



# CONCORDIA CURRICULUM GUIDE



GRADE  
8

Science



# C O N T E N T S

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# P R E F A C E

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## **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-

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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

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## 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

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## Science Curriculum Standards for Students in Grade 8

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. Scientific 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 2.3.1.8 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 2.3.1.8 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 2.3.1.8 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 2.3.1.8 is found in the natural sciences area of the grade 2 standards relating to the category of space studies, refers to the eighth 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



## **8.1 Eighth-grade students in Lutheran schools will understand concepts related to the physical sciences.**

### **8.1.1 Composition of Matter**

- 8.1.1.1 Construct a classification system based on similarities and differences.
- 8.1.1.2 Explain that all matter is composed of atoms.
- 8.1.1.3 Illustrate the structure of the atom, including identifying and explaining the activities of protons, neutrons, and electrons.
- 8.1.1.4 Describe the basic structure of matter by identifying the elements and researching their distinct properties and atomic structures.
- 8.1.1.5 Define compounds.
- 8.1.1.6 Give examples of several compounds, and describe their properties.
- 8.1.1.7 Identify molecules as the smallest part of a compound.
- 8.1.1.8 Compare the properties of compounds with the properties of the elements from which they are made.
- 8.1.1.9 Demonstrate physical processes, include freezing and boiling, in which materials change form but where there is no chemical reaction.
- 8.1.1.10 Explain that although mixtures can be separated using physical properties, compounds cannot be separated using physical properties.
- 8.1.1.11 Affirm chemical reactions as processes in which atoms are rearranged into different combinations of molecules.
- 8.1.1.12 Use atoms to explain the conservation of matter, especially in chemical reactions.
- 8.1.1.13 Illustrate that chemical reactions usually liberate heat or absorb it.
- 8.1.1.14 Describe a chemical reaction, naming the reactants and products when given a symbolic equation, a word equation, or a description of the reaction.
- 8.1.1.15 Determine whether a solution is acidic, basic, or neutral.
- 8.1.1.16 Explain that the organization of the periodic table is based on the properties of the elements and reflects the structure of atoms.
- 8.1.1.17 Identify regions on the periodic table that correspond to metals, nonmetals, and noble gases.
- 8.1.1.18 Explain that 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.
- 8.1.1.19 Give the number of protons and electrons in a neutral atom based on the atom's atomic number.
- 8.1.1.20 Identify the mass number of an atom as the sum of the protons and neutrons in the atom.
- 8.1.1.21 Differentiate the arrangement and motion of atoms or molecules of solids, liquids, and gases.
- 8.1.1.22 Define molecules as groups of atoms that are chemically combined.
- 8.1.1.23 Give the location, relative charge, and relative mass of protons, neutrons, and electrons.
- 8.1.1.24 Classify substances by their properties, using data regarding melting temperature, density, hardness, and thermal and electrical conductivity.
- 8.1.1.25 Define density as mass per unit volume.

# CHAPTER 5

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## Information and Activities for Integrating the Faith as Keyed to Grade 8 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. Scientific 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 8 in 2.3.1.8 is found in grade 2, in the natural sciences area, relating to the category of space studies, and is the eighth 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 chap 4). Beside each entry in the right-hand column under the heading “Discussion Points/Activities,” you will find helpful ideas 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

## 8.1 Eighth-grade students in Lutheran schools will understand concepts related to the physical sciences.

### 8.1.1 Composition of Matter

#### Matter, Classification of

In God's wisdom, He created every kind of matter that living creatures would need, from freshwater rivers and saltwater oceans to soil necessary for many different kinds of plants. Scripture tells us that people were to be good stewards of God's creation (Genesis 1:26). For us to be good stewards of God's creation, we must know about different parts of creation. As you teach lessons on classifying matter, focus on God's wisdom in making different kinds of matter for people to manage and use and the importance of understanding these differences in the world God created. (8.1.1.1)

