Algebra II Curriculum Essentials Document

Boulder Valley School District
Department of Curriculum and Instruction
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Boulder Valley School District
Board of Education

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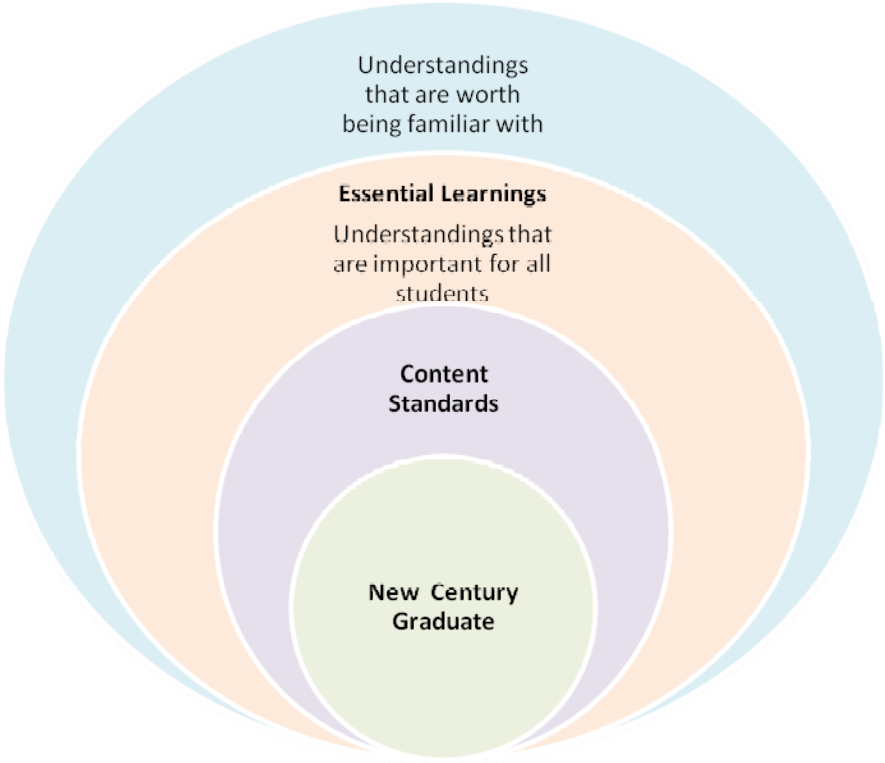
Algebra II Curriculum Essentials

General Introduction

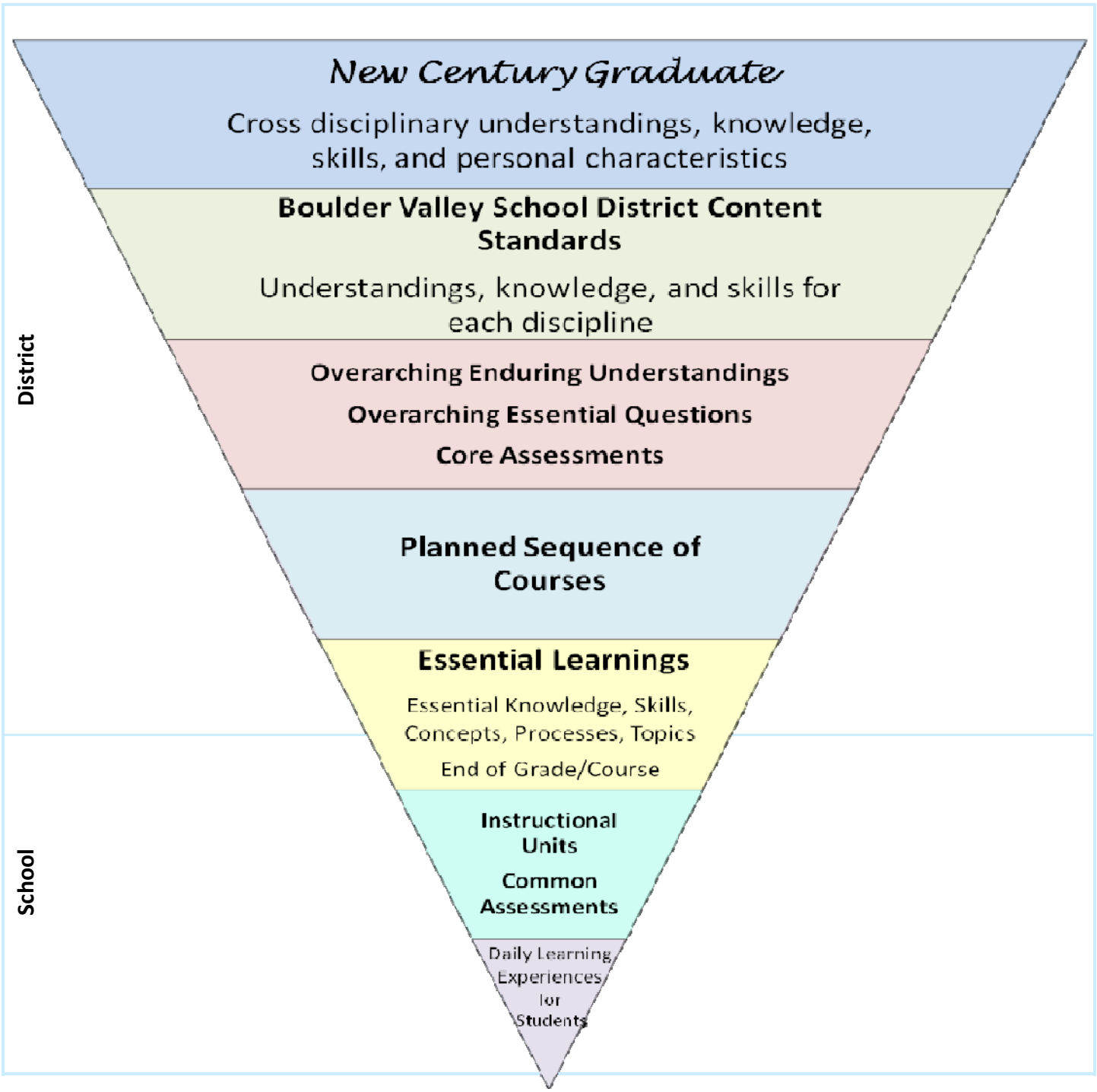
What is a Curriculum Essentials Document? How Does it Relate to a Guaranteed and Viable Curriculum?



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

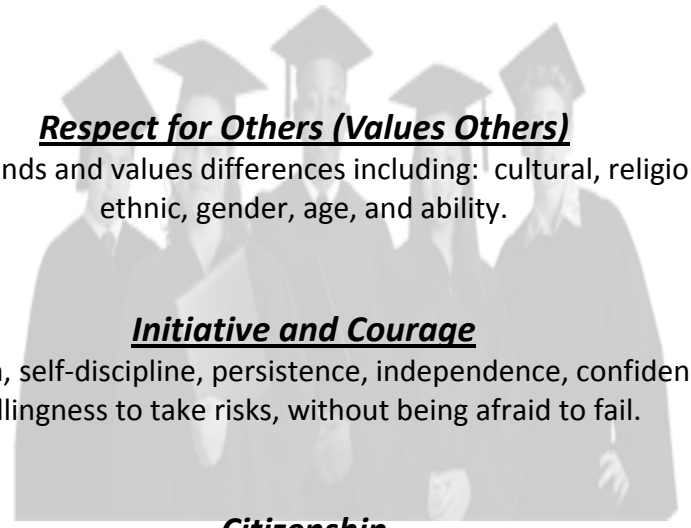
Demonstrates basic sciences knowledge and understands high-level scientific systems including environmental systems.

