Science
Curriculum Guide

Kindergarten thru 12

Morrison Academy

2009

Science
Curriculum Guide

Tim McGill, Superintendent
Matt Strange, Director of Curriculum and Professional Development

Task Force

Jeff Sheppard, Chair
Linda Lyon, K-1
Marcy Miller, 2-3
Jackie Moon, 4-5
Adrienne Ruegg, Grade 6
Adrienne, Seppie and Carl, Grade 7
Seppie Myburgh, Grade 8
Carl Collins, Grade 9 Biology
Mark Senner, HS Physics and Physical Science
Bill Gulliver, HS Chemistry and AP Chemistry
Scott McGrew, Human Anatomy and AP Biology (writing benchmarks only)

Part of planning stage (Spring 2007):
Katie Martens
Dan Minnich

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Morrison Christian Academy
136-1 Shui-Nan Road
Taichung 406, Taiwan, R.O.C.

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Introduction/Philosophy

Morrison recognizes the universe as God's special creation and seeks to equip students to fulfill God's mandate (Gen 1:28). Science, as exemplified in the scientific method, is a process that enables all mankind to understand and appreciate creation, the laws that govern it, and the character of God.

Morrison's science program seeks to help students gain knowledge of God through the study of His creation. This is accomplished with an activity-oriented program where teachers and students think analytically and logically, solve problems creatively, and use technology as a tool. Morrison endeavors to help students acquire developmentally appropriate concepts and science skills to make positive contributions as Christians in an increasingly scientific and technological society.

Vision for Our Science Learners

Spiritual Discerner

1. Students will recognize God as creator
2. Students will recognize God's qualities through the natural world. (Rom. 1:20)
3. Natural laws in science will point students toward understanding of God.
4. Students will accept their self worth as God's creation.

Moral and Ethical Citizen

1. Students will recognize God's authority in the use of science and technology.
2. Students will have a moral and ethical base from which to decide how or whether to pursue scientific research / technology and how to apply what is discovered.

Effective Communicator

1. Students will recognize the importance of communication among scientists and between scientists and the general public in advancing discovery and technology.
2. As Christians, students need to have knowledge of theistic and atheistic positions and be able to effectively and respectfully communicate a Biblical perspective in the scientific community.

Life Long Learner

1. Students should recognize that scientific theory is constantly being revised because of new discoveries / updates and that scientists may have different perspectives scientific theory.
2. Students will value science as an ongoing process and that concepts and knowledge change as new discoveries / updates are made.
3. Students will be equipped with various skills to update their scientific knowledge.
4. Students will utilize technology appropriately.

Steward of Quality of Life

1. Students will recognize their role in personal health, the community and the world.
2. Students will recognize man's role in governing the natural world.
3. Students will recognize their responsibility to take care of what God has created and commissioned us to manage (personal health, the community, and the world).
4. Students will recognize the interconnectedness of life and our stewardship in the world.

Rational and Critical Thinker

1. Students will recognize the importance of the scientific method in examining and investigating the empirical world.
2. Students will be able to analyze, interpret, evaluate, and synthesize concepts within various contexts.
3. Students will be able to discern reliability of scientific data.

Hallmarks

Biblical Worldview

How one perceives the physical universe directly impacts one's worldview. Christians who hold a biblical worldview sees God at work in the origins (Genesis 1:1) and continuance of the universe and of life itself (Colossians 1:15-17). As God's creation, man is accountable for subduing the earth (Genesis 1:28) through discovery, innovation and stewardship. A science curriculum that carries the hallmark of being rooted in a biblical worldview will therefore feature a deep commitment to an interaction between science and faith where God has priority in our thinking. Teachers of such a curriculum will:

1. Center their thinking on the authority of the biblical revelation.
   - God is the Creator, a rational and intelligent Person
   - Faith in God forms the basis for our belief system and lifestyle
   - Careful investigation of Creation is encouraged and reveals the mind of God
   - Scriptural truth matches scientific knowledge
   - Encourage respectful discussion among those of differing worldviews
   - Know that bias is a human problem and not a religious one

2. Embrace and practice science as a valid means of knowing
   - Put a high premium on using the scientific method in an honest, unbiased way
   - Search for truth in an open ended manner, unrestricted by naturalistic rules
   - Keep the flame of curiosity burning brightly
   - Seek to formulate hypotheses that nobody ever dare asks or thinks
   - Stay informed regarding recent discoveries and developments
   - Science, as a way of knowing, has limitations

Brand, Leonard, Professor of Biology and Paleontology at Loma Linda University, A Biblical Perspective on the Philosophy of Science accessed 4/21/0, http://www.grisda.org/origins/59006.pdf

Technology (in research, experimentation, and presentation)

The integration of technology (i.e. lab probes, computer simulations, Internet initiatives, microscope cameras, etc.) into the Morrison Science program is based on the premise that the use of technology will increase student learning.[1] When properly employed, the use of technology enhances the delivery of the curriculum. Students are "…more active participants in research and learning" and teachers have "…more flexibility in presentation, [and] better management of instructional techniques."[2]

[1]Crader, John, Far West Laboratory, Summary of Current Research and Evaluation Findings on Technology in Education, accessed 2/28/2007 at http://www.wested.org/techpolicy/refind.html.

[2]NSTA Position Statement, The Use of Computers in Science Education, accessed 3/12/2007, http://www.nsta.org/positionstatement&psid=4&print=y.

The Impact of Positive Teacher/Student Relationships

The science program at Morrison Academy not only regards positive student/teacher relationships as a powerful factor in the promotion of the students' academic achievement and psychological adjustment, but also deems it vital because it is the essence of our call as Christian educators. Warm, caring teachers minimize the risk of social/emotional adjustment in students for learning to be optimized.(Needs some clarification.) At Morrison we pursue quality relationships with our students through lower class sizes, less dense curricular demands (what does this mean?) and an emphasis on interactive lab/group work.

Fredriksen, Katia and Rhodes, Jean, The Role of Teacher Relationships in the Lives of Students accessed 4/21/07,
http://www.pearweb.org/ndyd/pdfs/samplechapter.pdf

Quality of Instruction

Instruction is most effective when it's personalized – when teachers sufficiently honor learners' interests, curiosity, strengths, contributions, and prior knowledge, making learners feel that they are an important part of something larger than themselves (Wiggins, McTighe, 2006) Morrison's Science teachers endeavor to choose instructional strategies that will maximize student learning. The suggestions from "Classroom Instruction that Works"1 form the core that allow students in all grade levels to improve. They strive to develop life-long learners and problem-solvers thus teaching for meaning rather than just procedural answers. They lead class discussions with warranted open-ended questions, provide choices when appropriate, and engage students in movement at critical times during the lesson to help increase retention of the newly acquired information. The marriage of effective strategies with interesting and thought-provoking activities and experiments ensure student engagement. This engagement ultimately leads to improved achievement.

(Leinwand, Fleischman, 2004) (Jensen, 1998)

[1]Marzano, Robert J., Debra J. Pickering, Jane E. Pollock, Classroom instruction that works: Research-based strategies for increasing student achievement, ASCD, 2001

Explicit Instruction with Hands-on Learning (Inquiry, Hands-on, Minds-on, and Discovery Learning)

Researchers have found hands-on learning is most beneficial when accompanied with direct instruction. If using only hands-on learning without direct instruction, difficulties can arise which include misinformation and gaps in feedback. (David Klahr, PhD., psychology professor at Carnegie Mellon University) Benefits for students derived from direct instruction with hands-on learning are believed to include increased learning in the following areas:

- motivation to learn
- enjoyment of learning
- skill proficiency (including communication skills)
- independent thinking and decision making (based on direct evidence and experiences)
  perception and creativity

("Perspectives of Hands-On Science Teaching:" Question #2, Summary)

Technology can extend hands-on learning (without replacing the real life, activity-based approach) by allowing students to participate in non-traditional forms such as virtual learning (minds-on skills). ("Perspectives of Hands-On Science Teaching," Question 1, p.2)

Cooperative Learning

Cooperative learning must be an intricate part in science classroom instruction at Morrison Academy. In the Morrison school system, cooperative learning can be seen as grouping students to accomplish two specific goals. First, grouping aids in making a smaller achievement gap between students through peer learning and full-class participation. Secondly, cooperative learning creates an environment that resembles real-life science investigation.

Cultural Sensitivity

Cultural Sensitivity honors those we serve. As an international school in Taiwan, this means Morrison is mindful and responsive to the diverse cultural backgrounds and of students found in our schools. Therefore, the resources, instructional strategies, and assessment practices we employ address and appropriately adapt to the unique features of our student population.

For science, this includes being aware of students' cultural backgrounds, understanding how different learners construct knowledge, holding affirming views about diversity, and using appropriate instructional strategies. It is the science teachers ambition to provide for every student, regardless of cultural background, the opportunity to succeed and meet his or her potential in the sciences.

Villegas, A.M. & Lucas T., The Culturally Responsive Teacher, Educational Leadership: March 2007, vol 63, no 6.

