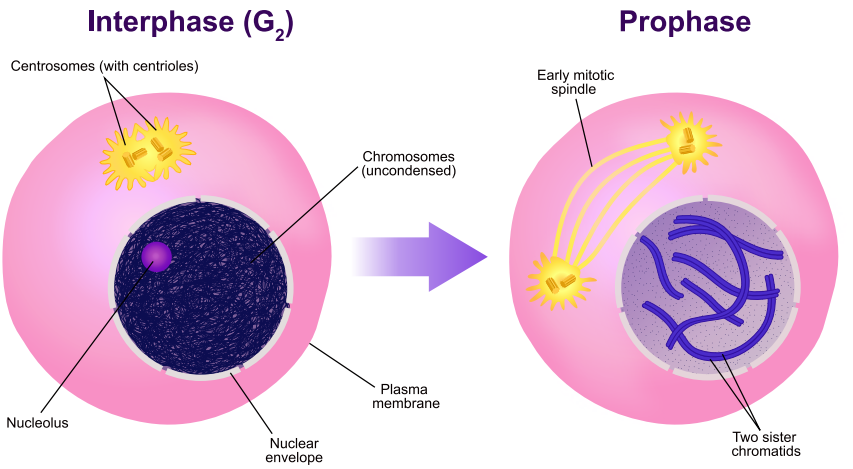
anaphase—mitosis substage when sister chromatids separate to opposite ends of the cell

telophase—last mitosis substage, when, in both cells, chromosomes and centrioles disappear, and nuclear envelope and nucleoli appear

prometaphase—mitosis substage some place after the prophase, when the nuclear envelope dissolves

1. **prophase** ('pro' or *pre* phase), when chromosomes complete their condensation, the nucleolus and the nuclear envelope dissolve, centrioles (aka centrosomes) develop on opposites ends of the cell (toward which cell components will be pulled for each daughter cell), and spindle fibers begin forming (microtubule molecules that function as ropes to pull cell components to each centriole);
2. **metaphase**[a] ('meta' or *change* phase), when the chromosomes line up in a plane halfway between the centrioles, and the sister chromatids of each chromosome attach by spindle fibers to opposite centrioles;
3. **anaphase** ('ana' or *separation* phase), when the sister chromatids are separated from each other and pulled to centrioles at opposite ends of the cell; and

a Many modern biologists see enough significance to the interesting process of dissolving the nuclear envelope to insert the **prometaphase** between prophase and metaphase (containing the end of the old prophase and the beginning of the old metaphase). Mitosis is described in this text with four stages (without the prometaphase) simply to make the mitosis stages easier to remember.



