El Monte Union High School District

Course Outline

High School District

Title: Integrated Math 2 P

Transitional*_____(Eng. Dept. Only)

Sheltered (SDAIE)*____Bilingual*___

AP** Honors**

Department: Math

Grade Level (s): 9 – 12

Semester Year X

Based on Mathematics CCSS

This course meets graduation requirements:

( ) English
( ) Fine Arts
( ) Foreign Language
( ) Health & Safety
(X) Math
( ) Physical Education
( ) Science
( ) Social Science
( ) Elective

Department/Cluster Approval Date

_____ _____

*Instructional materials appropriate for English Language Learners are required.

**For AP/Honors course attach a page describing how this course is above and beyond a regular course. Also, explain why this course is the equivalent of a college level class.

1. **Prerequisite(s):** Recommended (not required per Administrative Regulation 5121):
   - Completion of 2nd semester of Integrated Math 1 or equivalent with a C- or better

OR

   - Completion of Integrated Math Bridge 1 summer course with a C or better

OR

   - Completion of 2nd semester of Integrated Math 1 or equivalent with a D- or better **AND** one of the following:
     - 8th grade Math CAASPP achievement Level Scale Score of 2586 or higher (Standard Met or Exceeded)
     - End-of-Year Math Inventory Quantile score of 1000Q.
     - Math teacher recommendation

2. **Short description of course which may also be used in the registration manual**:

Integrated Math 2 focuses on six primary critical areas:

- Extending the Number System
- Quadratic Functions and Modeling
- Expressions and Equations
- Applications of Probability
- Similarity, Right Triangles, Trigonometry, and Proof
- Circles With and Without Coordinates

This course is designed to meet the Common Core State Standards for high schools following the Integrated Math Pathway. Standards for the 8 mathematical practices are also addressed throughout the course.

3. Describe how this course integrates the schools SLOs (School-wide Learning Outcomes): This section may be replaced with specific site SLOs.

All schools have SLOs that refer to students as academic achievers, critical thinkers, and effective communicators. This course addresses the mentioned SLOs.

4. Describe the additional efforts/teaching techniques/methodology to be used to meet the needs of English Language Learners:

The special needs of English language learners are met throughout the course in a number of ways:

- By using the Sheltered Instruction Observation Protocol (SIOP) or other researched based strategies that engage students in learning and communicating their thoughts in the four language domains.
- By probing prior knowledge to connect existing knowledge with knowledge to be learned.
- By teaching concepts for which English learners may not have a cultural reference, including obscure terms, and academic vocabulary.
- By defining abstract concepts in concrete terms, and using specific examples.
- By using graphic organizers and rubrics to set expectations and facilitate organization of thought.
- By using a variety of other visual aids during instruction, such as pictures, films, and realia.
- By encouraging students to express themselves in a variety of modalities.

5. Describe the interdepartmental articulation process for this course:

The study of mathematics in each year of high school leads directly to preparedness for college and career readiness. The skills learned in math are applied to other courses of study including science, social science, and Career Technical Education (CTE). Problem solving, communicating reasoning, modeling and data analysis that are used in mathematics prepare students to apply those same skills in all courses and in real-world scenarios.

6. Describe how this course will integrate academic and vocational concepts, possibly through connecting activities. Describe how this course will address work-based learning/school to career concepts:

Various projects and Performance Tasks that relate real-life problems are implemented throughout the course. These Performance Tasks are usually assigned at the end of each chapter to assess the ability of students to apply concepts learned throughout the chapter towards a real-world situation.

7. Materials of Instruction (Note: Materials of instruction for English Language Learners are required and should be listed below.)

A. Textbook(s) and Core Reading(s):

- Integrated Mathematics 2: Common Core (HMH) Teacher and Student Edition Textbooks.

By Timothy Kanold, Edward Burger, Juli Dixon, Matthew Larson, Steven Leinwand
Copyright 2015 by Houghton Mifflin Harcourt Publishing Company

B. Supplemental Materials and Resources:

- Overhead transparencies or documents for projection
- Extra practice worksheets
- Kuta Software
- Examview Test Generator
- ALEKS
- my.hrw.com (online resources from HMH)
- Performance Tasks
- Teacher made resources and manipulatives
- Materials found on-line: projects; performance tasks, problems of the week...

