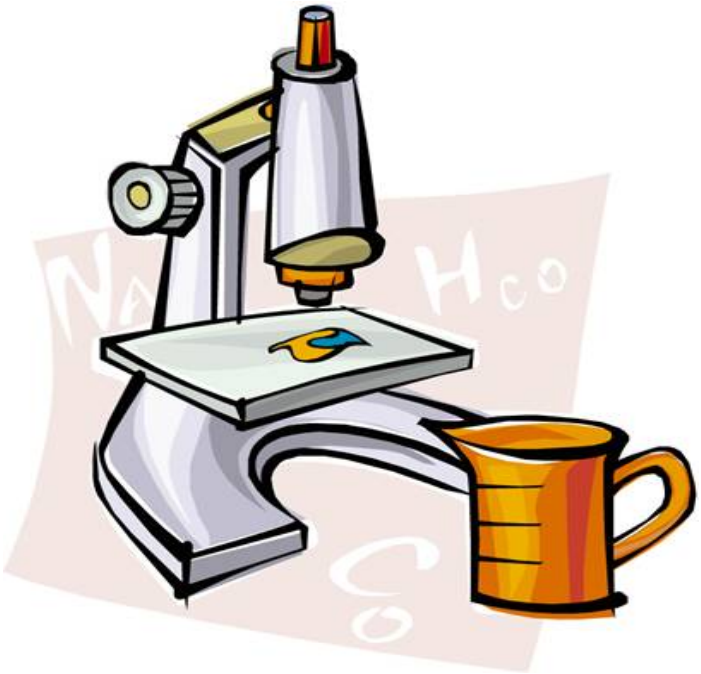
Middle School Earth and Space Science Curriculum Essentials



Boulder Valley School District
Department of Curriculum and Instruction
May 2009

Boulder Valley School District
Board of Education

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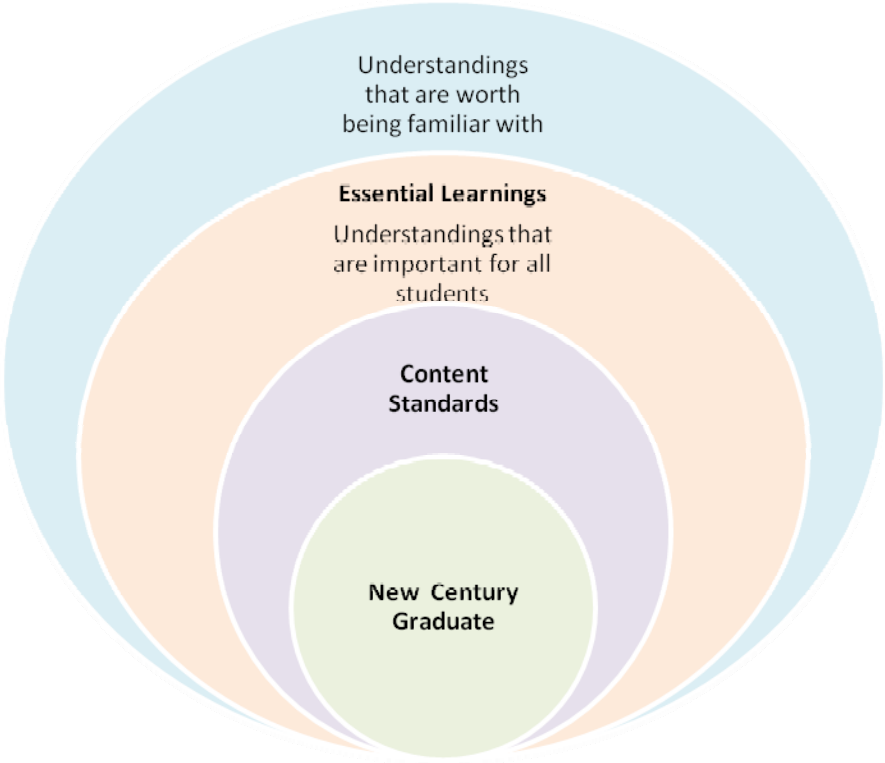
Middle School Life Science Curriculum Essentials

General Introduction

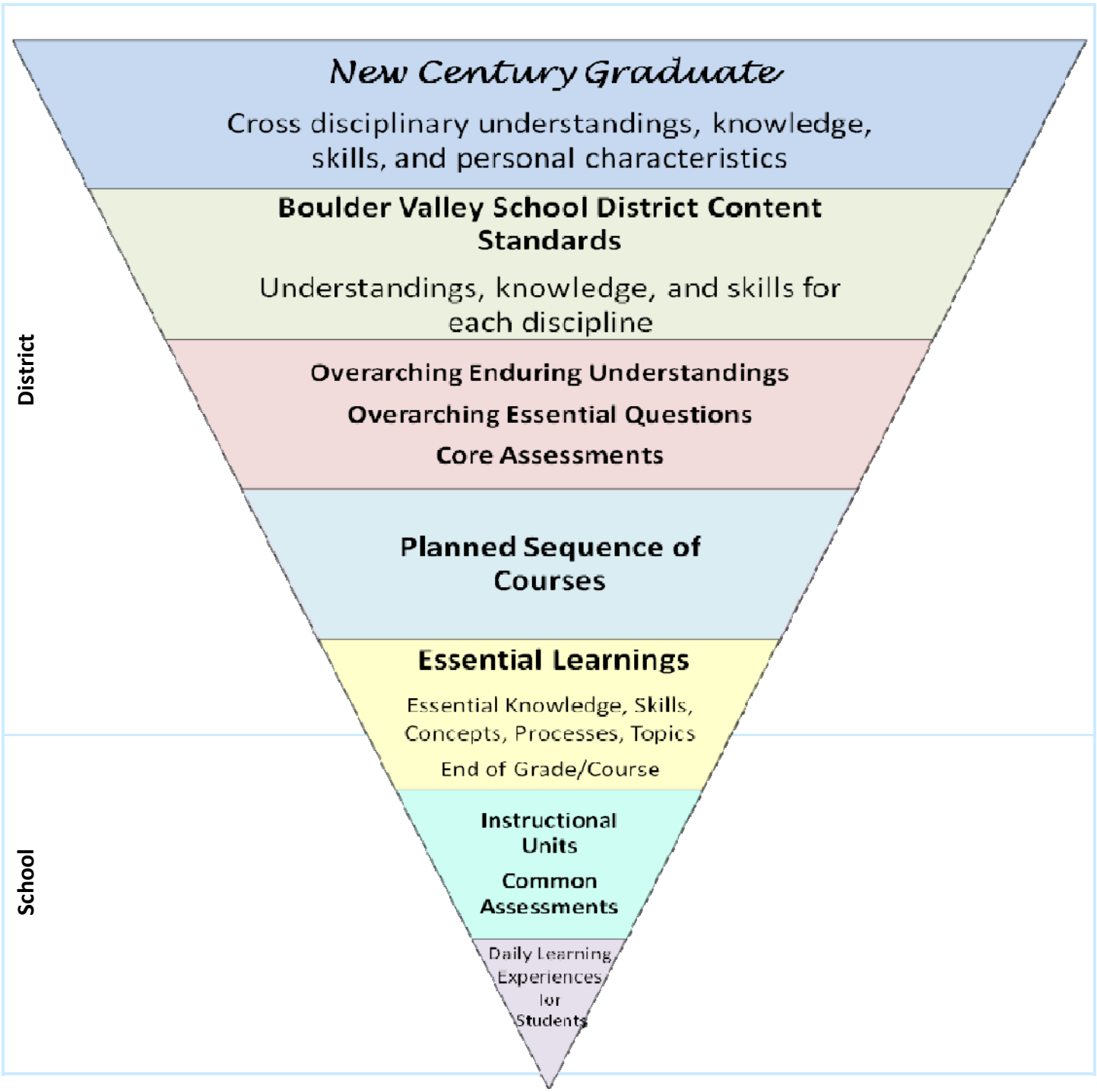
What is a Curriculum Essentials Document? How Does it Relate to a Guaranteed and Viable Curriculum?



Because we are faced with more content than we can reasonably address, we are obligated to make choices and frame priorities. A useful framework for establishing priorities is graphically depicted using 4 nested ovals. The innermost oval, *New Century Graduate*, represents the goals of schooling that have been identified by the Boulder Valley School District community. Moving to the next oval, *Content Standards*, levels of performance for each program of study are clearly articulated. The third oval, *Essential Learnings*, represents the **viable curriculum**. A curriculum is viable when the number of learnings can be accomplished in the time provided (usually a semester, trimester, or year). Thus, an Essentials Document identifies the priorities for learning that are necessary for successful learning at a particular grade level or course and beyond. It also identifies the essential knowledge, skills, concepts, topics, and processes that support the attainment of the essential learning. Finally, the largest oval represents the field of all possible content that might be examined during a grade level or course. This includes extended learning opportunities for students who have achieved the essential learnings or attending to background knowledge and skills that students may need to review or learn to ensure achievement of grade level or course essential learnings.

Curriculum Framework: Macro and Micro Levels

The New Century Graduate identifies the knowledge, skills and personal characteristics that our community has identified as the goals of schooling. Programs of study and curricular content are identified and addressed as a means



Adapted from Grant Wiggins and Jay McTighe (2007). *Schooling by Design.* Alexandria, VA: Association for Supervision and Curriculum

New Century Graduate
Knowledge and Skills

Life Competencies

Leads a balanced life: exhibits physical fitness, knows good nutrition rules, stays safe and drug free, knows how to have fun and relax, manages anger and stress, exhibits self-sufficiency and self confidence, and finishes tasks.

Understands money management, budgeting, balancing a checkbook, debt management, and record keeping.

Demonstrates time management skills and a broad base of knowledge in practical skills such as cooking, sewing, driving, and map reading.

Knows how to search for a job and knows where to go to find answers.

Communication: Speaking and Writing

Writes and speaks thoughtfully and articulately to inform, to express one's thinking and creativity, and to communicate to diverse audiences.

Uses correct grammar, spelling, and mechanics; organizes for effectiveness

Uses technology for effective communication

.

Multicultural/Global Perspective

Understands global customs, economics, literature, history, politics, religions, geography, and demographics.

Understands the contributions of different cultures to our society

Demonstrates proficiency in a language other than English.

Literacy: Reading

Reads critically, fluently, and with comprehension.

Reads for information research, pleasure and knowledge of literature.

Mathematics

Demonstrates basic math computational skills and understand higher-level mathematical concepts and reasoning.

Understands conservation and resource management.

History

Possesses knowledge of American and World Histories and their influence upon the present and the future.

Employs literature as a tool for learning about history across cultures.

Science

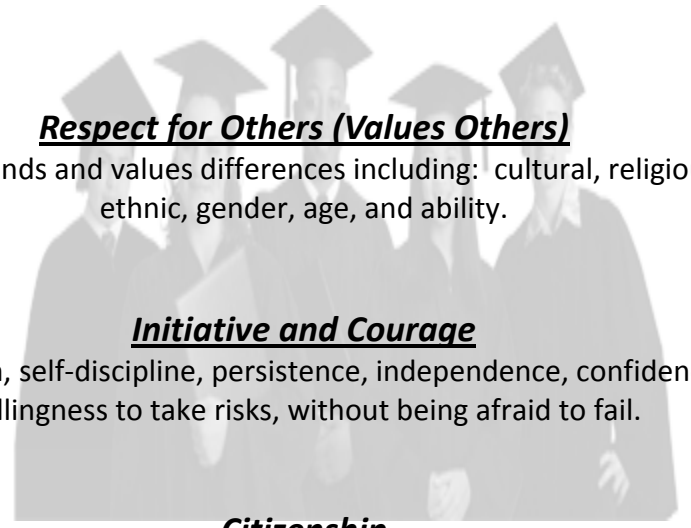
Demonstrates basic sciences knowledge and understands high-level scientific systems including environmental systems.

Knows how to apply the scientific method to real situations.

Arts

Experiences and appreciates music, visual arts, dance and theater.

New Century Graduate
Personal Characteristics



Respect for Others (Values Others)
Understands and values differences including: cultural, religious, ethnic, gender, age, and ability.