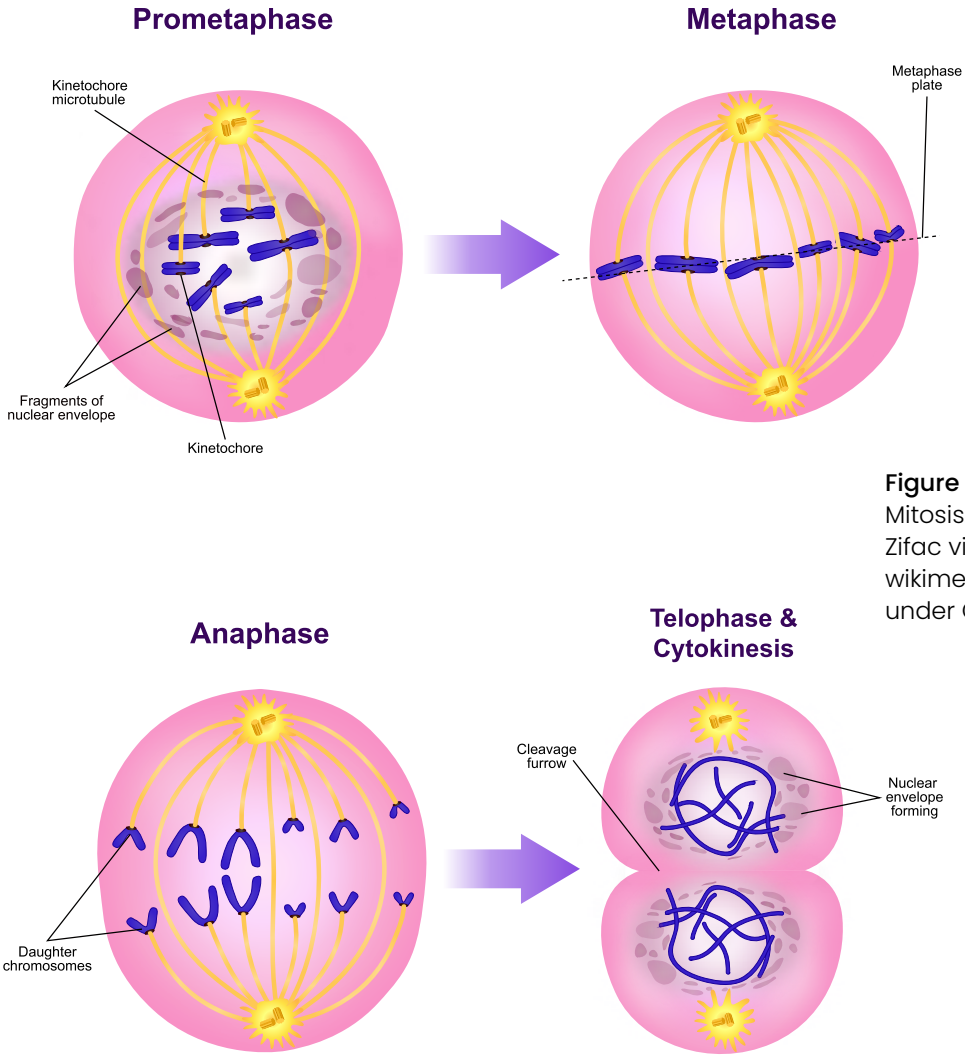


Figure 14.1
Mitosis. Image by Ali Zifac via commons.wikimedia.org, used under CCby4.0.

4. **telophase** ('telo' or *purpose* phase), when spindle fibers dissolve, centrioles disappear, chromosomes begin decondensing, a nuclear envelope begins forming around each set of chromosomes, and nucleoli begin reforming.

In the process of mitosis, a cell with one nucleus containing two identical copies of the DNA becomes a cell with two nuclei—one on each end of the cell—each nucleus containing an identical set of DNA to the parent cell before replication. Following mitosis, cytokinesis divides the cell into two daughter cells.

VIDEO 14.2

14.2 | Meiosis

God desired to demonstrate the diversity of His own being by creating a high diversity of species. He also created great variation *within* each species. Genes found in the same species can assume different forms. To increase this diversity even more, God designed many organisms requiring *two* copies of every gene, not just one. By the many different combinations that are possible, this diploid condition, squares the number of different traits. For an organism to be diploid, every chromosome has a **homologous chromosome** of the same length with similar sets of genes in the same sequence.

homologous chromosomes—two chromosomes containing the same genes in the same sequence

Even more variety is introduced by sexual reproduction, when offspring are created by combining DNA from two parent organisms. To make sure that this results in the proper amount of DNA in the offspring, special **gamete** cells (also known as sex cells) are produced. These are called haploid cells because each carries only half the DNA of the parent.

gamete—haploid cell generated by meiosis in sexual organisms (aka sex cell). Types: a sperm, at fertilization, contributes only DNA; an egg cell, after fertilization, grows into an adult organism

The gamete carrying half the male parent's DNA is a **sperm cell**. The gamete carrying half of the female parent's DNA is an **egg cell**. Fertilization occurs when the DNA of the sperm cell is injected into the egg cell. In most cases, the fertilized egg that results contains the same amount of DNA as each parent—two haploid sets of DNA make up a full diploid set of DNA. Meiosis is the type of nuclear division needed to produce egg cells or sperm cells.

