SCIENCE ACADEMIES FOR GRADES K–4

SUPPORT FRAMEWORKS

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Science Academies for Grades K–4

College and Career Readiness Standards

The 79th Texas Legislature passed House Bill 1, the "Advancement of College Readiness in Curriculum," Section 28.008 of the Texas Education Code, to increase the number of students who are college and career ready when they graduate high school. The Texas College and Career Readiness Standards (CCRS) that resulted from that legislation were developed and assessed by vertical teams composed of secondary and postsecondary faculty across the content areas of English/language arts, mathematics, science, and social studies, using a multilevel framework that focuses on subject matter and the way it is organized and presented in the classroom.

Incorporated into the Texas Essential Knowledge and Skills (TEKS) in 2008, the CCRS emphasize secondary-level content knowledge that stimulates students to engage in deeper levels of thinking. The framework of the CCRS recognizes that at a postsecondary level, students must (1) have core foundational knowledge of a discipline and be able to use that knowledge with facility and fluency; and (2) be able to understand the vertical structure of a discipline and how knowledge expands from the initial study of a topic.

The CCRS also address cross-disciplinary foundational knowledge and skills, which delineate the horizontal structure of learning across all disciplines and how core foundational knowledge of one subject is utilized in the mastery of other subjects. For example, when students utilize scientific inquiry, they utilize other foundational skills such as mathematics, communication, and social ethics, as well as personal skills such as time management, self-discipline, and organization.

CCRS for Science

The Science CCRS are extensive yet specific and strongly emphasize the importance of acquiring the cross-disciplinary, foundational cognitive skills needed to succeed in all entry-level college science courses. The CCRS view science vocabulary as a tool. College-ready students should be able to engage actively in the study of science and communicate with others in a clear, concise, and meaningful manner.

The Science CCRS extend the TEKS standards for each of the three traditional high school science courses—biology, chemistry, and physics—in the requirement of student mastery of the core principles and procedures for scientific inquiry, i.e., collecting, analyzing, evaluating, and synthesizing, that are necessary for the study of all science disciplines. Overall, the Science CCRS are focused to ensure student readiness to explore and appreciate the richness and complexity of the natural world, to process and develop new ideas and divergent interpretations, and to master the powerful techniques of scientific investigation.

Source: *Texas College and Career Readiness Standards*, Texas Education Agency and Texas Higher Education Coordinating Board

For a complete list of CCRS, see *Texas College and Career Readiness Standards* at www.txccrs.org.

Texas College and Career Readiness Standards

Science Standards

I. Nature of Science: Scientific Ways of Learning and Thinking

A. Cognitive skills in science

1. Utilize skepticism, logic, and professional ethics in science.
2. Use creativity and insight to recognize and describe patterns in natural phenomena.
3. Formulate appropriate questions to test understanding of natural phenomena.
4. Rely on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes.

B. Scientific inquiry

1. Design and conduct scientific investigations in which hypotheses are formulated and tested.

C. Collaborative and safe working practices

1. Collaborate on joint projects.
2. Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms.
3. Demonstrate skill in the safe use of a wide variety of apparatuses, equipment, techniques, and procedures.

D. Current scientific technology

1. Demonstrate literacy in computer use.
2. Use computer models, applications, and simulations.
3. Demonstrate appropriate use of a wide variety of apparatuses, equipment, techniques, and procedures for collecting quantitative and qualitative data.

E. Effective communication of scientific information

1. Use several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic.
2. Use essential vocabulary of the discipline being studied.

II. Foundation Skills: Scientific Applications of Mathematics

A. Basic mathematics conventions

1. Understand the real number system and its properties.
2. Use exponents and scientific notation.
3. Understand ratios, proportions, percentages, and decimal fractions, and translate from any form to any other.

4. Use proportional reasoning to solve problems.
5. Simplify algebraic expressions.
6. Estimate results to evaluate whether a calculated result is reasonable.
7. Use calculators, spreadsheets, computers, etc., in data analysis.

B. Mathematics as a symbolic language

1. Carry out formal operations using standard algebraic symbols and formulae.
2. Represent natural events, processes, and relationships with algebraic expressions and algorithms.