Jegede O.J. & Aikenhead G.S., Transcending Cultural Borders, accessed April 23, 2007, http://www.ouhk.edu.hk/cridal/misc/jegede.htm

Engaged Instructional Time Requirements

Science instructional time from Kindergarten through Grade 5 is 112.5 minutes per five-day cycle, or 6.25 percent of instructional time. Middle school instructional time is 225 minutes per five-day cycle, or 12.5 percent of instructional time. High school graduation requirements are two units of lab science. Through integration of science with other subject areas, the effectiveness of science instruction at all levels can be maximized. All engaged instructional time requirements can be found in procedure 295.

K-12 Strands

K-5 Science Strands

1. Physical Sciences
2. Life Sciences
3. Earth Sciences
4. Investigation and Experimentation

6-12 Science Strands

1. Physical Sciences
2. Life Sciences
3. Earth Sciences
4. Investigation and Experimentation
5. Connections

Scope and Sequence for Grades K-5

Grade	Earth, Life and Physical Science Unit Focus					Exploring and Connecting Focus
K	Introduction to Properties of Matter	Major Characteristics of Plants & Animals	Introduction to Land, Air, & Water (Natural Resources & Conservation)	Weather and Seasons		Five Senses, Sorting by attributes Observations
1	Matter Changes (solid, liquid, & gas)		Animals (Environment, adaptations, features)	Plant Life	Weather (using tools)	Discerning differences, Observe & collect data, bar graphs, positions of objects
2	Plant & Animal Life Cycles	Rocks, Minerals, Natural Resources, Fossils	Motion, force, simple machines, magnets, gravity	Sound		Bar graphs, measurement, magnify, observations
3	Energy	Matter (solid, liquid, gas) atoms, periodic table	Light	Animal/Plant adaptation, environmental changes — dinosaurs	Space	Scientific Method (Evidence vs. opinion)
4	Electricity & Magnetism	Organisms (food chains, ecosystems)	Rocks & Minerals	Shaping Earth's surface		Questioning & experimentation, interpreting data, observations, graphs, written instructions, cause & effect, predictions, multiple trials
5	Elements	Plant & Animal Systems	Water Cycle	Weather Patterns	Solar System	Pure Scientific Method

Scope and Sequence for Grades 6-12

Discipline	***Grade Level***				
	Six	***Seven***	***Eight***	***Nine***	***Ten - Twelve***
Earth Science					
Life Science					
Physical Science					
Biology					
One Elective *(from course offerings)*					

Resources for Instruction

Grades K-5
Harcourt School Publishers Science ©2008
Primary units being taught with Harcourt resources

Kindergarten: A, B, C, E
1st Grade: is doing Units A, B, C, D, F
2nd Grade: Units A, C, F
3rd Grade: Units A, B, D, E
4th Grade: Unit A, B, C, F
5th Grade: Unit A, B, C, D, E

Grade 6
Holt, Rinehart and Winston - Science and Technology, Earth Science ©2008

Grade 7
Holt, Rinehart and Winston - Science and Technology, Life Science ©2008

Grade 8
Holt, Rinehart and Winston - Science and Technology, Physical Science ©2008

Grade 9
Holt, Rinehart and Winston, Modern Biology ©2009

Physical Science
Glencoe, Physical Science ©2008

Physics
Glencoe, Physics: Principles and Problems ©2009

Chemistry
Glencoe, Chemistry: Matter and Change ©2008

AP Chemistry
Pearson, Chemistry: The Central Science 11th editions ©2007

Human Anatomy
University Readers, The Human Body: Essentials of Anatomy and Physiology - Second Color Edition, Bruce Wingerd ©2008

AP Biology
Pearson, Biology 8th Edition (Campbell/Reece), ©2008
Cliff's AP Biology Notes © 2007

Science Overview by Grade/Course

K-5 Program

Kindergarten

Students will learn that their physical world consists of materials that float or sink and can be changed by heating or freezing. Kindergarteners will learn that magnets attract some materials and will explore the water cycle and evaporation. They will identify the major characteristics and needs of plants and animals that help them survive in different environments. They will know that soil, water, gases and other living things are natural resources that need to be protected. The students will identify land forms and bodies of water. They will use tools to help them observe changes in the Earth's temperatures and weather patterns that result in the seasons that affect their lives. Students are asked to create meaningful questions and conduct careful investigations.

Grade 1

Students will explore the effects of change on physical properties caused by mixing, cooling and heating. They will learn to measure and evaluate how we use force and magnets to move objects to improve our lives. They will learn about plant and animal needs, features, habitats and dependence on each other to survive. Students will explore the diets of animals and the functions of the parts of plants. First graders will use tools to measure the predictability of seasonal conditions and keep records of daily weather changes. They will practice the scientific method to collect data and predict and record results. Students are asked to create meaningful questions and conduct careful investigations.

Grade 2

Students will explore how the motion of objects can be observed and measured by learning about gravity, machines, magnets, and sound. They will also consider how all plants and animals have predictable life cycles and examine that the Earth is made of materials that have distinct properties and provides resources for human activities. Students are asked to create meaningful questions and conduct careful investigations.

Grade 3

Students will discover that energy and matter have multiple forms and can be changed from one form to another. They will also examine that light has a source and travels in a direction and consider that adaptations in physical structure or behavior may improve an organism's chance for survival. As they look at the topic of space, they will learn that objects in the sky move in regular and predictable patterns. Students are asked to create meaningful questions and conduct careful investigations.

Grade 4

Students will explore how electricity and magnetism are related and their useful applications to everyday life. They will also consider how all organisms need energy and matter to live and grow in their ecosystems and examine the properties of rocks and minerals and the causes which reshape Earth's landforms. Students are asked to consider meaningful questions and to conduct careful investigations.

Grade 5

Students will consider how elements and their combinations account for all the varied types of matter in the world. They will also study plant and animal structures for respiration, digestion, waste disposal, and transporting materials and examine how water on Earth moves between the oceans and land through the processes of evaporation and condensation. As the learn about the Solar System, students will keep in mind that the Sun's uneven heating of the earth causes air movements which result in changing weather patterns and will see that the solar system consists of planets and other bodies that orbit the Sun in predictable paths. Students will engage in the scientific process by asking meaningful questions and conducting careful investigations.

Middle School Program

Grade 6 – Earth Science

Earth science is a study of the Earth and its processes. Students will become familiar with plate tectonics, the shaping of Earth's surface, Earth's structure, energy in the Earth's system, Earth's history as well as learn how to function within a science lab. Students will understand essential ideas about the composition and structure of the universe and the Earth's place within it. Students will also study creation and evolution as it pertains to Earth science.

Grade 7 – Life Science

Life science covers the basic concepts of biology. Class content will give students a broad grasp of the topics of cell biology, genetics, structure and function in living systems, classification, and ecology in preparation for further study in high school science courses. There will also be a discussion of how creation and evolution pertains to our study of life science will take place throughout the course.

Grade 8 – Physical Science

Physical science covers the basic concepts of chemistry and physics. Class content will give students a broad grasp of the topics of matter, reactions, the periodic table, energy, force, and motion in preparation for further study in high school science courses. Students will also participate in a problem solving project as part of this course.

High School Program

Biology

This introductory course makes science more relevant for students and lays a foundation for future biology courses. It is the study of living things with comparisons of the basic animal and plant taxon. Life processes will be studied as they apply to plants, animals, and humans. Class content gives the students a broad grasp of the meaning of life, and creation in God's design. This class is normally taken in 9th or 10th grade.

AP Biology

This course is a comprehensive, in-depth investigation of modern biological principles in action at a university level. The course is designed for students pursuing careers in science or allied disciplines. There is a heavy emphasis on independent study, analysis of scientific journal articles, text readings, and writing critical laboratory reports. See AP courses policies in appendix. (Prerequisites: A minimum of a B in both Chemistry and Algebra II, and teacher (of those subjects) recommendation, Advanced Math and Physics recommended. Student course load and extracurricular involvement is also considered to insure that the prospective AP student has adequate time to commit to this course.) Maximum of 16 students per section.

Chemistry

This course addresses the composition, structure, and reactions of matter. The major emphasis is on inorganic compounds. A laboratory is coordinated to enhance understanding. The theoretical basis of concepts and their applications to a variety of written problems will be the major focus of the course with somewhat less emphasis on the application of concepts to contemporary life. (Prerequisite: Biology, B in Algebra 1or Physical Science.)

AP Chemistry

This course meets all the depth and rigor of freshman chemistry at the college level. Topics covered are the structure of atoms, ions and molecules, mass relationships, chemical reaction, gases, thermochemistry, quantum theory, periodic relationships, bonding liquids and solids, kinetics, equilibrium, acids-base and solubility equilibrium, entropy, electrochemistry, metallurgy, and nuclear and organic chemistry. Students will further their skills and enhance understanding by work with corresponding labs and computer simulations. See AP courses policies in appendix. (Prerequisite: A minimum of a B in both Chemistry and Algebra II, and teacher (of those subjects) recommendation. Advanced Math recommended.) A maximum of 16 students per section.

