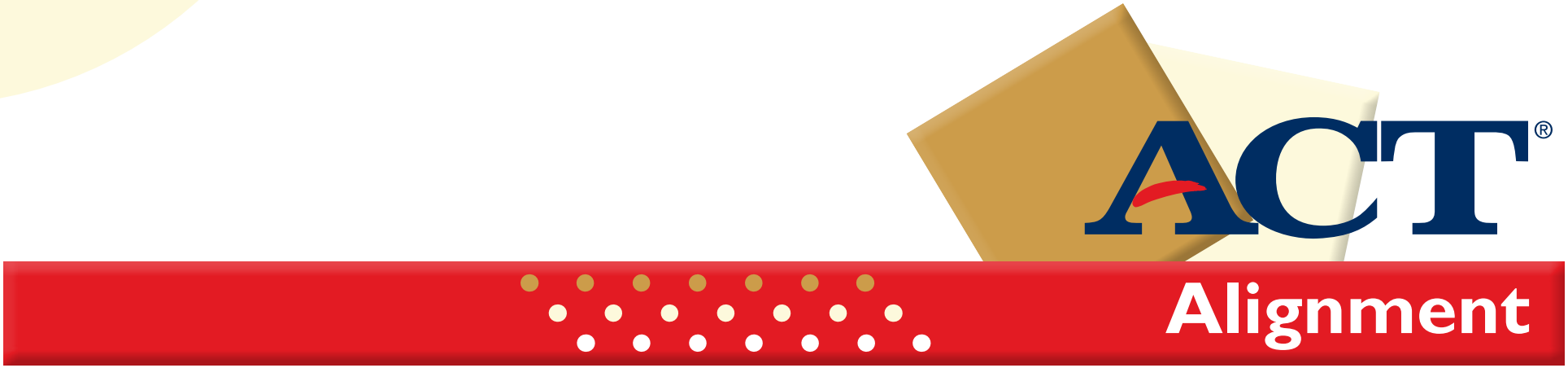
- English Language Arts
- Mathematics
- Science



Nebraska

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Executive Summary

Overview

ACT has been dedicated to improving college and career readiness for all students since its inception in 1959. ACT's renowned longitudinal programs (all leading up to the ACT® test) have been unparalleled in successfully measuring student college and career readiness and validating the assessment scores and inferences by comparing to actual student performance at the postsecondary level. The ACT is the most popular college entrance exam in the United States, and ACT's National Career Readiness Certificate using ACT WorkKeys® assessments is embraced by employers as a portable credential of workplace employability skills.

ACT's test development process extends beyond expert opinions to include ACT's rich research base on college and career, educational research, empirical analyses, and actual student performance data. Over fifty years of empirical research provides the foundation for the ACT. ACT solutions are explicitly designed to assess student progress toward college and career readiness. ACT is the only system that has longitudinal validity evidence to support this claim. Since Nebraska and ACT share the common goal of preparing students for college and career, the ACT is a strong match with Nebraska's College and Career Ready Standards for English Language Arts (ELA), mathematics, and Nebraska Science Standards.

ACT's extensive research results in an empirically based, externally validated vertical scale that measures college and career readiness in each of the content areas including English, reading, writing, mathematics, and science. ACT tests are designed to measure student preparedness to achieve their academic and workplace goals. The principal philosophical basis for this longitudinal system of tests is that preparedness is best assessed by measuring, as directly as possible, the academic skills that students will need in order to perform college-level work. Complexity is one important characteristic of such skills. Thus, ACT tests are designed to determine students' level of skill in solving problems, grasping implied meanings, drawing inferences, evaluating ideas, and making judgments.

ACT tests use a strategic domain sampling approach to ensure that each test form supports strong claims about the knowledge, skills, and abilities important for students at that level. Coherence across the trajectory is also required in order to support inferences about individual and aggregate growth. Each academic grade should not be treated in isolation from the previous. As the standards clearly illustrate, skills and understanding progress over time, which means that students must learn new material and must also apply what they have previously learned in more sophisticated ways. The ACT has a variety of scores and reporting categories that give a detailed profile, leading to instructionally actionable insights not possible with less-detailed information. Using this approach, educators can more easily identify deficits and address them.

It is important to note, however, that certain kinds of standards are not covered on ACT's assessments. Standards requiring inferences about students' abilities to collaborate, speak and listen, extend and refine a practice over time, or execute their own research are not covered by the ACT. Evidence to support such standards would best be gathered directly from activities that are not currently practical in large-scale summative test administration conditions.

Nebraska's College and Career Ready Standards are a robust framework for aligning assessments with instruction across the academic continuum, with the goal of ensuring that all students are academically on track to succeed. ACT's testing program offers an unparalleled design, built on a foundation of validity evidence, to support Nebraska students and teachers. Through ACT's data-driven, domain-sampling approach, each test targets the most important college and career readiness skills in a focused and coherent way. ACT is able to report on these skills in instructionally meaningful ways.

The empirical foundations of ACT's college and career readiness assessments

ACT's college and career readiness assessment—the ACT—is validated with empirical data about what students actually need to know and be able to do in postsecondary education after high school and how they actually perform once they get there. No other organization can make the research-driven claims that ACT can make about student readiness.

To better understand the different types of empirical research that shape the ACT assessment, the design process should be visualized as a set of "feedback loops":

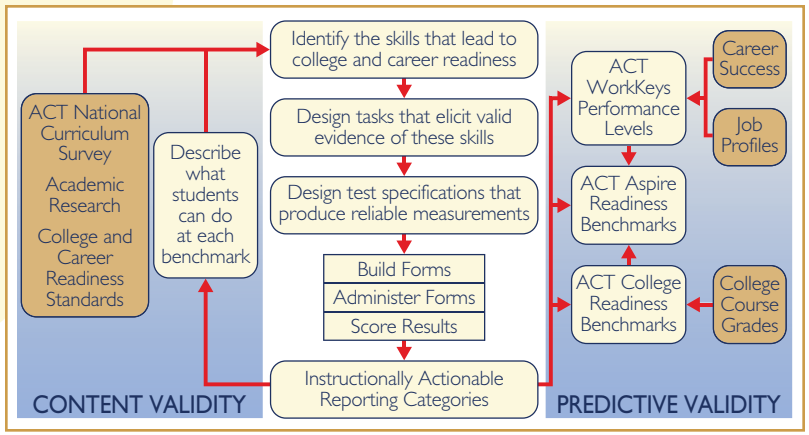

Figure 1. The Science of ACT Assessments

One source of data pictured here is ACT's National Curriculum Survey. Conducted every three to four years, it is the only survey of its kind in the United States. ACT first identifies what postsecondary faculty—including those who teach entry-level college and workforce training program courses—expect of their entering students. The survey allows ACT to determine the knowledge and skills students need to demonstrate in order to be ready for entry-level college courses. ACT then compares these postsecondary expectations to elementary, middle, and high school practice—to what's really happening in classrooms. ACT uses the results of these comparisons to guide its test blueprints and thereby determine what skills and knowledge should be measured on ACT's readiness assessments.