sperm—(haploid) gamete of a sexual (usually male) organism that contributes only its DNA at fertilization

egg cell—(haploid) gamete of a sexual (usually female) organism that grows into an adult after fertilization

Since the process of mitosis divides twice the original amount of DNA into two cells, each with the original amount of DNA, if mitosis were performed twice in a row, the result will create four cells, each with half the original amount of DNA. That is roughly what meiosis involves—a cell going through something like mitosis twice in

succession, thus creating four gamete cells. The substages of meiosis are as follows:

1. Meiosis I
    a. **prophase I** is identical to prophase in mitosis (with the completion of condensation, the disappearance of the nucleolus and nuclear envelope, and the appearance of centrioles and spindle fibers) *and* homologous chromosomes connect at their centromeres and **crossing over** occurs (equivalent sections of chromosomes are traded from one chromosome to another);
    b. **metaphase I**[a], when pairs of homologous chromosomes line up in a plane halfway between the centrioles and spindle fibers connect the centromeres of each homologous chromosome to opposite centrioles.

a As in the case of mitosis, meiosis is often described now with an additional phase, **prometaphase I**.

prophase I—first meiosis substage: chromosomes, centrioles, & spindle fibers appear, nuclear envelope & nucleoli disappear, homologous chromosomes pair, and crossing over occurs; see prometaphase I

crossing over—process in prophase I when homologous chromosomes exchange genetic material

metaphase I—meiosis substage when homologous chromosome pairs align and attach to spindle fibers

prometaphase I—meiosis substage some place after prophase I, when the nuclear envelope dissolves

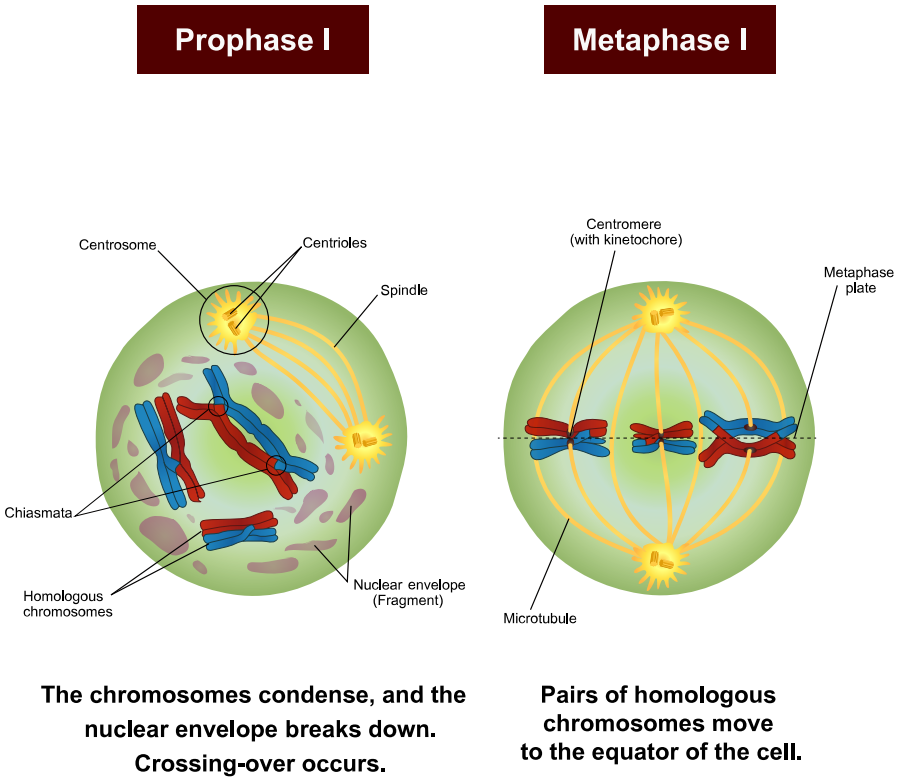


Figure 14.2a
Meiosis I & II. Image by Ali Zifac via commons.wikimedia.org, used under CCby4.0.

