STATE MATCH

Connecticut Curriculum Framework

English Language Arts, Mathematics, and Science
Grades 8–12

and

EXPLORE®, PLAN®, the ACT®, and WorkKeys®

November 2008

ACT®

About This Report

EXECUTIVE SUMMARY
(pp. 1–3)

This portion summarizes the findings of the alignment between Connecticut's Curriculum Framework and ACT's Educational Planning and Assessment System (EPAS™) tests—EXPLORE® (8th and 9th grades), PLAN® (10th grade), and the ACT® (11th and 12th grades)—and ACT's WorkKeys® assessments (Reading for Information, Applied Mathematics, and Locating Information). It also presents ACT's involvement in meeting NCLB requirements and describes additional information about the unique programs and services ACT can provide to Connecticut.

SECTION A
(pp. 5–7)

This section provides tables by content area (English Language Arts, Mathematics, and Science), listing the precise number of Connecticut Standards measured by ACT's EPAS tests and/or WorkKeys assessments by grade level.

SECTION B
(pp. 9–24)

All Connecticut Standards are listed here; each one highlighted is measured by ACT's EPAS tests and/or WorkKeys assessments. Connecticut Standards listed here are from the Connecticut Curriculum Frameworks as presented on the Connecticut Department of Education's website in October 2008. Underlined science content indicates that the content topics are included in, but not directly measured by, ACT's EPAS Science tests.

SECTION C
(pp. 25–34)

ACT's College Readiness Standards appear here. Highlighting indicates that a statement reflects one or more statements in the Connecticut Standards. College Readiness Standards not highlighted are not addressed in the Connecticut Standards.

SECTION D
(pp. 35–36)

WorkKeys Skills appear here. Highlighting indicates that a statement reflects one or more statements in the Connecticut Standards. Skills not highlighted are not addressed in the Connecticut Standards.

A supplement that identifies the specific ACT College Readiness Standard(s) and WorkKeys Skill(s) corresponding to each Connecticut Standard in a side-by-side format is available at **www.act.org/education/statematch**.

ACT

Executive Summary

We at ACT believe our programs offer many advantages to Connecticut students and educators, and this report offers strong evidence for this belief. This alignment analysis clearly answers four critical questions:

1. To what extent do ACT's Educational Planning and Assessment System (EPAS™) tests—EXPLORE® (8th and 9th grades), PLAN® (10th grade), and the ACT® (11th and 12th grades)—and ACT's WorkKeys® assessments (Reading for Information, Applied Mathematics, and Locating Information) measure Connecticut's Standards?
2. Can the results from ACT's testing programs be used to meet Connecticut's NCLB requirement?
3. Why should Connecticut choose EPAS?
4. Why choose to include WorkKeys assessments?

ACT'S TESTS MEASURE ALMOST ALL IMPORTANT CONNECTICUT STANDARDS IN ENGLISH LANGUAGE ARTS, MATHEMATICS, AND SCIENCE.

1. Match Results: Comparisons conducted by our content specialists show that ACT's Reading, English, Writing, Mathematics, and Science tests and WorkKeys Reading for Information and Applied Mathematics assessments measure almost all of Connecticut's English Language Arts, Mathematics, and Science Standards. WorkKeys Locating Information assessment measures some skills listed in Connecticut's Science courses (Objective match totals appear in Section A.):

- English Language Arts: 4 out of 4 Standards

  Most Connecticut English Language Arts Standards are covered by ACT's English, Reading, and Writing tests and WorkKeys Reading for Information (RI) assessment.

- Mathematics: 4 out of 4 Standards

  Almost all Connecticut Mathematics Standards are covered by ACT's Mathematics tests and WorkKeys Applied Mathematics (AM) assessment.

- Science: Process Standards: 3 out of 3
  (Content Standards: Grades 8–10 Core 19 out of 19
  High School Enrichment 27 out of 27)

  Almost all Connecticut Science Standards are covered by ACT's Science tests and WorkKeys Locating Information (LI) assessment.

  (A note about science content: ACT's Science tests present content from biology, chemistry, physics, and Earth/space sciences. Although content knowledge in these content areas is needed to answer some of the test questions, the test questions emphasize scientific reasoning and are based in experimental science contexts. Factual content knowledge, although needed to answer some of the test questions, is not systematically sampled from the full content knowledge domain. Therefore, each ACT Science Test covers some, but not all, of the discrete science content knowledge specifically described in the Connecticut Science Standards.

  To emphasize the point that content is included, but not necessarily covered in its entirety, on every test form, science content match results appear in parentheses in Section A of this document (which describes the number of Connecticut Standards measured by ACT's tests), and are underlined rather than highlighted in Section B. Our goal here is to clearly

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STATES CHOOSE ACT BECAUSE:

- **STUDENT MOTIVATION IS HIGH.**
- **ACT'S IS THE ONLY CURRICULUM-BASED ASSESSMENT SYSTEM THAT MEASURES STUDENT READINESS ALONG A CONTINUUM OF EMPIRICALLY DERIVED COLLEGE READINESS BENCHMARKS.**
- **EPAS DATA PROVIDE HELPFUL FEEDBACK FOR TEACHERS, STUDENTS, AND POLICYMAKERS TO MAKE EDUCATIONAL DECISIONS AND IDENTIFY WAYS TO IMPROVE.**

ACT BUILDS ITS DEFINITION OF COLLEGE READINESS ON A SOUND EMPIRICAL BASE:

1. **THE ACT NATIONAL CURRICULUM SURVEY**
2. **ACT'S COLLEGE READINESS BENCHMARK SCORES**
3. **ACT'S COLLEGE READINESS STANDARDS™**

communicate that science content will be included, but each specific content topic will not be covered consistently enough for inferences to be made about student proficiency in all areas.)

Most exceptions to a match between ACT's tests and Connecticut's Standards arise from standards not being assessable in group settings, standards that are personal in nature, and standards requiring measurement over extended time. If additional testing is deemed necessary, ACT would be interested in working with Connecticut on developing any necessary augmentation.

2. NCLB requirement? Yes; states like Michigan and Illinois use ACT components as part of testing that is submitted to the U.S. Department of Education for NCLB approval.

3. Why choose ACT? States and school districts choose ACT's EPAS programs because student motivation is high, and EPAS is the *only curriculum-based assessment system that measures student readiness along a continuum of empirically derived college readiness benchmarks*. Various groups claim to describe what students truly need to know and be able to do for college and/or workplace readiness. Such groups typically ask individual experts in education to gather and discuss what they feel is important for students to understand. Not surprisingly, the answers vary. In contrast, ACT defines college readiness through a unique and rigorous empirical process:

- **The knowledge and skills necessary for students to be ready for college-level work are empirically identified via the ACT National Curriculum Survey®**

  ACT surveys thousands of secondary and postsecondary instructors across the nation to determine which skills and knowledge are most important at each course level and for college and work readiness. The responses drive the test specifications for EXPLORE, PLAN, and the ACT.

- **The empirically derived performance levels necessary for students to be ready to succeed in college-level work are defined in ACT's College Readiness Benchmark Scores.**

  ACT analyzed thousands of student records to identify the ACT scores associated with success in postsecondary coursework (i.e., a 50% chance of earning a B or better in credit-bearing first-year college courses): 18 for English, 22 for Math, 21 for Reading, and 24 for Science.

- **Skills and knowledge a student currently has and areas for improvement can be identified by the empirically derived ACT College Readiness Standards.**

  Using thousands of student records and responses, content and measurement experts at ACT have developed detailed statements that describe what students typically know and are able to do at different levels of test performance. These data-driven, empirically derived score descriptors articulate student achievement within various score ranges on the English,

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Reading, Writing, Mathematics, and Science tests on the EXPLORE, PLAN, and ACT. These statements provide specific details about students' college readiness and can be used to identify next steps for improvement.

4. Why choose to include WorkKeys assessments? Students can use WorkKeys to help determine the skill levels and education required for various jobs. Educators can use WorkKeys to ensure that students enter the work world with the foundational skills needed in any field they choose.

Further, the WorkKeys scores offer a clear way for students to demonstrate their knowledge and skills to prospective employers. WorkKeys is at the center of the nationwide Career Readiness System that links qualified individuals with employers who recognize the value of skilled job applicants. ACT's National Career Readiness Certificate (NCRC) ensures that an individual has certain foundational skills that are important across a range of positions. The NCRC is a portable credential that employees can use anywhere in the nation. Individuals seeking employment gain a competitive edge with an NCRC because they are able to provide prospective employers with clear evidence that their knowledge and skills align with the requirements of the job they are applying for. The NCRC offers job seekers, employers, and educators an easily understood, conveniently attained, and universally valued credential.

Test takers are most commonly certified in the skills areas of Applied Mathematics, Locating Information, and Reading for Information. Higher scores qualify students for more jobs than do lower scores. New Jersey, Virginia, Louisiana, Kentucky, North Carolina, and New Mexico have already initiated certificate programs, and many other states are in the process of developing similar programs.