Additional research shapes ACT's own achievement standards, which, in turn, inform the test designs. Whereas expert judgment can vary dramatically from one expert to another, the ACT College and Career Readiness Standards have two research-based components: 1) standards that describe in detail what students should know and be able to do at different levels of ability corresponding to ACT score ranges; and 2) the progression of skills across ACT score ranges, which provide students and teachers a clear map of progress towards readiness for postsecondary opportunities. The standards are based on analysis of thousands of actual student responses across multiple test forms developed from the test blueprints. Both components work together with ACT's longitudinal data from students who continue on to college. Using this stream of data, ACT has been able to validate its own system of College and Career Readiness Standards and use the standards to give further insights about postsecondary readiness.

Student performance on the assessments is anchored by ACT's College Readiness Benchmark scores. The ACT College Readiness Benchmarks are the minimum scores required in each subject test on the ACT (English, mathematics, reading, and science) that students must achieve in order to have a high probability of success in credit-bearing, entry-level college courses in that subject area. ACT has College Readiness Benchmarks for the most commonly taken entry-level college courses (English Composition, College Algebra, introductory social science courses, and Biology) as well as for other courses (e.g., Calculus, Chemistry).

Students who meet a Benchmark on the ACT have approximately a 50-percent likelihood of earning a B or better, and approximately a 75-percent likelihood of earning a C or better, in the corresponding college course or course area, without remediation. The ACT College Readiness Benchmarks give students, parents, and counselors useful guidelines to assess whether a student has mastered the necessary skills and has a reasonable chance of success in postsecondary education.

The Benchmarks were developed, and are periodically updated, based on ACT's data about actual student performance in college. As part of its Course Placement Service, ACT provides colleges research services to help them place students in entry-level courses as accurately as possible. In providing these research services, ACT has compiled an extensive database of course-grade and test-score data from a large number of first-year college students across a wide range of U.S. postsecondary institutions. These data provide an overall measure of what it takes to be successful in selected first-year college courses. Data from 214 institutions and more than 230,000 students were used to establish the most recent iteration of the Benchmarks, which are weighted so that they are representative of two- and four-year postsecondary institutions nationwide.

Gathering data from various sources ensures that ACT's assessments, College and Career Readiness Standards, and benchmarks continue to provide up-to-date information for stakeholders at the high-school and postsecondary levels,

as well as for workforce training programs. This unique approach, refined over several years, allows ACT's assessments to align not only to the expectations of postsecondary education—including recruitment, admission, and placement—but also to the college and career readiness expectations of states and their students. For these reasons, ACT's assessments are an ideal way for states that have adopted college and career readiness standards to measure the progress of their students toward meeting high-quality state standards, regardless of the specific origin of those standards.

Nebraska's College and Career Ready Standards for English Language Arts

The section of this report containing Nebraska's College and Career Ready Standards for ELA has highlighting to illustrate alignment with the domain of the ACT ELA tests. Highlighting indicates which knowledge, skills, and abilities in the standards are assessed by the three tests that make up the ELA portion of the ACT.

The ACT English, reading, and writing tests each target vital literacy skills, but the tests are also designed to complement one another as a holistic system. This design reflects the integrated approach to English language arts and literacy exemplified by Nebraska's College and Career Ready Standards. At each grade—and across the grades—ACT's three ELA tests work together to assess the core skills in the standards that offer the strongest evidence of student progress towards key literacy benchmarks. Rich, meaningful tasks that combine reading, writing, and language skills support the focus and coherence that the standards' authors intended.

Each of the ELA tests is also designed to provide key insights about individual areas of student growth that are focal points in the Nebraska standards. Three important threads that run through the standards are 1) focus on reading closely and using evidence to understand complex texts; 2) focus on writing for a range of purposes with a variety of text types; and 3) focus on the wide range of grammar and language skills that provide a foundation for reading, writing, speaking, and listening.

The ACT ELA tests measure student ability to read complex texts closely and independently. As the highlighting in the standards indicates, the tests give students at every grade a balance of literary and informational passages on engaging topics, and questions require students to read critically and strategically in order to draw inferences. Technology-enhanced and constructed-response questions on every reading test require students to provide textual evidence to support valid inferences and synthesize information from multiple passages.

Educators know that good questions alone do not make for good language-arts tests. To fully appreciate how the ELA tests align to Nebraska standards, it is also necessary to understand ACT's approach to using high-quality, complex texts. Students grow as readers and critical thinkers when they are challenged by increasingly complex texts that prepare them for the reading they will do in college and career. ACT accounts for this dimension of progress by ensuring that all texts on the ELA tests are high quality and aligned to a scale of text complexity that is anchored at the upper end by college-level reading. Research-based methods are used to level the passages, and on the test at each grade, students demonstrate the skills and strategies in the standards by reading texts of various complexities. Based on these authentic reading tasks, ACT is able to report scores on student progress with complex texts.

ACT's ELA tests measure writing and language skills in a variety of ways to provide insight at different levels of detail. The highlighted standards in the Writing strand show that ACT targets narrative, expository, and argumentative writing by spiraling through these text types with one extended writing task at each grade. Like the standards, ACT's writing tests include narrative tasks but place more emphasis in the upper grades on informational and argumentative writing. Each writing task is scored with an analytic rubric that produces four domain scores, including a score for student control of language conventions in the Language strand of the standards.

The English and reading tests provide additional measures of the knowledge and skills in the Language strand: the English test contains real-world editing and revision tasks that allow students to show mastery of grammar and usage conventions, evaluate word choices, and make rhetorical decisions about style and tone; the reading and English tests measure vocabulary knowledge with questions that have students use context to determine meaning.

Nebraska's College and Career Ready Standards for Mathematics

The mathematics section of this report uses highlighting to show alignment with the domain of the ACT. Most topics are highlighted, meaning that those topics are in the domain and could be assessed when a student takes the test.