anaphase I— meiosis substage when homologous chromosomes separate to opposite ends of the cell

telophase I— meiosis substage, after homologous chromosomes separate, when centrioles disappear

cytokinesis I— meiosis substage, after homologous chromosomes separate, when the cell first divides

c. **anaphase I**, when the homologous chromosomes are separated from each other and pulled to centrioles at opposite ends of the cell;

d. **telophase I**, when spindles dissolve, releasing a set of chromosomes at each end of the cell;

e. **cytokinesis I**, when the cell makes its first division;

2. Meiosis II

a. **prophase II**, when centrioles develop on opposites ends of each cell, and spindle fibers begin forming;

b. **metaphase II**, when the chromosomes in each cell line up in a plane halfway between the centrioles in that cell, and the sister chromatids of each chromosome attach by spindle fibers to opposite centrioles;

c. **anaphase II**, when the sister chromatids in each cell are separated from each other and pulled to centrioles at opposite ends of the cell; and

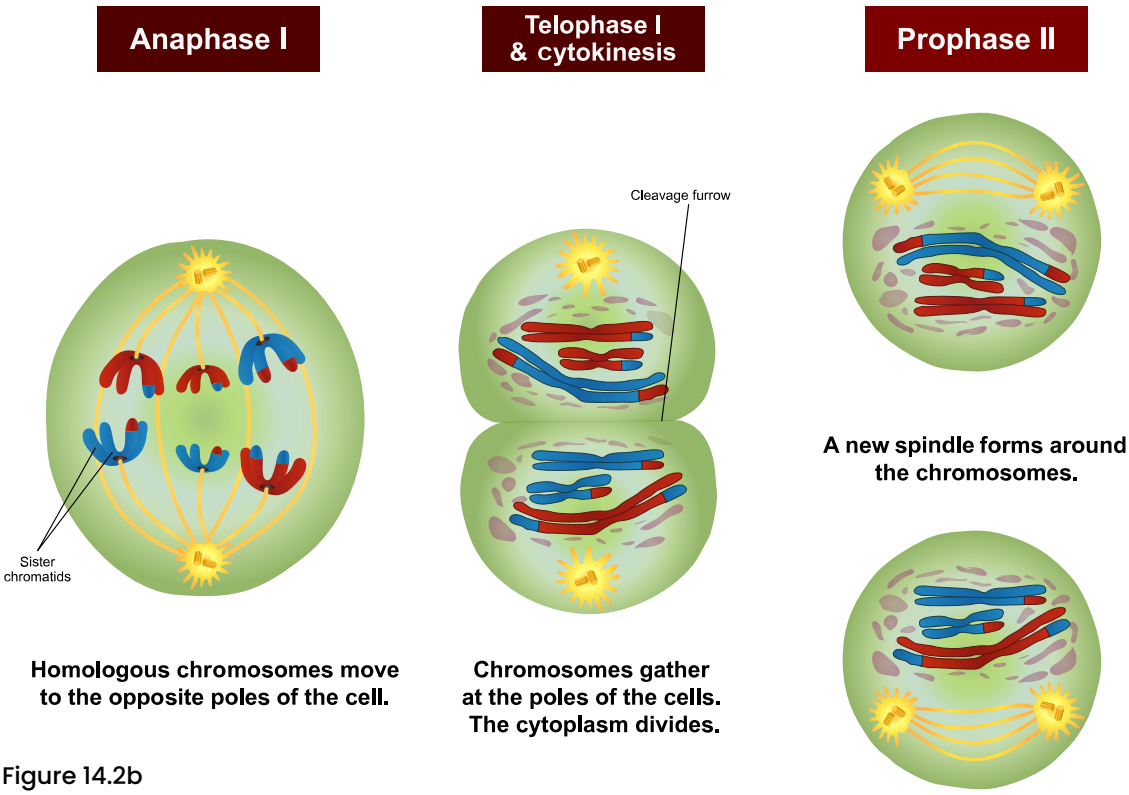


Figure 14.2b
Meiosis I & II. Image by Ali Zifac via commons.wikimedia.org, used under CCby4.0.

d. **telophase II** (the reverse of prophase I), when spindle fibers dissolve, centrioles disappear, chromosomes begin decondensing, a nuclear envelope begins forming around each set of chromosomes, and nucleoli begin reforming.