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.

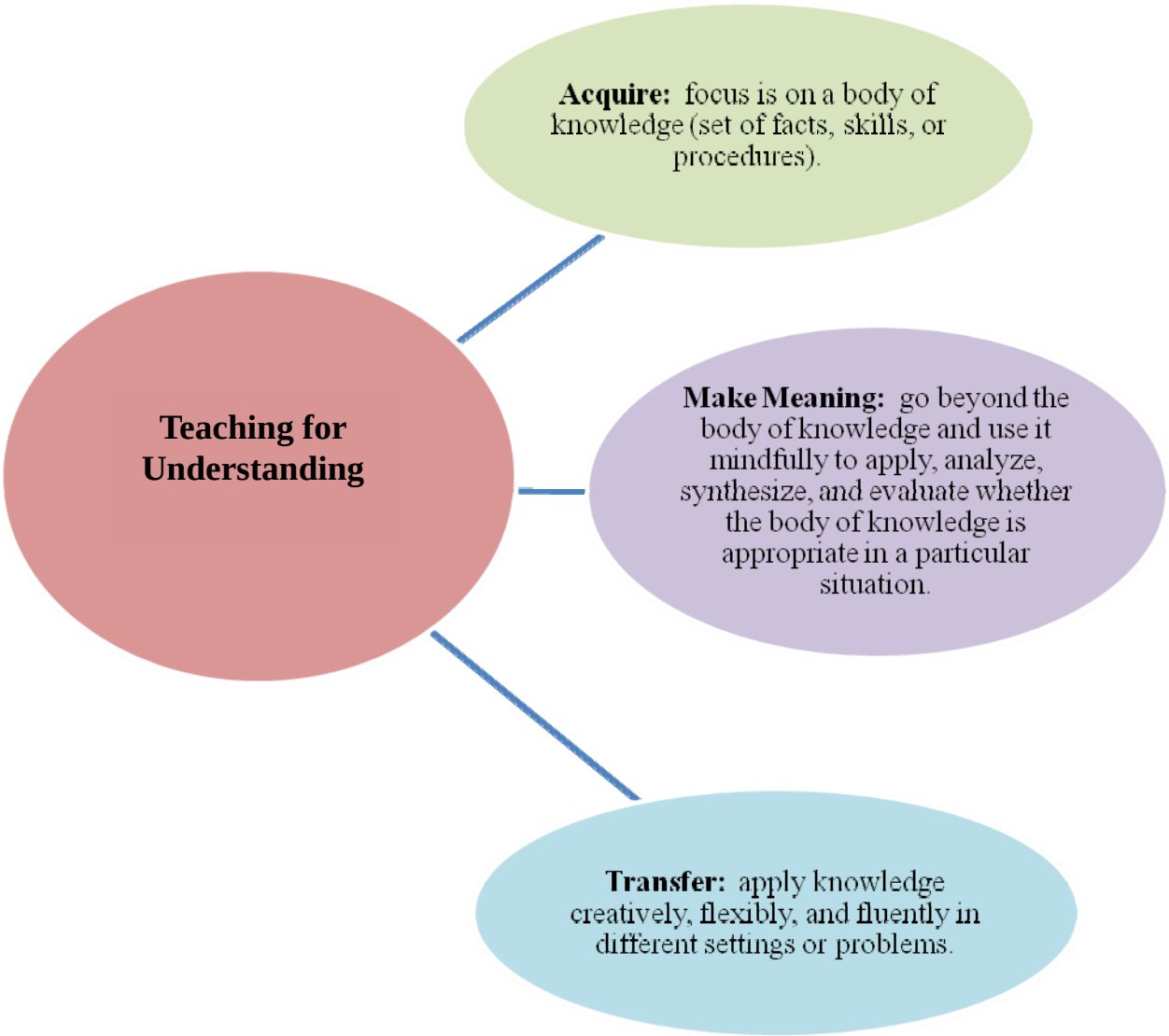
An understanding can be overarching or topical. Overarching understandings are broad (as the name implies) and offer a possible bridge to other units and courses. Overarching understandings at identified at the district-level. Topical understandings are unit specific, identified by teachers about the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

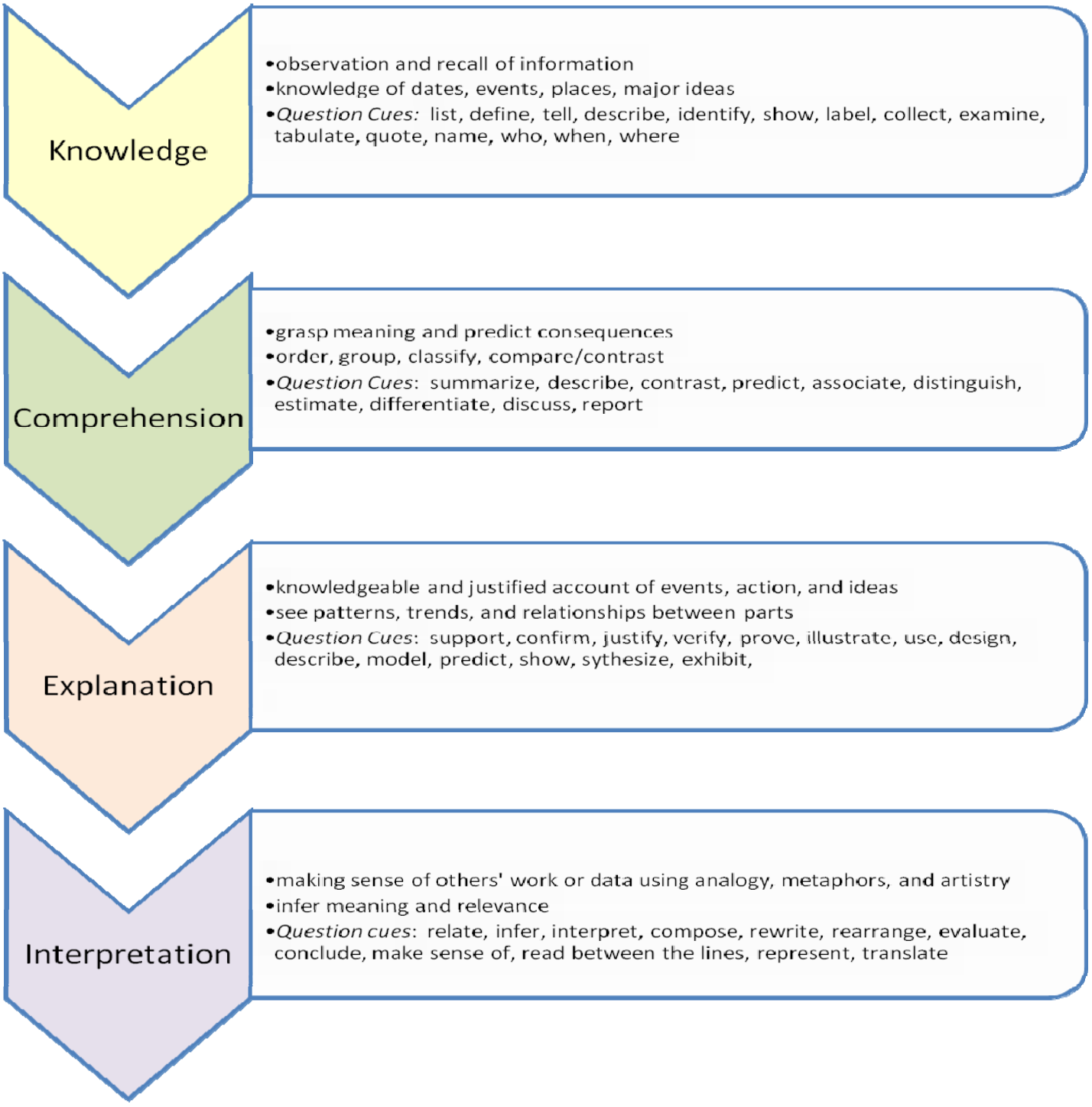
An essential questions can be either overarching or topical in scope. Overarching essential questions are general in nature, causing genuine and relevant inquiry into the big ideas and core content. They cut across units and/or courses. Topical essential questions focus on a specific topic and meant 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?