ACT takes a thoughtful approach to assessing college and career readiness, one that is strongly aligned with Nebraska's College and Career Ready Standards for Mathematics. The ACT assesses the important essentials of mathematics that define the college and career readiness level expected of all students, and then the ACT adds on a small component of advanced standards so that students, schools, and the state will know about science, technology, engineering, and mathematics (STEM) levels of readiness in Nebraska. As part of this assessment of readiness, the ACT reports on the important foundational skills upon which much of mathematical reasoning is based.

The approach and depth of Nebraska's College and Career Ready Standards is specified in a way new to state standards. But, we know that many good

Nebraska teachers have long been teaching to this depth for their students. ACT has worked with such teachers and understands this level of depth and rigor. ACT data includes student performances with this level of expectation.

We put all of our research and data behind the ACT, keeping it fresh and relevant, and we want this assessment to be used to help students and teachers. Alignment to Nebraska's College and Career Ready Standards is very strong. Scores are informative and, for the ACT, desired by colleges. There is a strong support network. Nebraska needs and deserves ACT quality.

Comparison of the ACT science test to Nebraska's Academic Standards for Science

When comparing the ACT science test to the Nebraska Science Standards, it is important to recognize that the Nebraska Science Standards are intended to be the basis for science curricula, while the ACT science test is part of an assessment system designed to measure college and career readiness. This document will demonstrate strong overlap between the two entities, but they are inherently different. The ACT science test is designed to give all students—those with stronger science backgrounds, those with weaker science backgrounds, and those in between—actionable measures of college and career readiness in science. Because the ACT science test measures college and career readiness in science and is not tied to any one set of standards, it can provide a reliable independent measure of how well a set of standards or curriculum framework, such as the Nebraska Science Standards, and its implementation are helping students prepare for success at the next level.

The nature of the ACT science test: What does it measure?

The ACT science test assesses and reports on science knowledge and process skills across three domains:

- Interpretation of Data
- Scientific Investigation
- Evaluation of Models, Inferences, and Experimental Results

These three domains, and the knowledge and skills encompassed in each domain, were derived from ACT's decades of empirical data and research on college and career readiness in science. The domains and their skills comprise the ACT College and Career Readiness Standards for Science, which link specific skills and knowledge with quantitatively determined score ranges for the ACT science test and a benchmark science score that is predictive of success in science at the postsecondary level. The ACT science test is built on these same skills that students need to learn early, and then continually refine, in order to be on a path to college and career readiness in science. All questions on the ACT science test are based on authentic scientific scenarios that are built around important scientific concepts and are designed to mirror the experiences of students and working scientists engaging in real science. Some of the questions require that the students have discipline-specific content knowledge (e.g., on the ACT science test, knowledge specific to an introductory high school physical science or biology course), but science content is always assessed in concert with science process. ACT's research on science curricula and instruction at the high school and postsecondary levels shows that while science content is important, science process skills are more strongly tied to college and career readiness in science. The ACT science test focuses on measuring the science skills and knowledge that are empirically tied to college and career readiness. In fact, the Nebraska Department of Education Science website (https://www.education.ne.gov/science/) specifically mentions the 2013 ACT College and Career Readiness Standards in Science as one of the resources that will be used in the standards revision process for science beginning in 2016.

How does the content of the ACT science test relate to the Nebraska Science Standards?

At all grade levels and for each of the individual courses detailed in the Nebraska Science Standards, there are benchmarks pertaining to science as inquiry (or *science practices*—those activities essential to science that span all the science disciplines), and other benchmarks that focus on discipline-specific content. The latter, though, typically involve an active process (such as investigating, analyzing, evaluating). The emphasis on science processes like inquiry, and then the integration of content and process, is central to the Nebraska Science Standards and to the ACT science test.

On the ACT science test, students must apply important science skills, such as data analysis and inquiry, to authentic, content-rich scenarios. While the ACT science test does not focus on recall of science content knowledge, students who bring fundamental science content to the test will be more readily able to navigate the scientific data, investigations, and debates in which science college and career readiness skills are assessed. The ACT science test assesses scientific inquiry—from how data should be gathered, to how the data can be interpreted, and how interpretations can be evaluated and debated—in ways that are empirically predictive of college and career readiness. This aligns well with the statement from the Sample K–12 Science Curriculum 2011, https://www.education.ne.gov/science/Documents/2011%20Sample%20K-12.pdf: "Science literacy is necessary for all citizens to make choices in everyday life, to participate in public discussions, to function in today's work force, and to enjoy the natural world."

Nebraska's College and Career Ready Standards for English Language Arts alignment with ACT's ELA Tests

Nebraska's College and Career Ready Standards for English Language Arts, reproduced in the following section, have highlighting to illustrate alignment with the domain of the ACT ELA tests. Highlighting indicates which knowledge, skills, and abilities in the standards are assessed by the three tests that comprise the ELA portion of the ACT.

ACT reporting categories for skills that align to the standard are listed at the end of each standard. Codes are provided for standards; all statements listed below the standard level are covered by the reporting categories aligned to the superordinate standard.

Key:

- Reading — R
  - Key Ideas and Details — KID
  - Craft and Structure — CS
  - Integration of Knowledge and Ideas — IKI
  - Progress with Text Complexity — PTC
  - Understanding Complex Texts Progress Indicator — UCT
- English — E
  - Production of Writing — POW
  - Knowledge of Language — KLA
  - Conventions of Standard English — CSE
- Writing — W
  - Ideas and Analysis — IA
  - Development and Support — DS
  - Organization — ORG
  - Language Use and Conventions — LUC

Example:

Key Ideas and Details

LA 12.1.6 Comprehension

Students will construct meaning by applying prior knowledge, using text information, and monitoring comprehension while reading increasingly complex grade-level literary and informational text. (R: KID, CS, IKI, UCT)

LA 12.1 Reading

Students will learn and apply reading skills and strategies to comprehend text.

LA 12.1.1 Concepts of Print

Students will demonstrate knowledge of the concepts of print.
Mastered in Grade 1 and blended with other skills at this grade level.

LA 12.1.2 Phonological Awareness

Students will demonstrate phonological awareness through oral activities.
Mastered in Grade 1 and blended with other skills at this grade level.

LA 12.1.3 Word Analysis

Students will use phonetic analysis to read and write grade-level text.

LA 12.1.3.a Know and apply phonetic and structural analysis (e.g., Greek and Latin roots and affixes, multisyllabic words) when reading, writing, and spelling grade-level text.

