



CONCORDIA CURRICULUM GUIDE



GRADE
6

Science



C O N T E N T S

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P R E F A C E

Ministry of Christian Schools

Parental expectations of Christian schools include

- excellent discipline;
- high academic standards;
- low teacher-student ratios;
- dedicated, conscientious teachers.

Many Christian schools offer these advantages. But the real distinction is that Christian schools proclaim Jesus Christ as the Son of God and Savior of the world. Teaching Jesus Christ, then, is “the real difference” between Christian and public schools. In Christian schools, teachers and students witness personally and publicly to their faith in Jesus Christ. Students study the Bible and worship God daily. Teachers relate Jesus Christ to all aspects of the curriculum. Teachers and students share Christian love and forgiveness.

Those who teach in Christian schools are privileged with the opportunity to

- teach the Word of God in its truth and purity;
- acknowledge the Bible as God’s infallible Word and the Confessions as the true exposition of the Word;
- identify God’s Word, Baptism, and the Lord’s Supper as the means through which God creates and sustains faith;
- emphasize Law and Gospel as the key teaching of Scripture;
- seek to apply Law and Gospel properly in daily relationships with students, parents, and other teachers;
- teach all of what Scripture teaches (including Christian doctrines) to all students, no matter what backgrounds they have;
- share with students what Jesus, the Savior, means to them personally;
- equip students to proclaim the Good News to others;

- encourage students to find the support and encouragement found only in the body of Christ, of which Jesus Himself is the head.

In Christian schools, Christ permeates all subjects and activities. Religion is not limited to one hour or one class. Teachers seek opportunities to witness in every class and to relate God’s Word to all aspects of life. Through this process, and by the power of the Holy Spirit, students grow in faith and in a sanctified life, and view all of life, not just Sunday, as a time to serve and worship God.

In summary, it is intrinsic to ministry in a Christian school that all energies expended in the educational process lead each child to a closer relationship with the Savior and with other members of the Christian community.

How to Use This Guide

The Concordia Curriculum Guide series is designed to guide you as you plan and prepare to teach. The introductory chapters provide foundational information relevant to the teaching of science to students in a Christian school. But the majority of the pages in this volume focus on science standards and performance expectations together with ideas and activities for integrating them with various aspects of the Christian faith. This volume does not provide a curriculum plan or lesson plan for any particular period or day. Instead, it provides a wealth of ideas from which you can choose and a springboard to new ideas you may create. You may use this curriculum guide with any textbook series.

The science standards included in this book are informed by the Benchmarks for Science Literacy, published in conjunction with Project 2061 of the American Association for the Advancement of Science (AAAS) (see also ch. 3), and are provided as a compilation of the science standards and performance expectations adopted by the individual states. In order to offer a well-coordinated curriculum design, the science objec-

tives for this grade level relate to and connect with the standards provided at other grade levels.

The standards, then, can serve you and your whole faculty in several ways. They can help you

1. plan your teaching in an organized way;
2. coordinate your teaching of a subject with the teaching in other grades in your school;
3. select textbooks and other learning or teaching materials;
4. evaluate your current instruction, materials, and objectives;
5. implement procedures for school accreditation;
6. nurture the Christian faith of your students as you teach science.

We assume that teachers will use materials in addition to those included in the guide, but, since many materials do not integrate the Christian faith, we have provided suggestions for specific methods to use as you teach day by day. Everyone has a different teaching style. No one will be able to use all the ideas in this volume. As you think about practices that will work for you and would be helpful in your classroom, consider these possible ways to find and use ideas from this volume:

- Read the entire volume before school starts. Highlight the ideas you think you can use.
- Write ideas in your textbooks. List the page numbers from this volume that contain suggestions you would like to use in connection with a lesson or unit.
- Throughout the year, designate periods of time, perhaps at faculty meetings, to discuss portions of this volume as you seek to improve your integration of the faith in science. Brainstorm, develop, and implement your ideas. Then follow up with other meetings to share your successes and challenges. Together, find ways to effectively use the suggestions in this volume.