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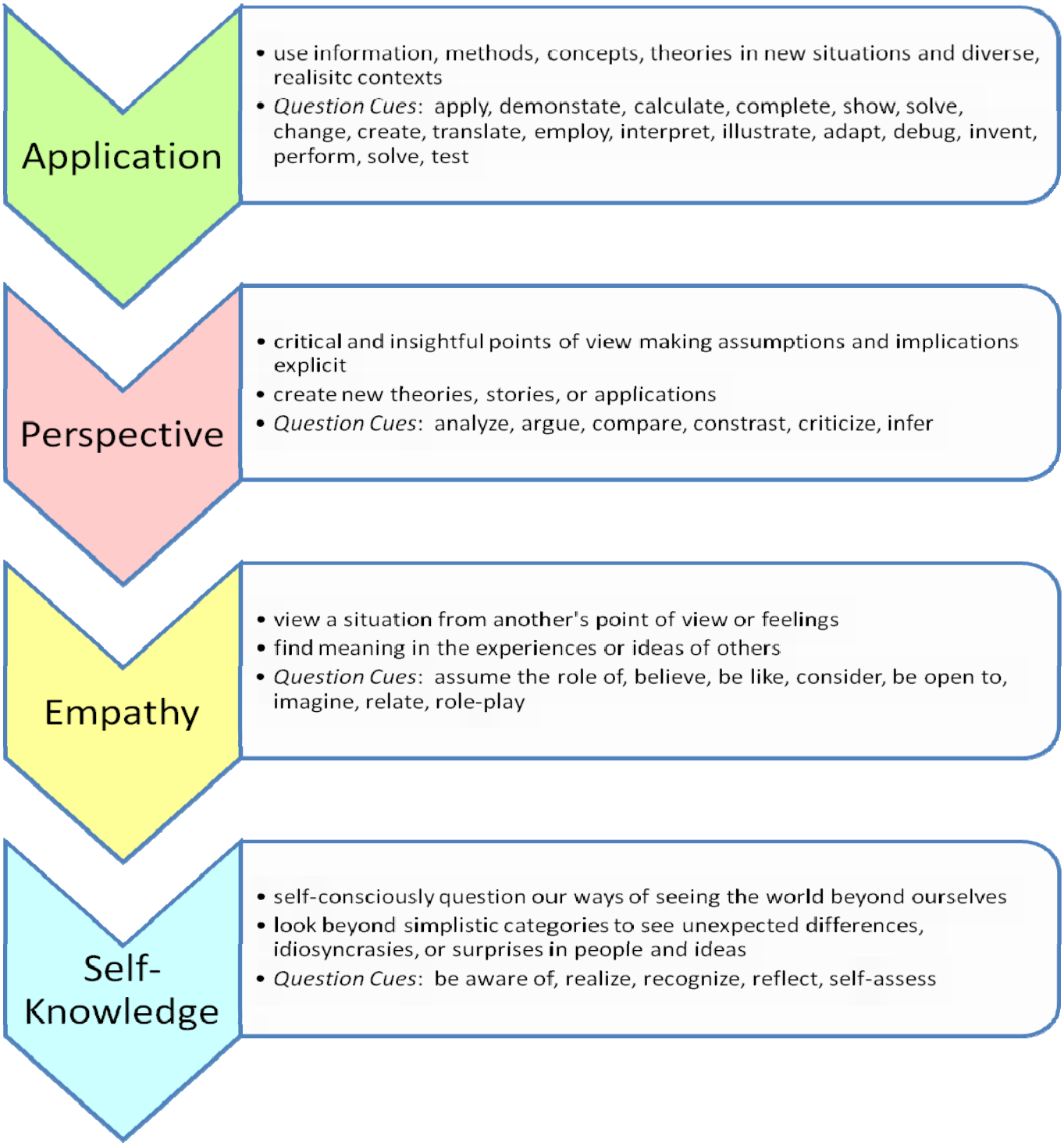
What Does it Mean to Understand? (continued)



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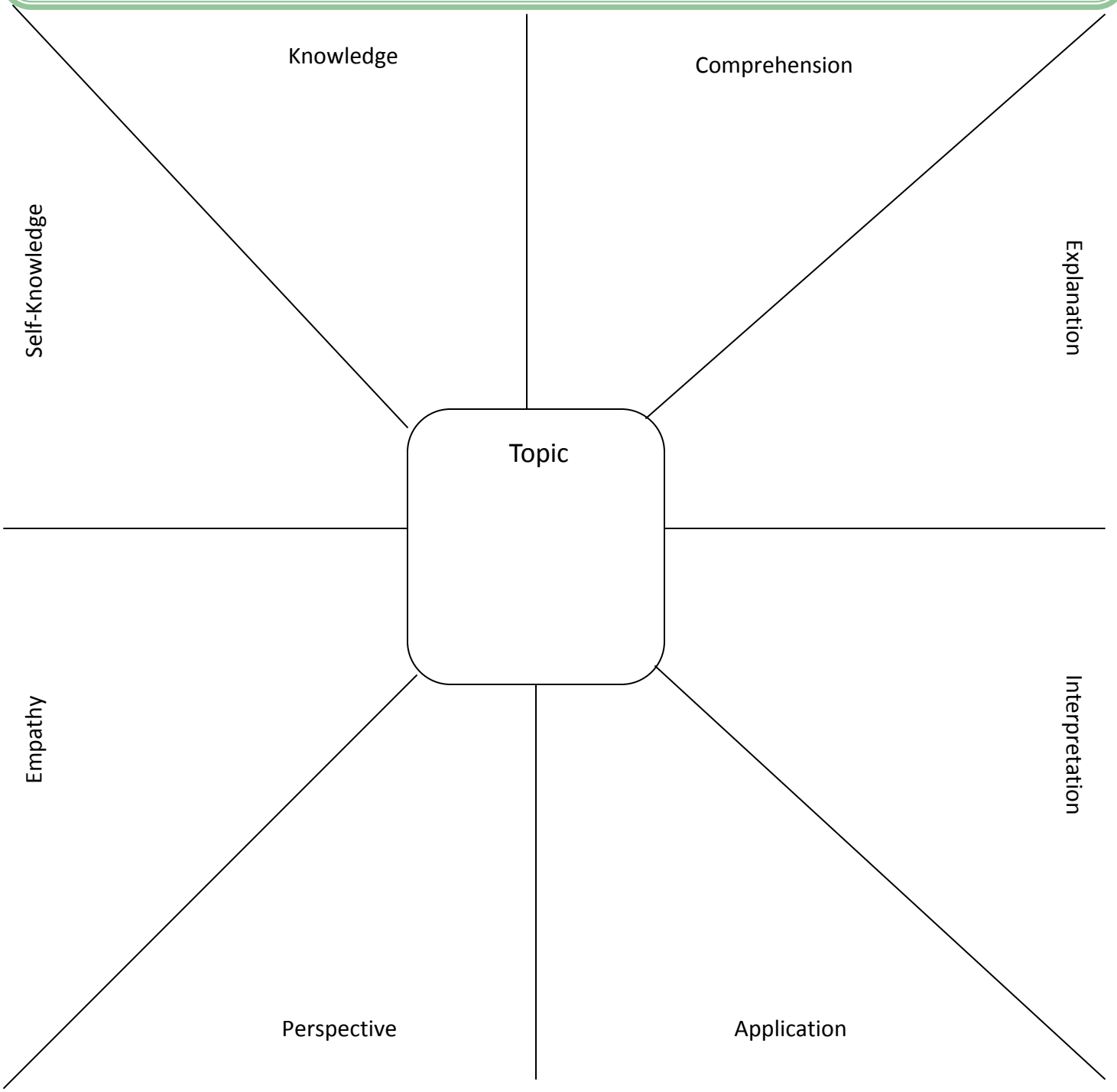
Levels of Understanding
Essential Questions