LA 12.1.4 Fluency

Students will develop accuracy, phrasing, and expression while reading a variety of grade-level print/digital text to support comprehension.

LA 12.1.4.a Adjust reading strategies to persevere through text of increasing length and/or complexity.

LA 12.1.5 Vocabulary

Students will build and use conversational, academic, and content-specific grade-level vocabulary. **(E: KLA) (R: CS) (W: LUC)**

LA 12.1.5.a Apply word analysis strategies to determine the meaning of unknown and multiple-meaning words across content areas to aid in comprehension and improve writing.

LA 12.1.5.b *Skills blended with 10.1.5.a at this level.*

LA 12.1.5.c Acquire new academic and content-specific grade-level vocabulary, relate to prior knowledge, and apply in new situations.

LA 12.1.5.d Use semantic relationships (e.g., figurative language, connotations, technical and multiple-meaning words, and key terms or phrases) to analyze the impact of specific word choices on meaning and tone, aid in comprehension, and improve writing.

LA 12.1.5.e Verify meaning and pronunciation of words or phrases using print and/or digital reference materials when appropriate.

LA 12.1.6 Comprehension

Students will construct meaning by applying prior knowledge, using text information, and monitoring comprehension while reading increasingly complex grade-level literary and informational text. **(R: KID, CS, IKI, UCT)**

LA 12.1.6.a Evaluate the meaning, reliability, and validity of text considering author's purpose, perspective, rhetorical style, and contextual influences.

LA 12.1.6.b Analyze and evaluate the relationships between elements of literary text (e.g., characterization, setting, plot development, internal and external conflict, inferred and recurring themes, point of view, tone, mood).

LA 12.1.6.c Analyze the function and critique the effects of the author's use of literary devices (e.g., allusion, symbolism, metaphor, personification, epiphany, oxymoron, dialect, tone, mood).

LA 12.1.6.d Summarize, analyze, and synthesize the themes and main ideas between multiple literary and informational works (print, digital, and/or other media).

LA 12.1.6.e *Skills blended with 12.1.6.d at this level.*

LA 12.1.6.f Interpret and evaluate information from print and digital text features to support comprehension.

LA 12.1.6.g Cite specific textual evidence to analyze and evaluate the effects of historical, cultural, biographical, and political influences of literary and informational text written by culturally diverse authors, to develop a regional, national, and international multicultural perspective.

LA 12.1.6.h *Skills blended with 12.1.6.g at this level.*

LA 12.1.6.i Construct and/or answer literal, inferential, critical, and interpretive questions, analyzing and synthesizing evidence from the text and additional sources to support answers.

LA 12.1.6.j Apply knowledge of organizational patterns to comprehend informational text (e.g., sequence, description, cause and effect, compare/contrast, fact/opinion, proposition/support, concept definition, question/answer).

LA 12.1.6.k Select text for a particular purpose (e.g., answer a question, solve problems, enjoy, form an opinion, understand a specific viewpoint, predict outcomes, discover models for own writing, accomplish a task), citing evidence to support analysis, reflection, or research.

LA 12.1.6.l Build background knowledge and activate prior knowledge to clarify text, deepen understanding, and make connections while reading complex text.

LA 12.1.6.m Self-monitor comprehension and independently apply appropriate strategies to understand complex text.

LA 12.1.6.n Formulate and justify inferences with text evidence while previewing, reading, and analyzing literary and informational text in various formats.

LA 12.1.6.o Demonstrate an understanding of complex text by using textual evidence to support analysis, reflection, and research via multiple mediums (e.g., writing, artistic representation, video, other media).

LA 12.1.6.p Analyze multiple interpretations of a story, drama, or poem (e.g., recorded or live production of a play or recorded novel or poetry), evaluating how each version interprets the source text.

LA 12.2 Writing

Students will learn and apply writing skills and strategies to communicate.

LA 12.2.1 Writing Process

Students will apply the writing process to plan, draft, revise, edit, and publish writing using correct spelling, grammar, punctuation, and other conventions of standard English appropriate for grade-level. **(W: IA, DS, ORG, LUC) (E: POW, KLA, CSE)**

- LA 12.2.1.a Use multiple writing strategies recursively to investigate and generate ideas, organize information, guide writing, answer questions, and synthesize information.
- LA 12.2.1.b Generate a draft that interprets complex ideas, raises relevant questions, solves problems, or evaluates ideas through synthesis, analysis, reflection, and use of effective organizational patterns that are appropriate to the purpose and intended audience.
- LA 12.2.1.c Gather and use relevant information and evidence from multiple authoritative print and/or digital sources including primary and secondary sources to support claims or theses.
- LA 12.2.1.d Apply standard rules of grammar and paragraph formation, including parallel structure and subordination.
- LA 12.2.1.e Revise to improve and clarify writing through self-monitoring strategies and feedback from others.
- LA 12.2.1.f Provide oral, written, and/or digital descriptive feedback to other writers.
- LA 12.2.1.g Adjust writing processes to persevere in short and long-term writing tasks of increasing length and complexity.
- LA 12.2.1.h Proofread and edit writing recursively for format and conventions of standard English (e.g., spelling, capitalization, grammar, punctuation, syntax, semantics).
- LA 12.2.1.i Display academic honesty and integrity by avoiding plagiarism and/or overreliance on any one source and by following a standard format for citation.
- LA 12.2.1.j Publish a legible document using a variety of media, and apply various formatting techniques to enhance the readability and impact of the document (e.g., fonts, spacing, design, images, style conventions, citations, and manuscript requirements).

LA 12.2.2 Writing Modes

Students will write in multiple modes for a variety of purposes and audiences across disciplines. **(W: IA, DS, ORG) (E: POW, KLA) (R: KID, CS, IKI)**

- LA 12.2.2.a Communicate information and ideas effectively in analytic, argumentative, descriptive, informative, narrative, poetic, persuasive, and reflective modes to multiple audiences using a variety of media and formats.
- LA 12.2.2.b Provide evidence from literary or informational text to support analysis, reflection, and research.
- LA 12.2.2.c Conduct and publish both short and sustained research projects to answer questions or solve problems using multiple primary and/or secondary sources to support theses.
- LA 12.2.2.d Use precise word choice and domain-specific vocabulary to write in a variety of modes.
- LA 12.2.2.e Analyze various mentor texts and/or exemplars in order to create a similar piece.

LA 12.3 Speaking and Listening

Students will develop and apply speaking and listening skills and strategies to communicate for a variety of purposes.

The standards for Speaking and Listening are not currently measured by ACT assessments.