In sum, ACT's EPAS and WorkKeys programs provide abundant data regarding student readiness for college and work. This information can help Connecticut educators and students make well-informed decisions in planning students' career and academic goals.

Section A: Number of Connecticut Standards Measured by EXPLORE, PLAN, the ACT, and WorkKeys

Table A-1. Number of Connecticut English Language Arts Standards Measured by EXPLORE, PLAN, the ACT, and WorkKeys

Connecticut Standards*	Number of Connecticut Component Statements Measured by ACT's tests	Aspects of Connecticut Standards that are Not Measured
Reading and Responding	Grade 8 3 out of 4 Grades 9–12 3 out of 4	Communicate with others to create interpretations of written, oral and visual texts
Exploring and Responding to Literature	Grade 8 2 out of 4 Grades 9–12 1 out of 4	Explore multiple responses to literature Recognize that readers and authors are influenced by individual, social, cultural and historical contexts
Communicating with Others	Grade 8 1 out of 2 Grades 9–12 2 out of 2	Use descriptive, narrative, expository, and poetic modes Research information from multiple sources for a specific purpose
Applying English Language Conventions	Grade 8 2 out of 3 Grades 9–12 2 out of 3	Use knowledge of language and culture to improve competency in English
TOTALS 4 out of 4 Standards	Grade 8 8 out of 13 Grades 9–12 8 out of 13	

*Refer to Connecticut's English Language Arts Standards on pages 9–12.

Table A-2. Number of Connecticut Mathematics Standards Measured by EXPLORE, PLAN, the ACT, and WorkKeys		
Connecticut Standards*	**Number of Connecticut Component Statements Measured by ACT's tests**	**Aspects of Connecticut Standards that are Not Measured**
Algebraic Reasoning: Patterns and Functions	Grade 8 3 out of 3 Grades 9–12 Core 3 out of 3 Grades 9–12 Extended 3 out of 3	
Numerical and Proportional Reasoning	Grade 8 2 out of 2 Grades 9–12 Core 2 out of 2 Grades 9–12 Extended 2 out of 2	
Geometry and Measurement	Grade 8 3 out of 3 Grades 9–12 Core 3 out of 3 Grades 9–12 Extended 3 out of 3	
Working with Data: Probability and Statistics	Grade 8 3 out of 3 Grades 9–12 Core 3 out of 3 Grades 9–12 Extended 3 out of 3	
TOTALS 4 out of 4 Standards	Grade 8 11 out of 11 Grades 9–12 Core 11 out of 11 Grades 9–12 Extended 11 out of 11	

*Refer to Connecticut's Mathematics Standards on pages 13–15.

Table A-3. Number of Connecticut Grades 8–10 Science Core Standards Measured by EXPLORE, PLAN, and the ACT		
Connecticut Standards*	**Number of Connecticut Expected Performances/ Standards Measured by ACT's tests**	**Aspects of Connecticut Standards that are Not Measured**
Scientific Inquiry, Literacy and Numeracy	Grades 8–10 10 out of 10	
Process TOTALS 3 out of 3 Standards	Grades 8–10 10 out of 10	
Content Standards	Grade 8 (4) out of (4) Grade 9 (9) out of (9) Grade 10 (6) out of (6)	
Content TOTALS 19 out of 19 Standards	Grade 8 (4) out of (4) Grade 9 (9) out of (9) Grade 10 (6) out of (6)	

Table A-4. Number of Connecticut High School Science Enrichment Standards Measured by EXPLORE, PLAN, and the ACT		
Connecticut Subjects*	**Number of Connecticut Standards Measured by ACT's tests**	**Aspects of Connecticut Standards that are Not Measured**
Biology	(10) out of (10)	
Earth Science	(7) out of (7)	
Chemistry	(5) out of (5)	
Physics	(5) out of (5)	
Content TOTALS 4 out of 4 Subjects	(27) out of (27)	

*Refer to Connecticut's Science Standards on pages 16–24.

English Language Arts

Connecticut Grade 8 English Language Arts
Curriculum Framework

Standard 1: Reading and Responding

Students read, comprehend and respond in individual, literal, critical and evaluative ways to literary, informational and persuasive texts in multimedia formats.

1.1 Students use appropriate strategies before, during and after reading in order to construct meaning.

a. activate prior knowledge, establish purposes for reading and adjust the purposes while reading.

b. monitor comprehension and apply appropriate strategies when understanding breaks down.

c. select and organize relevant information from text to summarize.

d. identify, use and analyze text structures.

e. draw conclusions and use evidence to substantiate them by using texts heard, read and viewed.

f. make and justify inferences from explicit and or implicit information.

1.2 Students interpret, analyze and evaluate text in order to extend understanding and appreciation.

a. generate and respond to questions.

b. interpret information that is implied in a text.

c. distinguish between fact and opinion.

d. make and support judgments about texts.

e. discuss and respond to texts by making text-to-self, text-to-text and text-to-world connections.

f. identify and discuss the underlying theme or main idea in texts.

g. choose a variety of genres to read for personal enjoyment.

1.3 Students select and apply strategies to facilitate word recognition and develop vocabulary in order to comprehend text.

a. use phonetic, structural, syntactical and contextual clues to read and understand words.

b. NA

c. analyze the meaning of words and phrases in context.

d. develop vocabulary through listening, speaking, reading and writing.

e. use content vocabulary appropriately and accurately (math, music, science, social studies, etc.).

1.4 Students communicate with others to create interpretations of written, oral and visual texts.

a. respond to the ideas of others and recognize the validity of differing views.

b. persuade listeners about judgments and opinions of works read, written and viewed.

Standard 2: Exploring and Responding to Literature

Students read and respond to classical and contemporary texts from many cultures and literary periods.

2.1 Students recognize how literary devices and conventions engage the reader.

a. explain how and why literary conventions and techniques contribute to their understanding of and experience with the text.

b. identify and analyze the differences between the structures of fiction and nonfiction.

c. discuss what makes a text engaging and appealing to a reader.

d. identify and analyze literary techniques an author uses that contribute to the meaning and appeal of texts.

2.2 Students explore multiple responses to literature.

a. develop and defend multiple responses to literature using individual connections and relevant text references.

b. develop a critical stance and cite evidence to support the stance.

2.3 Students recognize and appreciate that contemporary and classical literature has shaped human thought.

a. discuss, analyze and evaluate how characters deal with the diversity of human experience and conflict.

b. compare/contrast and evaluate ideas, themes and/or issues across classical and contemporary texts.

c. compare, respond to and analyze texts that represent many multicultural experiences.

2.4 Students recognize that readers and authors are influenced by individual, social, cultural and historical contexts.

a. evaluate an author's values, ethics and beliefs included in many texts.

b. discuss how the experiences of an author influence the text.

c. discuss how the experiences of a reader influence the interpretation of a text.

d. analyze and evaluate themes and connections that cross cultures.

e. interpret, analyze and evaluate the influence of culture, history and ethnicity on themes and issues in literature.

f. evaluate the effectiveness of the choices that authors, illustrators and filmmakers make to express political and social issues.

Standard 3: Communicating with Others

Students produce written, oral and visual texts to express, develop and substantiate ideas and experiences.

3.1 Students use descriptive, narrative, expository, persuasive and poetic modes.

a. use oral language with clarity, voice and fluency to communicate a message.

b. listen to or read a variety of genres to use as models for writing in different modes.

c. use the appropriate features of persuasive, narrative, expository or poetic writing.

d. write to delight in the imagination.

3.2 Students prepare, publish and/or present work appropriate to audience, purpose and task.

a. determine purpose, point of view and audience, and choose an appropriate written, oral or visual format.

b. apply the most effective processes to create and present a written, oral or visual piece.

c. revise texts for organization, elaboration, fluency and clarity.

d. research information from multiple sources for a specific purpose.

e. evaluate the validity and authenticity of primary and secondary sources of information.

f. publish and/or present final products in a myriad of ways, including the use of the arts and technology.

Standard 4: Applying English Language Conventions

Students apply the conventions of standard English in oral, written and visual communication.

4.1 Students use knowledge of their language and culture to improve competency in English.

a. read, listen to and tell stories from a variety of cultures, and identify the similarities and differences in the way language is used.

b. recognize and understand variations among language patterns.

4.2 Students speak and write using standard language structures and diction appropriate to audience and task.

a. use sentence patterns typical of spoken and written language to produce text.

b. evaluate the impact of language as related to audience and purpose.

4.3 Students use standard English for composing and revising written text.

a. recognize the difference between standard and nonstandard English and use language appropriately.

b. demonstrate proficient use of proper mechanics, usage and spelling skills.

c. use resources for proofreading and editing.

Standard 1: Reading and Responding

Students read, comprehend and respond in individual, literal, critical and evaluative ways to literary, informational and persuasive texts in multimedia formats.