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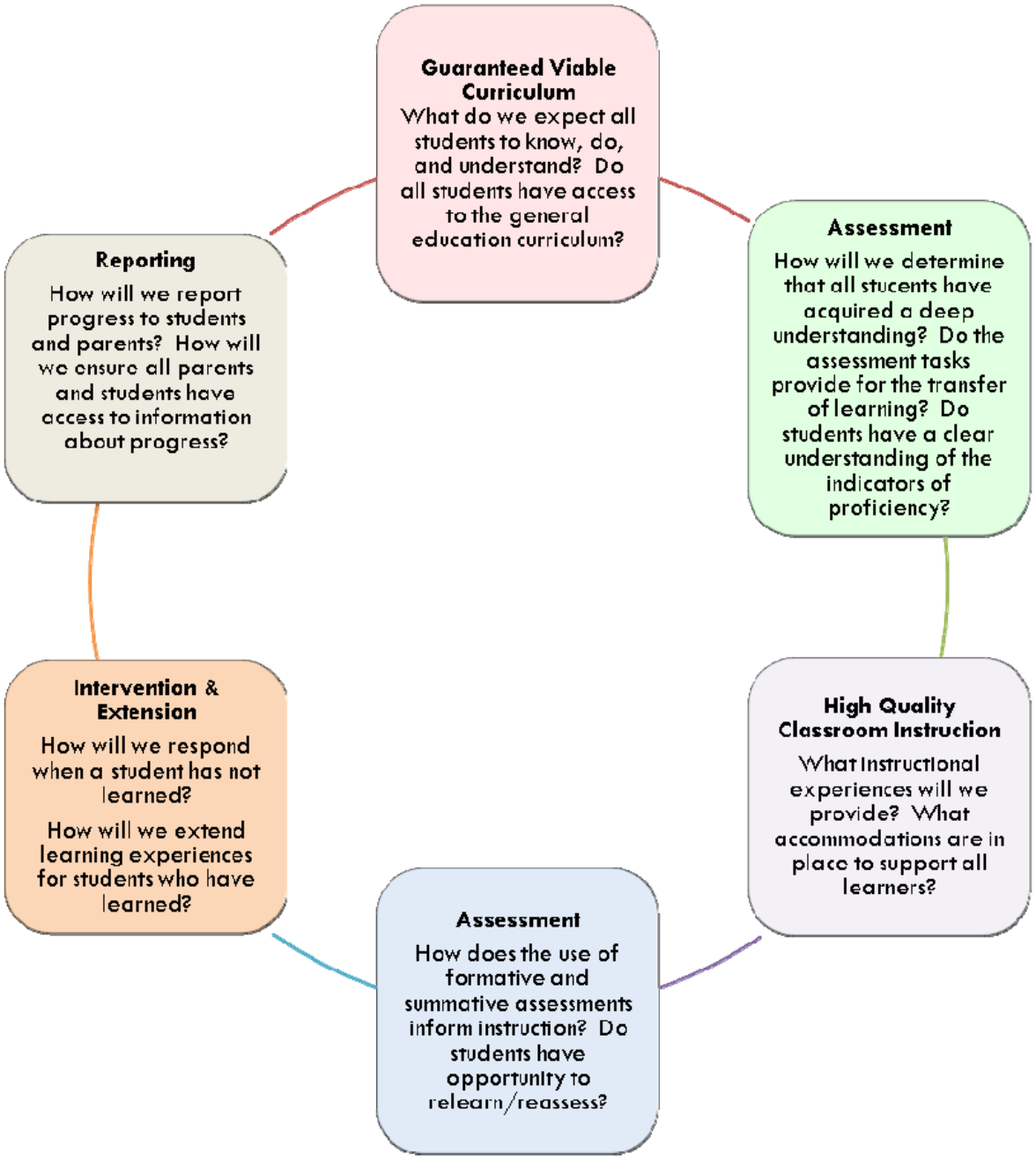
Instructional Framework
Making the Connections

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

High School Mathematics Essential Learnings

Algebra I

- Simplifies expressions involving rational numbers, exponents and absolute value and justifies each step using properties of real numbers and laws of exponents
- Investigates and analyzes functions and function families
- Analyzes and represents linear functions and inequalities to solve problems
- Solves quadratic equations both symbolically and graphically
- Uses the language of mathematics to express ideas precisely through reasoning, representations, and communication

Geometry I

- Applies congruence and similarity correspondences and properties of the figures to find missing parts of geometric figures and provide logical justification
- Uses algebraic, coordinate, and deductive methods to solve problems involving parallel and perpendicular lines and distance and midpoint formulas
- Investigates and indentifies properties of polygons and circles
- Solves practical problems involving right triangles by using the Pythagorean Theorem, properties of special right triangles, and right triangle trigonometry
- Uses formulas to solve practical problems involving perimeter, area, surface area, and volume and use appropriate units of measurement
- Construct and judge the validity of a logical argument consisting of a set of premises and a conclusion

High School Mathematics Essential Learnings

Algebra II

- Performs operations on expressions containing complex numbers, rational exponents and complex fractions
- Recognizes classes of functions including linear, polynomial, absolute value, step, rational, and exponential from multiple representations such as graphical, tabular, and symbolic and converts between these representations
- Performs operations on and finds solutions for various types of functions including linear, polynomial, absolute value, and rational
- Solves linear and nonlinear systems of equations and inequalities symbolically and graphically and performs operations on matrices
- Uses the language of mathematics to express ideas precisely through reasoning, representations, and communication

Pre-Calculus

- Investigates and identifies the characteristics of exponential and logarithmic functions in order to graph these functions and solve equations and practical problems
- Applies trigonometric functions and inverse trigonometric functions to solve practical problems
- Investigates and identifies the characteristics of the conic sections in order to graph these functions and solve equations and practical problems
- Investigates and applies the properties of arithmetic and geometric sequences and series to solve practical problems
- Uses the language of mathematics to express ideas precisely through reasoning, representations, and communication

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.