C. Tools, Equipment, Technology, Manipulatives, Audio-Visual:

- Protractors
- Graphing Calculators
- Projectors
- Chromebooks
- Document Readers

8. (see below and attached)

- **Objectives of Course:** The objective of this course is to extend the mathematics students learned in Integrated Math 1 with emphasis on Quadratic Functions, Statistics/Probability, and Geometry/Trigonometry. The Mathematical Practice Standards will be infused throughout the course together with the CCSS for mathematics. This attention to the Practice Standards as well as the Content Standards will ensure that students experience mathematics as coherent, useful, and logical and make use of the student's ability to make sense of problem situations. After completing this course successfully, students will be prepared to proceed to Integrated Math 3.

- **Unit detail including projects and activities including duration of units (see attached)**

SEE ATTACHED DOCUMENT

- **Indicate references to state framework(s)/standards (If state standard is not applicable then national standard should be used)**

- **Student performance standards**

Guidelines for grading are:

A 90 – 100%
B 80 – 89%
C 70 – 79%
D 60 – 69%
F 59% and below

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

- **Evaluation/assessment/rubrics**

- District assessments (Common Formative Benchmark Assessments)
- Site assessments to include formative assessments
- Performance Tasks

- **Include minimal attainment for student to pass course**

Students must attain <u>at least</u> 60% overall average for all assignments (Tests, Quizzes, Homework, Classwork, Notes, etc.) for the course.

HMH Integrated Math 2 Unit/Module Detail

Module 1 – Analyzing Functions **(Covered in IM 3 Module 5)**
1.1: Domain, Range, and End Behavior
F-IF.5 Intervals, restricted domains
1.2: Characteristics of Function Graphs
F-IF.4 Graph from descriptions
1.3: Inverses of Functions
F-BF.4 Finding and modeling inverses

Module 2 – Absolute Value Functions, Equations, and Inequalities
2.1: Graphing Absolute Value Functions **(Covered in IM 3 Module 5)**
F-IF.7b Graph, write, and model
2.2: Solving Absolute Value Equations **(Covered in IM 1 Module 13)**
A-REI.3.1 Solve algebraically and graphically
2.3: Solving Absolute Value Inequalities **(NONE)**
A-REI.3.1 Solve algebraically and graphically

Unit 2: Polynomial Operations

Module 3 – Rational Exponents and Radicals **(Covered in IM 3 Module 11)**
3.1: Understanding Rational Exponents and Radicals
N-RN.1 Integer and rational exponents
3.2: Simplifying Expressions with Rational Expressions and Radicals
N-RN.2 Rational, irrational, multivariable

Module 4 – Adding and Subtracting Polynomials
4.1: Understanding Polynomial Expressions
A-SSE.1a Classify polynomials, standard form
4.2: Adding Polynomial Expressions
A-APR.1 Algebra tiles, vertical, horizontal models
4.3: Subtracting Polynomial Expressions
A-APR.1 Algebra tiles, vertical, horizontal models

Module 5 – Multiplying Polynomials
5.1: Multiplying Polynomial Expressions by Monomials
A-APR.1 Multiply polynomials /monomials
5.2: Multiplying Polynomial Expressions
A-APR.1 Multiply using distributive
5.3: Special Products
A-APR.1 $(a+b)(a-b)$, $(a+b)^2$, $(x-b)^2$