LA 12.4 Multiple Literacies

Students will apply information fluency and practice digital citizenship.

LA 12.4.1 Information Fluency

Students will evaluate, create, and communicate information in a variety of media and formats (textual, visual, and digital). **(R: KID, CS, IKI) (W: IA, DS, ORG)**

- LA 12.4.1.a Locate, organize, analyze, evaluate, and synthesize information from print and digital resources to create new understandings and defend conclusions.
- LA 12.4.1.b Demonstrate ethical use of information and copyright guidelines by appropriately quoting or paraphrasing from a text and citing the source using available resources (e.g., online citation tools, publication guidelines).
- LA 12.4.1.c Use or decipher multiple formats of print and digital text (e.g., cursive, manuscript, font, graphics, symbols).

LA 12.4.2 Digital Citizenship

Students will practice the norms of appropriate and responsible technology use.

- LA 12.4.2.a Practice safe and ethical behaviors when communicating and interacting with others digitally (e.g., safe information to share, appropriate language use, utilize appropriate sites and materials, respect diverse perspectives).
- LA 12.4.2.b Use appropriate digital tools (e.g., social media, online collaborative tools, apps) to communicate with others for conveying information, gathering opinions, and solving problems.

Nebraska's College and Career Ready Standards for Mathematics alignment with ACT's Mathematics Test

This section has highlighting to show alignment with the domains of the ACT. Most topics are highlighted, meaning that those topics are in the domain and could be assessed when a student takes the test. This domain-centered way of thinking about alignment is better than looking at what is represented on a single test, which is only a sample from the domain. Each test includes a variety of topics, with broad representation in order to capture reliable information that drives valid inference. But each test will have a somewhat different mix of topics. Those who teach and plan curriculum would be misled by looking only at individual tests when judging the preparation students need.

Saying that a topic is assessed means that a student with understanding of the topic, and with skills associated with that topic, will be more likely to answer questions correctly compared to a student without those understandings and skills, and will therefore be more likely to get a higher score.

Nebraska Mathematical Processes

1. **Solves mathematical problems.**

   Through the use of appropriate academic and technical tools, students will make sense of mathematical problems and persevere in solving them. Students will draw upon their prior knowledge in order to employ critical thinking skills, reasoning skills, creativity, and innovative ability. Additionally, students will compute accurately and determine the reasonableness of solutions.

2. **Models and represents mathematical problems.**

   Students will analyze relationships in order to create mathematical models given a real-world situation or scenario. Conversely, students will describe situations or scenarios given a mathematical model.

3. **Communicates mathematical ideas effectively.**

   Students will communicate mathematical ideas effectively and precisely. Students will critique the reasoning of others as well as provide mathematical justifications. Students will utilize appropriate communication approaches individually and collectively and through multiple methods, including writing, speaking, and listening.

4. **Makes mathematical connections.**

   Students will connect mathematical knowledge, ideas, and skills beyond the math classroom. This includes the connection of mathematical ideas to other topics within mathematics and to other content areas. Additionally, students will be able to describe the connection of mathematical knowledge and skills to their career interest as well as within authentic/real-world contexts.

MA 11.1 Number

Students will communicate number sense concepts using multiple representations to reason, solve problems, and make connections within mathematics and across disciplines.

MA.11.1.1 Numeric Relationships

Students will demonstrate, represent, and show relationships among the subsets of real numbers and the complex number system.

- MA 11.1.1.a Compare and contrast subsets of the complex number system, including imaginary, rational, irrational, integers, whole, and natural numbers.
- MA 11.1.1.b Recognize that closure properties apply to the subsets of the complex number system, under the standard operations.
- MA 11.1.1.c Use drawings, words, and symbols to explain the effects of operations such as multiplication and division on the magnitude of quantities in the real number system, including powers and roots (e.g., if you take the square root of a number, will the result always be smaller than the original number?).

MA 11.1.2 Operations

Students will compute with real and complex numbers.

- MA 11.1.2.a Compute with subsets of the complex number system, including imaginary, rational, irrational, integers, whole, and natural numbers.
- MA 11.1.2.b Simplify expressions with rational exponents.
- MA 11.1.2.c Select, apply, and explain the method of computation when problem solving using real numbers (e.g., models, mental computation, paper-pencil, or technology).
- MA 11.1.2.d Use estimation methods to check the reasonableness of real number computations and decide if the problem calls for an approximation (including appropriate rounding) or an exact number.

MA 11.2 Algebra

Students will communicate algebraic concepts using multiple representations to reason, solve problems, and make connections within mathematics and across disciplines.

MA 11.2.1 Algebraic Relationships

Students will demonstrate, represent, and show relationships with functions.

- MA 11.2.1.a Define a function and use function notation.
- MA 11.2.1.b Analyze a relation to determine if it is a function given graphs, tables, or algebraic notation.
- MA 11.2.1.c Classify a function given graphs, tables, or algebraic notation, as linear, quadratic, or neither.
- MA 11.2.1.d Identify domain and range of functions represented in either algebraic or graphical form.
- MA 11.2.1.e Analyze and graph linear functions and inequalities (point-slope form, slope-intercept form, standard form, intercepts, rate of change, parallel and perpendicular lines, vertical and horizontal lines, and inequalities).
- MA 11.2.1.f Analyze and graph absolute value functions (finding the vertex, symmetry, transformations, determine intercepts, and minimums or maximums using the piecewise definition).
- MA 11.2.1.g Analyze and graph quadratic functions (standard form, vertex form, finding zeros, symmetry, transformations, determine intercepts, and minimums or maximums).
- MA 11.2.1.h Represent, interpret, and analyze inverses of functions algebraically and graphically.

MA 11.2.2 Algebraic Processes

Students will apply the operational properties when evaluating rational expressions, and solving linear and quadratic equations, and inequalities.

- MA 11.2.2.a Convert equivalent rates (e.g., miles per hour to feet per second).
- MA 11.2.2.b Identify and explain the properties used in solving equations and inequalities.
- MA 11.2.2.c Simplify algebraic expressions involving integer and fractional exponents.
- MA 11.2.2.d Perform operations on rational expressions (add, subtract, multiply, divide, and simplify).
- MA 11.2.2.e Evaluate expressions at specified values of their variables (polynomial, rational, radical, and absolute value).
- MA 11.2.2.f Solve an equation involving several variables for one variable in terms of the others.
- MA 11.2.2.g Solve linear and absolute value equations and inequalities.
- MA 11.2.2.h Analyze and solve systems of two linear equations and inequalities in two variables algebraically and graphically.
- MA 11.2.2.i Perform operations (addition subtraction, multiplication, and division) on polynomials.
- MA 11.2.2.j Factor polynomials to include factoring out monomial terms and factoring quadratic expressions.
- MA 11.2.2 k Recognize polynomial multiplication patterns and their related factoring patterns (e.g., $(a + b)^2 = a^2 + 2ab + b^2$, $a^2 - b^2 = (a + b)(a - b)$).