- Plan ways to adapt ideas not closely related to specific lessons or units in your secular textbooks. Inside your plan book, clip a paper with a list of suggestions from the volume that you would like to use, or list each idea on a file card and keep the cards handy for quick review. Use those ideas between units or when extra time is available.
- Evaluate each suggestion after you have tried it. Label it as “use again” or “need to revise.” Always adapt the suggestions to fit your situation.
- Think about integrating the faith each time you plan a lesson. Set a goal for yourself (e.g., two ideas from this volume each week), and pray that God will help you to achieve it. You will find the index at the back of this volume especially helpful in finding faith-connecting activities relative to specific topics.
- If the ideas in the Concordia Curriculum Guide series seem overwhelming, begin by concentrating on only one subject per month. Or attempt to use the suggested ideas in only two to four subjects the first year. Add two to four subjects per year after that.

Probably the most effective teaching occurs when teachers take advantage of natural opportunities that arise to integrate the faith into their teaching. In those situations, you will often use your own ideas instead of preparing a lesson plan based on teaching suggestions in this guide. Use the white space on the pages of this book to record your own ideas and activities for integrating the Christian faith. We hope this volume will be an incentive to you to create your own effective ways to integrate the Christian faith into the entire school day.

We believe that Christian schools are essential because we believe that our relationship with Jesus Christ permeates every part of our lives. That is why our Christian faith permeates our teaching. That is why we teach in a Christian school.

CHAPTER 1

Vocations in Science and Education

By

Nathan Jastram

Dr. Nathan Jastram was born and raised in Japan, the son of missionary parents. He received a bachelor's degree in classical languages at the University of South Dakota in Vermillion. He earned his master's degree in theology at Concordia Theological Seminary in Fort Wayne, Indiana. He then went on to obtain his doctorate in ancient Near Eastern languages and civilizations—with a dissertation on the Dead Sea Scrolls—from Harvard University (Cambridge, Massachusetts). He taught at Concordia University, River Forest, Illinois, from 1990 to 1999. Dr. Jastram has been teaching at Concordia University Wisconsin, Mequon, since 1999. He is currently the chairman of the theology division.

The Vocation of Scientist

Christian educators live out their vocation as they help others by word, attitude, and example to grow in knowledge, understanding, and skills while sharing with them the love of Jesus. Christians in the field of science serve God and others through their efforts to better understand and apply their understandings of God's creation. Although God has not specifically ordained the vocation of scientist in the Bible, the vocation of science is filled by people who love knowledge and search for wisdom, two attributes often praised in the Bible. Solomon urges, "Get wisdom, get understanding" (Proverbs 4:5 NIV), and rhapsodizes, "How much better to get wisdom than gold, to choose understanding rather than silver!" (Proverbs 16:16 NIV). The wisdom that is extolled so highly begins with the fear of the Lord: "The fear of the LORD is the beginning of wisdom" (Proverbs 9:10 NIV). It continues with the intricacies of creation: "By wisdom the LORD laid the earth's foundations, by understanding He set the heavens in place; by His knowledge the deeps were divided, and the clouds let drop the dew" (Proverbs 3:19–20 NIV). Before the fall into sin, Adam exercised his godly wisdom by engaging in the scientific activity of

naming animals (Genesis 2:19–20). Unlike those in the generations to follow him, Adam's understanding came directly from God; no human instruction was available or required.

Discovering How the World Works

When Adam fell into sin, his relationships with Eve, God, and the Earth became marked by disharmony, misunderstanding, and adversity. In some mysterious way, the Earth itself was affected. "Cursed is the ground because of you" (Genesis 3:17 NIV). The apostle Paul writes, "The creation was subjected to frustration, not by its own choice, but by the will of the one who subjected it, in hope that the creation itself will be liberated from its bondage to decay and brought into the glorious freedom of the children of God. We know that the whole creation has been groaning as in the pains of childbirth right up to the present time" (Romans 8:20–22 NIV).

The vocations of Christians who are scientists and of Christian educators are callings through which God shares understanding of the world. Scientists study God's creation to learn more about it. In recent times, it has become possible for scientists to work with the code of life itself as they experiment with DNA. This is a heady development that allows scientists to participate in the creative activity of God, the author and

CHAPTER 2

Teaching and Learning Science from a Christian Perspective

Why Integrate Religion with Science?

Knowledge of science helps students understand what makes things happen as they do in the world. The relationships that exist were established by God at the time of creation. The laws of science are human descriptions of these relationships. They are as accurate as our understanding of nature is at the moment, but they are never absolute. These laws are continually refined, expanded, and sometimes abandoned as we uncover additional information about natural phenomenon.