Unit 3: Polynomial Functions, Expressions, and Equations

Module 6 – Graphing Quadratic Functions

6.1: Understanding Quadratic Functions

F-BF.3 $f(x)=x^2$, $f(x)=ax^2$, maximum, minimum

6.2: Transforming Quadratic Functions

F-BF.3 $f(x)=a(x+h)^2+k$

6.3: Interpreting Vertex Form and Standard Form

F-IF.4 Write an equation, given a table

Module 7 – Connecting Intercepts, Zeros, and Factors

7.1: Connecting Intercepts and Zeros

F-IF.7a Using zeros and intercepts to graph

7.2: Connecting Intercepts and Linear Factors **(Covered in IM 3 Module 5)**

A-APR.3 Using factored form, intercepts to write

7.3: Applying the Zero Product Property to Solve Equations

A-REI.4 Solve quadratics using zero product

Unit 4: Quadratic Equations and Models

Module 8 – Using Factors to Solve Quadratic Equations

8.1: Solving Equations by Factoring $x^2 + bx + c$

A-SSE.2 Factor and solve by factoring

8.2: Solving Equations by Factoring $ax^2 + bx + c$

F-LE.6 Factor and solve by factoring

8.3: Using Special Factors to Solve Equations

A-SSE.3a Perfect squares, perfect square trinomial

Module 9 – Using Square Roots to Solve Quadratic Equations

9.1: Solving Equations by Taking Square Roots

A-REI.4b Solve $ax^2-c=0$ and $a(x+b)^2=c$

9.2: Solving Equations by Completing the Square

A-SSE.3b Solve x2+bx+c=0 by completing Square

9.3: Using the Quadratic Formula to Solve Equations

A-REI.4a Derive, solve, use the discriminant

9.4: Choosing a Method for Solving Quadratic Equations

A-REI.4b Solve using different methods

9.5: Solving Nonlinear Systems

A-REI.7 Solve systems algebraically & graphically

Module 10 – Linear, Exponential, and Quadratic Models **(Covered in IM 3 Mod 14)**

10.1: Fitting a Linear Model to Data

S-ID.6b Plot/Analyze residuals, linear regressions

10.2: Graphing Exponential Functions

F-IF.7e Increasing, decreasing

10.3: Modeling Exponential Growth and Decay

F-IF.7e End behavior, comparing, word problems

10.4: Modeling with Quadratic Functions

A-CED.2 Second differences, quadratic regression

10.5: Comparing Linear, Exponential, and Quadratic Models
F-LE.7b End behavior, justify, appropriate models

Unit 5: Extending Quadratic Equations

Module 11 – Quadratic Equations and Complex Numbers
11.1: Solving Quadratic Equations by Taking Square Roots
N-CN.1 Define imaginary numbers/solutions
11.2: Complex Numbers
N-CN.2 Add, subtract, multiply complex numbers
11.3: Finding Complex Solutions of Quadratic Equations
N-CN.7 Complete square, quadratic formula

Module 12 – Quadratic Relations and Systems of Equations
12.1: Circles
G-GPE.3.1 Write equations and graph
12.2: Parabolas
G-GPE.3.1 Write equations and graph
12.3: Solving Linear-Quadratic Systems
A-REI.7 Solve systems algebraically & graphically

Module 13 – Functions and Inverses **(Covered in IM 3 Modules 5 and 10)**
13.1: Graphing Polynomial Functions
F-IF.7c even and odd, cubic and quartic graphs
13.2: Understanding Inverse Functions
F-BF.4a Graph and write inverse functions
13.3: Graphing Square Root Functions
F-IF.7b Graph f(x)=ax-h+k
13.4: Graphing Cube Root Functions
F-IF.7b Graph f(x)=a3x-h+k

Unit 6: Geometric Proof

Module 14 – Proofs with Lines and Angles **(Covered in IM 1 Module 19)**
14.1: Angles Formed by Intersecting Lines
G-CO.9 Vertical, Supplementary, Complementary
14.2: Transversals and Parallel Lines
G-CO.9 alternate interior, corresponding angles
14.3: Proving Lines are Parallel
G-CO.9 Construct parallel lines, angle pairs
14.4: Perpendicular Lines
G-CO.9 Construct perpendicular lines & bisectors

Module 15 – Proofs with Triangles and Quadrilaterals **(Covered in IM 1 Module 22, 23, and 24)**
15.1: Interior and Exterior Angles
G-CO.10 Interior/exterior angles of polygons

15.2: Isosceles and Equilateral Triangles
G-CO.10 Theorem, converse, properties
15.3: Triangle Inequalities
G-GMD.6 find possible side lengths and angles
15.4: Perpendicular Bisectors of Triangles
G-C.3 Concurrency and circumcenter
15.5: Angle Bisectors of Triangles
G-C.3 Properties, construct inscribed circle
15.6: Properties of Parallelograms
G-CO.11 Opposite sides & angles, diagonals
15.7: Conditions for Rectangles, Rhombuses, and Squares
G-CO.11 Opposite sides & angles, diagonals