Algebra II Curriculum Essentials

Boulder Valley School District Mathematics Background

The National Mathematics Advisory Panel's Final Report (2008) and the National Council of Teachers of Mathematics' *Curriculum Focal Points* (2006) provided the structure and guiding principals for the BVSD revision of the mathematics curriculum. The National Mathematics Advisory Panel's Report delineated the prerequisite knowledge necessary for success in algebra and key algebra topics students should learn. The *Curriculum Focal Points* recommended focusing each year on relatively few but highly important topics a change from the mile wide inch deep curriculums in use across the country. As a result of these recommendations, this BVSD mathematics curriculum asks students to focus on only a few essential learnings designed to prepare students for learning in future mathematical courses and careers. By focusing on only a few essential learnings students receive extended experiences with key ideas that build deep understanding, fluency with skills, and the ability to generalize and transfer knowledge to future learning.

Boulder Valley School District Mathematics Technology & Information Literacy

The National Council of Teachers of Mathematics Principles and Standards (2000) states that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (p. 24). The use of technology in BVSD mathematics classrooms is chosen carefully and integrated consistently throughout the curriculum in order to enhance learning and support effective teaching. Technology is not a replacement for understanding of key ideas and skills, however it can and should be used to expand the topics that are accessible to all students at each grade level. The use of technology provides opportunities for students to focus on mathematical concepts, create conjectures, generalize their thinking, and create justifications. Technology has the potential for extending the boundaries of the classroom and providing students with opportunities for increased practice and access to novel problems deemed inaccessible prior to technology.

Boulder Valley School District Mathematics Process Standards

The Process Standards of the National Council of Teachers of Mathematics are a key component to the BVSD mathematics curriculum. They indicate the ways in which students should acquire and use their content knowledge. The five process standards in mathematics are problem solving, reasoning communication, connections, and representations. These processes are an integral part of all mathematics learning and teaching. A mathematical learning experience focused on the five process standards prepares students with the processes necessary for continued learning in future mathematical courses and careers. Therefore every process standards should be an integral part of the learning and assessment of every essential learning.

Communication

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

Representations

- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems
- Use representations to model and interpret physical, social, and mathematical phenomena

Reasoning

- Recognize reasoning and proof and fundamental aspects of math
- Make and investigate mathematical conjectures
- Develop and evaluate mathematical arguments
- Select and use various types of reasoning and methods of proof

Connections

- Recognize and use connections among mathematical ideas
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

Problem Solving

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Boulder Valley School District Mathematics Content Standards

Mathematics Standard 1 (Number)

Students develop number sense and use number relationships to solve problems. They communicate their reasoning used to solve these problems.

Mathematics Standard 2 (Algebra)

Students use algebraic methods to solve problems by exploring, modeling, and describing patterns and relations involving numbers, shapes, data, and graphs. They communicate their reasoning used to solve these problems.

Mathematics Standard 3 (Data Analysis and Probability)

Students use data collection and analysis, statistics, and probability to solve problems. They communicate their reasoning used to solve these problems and accurately display the data in a way that conclusions can be drawn.

Mathematics Standard 4 (Geometry)

Students use geometric concepts, properties, and relationships in one, two, and three dimensions to model and solve problems. They communicate their reasoning used to solve these problems.

Mathematics Standard 5 (Measurement)

Students use a variety of measurement tools, techniques, and systems to solve problems. They communicate their reasoning used to solve these problems.

Mathematics Standard 6 (Operations)

Students make connections between concepts and procedures to effectively use computational skills to solve problems. They use appropriate techniques for the problem or situation (for example: estimation, mental math, paper and pencil, calculators, computers). They communicate their reasoning used to solve these problems.

Mathematics Overarching Enduring Understanding and Essential Questions

Overarching Enduring Understanding	Overarching Essential Question
• Mathematics can be used to solve problems outside of the mathematics classroom.	• Is your plan working? • Do you need to reconsider what you are doing?
• Mathematics is built on reason and always makes sense.	• How are solving and proving different? • How are showing and explaining different?
• Reasoning allows us to make conjectures and to prove conjectures.	• How do you know when you have proven something? • What does it take to verify a conjecture? • How do you develop a convincing argument?
• Classifying helps us to build networks of mathematical ideas.	• Why do we classify? • Why do we classify numbers, geometric objects and functions?
• Precise language helps us express mathematical ideas and receive them.	• How do you make sense of different strategies? How do you determine their strengths and weaknesses? • How do you determine similarities and differences?

Boulder Valley School District Content Standards and Algebra II Essential Learnings

Mathematics Standard 1 (Number): *Students develop number sense and use number relationships to solve problems. They communicate their reasoning used to solve these problems.*
Mathematics Standard 6 (Operations): *Students make connections between concepts and procedures to effectively use computational skills to solve problems. They use appropriate techniques for the problem or situation (for example: estimation, mental math, paper and pencil, calculators, computers). They communicate their reasoning used to solve these problems.*

To meet this standard, an Algebra II student:

√ Performs operations on expressions containing complex numbers, rational exponents and complex fractions.

Standard 3 (Data Analysis and Probability): *Students use data collection and analysis, statistics, and probability to solve problems. They communicate their reasoning used to solve these problems and accurately display the data in a way that conclusions can be drawn.*

No essential learning at this grade level. Addressed through connections.

Mathematics Standard 2 (Algebra): *Students use algebraic methods to solve problems by exploring, modeling, and describing patterns and relations involving numbers, shapes, data, and graphs. They communicate their reasoning used to solve these problems.*

To meet this standard, an Algebra II student:

√ Recognizes classes of functions including linear, polynomial, absolute value, step, rational, and exponential from multiple representations such as graphical, tabular, and symbolic and converts between these representations

√ Performs operations on and finds solutions for various types of functions including linear, polynomial, absolute value, and rational

√ Solves linear and nonlinear systems of equations and inequalities symbolically and graphically and performs operations on matrices

Mathematics Standard 4 (Geometry): *Students use geometric concepts, properties, and relationships in one, two, and three dimensions to model and solve problems. They communicate their reasoning used to solve these problems.*
Standard 5 (Measurement): *Students use a variety of measurement tools, techniques, and systems to solve problems. They communicate their reasoning used to solve these problems.*

No essential learning at this grade level.

Mathematical Processes: *Students use the mathematical processes of problem solving, reasoning and proof, communication, connections and representations to acquire and use mathematical knowledge.*