1.1 Students use appropriate strategies before, during and after reading in order to construct meaning.

- a. activate prior knowledge, establish purposes for reading and adjust the purposes while reading.
- b. determine and apply the most effective means of monitoring comprehension and apply the appropriate strategies.
- c. select and organize relevant information from text to summarize.
- d. identify, use and analyze text structures.
- e. draw conclusions and use evidence to substantiate them by using texts heard, read and viewed.
- f. make and justify inferences from explicit and or implicit information.

1.2 Students interpret, analyze and evaluate text in order to extend understanding and appreciation.

- a. generate and respond to questions.
- b. interpret information that is implied in a text.
- c. distinguish between fact and opinion.
- d. make, support and defend judgments about texts.
- e. discuss and respond to texts by making text-to-self, text-to-text and text-to-world connections.
- f. identify and discuss the underlying theme or main idea in texts.
- g. choose a variety of genres to read for personal enjoyment.

1.3 Students select and apply strategies to facilitate word recognition and develop vocabulary in order to comprehend text.

- a. use phonetic, structural, syntactical and contextual clues to read and understand words.
- b. NA
- c. analyze the meaning of words and phrases in context.
- d. develop vocabulary through listening, speaking, reading and writing.
- e. use content vocabulary appropriately and accurately (math, music, science, social studies, etc.).

1.4 Students communicate with others to create interpretations of written, oral and visual texts.

- a. respond to the ideas of others and recognize the validity of differing views.
- b. persuade listeners about understandings and judgments of works read, written and viewed.

Standard 2: Exploring and Responding to Literature

Students read and respond to classical and contemporary texts from many cultures and literary periods.

2.1 Students recognize how literary devices and conventions engage the reader.

- a. identify the various conventions within a genre and apply this understanding to the evaluation of the text.
- b. identify and analyze the differences between the structures of fiction and nonfiction.
- c. explain and explore their own and others' aesthetic reactions to texts.
- d. analyze literary conventions and devices an author uses and how they contribute meaning and appeal.

2.2 Students explore multiple responses to literature.

- a. develop and defend multiple responses to literature using individual connections and relevant text references.
- b. develop a critical stance and cite evidence to support the stance.

2.3 Students recognize and appreciate that contemporary and classical literature has shaped human thought.

- a. discuss, analyze and evaluate how characters deal with the diversity of human experience and conflict.
- b. compare/contrast and evaluate ideas, themes and/or issues across classical and contemporary texts.
- c. create responses to texts and examine each work's contributions to an understanding of human experience across cultures.

2.4 Students recognize that readers and authors are influenced by individual, social, cultural and historical contexts.

- a. analyze and evaluate the basic beliefs, perspectives and assumptions underlying an author's work.
- b. discuss how the experiences of an author influence the text.
- c. discuss how the experiences of a reader influence the interpretation of a text.
- d. analyze and evaluate themes and connections that cross cultures.
- e. interpret, analyze and evaluate the influence of culture, history and ethnicity on themes and issues in literature.
- f. evaluate the effectiveness of the choices that authors, illustrators and filmmakers make to express political and social issues.

 = Measured by EXPLORE, PLAN, and/or ACT English, Reading, and/or Writing tests and/or WorkKeys RI

Standard 3: Communicating with Others

Students produce written, oral and visual texts to express, develop and substantiate ideas and experiences.

3.1 Students use descriptive, narrative, expository, persuasive and poetic modes.

a. use oral language with clarity, voice and fluency to communicate a message.

b. listen to or read a variety of genres to use as models for writing in different modes.

c. use the appropriate features of persuasive, narrative, expository or poetic writing.

d. write to delight in the imagination.

3.2 Students prepare, publish and/or present work appropriate to audience, purpose and task.

a. determine purpose, point of view and audience, and choose an appropriate written, oral or visual format.

b. apply the most effective processes to create and present a written, oral or visual piece.

c. revise texts for organization, elaboration, fluency and clarity.

d. research information from multiple sources for a specific purpose.

e. evaluate the validity of primary and secondary sources of information to authenticate research.

f. publish and/or present final products in a myriad of ways, including the use of the arts and technology.

Standard 4: Applying English Language Conventions

Students apply the conventions of standard English in oral, written and visual communication.

4.1 Students use knowledge of their language and culture to improve competency in English.

a. read, listen to and tell stories from a variety of cultures, and identify the similarities and differences in the way language is used.

b. recognize and understand variations between language patterns.

4.2 Students speak and write using standard language structures and diction appropriate to audience and task.

a. use sentence patterns typical of spoken and written language to produce text.

b. evaluate the impact of language as related to audience and purpose.

4.3 Students use standard English for composing and revising written text.

a. recognize the difference between standard and nonstandard English and use language appropriately.

b. demonstrate proficient use of proper mechanics, usage and spelling skills.

c. use resources for proofreading and editing.

= Measured by EXPLORE, PLAN, and/or ACT English, Reading, and/or Writing tests and/or WorkKeys RI

Connecticut Grade 8 Mathematics
Curriculum Framework

Algebraic Reasoning: Patterns and Functions

Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Understand and describe patterns and functional relationships.

- a. Analyze physical phenomena, functions and patterns to identify relationships and make generalizations.

1.2 Represent and analyze quantitative relationships in a variety of ways.

- a. Describe the effects of characteristics of linear relationships on the way the relationships are represented verbally and in tables, graphs and equations.

1.3 Use operations, properties and algebraic symbols to determine equivalence and solve problems.

- a. Solve problems using various algebraic methods and properties.

Numerical and Proportional Reasoning

Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

2.1 Understand that a variety of numerical representations can be used to describe quantitative relationships.

- a. Compare and order integers, powers and roots using number lines and grids.
- b. Extend the understanding of scientific notation to very small numbers.

2.2 Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

- a. Solve problems involving fractions, decimals, ratios and percents.
- b. Make generalizations about operations with very large and very small numbers.
- c. Connect the exponential growth and decay models to repeated multiplication by the same factor.

Geometry and Measurement

Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies.

3.1 Use properties and characteristics of two- and three-dimensional shapes and geometric theorems to describe relationships, communicate ideas and solve problems.

- a. Explore the relationships among sides, angles, perimeters, areas, surface areas and volumes of congruent and similar polygons and solids.

3.2 Use spatial reasoning, location and geometric relationships to solve problems.

- a. Model geometric relationships in a variety of ways.

3.3 Develop and apply units, systems, formulas and appropriate tools to estimate and measure.

- a. Use a variety of concrete methods, including displacement, to find volumes of solids.
- b. Solve problems involving measurement through the use of appropriate tools, techniques and strategies.

Working with Data: Probability and Statistics

Data can be analyzed to make informed decisions using a variety of strategies, tools and technologies.

4.1 Collect, organize and display data using appropriate statistical and graphical methods.

- a. Construct appropriate representations of data based on the size and kind of data set and the purpose for their use.

4.2 Analyze data sets to form hypotheses and make predictions.

- a. Make and evaluate statistical claims and justify conclusions with evidence.

4.3 Understand and apply basic concepts of probability.

- a. Determine possible outcomes using a variety of counting techniques.

Algebraic Reasoning: Patterns and Functions

Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Understand and describe patterns and functional relationships.

- a. Describe relationships and make generalizations about patterns and functions.

1.2 Represent and analyze quantitative relationships in a variety of ways.

- a. Represent and analyze linear and nonlinear functions and relations symbolically and with tables and graphs.

1.3 Use operations, properties and algebraic symbols to determine equivalence and solve problems.

- a. Manipulate equations, inequalities and functions to solve problems.

Numerical and Proportional Reasoning

Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

2.1 Understand that a variety of numerical representations can be used to describe quantitative relationships.

- a. Extend the understanding of number to include integers, rational numbers and real numbers.
- b. Interpret and represent large sets of numbers with the aid of technologies.

2.2 Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

- a. Develop strategies for computation and estimation using properties of number systems to solve problems.
- b. Solve proportional reasoning problems.

Geometry and Measurement

Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies.

3.1 Use properties and characteristics of two- and three-dimensional shapes and geometric theorems to describe relationships, communicate ideas and solve problems.

- a. Investigate relationships among plane and solid geometric figures using geometric models, constructions and tools.
- b. Develop and evaluate mathematical arguments using reasoning and proof.

3.2 Use spatial reasoning, location and geometric relationships to solve problems.

- a. Verify geometric relationships using algebra, coordinate geometry, and transformations.

3.3 Develop and apply units, systems, formulas and appropriate tools to estimate and measure.

- a. Solve a variety of problems involving 1-, 2- and 3-dimensional measurements using geometric relationships and trigonometric ratios.

Working with Data: Probability and Statistics

Data can be analyzed to make informed decisions using a variety of strategies, tools and technologies.

4.1 Collect, organize and display data using appropriate statistical and graphical methods.

- a. Create the appropriate visual or graphical representation of real data.

4.2 Analyze data sets to form hypotheses and make predictions.

- a. Analyze real-world problems using statistical techniques.

4.3 Understand and apply basic concepts of probability.

- a. Understand and apply the principles of probability in a variety of situations.