Initiative and Courage
Exhibits self-motivation, self-discipline, persistence, independence, confidence, curiosity, and willingness to take risks, without being afraid to fail.

Citizenship
Understands his or her role and responsibilities and contributes to the community, nation, and world.

Responsibility
Takes responsibility for own thoughts and actions, accepting the consequences.

Ethical Behavior
Exhibits personal integrity through honesty, fairness, sincerity, and a sense of justice.

Flexibility and Open Mindedness
Demonstrates flexibility, open-mindedness, adaptability, resiliency, and openness to change.

Self-respect
Possesses self-respect and confidence, while recognizing one's own limitations.

What are Enduring Understandings and Essential Questions?

Enduring Understandings

are the big ideas central to a content area that have lasting value beyond the classroom and are transferable to new situations. Enduring understandings describe what, specifically, students should understand about the topic. Such understandings are generally abstract in nature and are often not obvious, thus requiring uncovering of a topic through sustained inquiry.

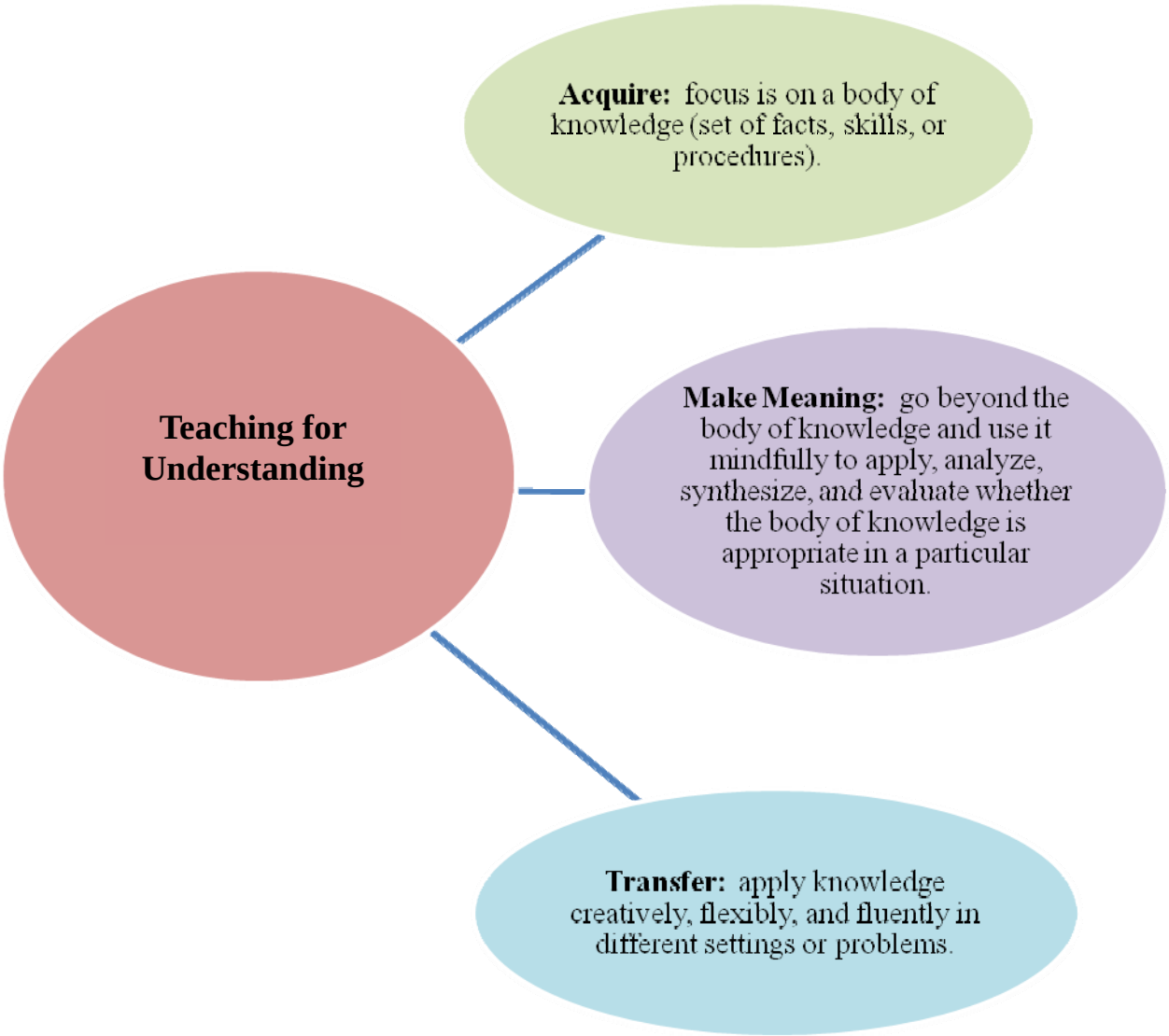
An understanding can be overarching or topical. Overarching understandings are broad (as the name implies) and offer a possible bridge to other units and courses. Overarching understandings at identified at the district-level. Topical understandings are unit specific, identified by teachers about the understandings the unit will cultivate about specific topics.

Essential Questions provoke deep thought, lively discussion, sustained inquiry, and new understandings culminating in meaningful performances. They require students to consider alternatives, weigh evidence, support their ideas, and justify answers. Essential questions do not yield a single straightforward answer, but produce different plausible responses, about which thoughtful and knowledgeable people may disagree. Essential questions spark meaningful connections with prior learnings and personal experiences and create opportunities for transfer to other situations and subjects.

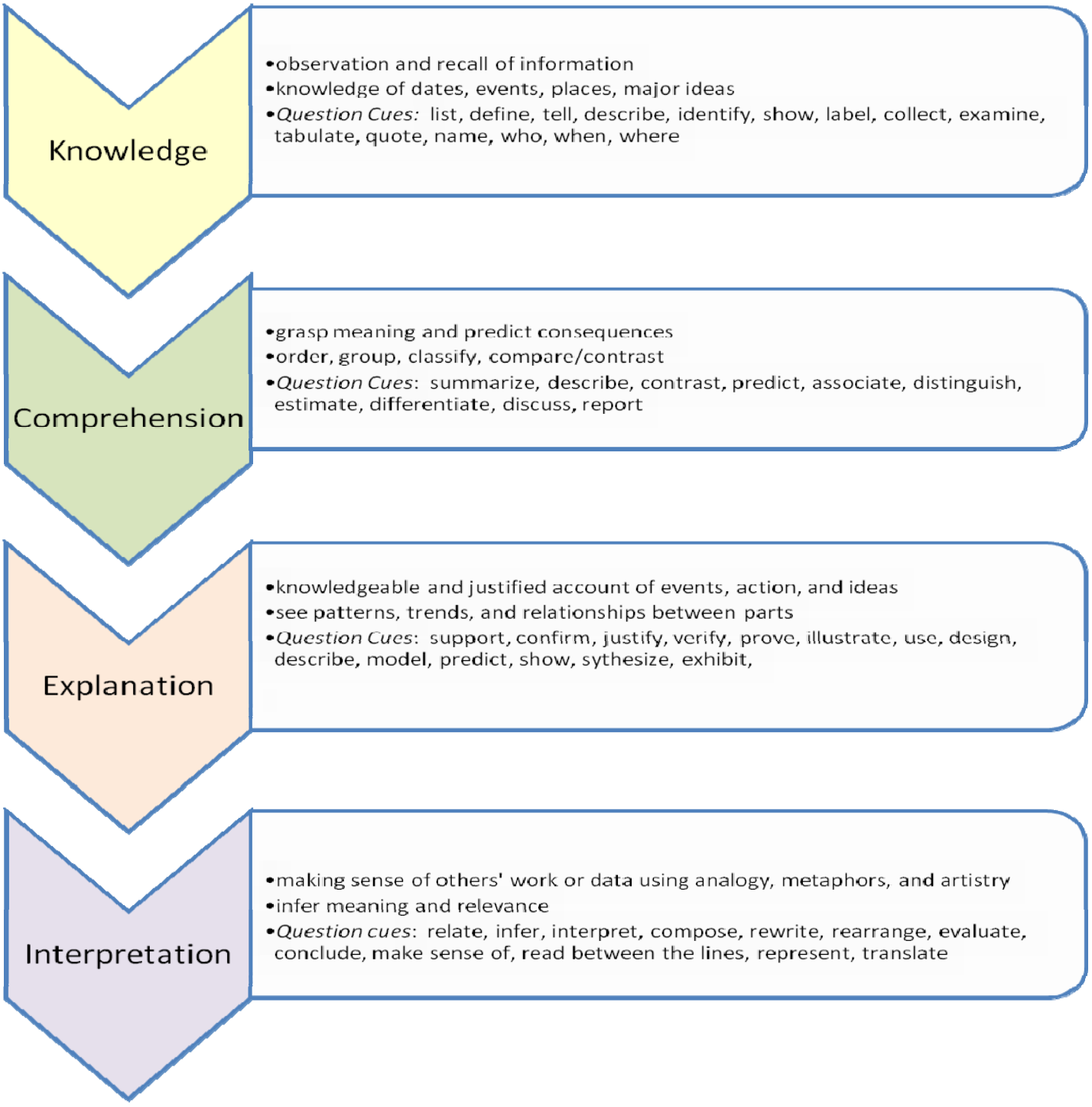
An essential questions can be either overarching or topical in scope. Overarching essential questions are general in nature, causing genuine and relevant inquiry into the big ideas and core content. They cut across units and/or courses. Topical essential questions focus on a specific topic and meant to be answered—if only provisionally—by unit's end.

Teaching for Understanding

If learning is to endure in a flexible, adaptable way for future use, then teachers must design units that in provide opportunity for students to 1) acquire knowledge; 2) to deepen the meaning of that knowledge by using it mindfully, and 3) to transfer their learning to new situations or problems.

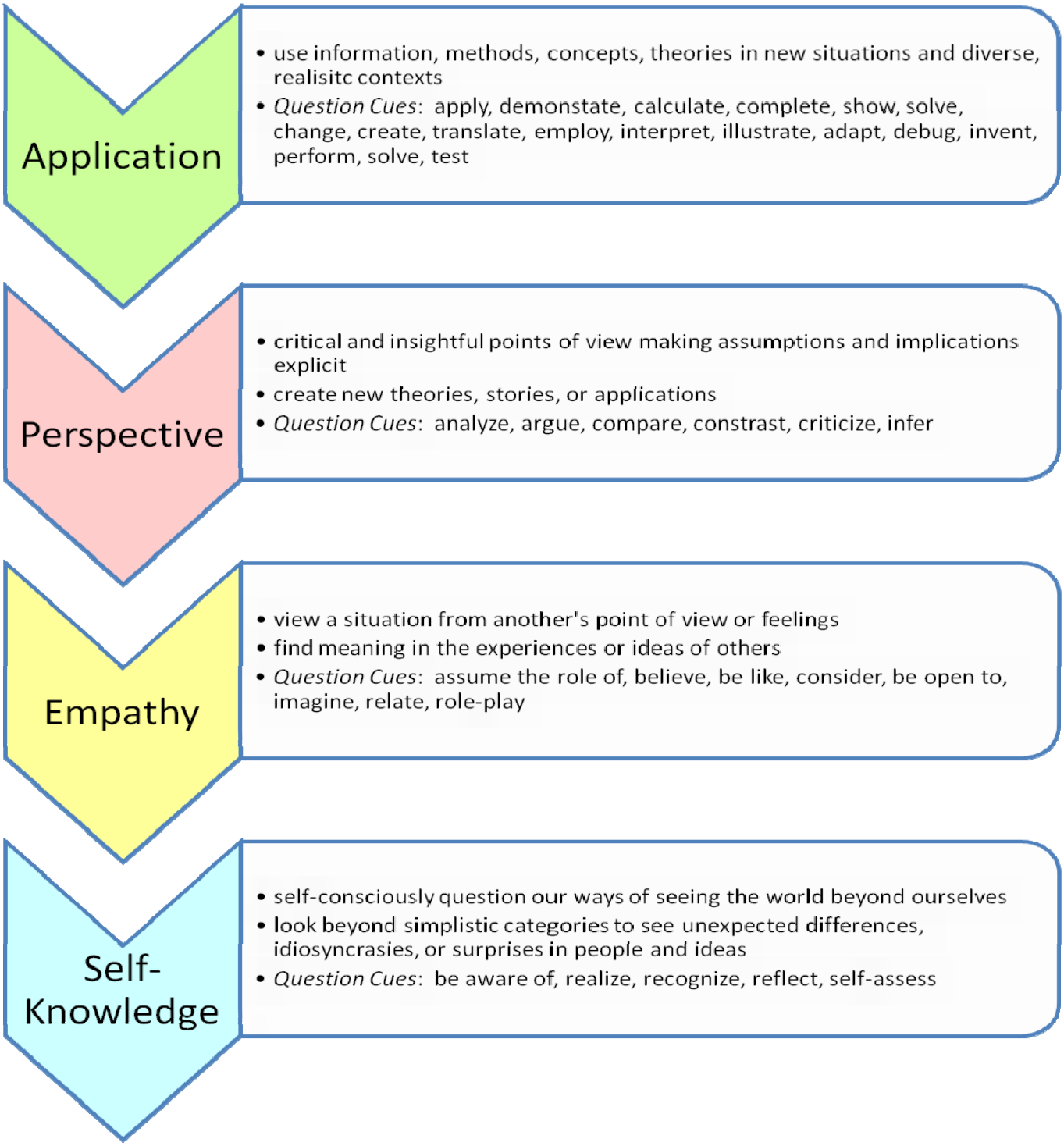


What Does it Mean to Understand?