Human Anatomy and Physiology

This advanced course is designed for students interested in the medical profession e.g. doctor, nurse, technician, physical therapy, geriatrics, and/or those desiring careers in the health or physical education areas. The eleven body systems are covered extensively with laboratory exercises to reinforce major concepts.

Physical Science

The intent of the course is to provide a basic background of physical sciences for students who want another year of Math before taking Chemistry. The topics covered are very similar to those in basic chemistry and physics but with a less rigorous application of algebra. This course will serve to prepare students for taking Chemistry.

Physics

This course studies force and motion, work and energy, electricity and magnetism, wave motions, sound and light, and electronics. A strong background in Algebra 1 and a good knowledge of Geometry and Right Triangle Trigonometry is assumed. This course is designed for 11th & 12th grade students. (Prerequisite: Geometry and Algebra 2)

Teaching About Creation, Evolution and the Age of the Earth

NOTE: The following section was slightly modified and inserted with permission from Delaware County Christian School Newtown Square, PA 19073

Introduction

In our culture, there are two basic positions regarding ultimate reality and thus the origin of the universe. (Here and below, *universe*, *world*, and *nature* are used to refer to the sum total of all matter and energy in existence.) The first position is **theism**, which holds that the universe results from the action of a purposive supernatural being (God). The second position is **naturalism**, the belief that matter and energy are all that exist, or at least all that affect events in the universe. Naturalism holds that undirected, purposeless natural processes have accidentally resulted in the existence and characteristics of everything.

The Primary Issue

Christian orthodoxy has always held that the God of the Bible is the ultimate cause of the universe around us; thus **all Christians agree that God made everything**. (The term *Christian* is used here to denote those who believe that the Bible is *inspired*—God's supernatural revelation to mankind—and who believe the historic creeds of the Christian church.) Christians agree that God made everything because the Bible clearly and repeatedly says so (e.g., Genesis 1:1, Exodus 4:11 & 20:11, Job 38:4, Proverbs 3:19, Isaiah 51:13, Jeremiah 32:17, Colossians 1:16, Hebrews 1:10, Revelation 14:7, and many other places). Christians also find support for this conviction from science. The more scientists learn about the structure and function of the universe, the more we appreciate the degree to which it is just right for the existence of human life.

Consistent with Scripture and historic Christian belief, Morrison Academy insists that God made the universe. The school teaches that the universe does not exist by accident, and that the better we understand its structure and function (which is the goal of science), the more impressed we will become with its Maker (Psalm 19:1, Proverbs 3:19).

Secondary Issues

It is important to recognize that while Christians agree that God made everything, **we do not agree about exactly *how* and *when* God did it**. The most obvious reason is that the Bible speaks much less clearly and frequently about how and when God made everything, than of the fact that He did so. As a result, Christians reach different conclusions about what God is saying regarding the timing and method of creation. Christians also differ in their awareness of relevant scientific data, and in their convictions regarding how such data should be used to clarify their understanding of the Bible.

Virtually all Christians now believe that the earth orbits the sun, despite objections to this idea by such a hero of the faith as Martin Luther. Evidence from science eventually convinced us that we had *misunderstood* figurative Biblical language (such as

references to the sun's rising and setting, and statements about the sun— not the earth—standing still in Joshua 10). However, Christians today have not reached consensus on whether we have misunderstood the *Bible*, the *scientific data*, or *both*, about how and when God created. The result of this disagreement is that Christians who believe in the inspiration of Scripture may be found in each of the following three camps: young-earth creationists, old-earth creationists, and theistic evolutionists.

At Morrison Academy, we believe that solving puzzles like how and when God created requires careful attention to both God's special revelation in the Bible and His general revelation in nature. **We teach our students that neither God's *Word* nor His *world* lie to us, although both can be misunderstood. Thus, accurately discerning *how* and *when* God made everything requires careful study of both the Bible and nature**. This is one reason why it is a high calling for Christian young people, confident of the Bible's reliability, to pursue training in the sciences.

In light of the diversity of opinion among Christian Bible scholars and scientists regarding exactly how and when God created, Morrison chooses not to take an official position on either question. We emphasize that God made everything, but we do not require or expect students to accept a particular view of how or when God did it. Younger students are taught that God is the maker of the universe, that we exist for a purpose, and that it is false to claim that life (or anything else) exists by accident. We do not consider specific arguments or teacher assertions for or against special creation, evolution, a young earth, or an old earth to be appropriate in the early grades. With younger students, we prefer to leave discussion of these matters to families and churches. In the elementary school library, we avoid stocking books that forcefully advocate a particular view of how or when God created, although passing references to these issues are unavoidable in books on some subjects. Older students are taught that naturalistic (i.e., impersonal, undirected, accidental) evolution is not Biblical, but that Christians hold a variety of other views on how and when God created. Without saying or implying that they should accept a particular view, we want our older students to understand the following positions: theistic (i.e., God-ordained) evolution, special creation, belief in a young earth (i.e., thousands of years old), and belief in an old earth (i.e., billions of years old).

Four Christian Views On Origins

Much confusion surrounds origins issues. This is partly because terms are often used carelessly. The word *evolution*, for example, has so many meanings that it is almost useless. With this in mind, the sections below briefly describe four broad positions which Christians hold, and which we want our older students to understand. The descriptions below are generic; individuals within each group differ (sometimes widely) in their specific views.

Two Views on ***How*** God Made ***Living Things***

Special Creation

God created the basic kinds of living things by miracle. Since then, natural processes like genetic drift and natural selection have produced small changes in the original stock, resulting in *new varieties of the same basic kind of creature*. For example, creationists believe that God miraculously created elephant-kind, and then the natural processes God built into nature produced African and Indian elephants (and perhaps mastodons and mammoths) from the original stock. The process of producing such minor variations in organisms is sometimes called *microevolution*. Creationists have no argument with this level of evolution. The many breeds of domestic dogs provide further examples of the result of microevolution: they are new varieties, but all are still dogs. Creationists believe that God has placed limits on how far natural change in organisms can go. Variation can occur *within a created kind*, but no new kinds will arise this way. For example, no matter how much time is available for variations to occur, no group of hoofed land mammals would ever give rise to anything as different as a whale. *Young-Earth* creationists believe that God made the basic kinds of organisms over a period of six 24-hour days, perhaps 10,000 years ago. *Old-Earth* creationists believe that God made them (by miracle) at various times over a period of several billion years. **Creationists do not agree about the age of the Earth.**

Theistic Evolution

Theistic evolution is *God-ordained evolution.* Theistic evolutionists are convinced that God used a *process* and not *miracles* to make the major groups of creatures (this is what defines them as evolutionists and not creationists). *But theistic evolutionists reject the naturalistic idea that evolution is ultimately accidental and purposeless.* They believe that God very much gets credit for the existence of all creatures because *He invented* the process of evolution; it was *His tool* to bring about the living things *He wanted*.

Theistic evolutionists do not agree with those naturalistic evolutionists who claim that the evolutionary process makes belief in God unnecessary. Christian theistic evolutionists also disagree with those who deny the reality of miracles. They accept Jesus' virgin birth, His walking on water, His resurrection, etc. They believe in a miracle-working God, who for His own reasons chose to create living creatures using an evolutionary process. (Special creationists wonder why theistic evolutionists accept these miracles but do not accept miracles in creation.)

Thus, theistic and naturalistic evolutionists disagree about *why* evolution happens, but there is little disagreement between them about the general history of *how* living things have developed over the ages. The discussion below outlines the theory of evolution as a theistic evolutionist might explain it (i.e., God is given credit for the process).

God used natural processes to eventually produce whole new basic kinds of creatures. Unlike creationists, evolutionists do not believe that God imposed strict limits on natural change in living things. Given enough time (all evolutionists believe the old-earth view) and the right circumstances, a group of organisms can diversify into forms so different from the original stock that a whole new kind of creature has appeared. This

production of a whole new kind of creature is called macroevolution. For example: Evolutionists hold that variation in some fish gave rise to amphibians, variation in some amphibians produced reptiles, and variation in different groups of reptiles gave rise to mammals and birds. **Note that the evolution–creation debate is not about whether creatures change, but about *how far natural changes can go*. Creationists agree with microevolution but disagree with macroevolution.**

Evolutionists debate among themselves about exactly *how* macroevolution occurs. The standard textbook explanation used to be that *multitudes* of small changes (i.e., *lots and lots of* microevolution) gradually add up and result in the existence of a very different sort of creature than existed before. In other words, macroevolution is just the logical end product of micro-evolution carried on for a very long time. This model is sometimes called Darwinian evolution, since it reflects Charles Darwin's idea that evolution occurs in accumulated small steps.

However, most leading evolutionists today do not believe that the evidence supports strictly Darwinian evolution. They are committed evolutionists in that they believe *there are natural processes*—rather than a series of miracles—that explain the existence of modern living things. However, they do not think that accumulated microevolution is the sole cause of macroevolution. Research and debate continue as to what the processes behind macroevolution might be.