- Obtain a sample mixture of table salt, sand, and iron filings from the teacher. Observe the mixture in the container, and write down your observations. Next, lay out a sheet of white paper onto the table, and pour the mixture onto the paper. Spread the mixture out evenly. Move a magnet slowly above the mixture. Record the results, and continue separating the mixture until all of the iron filings have been removed from the mixture. Identify the property that allowed the iron filings to be removed from the mixture. Next, pour the remaining mixture into a container of water, and stir for several minutes. Record your results. Then pour the mixture through a coffee filter into another container. Record your results. Describe the properties of sand and salt that allowed the mixture to be separated. Place the salt water container onto the window sill, and let the water evaporate over a period of days. Record your findings. As you work to separate the mixture, consider how God has made every kind of matter unique and how He changed the properties of matter to create the first man and woman (Genesis 2:7, 20–22).
- Using a periodic table of the elements and resource material, compare and contrast properties of the elements by making a taxonomic key of the elements based upon specific properties of matter. List the different categories of elements on your taxonomic key when you are finished, and identify the unique characteristic that sets each category apart. Think about how people are like matter, having similar and distinctly different characteristics. Make a comparison and contrast chart of Cain and Abel (Genesis 4:1–12).

#### Atoms, Building Blocks of Matter

Scripture tells us that God created all matter. He did so making different compounds from basic particles that we call atoms. Each atom has different chemical properties that make it unique and give it different bonding capabilities. As you teach this lesson on the composition of matter, stress the importance of the atom as the building block in the formation of different substances. Relate this

- The atom is the building block of all substances. Identify the kinds of atoms that make up each of the substances listed, and tell how many of each kind of atom is involved. The substances are sodium hydroxide (NaOH), sulphuric acid (H<sub>2</sub>SO<sub>4</sub>), calcium chloride (CaCl<sub>2</sub>), table salt (NaCl), carbon tetrachloride (CCl<sub>4</sub>), oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), and potassium nitrate (KNO<sub>3</sub>). As God is



#### INFORMATION BY TOPIC

importance to God's awesome plan and design that separates humans from all other things in His creation (Genesis 1:27–28). (8.1.1.2)

#### DISCUSSION POINTS/ACTIVITIES

source of all creation, the atom is the source of all substances in creation. Write a paragraph explaining the relationship between the atom and God.

- Using large marshmallows to represent a carbon atom, small marshmallows to represent a hydrogen atom, and toothpicks to represent electron bonds, form the following single-bonded hydrocarbons:  $C_2H_6$ ,  $C_3H_8$ ,  $C_4H_{10}$ . Record what you notice about the relationships between the carbon atoms and the hydrogen atoms. What is the general formula relating the number of hydrogen atoms to carbon atoms in a single-bonded hydrocarbon? If the pattern holds true, how many hydrogen atoms would be needed to form a single-bonded hydrocarbon with twelve carbon atoms? As you think about atoms as the foundation of substances and the electron bonds that hold them together, reflect on how God is the Creator of all substances, and consider the bond that He has with humanity.

#### Atoms, Structure of (Protons, Neutrons, Electrons)

Comment that the three subatomic parts of the atom make a great analogy to the Holy Trinity. As God is three persons (John 6:40; 10:38; Matthew 1:18), so also the atom is one entity made up of three distinct subatomic particles: the proton, the neutron, and the electron. (8.1.1.3)

- Draw a diagram showing the location and relationships among protons, neutrons, and electrons for the following elements: lithium, gold, carbon, oxygen, chlorine, and neon. Identify protons with positive charges, neutrons with neutral charges, and electrons with negative charges. After drawing and labeling the diagrams, think about the three persons of God. Draw a diagram showing how God has three distinct persons (Matthew 28:19).
- Draw a Venn diagram showing the three parts of the atom. Label each part of the atom, and tell its charge. Write a paragraph explaining where most of the mass of the atom is located, and explain the relationship between each of the subatomic particles. Next, draw a Venn diagram showing the relationships among the three persons of the Trinity. Inside each part of the Venn diagram, list the Father, Son, and Holy Spirit. Then label the correct person with one of the following characteristics: Redeemer, Sanctifier, or Creator (Galatians 4:5; 2 Thessalonians 2:13; Matthew 19:4).

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