Adapted from Wiggins, Grant and McTighe, Jay. *Understanding by Design*. Alexandria, VA: Association for Supervision and Curriculum Development, 2006.

What Does it Mean to Understand? (continued)



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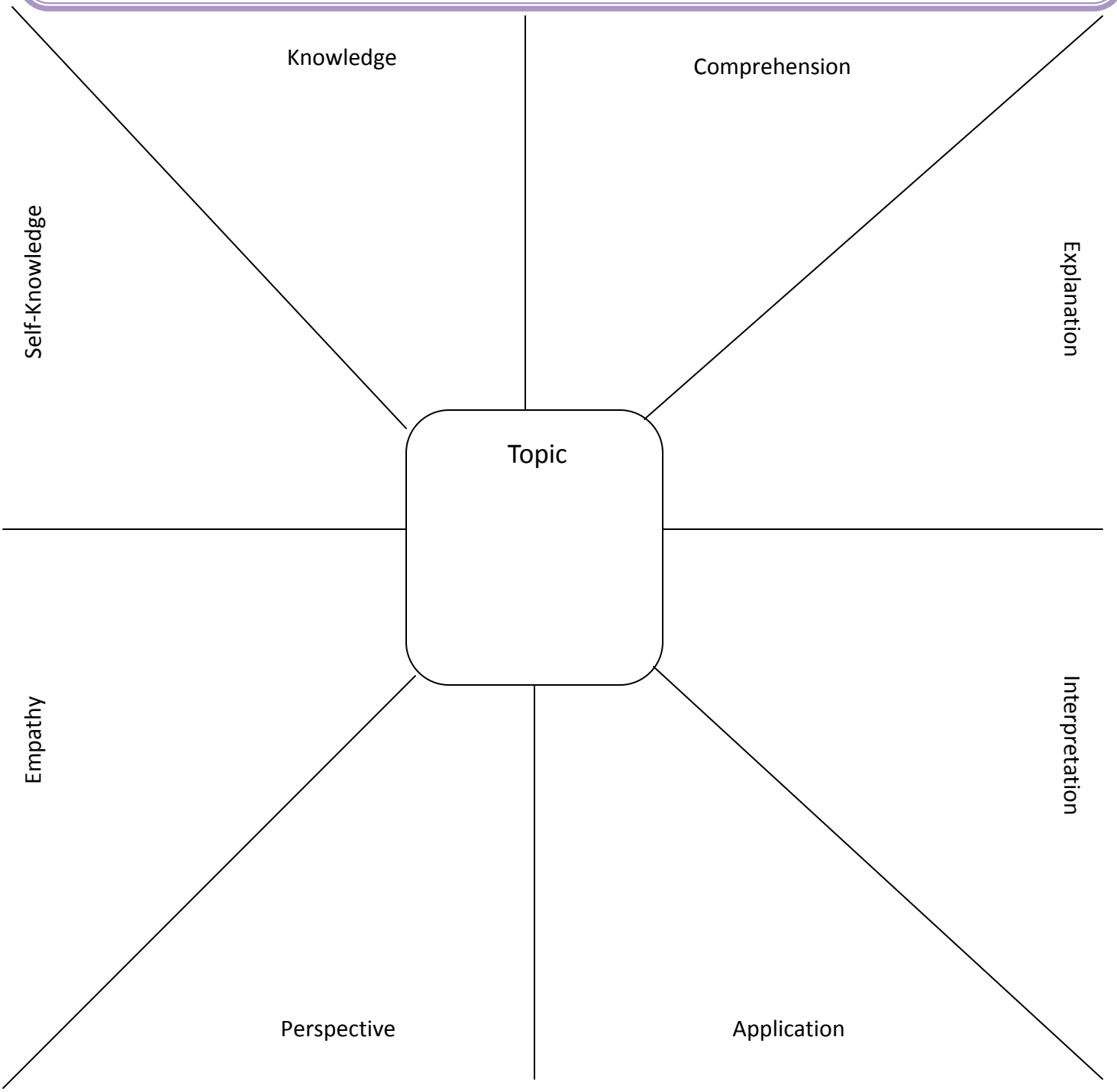
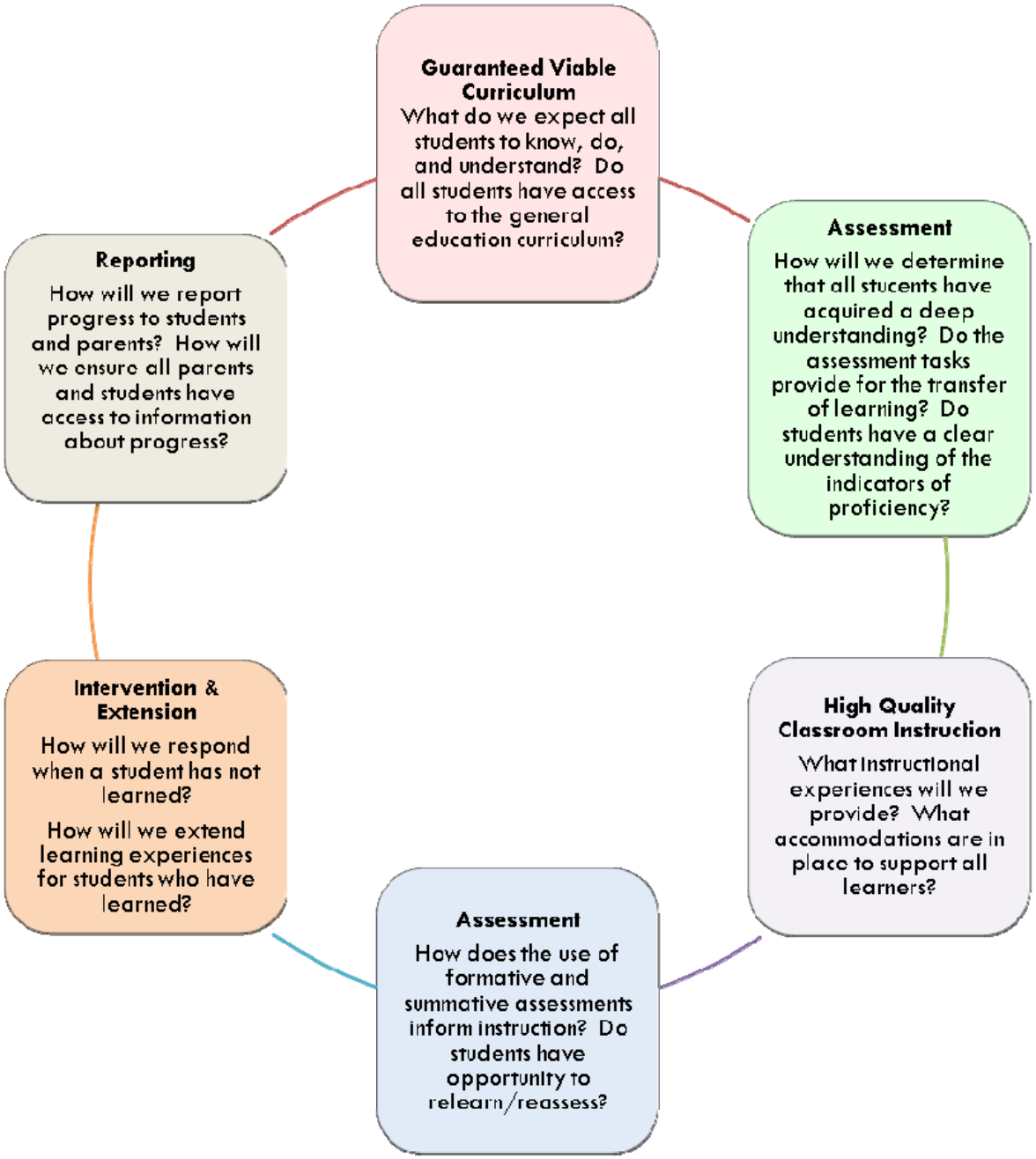
Levels of Understanding Essential Questions



Adapted from Wiggins, Grant and McTighe, Jay. *Understanding by Design*. Alexandria, VA: Association for Supervision and Curriculum Development, 2006.

Instructional Framework
Making the Connections

A rigorous and challenging standards-based instructional program ensures maximum academic achievement for all students. The Boulder Valley School District Instructional Framework is a graphic representation that demonstrates how all of the components of an instructional program fit together. Teachers should use this framework and its questions to guide instructional planning and decision-making.



Characteristics of a Boulder Valley School District Standards-based Classroom

Curriculum

All Students Have Access to the General Education Curriculum

- Standards/essential learnings are clearly visible—in writing—in age appropriate student-friendly language
- Continual correlation of curriculum is made to the standards/essential learnings
- Models of high quality products (teacher generated, student generated or both) are provided by the district
- Students and parents are informed of expectations (course syllabus course, standards/essential learnings, grading policy, homework policy, and final culminating activity)
- All students are guaranteed access to the standards/essential learnings
- Lessons and units are developed using a backwards design process
- Suggested timelines are followed

Instruction

Quality Instruction Demands Student-Teacher Collaboration in the Learning Process

Instruction focuses on standards/essential learnings/curriculum

- Clear and high expectation for all students
- Instruction driven by standards/curriculum, not materials or a published program
- Frequent, timely, meaningful feedback of student accomplishment

Instruction supports equity with multiple opportunities to learn through grouping, scaffolding, differentiation, and extension

- Teachers use multiple forms of representation are used (e.g., pictures, words, symbols, diagrams, tables, graphs, word walls)

Students actively engage in learning

- Participate in classroom talk (listening, elaborating, clarifying, expanding)
- Apply rigorous, strategic thinking (application, explanation, perspective, interpretation, perspective, empathy, self-knowledge)

Characteristics of a Boulder Valley School District Standards-based Classroom

Assessment

Assessments are Tightly Aligned to the Standards

- Students and parents are provided with clear descriptions of proficiency
- Classroom grading practices clearly show how students are progressing toward essential learnings/standards
- Grading is based on attainment of the standards
- Student understanding is assessed through multiple types of formative and summative assessments
- Student assessment results are used to make instructional decisions about what direction to take
- Feedback explicitly guides continuous progress toward mastery of the standard and is provided to students in a timely manner
- Opportunities to relearn, reassess, and extend learning are embedded in every classroom
- Teachers collaborate in the design and analysis of common assessments that are aligned to standards
- Students create authentic products and performances for critical audiences

Learning Environment

A Healthy Community of Learners Thrives on Collaborative Processes That Value the Input of All Members