= Measured by EXPLORE, PLAN, and/or ACT Mathematics tests and/or WorkKeys AM Test

Algebraic Reasoning: Patterns and Functions

Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Understand and describe patterns and functional relationships.

- a. Model real-world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Represent and analyze quantitative relationships in a variety of ways.

- a. Relate the behavior of functions and relations to specific parameters and determine functions to model real-world situations.

1.3 Use operations, properties and algebraic symbols to determine equivalence and solve problems.

- a. Use and extend algebraic concepts to include real and complex numbers, vectors and matrices.

Numerical and Proportional Reasoning

Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

2.1 Understand that a variety of numerical representations can be used to describe quantitative relationships.

- a. Extend the understanding of number to include the set of complex numbers.

2.2 Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

- a. Investigate mathematical properties and operations related to objects that are not numbers.

Geometry and Measurement

Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies.

3.1 Use properties and characteristics of two- and three-dimensional shapes and geometric theorems to describe relationships, communicate ideas and solve problems.

- a. Use methods of deductive and inductive reasoning to make, test and validate geometric conjectures.
- b. Explore non-Euclidean geometries.

3.2 Use spatial reasoning, location and geometric relationships to solve problems.

- a. Use a variety of coordinate systems and transformations to solve geometric problems in 2 and 3 dimensions using appropriate tools and technologies.

3.3 Develop and apply units, systems, formulas and appropriate tools to estimate and measure.

- a. Approximate measurements that cannot be directly determined with some degree of precision using appropriate tools, techniques and strategies.

Working with Data: Probability and Statistics

Data can be analyzed to make informed decisions using a variety of strategies, tools and technologies.

4.1 Collect, organize and display data using appropriate statistical and graphical methods.

- a. Model real data graphically using appropriate tools, technologies and strategies.

4.2 Analyze data sets to form hypotheses and make predictions.

- a. Describe and analyze sets of data using statistical models.

4.3 Understand and apply basic concepts of probability.

- a. Solve problems using the methods of discrete mathematics.
- b. Make statistical inferences through the use of probability.

= Measured by EXPLORE, PLAN, and/or ACT Mathematics tests and/or WorkKeys AM Test

Connecticut Grade 8 Science
Curriculum Framework

Scientific Inquiry, Literacy and Numeracy

C INQ.1 Identify questions that can be answered through scientific investigation.

C INQ.2 Read, interpret and examine the credibility of scientific claims in different sources of information.

C INQ.3 Design and conduct appropriate types of scientific investigations to answer different questions.

C INQ.4 Identify independent and dependent variables, and those variables that are kept constant, when designing an experiment.

C INQ.5 Use appropriate tools and techniques to make observations and gather data.

C INQ.6 Use mathematical operations to analyze and interpret data.

C INQ.7 Identify and present relationships between variables in appropriate graphs.

C INQ.8 Draw conclusions and identify sources of error.

C INQ.9 Provide explanations to investigated problems or questions.

C INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Core Themes, Content Standards and Expected Performances

8.1 An object's inertia causes it to continue moving the way it is moving unless it is acted upon by a force to change its motion.

C 22. Calculate the average speed of a moving object and illustrate the motion of objects in graphs of distance over time.

C 23. Describe the qualitative relationships among force, mass and changes in motion.

C 24. Describe the forces acting on an object moving in a circular path.

8.2 Reproduction is a characteristic of living systems and it is essential for the continuation of every species.

C 25. Explain the similarities and differences in cell division in somatic and germ cells.

C 26. Describe the structure and function of the male and female human reproductive systems, including the process of egg and sperm production.

C 27. Describe how genetic information is organized in genes on chromosomes, and explain sex determination in humans.

8.3 The solar system is composed of planets and other objects that orbit the sun.

C 28. Explain the effect of gravity on the orbital movement of planets in the solar system.

C 29. Explain how the regular motion and relative position of the sun, Earth and moon affect the seasons, phases of the moon and eclipses.

8.4 In the design of structures there is a need to consider factors such as function, materials, safety, cost and appearance

C 30. Explain how beam, truss and suspension bridges are designed to withstand the forces that act on them.

= Measured by EXPLORE Science Test
_____ = Content sampled by EXPLORE Science Test

Scientific Inquiry, Literacy and Numeracy

D INQ.1 Identify questions that can be answered through scientific investigation.

D INQ.2 Read, interpret and examine the credibility and validity of scientific claims in different sources of information.

D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.

D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

D INQ.6 Use appropriate tools and techniques to make observations and gather data.

D INQ.7 Assess the reliability of the data that was generated in the investigation.

D INQ.8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.

D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

D INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Core Themes, Content Standards and Expected Performances

Strand I: Energy Transformations

9.1 Energy cannot be created or destroyed; however, energy can be converted from one form to another.

- D 1. Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.
- D 2. Explain how energy is transferred by conduction, convection and radiation.
- D 3. Describe energy transformations among heat, light, electricity and motion.

9.2 The electrical force is a universal force that exists between any two charged objects.

- D 4. Explain the relationship among voltage, current and resistance in a simple series circuit.
- D 5. Explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.
- D 6. Describe the relationship between current and magnetism.

9.3 Various sources of energy are used by humans and all have advantages and disadvantages.

- D 7. Explain how heat is used to generate electricity.
- D 8. Describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.
- D 9. Describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

Strand II: Chemical Structures and Properties

9.4 Atoms react with one another to form new molecules.

- D 10. Describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.
- D 11. Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).
- D 12. Explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.

9.5 Due to its unique chemical structure, carbon forms many organic and inorganic compounds.

- D 13. Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.
- D 14. Describe combustion reactions of hydrocarbons and their resulting by-products.
- D 15. Explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.

9.6 Chemical technologies present both risks and benefits to the health and well-being of humans, plants and animals.

- D 16. Explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers.
- D 17. Explain how the chemical structure of polymers affects their physical properties.
- D 18. Explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

Strand III: Global Interdependence

9.7 Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.

- D 19. Explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.
- D 20. Explain how solar energy causes water to cycle through the major earth reservoirs.
- D 21. Explain how internal energy of the Earth causes matter to cycle through the magma and the solid earth.

= Measured by EXPLORE Science Test
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9.8 The use of resources by human populations may affect the quality of the environment.

D 22. Explain how the release of sulfur dioxide (SO_2) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures.

D 23. Explain how the accumulation of carbon dioxide (CO_2) in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes.

D 24. Explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

9.9 Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.

D 25. Explain how land development, transportation options and consumption of resources may affect the environment.

D 26. Describe human efforts to reduce the consumption of raw materials and improve air and water quality.

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Scientific Inquiry, Literacy and Numeracy

D INQ.1 Identify questions that can be answered through scientific investigation.

D INQ.2 Read, interpret and examine the credibility and validity of scientific claims in different sources of information.

D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.

D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

D INQ.6 Use appropriate tools and techniques to make observations and gather data.

D INQ.7 Assess the reliability of the data that was generated in the investigation.

D INQ.8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.

D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

D INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Core Themes, Content Standards and Expected Performances

Strand IV: Cell Chemistry and Biotechnology

10.1 Fundamental life processes depend on the physical structure and the chemical activities of the cell.

D 27. Describe significant similarities and differences in the basic structure of plant and animal cells.

D 28. Describe the general role of DNA and RNA in protein synthesis.

D 29. Describe the general role of enzymes in metabolic cell processes.

D 30. Explain the role of the cell membrane in supporting cell functions.

10.2 Microorganisms have an essential role in life processes and cycles on Earth.

D 31. Describe the similarities and differences between bacteria and viruses.

D 32. Describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases.

D 33. Explain how bacteria and yeasts are used to produce foods for human consumption.

10.3 Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.

D 34. Describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.

D 35. Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.

Strand V: Genetics, Evolution and Biodiversity

10.4 In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.

D 36. Explain how meiosis contributes to the genetic variability of organisms.

D 37. Use the Punnet Square technique to predict the distribution of traits in mono- and di-hybrid crossings.

D 38. Deduce the probable mode of inheritance of traits (e.g., recessive/dominant, sex-linked) from pedigree diagrams showing phenotypes.

D 39. Describe the difference between genetic disorders and infectious diseases.

10.5 Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.

D 40. Explain how the processes of genetic mutation and natural selection are related to the evolution of species.

D 41. Explain how the current theory of evolution provides a scientific explanation for fossil records of ancient life forms.

D 42. Describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.

10.6 Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.

D 43. Describe the factors that affect the carrying capacity of the environment.

D 44. Explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.

D 45. Explain how technological advances have affected the size and growth rate of human populations throughout history.

= Measured by PLAN Science Test
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Connecticut High School Biology
Enrichment Standards

Cell Biology

The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.

- Cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.
- Enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions and the pH of the surroundings.
- Prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.
- The central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.
- The endoplasmic reticulum and Golgi apparatus have a role in the secretion of proteins.
- Usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.
- The role of the mitochondria is to make stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.
- Most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.

Genetics

Mutation and sexual reproduction lead to genetic variation in a population.

- Meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.
- Only certain cells in a multicellular organism undergo meiosis.
- Random chromosome segregation explains the probability that a particular allele will be in a gamete.
- New combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).
- Approximately half of an individual's DNA sequence comes from each parent.
- Genes on specific chromosomes determine an individual's sex.
- Possible combinations of alleles in a zygote can be predicted from the genetic makeup of the parents.

A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.

- The probable outcome of phenotypes in a genetic cross can be predicted from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).
- Mendel's laws of segregation and independent assortment are the basis of genetics.
- The probable mode of inheritance can be predicted from a pedigree diagram showing phenotypes.
- Data on frequency of recombination at meiosis can be used to estimate genetic distances between loci and to interpret genetic maps of chromosomes.

Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.

- Ribosomes synthesize proteins, using tRNAs to translate genetic information in the mRNA.
- The sequence of amino acids in a protein can be predicted from the sequence of codons in the RNA, by applying universal genetic coding rules.
- Mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.
- Specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.
- Proteins can differ from one another in the number and sequence of amino acids.
- Proteins having different amino acid sequences typically have different shapes and chemical properties.

The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

- Base-pairing rules are used to explain the precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.
- Genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.
- DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation and transformation) is used to construct recombinant DNA molecules.
- Exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.

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Ecology

Stability in an ecosystem is a balance between competing effects.

- Biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
- Changes in an ecosystem can result from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- Fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration and death.
- Water, carbon and nitrogen cycle between abiotic resources and organic matter in the ecosystem and oxygen cycles through photosynthesis and respiration.
- A vital part of an ecosystem is the stability of its producers and decomposers.
- At each link in a food web some energy is stored in newly made structures, but much energy is dissipated into the environment as heat.
- The accommodation of an individual organism to its environment is different from the gradual adaptation of a lineage of organisms through genetic change.

Evolution

The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time.

- Natural selection acts on the phenotype rather than the genotype of an organism.
- Alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.
- New mutations are constantly being generated in a gene pool.
- Variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.

Evolution is the result of genetic changes that occur in constantly changing environments.

- Natural selection determines the differential survival of groups of organisms.
- A great diversity of species increases the chance that at least some organisms survive major changes in the environment.
- Genetic drift affects the diversity of organisms in a population.
- Reproductive or geographic isolation affects speciation.
- Fossil evidence contributes to our understanding of biological diversity, episodic speciation and mass extinction.
- Several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another.

Physiology

As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.

- The complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.
- The nervous system mediates communication between different parts of the body and the body's interactions with the environment.
- Feedback loops in the nervous and endocrine systems regulate conditions in the body.
- The neurons transmit electrochemical impulses.
- Sensory neurons, interneurons and motor neurons all have a role in sensation, thought and response.
- Digestion includes the secretion of stomach acid, digestive enzymes (amylases, proteases, nucleases, lipases) and bile salts into the digestion system.
- The kidneys have a homeostatic role in the removal of nitrogenous wastes from the blood.
- The liver has a homeostatic role in detoxification and keeping the blood glucose balance.
- Actin, myosin, Ca2 and ATP have a role in the cellular and molecular basis of muscle contraction.
- Hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.

Organisms have a variety of mechanisms to combat disease.

- The skin provides nonspecific defenses against infection.
- Antibodies have a role in the body's response to infection.
- Vaccination protects an individual from infectious diseases.
- There are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.
- An individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.
- Phagocytes, B-lymphocytes and T-lymphocytes have a role in the immune system.

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Connecticut High School Earth Science
Enrichment Standards

Earth's Place in the Universe

Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies and the universe over time.

- The differences and similarities among the sun, the terrestrial planets and the gas planets may have been established during the formation of the solar system.
- Evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.
- Evidence from geological studies of Earth and other planets suggests that the early Earth was very different from Earth today.
- The sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.
- Asteroids and meteorites had a significant role in shaping the surface of planets and their moons and in mass extinctions of life on Earth.
- The solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years.
- Galaxies are made of billions of stars and comprise most of the visible mass of the universe.
- Evidence indicates that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars. Visual, radio and X-ray telescopes may be used to collect data that reveal those differences in the life cycles of stars.
- The "big bang" model suggests that the universe has been expanding for 10 to 20 billion years.

Dynamic Earth Processes

Plate tectonics operating over geologic time has changed the patterns of land, sea and mountains on Earth's surface.

- Features of the ocean floor, as well as the shape and rock composition of the major plates, provide evidence of plate tectonics.
- Volcanic eruptions and earthquakes are the result of the movement of matter and energy within the Earth.
- The properties of rocks and minerals can be explained based on the physical and chemical conditions in which they were formed, including plate tectonic processes.

Energy in the Earth System

Energy enters the Earth system primarily as solar radiation and eventually escapes as heat.

- The sun is a major source of energy for Earth and other planets.
- Some of the solar radiation is reflected back into the atmosphere and some is absorbed by matter and photosynthetic processes.
- Different atmospheric gases absorb the Earth's thermal radiation.
- The greenhouse effect may cause climatic changes.

Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.

- Differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
- The rotation of Earth influences the circular motions of ocean currents and air.
- Properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.
- The interaction of wind patterns, ocean currents, and the distribution of land masses result in a global pattern of latitudinal bands of rain forests and deserts.

Climate is the long-term average of a region's weather and depends on many factors.

- Weather and climate involve the transfer of energy into and out of the atmosphere.
- Latitude, elevation, topography, proximity to large bodies of water, and cold or warm ocean currents affect the climate.
- Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition and other factors, such as solar radiation and plate movement.

Biogeochemical Cycles

Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.

- The movement of matter among reservoirs is driven by Earth's internal and external sources of energy.
- Carbon cycles through the reservoirs of the atmosphere, lithosphere, hydrosphere and biosphere.

Structure and Composition of the Atmosphere

Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life.

- The atmosphere has specific thermal structure and chemical composition.
- The composition of Earth's atmosphere has evolved over geologic time.
- The origin of atmospheric oxygen is photosynthetic processes.
- The ozone layer in the upper atmosphere absorbs ultraviolet radiation. This layer varies both naturally and in response to human activities.

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Atomic and Molecular Structure

The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.

- The nucleus of the atom is much smaller than the atom, yet contains most of its mass.
- The quantum model of the atom is based on experiments and analyses by many scientists, including Dalton, Thomson, Bohr, Rutherford, Millikan and Einstein.
- The position of an element in the periodic table is related to its atomic number.
- The periodic table can be used to identify metals, semimetals, non-metals and halogens.
- The periodic table can be used to identify trends in ionization energy, electronegativity, the relative sizes of ions and atoms, and the number of electrons available for bonding.
- The electronic configuration of elements and their reactivity can be identified based on their position in the periodic table.

Chemical Bonds

Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.

- Atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
- Chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules are covalent.
- Salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.
- The atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.
- Lewis dot structures can provide models of atoms and molecules.
- The shape of simple molecules and their polarity can be predicted from Lewis dot structures.
- Electronegativity and ionization energy are related to bond formation.
- Solids and liquids held together by Van der Waals forces or hydrogen bonds are affected by volatility and boiling/melting point temperatures.

Conservation of Matter and Stoichiometry

The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

- Chemical reactions can be described by writing balanced equations.
- The quantity one mole is set by defining one mole of carbon-12 atoms to have a mass of exactly 12 grams.
- One mole equals 6.02×10^{23} particles (atoms or molecules).
- The molar mass of a molecule can be determined from its chemical formula and a table of atomic masses.
- The mass of a molecular substance can be converted to moles, number of particles, or volume of gas at standard temperature and pressure.
- Hess's law is used to calculate enthalpy change in a reaction.

Reaction Rates

Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.

- The rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.
- Reaction rates depend on factors such as concentration, temperature and pressure.
- Equilibrium is established when forward and reverse reaction rates are equal.
- Catalysts play a role in increasing the reaction rate by changing the activation energy in a chemical reaction.

Organic Chemistry and Biochemistry

The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes and chemical properties, and provide the biochemical basis of life.

- Large molecules (polymers), such as proteins, nucleic acids and starch, are formed by repetitive combinations of organic monomers.
- The bonding characteristics of carbon result in the formation of a large variety of structures, ranging from simple hydrocarbons to complex biological molecules and synthetic polymers.
- Amino acids are the building blocks of proteins.

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Connecticut High School Physics
Enrichment Standards

Motion and Forces

Newton's laws predict the motion of most objects.

- When forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest.
- The law $F = ma$ is used to solve motion problems that involve constant forces.
- When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction.
- Applying a force to an object perpendicular to the direction of its motion causes the object to change direction.
- Circular motion requires the application of a constant force directed toward the center of the circle.
- Newton's laws are not exact, but provide very good approximations unless an object is small enough that quantum effects become important.

Conservation of Energy and Momentum

The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.

