STC™ Meets the Standards

An Analysis of the Alignment between the Science and Technology for Children™ Curriculum and the National Science Education Standards

The STC curriculum was developed by the
National Science Resources Center
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Additional copies of *STC™ Meets the Standards* are available from Carolina Biological Supply Company (1-800-227-1150).

How to Use This Book

The purpose of this publication is to help school administrators, curriculum coordinators, teachers, and members of curriculum adoption committees determine how the Science and Technology for Children™ (STC™) curriculum aligns with the National Science Education Standards (NSES) of the National Research Council.

Part 1 summarizes key elements of the STC learning philosophy and goals and how the curriculum was developed. It describes the components of the STC curriculum and related products. A chart sets forth the names of the 24 units and the sequence in which they are meant to be delivered. Part 1 also describes the programs of the National Science Resources Center, which developed STC.

Part 2 provides an overview of the NSES content, teaching, and assessment standards. It explains how to use the charts and narrative information in this book to identify the alignment between STC and the NSES science content standards. It also provides summary information about STC in relation to the NSES teaching and assessment standards.

Parts 3 through 8—one part each for grades 1 through 6, respectively—provide detailed, grade-by-grade information on the 24 STC units. There are four units for each grade level. Each part begins with a table highlighting the unit titles for that grade. Next, a dot matrix summarizes the NSES science content in each STC unit in that grade level. It then presents the following information on each unit for that grade:

- A one-page summary of the unit narrative, science content, and assessment strategies
- Learning goals (presented as concepts, skills, and attitudes)
- NSES science content standards covered in the unit (including the title of the standard and its conceptual organizers and fundamental principles and concepts). Because the STC units are grade-flexible, information on alignment for fourth- and fifth-grade STC units is presented under both the K–4 and 5–8 NSES categories.

Contents

PART 1

Introduction to the Science and Technology for Children™ Curriculum

Overview

The Science and Technology for Children (STC™) curriculum offers 24 units for students in grades 1 through 6. It covers four broad topic areas: life, earth, and physical sciences and technological design. The curriculum is flexible with respect to grade level; to meet specific needs, school districts may offer an STC unit one grade above or below that for which it was designed. STC is an inquiry-based curriculum. Each unit provides students with an opportunity to explore science concepts and phenomena firsthand, to reflect on their observa-tions, to share them with classmates, and to apply their learning in new situations.

Grade	Life, Earth, and Physical Sciences and Technology			
1	Organisms	Weather	Solids and Liquids	Comparing and Measuring
2	The Life Cycle of Butterflies	Soils	Changes	Balancing and Weighing
3	Plant Growth and Development	Rocks and Minerals	Chemical Tests	Sound
4	Animal Studies	Land and Water	Electric Circuits	Motion and Design
5	Microworlds	Ecosystems	Food Chemistry	Floating and Sinking
6	Experiments with Plants	Measuring Time	Magnets and Motors	The Technology of Paper

STC™ Instructional Materials

STC instructional materials include a teacher's guide, student activity books or notebooks, and science materials.

- The **teacher's guide** contains background material on science and pedagogy, guidance on science materials preparation and setup, and detailed instructions for facilitating classroom science investigations. It also contains master copies of student record sheets and other materials, suggestions for relating science to other areas of the curriculum, assessment strategies, and a bibliography.
- Reusable **student activity books,** for grades 3 through 6, contain step-by-step instructions that guide students through their classroom activities. Optional student notebooks are available for the first- and second-grade units. Since students write in these notebooks, they must be repurchased each time the unit is presented.
- Each STC kit contains the **science equipment** needed to present the unit once to a class of 30 students. Kits of expendable materials for refurbishing the classroom science materials are also available from Carolina Biological Supply Company, the STC publisher.

Carolina Biological Supply Company is now producing teacher-training videotapes to accompany the STC units. In addition, the STC student books are being translated into Spanish. Spanish editions of several units are already available.

STC Discovery Decks™

STC is developing Discovery Decks to accompany the STC units for grades 4 through 6. Discovery Decks extend the science content of the STC units. They are particularly useful in enriching learning related to the NSES categories of "Science in Personal and Social Perspectives" and of "History and Nature of Science."

Each Discovery Deck consists of approximately 32 large ($9 \times 12''$), attractively illustrated cards that elaborate on the topics introduced in the unit it accompanies. Each deck includes cards on history (for example, information on famous people and inventions), problems to solve, and connections with students' everyday world. The cards may be used in the classroom or for home projects.