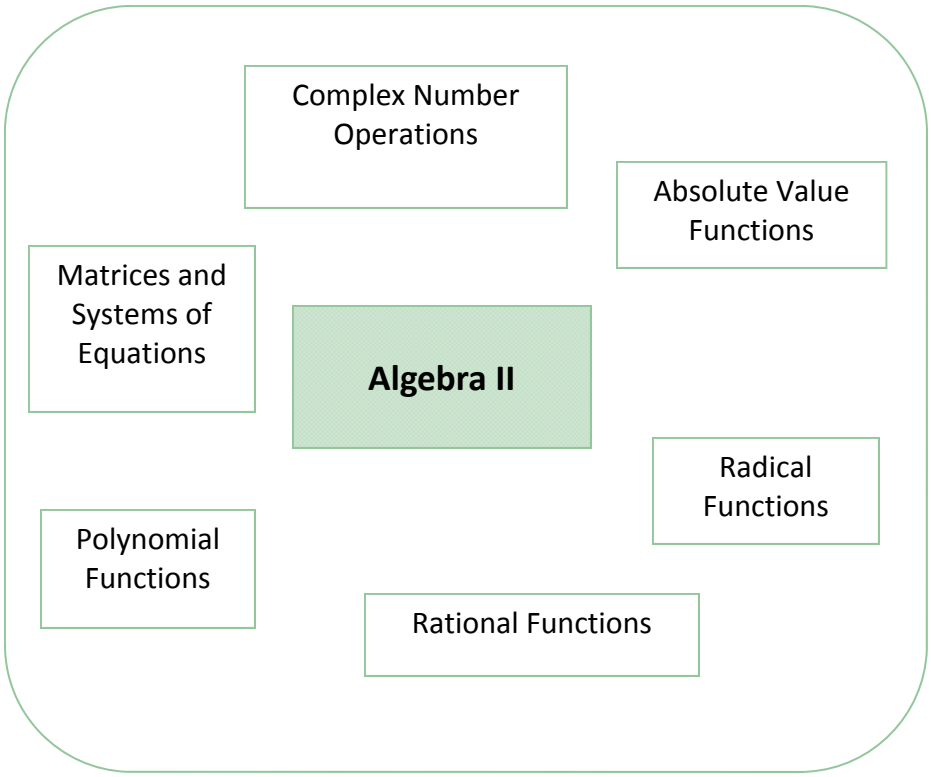
To meet this process, an Algebra II student:

√ Uses the language of mathematics to express ideas precisely through reasoning, representations, and communication.

BVSD Algebra II Overview

Course Description

Mathematics at the Algebra II level focuses on operating on complex numbers and the study of function families including polynomial, rational, absolute value, radical, and exponential. Problem solving, representations, reasoning, communication, and connections within and outside of mathematics underline all of the teaching and learning at the Algebra II level.



Assessment

√ CSAP
√ Teacher Created Assessments

Effective Components of a Algebra II Program

- Structures for mental math are utilized regularly
- Mathematical ideas are connected to experiences and prior knowledge
- Misconceptions are addressed quickly
- Students communicate using mathematical language
- Varied representations and models are used to learn a concept
- Strategies and conjectures are justified and explained

Essential Questions

- What makes a strategy both effective and efficient?
- How can change be described mathematically?
- How do mathematical models/ representations shape our understanding of mathematics?
- What makes a solution optimal?
- How are patterns of change related to the behavior of functions?

Technology Integration & Information Literacy

- Employs technology to visualize, model, investigate, and extend mathematical reasoning
- Uses technology to practice and assess needed math skills
- Displays, presents, creates and/or shares learning in mathematics using available technology
- Accesses school library, teacher-librarian, Internet, and other age-appropriate mathematical resources
- Uses technology responsibly

For information about available core software, relevant web resources, and other integration activities, please use the following website: http://bvsd.org/iteach/integration

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Mathematic Standard 1 (Number)

Students develop number sense and use number relationships to solve problems. They communicate their reasoning used to solve these problems.

Mathematic Standard 6 (Operations)

Students make connections between concepts and procedures to effectively use computational skills to solve problems. They use appropriate techniques for the problem or situation (for example: estimation, mental math, paper and pencil, calculators, computers). They communicate their reasoning used to solve these problems.

Enduring Understanding

Being able to compute fluently means making smart choices about which tools to use and when to use them.

Essential Question

What makes a strategy both effective and efficient?

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts	A2M1	Performs operations on expressions containing complex numbers, rational exponents and complex fractions	
		a	Adds, subtracts, multiplies, divides and simplifies rational expressions, including complex fractions
		b	Writes radical expressions as expressions containing rational exponents and vice versa
		c	Adds, subtracts, multiplies, divides, and simplifies radical expressions containing positive rational numbers and rational exponents
		d	Defines complex numbers (e.g., a + b*i*) and performs operations on them and expresses the results in simplest form using the patterns of the powers of *i*

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Mathematics Standard 2 (Algebra)

Students use algebraic methods to solve problems by exploring, modeling, and describing patterns and relations involving numbers, shapes, data, and graphs. They communicate their reasoning used to solve these problems.

Enduring Understanding

Change is fundamental to understanding functions.

Essential Question

How can change be described mathematical?

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts	**A2M2**	**Recognizes classes of functions including linear, polynomial, absolute value, step, rational, and exponential from multiple representations such as graphical, tabular, and symbolic and converts between these representations**	
		a	Distinguishes between relations and functions that are expressed symbolically and graphically
		b	Finds the domain, range and inverse where possible for each class of function both graphically and symbolically and describes the importance of a one to one function when finding the inverse of a function (e.g., restricted and discontinuous domains and ranges)
		c	Describes the characteristics of the graphs for each class of function including when appropriate the intercepts, symmetries, asymptotes, vertices, number and location of turning points, and end behaviors
		d	Using the general shape of a graph of a function, identifies the family of graphs to which a particular graph belongs including polynomial, rational, exponential and functions *Data Connection: Analyzes data to determine if patterns exist, identifies patterns, finds equations for curves of best fit using technology and uses the equations to make predictions about practical problems*
		e	Investigates and describes, through the use of graphs, the relationships between the solution of an equation, zero of a function, x-intercept of a graph, and factors of a polynomial expression
		f	Writes the equation of a linear, quadratic ([*h, k*] form), or absolute value function given the graph of the parent function or an integral translation of a parent function and vice versa

Continued on next page

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Mathematics Standard 2 (Algebra) (continued)

Students use algebraic methods to solve problems by exploring, modeling, and describing patterns and relations involving numbers, shapes, data, and graphs. They communicate their reasoning used to solve these problems.

Enduring Understanding

Rules of arithmetic and algebra can be used together with notions of equivalence to transform equations and inequalities so solutions can be found.

Essential Question

How do mathematical models/representations shape our understanding of mathematics?

Essential Learning

Essential Knowledge, Skills, Topics, Processes, and Concepts	A2M3	Performs operations on and finds solutions for various types of functions including linear, polynomial, absolute value, and rational	
		a	Performs operations (e.g., add, subtract, multiply, divide) on a given function *f*(x) including the composition of multiple functions and describe the resulting translations graphically and symbolically to the original function
		b	Finds the value of a function for a given element in its domain
		c	Solves equations involving rational and radical expressions both symbolically and graphically
		d	Identifies and factors completely polynomials representing the difference of squares, perfect square trinomials, the sum and difference of cubes, and general trinomials *Probability Connection: Demonstrate an understanding of the binomial theorem and use it solve problems involving probability*
		e	Selects and applies an appropriate strategy (e.g, factoring, completing the square, using the quadratic formula, or graphing) to solve a quadratic over the set of complex numbers
		f	Identifies maximum and minimum values of functions and apply to the solution of problems
		g	Identifies the number of solutions to a quadratic from its determinant and relates it to the graph of the equation

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Mathematics Standard 2 (Algebra) (continued)

Students use algebraic methods to solve problems by exploring, modeling, and describing patterns and relations involving numbers, shapes, data, and graphs. They communicate their reasoning used to solve these problems.

Enduring Understanding (continued)

Rules of arithmetic and algebra can be used together with notions of equivalence to transform equations and inequalities so solutions can be found.

Essential Question

What makes a solution optimal?