Those teaching in Christian classrooms have the opportunity to point their students to evidence in creation of God's love, wisdom, power, and majesty. Connections made between the concepts of science and the Word of God will help students respond with love, gratitude, awe, and reverence toward their Creator. By the power of the Holy Spirit, science instruction can help students develop these gifts:

Knowledge and understanding

- Learners will appreciate God's power and majesty in establishing and governing the universe and controlling and governing the forces of nature.
- Learners will recognize the constancy and order God designed for the natural world.
- Learners will respond to God's grace by helping make the world a richer, safer, more beautiful place for present and future generations.

Skills

- Learners will use their scientific insights in a life of praise and devotion to God.
- Learners will grow in the ability to think critically and wisely, ever looking to God for guid-

ance when human inquiry fails to find answers or when it leads them away from God's revelation in His Word.

Connecting Science and the Christian Faith

Through the study of science, we learn more about our God—the one who made the world, redeemed it, and supports and preserves all things for the benefit of humanity. Teaching science from a distinctively Christian perspective involves building all lessons on the foundation of God's Word. The message of God's Word relates to science concepts in the following ways.

God made the world: He upholds the universe.

God created all things. He made the universe and everything in it in six days.

He made the world of intricate design and complex order.

God made the plants and animals, each after its own kind. On the sixth day, He created the first people, Adam and Eve, in His image.

The natural world reveals to us the existence of God the Creator (Romans 1:20).

The universe has fallen under the influence of sin.

Yielding to the temptation to abandon God's will, Adam and Eve sinned.

All of creation suffered sin's devastating consequences.

Strife between God and fallen humanity, among people, between people and animals, among animals, and between people and their environment continues as a result of sin (Genesis 3).

CHAPTER 3

Using the Benchmarks for Science Literacy

In 1993, the American Association for the Advancement of Science (AAAS), specifically Project 2061's Science for All Americans (SFAA), published a list of Benchmarks for Science Literacy. This resource was developed by teachers and administrators with the help and input of education specialists and scientists. Its intent is to provide a curriculum design tool helpful to those planning curriculum so that desired science literacy outcomes can be obtained. These benchmarks are organized by grade level according to the following categories.

The Scientific Worldview

Kindergarten–Grade 2
Grades 3–5
Grades 6–8
Grades 9–12

Scientific Inquiry

Kindergarten–Grade 2
Grades 3–5
Grades 6–8
Grades 9–12

The Scientific Enterprise

Kindergarten–Grade 2
Grades 3–5
Grades 6–8
Grades 9–12

These benchmarks have been adapted as follows to incorporate elements of the Christian faith.

A. The Scientific Worldview

Kindergarten–Grade 2

By the end of the second grade, students should know this:

- When a science investigation is done the way it was done before, they can expect to get a very similar result because of the laws God put into place at creation.
- Science investigations generally work the same way in different places.

Grades 3–5

By the end of the fifth grade, students should know this:

- Results of similar scientific investigations seldom turn out exactly the same. Sometimes this is because of unexpected differences in the things being investigated, sometimes because of unrealized differences in the methods used or in the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations. It is not always easy to tell which. Some of these differences characterize life in our fallen world as contrasted with the perfection our first parents enjoyed in Eden.

Grades 6–8

By the end of the eighth grade, students should know this:

- When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, and it often takes further studies to decide. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as correct.

CHAPTER 4

Science Curriculum Standards for Students in Grade 6

This chapter includes science standards that have been compiled from the individual state departments of education. They are organized, grade by grade, into the following four areas:

1. Physical Sciences 
2. Life Sciences 
3. Natural Sciences 
4. Science Processes and Approaches 

The Concordia standards have been systematized according to the following numerical designations to indicate grade level, area, category, and performance objective:

- The first digit indicates the grade level (e.g., the 2 in 2.3.1.4 designates that the performance expectation is for grade 2).
- The second digit indicates the area of science (as listed above) addressed by the standard (e.g., the 3 in 2.3.1.4 designates the standard as a natural sciences area since 3 is the number for natural sciences).
- The third digit indicates a category within the area. These categories are the same at every grade level (e.g., the 1 in 2.3.1.4, relates to the category of space studies, which is the first category of natural sciences at every grade level).
- The fourth digit indicates the number of the specific performance expectation. These expectations will vary from level to level (e.g., the 8 in 2.3.1.4, as found in the natural sciences area of the grade 2 standards relating to the category of space studies, refers to the fourth item in that category).