Following meiosis II, both cells divide by **cytokinesis II**, creating a total of four cells. In the process of **meiosis**, a cell with one nucleus containing two identical copies of the DNA becomes four cells containing only half the DNA of the parent cell before replication. As a result of the crossing over, each sperm and each egg carries a unique combination of traits. Depending on which sperm fertilizes which egg, even more variety can be produced.

telophase II—last meiosis substage, when, in all four cells, chromosomes and centrioles disappear, and nuclear envelopes and nucleoli reappear

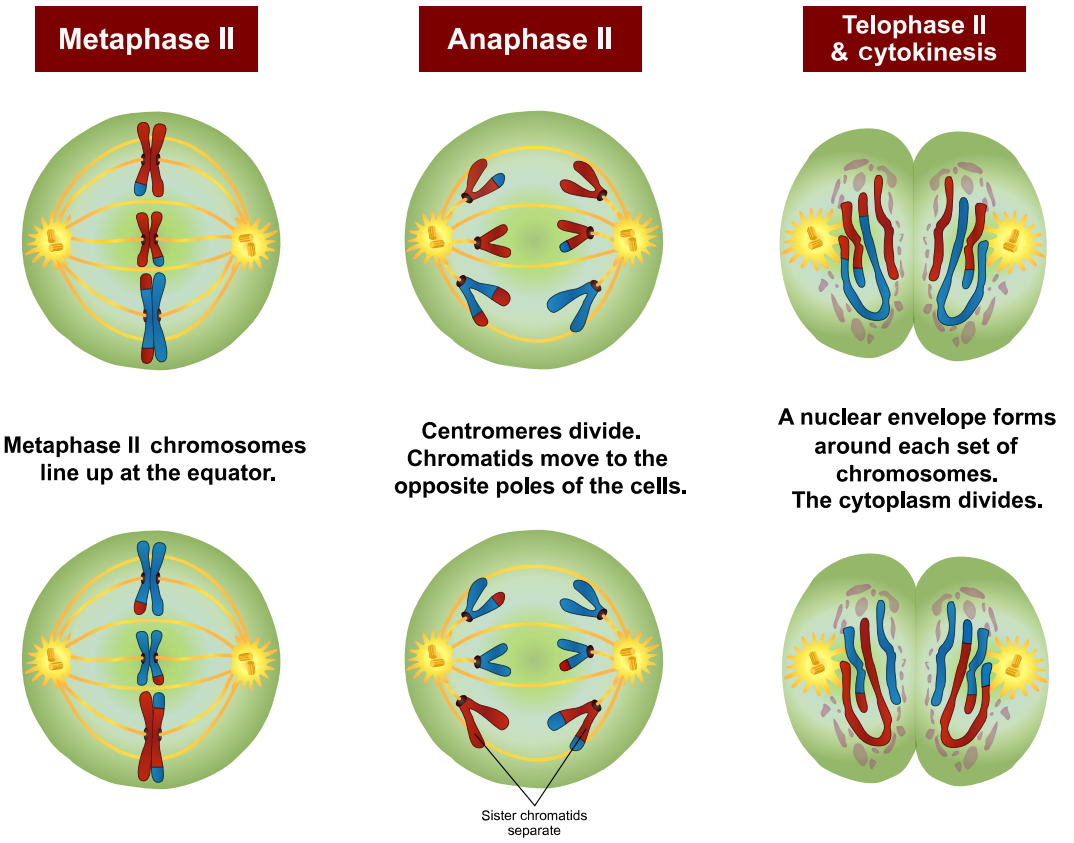
cytokinesis II—meiosis substage after the separation of sister chromatids, when the two cells divide

meiosis—(in generating sex cells) cell cycle stage yielding four nuclei with unique, haploid DNA sequences

prophase II—meiosis substage, after cytokinesis I, when centrioles and spindle fibers appear in each cell

metaphase II—meiosis substage after cytokinesis I: chromosomes align & attach to spindles in each cell

anaphase II—meiosis substage after cytokinesis I, when sister chromatids separate in each cell