Obviously, any Christian view on origins must explain the first few chapters of Genesis. Christians who are theistic evolutionists have many different ideas about exactly what God is telling us in Genesis; some take the creation story as something like a parable. However, Morrison believes that Genesis clearly teaches the reality of an historical Adam, made sinless in God's image, who later sinned and brought judgment on humankind.

Two Views on ***When*** God Made ***The Earth & Universe***

Young-Earth View

(Also called Young-Universe, Recent-Creationism, Scientific Creationism, Flood Geology)

God made everything in six 24-hour days, roughly 10,000 years ago. He used miracles (rather than natural processes He had set in place) to make the stars and planets. Many of the geological features on earth's surface appear to have taken millions of years to form, but are more accurately understood as effects of Noah's Flood. The Flood covered the entire planet, deposited most of earth's sedimentary rock layers, buried most of the fossils, and radically reshaped earth's surface.

All who believe that earth is young are also creationists, since 10,000 years is not nearly enough time for evolution to have produced the living things on earth today. But many creationists do not hold a young-earth view.

Young-earth creationists are convinced that the early chapters of Genesis indicate a recent creation date, and believe that other interpretations (including those of old-earth creationists) compromise the reliability of Scripture. They consider the scientific arguments for billions of years of Earth and space history to be misleading. This might be because the evidence has been misinterpreted by scientists with a bias against Biblical truth and/or because scientists are wrongly assuming that studying present natural processes will tell us how events happened in the past … a past in which God did spectacular one-time miracles (e.g., creation, Noah's flood). The universe and Earth may thus *look old* in some ways, but not actually *be old.* This is a widespread view among evangelicals today. However, it is a minority view among scientists, including Christians who are scientists. This is especially true among scientists who deal directly with the evidence for the age of the earth and universe (e.g., geologists and astronomers).

Old-Earth View

God used natural processes to form the stars and planets, beginning about 14 billion years ago with the Big Bang. Earth is about 4.6 billion years old and the fossils were buried in separate local incidents over the last few billion years of that time.

In response to accumulating evidence that earth was very old, the scientific community began to accept an ancient age for the earth before Darwin published his theory of evolution. **Most scientists today, both Christians and non-Christians, accept an age for the earth of billions of years. Some of these Christians are theistic evolutionists, but many are not. Many Christians who reject the theory of evolution accept an ancient earth; they are old-earth creationists.**

Christians who hold an old-earth view understand the early chapters of Genesis in various ways. As mentioned above, many *theistic evolutionists* take them figuratively. Many old-earth *creationists* take them literally, with the *days* in chapter one being understood in various ways: from very long periods of time, to 24-hour days in which God revealed the story to Moses. Although Christians who accept an ancient earth believe that young-earth creationists misunderstand the Bible regarding the creation date, both groups agree that the Bible is God's Word and that God is the maker of everything.

Kindergarten

1. Physical Sciences

a. I know objects can be described in terms of the materials they are made of (e.g., clay, cloth, paper) and their physical properties (e.g., color, size, shape, weight, texture, flexibility, attraction to magnets, floating, sinking).

b. I know water can be a liquid or a solid and can be made to change back and forth from one form to the other.

c. I know water left in an open container evaporates (goes into the air) but water in a closed container does not.

2. Life Sciences

a. I know how to observe and describe similarities and differences in the appearance and behavior of plants and animals (e.g., seed-bearing plants, birds, fish, insects).
b. I know stories sometimes give plants and animals attributes they do not really have.
c. I know how to identify major structures of common plants and animals (e.g., stems, leaves, roots, arms, wings, legs).

3. Earth Sciences

a. I know characteristics of mountains, rivers, oceans, valleys, deserts, and local landforms.
b. I know changes in weather occur from day to day and across seasons, affecting Earth and its inhabitants.
c. I know how to identify resources from Earth that are used in everyday life and understand that many resources can be conserved.

4. Exploring and Connecting

a. I can observe common objects by using the five senses.
b. I can describe the properties of common objects.
c. I can describe the relative position of objects by using one reference (e.g., above or below).
d. I can compare and sort common objects by one physical attribute (e.g., color, shape, texture, size, weight).
e. I can communicate observations orally and through drawings.

Grade One

1 Physical Sciences

a. I know solids, liquids, and gases have different properties.
b. I know the properties of substances can change when the substances are mixed, cooled, or heated.

2 Life Sciences

a. I know different plants and animals inhabit different kinds of environments and have external features that help them thrive in different kinds of places.
b. I know both plants and animals need water, animals need food, and plants need light.
c. I know animals eat plants or other animals for food and may also use plants or even other animals for shelter and nesting.
d. I know how to infer what animals eat from the shapes of their teeth (e.g., sharp teeth: eats meat; flat teeth: eats plants).
e. I know roots are associated with the intake of water and soil nutrients and green leaves are associated with making food from sunlight.

3 Earth Sciences

a. I know how to use simple tools (e.g., thermometer, wind vane) to measure weather conditions and record changes from day to day and across the seasons.
b. I know that the weather changes from day to day but that trends in temperature or of rain (or snow) tend to be predictable during a season.
c. I know the sun warms the land, air, and water.

4 Investigation and Experimentation

a. I can draw pictures that portray some features of the thing being described.
b. I can record observations and data with pictures, numbers, or written statements.
c. I can record observations on a bar graph.
d. I can describe the relative position of objects by using two references (e.g., above and next to, below and left of).
e. I can make new observations when discrepancies exist between two descriptions of the same object or phenomenon.

Grade Two

1. Physical Sciences

a. I know the position of an object can be described by locating it in relation to another object or to the background.
b. I know an object's motion can be described by recording the change in position of the object over time.
c. I know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.
d. I know tools and machines are used to apply pushes and pulls (forces) to make things move.
e. I know objects fall to the ground unless something holds them up.
f. I know magnets can be used to make some objects move without being touched.
g. I know sound is made by vibrating objects and can be described by its pitch and volume.

2. Life Sciences

a. I know that organisms reproduce offspring of their own kind and that the offspring resemble their parents and one another.
b. I know the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.
c. I know many characteristics of an organism are inherited from the parents. Some characteristics are caused or influenced by the environment.
d. I know there is variation among individuals of one kind within a population.
e. I know light, gravity, touch, or environmental stress can affect the germination, growth, and development of plants.
f. I know flowers and fruits are associated with reproduction in plants.

3. Earth Sciences

a. I know how to compare the physical properties of different kinds of rocks and know that rock is composed of different combinations of minerals.
b. I know smaller rocks come from the breakage and weathering of larger rocks.
c. I know that soil is made partly from weathered rock and partly from organic materials and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants.
d. I know that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils.
e. I know rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use.
f. I know that the universe is God’s creation.
g. I know that we are stewards of God’s creation.

4. Investigation and Experimentation

a. I can make predictions based on observed patterns and not random guessing.
b. I can measure length, weight, temperature, and liquid volume with appropriate tools and express those measurements in standard metric system units.
c. I can compare and sort common objects according to two or more physical attributes (e. g., color, shape, texture, size, weight).
d. I can write or draw descriptions of a sequence of steps, events, and observations.
e. I can construct bar graphs to record data, using appropriately labeled axes.
f. I can use magnifiers or microscopes to observe and draw descriptions of small objects or small features of objects.
g. I can follow oral instructions for a scientific investigation.

Grade Three

1 Physical Sciences

a. I know energy comes from the Sun to Earth in the form of light.
b. I know sources of stored energy take many forms, such as food, fuel, and batteries.
c. I know machines and living things convert stored energy to motion and heat.
d. I know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.
e. I know matter has three forms: solid, liquid, and gas.
f. I know evaporation and melting are changes that occur when the objects are heated.
g. I know that when two or more substances are combined, a new substance may be formed with properties that are different from those of the original materials.
h. I know all matter is made of small particles called atoms, too small to see with the naked eye.
i. I know people once thought that earth, wind, fire, and water were the basic elements that made up all matter. Science experiments show that there are more than 100 different types of atoms, which are presented on the periodic table of the elements.
j. I know sunlight can be blocked to create shadows.
k. I know light is reflected from mirrors and other surfaces.
l. I know the color of light striking an object affects the way the object is seen.
m. I know an object is seen when light traveling from the object enters the eye.

2 Life Sciences

a. I know plants and animals have structures that serve different functions in growth, survival, and reproduction.
b. I know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
c. I know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
d. I know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.
e. I know that some kinds of organisms that once lived on Earth have completely disappeared and that some of those resembled others that are alive today.
f. I know that the universe is God's creation.
g. I know that we are stewards of God's creation.

3 Earth Sciences

a. I know the patterns of stars stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.
b. I know the way in which the Moon's appearance changes during the four-week lunar cycle.
c. I know telescopes magnify the appearance of some distant objects in the sky, including the Moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than the number that can be seen by the unaided eye.
d. I kno*w* that Earth is one of several planets that orbit the Sun and that the Moon orbits Earth.
e. I know the position of the Sun in the sky changes during the course of the day and from season to season.