MA 11.2 Algebra *(continued)*

MA 11.2.2.l Make the connection between the factors of a polynomial and the zeros of a polynomial.

MA 11.2.2.m Combine functions by composition and perform operations (addition, subtraction, multiplication, division) on functions.

MA 11.2.2.n Solve quadratic equations involving real coefficients and real or imaginary roots.

MA 11.2.3 Applications

Students will solve real-world problems involving linear equations and inequalities, systems of linear equations, quadratic, exponential, square root, and absolute value functions.

MA 11.2.3.a Analyze, model, and solve real-world problems using various representations (graphs, tables, linear equations and inequalities, systems of linear equations, quadratic, exponential, square root, and absolute value functions).

MA 11.3 Geometry

Students will communicate geometric concepts and measurement concepts using multiple representations to reason, solve problems, and make connections within mathematics and across disciplines.

MA 11.3.1 Characteristics

Students will identify and describe geometric characteristics and create two- and three-dimensional shapes.

MA 11.3.1.a Know and use precise definitions of ray, line segment, angle, perpendicular lines, parallel lines, and congruence based on the undefined terms of geometry: point, line and plane.

MA 11.3.1.b Prove geometric theorems about angles, triangles, congruent triangles, similar triangles, parallel lines with transversals, and quadrilaterals using deductive reasoning.

MA 11.3.1.c Apply geometric properties to solve problems involving similar triangles, congruent triangles, quadrilaterals, and other polygons.

MA 11.3.1.d Identify and apply right triangle relationships including sine, cosine, tangent, special right triangles, and the converse of the Pythagorean Theorem.

MA 11.3.1.e Create geometric models to visualize, describe, and solve problems using similar triangles, right triangles, and trigonometry.

MA 11.3.1.f Know and use precise definitions and terminology of circles, including central angle, inscribed angle, arc, intercepted arc, chord, secant, and tangent.

MA 11.3.1.g Apply the properties of central angles, inscribed angles, angles formed by intersecting chords, and angles formed by secants and/or tangents to find the measures of angles related to the circle.

MA 11.3.1.h Sketch, draw, and construct appropriate representations of geometric objects using a variety of tools and methods which may include ruler/straight edge, protractor, compass, reflective devices, paper folding, or dynamic geometric software.

MA 11.3.2 Coordinate Geometry

Students will determine location, orientation, and relationships on the coordinate plane.

MA 11.3.2.a Derive and apply the midpoint formula.

MA 11.3.2.b Use coordinate geometry to analyze linear relationships to determine if lines are parallel or perpendicular.

MA 11.3.2.c Given a line, write the equation of a line that is parallel or perpendicular to it.

MA 11.3.2.d Derive and apply the distance formula.

MA 11.3.2.e Use coordinate geometry to prove triangles are right, acute, obtuse, isosceles, equilateral, or scalene.

MA 11.3.2.f Use coordinate geometry to prove quadrilaterals are trapezoids, isosceles trapezoids, parallelograms, rectangles, rhombi, kites, or squares.

MA 11.3.2.g Perform and describe positions and orientation of shapes under a single translation using algebraic notation on a coordinate plane.

MA 11.3.2.h Perform and describe positions and orientation of shapes under a rotation about the origin in multiples of 90 degrees using algebraic notation on a coordinate plane.

MA 11.3.2.i Perform and describe positions and orientation of shapes under a reflection across a line using algebraic notation on a coordinate plane.

MA 11.3.2.j Perform and describe positions and orientation of shapes under a single dilation on a coordinate plane.

MA 11.3.2.k Derive the equation of a circle given the radius and the center.

MA 11.3.3 Measurement

Students will perform and compare measurements and apply formulas.

MA 11.3.3.a Convert between various units of length, area, and volume (e.g., such as square feet to square yards).

MA 11.3.3.b Convert between metric and standard units of measurement.

MA 11.3.3.c Apply the effect of a scale factor to determine the length, area, and volume of similar two- and three-dimensional shapes and solids.

MA 11.3.3.d Find arc length and area of sectors of a circle.

MA 11.3.3.e Determine surface area and volume of spheres, cones, pyramids, and prisms using formulas and appropriate units.

MA 11.4 Data

Students will communicate data analysis/probability concepts using multiple representations to reason, solve problems, and make connections within mathematics and across disciplines.

MA 11.4.1 Representations

Students will create displays that represent data.

No additional indicator(s) at this level. Mastery is expected at previous grade levels.

MA 11.4.2 Analysis & Applications

Students will analyze data to address the situation.

- MA 11.4.2.a Identify and compute measures of central tendency (mean, median, mode) when provided data both with and without technology.
- MA 11.4.2.b Explain how transformations of data, including outliers, affect measures of central tendency.
- MA 11.4.2.c Compare data sets and formulate conclusions.
- MA 11.4.2.d Support conclusions with valid arguments.
- MA 11.4.2.e Develop linear equations for linear models to predict unobserved outcomes using the regression line and correlation coefficient with technology.
- MA 11.4.2.f Describe the shape, identify any outliers, and determine the spread of a data set.
- MA 11.4.2.g Explain the impact of sampling methods, bias, and the phrasing of questions asked during data collection, and the conclusions that can rightfully be made.
- MA 11.4.2.h Explain the differences between a randomized experiment and observational studies.
- MA 11.4.2.i Using scatter plots, analyze patterns and describe relationships in paired data.
- MA 11.4.2.j Recognize when arguments based on data confuse correlation with causation.
- MA 11.4.2.k Interpret data represented by the normal distribution, formulate conclusions, and recognize that some data sets are not normally distributed.

MA 11.4.3 Probability

Students will interpret and apply concepts of probability.

- MA 11.4.3.a Construct sample spaces and probability distributions.
- MA 11.4.3.b Use appropriate counting techniques to determine the probability of an event.
- MA 11.4.3.c Determine if events are mutually exclusive and calculate their probabilities in either case.