GLOSSARY

abiogenesis—naturalistic theory for the origin of the first cell from non-living material

abrupt appearance—status of a fossil organism when it is not preceded in the fossil record by intermediates to any other fossil organism

acid rain—rain made more acidic than normal due to acid-causing pollutants in the atmosphere

aging, degenerative—gradual wearying of an organism—a negative effect of the curse

alga (pl. *algae*)—eukaryotic organism that is generally a one-celled, aquatic producer

allele—one of multiple character states for a particular gene

amino acid—monomer for proteins

anabolism—chemical reactions in cells that build molecules

anaphase—mitosis substage when sister chromatids separate to opposite ends of the cell

anaphase I—meiosis substage when homologous chromosomes separate to opposite ends of the cell

anaphase II—meiosis substage after cytokinesis I, when sister chromatids separate in each cell

animal—(multi-cellular) eukaryotic organism whose cells lack cell walls (also possesses biblical life)

antediluvian epoch—period of earth history between the curse and the Flood (at least 15 centuries long)

anthropic principle—the universe has characteristics that suggest it is was fashioned with man in mind

Arphaxadian epoch—first few centuries after the Flood, when the earth began recovering from the Flood

atom—an electrically neutral arrangement of proton(s) and an equal number of orbiting electrons(s)

atomic number—number of protons in an atom's nucleus (determining the properties of that atom)

autotroph—organism that gets energy from the non-biological world. Types: photoautotroph gets energy from sunlight; chemoautotroph gets energy from inorganic molecules

bacterium (pl. *bacteria*)—single-celled organisms small enough not to need organelles (aka prokaryote)

baramin—recognizable group of similar organisms surrounded by deep discontinuity that persists by members interbreeding and producing similar offspring (aka biblical kind)

baraminology—the science of the discovery and study of baramins; a creationist biosystematics method

beauty—the attractive holistic fit of an entity's attributes; deep beauty is beauty at multiple scales

bioaccumulation—accumulation and storage of pollutants by an organism

biodegradable—decomposable into components that organisms can use (vs. non-biodegradable)

biodiversity—the number of taxa (usually species)

biogenesis, law of—a general observation that a given type of organism only arises from another organism of the same type, sometimes briefly summarized by 'life only comes from life'

biogeochemical cycle—organism-driven process continuously supplying organisms with a required element by fixing the element from an inorganic reservoir, passing it through all organisms and then returning the element to the reservoir

biogeography—discipline of biology that studies where organisms live and how they got there

biological evil—anything in the biological world that causes suffering of humans or animals

biology—a science that studies organisms

biomatrix—system of bacteria, algae, protozoa, and fungi required for plants and animals to live on earth (aka organo-substrate)

biome—flora and fauna found in a particular climate and across a large area of the earth's surface

bioremediation—transformation of a harmful substance into a less toxic form

biosystematics—the science of classifying (grouping) and naming organisms

breeding—human activity of controlling what sorts of organisms are produced in the next generation by selecting which parents are mated (or 'crossed')

breeds—distinguishable group of animals that remains distinct only with breeding

Calvin cycle—chemical reactions in photosynthesis' light independent reactions that fix carbon

capillary action—natural tendency of a liquid's surface to rise where the surface intersects a vertical wall

carbohydrate—organic molecule with carbon, hydrogen, and oxygen atoms in a ratio of 1:2:1

carnivore—an animal that eats another animal (aka predator)

carnivory—the eating of animals by other animals (aka predation), an evil-minimizing effect of the curse