4 Investigation and Experimentation

a. I can repeat observations to improve accuracy and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods being used, or uncertainty in the observation.
b. I can differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.
c. I can use numerical data in describing and comparing objects, events, and measurements.
d. I can predict the outcome of a simple investigation and compare the result with the prediction.
e. I can collect data in an investigation and analyze those data to develop a logical conclusion.
f. I know that men and women have made a variety of contributions throughout history of science and technology.

Grade Four

1. Physical Sciences

a. I know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.
b. I know that magnets and electrically charged materials have magnetic fields (can attract or repel other charged materials).
c. I know how to build a simple electromagnet.
d. I know how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
e. I know the role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.
f. I know electrical energy can be converted to heat, light, and motion.

2. Life Sciences

a. I know plants are the primary source of matter and energy entering most food chains.
b. I know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.
c. I know some of the decomposers (e.g., fungi, insects, and microorganisms, etc.) and that they recycle matter from dead plants and animals.
d. I know ecosystems can be characterized by their living and nonliving components.
e. I know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
f. I know many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.

3. Earth Sciences

a. I know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).
b. I know some changes on the earth’s surface can be caused by a combination of slow
processes (e.g., weathering, erosion, sediment deposits, temperature changes, etc.) and rapid processes (e.g., landslides, earthquakes, volcanic eruptions, flooding, etc.)
c. I know how soil is composed (e.g., weathered rock/silt deposits, decomposition of plant and animal products by living organisms, etc.) and its properties (color, texture, capacity to retain water, ability to support plant growth, etc.).

4. Exploring and Connecting

a. I can differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
b. I can plan and conduct simple investigations to test a hypothesis (e.g., make systematic observations, conduct simple experiments, etc.).
c. I can follow a set of written instructions for a scientific investigation.
d. I can identify careers that use science and technology.
e. I can compare a model with what it actually represents (e.g., comparing a model of the earth to the earth itself).

Grade Five

1. Physical Sciences

a. I know all matter is made of atoms, which may combine to form molecules.
b. I know metals have properties in common, such as high electrical and thermal conductivity.
c. I know that each element is made of one kind of atom and that the elements are organized in the periodic table by their chemical properties.
d. I know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.
e. I know properties of solid, liquid, and gaseous substances, such as water (H2O), neon (Ne), oxygen (O2), nitrogen (N2), and carbon dioxide (CO2).
f. I know living organisms and most materials are composed of just a few elements.
g. I know that scientist use inquiry tools for handling, observing, and measuring objects (e.g., microscopes, balances, thermometers, and spring scales).

2. Life Sciences

a. I know how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO2) and oxygen (O2) are exchanged in the lungs and tissues.
b. I know the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system.
c. I know the role of the kidney in removing cellular waste from blood and converting it into urine, which is stored in the bladder.
d. I know many multicellular organisms have specialized structures to support the transport of materials.
e. I know how sugar, water, and minerals are transported in a vascular plant.
f. I know plants use carbon dioxide (CO2) and energy from sunlight to build molecules of sugar and release oxygen.
g. I know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO2) and water (respiration).

3. Earth Sciences

Water Cycle

a. I know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
b. I know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.

c. I know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.
d. I know that the amount of fresh water located in rivers, lakes, under-ground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

Weather Patterns

e. I know uneven heating of Earth causes air movements (convection currents).
f. I know the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
g. I know the causes and effects of different types of severe weather.
h. I know that the Earth's atmosphere exerts a pressure that decreases with distance above Earth's surface.

Solar System

i. I know the Sun, an average star, is the central and largest body in the solar system and is composed primarily of hydrogen and helium. (With J could this be deleted or do I need to include the gases hydrogen and helium.)
j.I know the solar system includes the Sun (the central and largest body in the solar system), the planet Earth, the Moon, eight other planets and their satellites, and smaller objects, such as asteroids and comets.
k. I know the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet.

4. Exploring and Connecting

a. I can plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
b. I can identify the controls and variable in an investigation.
c. I can explain how this variable can be used to collect information to answer a question about the results of the experiment.
d. I can select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
e. I can record data by using appropriate graphic representations (e.g., charts, graphs, and labeled diagrams), make inferences based on those data, and draw conclusions from scientific evidence.
f. I can investigate and describe human uses of renewable and non-renewable resources (e.g., water supply, fossil fuels).
g. I can recognize the diversity of resources provided by the Earth and Sun (e.g., soil, fuels, minerals, medicines, and food).

Grade Six - Earth Science

1 Plate Tectonics and Earth's Structure

Plate tectonics accounts for important features of Earth's surface and major geologic events. As a basis for understanding this concept:

a. I know evidence of plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and midocean ridges; and the distribution of fossils, rock types, and ancient climatic zones.
b. I know that the Earth is composed of several layers: a cold, brittle lithosphere; a hot, convecting mantle; and a dense, metallic core.
c. I know about lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle.
d. I know that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface.
e. I know major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions.
f. I can explain major features of Taiwan geology (including mountains and volcanoes) in terms of plate tectonics.
g. I can determine the epicenter of an earthquake and know that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construction in the region.

2 Shaping Earth's Surface

Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:

a. I know that water running downhill is the dominant process in shaping the landscape, including Taiwan's landscape.
b. I know that rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.
c. I know that beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves.
d. I know that earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

3 Energy in the Earth System

Many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents. As a basis for understanding this concept:

a. I know the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.
b. I know solar energy reaches Earth through radiation, mostly in the form of visible light.
c. I know heat from Earth's interior reaches the surface primarily through convection.
d. I know convection currents distribute heat in the atmosphere and oceans.
e. I know differences in pressure, heat, air movement, and humidity result in changes of weather.

4 Earth and Life History

Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept:

a. I know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
b. I know the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids.
c. I know that the rock cycle includes the formation of new sediment and rocks are often found in layers, with the oldest generally on the bottom.
d. I know that some interpret the evidence from geologic layers and radioactive dating as proof that the Earth is approximately 4.6 billion years old and that life on this planet has existed for more than 3 billion years.
e. I know how fossils provide evidence of how life and environmental conditions have changed.
f. I know geographic connections have affected the past and present distribution of organisms.
g. I know that Christian views of origins vary, but that Christians acknowledge God's initiatives and design in creating the universe and life
h. I know evidence for the defense of the creationist worldview as it pertains to Earth Science

i. I know that the Earth is the only body in our solar system that appears able to support life.
j. I know that the planet Earth and our Solar system appear to be somewhat unique, although similar systems might yet be discovered in the universe.

5 Earth in the Solar System

The structure and composition of the universe can be learned from studying stars and galaxies and their evolution. As a basis for understanding this concept:

a. I know galaxies are clusters of billions of stars and may have different shapes.
b. I know that the Sun is one of many stars in the Milky Way galaxy and that stars may differ in size, temperature, and color.
c. I know how to use astronomical units and light years as measures of distances between the Sun, stars, and Earth.
d. I know that stars are the source of light for all bright objects in outer space and that the Moon and planets shine by reflected sunlight, not by their own light.
e. I know the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

6 Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, I should develop their own questions and perform investigations. I will:

a. I can develop a hypothesis.
b. I can select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
c. I can communicate the steps and results from an investigation in written reports and oral presentations. (throughout in lab reports)
d. I can read a topographic map and a geologic map for evidence provided on the maps and construct and interpret a simple scale map.
e. I can interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions).

Grade Seven - Life Science

1 Cell Biology

All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept:

a. I know cells function similarly in all living organisms.
b. I know the characteristics that differentiate prokaryotic cells and eukaryotic cells
c. I know the characteristics that differentiate plant cells and animal cells.
d. I know the nucleus is the repository for genetic information in plant and animal cells.
e. I know that cells are made up of a variety of organelles, each with a different function in the cell.
f. I know that as multicellular organisms develop, their cells differentiate.
g. I know the basic steps in the processes of meiosis and mitosis and how they function differently in organisms.

2 Genetics

A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:

a. I know the differences between the life cycles and reproduction methods of sexual and asexual organisms.
b. I know sexual reproduction produces offspring that inherit half their genes from each parent.
c. I know that an inherited trait can be determined by one or more genes.
d. I know plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
e. I know DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell
f. I know the basic steps in the process of protein synthesis including transcription and translation.

3 Origins and Diversity of Life

Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:

a. I know both genetic variation and environmental factors are causes of evolution and diversity of organisms.
b. I can explain the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.
c. I know how lines of evidence from comparative anatomy provide the bases for the theory of evolution.
d. I know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.
e. I understand areas of overlap and agreement on the spectrum of evolutionary theory, from a Bible based theistic or Creation orientation to a purely naturalistic orientation.
f. I know evidence for the defense of the creationist worldview.

4 Structure and Function in Living Systems

The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:

a. I know that both plants and animals have levels of organization for structure and function.
b. I know the function of the major organ systems of the human body.
c. I know the major parts of plants and the structural differences between seedless and seed plants.
d. I know the major processes of plants including photosynthesis, reproduction, growth and responses to the environment.