For more information on the STC Discovery Decks, contact Carolina Biological Supply Company (1-800-227-1150).

STC Goals

The goals of the STC curriculum are to

- Make science relevant, interesting, and challenging for all children.
- Contribute to children's conceptual understanding of their world.
- Help children develop scientific-reasoning and problem-solving skills.
- Foster the development of scientific attitudes, such as curiosity, respect for evidence, flexibility, and sensitivity to living things.

These goals are reflected in each STC unit, where they are expressed as concepts, skills, and attitudes. Each lesson in an STC unit also contains a set of student learning objectives.

The STC™ Learning Cycle

Each STC unit is based on a four-stage learning cycle that is grounded in research on how children learn. The four steps in this cycle are Focus, Explore, Reflect, and Apply.

- First, students **focus** on what they know about a topic and what they would like to learn about it. In other words, learning begins with the student's existing knowledge and experience.
- Next, students **explore** a scientific concept or phenomenon by completing a sequence of activities. Classroom explorations are usually done in groups of two or four children.
- To reinforce learning, students **reflect** on their findings, record them in their science journals, and discuss them with their classmates.
- Finally, students **apply** their new learning to real-life situations and to other areas of the curriculum.

STC and the Development of Scientific-Reasoning Skills

The creators of the STC curriculum believe that children learn science best when the content is developmentally appropriate. For this reason, STC is structured on the basis of a sequence of scientific-reasoning skills.

This sequence begins in grade 1, where students focus on observing, measuring, and identifying properties. By grade 2, they are able to begin to recognize patterns and cycles. By grade 4, many students are able to identify cause-and-effect relationships. Finally, by grade 6, students can design and conduct their own controlled experiments. As they progress through this sequence, students not only gain an understanding of science concepts and phenomena but also develop critical-thinking skills.

Development and Distribution of the STC Curriculum

STC was developed by the National Science Resources Center (NSRC), a nonprofit organization jointly operated by the Smithsonian Institution and the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. The NSRC's offices are in Washington, D.C.

Each STC unit was written by a teacher-developer working in collaboration with educators, scientists, and evaluators, as well as with science editors and illustrators. All units were pilot-tested in elementary schools in the Washington, D.C., metropolitan area and field-tested in demographically diverse classrooms throughout the United States. Input from teachers and students who participated in the field tests, as well as recommendations provided by an independent evaluator, were incorporated into the final version of the text.

STC is published exclusively by Carolina Biological Supply Company, Burlington, North Carolina. Carolina, the nation's largest distributor of classroom science materials, is the only company that distributes STC science kit materials that have been reviewed and approved by the NSRC.

Other NSRC Activities and Programs

In 1997, the National Science Resources Center received a grant from the National Science Foundation to produce a new curriculum, Science and Technology Concepts for Middle Schools™ (STC/MS™), which will complement STC™. It will contain eight modules that will focus on topics related to the life, earth, and physical sciences and technological design. Two professional-development modules for teachers will also be developed.

In addition to developing science curricula, the NSRC publishes books and other documents of interest to science educators. Among the NSRC's most recent publications are *Science for All Children: A Guide to Improving Elementary Science Education in Your School District* and *Resources for Teaching Elementary School Science*, both of which were published by the National Academy Press. Slated for publication in early 1998 is *Resources for Teaching Middle School Science.*

A third area of NSRC activity is leadership training. The NSRC conducts leadership institutes at the national and regional levels to prepare teams of science teachers, school administrators, and scientists, engineers, and business leaders to organize science education reform efforts in their communities. The NSRC is funded through grants from government agencies, corporations, and philanthropic foundations.

PART 2

STC™ and the National Science Education Standards

Introduction

The National Science Education Standards, published by the National Research Council in 1996, call for a new vision of science literacy for all students. The standards are not prescriptive; rather, they set forth criteria that each school district can use as a basis for designing a science program that best meets the needs of its students. These criteria cover six areas: science content, teaching methods, professional development, assessment, program design, and science systems.

This publication analyzes the STC curriculum in light of three NSES criteria—science content, teaching methods, and assessment. This chapter provides a brief introduction to the standards in these three areas.

NSES Science Content Standards

Content standards are the heart of a science program. They describe what students should understand and be able to do in science from kindergarten through their senior year in high school.

Each NSES content standard has four parts: a title, a stem, a list of conceptual organizers, and a series of fundamental concepts and principles.