- Kinetic energy can be calculated by using the formula $E = \left(\frac{1}{2}\right) mv^2$.
- Changes in gravitational potential energy near Earth can be calculated by using the formula (change in potential energy) = mgh.
- Momentum is calculated as the product mv.
- Momentum is a separately conserved quantity different from energy.
- An unbalanced force on an object produces a change in its momentum.
- The principles of conservation of momentum and energy can be used to solve problems involving elastic and inelastic collisions.

Heat and Thermodynamics

Energy cannot be created or destroyed although, in many processes, energy is transferred to the environment as heat.

- Heat flow and work are two forms of energy transfer between systems.
- The work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature.
- The internal energy of an object includes the energy of random motion of the object's atoms and molecules. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.
- Most processes tend to decrease the order of a system over time, so that energy levels eventually are distributed more uniformly.

Waves

Waves have characteristic properties that do not depend on the type of wave.

- Waves carry energy from one place to another.
- Transverse and longitudinal waves exist in mechanical media, such as springs and ropes, and in the Earth as seismic waves.
- Wavelength, frequency and wave speed are related.
- Sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.
- Radio waves, light and X-rays are different wavelength bands in the spectrum of electromagnetic waves, the speed of which in a vacuum is approximately $3 \times 10^8 m/s$, and less when passing through other media.
- Waves have characteristic behaviors, such as interference, diffraction, refraction and polarization.
- Beats and the Doppler Effect result from the characteristic behavior of waves.

Electric and Magnetic Phenomena

Electric and magnetic phenomena are related and have many practical applications.

- The voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors and capacitors can be predicted using Ohm's law.
- Any resistive element in a DC circuit dissipates energy, which heats the resistor.
- The power in any resistive circuit element can be calculated by using the formula Power = I^2R.
- Charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.
- Magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.
- Changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.
- Plasmas, the fourth state of matter, contain ions, or free electrons or both and conduct electricity.

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Section C: ACT's College Readiness Standards Included in Connecticut's Grade 8–12 Curriculum Framework

In recent years ACT has brought a distinctive voice to the debate on what it means to be truly ready for college. Using a wealth of longitudinal data—data that no one else possesses—ACT has pioneered empirical approaches to assessing students' college readiness. Using thousands of student records and responses, content and measurement experts at ACT have developed detailed statements that describe what students typically know and are able to do at different levels of test performance. These data-driven, empirically derived score descriptors, known as **ACT's College Readiness Standards,** describe student achievement within various score ranges on the English, Reading, Writing, Mathematics, and Science tests on the EXPLORE, PLAN, and ACT.

In this section (Section C), the ACT College Readiness Standards included in Connecticut's Curriculum Framework are highlighted. Standards not highlighted are those that include specific content, complexity, and/or proficiency level descriptors that ACT content experts determined were not included in Connecticut's Curriculum Framework.

Table C-1. ACT's College Readiness Standards — English

	Topic Development in Terms of Purpose and Focus	Organization, Unity, and Coherence	Word Choice in Terms of Style, Tone, Clarity, and Economy
13–15		Use conjunctive adverbs or phrases to show time relationships in simple narrative essays (e.g., *then*, *this time*)	Revise sentences to correct awkward and confusing arrangements of sentence elements Revise vague nouns and pronouns that create obvious logic problems
16–19	Identify the basic purpose or role of a specified phrase or sentence Delete a clause or sentence because it is obviously irrelevant to the essay	Select the most logical place to add a sentence in a paragraph	Delete obviously synonymous and wordy material in a sentence Revise expressions that deviate from the style of an essay
20–23	Identify the central idea or main topic of a straightforward piece of writing Determine relevancy when presented with a variety of sentence-level details	Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first*, *afterward*, *in response*) Decide the most logical place to add a sentence in an essay Add a sentence that introduces a simple paragraph	Delete redundant material when information is repeated in different parts of speech (e.g., "alarmingly startled") Use the word or phrase most consistent with the style and tone of a fairly straightforward essay Determine the clearest and most logical conjunction to link clauses
24–27	Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal Delete material primarily because it disturbs the flow and development of the paragraph Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement	Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore*, *however*, *in addition*) Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward	Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence Identify and correct ambiguous pronoun references Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay
28–32	Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence, or to determine the need to delete plausible but irrelevant material Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation	Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs Rearrange sentences to improve the logic and coherence of a complex paragraph Add a sentence to introduce or conclude a fairly complex paragraph	Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., "an aesthetic viewpoint" versus "the outlook of an aesthetic viewpoint") Correct vague and wordy or clumsy and confusing writing containing sophisticated language
33–36	Determine whether a complex essay has accomplished a specific purpose Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay	Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay	Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole

Table C-1. ACT's College Readiness Standards — English (continued)

	Sentence Structure and Formation	Conventions of Usage	Conventions of Punctuation
13–15	Use conjunctions or punctuation to join simple clauses Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences	Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives	Delete commas that create basic sense problems (e.g., between verb and direct object)
16–19	Determine the need for punctuation and conjunctions to avoid awkward-sounding sentence fragments and fused sentences Decide the appropriate verb tense and voice by considering the meaning of the entire sentence	Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject-verb and pronoun-antecedent agreement, and which preposition to use in simple contexts Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*	Provide appropriate punctuation in straightforward situations (e.g., items in a series) Delete commas that disturb the sentence flow (e.g., between modifier and modified element)
20–23	Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers)	Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*) Ensure that a verb agrees with its subject when there is some text between the two	Use commas to set off simple parenthetical phrases Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause)
24–27	Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence	Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences Identify the correct past and past participle forms of irregular and infrequently used verbs and form present-perfect verbs by using *have* rather than *of*	Use punctuation to set off complex parenthetical phrases Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*) Use apostrophes to indicate simple possessive nouns Recognize inappropriate uses of colons and semicolons
28–32	Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole	Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom* Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject-verb order is inverted or when the subject is an indefinite pronoun)	Use commas to set off a nonessential/nonrestrictive appositive or clause Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical) Use an apostrophe to show possession, especially with irregular plural nouns Use a semicolon to indicate a relationship between closely related independent clauses
33–36	Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses	Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb	Use a colon to introduce an example or an elaboration

Table C-2. ACT's College Readiness Standards — Reading		
	Main Ideas and Author's Approach	**Supporting Details**
13–15	Recognize a clear intent of an author or narrator in uncomplicated literary narratives	Locate basic facts (e.g., names, dates, events) clearly stated in a passage
16–19	Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives	Locate simple details at the sentence and paragraph level in uncomplicated passages Recognize a clear function of a part of an uncomplicated passage
20–23	Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages	Locate important details in uncomplicated passages Make simple inferences about how details are used in passages
24–27	Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages Infer the main idea or purpose of straightforward paragraphs in more challenging passages Summarize basic events and ideas in more challenging passages Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages	Locate important details in more challenging passages Locate and interpret minor or subtly stated details in uncomplicated passages Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages
28–32	Infer the main idea or purpose of more challenging passages or their paragraphs Summarize events and ideas in virtually any passage Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage	Locate and interpret minor or subtly stated details in more challenging passages Use details from different sections of some complex informational passages to support a specific point or argument
33–36	Identify clear main ideas or purposes of complex passages or their paragraphs	Locate and interpret details in complex passages Understand the function of a part of a passage when the function is subtle or complex

Descriptions of the ACT Reading Passages

Uncomplicated Literary Narratives refers to excerpts from essays, short stories, and novels that tend to use simple language and structure, have a clear purpose and a familiar style, present straightforward interactions between characters, and employ only a limited number of literary devices such as metaphor, simile, or hyperbole.

More Challenging Literary Narratives refers to excerpts from essays, short stories, and novels that tend to make moderate use of figurative language, have a more intricate structure and messages conveyed with some subtlety, and may feature somewhat complex interactions between characters.

Complex Literary Narratives refers to excerpts from essays, short stories, and novels that tend to make generous use of ambiguous language and literary devices, feature complex and subtle interactions between characters, often contain challenging context-dependent vocabulary, and typically contain messages and/or meanings that are not explicit but are embedded in the passage.

Table C-2. ACT's College Readiness Standards — Reading (continued)			
	Sequential, Comparative, and Cause-Effect Relationships	**Meanings of Words**	**Generalizations and Conclusions**
13–15	Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages Recognize clear cause-effect relationships described within a single sentence in a passage	Understand the implication of a familiar word or phrase and of simple descriptive language	Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives
16–19	Identify relationships between main characters in uncomplicated literary narratives Recognize clear cause-effect relationships within a single paragraph in uncomplicated literary narratives	Use context to understand basic figurative language	Draw simple generalizations and conclusions about people, ideas, and so on in uncomplicated passages
20–23	Order simple sequences of events in uncomplicated literary narratives Identify clear relationships between people, ideas, and so on in uncomplicated passages Identify clear cause-effect relationships in uncomplicated passages	Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages	Draw generalizations and conclusions about people, ideas, and so on in uncomplicated passages Draw simple generalizations and conclusions using details that support the main points of more challenging passages
24–27	Order sequences of events in uncomplicated passages Understand relationships between people, ideas, and so on in uncomplicated passages Identify clear relationships between characters, ideas, and so on in more challenging literary narratives Understand implied or subtly stated cause-effect relationships in uncomplicated passages Identify clear cause-effect relationships in more challenging passages	Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages	Draw subtle generalizations and conclusions about characters, ideas, and so on in uncomplicated literary narratives Draw generalizations and conclusions about people, ideas, and so on in more challenging passages
28–32	Order sequences of events in more challenging passages Understand the dynamics between people, ideas, and so on in more challenging passages Understand implied or subtly stated cause-effect relationships in more challenging passages	Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts	Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so on
33–36	Order sequences of events in complex passages Understand the subtleties in relationships between people, ideas, and so on in virtually any passage Understand implied, subtle, or complex cause-effect relationships in virtually any passage	Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage	Draw complex or subtle generalizations and conclusions about people, ideas, and so on, often by synthesizing information from different portions of the passage Understand and generalize about portions of a complex literary narrative

Uncomplicated Informational Passages refers to materials that tend to contain a limited amount of data, address basic concepts using familiar language and conventional organizational patterns, have a clear purpose, and are written to be accessible.