5 Classification

a. I know the classification structure and the names of the levels from Kingdom to Species.
b. I know the Kingdoms and Phyla and examples of each.
c. Within the animal kingdom, I know the Classes, characteristics of each and examples within each.

6 Ecology (Life Sciences)

Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:

a. I know how energy entering an ecosystem in the form of sunlight is converted and transported to multiple members of the food chain.
b. I understand basic Ecological structures from Biosphere to Organism.
c. I know populations of organisms can be categorized by the functions they serve in an ecosystem.
d. I understand that there are many types of interactions that take place in an environment, between similar and different types of organisms.
e. I know that the characteristics of different ecosystems determine the organisms that can live there.
f. I know the major cycles that take place in ecosystems including the Water Cycle, Carbon Cycle, Nitrogen Cycle and Ecological Succession.

7 Investigation and Experimentation

a. I can select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
b. I can communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
c. I can construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).
d. I can communicate the steps and results from an investigation in written reports and oral presentations.

Grade Eight - Physical Science

1. Motion

The velocity of an object is the rate of change of its position. As a basis for understanding this concept:

a. I know position is defined in relation to some choice of a standard reference point and a set of reference directions.
b. I know that average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.
c. I know how to solve problems involving distance, time, and average speed.
d. I know the velocity of an object must be described by specifying both the direction and the speed of the object.
e. I know changes in velocity may be due to changes in speed, direction, or both. I know how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.

2. Forces

Unbalanced forces cause changes in velocity. As a basis for understanding this concept:

a. I know a force has both direction and magnitude.
b. I know when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.
c. I know when the forces on an object are balanced, the motion of the object does not change.
d. I know how to identify separately the two or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
e. I know that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).
f. I know the greater the mass of an object, the more force is needed to achieve the same rate of change in motion.
g. g. I know how machines confer mechanical advantage in order to make work easier.

h. I know the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.

3. Structure of Matter

Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:

a. I know the structure of the atom and know it is composed of protons, neutrons, and electrons.
b. I know that compounds are formed by combining two or more different elements and that compounds have properties that are different from their constituent elements.
c. I know atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.
d. I know the states of matter (solid, liquid, gas) depend on molecular motion.
e. I know that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.
f. I know how to use the periodic table to identify elements in simple compounds.

4. Reactions

Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept:

a. I know reactant atoms and molecules interact to form products with different chemical properties.
b. I know the idea of atoms explains the conservation of matter: In chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
c. I know chemical reactions usually liberate heat or absorb heat.
d. I know physical processes include freezing and boiling, in which a material changes form with no chemical reaction.
e. I know how to determine whether a solution is acidic, basic, or neutral.

5. Periodic Table

The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept:

a. I know how to identify regions corresponding to metals, nonmetals, and inert gases.
b. I know each element has a specific number of protons in the nucleus (the atomic number) and each isotope of the element has a different but specific number of neutrons in the nucleus.
c. I know substances can be classified by their properties, including their melting temperature, density, hardness, and thermal and electrical conductivity.

6. Density and Buoyancy

All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept:

a. I know density is mass per unit volume.
b. I know how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume.
c. I know the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced.
d. I know how to predict whether an object will float or sink.

7. Heat

Heat moves in a predictable flow from warmer objects to cooler objects until all the objects are at the same temperature. As a basis for understanding this concept:

a. I know energy can be carried from one place to another by heat flow or by waves (including water, light and sound waves) or by moving objects.
b. I know heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and by convection (which involves flow of matter).
c. I know heat energy is also transferred between objects by radiation (radiation can travel through space).

8. Energy

Energy is a property of many substances and may be changed in form with varying efficiency. As a basis for understanding this concept:

a. I know that energy cannot be created or destroyed, but only change from one form to another.
b. I know the various forms in which energy comes to the Earth from the sun.
c. I know visible light is a small band within a very broad electromagnetic spectrum.
d. I know the properties of waves and the effects different media has on waves.

9. Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in all three strands, students should develop their own questions and perform investigations.
Students will:

a. I plan and conduct a scientific investigation to test a hypothesis.
b. I evaluate the accuracy and reproducibility of data.
c. I distinguish between variable and controlled parameters in a test.
d. I recognize the slope of the linear graph as the constant in the relationship y=kx and apply this principle in interpreting graphs constructed from data.
e. I construct appropriate graphs from data and develop quantitative statements about the relationships between variables
f. I apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including speed = distance/time, density = mass/volume, force = pressure × area, volume = area × height). (Math Connection)
g. I distinguish between linear and nonlinear relationships on a graph of data (Math Connection)

Grade Nine - Biology

1 Biological Principles

The student will understand the basic concepts about the structure and properties of matter.

a. I know the major themes of biology and the subfields of biological studies
b. I can use the basic skills of scientific study, including measurement and use of tools, as well as scientific procedures included in the Scientific Method.
c. I have knowledge of the basic concepts of chemistry as they relate to biological sciences including the basic structure and function of the major macromolecules of life.

2 Cells

The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:

a. I can understand basic cell theory and the differences between Prokaryotic and Eukaryotic cells.
b. I can understand the structure and function of the basic cell organelles.
c. I can understand the processes of homeostasis and cell transport and the role they play in the functioning of organisms.
d. I can understand the processes of photosynthesis and cell respiration and the role they play in the functioning of organisms.
e. I can understand the processes of Mitosis and Meiosis.

3 Genetics and the Origin of Life

Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:

a. I can understand the basic concepts of Mendelian genetics including dominant and recessive traits, genotype and phenotype prediction and the laws of segregation and independent assortment.
b. I can know the structure of DNA and understand the process by which proteins are synthesized and the roles DNA and RNA play in that process
c. I can understand the process by which traits are inherited and the effect that mutations have on the expression of those traits.

d. I can understand the tools and technologies that are used to predict and manipulate genetic expression and how these are applied in the fields of biotechnology

4 Origins and Diversity of Life

The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:

a. I can understand the different viewpoints, both naturalistic and theistic, of the origins of the universe and life.
b. I can understand Darwin's theories of evolution and natural selection.
c. I am familiar with evidence supporting a Christian view of the diversity of life.
d. I can understand the diversity of life through a study of the domains and kingdoms.

5 Ecology

Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:

a. I can understand that all factors (biotic and abiotic) of an ecosystem are linked through the cycling of energy and materials.
b. I can understand the basic principles of population study including population measurement, density and fluctuation cycles.
c. I can understand that populations interact in a variety ways within communities and those communities can change over time.
d. I can understand the diversity of ecosystems present in our world.
e. I can understand the effects of human interactions with the natural world.

6 Human Body Systems

As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:

a. I understand the structure and function of human body systems.

High School - Chemistry

1. Atomic and Molecular Structure

The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:

a. I know that most elements have two or more isotopes (i.e. atoms that differ in the number of neutrons in the nucleus); although the number of neutrons has little effect on how the atom interacts with other atoms, it does affect the mass and stability of the nucleus.
b. I can explain trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.
c. I know how to relate the position of an element in the periodic table to its quantum electron configuration, bonding capabilities, and to its reactivity with other elements in the table.
d. I know the experimental basis for the various models of the atom(Dalton, Thomson, Rutherford, Bohr, Quantum Mechanical).
e. I can explain the cause of spectral lines and perform calculations about them.
f. know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.
g. I know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.
h. I know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.

2. Chemical Bonds

Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:

a. I know the types and characteristics of crystals produced in ionic and covalent structures.
b. I know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.
c. I know how to draw Lewis dot structures and can use the structures to predict the shape of simple molecules and their polarity.

3. **Conservation of Matter and Stoichiometry**
   The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept:

   a. I know how to describe chemical reactions by writing balanced equations.
   b. I know the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams and contains 6.02x1023particles (atoms or molecules).
   c. I know how to perform stoichiometry calculations.
   d. I know how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.

4. **Gases and Their Properties**
   The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:

   a. I know the assumptions of the Kinetic Molecular Theory of gases.
   b. I can use the Kinetic Molecular Theory to explain the characteristics of gases.
   c. I know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.
   d. I know how to solve problems by using the ideal gas law in the form PV = nRT.

5. **Acids and Bases**
   Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:

   a. I know the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.
   b. I know strong acids and bases fully dissociate and weak acids and bases partially dissociate.
   c. I know how to calculate pH from the hydrogen-ion concentration.
   d. I know buffers stabilize pH in acid-base reactions.

6. **Solutions**
   Solutions are homogeneous mixtures of two or more substances. As a basis for understanding this concept:

   a. I know temperature, pressure, and surface area affect the dissolving process.
   b. I know how to calculate the concentration of a solute in terms of grams per liter and molarity.
   c. I know the relationship between the molality of a solute in a solution and the solution's depressed freezing point or elevated boiling point.
   d. I know how molecules in a solution are separated or purified by the methods of chromatography and distillation.

7. Chemical Thermodynamics

Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:

a. I know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).
b. I know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.
c. I know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.
d. I know how to apply Hess's law to calculate enthalpy change in a reaction.
e. I know how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.