Nebraska Science Standards alignment with ACT's Science Test

Methods used for comparing the Nebraska Science Standards to the ACT science test

Alignment is indicated in two ways—highlighting and underlining. Highlighting indicates direct alignment of the Nebraska Science Standards benchmark (or part of the benchmark) to the ACT science test. Underlining indicates that there is alignment, but that the alignment is not as direct. An example of where underlining is more appropriate than highlighting is a benchmark that is purely based on discipline-specific science content knowledge. We indicate alignment because the ACT science test is built on important and fundamental science content and because students do need science content knowledge to answer some questions on the test. We also indicate alignment because our research consistently links taking rigorous core science courses to success on our science tests, and it also shows that those courses focus heavily on discipline-specific science content knowledge. Lastly, the test is very rich in science content and those students with a clearer grasp of fundamental discipline-specific content can much more readily navigate the scientific scenarios and questions. The alignment, though, is not considered direct because (as discussed earlier) the focus of the assessments is on science process and because students do not receive a specific score or indicator regarding any particular subject in science (e.g., a biology score or a chemistry score). For benchmarks that involve aspects that fully and partially align, there is a mix of highlighting and underlining. Here are three examples showing different degrees of alignment.

> Formulate a testable hypothesis supported by prior knowledge to guide an investigation
>
> (12.1.1.a)

> Identify the complex molecules (carbohydrates, lipids, proteins, nucleic acids) that make up living organisms
>
> (12.3.1.a)

> Students will investigate and describe matter in terms of its structure, composition and conservation.
>
> (12.2.1)

In the first case, the complete benchmark is highlighted because it represents a process skill that is directly measured on the tests and it matches skills that are part of the ACT reporting category *Scientific Investigation*. In the second case, the benchmark is underlined because it is solely representing discipline-specific science content knowledge, which aligns with science content presented on the ACT science test, but is not highlighted because it is not directly measured by the test and is not reported on (i.e., students don't receive a biology score). In the third case, the entire benchmark is matched because it aligns to the ACT science test, but only the part of the benchmark that is directly assessed (which is a science process skill) is highlighted, while the rest of the benchmark (which has discipline-specific content) is underlined.

Other aspects related to science and that involve science process, but are not assessed on the ACT science test, involve value judgments, such as cost, ethics, and diversity. These are important ways in which science is embedded in our society, but involve opinion, perspective, and other aspects that may not have clear-cut answers, and thus, are not appropriate for a large-scale, national science assessment.

SC 1: Inquiry, the Nature of Science, and Technology

Students will combine scientific processes and knowledge with scientific reasoning and critical thinking to ask questions about phenomena and propose explanations based on gathered evidence.

1.1. Abilities to do Scientific Inquiry

12.1.1 Students will design and conduct investigations that lead to the use of logic and evidence in the formulation of scientific explanations and models.

Scientific Questioning

12.1.1.a Formulate a testable hypothesis supported by prior knowledge to guide an investigation

Scientific Investigations

12.1.1.b Design and conduct logical and sequential scientific investigations with repeated trials and apply findings to new investigations

Scientific Controls and Variables

12.1.1.c Identify and manage variables and constraints

Scientific Tools

12.1.1.d Select and use lab equipment and technology appropriately and accurately

Scientific Observations

12.1.1.e Use tools and technology to make detailed qualitative and quantitative observations

Scientific Data Collection

12.1.1.f Represent and review collected data in a systematic, accurate, and objective manner

Scientific Interpretations, Reflections, and Applications

12.1.1.g Analyze and interpret data, synthesize ideas, formulate and evaluate models, and clarify concepts and explanations

12.1.1.h Use results to verify or refute a hypothesis

12.1.1.i Propose and/or evaluate possible revisions and alternate explanations

Scientific Communication

12.1.1.j Share information, procedures, results, conclusions, and defend findings to a scientific community (peers, science fair audience, policy makers)

12.1.1.k Evaluate scientific investigations and offer revisions and new ideas as appropriate

Mathematics

12.1.1.l Use appropriate mathematics in all aspects of scientific inquiry

1.2. Nature of Science

12.1.2 Students will apply the nature of scientific knowledge to their own investigations and in the evaluation of scientific explanations.

Scientific Knowledge

12.1.2.a Recognize that scientific explanations must be open to questions, possible modifications, and must be based upon historical and current scientific knowledge

Science and Society

12.1.2.b Describe how society influences the work of scientists and how science, technology, and current scientific discoveries influence and change society

Science as a Human Endeavor

12.1.2.c Recognize that the work of science results in incremental advances, almost always building on prior knowledge, in our understanding of the world

12.1.2.d Research and describe the difficulties experienced by scientific innovators who had to overcome commonly held beliefs of their times to reach conclusions that we now take for granted

1.3. Technology

12.1.3 Students will solve a complex design problem.

Abilities to do Technical Design

12.1.3.a Propose designs and choose between alternative solutions of a problem

12.1.3.b Assess the limits of a technical design

12.1.3.c Implement the selected solution

12.1.3.d Evaluate the solution and its consequences

12.1.3.e Communicate the problem, process, and solution

Understanding of Technical Design

12.1.3.f Compare and contrast the reasons for the pursuit of science and the pursuit of technology

12.1.3.g Explain how science advances with the introduction of new technology

12.1.3.h Recognize creativity, imagination, and a good knowledge base are all needed to advance the work of science and engineering

SC 2: Physical Science

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.

2.1. Matter

12.2.1 Students will investigate and describe matter in terms of its structure, composition and conservation.

Properties and Structure of Matter

12.2.1.a Recognize bonding occurs when outer electrons are transferred (ionic) or shared (covalent)

States of Matter

12.2.1.b Describe the energy transfer associated with phase changes between solids, liquids, and gases

12.2.1.c Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle arrangement, particle motion, and strength of bond between molecules

Physical and Chemical Changes

12.2.1.d Recognize a large number of chemical reactions involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base) between reacting ions, molecules, or atoms

12.2.1.e Identify factors affecting rates of chemical reactions (temperature, particle size, surface area)

Atomic Structure

12.2.1.f Recognize the charges and relative locations of subatomic particles (neutrons, protons, electrons)

12.2.1.g Describe properties of atoms, ions, and isotopes

Classification of Matter

12.2.1.h Describe the organization of the periodic table of elements with respect to patterns of physical and chemical properties

2.2. Force and Motion

12.2.2 Students will investigate and describe the nature of field forces and their interactions with matter.

Motion

12.2.2.a Describe motion with respect to displacement and acceleration

Inertia/Newton's 1st Law

12.2.2.b Describe how the law of inertia (Newton's 1st law) is evident in a real-world event

Forces/Newton's 2nd Law

12.2.2.c Make predictions based on relationships among net force, mass, and acceleration (Newton's 2nd law)

Newton's 3rd Law

12.2.2.d Recognize that all forces occur in equal and opposite pairs (Newton's 3rd law)

12.2.2.e Describe how Newton's 3rd law of motion is evident in a real-world event

Universal Forces

12.2.2.f Describe gravity as a force that each mass exerts on another mass, which is proportional to the masses and the distance between them

12.2.2.g Recognize that an attractive or repulsive electric force exists between two charged particles and that this force is proportional to the magnitude of the charges and the distance between them

2.3. Energy

12.2.3 Students will describe and investigate energy systems relating to the conservation and interaction of energy and matter.