Essential Learning

Essential Knowledge, Skills, Topics, Processes, and Concepts	A2M4	Solves linear and nonlinear systems of equations and inequalities symbolically and graphically and performs operations on matrices	
		a	Models and solves practical problems with systems of linear inequalities by identifying a feasibility region and the maximum or minimum value for the function and describes its meaning (i.e., linear programming)
		b	Identifies a system of two equations as either linear-linear, linear-quadratic or quadratic-quadratic and solves them both symbolically and graphically including predicting the number of solutions given the graph of the equations
		c	Expresses a system of linear equations as a matrix equation and uses the inverse matrix method to solve the system
		d	Performs scalar multiplication, addition and multiplication on matrices and recognizes when which matrices can be multiplied
		e	Solves a system of equations using a graphing calculator (e.g., graphically, matrix method)

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Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts

Mathematical Processes

Students use the mathematical processes of problem solving, reasoning and proof, communication, connections and representations to acquire and use mathematical knowledge.

Enduring Understanding

Mathematics can be used to solve problems outside of the mathematics classroom.
Mathematics is built on reason and always makes sense.
Reasoning allows us to make conjectures and to prove conjectures.
Precise language helps us express mathematical ideas and receive them.

Essential Question

Is your plan working? Do you need to reconsider what your are doing?
How are showing and explaining different?
How do you develop a convincing argument?
How do you make sense of different strategies? How do you determine their strengths and weaknesses?

Essential Learnings

Essential Knowledge, Skills, Topics, Processes, and Concepts	A2M6	Uses the language of mathematics to express ideas precisely through reasoning, representations, and communication	
		a	Selects, applies, and translates among mathematical representations to solve problems and justifies the reasonableness of solutions
		b	Creates and uses representations to organize, record and explain mathematical ideas clearly to peers, teachers and others
		c	Analyzes and evaluates the mathematical thinking, strategies and arguments of peers, teachers and others
		d	Recognizes, uses, and explains connections among mathematical ideas in contexts both inside and outside of mathematics classrooms
		e	Develops, tests and explains mathematical conjectures
		f	Recognizes and utilizes key academic vocabulary relevant to mathematics in verbal and written communication
		g	Given a real-world problems selects an appropriate method to solve the problem by determining if the information provided is sufficient, insufficient or extraneous
		h	Creates and illustrates a real-world problem from a given math sentence

Suggested Timelines

Topic	Suggested Timeframe
Performs operations on expressions containing complex numbers, rational exponents and complex fractions.	Four weeks of instruction over the course of the school year.
Recognizes classes of functions including linear, polynomial, absolute value, step, rational, and exponential from multiple representations such as graphical, tabular, and symbolic and converts between these representations	Six weeks of instruction over the course of the school year.
Performs operations on and finds solutions for various types of functions including linear, polynomial, absolute value, and rational	Ten weeks of instruction over the course of the school year.
Solves linear and nonlinear systems of equations and inequalities symbolically and graphically and performs operations on matrices	Ten weeks of instruction over the course of the school year.

Mathematics Scope & Sequence K-2

Standard	K	1	2
Number and Operation	Numbers to 20 Combinations to 5 Coin Identification	Numbers to 100 Ordinal Numbers Combinations to 10 Skip Counts Addition and Subtraction Contexts Values of Coins	Numbers to 1000 Addition and Subtraction Facts Estimation of Sums and Differences Halves, Thirds and Fourths Combinations of Coins
Algebra	Repeating patterns	Repeating Patterns Number Equality Odd and Even Commutative Property of Addition Inverse Relationship of Addition and Subtraction	Growing and Repeating Patterns Commutative Property of Addition Qualitative and Quantitative Change
Geometry and Measurement	Basic Shapes Days of Week Relative Location Non-Standard Measurement	Time to half hour Months of the Year Inch and Foot Shapes and Solids Tessellations	Time to five minute Inches and Centimeters Attributes of Shapes Symmetry Rectangular Arrays
Data Analysis and Probability	Data Collection	Data Collection Data Interpretation	Data Analysis Questions Data Collection Graphical Representations Data Interpretation Mode Simple Probability
Mathematical Processes	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections

Mathematics Scope & Sequence 3-5

Standard	3	4	5
Number and Operation	Numbers to 10,000 Multi-Digit Addition and Subtraction Multiplication and Division Context Fraction Models Money Addition and Subtraction	Number to 100,000 Multiplication Facts Multi-Digit Multiplication Multiples and Factors Prime and Composite Divisibility Rules Rational Number Comparison	Multi-Digit Multiplication and Division Remainders as Decimals and Fractions Addition and Subtraction of Rational Numbers
Algebra	Growing Patterns Properties of Addition Odd and Even In/Out Tables Inverse Relationship of Multiplication and Division	Properties of Multiplication In/Out Tables Tabular and Graphical Patterns Distributive Property	Growth Pattern Equations Rates of Change Variables Rational Number Conjectures
Geometry and Measurement	Measurement Time to minute Perimeter Parallel Congruence Points, Lines and Rays	Area and Perimeter Distance and Scale Coordinate Graphing Measurement to half unit	Angles Transformations Measurement to quarter unit 2-D Representations of Solids
Data Analysis and Probability	Combination Problems Graphical Representations Data Interpretation	Fairness Sample Space Likelihood of Events Data Analysis Mode, Median, Range Clusters, Outliers	Categorical and Numerical Questions Data Collection Methods Graphical Representations Data Descriptions and Analysis
Mathematical Processes	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections

Mathematics Scope & Sequence 6-8

Standard	6	7	8
Number and Operation	Positive Rational Numbers Addition, Subtraction Multiplication, Division Estimation Percent Problems Properties of Positive Rational Numbers	Integers Negative Rational Numbers Addition, Subtraction Multiplication, Division Properties of Rational Numbers Order of operations Distributive Property Ratios and Proportion	Exponents Scientific Notation Irrational Numbers Estimation
Algebra	Represent and Analyze Patterns Variables and Expressions Descriptions of Change	Linear Relationships Analysis of Change Simple Linear Equation Solutions	Slope Y-intercepts Linear Functions Functional Relationships
Geometry and Measurement	Area and Perimeter Formulas Estimation of Irregular Areas Maximum/Minimum Area and Perimeter Problems Circumference and Area of Circles	Similarity Similar Figures Scale Factor Linear Dimensions, Angles, Perimeters and Areas Four Quadrant Coordinate Graphs	Pythagorean Theorem Rectangular Prisms Pyramids Volume Surface Area
Data Analysis and Probability	Measures of Central Tendency Mean, Median, Mode Graphical Representations Data Analysis Hypotheses and Conclusions	Coordinate Graphing Data Analysis Simple Probability	Population and Samples Sample Size Random Samples Probability Sample Distributions
Mathematical Processes	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections

Mathematics Scope & Sequence 9-12

Standard	Algebra	Geometry	Algebra 2	Pre-Calculus
Number and Operation	Real Number Operations Order of Operations Law of Exponents Absolute Value Scientific Notation		Complex Number Operations	
Algebra	Polynomial Operations Functions Linear Equations/ Inequalities Quadratic Equations Systems of Equations		Families of Functions Polynomial, Radical Absolute Value, Rational, Systems of Linear and Nonlinear Equations Matrices Solutions of Linear, Polynomial, Rational and Radical	Exponential and Logarithmic Functions Limits of Functions Conic Sections Sequences and Series Circle and Triangle Representations of Trigonometric Functions
Geometry and Measurement		Congruence/ Similarity Properties of Polygons Properties of Circles Pythagorean Theorem Trigonometric Ratios Perimeter, Area, Volume Unit Conversions Proof and Argument		
Data Analysis and Probability				
Mathematical Processes	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections	Communication Representations Reasoning and Proof Problem Solving Connections	