carrying capacity—the number of organisms a particular environment can support over the long term

catabolism—chemical reactions in cells that break down molecules

catastrophic die-off—the death, due to harsh conditions, of a large percentage of a population—usually because that population exceeds the carrying capacity of the environment

cell—tiny, membrane-bound structures that make up all organisms; smallest unit of biological life

cell cycle—stages and substages in the life of a cell. Stages: interphase when the nucleus is not dividing; mitosis or meiosis when the nucleus is dividing

cell theory—1: every organism is made of one or more cells; 2: the cell is the smallest unit of biological life; 3: every cell comes from the division of a pre-existing cell; 4: all metabolism occurs within cells; 5: heredity information is located in cells; 6: every cell has the same basic chemical ingredients

cell wall—structure outside the cell membrane strengthening cells of bacteria, algae, plants, and fungi

cellular reproduction—cell process that divides a (parent) cell into two or more daughter cells.

cellulose—complex carbohydrate making plant structure (fiber); earth's most abundant organic molecule

centromere—section of a chromosome containing proteins for attachment

chemoautotroph—organism that gets its energy from inorganic molecules

chemosynthesis—cellular process that extracts energy from chemicals in the physical environment

chitin—complex carbohydrate making up cell walls of fungi and exoskeletons of arthropods

chloroplast—triple-membraned organelle where photosynthesis occurs

Christian theism—a worldview that begins with the existence of the Christian God, Creator of the physical world and its organisms as well as the non-physical world and its non-physical beings

chromosome—(in a eukaryotic cell) a linear segment of DNA and its associated proteins

citric acid (or Krebs) cycle—aerobic respiration reactions that extract energy from carbon-hydrogen bonds

class—taxonomic level above order and below phylum

climate—average temperature (and rainfall) at a given location (*e.g.* tropical; temperate; polar; arid)

climax community—the stable community for a particular area; the last in community succession

clone—an organism with identical DNA as another organism

cloning, reproductive—producing from one organism, another organism with identical DNA. Types: horticultural cloning by rooting a plant cutting; embryonic splitting by separating the first cells of a developing animal; adult cloning by getting an adult cell to develop into a mature organism

codominant—allele type that is fully expressed when both homologous alleles are codominant

codon—sequence of three nucleotides on DNA or RNA that represents a 'letter' of the genetic code

commensalism—symbiosis where only one organism benefits; the other(s) neither harmed nor helped

community—(biological) system of plant, animal, and biomatrix species found in a particular location

community succession—a sequence of communities in a particular area leading to the climax community in that area, each community altering the environment for the community to follow

competition—the struggle of organisms to survive when resources are limited; caused by overproduction, leads to natural selection, and designed as an evil-minimizing effect of the curse

compound—a combination of elements that exhibits properties different from the component elements

condensation—the dense packing of a chromosome that occurs at the beginning of mitosis or meiosis

conditioned response—behavior learned through repeated rewards or punishments

coniferous forest—forest land biome found between the temperate and polar zones of the earth

conservation biology—discipline of biology that seeks to preserve organisms and biological communities

consumer—an organism that gets its energy by consuming organic molecules (vs. producer)

coral reef—high diversity, low-latitude marine biome living in limestone structures built by organisms

covalent bond—(strong) attraction between atoms caused by sharing electrons

Creation Week—first six days (~6000 years ago) of time, during which God created the physical world

creation, young-age—the belief that God created the entire universe about 6000 years ago (vs. naturalistic evolution)

crossing over—process in prophase I when homologous chromosomes exchange genetic material

cultivars—distinguishable group of plants that remain distinct only with breeding (aka varieties)

curse—natural evil allowed into the creation by God in response to Adam's disobedience. Types of changes: negative effects: truly negative changes, probably imperfections in cycles and repair processes; evil-minimizing effects: changes introduced to minimize natural evil in a cursed creation

cytokinesis—cell process that divides a cell in two

cytokinesis I—meiosis substage, after homologous chromosomes separate, when the cell first divides

INDEX