- Positive respectful relationships are evident within the classroom
- Students monitor and manage the quality of their own learning
- Student enrollment shows gender and racial/ethnic diversity
- Verbal and nonverbal cues indicate student engagement
- Teachers plan so that time is used purposefully and efficiently
- Students use time provided purposefully and efficiently
- Students and teachers negotiate and share decisions that positively impact the learning environment
- Teachers help students make connections between community, nation, world, and self
- Teachers show a connectedness with all students, respectful of student diversity and individual differences
- Students believe they are capable of success, take risks to engage in new experiences, and extend skills and habits of mind

Middle School Science Essential Learnings

Middle School Physical Science

- Creates and conducts plans for investigations that include: asking questions, stating hypotheses, identifying variables, identifying constants, and collecting data accurately
- Uses appropriate tools and technology and metric measurement units to gather and organize data and to report results
- Interprets data and recognizes bias in order to formulate logical conclusions
- Communicates the design and results of scientific investigations in appropriate ways (written, oral, pictorial, digital)
- Follows lab and safety procedures when conducting scientific investigations
- Uses the particulate model of matter to explain the physical properties of solids, liquids, gases, and plasma state and their changes
- Separates mixtures based on properties
- Applies an understanding of the conservation of mass to physical and chemical changes within a system
- Distinguishes between mass and weight
- Explains that matter is made up of atoms that are comprised of protons, neutrons, and electrons, and when a substance is made up of only one type of atom, it is an element
- Describes the similarities and differences among elements, molecules, compounds, and mixtures
- Describes, measures, and calculates interactions between moving objects in a system
- Explains that energy appears in different forms and can be transferred (moved) and be transformed (changed)
- Explains that electric circuits provide a means of transferring electrical energy
- Explains that white light is made up of different colors that correspond to different wavelengths
- Identifies renewable and non-renewable sources of energy
- Explains that a controlled experiment must have comparable results when repeated
- Creates and uses physical and conceptual models for explanations and predictions
- Recognizes that people in different cultures and at different times in history have made contributions to the advancement of science
- Recognizes that the interrelationship of science and technology has implications for the social, cultural, economic, and ecological systems within which we live

Middle School Science Essential Learnings

Middle School Life Science

- Creates and conducts plans for investigations that include: asking questions, stating hypotheses, identifying variables, identifying constants, and collecting data accurately
- Uses appropriate tools and technology and metric measurement units to gather and organize data and to report results
- Interprets and analyzes data and recognizes bias in order to formulate logical conclusions
- Communicates about scientific investigations in appropriate ways (written, oral, pictorial, digital)
- Follows lab and safety procedures when conducting scientific investigations
- Identifies characteristics common to all living things and classifies organisms based on difference in physical characteristics
- Describes the functions and interactions of human body systems (for example: circulatory, respiratory, muscular, skeletal, digestive) and the levels of organization within the human body
- Compares and contrast a variety of ways in which multi-cellular organisms transport materials
- Explains how matter cycles and energy flows through ecosystems and describes the significance of photosynthesis and respiration to these processes
- Relates structure and function in different types of cells and cellular organelles
- Describes the role of genetic material in the transfer of biological characteristics from one generation to another
- Analyzes implications of interactions among organisms, populations, and their environment
- Gives examples of adaptations and of evidence that organisms have evolved over time
- Explains why it is important to repeat scientific investigations
- Creates and uses physical and conceptual models for explanation and prediction
- Recognizes that people in different cultures and at different times in history have made contributions to the advancement of science
- Explains that scientific knowledge changes as new knowledge is acquired and previous ideas are modified

Middle School Science Essential Learnings

Middle School Earth and Space Science

- Creates, evaluates, and conducts plans for investigations that include: asking questions, stating testable hypotheses, identifying variables and constants, collecting data accurately, and identifying different methods for investigating scientific questions
- Accurately uses appropriate tools and technology and metric measurement units to gather, organize, and analyze data and to report results
- Interprets, analyzes, and evaluates data and recognizes bias in order to formulate logical conclusions
- Communicates about scientific investigations in appropriate ways (written, oral, pictorial, digital)
- Follows lab and safety procedures when conducting scientific investigations
- Identifies and explains the processes that create minerals, rocks, and soils
- Describes how a variety of constructive and destructive natural processes shape Earth's surface
- Uses evidence to explain how natural events follow patterns of distribution that reflect geological cause and effect
- Infers geologic, environmental, and biological changes through time based on fossil evidence
- Relates the structure and function of the atmosphere to its properties and composition
- Describes or illustrates the processes by which energy from the Sun drives atmospheric circulation
- Predicts weather and climate patterns by observing, measuring, and recording weather condition across time and space
- Describes how water changes physical states as it circulates through and within the Earth's crust, oceans and atmosphere
- Connects the characteristics and composition of water bodies to the behavior and effect of water on Earth
- Describes the main components of the Solar System and explain how the Sun, Moon, and Earth interacts to cause day, year, seasons, phases of the Moon and eclipses
- Compares and contrasts Earth with other planets in the Solar System, and explains why technology is necessary to study other planets and the universe beyond our Solar System
- Explains why it is important to repeat scientific investigations
- Creates and uses physical and conceptual models for explanation and prediction
- Recognizes that people in different cultures and at different times in history have made contributions to the advancement of science
- Explains that scientific knowledge changes as new knowledge is acquired and previous ideas are modified

Design Templates

Unit Design Template

Desired Results	
BVSD Standard(s)/Essential Learnings	
Unit Enduring Understandings	**Unit Essential Questions**
Students will know……	**Students will be able to……**
Assessment Evidence	
Performance/Transfer Tasks	**Other Evidence**
Rubric	**Student Self-Assessment and Reflection**

Unit Design Template (continued)

Learning Plans

Learning Activities

Materials

Accommodations

Technology Integration

Unit Design Template

Essential Learning:

Assessment:

Teaching for Understanding

	Acquire Knowledge	Make Meaning	Transfer
Essential Questions			
Learning Activities			
Materials			
Accommodations			

Curriculum Map

Month	Standards/Essential Learnings	Assessment	Knowledge Skills	Learning Activities	Accommodations	Materials

Curriculum Map

	August	September	October	November	December
Standards/ Essential Learnings					
Assessment					
Knowledge					
Skills					
Learning Activities					
Accommodations					
Materials					

Curriculum Map

	January	February	March	April	May
Standards/ Essential Learnings					
Assessment					
Knowledge					
Skills					
Learning Activities					
Accommodations					
Materials					

Curriculum Map

Month
Theme:
Unit Guiding Question(s):

Standards	Assessment	Knowledge and Skills	Learning Activities	Accommodations	Materials
Science					
Math					
Reading					
Writing					
Speaking					
Listening					
Social Studies					
Health					

Curriculum Map

Year At A Glance							
	Reading	Writing	Math	Science	Social Studies	Health	Speaking/ Listening
August							
September							
October							
November							
December							
January							
February							
March							
April							
May							

Curriculum Map

Unit: Timing:

Essential Questions					
Standards/Essential Learnings					
Notes	**Assessments**	**Knowledge and Skills**	**Learning Activities**	**Accommodations**	**Materials**

Curriculum Map

Unit: Timing:

Standards/Essential Learnings	
Enduring Understandings **Essential Questions**	**Assessment** **Knowledge and Skills** **Learning Activities** **Accommodations** **Materials**

Curriculum Glossary of Terms

Anchor	An anchor is a sample of work or performance used to set the specific performance standard for each level of proficiency. Anchors contribute to scoring reliability and support students by providing tangible models of quality work.
Assessment	Assessment refers to the act of determining a value or degree.
Authentic assessment	An authentic assessment is one composed of tasks and activities design to simulate or replicate important, real-world challenges. It asks a student to use knowledge in real-world ways, with genuine purposes, audiences, and situational variables. Authentic assessments are meant to do more than "test;" they should teach students what the "doing" of a subject looks like and what kinds of performance challenges are actually considered most important in a field or profession.
Backward Design	An approach to designing a curriculum or unit that begins with the end in mind and designs toward that end. This term is used by Grant Wiggins and Jay McTighe in *Understanding by Design*.
Benchmark	Clearly demarcated progress points that serve as concrete indicators for a standard.
Big Idea	In *Understanding by Design* (Wiggins and McTighe, 2005), the core concepts, principles, theories, and processes that should serve as the focal point of the curriculum, instruction, and assessment. Big ideas are enduring and important and transferable beyond the scope of a particular unit.
Concept	A concept is a mental construct or category represented by a word or phrase. Concepts include both tangible objects (chair, telephone) and abstract ideas (bravery, anarchy).
Content Standard	A content standard answers the question, "What *a student should know, do or understand*?"
Curriculum	The curriculum represents what should be taught. It is an explicit and comprehensive plan that is based on content and process standards.
Curriculum Implementation	Curriculum implementation is putting the curriculum into place.
Curriculum Mapping	Curriculum mapping and webbing are approaches that require teachers to align the curriculum, standards, and learning activities across grade levels, within a grade level to ensure a continuum of learning that makes sense for all students.
Enduring Understanding	Enduring understandings are specific inferences, based on big ideas that have lasting value beyond the classroom. They are full-sentence statements that describe specifically what students will understand about the topic.

Curriculum Glossary of Terms (continued)

Essential Learnings	Essential Learnings are the backbone of a guaranteed viable curriculum. Essential Learnings are aligned with standards and articulate the skills, content, and concepts determined to be non-negotiable areas of proficiency attainment by all students so that they are prepared for the next year/level of education. The Essential Learnings are the mandated curriculum of the Boulder Valley School District and form the basis upon which summative assessments are created.
Essential Question	An Essential Question lies at the heart of a subject or a curriculum (as opposed to being either trivial or leading) and promotes inquiry and uncoverage of a subject. Essential questions do not yield a single answer, but produce different plausible responses, about which thoughtful and knowledgeable people may disagree. An essential question can be overarching, grade level specific, or unit specific in scope.
Essential Topics, Skills, Processes, Concepts	The topics, skills, processes, and concepts clarify the Essential Learnings, describe indicators of achievement, and inform the selection of formative and summative assessments.
Formative assessment	An assessment is considered formative when the feedback from learning activities is actually used to adapt the teaching to meet the learner's needs.
Guaranteed Viable Curriculum	In researching what works in schools, Robert Marzano (2003), found five school-level factors that promote student achievement. Using the process of statistical effect size analysis, Marzano concluded that a guaranteed and viable curriculum is the most powerful school-level factor in determining overall student achievement. Marzano defines a guaranteed and viable curriculum as a combination of opportunity to learn (guaranteed) and time to learn (viable). According to Marzano, students have the opportunity to learn when they study a curriculum that clearly articulates required standards to be addressed at specific grade levels and in specific courses. A curriculum is viable when the number of required standards is manageable for a student to learn to a level of mastery in the time provided (usually a semester, trimester, or year).
Learning Activities	These represent the experiences and instruction that will enable students to achieve the desired results such as materials, projects, lectures, videos, homework, assignments, presentations, accommodations, and vocabulary.
Performance Task	A performance task uses one's knowledge to effectively act or bring to fruition a complex product that reveals one's knowledge and expertise.
Prerequisite knowledge and skill	The knowledge and skill required to successfully perform a culminating tasks or achieve an understanding. These typically identify discrete knowledge and know-how required to put everything together in a meaningful, final performance.

Curriculum Glossary of Terms (continued)

Processes	Processes include all the strategies, decisions, and sub-skills a student uses in meeting the content standard.
Product	The tangible and stable result of a performance and the processes that led to it. The product is valid for assessing the student's knowledge to the extent that success or failure in producing the product reflects the knowledge taught and being assessed.
Rubric	A scoring tool that rates performance according to clearly stated levels of criteria and enables students to self-assess. A rubric answers the question, *What does understanding or proficiency for an identified result look like?* The scales can be numeric or descriptive.
Scope and Sequence	Scope refers to the breadth and depth of content to be covered in a curriculum at any one time (e.g. week, term, year, over a student's school life). Sequence refers to the order in which content is presented to learners over time. The order in which you do it. Together a scope and sequence of learning bring order to the delivery of content, supporting the maximizing of student learning and offering sustained opportunities for learning. Without a considered scope and sequence there is the risk of ad hoc content delivery and the missing of significant learning.
Strategies	Strategies are procedures, methods, or techniques to accomplish an essential learning.
Summative assessment	An assessment is considered summative when the feedback is used as a summary of the learning up to a given point in time.

