



Comprehensive Curriculum

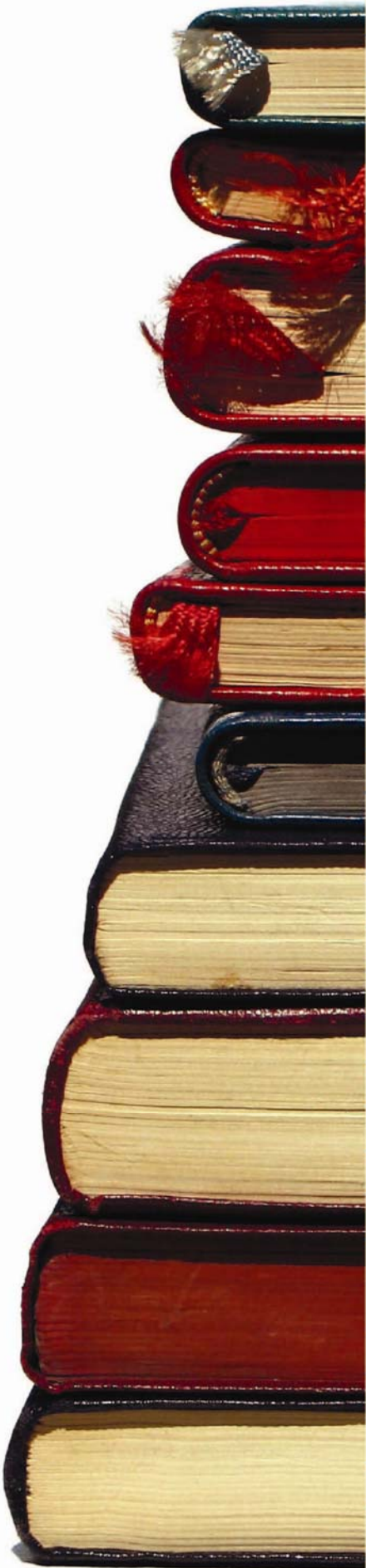
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Science



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The following course documents and corresponding blackline masters are provided as separate files in *Word*[®] and pdf formats:

- Kindergarten
- Grade 1
- Grade 2
- Grade 3
- Grade 4
- Grade 5
- Grade 6
- Grade 7
- Grade 8
- Physical Science
- Biology I
- Chemistry
- Earth Science
- Environmental Science
- Physics

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Preface

Purpose of the *Louisiana Comprehensive Curriculum*

“How well a school system works depends, in large part, on how well it aligns curriculum and assessment with standards throughout the district. In practical terms, this means that for students to succeed, they should be taught what they are expected to learn and assessed on what they are taught.”—Rebecca Burns, Curriculum Mapping

The Louisiana Department of Education is providing this revised version of the *Louisiana Comprehensive Curriculum* to every district in the state. The curriculum is aligned with state content standards, as defined by grade-level expectations (GLEs), and organized into coherent, time-bound units with sample activities and classroom assessments to guide teaching and learning.

Focus on What Is Important to Teach

A written, aligned curriculum brings academic expectations into sharp focus by describing what instruction will be presented, to whom, when, and how. Without a written curriculum, textbooks often become the de facto curriculum of a school or district. Unfortunately, so much is included in textbooks that they have little ability to focus instruction or to provide the depth needed for good teaching and learning. While the *Comprehensive Curriculum* may be used in conjunction with textbooks, it will help teachers limit the topics they address to those the Louisiana standards define as important. This alignment with standards can focus classroom activities and ensure a depth of coverage that will help students achieve mastery (Schmidt et al., 2001; Alexander, 1960; FitzGerald, 1979; Palmer, 1967; White, 1988; Beck & McKeown, 1994; Kulm et al, 1999; Loewen, 1995; www.project2061.org; Crismore, 1985; Rowe, 1985; Harste, 1989).