Chapter 5 provides faith-integration activities organized by category. These activities provide many opportunities to teach aspects of the Christian faith in conjunction with each area of the science curriculum. Each activity is keyed to a specific performance expectation.

A complete list of science standards performance expectations for this grade level is provided on the remaining pages of this chapter. In order to offer a well-coordinated curriculum design, the science education objectives for each grade level are related to and connected with the standards provided at other grade levels. Teachers and schools are invited to use the CD that is included in the *Concordia Curriculum Guide: Science* volume at each grade level to modify the Concordia science education standards for use in their own particular situation.

PHYSICAL SCIENCES



6.1 Sixth-grade students in Lutheran schools will understand concepts related to the physical sciences.

6.1.1 Composition of Matter

- 6.1.1.1 Classify items based on similarities and differences.
- 6.1.1.2 Articulate that each element of matter is made of one kind of atom.
- 6.1.1.3 Recognize that matter is made of atoms and that atoms combine to form molecules.
- 6.1.1.4 Explain the positioning of elements on the periodic table.
- 6.1.1.5 Explain that atoms combine to form molecules and that a molecule is the smallest unit of a compound.
- 6.1.1.6 Explain that in a physical change, such as those involving state, shape, and size, the chemical properties of a substance remain unchanged.
- 6.1.1.7 Demonstrate that in a chemical change new substances are formed with different properties than the original substance (e.g., rusting, burning).
- 6.1.1.8 Differentiate between acids and bases.
- 6.1.1.9 Explain the laws of conservation of matter and energy.
- 6.1.1.10 Demonstrate that the volume of objects can be calculated or measured by water displacement.
- 6.1.1.11 Define mass as a measure of the amount of matter in a solid, liquid, or gas.
- 6.1.1.12 Recognize that equal volumes of different substances usually differ in mass.
- 6.1.1.13 Acknowledge that objects with the same volume can have different masses and that objects with the same mass can have different volumes.
- 6.1.1.14 Calculate density from the mass and volume.
- 6.1.1.15 Describe the physical properties of various substances in terms of their density, boiling point, degree of solubility in water, and magnetism.
- 6.1.1.16 Demonstrate that mixtures are formed when two or more substances are physically combined.
- 6.1.1.17 Identify the mass of a mixture as equal to the sum of the masses of its components.
- 6.1.1.18 Identify the processes used to separate mixtures, including filtration, evaporation, and paper chromatography.
- 6.1.1.19 Differentiate between organic and inorganic compounds.

6.1.2 Magnetism, Force, and Motion

- 6.1.2.1 Illustrate and describe the magnetic fields surrounding a single bar magnet, two bar magnets with like poles facing, two bar magnets with opposite poles facing, and a horseshoe magnet.
- 6.1.2.2 Show that the strength of a simple electromagnet depends on the number of coils, the amount of current in the wire, and whether or not an iron core is used, and show that current moving through a wire produces a magnetic field which surrounds the wire.

6.1.3 Energy

- 6.1.3.1 Relate the size of the force applied to the size of the change in the object's motion.
- 6.1.3.2 Show that an object at rest remains at rest unless acted upon by an outside force.
- 6.1.3.3 Tell how an object can possess potential energy due to its position or chemical composition and can have kinetic energy by virtue of its motion.

CHAPTER 5

Information and Activities for Integrating the Faith as Keyed to Grade 6 Standards

The science standards included in this chapter have been compiled from the individual state departments of education and organized, grade by grade, into the following four areas:

1. Physical Sciences 
2. Life Sciences 
3. Natural Sciences 
4. Science Processes and Approaches 

The standards have been systematized according to the following numerical designations to indicate grade level, area, category, and performance objective as described on the first page of chapter 4.

Performance expectations are numbered sequentially (e.g., the 4 in 2.3.1.4 is found in grade 2, in the natural sciences area, relating to the category of space studies, and is the fourth item in that category). A complete list of science standards performance expectations for this grade level is provided in chapter 4.

On the pages of chapter 5, which follows, you will find an easy-to-reference two-column format for faith integration with the science standards. The left-hand column, under the heading *Information by Topic*, provides helpful teaching background information and insights relevant for integrating some aspect of the Christian faith. The number following the topic identifies the performance expectation to which the topic relates (see ch. 4). Beside each entry, in the right-hand column, under the heading *Discussion Points/Activities*, you will find ideas helpful for planning and organizing student learning experiences that reinforce and expand upon these faith connections.