Middle Level Earth & Space Science Curriculum Essentials

Boulder Valley School District Science Background

Content and Goals

Since the publications of the *National Science Education Standards* by the National Research Council in 1996, the teaching of science in grades K-12 has undergone a gradual revolution. Instead of presenting science as a collection of isolated facts, teachers strive to help each student develop the ability to conduct scientific inquiry, a strong understanding of scientific concepts and how they are connected, and an understanding of the nature and history of science. In 2007, the Colorado Department of Education published the most recent version of the Colorado Model Content Standards for Science and Colorado Assessment Frameworks for Science.

This revision of the Boulder Valley School District Science Curriculum had three key goals:

- Clearly articulate what every student should know, understand, and be able to do with regards to science at every grade level
- Align with the revised Colorado Standards and Frameworks
- Reduce the breadth of science content at each grade level so that concepts can be explored in greater depth.

Scientific Inquiry

A central focus of the revised BVSD science curriculum is scientific inquiry. The following definition from the *National Science Education Standards* serves as the basis for our common understanding of how scientific inquiry is defined.

> **Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work.**

> **Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world.**

The following points serve to clarify the vision of what inquiry means in BVSD.

- Inquiry involves five essential features. Students engaged in scientific inquiry should ask or respond to scientifically oriented questions, give priority to evidence, formulate explanations based on evidence, connect explanations to scientific knowledge, and communicate and justify explanations *(Inquiry and the National Science Education Standards).*
- Inquiry-based science instruction involves a continuum of learning experiences from teacher-led to learner self-directed activities, including but not limited to hands-on labs. Hence, both a structured assignment involving reading and written reflection and an open-ended, hands-on investigation could be considered inquiry as long as they involve the five essential features identified above.
- The ultimate goals of inquiry-based instruction are to engage learners, develop their conceptual understanding of the natural world around them, and to overcome misconceptions in science.
- Inquiry-based activities should balance students' application of content knowledge, creativity, and critical thinking in order to analyze data, solve a problem, or address a unique question.

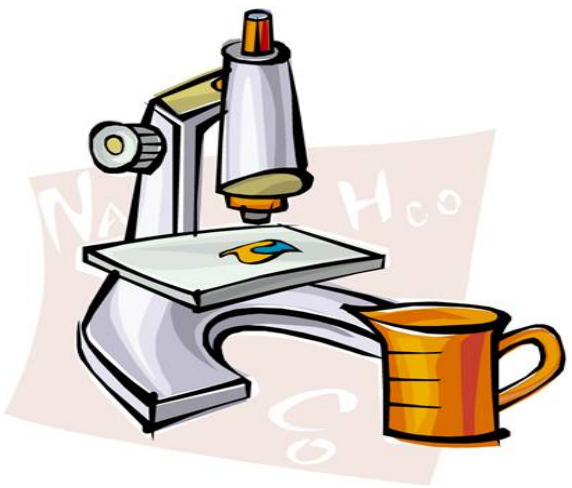
Literature Cited

National Research Council. 1996. *National Science Education Standards.* Washington, DC: National Academy Press.
National Research Council. 2000. *Inquiry and the National Science Education Standards*. Washington, DC: National Academy Press.

Boulder Valley School District Science Content Standards

Science Standard 1

Students apply the processes of scientific investigation and design, safely conduct, communicate about and evaluate such investigations.



Science Standard 2

Students know and understand common properties, forms, and changes in matter and energy.

Science Standard 3

Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

Science Standard 4

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Science Standard 5

Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.

Science Overarching Enduring Understandings and Essential Questions

Overarching Enduring Understanding

- Science involves a particular way of knowing that includes relying on empirical evidence, logical arguments, skepticism, and peer review. Scientific ideas are revised over time as new evidence becomes available.
- Benefits and costs of scientific research and technological innovation include consequences that are long-term as well as short-term, and indirect as well as direct.
- Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying explanations.
- Matter has properties related to its structure that can be measured and used to identify, classify and describe substances or objects.
- Energy occurs in different forms and is necessary to do work or to cause change.
- All organisms share similar characteristics and basic needs, but they also have differences that allow people to identify, describe and classify them.
- The Earth System is composed of and part of a multitude of systems, which cycle and interact resulting in dynamic equilibrium.

Overarching Essential Questions

- How is science different from other disciplines in the way it approaches questions?
- How have science and technology affected the quality of life?
- How do people use the process of science to investigate questions about the natural world?
- What is matter?
- What is energy?
- How does energy interact with matter to cause change and do work?
- How are all living things the same, and how are they different?
- How do Earth's systems interact?

Boulder Valley School District Science Content Standards and Middle Level Earth & Space Science Essential Learnings

Science Standard 1: *Students apply the processes of scientific investigation and design, safely conduct, communicate about and evaluate such investigations.*

To meet this standard, a Middle Level Earth & Space student:

√ Creates, evaluates, and conducts plans for investigations that include: asking questions, stating testable hypotheses, identifying variables and constants, collecting data accurately, and identifying different methods for investigating scientific questions.

√ Accurately uses appropriate tools and technology and metric measurement units to gather, organize, and analyze data and to report results.

√ Interprets, analyzes, and evaluates data and recognizes bias in order to formulate logical conclusions.

√ Communicates about scientific investigations in appropriate ways (written, oral, pictorial, digital).

√ Follows lab and safety procedures when conducting scientific investigations.

Science Standard 2: *Students know and understand common properties, forms, and changes in matter and energy.*

No essential learning in Middle Level Earth & Space Science.

Science Standard 3: *Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.*

No essential learning in Middle Level Earth & Space Science.

Boulder Valley School District Science Content Standards and Middle Level Earth & Space Science Essential Learnings (continued)

Science Standard 4: *Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.*

To meet this standard, a Middle Level Earth & Space student:

- √ Identifies and explains the processes that create minerals, rocks, and soils.
- √ Describes how a variety of constructive and destructive natural processes shape Earth's surface.
- √ Uses evidence to explain how natural events follow patterns of distribution that reflect geological cause and effect.
- √ Infers geologic, environmental, and biological changes through time based on fossil evidence.
- √ Relates the structure and function of the atmosphere to its properties and composition.
- √ Describes or illustrates the processes by which energy from the Sun drives atmospheric circulation.
- √ Predicts weather and climate patterns by observing, measuring, and recording weather condition across time and space.
- √ Describes how water changes physical states as it circulates through and within the Earth's crust, oceans and atmosphere.
- √ Connects the characteristics and composition of water bodies to the behavior and effect of water on Earth.
- √ Describes the main components of the Solar System and explain how the Sun, Moon, and Earth interacts to cause day, year, seasons, phases of the Moon and eclipses..
- √ Compares and contrasts Earth with other planets in the Solar System, and explains why technology is necessary to study other planets and the universe beyond our Solar System.

Science Standard 5: *Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.*

To meet this standard, a Middle Level Earth & Space student:

- √ Explains why it is important to repeat scientific investigations.
- √ Creates and uses physical and conceptual models for explanation and prediction.
- √ Recognizes that people in different cultures and at different times in history have made contributions to the advancement of science.
- √ Explains that scientific knowledge changes as new knowledge is acquired and previous ideas are modified.

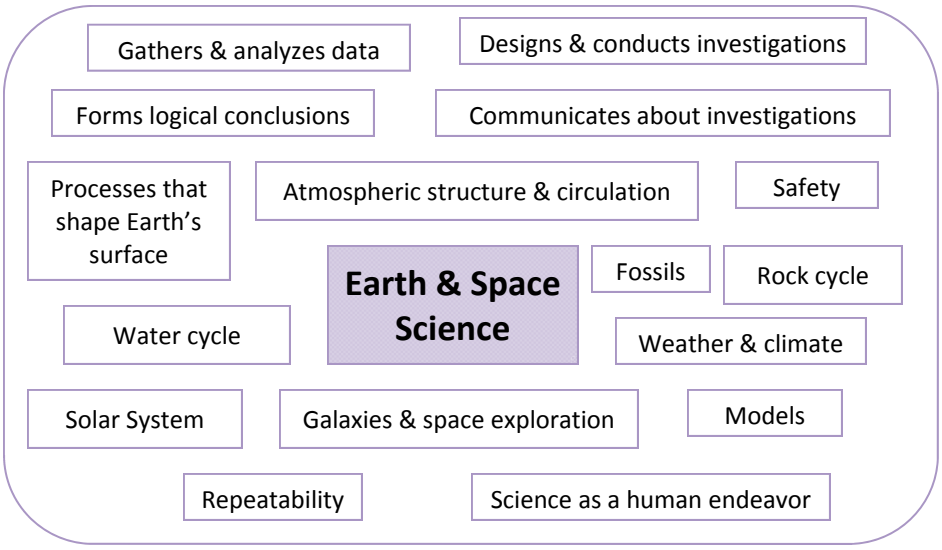
BVSD Earth & Space Science Overview

Course Description

In middle level Earth and Space Science, students will be designing and conducting scientific investigations and constructing scientific explanations based on evidence. Students will make measurements using metric units and will organize their data using bar and line graphs. Students will learn about fundamental concepts in earth and space science such as the rock cycle, processes that shape Earth's surface, fossils, atmospheric circulation, weather and climate, the water cycle, oceans and other water bodies, and the Earth in space. Students will also learn about the nature of science as a human endeavor.

Effective Components of a Earth & Space Science Program

- Maintains an inquiry-based learning environment
- Provides students with multiple opportunities to learn and timely feedback to help students know what they need to improve upon
- Uses assessment to guide instruction
- Differentiates instruction to meet student needs
- Draws out and actively engages the preexisting understandings about the natural world that students bring with them
- Assists students in developing metacognitive skills within the context of learning about science
- Integrates writing, reading, and mathematics with inquiry-based science
- Provides a safe, equitable and engaging learning environment for all students



Essential Questions

- What makes a question scientific?
- How do people use the process of science to investigate questions about the natural world?
- How do people ensure that scientific data are accurate?
- How do people ensure that the results of scientific investigations are valid?
- How can people make scientific investigations as safe as possible for themselves and for other living things?
- Where do rocks come from, and why are they not all the same?
- Why does the Earth's surface look the way it does, and how do we know?
- What are fossils, how do they form, and what can they tell us about past life?
- What is the atmosphere composed of and how do we know?
- How does the Sun affect the Earth's atmosphere and its changes?
- What causes weather and climate?
- What are the unique properties of water, and how does it cycle within the Earth's crust, atmosphere, oceans, and other bodies of water?
- What components make up the Solar System?
- What causes day/night cycles, yearly cycles, phases of the Moon and the seasons?
- How is Earth unique in the Solar System?
- What lies beyond our Solar System, and how do we know?
- Why do people repeat scientific investigations?
- Why do people use models in science?
- Why are diverse perspectives and a team approach important to scientific research?
- How has scientific knowledge changed in the field of life science and why?

Assessment

- 8th Grade Science CSAP
- Science Notebooks
- Teacher-created performance tasks

Technology Integration & Information Literacy

- Uses technology responsibly for communication and transfer of ideas.
- Collaborates with others to identify information problems and to seek their solutions.
- Uses digital devices to collect and/or analyze data.
- Formulates questions about a topic.
- Predicts outcomes.
- Creates a labeled diagram that supports information being shared.
- Organizes and reports information in a variety of complex ways including tables, graphs, charts, reports.
- Identifies various information sources (people, materials, equipment).
- Presents information in a variety of formats including written paragraphs posters, illustrations, etc.

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 1

Students apply the processes of scientific investigation and design, safely conduct, communicate about and evaluate such investigations.

Enduring Understanding

Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying explanations.

Essential Questions

What makes a question scientific?
How do people use the process of science to investigate questions about the natural world?
How do people ensure that scientific data are accurate?
How do people ensure that the results of scientific investigations are valid?
How can people make scientific investigations as safe as possible for themselves and for other living things?

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts	ESS1	Creates, evaluates, and conducts plans for investigations that include: asking questions, stating testable hypotheses, identifying variables and constants, collecting data accurately, and identifying different methods for investigating scientific questions	
		a	Develops a testable question
		b	States a testable hypothesis
		c	Uses the appropriate observation/measurement technique for data collection
		d	Identifies the independent and dependent variable and the variables held constant in an experiment
		e	Develops an appropriate procedure for an investigation/experiment

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Essential Learnings
Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 1 (continued)
Students apply the processes of scientific investigation and design, safely conduct, communicate about and evaluate such investigations.