- The **title** is the category of the standard. There are eight science content standards: unifying concepts and processes in science; science as inquiry; physical science; life science; earth and space science; science and technology; science in personal and social perspectives; and history and nature of science.
- The **stem** is an introductory phrase that stipulates grade span (that is, K–4, 5–8, or 9–12) and learning outcome (for example, "understanding").
- The **conceptual organizers** are comparable to lesson or unit topics. Under the title "Physical Science" in the K–4 grade span, for example, the conceptual organizers include "properties of objects and materials," "position and motion of objects," and "magnetism." By grades 9–12, the conceptual organizers under the same title are more complex and include "structure of atoms," "chemical reactions," and "interactions of energy and matter."
- The **fundamental concepts and principles** are the scientific principles or concepts that support the conceptual organizers. They appear in the NSES publication in paragraph form. Each concept is placed under the appropriate conceptual organizer.

STC™ and the NSES Content Standards

This publication uses two ways of showing how the STC units align with the standards: dot matrixes and narrative lists entitled "Fundamental Concepts and Principles Addressed."

Dot Matrixes

Two comprehensive dot matrixes appear on pages 14 to 16. In addition, grade-specific matrixes appear at the beginning of each chapter (see, for example, page 18). Two matrixes are provided for the fourth- and fifth-grade units; one matrix shows alignment with K–4 standards, and the other shows alignment with 5–8 standards.

On the matrixes, the NSES **title** category appears in gray and the **conceptual organizers** appear directly below it. A dot in the column under the STC unit title indicates that the conceptual organizer is addressed in one or more of the lessons or reading selections of that unit.

Fundamental Concepts and Principles Addressed

The pages entitled "Fundamental Concepts and Principles Addressed (K–4 or 5–8)" provide more detailed information than the dot matrixes (see, for example, page 21). On these pages, the NSES category title appears as a bold head. The **conceptual organizers** are subheads and appear in italics. The **fundamental principles** appear as bulleted items. In some cases, the original language has been shortened or paraphrased; only language that is applicable to the unit has been included. Each fourth- and fifth-grade unit is analyzed in relation both to the K–4 standards and the 5–8 standards.

STC's Grade-Level Flexibility

The writers of the NSES wanted science learning to be flexible. Learning outcomes are, therefore, set forth by grade span (that is, K–4, 5–8, and 9–12) rather than by grade level. Within each of these sequences, the science content may be presented at the grade level that a school district believes is most appropriate.

Like the standards, the STC curriculum is designed to provide maximum flexibility in grade levels. While each unit is designated for use at a particular grade level, it may be used at the level below or above the designated grade. Thus, depending on the overall science program or the abilities of students, *The Life Cycle of Butterflies,* developed for grade 2, may also be taught successfully at grade 1 or 3. It is helpful to think of each level of STC units as a band that crosses three grade levels.

This flexibility becomes critical at the interface of grades 4 and 5, which cross the NSES grade spans. For this reason, the information in this publication shows how grade 4 STC units align with 5–8, as well as K–4, content standards. To complete the picture, information on grade 5 units shows how these units align with K–4, as well as 5–8, standards. For example:

- The 5–8 earth science concept on the water cycle states that water "falls to earth where it collects in lakes, oceans, soil, and in rocks underground." This concept expands on the K–4 NSES physical science concept "water can change from one state to another." Both concepts, however, are covered in the fourth-grade STC earth science unit *Land and Water.*
- The fifth-grade STC unit *Food Chemistry* addresses both the K–4 NSES personal health principle "students should understand how the body uses food and how various foods contribute to health," as well as the 5–8 concept, "food provides energy and nutrients for growth and development."

By examining how the fourth- and fifth-grade units align with both the K–4 and 5–8 standards, districts may make appropriate decisions about where to place the unit in their curriculum. For example, many districts use *Land and Water,* designated as a fourth-grade unit, in grade 5. At the same time, districts may use the fifth-grade unit *Floating and Sinking* in grade 4.

NSES Teaching Standards

The six NSES science teaching standards describe the actions teachers must take and the knowledge and skills they need in order to plan for, facilitate, and assess student learning. They focus on the following areas:

- Tailoring learning opportunities to student needs.
- Facilitating inquiry.
- Assessing student learning on an ongoing basis.
- Creating an environment that provides the resources and atmosphere needed for science learning.
- Encouraging collaboration, respect for diverse ideas, and other values that are consistent with scientific inquiry.
- Working with peers to plan the overall science program.