Be sure to consult the index at the end of this volume for a complete listing of topics and where they may be found.

PHYSICAL SCIENCES



INFORMATION BY TOPIC

DISCUSSION POINTS/ACTIVITIES

6.1 Sixth-grade students in Lutheran schools will understand concepts related to the physical sciences.

6.1.1 Composition of Matter

Classification

Throughout the Old Testament, God set His people apart, making them different from other groups of people. The Lord made known to them and to the whole world that His people have been blessed to be a blessing through His Son, Jesus.

(6.1.1.1)

- Organize a scavenger hunt involving only items found in the students' desks. Be sure to call out specific items. Calling out "ruler" may get a number of responses, but calling out "Blue plastic ruler" may limit the number substantially.

Somewhat similarly, Jesus sought us in our lost condition (Luke 19:10) and called us out of darkness and into His marvelous light (1 Peter 2:9).

- Invite fellow students to bring in and show off their various collections. Collections may include coins, collector's cards, stamps, model cars, bottle caps, dolls, and shells. Talk about how your collections are organized or sorted. What is your classification system based on, and why do you sort your collections? Explain the sorting that will take place under our Lord's direction on the final day. See Matthew 13:36–43.

Atomic Elements

We are reminded in Psalm 139 that the Lord knew each of us before we were knit together in our mother's womb. Before there were periodic tables and electron microscopes, God knew us before our atoms were brought together. Just as the atoms of each element have the properties of that element, as the Holy Spirit works in Christians through Word and Sacrament, we become more and more Christlike. See Galatians 5:22–23. Our Lord has great love for us! (6.1.1.2)

- Have each student choose one element that occurs in our bodies and do a short report on that element. Students may make a model of their element, write a paper, or make a video involving their element. Remind the students that, before the elements were brought together to form them, God knew them and cared for them!

- Let each student come up with an interesting fact about one of the elements. Compile the facts, and let the students study them on a fact sheet. Divide the class in half, and turn the facts into questions. The first student correctly to guess which fact matches which element wins a point for his or her team.

**Molecules, Composition of**

Molecules can be used to describe our congregations. As molecules are made up of atoms, the Church is made of individuals that come together to form congregations. The congregation suffers when a person or people separate out from the group. Pray for cohesiveness and togetherness in our local congregations. (6.1.1.3)

- Using colored modeling clay and toothpicks, have students create three dimensional molecules. Allow the different colors to represent different atoms and the toothpicks to represent the bonds between the atoms. The easiest molecule would be water (two hydrogen atoms with an oxygen atom between them). Can your students create a sugar molecule? a salt molecule? How are individual Christians like the atoms in a molecule? What binds us together? See Colossians 3:12–14.
- Play some blob tag in your gym or on your school grounds. Blob tag begins with one person being “it.” That person runs and tags another. When another student is tagged, he or she joins hands/arms with the original person, and they seek out their next player. When a third person is tagged, he or she joins the group of two by holding one of the free arms or hands. Play continues until there are six people in the blob, at which time they may divide into three groups of two and continue to chase and tag fellow students. The last person caught is the “it” person to begin the next round. How are the students like atoms? What are their bonds? Read and discuss the words of the hymn “Blest be the tie that binds.” Sing the hymn together.

Periodic Table, Position of Elements on the

Rarely are elements ever found naturally in their pure form. Even in biblical times, the value of a pure element, particularly gold or silver, was held in the highest regard just as it is today. Higher yet is the value of our faith, as mentioned in 1 Peter 1:6–9. Remind students that their faith is more precious than refined gold! (6.1.1.4)

- Create a periodic symbol collection by finding items that represent the various types of elements. Gather items such as a magnet for the magnetic metals, a cup of water to represent the liquid elements, a mirror for the elements that can reflect light, or a filled balloon to represent the noble gas elements. Allow the students to come up with the symbols. How are the three states of matter like the Holy Trinity?
- Find the most pure example in your home of each of the series groupings. If an item cannot be brought in, take a photo or draw a picture of the item. Of course the rare Earth elements will be very hard to come by, but look for examples in your home of calcium, aluminum, boron, carbon, and other common elements.

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