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts		f	Predicts multiple possible outcomes of an investigation
		g	Identifies different methods used to investigate scientific questions (for example: controlled experiments, collecting specimens, constructing models, researching scientific literature, etc.)
	ESS2	**Accurately uses appropriate tools and technology and metric measurement units to gather, organize, and analyze data and to report results**	
		a	Records, reports, and analyzes data in a variety of forms (sketches, tables, charts, graphic organizers, digital media, etc.) from a scientific investigation using the appropriate tool and metric units
		b	Measures accurately using a various tools and technologies (for example: microscope, triple beam balance, graduated cylinder, meter stick, thermometer, spring scale, digital devices)
		c	Collects, organizes and, interprets data in tables and graphs
		d	Describes possible ways to minimize error in measurements
	ESS3	**Interprets, analyzes, and evaluates data and recognizes bias in order to formulate logical conclusions**	
		a	Interprets, analyzes, and evaluates data/observations (data tables, bar and line graphs, diagrams, written descriptions, digital sources, etc.) to formulate a logical conclusion
		b	Uses evidence to state if a hypothesis is supported or not supported
		c	Makes predictions based on experimental data
		d	States explanations that link claims and evidence
		e	Describes how one might minimize observer bias in an investigation

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 1 (continued)

Students apply the processes of scientific investigation and design, safely conduct, communicate about and evaluate such investigations.

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	**ESS4**	**Communicates about scientific investigations in appropriate ways (written, oral, pictorial, digital)**	
		a	Communicates about a scientific investigation in a variety of ways (written, oral, pictorial, digital) including writing in science notebooks
		b	Accurately creates a graph (bar and line) of the data with the dependent and independent variables on correct axes
		c	Provides, receives, and responds to feedback about a scientific investigation
	ESS5	**Follows lab and safety procedures when conducting scientific investigations**	
		a	Knows proper lab and safety procedures for grade appropriate work as demonstrated by proficient score on safety test
		b	Follows safety procedures consistently
		c	Uses laboratory tools appropriately and accurately

Key Academic Vocabulary: bias, constant, data, dependent variable, error, hypothesis, independent variable, testable

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

Minerals, rocks, and soils are formed by processes that occur above and within Earth's crust.

Essential Questions

Where do rocks come from, and why are they not all the same?

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts			
	ESS6	**Identifies and explains the processes that create minerals, rocks, and soils**	
		a	Identifies rocks based on observable characteristics as igneous, sedimentary, and metamorphic
		b	Describes how igneous, sedimentary, and metamorphic rocks form
		c	Describes the processes by which one rock can become another rock (the rock cycle)
		d	Describes how soils form and how weathering contributes to soil formation
		e	Explains the composition and relationships between rocks, minerals and soil formation
		f	Identifies minerals using observations, testing, and a data chart of characteristic properties
		g	Explains how weathering and erosion change a rock's shape and size to form sediments (pebble, sand, silt, clay)

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

The Earth's surface features The Earth's surface has changed dramatically over time, and changes continue to occur. Changes in the Earth's surface are caused by natural processes such as erosion, deposition and plate tectonics.

Essential Questions

Why does the Earth's surface look the way it does, and how do we know?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	**ESS7**	**Describes how a variety of constructive and destructive natural processes shape Earth's surface**	
		a	Explains why the Earth's surface is always building up in some places and wearing down in others
		b	Describes landforms that are formed by erosion and give examples
		c	Describes landforms that are formed by deposition and give examples
	ESS8	**Use evidence to explain how natural events follow patterns of distribution that reflect geological cause and effect**	
		a	Relates and explains the patterns of earthquakes, volcanoes, and landforms on a world map to each other and to plate boundaries (plate tectonics)
		b	Identifies a pattern of natural events as corresponding with regional surface features (landslides with mountain ranges, earthquakes with faults, etc.)

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

The Earth is billions of years old. Fossils provide evidence that life existed at least 3.5 billion years ago, and that living things have changed over time.

Essential Questions

What are fossils, how do they form, and what can they tell us about past life?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	ESS9	Infers geologic, environmental, and biological changes through time based on fossil evidence	
		a	Describes methods of fossil formation
		b	Interprets rock layers, including position (concept of superposition), composition and fossil content to determine past conditions
		c	Predicts the change in rock layer sequence due to folding, breaking, and uplifting
		d	Explains why fossils are more likely to occur in sedimentary rocks
		e	Describes how fossil evidence can be linked to environmental conditions and biological adaptations of the past

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

The atmosphere's properties and composition are related to its physical structure.

Essential Questions

What is the atmosphere composed of and how do we know?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	ESS10	Relates the structure and function of the atmosphere to its properties and composition	
		a	Identifies all the layers of the atmosphere, their order and the properties and individual characteristics that define them
		b	Identifies the main components of the atmosphere (nitrogen, oxygen, carbon dioxide, water, inert gases)
		c	Demonstrates that air takes up space and has mass

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

The atmosphere is a dynamic system driven by energy from the sun.

Essential Questions

How does the Sun affect the Earth's atmosphere and its changes?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	**ESS11**	**Describes or illustrates the processes by which energy from the Sun drives atmospheric circulation**	
		a	Explains why the poles receive less solar energy than the equator
		b	Explains that as air is heated it becomes less dense and rises
		c	Explains that the Sun heats the Earth via radiation that, in turn, heats the atmosphere via conduction and convection
		d	Interprets a diagram to show how water and land surfaces heat differently thus producing winds
		e	Identifies convection as a driving force for localized weather phenomena such as winds and storms

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

Weather and climate result from interactions of the atmosphere with Earth's other systems.

Essential Questions

What causes weather and climate?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	**ESS12**	**Predicts weather and climate patterns by observing, measuring, and recording weather conditions across time and space**	
		a	Interprets local weather data that has been collected and changes that have occurred over time
		b	Uses several pieces of evidence (cloud observations, weather maps) to identify causes of change in weather and weather patterns (for example: weather systems generally move from west to east in the United States)
		c	Relates changes in local weather to larger scale weather patterns (for example: the general motion of regional air masses)
		d	Explains how Earth's surface features (mountains, oceans) affect local weather
		e	Uses data tables, graphs, maps, satellite images, etc. to compare weather conditions in various locations and over time
		f	Explains the difference between weather and climate
		g	Identifies the factors affecting climate change over time

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface.

Essential Questions

What are the unique properties of water, and how does it cycle within the Earth's crust, atmosphere, oceans, and other bodies of water?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts			
	ESS13	**Describes how water changes physical states as it circulates through and within the Earth's crust, oceans, and atmosphere**	
		a	Explains the processes and relationships that connect elements of the water cycle
		b	Describes and models physical characteristics of water in each of its states
		c	Describes the change in volume when water changes from one state of matter to another
		d	Provides evidence that water does not disappear when it evaporates
		e	Interprets an illustration of the water cycle that includes ground water, glaciers, oceans, rivers, and the atmosphere
		f	Describes conditions that affect the rates of evaporation and condensation
	ESS14	**Connects the characteristics and composition of water bodies to the behavior and effect of water on Earth**	
		a	Describes the composition and physical characteristics of oceans (temperature, wavelength, ocean floor)
		b	Predicts effects of changes in salinity on the physical characteristics of water
		c	Compares similarities and differences of fresh water and salt water
		d	Describes how salinity and temperature changes the density of water thus affecting its circulation

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

Describe the main components of the Solar System and explain how the Sun, Moon, and Earth interact to cause day, year, seasons, phases of the Moon and eclipses.

Essential Questions

What components make up the Solar System?

What causes day/night cycles, yearly cycles, phases of the Moon and the seasons?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	**ESS15**	**Describes the main components of the Solar System and explains how the Sun, Moon, and Earth interact to cause day, year, seasons, phases of the Moon, and eclipses**	
		a	Describes the parts and motions of the Solar System (Sun, planets, moons, asteroids, comets)
		b	Compares and contrasts the characteristics of the Sun, Moon and Earth
		c	Examines and explains the scientific theories on the formation of our Solar System, Earth, and Moon
		d	Distinguishes objects in the Solar System from those outside it
		e	Sequences pictures of phases of the Moon and explain why the Moon appears to change shape
		f	Draws a sketch that shows the position of the Sun, Earth, and Moon to explain the new and full moons
		g	Explains solar and lunar eclipses
		h	Uses a model to show how the Earth rotates with respect to the Sun resulting in day and night
		i	Uses a model to show how the tilt and orbit of Earth result in seasons
		j	Uses a model to show how the Earth orbits the Sun resulting in a year
		k	Explains how gravity affects the movement of the Sun, Moon and Earth

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 4 (continued)

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Enduring Understanding

The universe consists of many billions of galaxies separated by vast distances, and technology is necessary to explore and learn about space, both within our Solar System and beyond.

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Essential Questions

How is Earth unique in the Solar System?

What lies beyond our Solar System, and how do we know?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts			
	ESS16	**Compares and contrasts Earth with other planets in the Solar System, and explains why technology is necessary to study other planets and the universe beyond our Solar System**	
		a	Compares and contrasts the internal and external characteristics of planets
		b	Shows relative size of planets, given a scale to use
		c	Shows the relative distances between planets, given a scale to use
		d	Lists several ways that Earth differs from the other planets
		e	Explains the destination, purposes, challenges and history of space exploration
		f	Describes the components of the universe in terms of galaxies, stars and solar systems
		g	Understands the technologies needed to explore space and evaluates their effectiveness and challenges

Key Academic Vocabulary: atmosphere, circulation, climate, condensation, conduction, convection, crust, deposition, eclipse, equator, erosion, evaporation, fossil, galaxy, gravity, igneous, landform, metamorphic, mineral, orbit, plate tectonics, planet, pole, radiation, rock cycle, rotation, salinity, sediment, sedimentary, soil, solar system, star, universe, uplift, water cycle, weather, weathering

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 5

Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.

Enduring Understanding

Because we expect science investigations that are done the same way to produce the same results, when they do not, it is important to try to figure out why. Sometimes similar investigations give different results because of differences in the things being investigated, the methods used, or the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations. It is not always easy to tell which.

Essential Questions

Why do people repeat scientific investigations?

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts	ESS17	Explains why it is important to repeat scientific investigations	
		a	Predicts that when repeating a controlled experiment, it should lead to comparable results
		b	Recognizes that if conditions are not kept the same, evidence collected through repeated experiments cannot be accurately compared to previous experimental results
		c	Suggests possible reasons why an experiment might not have the same results when it is repeated

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 5 (continued)

Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.

Enduring Understanding

A model of something is similar to, but not exactly like, the thing being modeled. Some models are physically similar to what they are representing, but others are not.

Essential Questions

How do people use models in science?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	**ESS18**	**Creates and uses physical and conceptual models for explanation and prediction**	
		a	Recognizes and/or describes that models can be used to obtain information about scientific processes and/or objects that may be difficult to study
		b	Gives examples of models that are used to understand scientific processes or concepts • when it may take several years to collect the data firsthand (for example: sea floor spreading) • where the event has already occurred and evidence has been lost or is limited (for example: asteroids, fossil record) • when a process is dangerous to study (for example: volcanoes, tornados) • when a process is very slow (for example: continental drift, climate change, erosion)

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 5 (continued)

Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.

Enduring Understanding

Many people from different cultures, from different parts of the world and from different backgrounds take part in scientific investigations and have made significant contributions to the advancement of scientific understanding. Science benefits as a discipline by engaging a diverse community of participants with different perspectives.

Essential Questions

Why are diverse perspectives and a team approach important to scientific research?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts	ESS19	Recognizes that people in different cultures and at different times in history have made contributions to the advancement of science	
		a	Describes a contribution to earth and space science made by someone from a non-dominant culture
		b	Describes a contribution to earth and space science made by someone from the past
		c	Explains that the process of science benefits from collaboration among people with diverse perspectives because different people have different ways of approaching problems, designing investigations and interpreting data

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Science Standard 5 (continued)

Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.