More Challenging Informational Passages refers to materials that tend to present concepts that are not always stated explicitly and that are accompanied or illustrated by more—and more detailed—supporting data, include some difficult context-dependent words, and are written in a somewhat more demanding and less accessible style.

Complex Informational Passages refers to materials that tend to include a sizable amount of data, present difficult concepts that are embedded (not explicit) in the text, use demanding words and phrases whose meaning must be determined from context, and are likely to include intricate explanations of processes or events.

Table C-3. ACT's College Readiness Standards — Writing

	Expressing Judgments	Focusing on the Topic	Developing a Position
3–4	Show a little understanding of the persuasive purpose of the task but neglect to take or to maintain a position on the issue in the prompt Show limited recognition of the complexity of the issue in the prompt	Maintain a focus on the general topic in the prompt through most of the essay	Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas Show little or no movement between general and specific ideas and examples
5–6	Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position	Maintain a focus on the general topic in the prompt throughout the essay	Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas Show little movement between general and specific ideas and examples
7–8	Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt Show some recognition of the complexity of the issue in the prompt by • acknowledging counterarguments to the writer's position • providing some response to counter-arguments to the writer's position	Maintain a focus on the general topic in the prompt throughout the essay and attempt a focus on the specific issue in the prompt Present a thesis that establishes focus on the topic	Develop ideas by using some specific reasons, details, and examples Show some movement between general and specific ideas and examples
9–10	Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion Show recognition of the complexity of the issue in the prompt by • partially evaluating implications and/or complications of the issue, and/or • posing and partially responding to counter-arguments to the writer's position	Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay Present a thesis that establishes a focus on the writer's position on the issue	Develop most ideas fully, using some specific and relevant reasons, details, and examples Show clear movement between general and specific ideas and examples
11–12	Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion Show understanding of the complexity of the issue in the prompt by • examining different perspectives, and/or • evaluating implications or complications of the issue, and/or • posing and fully discussing counter-arguments to the writer's position	Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay Present a critical thesis that clearly establishes the focus on the writer's position on the issue	Develop several ideas fully, using specific and relevant reasons, details, and examples Show effective movement between general and specific ideas and examples

Table C-3. ACT's College Readiness Standards — Writing (continued)

	Organizing Ideas	Using Language
3–4	Provide a discernible organization with some logical grouping of ideas in parts of the essay Use a few simple and obvious transitions Present a discernible, though minimally developed, introduction and conclusion	Show limited control of language by • correctly employing some of the conventions of standard English grammar, usage, and mechanics, but with distracting errors that sometimes significantly impede understanding • using simple vocabulary • using simple sentence structure
5–6	Provide a simple organization with logical grouping of ideas in parts of the essay Use some simple and obvious transitional words, though they may at times be inappropriate or misleading Present a discernible, though underdeveloped, introduction and conclusion	Show a basic control of language by • correctly employing some of the conventions of standard English grammar, usage, and mechanics, but with distracting errors that sometimes impede understanding • using simple but appropriate vocabulary • using a little sentence variety, though most sentences are simple in structure
7–8	Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas Use some simple and obvious, but appropriate, transitional words and phrases Present a discernible introduction and conclusion with a little development	Show adequate use of language to communicate by • correctly employing many of the conventions of standard English grammar, usage, and mechanics, but with some distracting errors that may occasionally impede understanding • using appropriate vocabulary • using some varied kinds of sentence structures to vary pace
9–10	Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas Present a somewhat developed introduction and conclusion	Show competent use of language to communicate ideas by • correctly employing most conventions of standard English grammar, usage, and mechanics, with a few distracting errors but none that impede understanding • using some precise and varied vocabulary • using several kinds of sentence structures to vary pace and to support meaning
11–12	Provide unity and coherence throughout the essay, often with a logical progression of ideas Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas Present a well-developed introduction and conclusion	Show effective use of language to clearly communicate ideas by • correctly employing most conventions of standard English grammar, usage, and mechanics, with just a few, if any, errors • using precise and varied vocabulary • using a variety of kinds of sentence structures to vary pace and to support meaning

Table C-4. ACT's College Readiness Standards — Mathematics

	Basic Operations & Applications	Probability, Statistics, & Data Analysis	Numbers: Concepts & Properties	Expressions, Equations, & Inequalities
13–15	Perform one-operation computation with whole numbers and decimals Solve problems in one or two steps using whole numbers Perform common conversions (e.g., inches to feet or hours to minutes)	Calculate the average of a list of positive whole numbers Perform a single computation using information from a table or chart	Recognize equivalent fractions and fractions in lowest terms	Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$) Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals
16–19	Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent Solve some routine two-step arithmetic problems	Calculate the average of a list of numbers Calculate the average, given the number of data values and the sum of the data values Read tables and graphs Perform computations on data from tables and graphs Use the relationship between the probability of an event and the probability of its complement	Recognize one-digit factors of a number Identify a digit's place value	Substitute whole numbers for unknown quantities to evaluate expressions Solve one-step equations having integer or decimal answers Combine like terms (e.g., $2x + 5x$)
20–23	Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average	Calculate the missing data value, given the average and all data values but one Translate from one representation of data to another (e.g., a bar graph to a circle graph) Determine the probability of a simple event Exhibit knowledge of simple counting techniques	Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor	Evaluate algebraic expressions by substituting integers for unknown quantities Add and subtract simple algebraic expressions Solve routine first-degree equations Perform straightforward word-to-symbol translations Multiply two binomials
24–27	Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)	Calculate the average, given the frequency counts of all the data values Manipulate data from tables and graphs Compute straightforward probabilities for common situations Use Venn diagrams in counting	Find and use the least common multiple Order fractions Work with numerical factors Work with scientific notation Work with squares and square roots of numbers Work problems involving positive integer exponents Work with cubes and cube roots of numbers Determine when an expression is undefined Exhibit some knowledge of the complex numbers	Solve real-world problems using first-degree equations Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions) Identify solutions to simple quadratic equations Add, subtract, and multiply polynomials Factor simple quadratics (e.g., the difference of squares and perfect square trinomials) Solve first-degree inequalities that do not require reversing the inequality sign
28–32	Solve word problems containing several rates, proportions, or percentages	Calculate or use a weighted average Interpret and use information from figures, tables, and graphs Apply counting techniques Compute a probability when the event and/or sample space are not given or obvious	Apply number properties involving prime factorization Apply number properties involving even/odd numbers and factors/multiples Apply number properties involving positive/negative numbers Apply rules of exponents Multiply two complex numbers	Manipulate expressions and equations Write expressions, equations, and inequalities for common algebra settings Solve linear inequalities that require reversing the inequality sign Solve absolute value equations Solve quadratic equations Find solutions to systems of linear equations
33–36	Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)	Distinguish between mean, median, and mode for a list of numbers Analyze and draw conclusions based on information from figures, tables, and graphs Exhibit knowledge of conditional and joint probability	Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers Exhibit knowledge of logarithms and geometric sequences Apply properties of complex numbers	Write expressions that require planning and/or manipulating to accurately model a situation Write equations and inequalities that require planning, manipulating, and/or solving Solve simple absolute value inequalities

Table C-4. ACT's College Readiness Standards — Mathematics (continued)