C. Understand relationships among geometry, algebra, and trigonometry

1. Understand simple vectors, vector notations, and vector diagrams, and carry out simple calculations involving vectors.
2. Understand that a curve drawn on a defined set of axes is fully equivalent to a set of algebraic equations.
3. Understand basic trigonometric principles, including definitions of terms such as sine, cosine, tangent, cotangent, and their relationship to triangles.
4. Understand basic geometric principles.

D. Scientific problem solving

1. Use dimensional analysis in problem solving.

E. Scientific application of probability and statistics

1. Understand descriptive statistics.

F. Scientific measurement

1. Select and use appropriate Standard International (SI) units and prefixes to express measurements for real world problems.
2. Use appropriate significant digits.
3. Understand and use logarithmic notation (base 10).

III. Foundation Skills: Scientific Applications of Communication

A. Scientific writing

1. Use correct applications of writing practices in scientific communication.

B. Scientific reading

1. Read technical and scientific articles to gain understanding of interpretations, apparatuses, techniques or procedures, and data.
2. Set up apparatuses, carry out procedures, and collect specified data from a given set of appropriate instructions.

3. Recognize scientific and technical vocabulary in the field of study and use this vocabulary to enhance clarity of communication.
4. List, use, and give examples of specific strategies before, during, and after reading to improve comprehension.

C. Presentation of scientific/technical information

1. Prepare and present scientific/technical information in appropriate formats for various audiences.

D. Research skills/information literacy

1. Use search engines, databases, and other digital electronic tools effectively to locate information.
2. Evaluate quality, accuracy, completeness, reliability, and currency of information from any source.

IV. Science, Technology, and Society

A. Interactions between innovations and science

1. Recognize how scientific discoveries are connected to technological innovations.

B. Social ethics

1. Understand how scientific research and technology have an impact on ethical and legal practices.
2. Understand how commonly held ethical beliefs impact scientific research.

C. History of science

1. Understand the historical development of major theories in science.
2. Recognize the role of people in important contributions to scientific knowledge.

V. Cross-Disciplinary Themes

A. Matter/states of matter

1. Know modern theories of atomic structure.
2. Understand the typical states of matter (solid, liquid, gas) and phase changes among these.

B. Energy (thermodynamics, kinetic, potential, energy transfers)

1. Understand the Laws of Thermodynamics.
2. Know the processes of energy transfer.

C. Change over time/equilibrium

1. Recognize patterns of change.

D. Classification

1. Understand that scientists categorize things according to similarities and differences.

E. Measurements and models

1. Use models to make predictions.
2. Use scale to relate models and structures.
3. Demonstrate familiarity with length scales from sub-atomic particles through macroscopic objects.

VIII. Physics

A. Matter

1. Demonstrate familiarity with length scales from sub-atomic particles through microscopic objects.
2. Understand states of matter and their characteristics.
3. Understand the concepts of mass and inertia.
4. Understand the concept of density.
5. Understand the concepts of gravitational force and weight.

B. Vectors

1. Understand how vectors are used to represent physical quantities.
2. Demonstrate knowledge of vector mathematics using a graphical representation.
3. Demonstrate knowledge of vector mathematics using a numerical representation.

C. Forces and motion

1. Understand the fundamental concepts of kinematics.
2. Understand forces and Newton's Laws.
3. Understand the concept of momentum.

D. Mechanical energy

1. Understand potential and kinetic energy.
2. Understand conservation of energy.
3. Understand the relationship of work and mechanical energy.

E. Rotating systems

1. Understand rotational kinematics.
2. Understand the concept of torque.
3. Apply the concept of static equilibrium.

4. Understand angular momentum.

F. Fluids

1. Understand pressure in a fluid and its applications.
2. Understand Pascal's Principle.
3. Understand buoyancy.
4. Understand Bernoulli's principle.

G. Oscillations and waves

1. Understand basic oscillatory motion and simple harmonic motion.
2. Understand the difference between transverse and longitudinal waves.
3. Understand wave terminology: wavelength, period, frequency, and amplitude.
4. Understand the properties and behavior of sound waves.