Enduring Understanding

Scientific knowledge changes as people discover new evidence and revise explanations.

Essential Questions

How has scientific knowledge changed in the field of earth and space science and why?

Essential Learnings (continued)

Essential Knowledge, Skills, Topics, Processes, and Concepts			
	ESS20	**Explains that scientific knowledge changes as new knowledge is acquired and previous ideas are modified**	
		a	Gives examples of reasons why scientific knowledge changes over time (for example: advances in technology – Hubble telescope and the discovery of vast numbers of galaxies)

Key Academic Vocabulary: controlled experiment, implication, model

Suggested Timelines

Topic (can be done in any order)	Suggested Timeframe (can be done in any order)
Scientific Investigations & Nature of Science	Embedded throughout
Rock Cycles	2-4 weeks
Processed that shape Earth's surface	4-5 weeks
Fossils	2 weeks
Atmospheric Structure and circulation	3 weeks
Weather and climate	3-4 weeks
Water cycle	2-4 weeks
Solar System	2-4 weeks
Galaxies and Space exploration	1 week

Science Scope & Sequence K-5

Standard	K	1	2	3	4	5
Scientific Investigations	Observation, simple questions and predictions, safety	Observation, simple questions and predictions, recording data, safety	Observation, simple questions and predictions, recording data, explanations, and safety	Designing investigations, measurement, explanations, safety	Designing investigations, organizing and representing data, measurement, explanations, safety	Fair test, identifying and controlling variables, organizing and representing data, explanations, safety
Physical Science	Properties of objects	Balance and motion	States of matter	Matter and Energy	Magnetism and electricity	Changes in matter, Force and motion
Life Science	Characteristics of living things	Structures and life cycles of plants	Structures and life cycles of insects	Human body systems	Structure, function, and energy in organisms	Ecosystems
Earth and Space Science	Seasons	Sorting and comparing Earth's materials	Air and weather	Fossils	Water Solar system	Landforms
Nature of Science	N/A	N/A	N/A	Repeating investigations and models	Repeating investigations and models	Repeating investigations and models

Science Scope & Sequence 6-12

Standard	6	7	8	Physical Science	Biology
Scientific Investigations	Design and conduct investigations Use tools and technology Organize and use data Communicate results Safety	Design and conduct investigations Use tools and technology Organize and use data Communicate results Safety	Design and conduct investigations Use tools and technology Organize and use data Communicate results Safety	Ask questions and state hypotheses Design and conduct investigations Safely use tools and technology Evaluate error and uncertainty Communicate and evaluate results	Ask questions and state hypotheses Design and conduct investigations Safely use tools and technology Evaluate error and uncertainty Communicate and evaluate results Alternative explanations and models
Standards 2-4 • **Physical Science** • **Life Science** • **Earth and Space Science**	**Physical Science** Particulate model of matter Atoms Mixtures and solutions Compounds and molecules Conservation of matter Mass and weight Energy sources Energy transformations Force and motion Electrical circuits Light waves	**Life Science** Characteristics of organisms Human body Transport within multi-cellular organisms Photosynthesis and respiration Interactions within ecosystems Matter and energy in ecosystems Cells Evolution Genetics	**Earth and Space Science** Water cycle Bodies of water Processes that shape Earth's surface Atmosphere structure and function Fossils Atmosphere circulation Minerals, rocks, and soils Weather and climate Plate tectonics Solar System Sun, Earth, Moon Galaxies and space exploration	**Physical Science** Kinetic-molecular model of matter Atomic structure and the periodic table Chemical bonding and reactions Separating complex mixtures Conservation of matter and energy Energy transformations Waves Force and motion Electricity and magnetism	**Life Science** Physical and biochemical characteristics of living things Cell structure, function and differentiation Homeostasis and cellular transport Molecular basis of heredity Evolution Photosynthesis and cellular respiration Interactions within ecosystems
Nature of Science	Repeatability Models Technology and impacts Science as a human endeavor	Repeatability Models Technology and impacts Science as a human endeavor	Repeatability Models Technology and impacts Science as a human endeavor	Technology and impacts Scientific hypotheses, theories and laws	Technology and impacts Scientific hypotheses, theories and laws Science as a human endeavor

Science Glossary of Terms

Abiotic	not associated with or derived from living organisms; abiotic factors in an environment include such items as sunlight, temperature, wind patterns, and precipitation
Adaptation	a change by which an organism becomes better suited to its environment
Air	the invisible gaseous substance surrounding the earth, a mixture mainly of oxygen and nitrogen
Air pressure	the pressure exerted by the atmosphere
Amino Acid	of a class of about twenty organic compounds which form the basic constituents of proteins and contain both acid and amine groups
Amplitude	the maximum extent of a vibration or oscillation from the point of equilibrium.
Asexual reproduction	reproduction without the fusion of gametes
Atmosphere	the envelope of gases surrounding the earth or another planet
Atom	the smallest particle of a chemical element, consisting of a positively charged nucleus surrounded by negatively charged electrons
Attract	to cause to draw near or adhere by physical force
Axis	an imaginary line through a body, about which it rotates
Bar graph	a graph consisting of parallel, usually vertical bars or rectangles with lengths proportional to the frequency with which specified quantities occur in a set of data
Bias	statistical sampling or testing error caused by systematically favoring some outcomes over others
Biosphere	a single cell, such as a D-cell, that produces an electric current
Body system	a group of organs or structures within the body that work together to perform one or more specific functions
Boiling point	the temperature at which a liquid boils at a fixed pressure, especially under standard atmospheric conditions
Brain	the portion of the vertebrate central nervous system that is enclosed within the cranium, continuous with the spinal cord, and composed of gray matter and white matter. It is the primary center for the regulation and control of bodily activities, receiving and interpreting sensory impulses, and transmitting information to the muscles and body organs. It is also the seat of consciousness, thought, memory, and emotion
Capacity	the maximum amount that can be contained

Science Glossary of Terms (continued)

Carbohydrate	any of a group of organic compounds that includes sugars, starches, celluloses, and gums and serves as a major energy source in the diet of animals. These compounds are produced by photosynthetic plants and contain only carbon, hydrogen, and oxygen, usually in the ratio 1:2:1
Cell	the smallest structural and functional unit of an organism.
Cell division	the process in reproduction and growth by which a cell divides to form daughter cells
Cellular respiration	the series of metabolic processes by which living cells produce energy through the oxidation of organic substances.
Celsius	of or relating to a temperature scale that registers the freezing point of water as 0° and the boiling point as 100° under normal atmospheric pressure
Centimeter	metric unit of length equal to 1/100 of a meter
Characteristic	a feature that helps to identify, tell apart, or describe recognizably; a distinguishing trait
Chemical change	a change in which the substances present at the beginning of the change are not present at the end; new substances are formed. The change cannot be “undone”
Chemical formula	a representation of a substance using symbols to represent constituent elements
Chloroplast	a structure in algal and green plant cells which contains chlorophyll and in which photosynthesis takes place
Chromosome	a thread-like structure found in the nuclei of most living cells, carrying genetic information in the form of genes
Circuit	a path followed or capable of being followed by an electric current
Circulation	movement in a circle or circuit
Circulatory system	the body system that circulates blood through the body, consisting of the heart and blood vessels
Classification system	an organized structure or system for arranging things into two or more groups, using two or more characteristics
Climate	meteorological conditions including temperature, precipitation, and wind which characteristically prevail in a particular region
Cohesion	the intermolecular attraction by which the elements of a body are held together
Community	a group of interdependent plants or animals growing or living together or occupying a specified habitat
Component	a single part of a larger system

Science Glossary of Terms (continued)

Composition	the combining of distinct parts or elements to form a whole
Compound	a pure, macroscopically homogeneous substance consisting of atoms or ions of two or more different elements in definite proportions that cannot be separated by physical means. A compound usually has properties unlike those of its constituent elements
Condensation	the process by which a gas or vapor changes to a liquid
Conduction	the transmission or conveying of something through a medium or passage, especially the transmission of electric charge or heat through a conducting medium without perceptible motion of the medium itself
Conductor	a substance or medium that conducts an electric charge
Conservation of energy	a principle stating that the total energy of an isolated system remains constant regardless of changes within the system
Conservation of mass	a principle in classical physics stating that the total mass of an isolated system is unchanged by interaction of its parts
Conservation of matter	a fundamental principle of classical physics that matter cannot be created or destroyed in an isolated system
Constant	an experimental or theoretical condition, factor, or quantity that does not vary or that is regarded as invariant in specified circumstances
Consumer	an organism that cannot make its own food and must eat in order to survive
Controlled experiment	an experiment that isolates the effect of one variable on a system by holding constant all variables but the one under observation
Convection	heat transfer in a gas or liquid by the circulation of currents from one region to another
Coriolis effect	result of an apparent force that as a result of the Earth's rotation deflects moving objects (as projectiles or air currents) to the right in the northern hemisphere and to the left in the southern hemisphere
Crust	solid, outermost layer of the Earth, lying above the mantle
Data	factual information (as measurements or statistics) used as a basis for reasoning, discussion, or calculation
Decomposer	an organism that breaks down organic materials in the environment
Decomposition	breakdown or decay of organic materials
Density	the mass of a substance per unit volume
Dependent variable	the observed or measured variable in an experiment or study whose changes are determined by the presence of one or more independent variables

Science Glossary of Terms (continued)

Deposition	the laying down of matter by a natural process
Development	the process of an individual organism growing organically; a purely biological unfolding of events involved in an organism changing gradually from a simple to a more complex level
Digestive system	body system consisting of the alimentary canal and digestive glands and responsible for the ingestion, digestion, and absorption of food
Dominant	an allele that produces the same phenotypic effect whether inherited with a homozygous or heterozygous allele
Earth	the third planet from the sun
Earth's material	any substance occurring naturally on Earth, such as water, soil, rocks, etc
Eclipse	the partial or complete obscuring, relative to a designated observer, of one celestial body by another
Ecosystem	a biological community of interacting organisms and their physical environment
Electricity	a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current
Electromagnetic	pertaining to or exhibiting magnetism produced by electric charge in motion; "electromagnetic energy"
Electron	an elementary particle in all atoms that has a negative charge
Element	a substance composed of atoms having an identical number of protons in each nucleus; elements cannot be reduced to simpler substances by normal chemical means
Embryo	an organism in its early stages of development, especially before it has reached a distinctively recognizable form
Energy	the capacity of a physical system to do work
Environment	the complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival
Equator	the imaginary great circle around the Earth's surface, equidistant from the poles and perpendicular to the Earth's axis of rotation; it divides the earth into the Northern Hemisphere and the Southern Hemisphere
Erosion	the group of natural processes; including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the Earth's surface

Science Glossary of Terms (continued)

Error	difference between a computed or measured value and a true or theoretically correct value
Evaporation	to convert or change into a vapor
Evidence	information acquired through objective experience
Evolution	a gradual process in which something changes into a different form
Explanation	a statement based on scientific evidence and logical argument about causes and effects or relationships between variables
Food chain	a succession of organisms in an ecological community that constitutes a continuation of food energy from one organism to another as each usually consumes a lower member and in turn is preyed upon by a higher member
Food web	a complex of interrelated food chains in an ecological community
Force	an influence tending to change the motion of a body or produce motion or stress in a stationary body; a push or a pull
Fossil	a remnant or trace of an organism of a past geologic age, such as a skeleton or leaf imprint, embedded and preserved in the earth's crust
Friction	a force that resists the relative motion or tendency to such motion of two bodies in contact
Fruit	the ripened ovary or ovaries of a seed-bearing plant
Function	the role or purpose of a structure
Galaxy	any of numerous large-scale aggregates of stars, gas, and dust that constitute the universe
Gas	the state of matter distinguished from the solid and liquid states by relatively low density and viscosity, relatively great expansion and contraction with changes in pressure and temperature, the ability to diffuse readily, and the spontaneous tendency to become distributed uniformly throughout any container
Gene	hereditary unit consisting of a sequence of DNA that occupies a specific location on a chromosome and determines a particular characteristic in an organism
Germination	the beginning of development of a seed after a period of dormancy or rest
Gram	the basic unit of mass in the metric system

Science Glossary of Terms (continued)