Sound/Mechanical Waves

12.2.3.a Describe mechanical wave properties (speed, wavelength, frequency, amplitude) and how waves travel through a medium

12.2.3.b Recognize that the energy in waves can be changed into other forms of energy

Light

12.2.3.c Recognize that light can behave as a wave (diffraction and interference)

Heat

12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)

12.2.3.e Compare and contrast methods of heat transfer and the interaction of heat with matter via conduction, convection, and radiation

Electricity/Magnetism

12.2.3.f Recognize that the production of electromagnetic waves is a result of changes in the motion of charges or by a changing magnetic field

12.2.3.g Compare and contrast segments of the electromagnetic spectrum (radio, micro, infrared, visible, ultraviolet, x-rays, gamma) based on frequency and wavelength

SC 2: Physical Science *(continued)*

Nuclear

12.2.3.h Recognize that nuclear reactions (fission, fusion, radioactive decay) convert a fraction of the mass of interacting particles into energy, and this amount of energy is much greater than the energy in chemical interactions

Conservation

12.2.3.i Interpret the law of conservation of energy to make predictions for the outcome of an event

Mechanical Energy

12.2.3.j Identify that all energy can be considered to be either kinetic, potential, or energy contained by a field (e.g., electromagnetic waves)

Chemical Energy

12.2.3.k Identify endothermic and exothermic reactions

SC 3: Life Science

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Life Sciences to make connections with the natural and engineered world.

3.1. Structure and Function of Living Systems

12.3.1 Students will investigate and describe the chemical basis of the growth, development, and maintenance of cells.

Characteristics of Life

12.3.1.a Identify the complex molecules (carbohydrates, lipids, proteins, nucleic acids) that make up living organisms

Cellular Composition of Organisms

12.3.1.b Identify the form and function of sub-cellular structures that regulate cellular activities

12.3.1.c Describe the cellular functions of photosynthesis, respiration, cell division, protein synthesis, transport of materials, and energy capture/release

Behavior

12.3.1.d Describe how an organism senses changes in its internal or external environment and responds to ensure survival

3.2. Heredity

12.3.2 Students will describe the molecular basis of reproduction and heredity.

Inherited Traits

12.3.2.a Identify that information passed from parents to offspring is coded in DNA molecules

12.3.2.b Describe the basic structure of DNA and its function in genetic inheritance

12.3.2.c Recognize how mutations could help, harm, or have no effect on individual organisms

Reproduction

12.3.2.d Describe that sexual reproduction results in a largely predictable, variety of possible gene combinations in the offspring of any two parents

3.3. Flow of Matter and Energy in Ecosystems

12.3.3 Students will describe, on a molecular level, the cycling of matter and the flow of energy between organisms and their environment.

Flow of Energy

12.3.3.a Explain how the stability of an ecosystem is increased by biological diversity

Ecosystems

12.3.3.b Recognize that atoms and molecules cycle among living and nonliving components of the biosphere

12.3.3.c Explain how distribution and abundance of different organisms in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials

Impact on Ecosystems

12.3.3.d Analyze factors which may influence environmental quality

3.4. Biodiversity

12.3.4 Students will describe the theory of biological evolution.

Biological Adaptations

12.3.4.a Identify different types of adaptations necessary for survival (morphological, physiological, behavioral)

Biological Evolution

12.3.4.b Recognize that the concept of biological evolution is a theory which explains the consequence of the interactions of: (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring

12.3.4.c Explain how natural selection provides a scientific explanation of the fossil record and the molecular similarities among the diverse species of living organisms

12.3.4.d Apply the theory of biological evolution to explain diversity of life over time

SC 4: Earth and Space Sciences

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of Earth and Space Sciences to make connections with the natural and engineered world.

4.1. Earth in Space

12.4.1 Students will investigate and describe the known universe.

Objects in the Sky and Universe

12.4.1.a Describe the formation of the universe using the Big Bang Theory

12.4.1.b Recognize that stars, like the Sun, transform matter into energy by nuclear reactions which leads to the formation of other elements

12.4.1.c Describe stellar evolution

4.2. Earth Structures and Processes

12.4.2 Students will investigate the relationships among Earth's structure, systems, and processes.

Properties of Earth Materials

12.4.2.a Recognize how Earth materials move through geochemical cycles (carbon, nitrogen, oxygen) resulting in chemical and physical changes in matter

Earth's Processes

12.4.2.b Describe how heat convection in the mantle propels the plates comprising Earth's surface across the face of the globe (plate tectonics)

Use of Earth Materials

12.4.2.c Evaluate the impact of human activity and natural causes on Earth's resources (groundwater, rivers, land, fossil fuels)

4.3. Energy in Earth's Systems

12.4.3 Students will investigate and describe the relationships among the sources of energy and their effects on Earth's systems.

Energy Sources

12.4.3.a Describe how radiation, conduction, and convection transfer heat in Earth's systems

12.4.3.b Identify internal and external sources of heat energy in Earth's systems

12.4.3.c Compare and contrast benefits of renewable and nonrenewable energy sources

Weather and Climate

12.4.3.d Describe natural influences (Earth's rotation, mountain ranges, oceans, differential heating) on global climate

4.4. Earth's History

12.4.4 Students will explain the history and evolution of Earth.

Past/Present Earth

12.4.4.a Recognize that in any sequence of sediments or rocks that has not been overturned, the youngest sediments or rocks are at the top of the sequence and the oldest are at the bottom (law of superposition)

12.4.4.b Interpret Earth's history by observing rock sequences, using fossils to correlate the sequences at various locations, and using data from radioactive dating methods

12.4.4.c Compare and contrast the physical and biological differences of the early Earth with the planet we live on today