Mathematics Glossary of Terms

Absolute value	A number's distance from zero on a number line. The absolute value of –6, shown as |6|, is 6, and the absolute value of 6, shown as |6|, is 6.
Algebraic methods	The use of symbols to represent numbers and signs to represent their relationships
Algorithm	A step-by-step procedure
Box plot (also called a box-and-whiskers plot)	A graphic method for showing a summary of data using median, quartiles, and extremes of data. A box plot makes it easy to see where the data are spread out and where they are concentrated. The longer the box, the more the data are spread out.
Capacity	The volume of a container given in units of liquid measure. The standard units of capacity are the liter and the gallon.
Combinations	Subsets chosen from a larger set of objects in which the order of the items doesn't matter (for example, the number of different committees of three that can be chosen from a group of twelve members).
Complex numbers	Numbers that can be written in the form a + bi, for example, -2.7 + 8.9i, where a and b are real numbers and i= $\sqrt{-1}$
Congruent or the concept of congruence	Two figures are said to be congruent if they are the same size and shape.
Coordinate geometry	Geometry based on the coordinate system
Coordinate system (also called rectangular coordinate system	A method of locating points in the plane or in space by means of numbers. A point in a place can be located by its distances from both a horizontal and a vertical line called the axes. The horizontal line is called the x-axis. The vertical line is called the y-axis. The pairs of number are called ordered pairs. The first number, called the x-coordinate, designates the distance along the horizontal axis. The second number, called the y-coordinate, designates the distance along the vertical axis. The point at which the two axes intersect has the coordinates (0,0) and is called the origin.
Conjecture	A statement that is to be shown true or false. A conjecture is usually developed by examining several specific situations.

Mathematics Glossary of Terms (continued)

Dilation	A transformation that either enlarges or reduces a geometric figure proportionally.
Exponential function	A function that has an equation of the form $y=a^x$ o. These functions are used to study population growth or decline, radioactive decay, and compound interest.
Exponent	A number used to tell how many times a number or variable is used as a factor. For example, 5^3 indicates that 5 is a factor 3 times, that is, 5 x 5 x 5. The value of 5^3 is 125.
Function	A function consists of a domain and a rule. The domain is a set of real numbers. The rule assigns to each number in the domain one and only one number
Integers	The set of numbers consisting of the counting numbers (that is, 1, 2, 3, 4, 5, …), their opposites (that is, negative numbers, -1, -2, -3, …), and zero.
Irrational numbers	The set of numbers which cannot be represented as fractions. Examples are $\sqrt{2}$, the cube root of 29, e, and 1/4.
Linear function	A function that has a constant rate of change.
Logarithm	Alternate way to express an exponent. For example, $\log_2 8=3$ is equivalent to 2 to the third power equals 8.
Matrix (pl. matrices)	A rectangular array of numbers (or letters) arranged in rows and columns
Measures of central tendency	Numbers which in some sense communicate the "center" or "middle" of a set of data. The mean, median, and mode of statistical data are all measures of central tendency.
Measures of variability	Numbers which describe how spread out a set of data is, for example, range and quartile.
Mental arithmetic	Performing computations in one's head without writing anything down. Mental arithmetic strategies include finding pairs that add up to 10 or 100, doubling, and halving.
Model	To make or construct a physical or mathematical representation.
Number sense	An understanding of number. This would include number meanings, number relationships, number size, and the relative effect of operations on numbers.

Mathematics Glossary of Terms (continued)

Open sentence	A statement that contains at least one unknown. It becomes true or false when a quantity if substituted for the unknown. For example, 3 + x = 5
Optimization problems	Real-world problems in which, given a number of constraints, the best solution is determined. For example, finding the best number of nonstop flights from Denver to San Francisco given the cost of fuel, number of passengers, number of crew required, etc.
Patterns	Regularities in situations such as those in nature, events, shapes, designs, and sets of number (for example, spirals, on pineapples, geometric designs in quilts, the number sequence 3, 6, 9, 12, …)
Permutations	All possible arrangements of a given number of items in which the order of the items makes a difference. For example, the different ways that a set of four books can be places on a shelf.
Prime number	A counting number that can only be evenly divided by two different numbers, 1 and the number itself. The first ten prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29.
Probability	The likeliness or chance of an event occurring.
Problem-solving situations	Contexts in which problems are presented that apply mathematics to practical situations in the real world, or problems that arise from the investigation of mathematical ideas.
Quadratic function	A function that has an equation of the form $y = ax^2 + bx + c$, where a, 0. These functions are used to describe the flight of a ball and the stream of water from a fountain.
Rational numbers	A number that can be expressed in the form a/b, where a and b are integers and b, 0, for example, 3/4, 2/1, or 11/3. Every integer is a rational number, since it can be expressed in the form a/b, for example, 5 = 5/1. Rational numbers may be expressed as fractional or decimal numbers, for example, 3/4 or .75. Finite decimals, repeating decimals, and mixed numbers all represent rational numbers.
Real numbers	All rational and irrational numbers
Real-world problems (also called real-world experiences)	Quantitative problems that arise from a wide variety of human experience which may take into consideration contributions from various cultures (for example, Mayan or American pioneers), problems from abstract mathematics, and applications to various careers (for example, making change or calculating the sale price of an item).

Mathematics Glossary of Terms (continued)

Reflection (also called a flip)	A transformation which produces the mirror image of a geometric figure.
Rotation (also called a turn)	A transformation which turns a figure about a point a given number of degrees.
Scatter plots (also called scatter diagram or scattergram)	A graph of the points representing a collection of data.
Scientific notation	A short-hand way of writing very large or very small numbers. A number expressed in scientific notation is expressed as a decimal number between 1 and 10 multiplied by a power of 10, for example, $4.53 \times 10^3 = 4350$.
Similarity	Objects or figures that are the same shape are similar figures. The are not necessarily the same size. If two figures are similar, we say that there is similarity between the figures.
Spatial visualization (also called spatial reasoning)	A type of reasoning in which a person can draw upon one's understanding of relationships in space, the three-dimensional world. For example, spatial reasoning is demonstrated by one's ability to build a three-dimensional model of a building shown in a picture. A person who uses spatial visualization is said to have spatial sense.
Square root	That number which when multiplied by itself produces the given number, for example, 5 is the square root of 25, because $5 \times 5 = 25$.
Stem-and-leaf plot	A frequency distribution made by arranging data. It is one way of visually portraying data that is frequently used in newspapers and magazines because it provides an efficient way of showing information as well as comparing different sets of data.
Symmetry	The correspondence in size, from, and arrangement of parts on opposite sides of a plane, line, or point. For example, a figure that has line symmetry has two halves which coincide if folding along its line of symmetry.
Transformation	The process of changing one configuration or expression into another in accordance with a rule. Common geometric transformations include translations, rotation, and reflections.
Translation (also called a slide)	A transformation that moves a geometric figure by sliding. Each of the points of the geometric figure moves the same distance in the same direction.
Trigonometric ratios	The ratios of the lengths of pairs of sides in a right triangle. There are three basic trigonometric ratios used in trigonometry: sine (sin), cosine (cos), and tangent (tan).

Mathematics Glossary of Terms (continued)

Variable	A quantity that may assume any one of a set of values. In the equations $2x + y = 9$, x and y are variables.
Vector	A quantity which has both magnitude and direction. Vectors may be interpreted as physical quantities such as velocity and force.
Volume	The measure of the interior of a three-dimensional figure. A unit for measuring volume is the cubic unit.