Gravity	the force that attracts a body towards the center of the earth, or towards any other physical body having mass
Habitat	the area or environment where an organism or ecological community normally lives or occurs
Heart	the chambered muscular organ in vertebrates that pumps blood received from the veins into the arteries, thereby maintaining the flow of blood through the entire circulatory system
Heat	a form of energy associated with the motion of atoms or molecules and capable of being transmitted through solid and fluid media by conduction through fluid media by convection, and through empty space by radiation
Heredity	genetic transmission of characteristics from parent to offspring
Hypothesis	a tentative explanation for an observation
Igneous	rocks or minerals formed by the cooling and hardening of magma or molten lava
Implication	a probable consequence
Independent variable	a manipulated variable in an experiment or study whose presence or degree determines the change in the dependent variable
Inheritance	genetic transmission of characteristics from parent to offspring
Insulator	a material that prevents the flow of electricity
Internal balance	balance within an organism of its internal environment
Intestines	the portion of the alimentary canal extending from the stomach to the anus and, in humans and other mammals, consisting of two segments, the small intestine and the large intestine
Kidneys	pair of organs in the dorsal region of the vertebrate abdominal cavity, functioning to maintain proper water and electrolyte balance, regulate acid-base concentration, and filter the blood of metabolic wastes, which are then excreted as urine
Kilogram	metric unit equaling 1000 grams
Kinetic	relating to the motion of an object: e.g. “kinetic energy” is the energy possessed by an object because of its motion
Landform	a recognizable, naturally formed feature on the Earth's surface. Landforms have a characteristic shape and can include such large features as plains, plateaus, mountains, and valleys, as well as smaller features such as hills, eskers, and canyons
Length	the distance of something from end to end, usually the longest dimension
Life cycle	the course of developmental changes in an organism from fertilized zygote to maturity when another zygote can be produced

Science Glossary of Terms (continued)

Life stage	the stages or forms that an insect goes through as it is developing; egg, larva, pupa, adult
Light	electromagnetic radiation that can produce a visual sensation
Line graph	a diagram that exhibits a relationship, often functional, between two sets of numbers as a set of points having coordinates determined by the relationship. Also called *plot*
Liquid	the state of matter in which a substance exhibits a characteristic readiness to flow, little or no tendency to disperse, and relatively high incompressibility
Liter	basic unit of fluid volume in the metric system
Liver	a large, reddish-brown, glandular vertebrate organ located in the upper right portion of the abdominal cavity that secretes bile and is active in the formation of certain blood proteins and in the metabolism of carbohydrates, fats, and proteins
Living	alive, having life, not dead
Locomotion	movement
Lungs	the two spongy, saclike respiratory organs in most vertebrates, occupying the chest cavity together with the heart and functioning to remove carbon dioxide from the blood and provide it with oxygen
Magnet	an object that sticks to iron
Magnetism	the property displayed by magnets and produced by the motion of electric charges, which results in attraction or repulsion between objects
Magnitude	relative size or extent
Mass	the quantity of matter which a body contains, as measured by its acceleration under a given force or by the force exerted on it by a gravitational field
Matter	physical substance or material in general, that which occupies space and possesses mass
Measure	to ascertain the dimensions, quantity, or capacity of
Mechanical	relating to the action of forces on material objects
Metamorphic	rocks altered considerably from the original structure and composition by pressure and heat
Metamorphosis	a change from larva to adult
Meter	metric unit of length
Metric	system of weights and measures based on multiples of ten

Science Glossary of Terms (continued)

Milliliter	one one-thousandth of a liter; 1000 milliliters equal 1 liter
Millimeter	one one-thousandth of a meter; 1000 millimeters equal 1 meter
Mineral	a naturally occurring, homogeneous inorganic solid substance having a definite chemical composition and characteristic crystalline structure, color, and hardness
Mixture	a composition of two or more substances that are not chemically combined with each other and are capable of being separated
Model	an explanation or representation of an object, system, or process that cannot be easily studied
Molecule	the simplest unit of a chemical compound that can exist, consisting of two or more atoms held together by chemical bonds
Moon (lunar) phases	one of the cyclically recurring apparent forms of the moon
Motion	a natural event that involves a change in the position or location of something
Movement	the act or an instance of moving; a change in place or position
Multicellular	describes organisms consisting of more than one cell
Muscular system	the body system that is composed of skeletal, smooth, and cardiac muscle tissue and functions in movement of the body or of materials through the body, maintenance of posture, and heat production
Natural resources	a material source of wealth, such as timber, fresh water, or a mineral deposit, that occurs in a natural state and has economic value
Nervous system	the system of cells, tissues, and organs that regulates the body's responses to internal and external stimuli. In vertebrates it consists of the brain, spinal cord and nerves
Neutron	a neutral elementary particle of about the same mass as a proton
Nonliving	not alive; referring to something that has never been alive
Nonrenewable resource	of or relating to an energy source, such as oil or natural gas, or a natural resource, such as a metallic ore, that is not replaceable after it has been used
Nuclear	relating to atomic nuclei; derived from the energy of atomic nuclei
Nutrient	any substance that can be metabolized by an organism to give energy and build tissue
Observation	the act of making and recording a measurement
Opinion	a belief or conclusion held with confidence but not substantiated by positive knowledge or evidence

Science Glossary of Terms (continued)

Orbit	the path of a celestial body or an artificial satellite as it revolves around another body
Organism	a living thing that has (or can develop) the ability to act or function independently
Organ	structure of the body that performs a particular function
Parallel circuit	a closed circuit in which the current divides into two or more paths before recombining to complete the circuit
Particle	a very small piece of matter
Particulate model	model of matter describing all matter as composed of particles with space in between them; the relative distance between particles and the motion of the particles can be used to explain the phases of matter (gas, liquid, solid)
Phase change	a change from one state (solid or liquid or gas) to another without a change in chemical composition
Photosynthesis	biochemical process of transforming light energy into stored chemical energy in the form of glucose; chemical formula $6CO_2 + 6H_20 +$ light energy $\rightarrow 6O_2 + C_6H_{12}O_6$
Physical property	property of a substance that can be measured without altering the identity of the substance
Planet	a non-luminous celestial body larger than an asteroid or comet
Plasma	an electrically neutral, highly ionized gas composed of ions, electrons, and neutral particles. It is a phase of matter distinct from solids, liquids, and normal gases.
Plate tectonics	a theory that explains the global distribution of geological phenomena such as seismicity, volcanism, continental drift, and mountain building in terms of the formation, destruction, movement, and interaction of the earth's lithospheric plates
Pole	either extremity of an axis through a sphere
Population	all the organisms that constitute a specific group or occur in a specified habitat
Position	place or location
Potential	the amount of energy required to move an object from a reference point to a designated point within a gravitational field
Precipitation	any form of water such as rain, snow, sleet, or hail which falls to the earth's surface
Prediction	a statement about what one thinks will happen in an investigation
Producer	an organism, such as a green plant, that produces its own food

Science Glossary of Terms (continued)

Product	a substance resulting from a chemical reaction
Property	something that can be known by looking at or feeling an object; something one can observe
Proton	an elementary particle in all atoms that has a positive charge
Qualitative	involving distinctions, descriptions, or comparisons based on qualities that can be observed without measurement (*e.g.* color, shape, appearance)
Quantitative	involving distinctions, descriptions, or comparisons that can be quantified or measured
Radiation	emission and propagation and emission of energy in the form of rays or waves
Ratio	the relationship between two quantities expressed as the quotient of one divided by the other
Receiver	a device that receives electricity
Recessive	an allele that does not produce a characteristic effect when present with a dominant allele; a trait that is expressed only when the determining allele is present in the homozygous condition
Record	to set down for preservation in writing or other permanent form
Recycle	to reprocess (something already used) for further use
Reduce	to make smaller or fewer
Renewable resource	any natural resource (as wood or solar energy) that can be replenished naturally with the passage of time
Repeat	to do again
Repel	push away, as similar poles of two magnets push away from one another
Respiratory system	the organs that are involved in breathing; these include the nose, throat, larynx, trachea, bronchi, and lungs. Also called the respiratory tract
Reuse	to use again
Resource	available supply of something that can be drawn upon when needed
Rock cycle	the process by which rocks are recycled and changed from one form of rock to another
Root	the part of a plant that grows downward in the soil. Roots provide support and take up water and nutrients
Rotation	the act or process of turning around a center or an axis

Science Glossary of Terms (continued)

Salinity	the relative proportion of salt in a solution
Science	the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment
Sediment	material that has been deposited by water, ice or wind
Sedimentary	rocks formed when sediment is deposited and becomes tightly compacted
Series circuit	an electric circuit connected so that current passes through each circuit element in turn without branching
Shelter	something that provides cover or protection
Skeleton	hard inner framework of bones inside an animal that provides shape, support, and protection
Skin	flexible organ that covers the body and protects it
Soil	the top layer of the earth's surface, consisting of rock and mineral particles mixed with organic matter
Solar system	a system of planets or other bodies orbiting another star
Solid	the state in which a substance has no tendency to flow under moderate stress; resists forces (such as compression) that tend to deform it; and retains a definite size and shape
Solution	homogeneous mixture of two or more substances, which may be solids, liquids, gases, or a combination of these
Sort	to arrange according to class, kind, or size; classify
Sound	vibrations transmitted through an elastic solid or a liquid or gas, capable of being detected by human organs of hearing
Source	the point or device from which electricity flows
Space	an empty area (usually bounded in some way between things); the expanse in which the solar system, stars, and galaxies exist; the universe
Speed	the rate or a measure of the rate of motion
Star	a celestial body of hot gases that radiates energy derived from thermonuclear reactions in the interior
State of matter	the physical state that matter exists in; solid, liquid or gas

Science Glossary of Terms (continued)

Static electricity	electricity that is generated when one object rubs against another object; positive and negative electric charges that are separated from each other and are not moving
Stem	any stalk supporting leaves, flowers, or fruit
Stomach	the enlarged, saclike portion of the alimentary canal, one of the principal organs of digestion, located in vertebrates between the esophagus and the small intestine
Structure	any identifiable part of an organism
Substance	a particular kind of matter with uniform properties
Support	to bear the weight of; to hold in position so as to keep from falling, sinking, or slipping
Switch	device used to open and close circuits
Surface	the outer or the topmost boundary of an object
System	a group of interacting, interrelated, or interdependent elements forming a complex whole
T-chart	a graphic organizer with two columns in which the entry in one column is paired with the entry in the other
Table	an orderly arrangement of data, especially one in which the data are arranged in columns and rows in an essentially rectangular form
Temperature	a measure of the average kinetic energy of the particles in a sample of matter, expressed in terms of units or degrees designated on a standard scale
Testable	able to be tested or investigated by a scientific investigation
Thermometer	a tool used to measure temperature
Tissue	aggregation of morphologically similar cells and associated intercellular matter acting together to perform one or more specific functions in the body

Science Glossary of Terms (continued)

Transfer	to convey or cause to pass from one place or thing to another
Transform	to convert from one form to another
Unit	a standard amount of a physical quantity, such as length or energy, used to express magnitudes of that quantity
Universe	all matter and energy, including the Earth, the galaxies, and the contents of intergalactic space, regarded as a whole
Uplift	upheaval; raising something to a higher level
Variable	a factor or condition that can change and might affect the outcome of an experiment.
Velocity	a vector quantity whose magnitude is a body's speed and whose direction is the body's direction of motion
Verify	to determine or test the accuracy of, as by comparison, investigation, or reference
Volume	the amount of 3-dimensional space occupied by an object
Water cycle	the circulation of the Earth's water, in which water from the sea evaporates, forms clouds, falls as rain or snow, and returns to the sea by rivers
Wavelength	the distance between one peak or crest of a wave of light, heat, or other energy and the next corresponding peak or crest
Weather	the state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity, and barometric pressure
Weathering	any of the chemical or mechanical processes by which rocks exposed to the weather undergo changes in character and break down
Weight	the force with which a body is attracted to Earth or another celestial body, equal to the product of the object's mass and the acceleration of gravity
Work	the transfer of energy from one physical system to another, especially the transfer of energy to a body by the application of a force that moves the body in the direction of the force
Year	the time taken by the Earth to make one revolution around the sun