STC™ and the NSES Teaching Standards

Successful implementation of the STC curriculum in the classroom and adherence to the NSES teaching standards go hand in glove. Unless a teacher adheres to these standards, he or she cannot facilitate learning in an STC classroom, as illustrated by the following examples.

In an STC classroom, the teacher . . .

- **Selects and adapts the curriculum** instead of using a "one size fits all" approach. During class brainstorming sessions, generally held at the beginning of each new unit or learning activity, students share what they already know about a new topic and what they would like to know. Teachers use this information as a basis for tailoring learning activities as well as for post-unit assessments of student learning.
- **Focuses on helping students ask questions, test ideas, and draw conclusions** on the basis of evidence instead of focusing on acquiring factual information.
- **Facilitates discussion and hands-on investigation** instead of presenting knowledge through lectures or teacher demonstrations.
- **Builds students' skills in cooperative learning and respect for the ideas of others** as they explore science phenomena with lab partners and in small groups.
- **Helps students build links between science and the real world and between science and other areas of the elementary curriculum** through the use of extensions, bibliographies, and other supplementary material.
- **Continually assesses student understanding** through observing students' daily activities and examining journals, record sheets, and performance-based assessments instead of testing students for factual information at the end of a unit.

NSES Assessment Standards

New ways of teaching and learning science demand new approaches to assessing student progress. In this new approach, learning and assessing are closely related. Assessments provide much more than a benchmark for student progress; they are the primary feedback mechanism in the science education system. To emphasize the key role of assessment, the NSES contain five criteria against which districts can judge the quality of their assessment strategies:

- The consistency of assessments with the decisions they are designed to inform.
- The assessment of achievement and opportunity to learn science.
- Matching the quality of data collected and the consequences of actions taken on the basis of those data.
- Fairness.
- The soundness of inferences made from the assessments.

STC™ and the NSES Assessment Standards

Assessment is a particular strength of the STC curriculum. In fact, all STC assessment activities have been professionally evaluated by researchers from the Program Evaluation and Research Group at Lesley College, Cambridge, Massachusetts. STC assessments are consistent with the NSES standards in that they are deliberately designed to focus on the science content and skills that are most important for students to learn. Their purpose is to determine students' scientific-reasoning skills as well as their understanding of science concepts. Because of their variety, the STC assessments offer opportunities for all students to demonstrate their strengths.

STC assessment strategies include

- Matched pre- and post-unit assessments that enable teachers to evaluate student growth.
- Embedded assessments that occur naturally within a unit and make assessment seamless with learning.
- Additional assessments (also called final assessments) at the end of the unit that offer a variety of opportunities to evaluate student progress. Some are performance-based assessments that challenge students to use their science materials to solve new problems. Others include teacher review of student work products, oral presentations, and paper-and-pencil tests.
- Student self-assessments that allow students and teachers to track progress.

STC™ Units and K–4 Science Content Standards Matrix

Developed for Grades	1	1	1	1	2	2	2	2	3	3	3	3
Unit Titles	Organisms	Weather	Solids and Liquids	Comparing and Measuring	The Life Cycle of Butterflies	Soils	Changes	Balancing and Weighing	Plant Growth and Development	Rocks and Minerals	Chemical Tests	Sound
Science as Inquiry												
Abilities necessary to do scientific inquiry	●	●	●	●	●	●	●	●	●	●	●	●
Understandings about scientific inquiry	●	●	●	●	●	●	●	●	●	●	●	●
Physical Science												
Properties of objects and materials		●	●	●		●	●	●		●	●	●
Position and motion of objects			●	●				●				●
Light, heat, electricity, and magnetism			●				●			●	●	
Life Science												
Characteristics of organisms	●				●	●			●			●
Life cycles of organisms	●				●				●			
Organisms and environments	●		●		●	●			●			●
Earth and Space Science												
Properties of earth materials			●			●	●		●	●	●	
Objects in the sky		●										
Changes in earth and sky		●	●				●			●		
Science and Technology												
Abilities of technological design				●		●	●	●	●			●
Understandings about science and technology	●	●	●	●	●	●	●	●	●	●	●	●
Abilities to distinguish between natural objects and objects made by humans	●	●							●	●	●	
Science in Personal and Social Perspectives												
Personal health		●	●		●		●				●	●
Characteristics and changes in populations												
Types of resources	●				●					●	●	
Changes in environments	●		●		●					●		
Science and technology in local challenges		●	●					●	●			●
History and Nature of Science												
Science as a human endeavor	●	●	●	●	●	●	●	●	●	●	●	●
Unifying Concepts and Processes												
Systems, order, and organization	●	●	●	●		●	●	●	●	●	●	●
Evidence, models, and explanation	●	●	●	●	●	●	●	●	●	●	●	●
Constancy, change, and measurement	●	●	●	●	●	●	●	●	●	●	●	●
Evolution and equilibrium								●		●		
Form and function	●		●	●	●	●		●	●	●		●