H. Thermodynamics

1. Understand the gain and loss of heat energy in matter.
2. Understand the basic laws of thermodynamics.

I. Electromagnetism

1. Discuss electric charge and electric force.
2. Gain qualitative and quantitative understanding of voltage, current, and resistance.
3. Understand Ohm's Law.
4. Apply the concept of power to electricity.
5. Discuss basic DC circuits that include voltage sources and combinations of resistors.
6. Dicuss basic DC circuits that include voltage sources and combinations of capacitors.
7. Understand magnetic fields and their relationship to electricity.
8. Relate electricity and magnetism to everyday life.

J. Optics

1. Know the electromagnetic spectrum.
2. Understand the wave/particle duality of light.
3. Understand concepts of gemotric optics.

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English Language Proficiency Standards

The English Language Proficiency Standards (ELPS) require that teachers provide linguistically accommodated instruction that corresponds to the students' levels of English proficiency. Districts are required to determine qualifying students' proficiency levels in the domains of listening, speaking, reading, and writing. Descriptors at each proficiency level—Beginning, Intermediate, Advanced, and Advanced High are used to determine reasonable expectations for students in each of the four domains. It is important to remember that English language learners are a diverse group, and students may have achieved a higher level of language proficiency in one or more of the domains than others.

Beginning—Indicates the initial stages of learning English and minimal ability to communicate in English in academic settings. Comprehension is demonstrated through action, gestures, and drawings. Students often communicate using memorized words and phrases.

Intermediate—Indicates the ability to use common, basic English in routine classroom activities. Comprehension is demonstrated through the use of key words and phrases and nonverbal responses. Students communicate simply when the topic of conversation is familiar, can generally follow social conversations, but not understand the details.

Advanced—Indicates the ability to use academic English in classroom activities, using more complex phrases and sentences with English language assistance provided when needed. Comprehension is demonstrated in context-reduced situations, both orally and in writing. Students still may have trouble with unfamiliar vocabulary and grammar.

Advanced High—Indicates the ability to use academic English in classroom activities with little English language support. Comprehension is demonstrated in situations with and without a context, both orally and in writing. Students communicate clearly in most situations.

Learning Strategies	
c1A: Use prior knowledge to understand meanings. c1B: Monitor self and use self-correcting techniques. c1C: Use techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to learn new vocabulary. c1D: Use learning strategies such as asking for help, nonverbal cues, synonyms, and circumlocution.	c1E: Internalize new language by using it in meaningful ways in speaking and writing activities. c1F: Use accessible language and learn new language in the process. c1G: Use formal and informal English in socially appropriate ways. c1H: Develop repertoire of learning strategies such as reasoning, looking for patterns in language, and analyzing expressions.

From *Embedding the ELPS With E's: High School Science*, 2009, Houston, TX: Region 4 Education Service Center. © 2010 Region 4 Education Service Center. Reprinted with permission.

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English Language Proficiency Standards

Listening		Speaking	
c2A:	Distinguish between different sounds and intonations.	c3A::	Continually improve pronunciation..
c2B:	Recognize phonics in new vocabulary.	c3B:	Use routine language needed for classroom communication.
c2C:	Learn new language heard in class.	c3C:	Speak using increasingly correct grammar.
c2D:	Monitor understanding and ask for help as needed.	c3D::	Speak using grade-level content-area vocabulary in context.
c2E:	Understand more complex spoken language with support.	c3E:	Share information in cooperative groups.
c2F:	Understand language from a variety of media.	c3F:	Ask and give information.
c2G:	Identify main ideas and supporting details from spoken English.	c3G:	Express opinions, ideas, and feelings.
c2H:	Understand implied ideas and information.	c3H:	Narrate, describe, and explain with increasing detail.
c2I:	Follow directions, summarize, respond to questions, collaborate, and take notes.	c3I:	Use formal and informal spoken language appropriately.
		c3J:	Respond orally to a wide variety of media.
Reading		**Writing**	
c4A:	Show ability to sound out words.	c5A:	Learn phonics rules to sound out words when writing.
c4B:	Be aware of directionality of English reading (left to right and top to bottom).	c5B:	Write using new vocabulary.
c4C:	Comprehend routine vocabulary and language structures used in class.	c5C:	Spell words with increasing accuracy.
c4D:	Use prereading supports and activities to increase reading comprehension.	c5D:	Edit writing for standard grammar and usage.
c4E:	Read with a decreasing need for linguistic accommodations.	c5E:	Use increasingly complex grammatical structures.
c4F:	Use support to read grade-appropriate content-area text.	c5F:	Use appropriate sentence structure with increasing accuracy.
c4G:	Participate in shared reading, summarizing, responding to questions, and taking notes.	c5G:	Narrate, describe, and explain with increasing detail.
c4H:	Read silently with increasing ease and comprehension.		
c4I:	Demonstrate comprehension of main ideas and supporting details.		
c4J:	Make inferences, predictions, and connections, and find supporting text evidence.		
c4K:	Use analytical skills to evaluate written information.		