Align Content, Instruction, and Assessment to State Standards

Research indicates that alignment is a powerful indicator of academic achievement (Cohen, 1987; English & Steffy, 2001; Moss-Mitchell, 1998; Neidermeyer & Yelon, 1981; Porter et al., 1994; Porter & Smithson, 2001; Price-Braugh, 1997; Wishnick, 1989). Curriculum alignment is more than establishing a scope and sequence of instruction. Aligning the curriculum is the process of ensuring a good match between the state standards—specifically the GLEs—and the lessons taught in classrooms every day (Corallo & McDonald, 2002). This process ensures that instructional activities are aligned to standards, that an appropriate amount of time is devoted to the activities, that unnecessary repetitions in the instructional program are removed, that gaps in content are identified, and that classroom assessments are appropriate.

Ensure Access for All Students

The *Comprehensive Curriculum* aligns with Louisiana standards, benchmarks, and the Grade-Level Expectations. Research indicates that an aligned curriculum can increase student achievement and helps to overcome the usual predictors of socioeconomic status, gender, race, and teacher quality variables (Laboratory Network Program, 1998; Moss-Mitchell, 1998; Wishnick, 1989). A pre-condition of a successful educational program is a clear and agreed understanding that instructional content and classroom assessments should reflect the instructional standards. In a district with a well-aligned curriculum, *all* students have the opportunity and responsibility to master the instructional content.

Organize Content into Coherent, Time-Bound Units

Structure and content sequence of curriculum has an effect on its outcomes (Schmidt et al., 2001). Simply teaching the GLEs fragments knowledge and skills into bits and pieces, much like a collection of puzzle pieces that don't mean anything taken alone. Units of instruction create coherent curriculum contexts that organize and connect learning experiences. The *Comprehensive Curriculum* is organized into units that bring together groups of GLEs that make sense as a whole, thus helping students get the “big picture,” like putting all the puzzle pieces together.

Each unit of this curriculum also includes time frames for mastering grade-level expectations included in the unit. The time frames help to govern time distribution among competing subject matter and topics (Zimmerman, 2001). When curriculum appropriately governs time *and* content, academic learning time—time students are on task while learning challenging content not learned previously—increases, and so will student achievement (Squires, Huitt, & Segars, 1983).

Create Feedback Systems

The Comprehensive Curriculum units include assessment components that strengthen curriculum by providing feedback that students have learned what was taught. Many activities in the curriculum were designed to have products, and these products should be assessed using a rubric to determine whether the products indicate student mastery (Ceperley & Squires, 2000).

For the curriculum to have an effect, it must be implemented. To know whether a curriculum is implemented, someone must monitor. The district needs to decide who will monitor and when and how the appropriate information will be collected. Unit time frames may be the most convenient points to collect data on student progress, but other strategies also may be employed. These include peer observations, forums with stakeholders, surveys, and the like (Ceperley & Squires, 2000).

Continuous improvement of the curriculum is another important aspect of monitoring. If districts gather data on how students did on the unit assessments, they can then compare those results with how the students did on the state assessments. This information can inform further curriculum development, assessment revision, policies about course-taking sequences for students, and remedial or enrichment opportunities for students. Updating of curriculum should occur on a continuous basis (Ceperley & Squires, 2000; Schmoker, 1999).

Serve as the Core of Professional Development

Introducing a new curriculum often means introducing new content, teaching strategies, and administrative responsibilities. The district has the responsibility to ensure that all faculty and staff participate in appropriate professional development activities that will result in the successful implementation of the written curriculum (National Staff Development Council, 2001).

Summary

The *Comprehensive Curriculum* indicates one way to align instruction with Louisiana standards, benchmarks, and grade-level expectations with the goal of improving student achievement across the state. The curriculum has been developed to help districts build a bridge between classroom activities and state standards, so what happens in the classroom will indeed reflect Louisiana's vision for student learning.

Principles of Science Teaching and Learning

“Learning science is something students do, not something that is done to them. In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others.”—National Research Council, National Science Education Standards

The Nature of Science

Science is the human activity of seeking natural explanations for what we observe in the world around us. Science does so through the use of observations, experimentation, inferences, and logical arguments while maintaining strict empirical standards and healthy skepticism. While assuming that anything that can be observed or measured is amenable to scientific investigation, science also explicates that the universe operates according to regularities that can be discovered and understood through scientific investigations. The testing of various explanations of natural phenomena for their consistency with empirical data is an essential part of the methodology of science. Scientific explanations must be consistent with experimental and observational data and be tested by scientists through additional observations and/or experimentation. Established theories stand until new facts are discovered, tested, and verified or a new hypothesis, which more closely explains the data, is developed and tested. Explanations that are not consistent with empirical evidence or cannot be tested empirically are not a part of science.