Developed for Grades	4	4	4	4	5	5	5	5
Unit Titles	Animal Studies	Land and Water	Electric Circuits	Motion and Design	Microworlds	Ecosystems	Food Chemistry	Floating and Sinking
Science as Inquiry								
Abilities necessary to do scientific inquiry	●	●	●	●	●	●	●	●
Understandings about scientific inquiry	●	●	●	●	●	●	●	●
Physical Science								
Properties of objects and materials		●	●	●	●	●	●	●
Position and motion of objects		●		●				●
Light, heat, electricity, and magnetism			●		●			
Life Science								
Characteristics of organisms	●				●	●	●	
Life cycles of organisms	●				●	●		
Organisms and environments	●	●				●		
Earth and Space Science								
Properties of earth materials		●				●		
Objects in the sky								
Changes in earth and sky		●						
Science and Technology								
Abilities of technological design	●	●	●	●		●		●
Understandings about science and technology	●	●	●	●	●	●	●	●
Abilities to distinguish between natural objects and objects made by humans	●	●			●	●	●	
Science in Personal and Social Perspectives								
Personal health			●				●	●
Characteristics and changes in populations								
Types of resources	●	●	●			●	●	
Changes in environments	●	●				●		
Science and technology in local challenges		●	●	●	●	●	●	●
History and Nature of Science								
Science as a human endeavor	●	●	●	●	●	●	●	●
Unifying Concepts and Processes								
Systems, order, and organization	●	●	●	●	●	●	●	●
Evidence, models, and explanation	●	●	●	●	●	●	●	●
Constancy, change, and measurement	●	●	●	●		●	●	●
Evolution and equilibrium	●	●		●		●		●
Form and function	●	●	●	●	●	●	●	●

STC™ Units and 5–8 Science Content Standards Matrix

Developed for Grades	4	4	4	4	5	5	5	5	6	6	6	6
Unit Titles	Animal Studies	Land and Water	Electric Circuits	Motion and Design	Microworlds	Ecosystems	Food Chemistry	Floating and Sinking	Experiments with Plants	Measuring Time	Magnets and Motors	The Technology of Paper
Science as Inquiry												
Abilities necessary to do scientific inquiry	●	●	●	●	●	●	●	●	●	●	●	●
Understandings about scientific inquiry	●	●	●	●	●	●	●	●	●	●	●	●
Physical Science												
Properties and changes of properties in matter		●	●				●	●			●	●
Motions and forces		●		●				●		●	●	
Transfer of energy			●	●	●					●	●	
Life Science												
Structure and function in living systems	●				●	●			●			
Reproduction and heredity	●				●	●			●			
Regulation and behavior	●	●			●	●			●		●	
Populations and ecosystems						●						
Diversity and adaptations of organisms	●				●				●			
Earth and Space Science												
Structure of the earth system		●				●						
Earth's history		●										
Earth in the solar system		●							●	●		
Science and Technology												
Abilities of technological design	●	●	●	●				●		●	●	●
Understandings about science and technology	●	●	●	●	●	●	●	●		●	●	●
Science in Personal and Social Perspectives												
Personal health	●		●			●	●	●			●	
Populations, resources, and environments		●				●						
Natural hazards		●				●						●
Risks and benefits		●				●	●					
Science and technology in society	●	●	●	●	●	●	●	●		●	●	●
History and Nature of Science												
Science as a human endeavor	●	●	●	●	●	●	●	●	●	●	●	●
Nature of science	●	●	●	●	●	●	●	●	●	●	●	●
History of science		●	●	●	●		●	●	●	●	●	●
Unifying Concepts and Processes												
Systems, order, and organization	●	●	●	●	●	●	●	●	●	●	●	
Evidence, models, and explanation	●	●	●	●	●	●	●	●	●	●	●	●
Constancy, change, and measurement	●	●	●	●		●	●	●	●	●	●	●
Evolution and equilibrium	●	●		●		●		●				
Form and function	●	●	●	●	●	●	●	●	●	●	●	●