High School - Physical Science

* Benchmark students have the opportunity to learn, but are not necessarily assessed over these benchmarks.

1. Motion and Forces

a. I can solve problems that involve constant speed and average speed.
b. I can apply Newton's Laws to solve motion problems.
    i. I know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).
    ii. I can apply the law F=ma to solve one-dimensional motion problems that involve constant forces (Newton's second law).
    iii. I know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
c. I know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.
    i. I know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed). I know circular motion requires the application of a constant force directed toward the center of the circle.
d. I know Newton's laws are not exact but provide very good approximations unless an object is moving close to the speed of light or is small enough that quantum effects are important.
e. I can resolve two-dimensional vectors into their components and graphically determine the magnitude and direction of a vector from its components.

2. Conservation of Energy and Momentum

a. I can solve problems involving conservation of energy in simple systems, such as falling objects.
    i. I can calculate kinetic energy by using the formula $E=(1/2)mv^2$.
    ii. I can calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =mgh (h is the change in the elevation).
    iii. I can calculate momentum as the product mv.
b. I can solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.
    i. I know momentum is a separately conserved quantity different from energy.
    ii. I know an unbalanced force on an object produces a change in its momentum.

3. **Heat and Thermodynamics**
    a. I know heat flow and work are two forms of energy transfer between systems.
        i. I know that the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (first law of thermodynamics) and that this is an example of the law of conservation of energy.
        ii. I know the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as thermal energy. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.
        iii. I can solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.
    b. I know that entropy is a quantity that measures the order or disorder of a system and that most processes tend towards disorder.
        i. I know the statement "Entropy tends to increase" is a law of statistical probability that governs all closed systems (second law of thermodynamics).

4. **Waves**

    a. I know waves carry energy from one place to another.
    b. I can identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves).
    c. I can solve problems involving wavelength, frequency, and wave speed.
    d. I know sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.
    e. I know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×108 m/s (186,000 miles/second).
    f. I can identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.
    g. I know light color depends upon the wavelength of the electromagnetic wave.

5. **Electric and Magnetic Phenomena**

    a. I can predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.
    b. I can solve problems involving Ohm's law.
    c. I know any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula Power = IR (potential difference) × I (current) = I2R.

d. I know charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.
e. I can solve problems related to magnetic fields, electric fields, and electromagnetic induction.
    i - I know magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.
    ii - I can determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.
    iii - I know changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.

6. Atomic and Molecular Structure

a. I can relate the position of an element in the periodic table to its atomic number and atomic mass. I can use the periodic table to identify metals, semimetals, nonmetals, and halogens. I can use the periodic table to determine the number of electrons available for bonding.
b. I can use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electro negativity, and the relative sizes of ions and atoms.

7. Chemical Bonds

a. I know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
b. I know chemical bonds between atoms in molecules such as H2, CH4, NH3, H2C2H2, N2, Cl2, and many large biological molecules are covalent.
c. I know salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.
d. I know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.

8. Gases and Their Properties

a. I know the random motion of molecules and their collisions with a surface create the observable pressure on that surface. I know the random motion of molecules explains the diffusion of gases.
b. I can apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.
c. I can convert between the Celsius and Kelvin temperature scales.
d. I know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.

9. Investigation and Experimentation

a. I can use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. I can identify and communicate sources of unavoidable experimental error. I can identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
c. I can recognize the issues of statistical variability and the need for controlled tests.
d. I can formulate explanations by using logic and evidence.
e. I can distinguish between hypothesis and theory as scientific terms.
f. I can recognize the usefulness and limitations of models and theories as scientific representations of reality.
g. I can analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

10. Connections*

a. I can analyze benefits, limitations, costs, and consequences involved in using technology or resources (for example, X-rays, agricultural chemicals, natural gas reserves).
b. I can analyze how the introduction of a new technology has affected or could affect human activity (for example, invention of the telescope, applications of modern telecommunications).
c. I can demonstrate the interrelationships between science and technology (for example, building a bridge, designing a better running shoe).
d. I can explain the use of technology in an occupation. For students continuing their science education beyond the standards, what they know and are able to do may include.
e. I can investigate careers based in the use of science and technology.
f. I can apply their knowledge and understanding of chemical and physical interactions to explain present and anticipated technologies (for example, lasers, ultrasound, superconducting materials, photocopy machines).
g. I can explore the scientific and technological aspects of contemporary problems (for example, issues related to nutrition, air quality, natural resources).
h. I know how to evaluate print and visual media for scientific evidence, bias, or opinion.
i. I can explain that the scientific way of knowing uses a critique and consensus process (for example, peer review, openness to criticism, logical arguments, skepticism).
j. I can use graphs, equations, or other models to analyze systems involving change and constancy (for example, comparing the geologic time scale to shorter time frames).

k. I can analyze and comparing models of cyclic change as used within and among scientific disciplines (for example, water cycle, circular motion, sound waves, and weather cycles).
l. I can identify and describing the dynamics of natural systems (for example, weather systems, ecological systems, body systems, systems at dynamic equilibrium).
m. I can analyze a model of a system involving change and constancy (for example, a mathematical expression for gas behavior; constructing a closed ecosystem such as an aquarium).

High School - Physics Benchmarks

** Benchmark students have the opportunity to learn, but are not necessarily assessed over these benchmarks.*

1. Motion and Forces

a. I can solve problems that involve constant speed and average speed.
b. I understand that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).
c. I can apply the law F=ma to solve one-dimensional motion problems that involve constant forces (Newton's second law).
d. I understand that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
e. I understand that the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.
f. I understand that applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).
g. I understand that circular motion requires the application of a constant force directed toward the center of the circle.
h. I understand that Newton's laws are not exact but provide very good approximations unless an object is moving close to the speed of light or is small enough that quantum effects are important. *
i. I can solve two-dimensional trajectory problems. *
j. I can resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components. *
k. I can solve two-dimensional problems involving balanced forces (statics). *
l. I can solve problems in circular motion by using the formula for centripetal acceleration in the following form: a=v2/r. *
m. I can solve problems involving the forces between two electric charges at a distance (Coulomb's law) or the forces between two masses at a distance (universal gravitation). *

2. Conservation of Energy and Momentum

a. I can calculate kinetic energy by using the formula E=(1/2)mv2 .
b. I can calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =mgh (h is the change in the elevation).
c. I can solve problems involving conservation of energy in simple systems, such as falling objects.
d. I can calculate momentum as the product mv.

e. I understand that momentum is a separately conserved quantity different from energy.
f. I understand that an unbalanced force on an object produces a change in its momentum.
g. I can solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.
h. I can solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs. *

3. Waves

a. I understand that waves carry energy from one place to another.
b. I can identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves).
c. I can solve problems involving wavelength, frequency, and wave speed.
d. I understand that sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.
e. I understand that radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×108 m/s (186,000 miles/second).
f. I can identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization

4. Electric and Magnetic Phenomena

a. I can predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.
b. I can solve problems involving Ohm's law.
c. I understand that any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula Power = IR (potential difference) × I (current) = I2R.
d. I understand that the properties of transistors and the role of transistors in electric circuits.
e. I understand that charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.
f. I understand that magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.
g. I can determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.
h. I understand that changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.
i. I understand that plasmas, the fourth state of matter, contain ions or free electrons or both and conduct electricity.

j. I understand that electric and magnetic fields contain energy and act as vector force fields. *
k. I understand that the force on a charged particle in an electric field is qE, where E is the electric field at the position of the particle and q is the charge of the particle. *
l. I can calculate the electric field resulting from a point charge. *
m. I understand that static electric fields have as their source some arrangement of electric charges. *
n. I understand that the magnitude of the force on a moving particle (with charge q) in a magnetic field is qvB sin(a), where a is the angle between v and B (v and B are the magnitudes of vectors v and B, respectively), and students use the right-hand rule to find the direction of this force. *
o. I can apply the concepts of electrical and gravitational potential energy to solve problems involving conservation of energy. *