Scientific Literacy

Students enjoy a natural sense of wonder in the events and organization of the world around them. Capturing and nurturing this inherent scientific curiosity is central to helping them achieve scientific literacy. Scientific literacy, the primary goal of science education, is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. It implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed (National Research Council, 1996).

A healthy and economically secure society is dependent on a strong foundation in science and mathematics. Science has profoundly affected material and societal progress through the use of knowledge and technology resulting from the discovery and application of the principles of science.

Science as Inquiry

“Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the world. Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires the identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.”—National Research Council, National Science Education Standards

Through inquiry experiences, students construct understanding of scientific concepts. The *National Science Education Standards* (1996) identifies three types of inquiry investigations: (1) describing objects, events, and organisms, (2) classifying objects, events, and organisms, and (3) experimentation carried out by students. Embedding inquiry investigations and process skills into content instruction means shifting the emphasis from teachers presenting information and covering textbook topics to students doing science.

Instructional Practices

“Teaching related to scientific literacy needs to be consistent with the spirit and character of scientific inquiry and with scientific values. This suggests such approaches as starting with questions about phenomena rather than answers to be learned; engaging students actively in the use of hypotheses, the collection and use of evidence, and the design of investigations and processes; and placing a premium on students’ curiosity and creativity.”—Zemelman, Daniels, and Hyde, *Best Practices*

Qualities that signify excellence in science instruction are

- Students are provided with opportunities to explore the significance of science in their lives.
- Effective inquiry investigations involve a series of process skills and planning steps that build students’ investigative and analysis skills.
- Meaningful science exploration aims to develop thinking, problem solving, and attitudes of curiosity, skepticism, and openness to modifying explanations.
- Instruction aims to build a knowledge base focused on essential, unifying concepts, not disconnected topics and bits of information.
- The integration of reading, writing, and mathematics occur consistently.

- Collaborative small-group work is implemented and more closely imitates how real scientists work in teams.
- The use of graphing organizers assists students in making connections and understanding complex concepts.
- Authentic, meaningful assessment includes performance tasks evaluated with rubrics, not just pencil and paper tests.
- Discussions of new discoveries and the possible impact of new technology are conducted frequently.
- The use of technology assists students in making observations, collecting data, and communicating results or information.

Instructional Technology

Technology used in the classroom is a tool to enhance the abilities of students to investigate science principles and develop understandings of fundamental concepts. Students and teachers must face the challenge of keeping up with the technological changes taking place in our society as the advances in technology are changing the way we think about and do science.

The science classroom has long been associated with technology because of the presence of microscopes, telescopes, and other devices that extend the senses. In today's classroom student data collection is aided by the use of graphing calculators and an array of probeware. In addition to improving the accuracy and precision of students' investigation efforts, work with these tools will provide training that may translate into skill development for later integration into the workforce. Computer software allows students of the twenty-first century an appropriate means of organizing data into user-friendly tables and other graphic representations. Lab investigations can be adapted and simulations prepared that allow students new opportunities for modeling. Use of the Internet provides a means to access not only information and real-time data, but also a rapidly expanding variety of resources that supplement the limited materials available in the classroom setting.

Habits of Mind Associated with Science. The Science as Inquiry strand of the *National Science Education Standards* (National Research Council, 1996), the *Louisiana Science Framework* (1997), and the *Grade-Level Expectations in Science* (2004) encourage the development of the habits of mind associated with science.

1. *Skepticism:* Recognize the importance of legitimate skepticism.
2. *Respect for Data:* Engage in consideration of the alignment between the data (evidence) and the conclusion reached.
3. *Limitations of Science:* Acknowledge the limitations of scientific techniques.
4. *Consideration of consequences:* Explore wider implications for the results of investigations.