Response to Intervention (RtI)

Response to Intervention, or RtI, a multitiered approach to instruction, is evolving as the framework of the general education program for all students including those who experience difficulties either academically or behaviorally. RtI helps to ensure that students have the opportunity to experience a full range of educational opportunities through the general education program.

Driven and documented by reliable data, the implementation of RtI in Texas schools can result in—

- more effective instruction;
- increased student achievement;
- more appropriate LD identification;
- increased professional collaboration; and
- overall school improvement.

Source: *2008–2009 Response to Intervention Guidance*, Texas Education Agency

Core RtI Features

- high-quality, research-based classroom instruction
- universal screenings of academics and behavior
- continuous progress monitoring
- research-based interventions
- continuous progress monitoring during interventions
- integrity of instruction and interventions

Core RtI Attributes

- tiered interventions
- implementation of differentiated curriculum
- instruction delivered by staff other than classroom teachers at higher tiers
- varied duration and frequency of interventions
- placement decisions that serve students with varied abilities
- standardized treatment protocol

Source: National Research Center on Learning Disabilities

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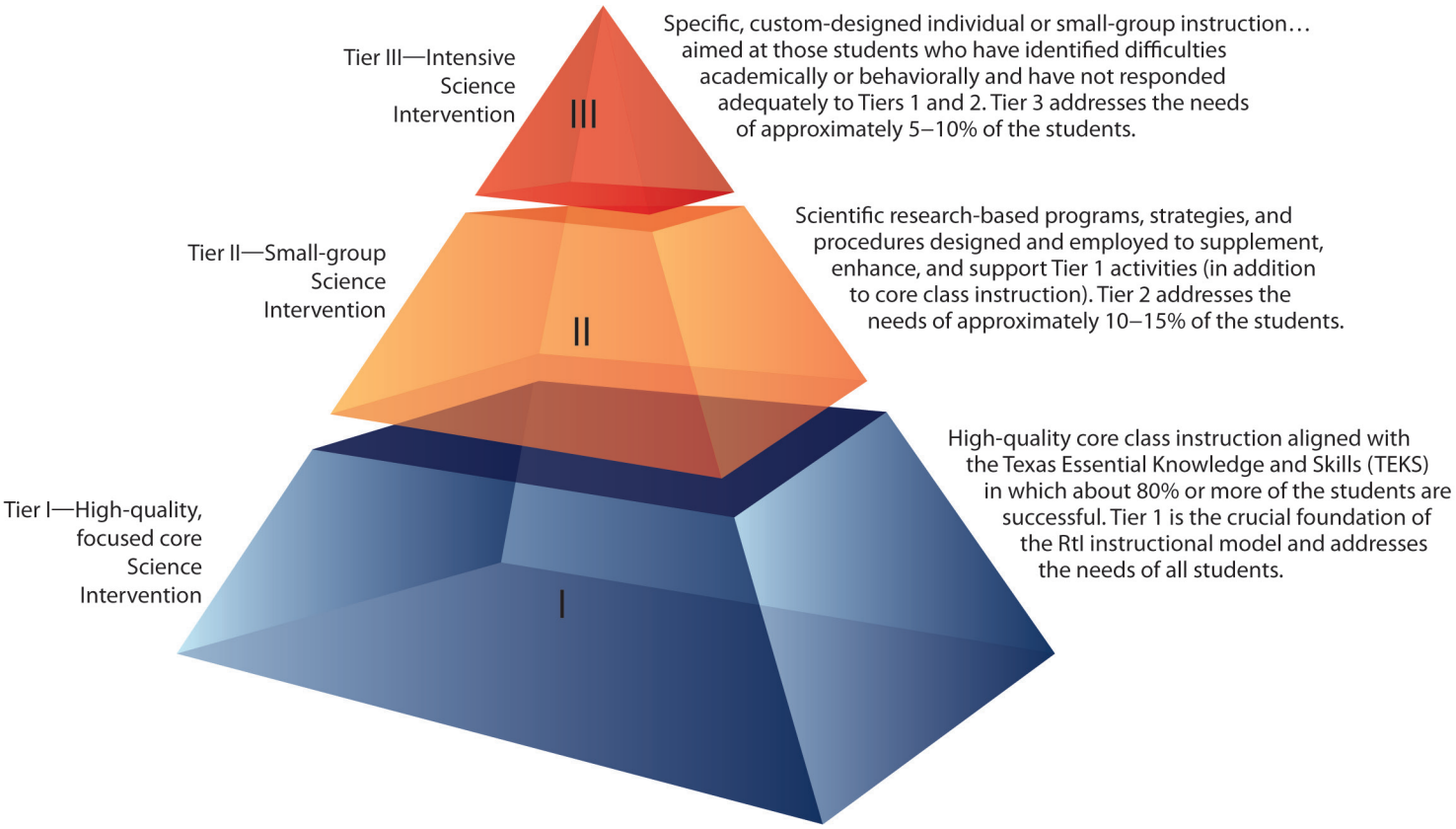
Response to Intervention (RtI)