5. Investigation and Experimentation

a. I can select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. I can identify and communicate sources of unavoidable experimental error.
c. I can identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. I can formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. I can distinguish between hypothesis and theory as scientific terms.
g. I can recognize the usefulness and limitations of models and theories as scientific representations of reality.
h. I can read and interpret topographic and geologic maps.
i. I can analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
j. I can recognize the issues of statistical variability and the need for controlled tests.
k. I can recognize the cumulative nature of scientific evidence.
l. I can analyze situations and solve problems that require combining and applying concepts from more than one area of science.
m. I can investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
n. I know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is

sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

6. Connections*

a. I can analyze the benefits, limitations, costs, and consequences involved in using technology or resources (for example, X-rays, agricultural chemicals, natural gas reserves)
b. I can analyze how the introduction of a new technology has affected or could affect human activity (for example, invention of the telescope, applications of modern telecommunications)
c. I can demonstrate the interrelationships between science and technology (for example, building a bridge, designing a better running shoe)
d. I can explain the use of technology in an occupation. For students continuing their science education beyond the standards, what they know and are able to do may include
e. I investigate careers based in the use of science and technology
f. I apply my knowledge and understanding of chemical and physical interactions to explain present and anticipated technologies (for example, lasers, ultrasound, superconducting materials, photocopy machines)
g. I can explore the scientific and technological aspects of contemporary problems (for example, issues related to nutrition, air quality, natural resources)
h. I can evaluate print and visual media for scientific evidence, bias, or opinion
i. I can explain that the scientific way of knowing uses a critique and consensus process (for example, peer review, openness to criticism, logical arguments, skepticism)
j. I can use graphs, equations, or other models to analyze systems involving change and constancy (for example, comparing the geologic time scale to shorter time frames)
k. I can analyze and compare models of cyclic change as used within and among scientific disciplines (for example, water cycle, circular motion, sound waves, weather cycles)
l. I can identify and describe the dynamics of natural systems (for example, weather systems, ecological systems, body systems, systems at dynamic equilibrium)
m. I can analyze a model of a system involving change and constancy (for example, a mathematical expression for gas behavior; constructing a closed ecosystem such as an aquarium)

High School - Human Anatomy

1 Body Organization

a. I have a working knowledge of body organization
b. I understand the chemical basis of the body
c. I can describe the structure and function of a cell
d. I can describe the structure and function of a tissue
e. I can describe the organs and systems of the body

2 Support/Cover/Movement Systems

a. I can describe the structure and function of the skeletal system
b. I can describe the structure and function of the integumentary system
c. I can describe the structure and functions of the muscular system

3 Communication Systems

a. I can describe the structure and function of the nervous system
b. I can identify the special senses and their functions
c. I can describe the general structures and functions of the endocrine system

4 Transport/Protect Systems

a. I can describe the structure and functions of the blood
b. I can describe the structure and functions of the cardiovascular system
c. I can describe the structure and functions of the lymphatic system

5 Metabolic Processes

a. I can describe the structures and functions of the respiratory system
b. I can describe the structures and functions of the digestive system
c. I can describe concepts of nutrition
d. I can describe the key structures and functions of the urinary system

6 Human Development

a. I can describe the structures and functions of the male and female reproductive systems
b. I can describe the stages of embryonic development and birth events

High School - Advance Placement Biology

1. Scientific inquiry and technological design

b. I know about and can apply the concepts, principles and processes of scientific inquiry.
   i. Formulate hypotheses referencing prior research and knowledge.
   ii. Design procedures to test the selected hypotheses.
   iii. Conduct systematic controlled experiments to test the selected hypotheses.
   iv. Apply statistical methods to make predictions and to test the accuracy of results. Report, display and defend the results of investigations to audiences that may include professionals and technical experts

c. I know about and can apply the concepts, principles and processes of technological design.
   i. Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time and costs.
   ii. Select criteria for a successful design solution to the identified problem.
   iii. Build and test different models or simulations of the design solution using suitable materials, tools and technology.
   iv. Choose a model and refine its design based on the test results.
   v. Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements.
   vi. Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts.

2. Interconnections of the life, physical and earth/space sciences.

a. I know about and can apply concepts that explain how living things function, adapt and change.
   i. Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy).
   ii. Analyze the transmission of genetic traits, diseases and defects.

b. Know and apply concepts that describe how living things interact with each other and with their environment.
   i. Analyze and explain biodiversity issues and the causes and effects of extinction.
   ii. Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions).

3. Relationships among science, technology and society

a. I know about and can apply the accepted practices of science.
   i. Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.
   ii. Explain criteria that scientists use to evaluate the validity of scientific claims and theories.
   iii. Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies.
   iv. Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims.

b. I know about and can apply concepts that describe the interaction between science, technology and society.
   i. Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, and technology obsolescence).
   ii. Analyze and describe the processes and effects of scientific and technological breakthroughs.
   iii. Design and conduct an environmental impact study, analyze findings and justify recommendations.
   iv. Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access).
   v. Assess how scientific and technological progress has affected other fields of study, careers and job markets and aspects of everyday life.

High School - Advance Placement Chemistry

1. Atomic Theory and Structure.

a I can analyze the structure of matter at the atomic level
   i Evidence for the atomic theory.
   ii Atomic masses; determination by chemical and physical means.
   iii Atomic number and mass number; isotopes.
   iv Electron energy levels: atomic spectra, quantum numbers, atomic orbitals.
   v Periodic relationships including, for example, atomic radii, ionization energies, electron affinities, oxidation states.

b I know how to examine the types of chemical bonds and the nature of each
   i Types: ionic, covalent, metallic, hydrogen bonding, van der Waals (including London dispersion forces).
   ii Relationships to states, structure, and properties of matter.
   iii Polarity of bonds, electronegativities.

c I can analyze conceptual models of bonding and molecular shape and the relation to chemical and physical properties of matter.
   i Lewis structures.
   ii VSEPR.
   iii Valence bond: hybridization of orbitals, resonance, sigma and pi bonds.
   iv Geometry of molecules and ions, structural isomerism of simple organic. molecules and coordination complexes; dipole moments of molecules; relation of properties to structure.

d I can assess the impact of nuclear chemistry
   i Nuclear decay equations.
   ii Half-life and radioactivity.
   iii Chemical applications.

2. States of Matter

a I know how to examine the relationships between pressure, volume and temperature of ideal gases
   i Laws of ideal gases: Boyle's, Charles'.
   ii The ideal gas equation.
   iii Partial pressures and Dalton's Law.

b I can analyze kinetic-molecular theory
   i Interpretation of ideal gas laws on the basis of this theory.
   ii Avogadro's hypothesis and the mole concept.
   iii Dependence of kinetic energy of molecules on temperature.

iv Deviations from ideal gas laws.

c I can assess the nature of liquids and solids
   i Liquids and solids from the kinetic-molecular viewpoint.
   ii Phase diagrams of one-component systems.
   iii Changes of state, including critical points and triple points.
   iv Structure of solids; lattice energies.

d I know how to examine the nature of solutions
   i Types of solutions and factors affecting solubility.
   ii Methods of expressing concentration (The use of normalities is not tested.).
   iii Raoult's law and colligative properties (nonvolatile solutes); osmosis.
   iv Non-ideal behavior (qualitative aspects).

3. Chemical Reactions.

a I can analyze the various types of common chemical reactions
   i Acid-base reactions; concepts of Arrhenius, Brönsted-Lowry, and Lewis;
   ii Coordination complexes; amphoterism.
   iii Precipitation reactions.
   iv Oxidation-reduction reactions; Oxidation number; The role of the electron in oxidation-reduction; Electrochemistry: electrolytic and galvanic cells; Faraday's laws; standard half-cell potentials; Nernst equation; prediction of the direction redox reactions.

b I can apply the principles of stoichiometry
   i Ionic and molecular species present in chemical systems: net ionic equations.
   ii Balancing of equations including those for redox reactions.
   iii Mass and volume relations with emphasis on the mole concept, including empirical formulas and limiting reactants.

c I can analyze chemical kinetics
   i Concept of rate of reaction.
   ii Use of differential rate laws to determine order of reaction and rate constant from experimental data.
   iii Effect of temperature change on rates.
   iv Energy of activation; the role of catalysts.
   v The relationship between the rate-determining step and a mechanism.

d I can analyze systems in dynamic equilibrium
   i Concept of dynamic equilibrium, both physical and chemical; Le Chatelier's principle; equilibrium constants.
   ii Quantitative treatment for gaseous reactions using Kp and Kc.
   iii Quantitative treatment for reactions in solution Kc.

iv Quantitative treatment of for acids and bases; using Ka and Kb, pKa and pKb and pH.
v Quantitative treatment for precipitation reactions and the dissolution of slightly soluble compounds using the solubility product constant, Ksp.
vi Common ion effect; buffers; hydrolysis.

e I can analyze chemical thermodynamics
i State functions.
ii First law: change in enthalpy; heat of formation; heat of reaction; Hess's law; heats of vaporization and fusion; calorimetry.
iii Second law: entropy; free energy of formation; free energy of reaction; dependence of change in free energy on enthalpy and entropy changes.
iv Relationship of change in free energy to equilibrium constants and electrode potentials.

4. Knowledge of Descriptive Chemistry

a I know how to examine chemical reactivity and predict the products of chemical reactions.

b I can analyze the relationships in the periodic table: horizontal, vertical, and diagonal with examples from alkali metals, alkaline earth metals, halogens, and the first series of transition elements.

c I can explore organic chemistry on an introductory level
i Hydrocarbons and functional groups (structure, nomenclature, chemical properties).
ii Physical and chemical properties of simple organic compounds should also be included as exemplary material for the study of other areas such as bonding, equilibria involving weak acids, kinetics, colligative properties, and stoichiometric determinations of empirical and molecular formulas

5. Scientific Inquiry

a I can complete appropriate lab activities for each unit
i Make observations of chemical reactions and substances
ii Record data
iii Calculate and interpret results based on the quantitative data obtained
iv Communicate effectively the results of experimental work