	Graphical Representations	Properties of Plane Figures	Measurement	Functions
13–15	Identify the location of a point with a positive coordinate on the number line		Estimate or calculate the length of a line segment based on other lengths given on a geometric figure	
16–19	Locate points on the number line and in the first quadrant	Exhibit some knowledge of the angles associated with parallel lines	Compute the perimeter of polygons when all side lengths are given Compute the area of rectangles when whole number dimensions are given	
20–23	Locate points in the coordinate plane Comprehend the concept of length on the number line Exhibit knowledge of slope	Find the measure of an angle using properties of parallel lines Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)	Compute the area and perimeter of triangles and rectangles in simple problems Use geometric formulas when all necessary information is given	Evaluate quadratic functions, expressed in function notation, at integer values
24–27	Identify the graph of a linear inequality on the number line Determine the slope of a line from points or equations Match linear graphs with their equations Find the midpoint of a line segment	Use several angle properties to find an unknown angle measure Recognize Pythagorean triples Use properties of isosceles triangles	Compute the area of triangles and rectangles when one or more additional simple steps are required Compute the area and circumference of circles after identifying necessary information Compute the perimeter of simple composite geometric figures with unknown side lengths	Evaluate polynomial functions, expressed in function notation, at integer values Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths
28–32	Interpret and use information from graphs in the coordinate plane Match number line graphs with solution sets of linear inequalities Use the distance formula Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)	Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles Use the Pythagorean theorem	Use relationships involving area, perimeter, and volume of geometric figures to compute another measure	Evaluate composite functions at integer values Apply basic trigonometric ratios to solve right-triangle problems
33–36	Match number line graphs with solution sets of simple quadratic inequalities Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$ Solve problems integrating multiple algebraic and/or geometric concepts Analyze and draw conclusions based on information from graphs in the coordinate plane	Draw conclusions based on a set of conditions Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas Use relationships among angles, arcs, and distances in a circle	Use scale factors to determine the magnitude of a size change Compute the area of composite geometric figures when planning or visualization is required	Write an expression for the composite of two simple functions Use trigonometric concepts and basic identities to solve problems Exhibit knowledge of unit circle trigonometry Match graphs of basic trigonometric functions with their equations

Table C-5. ACT's College Readiness Standards — Science

	Interpretation of Data	Scientific Investigation	Evaluation of Models, Inferences, and Experimental Results
13–15	Select a single piece of data (numerical or nonnumerical) from a simple data presentation (e.g., a table or graph with two or three variables; a food web diagram) Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels)		
16–19	Select two or more pieces of data from a simple data presentation Understand basic scientific terminology Find basic information in a brief body of text Determine how the value of one variable changes as the value of another variable changes in a simple data presentation	Understand the methods and tools used in a simple experiment	
20–23	Select data from a complex data presentation (e.g., a table or graph with more than three variables; a phase diagram) Compare or combine data from a simple data presentation (e.g., order or sum data from a table) Translate information into a table, graph, or diagram	Understand the methods and tools used in a moderately complex experiment Understand a simple experimental design Identify a control in an experiment Identify similarities and differences between experiments	Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model Identify key issues or assumptions in a model
24–27	Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table) Compare or combine data from a complex data presentation Interpolate between data points in a table or graph Determine how the value of one variable changes as the value of another variable changes in a complex data presentation Identify and/or use a simple (e.g., linear) mathematical relationship between data Analyze given information when presented with new, simple information	Understand the methods and tools used in a complex experiment Understand a complex experimental design Predict the results of an additional trial or measurement in an experiment Determine the experimental conditions that would produce specified results	Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models Determine whether given information supports or contradicts a simple hypothesis or conclusion, and why Identify strengths and weaknesses in one or more models Identify similarities and differences between models Determine which model(s) is(are) supported or weakened by new information Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion
28–32	Compare or combine data from a simple data presentation with data from a complex data presentation Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data Extrapolate from data points in a table or graph	Determine the hypothesis for an experiment Identify an alternate method for testing a hypothesis	Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model Determine whether new information supports or weakens a model, and why Use new information to make a prediction based on a model
33–36	Compare or combine data from two or more complex data presentations Analyze given information when presented with new, complex information	Understand precision and accuracy issues Predict how modifying the design or methods of an experiment will affect results Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results	Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models Determine whether given information supports or contradicts a complex hypothesis or conclusion, and why

Science College Readiness Standards are measured in the context of science topics students encounter in science courses. These topics may include:

Life Science/Biology	Physical Science/Chemistry, Physics	Earth & Space Science
• Animal behavior • Animal development and growth • Body systems • Cell structure and processes • Ecology • Evolution • Genetics • Homeostasis • Life cycles • Molecular basis of heredity • Origin of life • Photosynthesis • Plant development, growth, structure • Populations • Taxonomy	• Atomic structure • Chemical bonding, equations, nomenclature, reactions • Electrical circuits • Elements, compounds, mixtures • Force and motions • Gravitation • Heat and work • Kinetic and potential energy • Magnetism • Momentum • The Periodic Table • Properties of solutions • Sound and light • States, classes, and properties of matter • Waves	• Earthquakes and volcanoes • Earth's atmosphere • Earth's resources • Fossils and geological time • Geochemical cycles • Groundwater • Lakes, rivers, oceans • Mass movements • Plate tectonics • Rocks, minerals • Solar system • Stars, galaxies, and the universe • Water cycle • Weather and climate • Weathering and erosion

Section D: ACT's WorkKeys Skills Included in Connecticut's Curriculum Framework

Working with Charter States, national education organizations, educators, employers, and experts in employment and training requirements, ACT identified workplace skills that help individuals successfully perform a wide range of jobs. These skills form the basis of the WorkKeys assessments.

In this section (Section D), the WorkKeys Skills that are highlighted are those that are included in Connecticut's Curriculum Framework. WorkKeys Skills not highlighted are those statements that include specific content, complexity and/or proficiency level descriptions that were not described in Connecticut's Curriculum Framework.

Because Connecticut educators are the experts on the Connecticut Curriculum Framework, we would strongly encourage them to examine this document and offer their interpretations.

WorkKeys Skills

Level	Reading for Information	Applied Mathematics	Locating Information
3	Identify main ideas and clearly stated details Choose the correct meaning of a word that is clearly defined in the reading Choose the correct meaning of common, everyday and workplace words Choose when to perform each step in a short series of steps Apply instructions to a situation that is the same as the one in the reading materials	Solve problems that require a single type of mathematics operation (addition, subtraction, multiplication, and division) using whole numbers Add or subtract negative numbers Change numbers from one form to another using whole numbers, fractions, decimals, or percentages Convert simple money and time units (e.g., hours to minutes)	Find one or two pieces of information in a graphic Fill in one or two pieces of information that are missing from a graphic
4	Identify important details that may not be clearly stated Use the reading material to figure out the meaning of words that are not defined Apply instructions with several steps to a situation that is the same as the situation in the reading materials Choose what to do when changing conditions call for a different action (follow directions that include "if-then" statements)	Solve problems that require one or two operations Multiply negative numbers Calculate averages, simple ratios, simple proportions, or rates using whole numbers and decimals Add commonly known fractions, decimals, or percentages (e.g., ½, .75, 25%) Add three fractions that share a common denominator Multiply a mixed number by a whole number or decimal Put the information in the right order before performing calculations	Find several pieces of information in one or two graphics Understand how graphics are related to each other Summarize information from one or two straightforward graphics Identify trends shown in one or two straightforward graphics Compare information and trends shown in one or two straightforward graphics
5	Figure out the correct meaning of a word based on how the word is used Identify the correct meaning of an acronym that is defined in the document Identify the paraphrased definition of a technical term or jargon that is defined in the document Apply technical terms and jargon and relate them to stated situations Apply straightforward instructions to a new situation that is similar to the one described in the material Apply complex instructions that include conditionals to situations described in the materials	Decide what information, calculations, or unit conversions to use to solve the problem Look up a formula and perform single-step conversions within or between systems of measurement Calculate using mixed units (e.g., 3.5 hours and 4 hours 30 minutes) Divide negative numbers Find the best deal using one- and two-step calculations and then comparing results Calculate perimeters and areas of basic shapes (rectangles and circles) Calculate percentage discounts or markups	Sort through distracting information Summarize information from one or more detailed graphics Identify trends shown in one or more detailed or complicated graphics Compare information and trends from one or more complicated graphics
6	Identify implied details Use technical terms and jargon in new situations Figure out the less common meaning of a word based on the context Apply complicated instructions to new situations Figure out the principles behind policies, rules, and procedures Apply general principles from the materials to similar and new situations Explain the rationale behind a procedure, policy, or communication	Use fractions, negative numbers, ratios, percentages, or mixed numbers Rearrange a formula before solving a problem Use two formulas to change from one unit to another within the same system of measurement Use two formulas to change from one unit in one system of measurement to a unit in another system of measurement Find mistakes in items that belong at Levels 3, 4, and 5 Find the best deal and use the result for another calculation Find areas of basic shapes when it may be necessary to rearrange the formula, convert units of measurement in the calculations, or use the result in further calculations Find the volume of rectangular solids Calculate multiple rates	Draw conclusions based on one complicated graphic or several related graphics Apply information from one or more complicated graphics to specific situations Use the information to make decisions
7	Figure out the definitions of difficult, uncommon words based on how they are used Figure out the meaning of jargon or technical terms based on how they are used Figure out the general principles behind the policies and apply them to situations that are quite different from any described in the materials	Solve problems that include nonlinear functions and/or that involve more than one unknown Find mistakes in Level 6 items Convert between systems of measurement that involve fractions, mixed numbers, decimals, and/or percentages Calculate multiple areas and volumes of spheres, cylinders, or cones Set up and manipulate complex ratios or proportions Find the best deal when there are several choices Apply basic statistical concepts	