3-Tier Intervention Model



Sources:
RtI from All Sides: What Every Teacher Needs to Know, Mary Howard
2008–2009 Response to Intervention Guidance, Texas Education Agency

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Gifted/Talented Students

Texas State Goal for Gifted/Talented Students
Students who participate in services designed for gifted/talented students will demonstrate skills in self-directed learning, thinking, research, and communication as evidenced by the development of innovative products and performances that reflect individuality and creativity and are advanced in relation to students of similar age, experience, or environment. High school graduates who have participated in services for gifted/talented students will have produced products and performances of professional quality as part of their program services.

Training on the differentiation of curriculum, instruction, and assessment is essential for meeting the needs of students who are gifted/talented. These students require special provisions because of their strengths and above-grade instructional level or potential.

How can Response to Intervention (RtI) be used with gifted/talented students?

RtI is the practice of meeting the academic and behavioral needs of all students through a variety of services containing the following key elements:

- High-quality instruction and scientific research-based tiered interventions aligned with individual student need
- Frequent monitoring of student progress to make results-based academic and/or behavioral decisions
- Application of student response data to important educational decisions (such as those regarding placement, intervention, curriculum, and instructional goals and methodologies)

Using the three elements above, shift the focus from struggling learners to those students who learn at a faster pace or have a need to delve deeper into a subject. Each one could be applied when deciding how to implement an educational plan for a gifted/talented student using RtI.

Resources
Texas State Plan for the Education of Gifted/Talented Students http://www.tea.state.tx.us/index4.aspx?id=5158

Gifted/Talented Resources (Texas) http://www.tea.state.tx.us/index4.aspx?id=5158

Response to Intervention for Gifted Children, Council of Exceptional Children–The Association for the Gifted (CEC–TAG) http://www.docstoc.com/docs/20439420/Response-to-Intervention-for-Gifted-Children/

CEC–TAG Position Paper on RtI and Gifted/Talented Students http://www.gifted.uconn.edu/siegle/TAG/PositionPapers/CEC-TAG%20Position%20RtI.pdf

Response to Intervention (RtI): A Practitioner's Guide to Implementation, Colorado Department of Education http://www.cde.state.co.us/cdegen/downloads/RtIGuide.pdf

Response to Intervention and Gifted and Talented Education, Montana Office of Public Instruction http://opi.mt.gov/PDF/Gifted/RtI_GTFramework.pdf

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