Unifying Concepts in Science

It is essential that students gain an understanding that common themes found in science interconnect and link the separate science content strands: Earth/space, physical, life, and environment. For this reason, teachers should integrate the unifying concepts of science into their instruction as they embed inquiry skills and processes. By combining data, information, and knowledge from the different sciences, students learn to make connections. The unifying concepts of science that should be used to emphasize interconnections across the content strands are Systems, Models, Form and Function, Constancy and Change, and Evolution and Equilibrium. For a full description of each concept, see the *National Science Education Standards* (available online at <http://www.nsta.org/standards>).

Special Note Regarding Earth Science

The high school Earth Science GLEs that are addressed in the GEE 21 assessment program have been included in the related units of the other high school science courses in the curriculum.

Organization of the Comprehensive Curriculum

Components of the *Louisiana Comprehensive Curriculum*

The components of the *Comprehensive Curriculum* are intended to be reflective of the components that should be included in any good curriculum. The components are described below.

Curriculum Component	Explanation
Cover page	Displays content area and courses included in the document, name of the agency that developed the document, and the date the document was developed
Title page	Displays content area and courses included in the document, name of the agency that developed the document, and the date the document was developed
Board of Education	Lists the names of board members who approved the use of the curriculum document and the name of the superintendent
Acknowledgments	Lists individuals or groups who contributed to the development of the local curriculum
Table of Contents	Lists the courses and other curriculum components and where they can be found in the document
Preface	Provides background information including underlying law and policies that led to the development of the document
Purpose	Provides a statement of the intended purpose of the written, aligned curriculum, expectations for its use in the classroom, and the expected results in terms of student performance.
Principles of teaching and learning for specific content area	States beliefs about the content area and research-based principles of successful teaching and learning
Professional Development	Provides a summary statement of how appropriate professional development ensures that teachers possess knowledge and skills needed to teach the new curriculum
PreK–12 Courses	Includes a copy of each course in the relevant content area

Elements of the *Louisiana Comprehensive Curriculum Units*

The unit organizer format allows teachers to see the interrelationships among the GLEs and indicates best practice activities that should be used when teaching a particular concept or skill.

Unit Element	Explanation
Time Frame	An approximate time frame is specified for each unit of instruction (e.g., approximately two to three weeks). The time frame helps teachers pace instruction and learning. The time frame also helps administrators monitor the implementation of the curriculum.
Course Name	The course name specifies the grade level and the content area for courses Prekindergarten through Grade 8 (e.g., Grade 3 English Language Arts). For high school courses (Grades 9–12), the name specifies the content (e.g., Algebra I).
Unit Title	Each unit has a title designed to bring further focus to the collection of ideas and concepts to be learned in that unit (e.g., Poetry, Measuring and Comparing, and so on).
Unit Number	Units are numbered sequentially (e.g., Unit 1, Unit 2, and so on).
Unit Description	The unit description states broadly, in one or two sentences, the intent of the unit (e.g., The focus of this unit is how the availability of resources influences economic decisions).
Student Understandings	Student understandings are a brief description of the overarching concepts to be learned by the student.
Guiding Questions	This element contains a list of questions that teachers can use to determine if students understand the concepts being taught (e.g., Can students use the structure of the article to find information they need?)
Grade-Level Expectations (GLEs)	For each unit, there is a table that lists the number and the text of each GLE to be addressed by the unit. Benchmark codes are included at the end of each GLE.
Sample Activities	Each activity is numbered, named, and lists the GLE(s) that are addressed by the activity. It provides guidance to teachers as they plan their lessons throughout the school year.
Sample Assessments	At the end of each unit are suggested assessments that are linked to the processes of teaching and learning (e.g., graded homework, class projects, performance tasks, discussions with teachers, parents, classmates, diagnostic tests, teacher-made tests and quizzes, observation systems, performance assessment based on performance levels as defined by rubrics, portfolios, and so on).
Blackline Masters	Blackline masters are provided in a separate document for each course and are designed to assist in the implementation of an activity. Most blackline masters are for student use; however, some provide rubrics for evaluating student work or provide solution keys for student worksheets.

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