Unit 7: Similarity and Right Triangles

Module 16 – Similarity and Transformations
16.1: Dilations
G-SRT.1a,b properties, center, scale, similar
16.2: Proving Figures are Similar Using Transformations
G-SRT.2 Use transformations to prove similar
16.3: Corresponding Parts of Similar Figures
G-SRT.2 Applying properties of similar figures
16.4: AA Similarity of Triangles
G-SRT.3 AA, SSS, SAS SImilarity

Module 17 – Using Similar Triangles
17.1: Triangle Proportionality Theorem
G-SRT.4 Apply & prove the theorem & converse
17.2: Subdividing a Segment in a Given Ratio **(NONE)**
G-GPE.6 Partition a segment, construct a partition
17.3: Using Proportional Relationships
G-SRT.5 Find height & distance using proportions
17.4: Similarity in Right Triangles
G-SRT.4 Geometric Mean, Pythagorean Theorem

Module 18 – Trigonometry with Right Triangles
18.1: Tangent Ratio
G-SRT.6 Find sides and angles using tangent
18.2: Sine and Cosine Ratios
G-SRT.6 Find sides & angles using sine & cosine
18.3: Special Right Triangles
G-SRT.8.1 Trig ratios, Pythagorean Triples
18.4: Problem Solving with Trigonometry
G-SRT.8 Find area, sides, angles of right triangles
18.5: Using a Pythagorean Identity **(Covered in IM 3 Module 18)**
F-TF.8 Prove & apply Pythagorean/Trig Identities

Unit 8: Properties of Circles

Module 19 – Angles and Segments of Circles
- 19.1: Central Angles and Inscribed Angles
  - G-C.2 Find central & inscribed angles, arc measure
- 19.2: Angles in inscribed Quadrilaterals
  - G-C.3 Apply properties of inscribed quadrilaterals
- 19.3: Tangents and Circumscribed Angles
  - G-C.2 Angles formed with tangents
- 19.4: Segment Relationships in Circles
  - G-C.2 Chords, secants, tangents
- 19.5: Angle Relationships in Circles
  - G-C.2 Angles formed by Chords, secants, tangents

Module 20 – Arc Length and Sector Area
- 20.1: Justifying Circumference and Area of a Circle
  - G-GMD.1 Apply circumference and area formulas
- 20.2: Arc Length and Radian Measure
  - G-C.1 Arc length, concentric, convert radians
- 20.3: Sector Area
  - G-C.5 Develop and apply formulas

Unit 9: Volume

Module 21 – Volume Formulas
- 21.1: Volume of Prisms and Cylinders
  - G-GMD.1 Develop and apply formulas
- 21.2: Volume of Pyramids
  - G-GMD.1 Develop and apply formulas
- 21.3: Volume of Cones
  - G-GMD.1 Develop and apply formulas
- 21.4: Volume of Spheres
  - G-GMD.1 Develop and apply formulas
- 21.5: Scale Factor
  - G-GMD.5 Changing dimensions

Unit 10: Understanding Probability

Module 22 – Introduction to Probability
- 22.1: Probability and Set Theory
  - S-CP.1 Subset, intersection, union, complement
- 22.2: Permutations and Probability **NONE**
  - S-CP.9(+) Permutations with repetition
- 22.3: Combinations and Probability **NONE**
  - S-CP.9(+) Probability using combination/addition
- 22.4: Mutually Exclusive and Overlapping Events
  - S-CP.4 Find probability use two-way tables

Module 23 – Conditional Probability and Independence of Events

23.1: Conditional Probability
S-CP.4 Formulas and two-way tables
23.2: Independent Events
S-CP.2 Find probability of independent events
23.3: Dependent Events
S-CP.8 Find probability of dependent events

Module 24 – Probability and Decision Making
24.1: Using Probability to Make Fair Decisions **NONE**
S-MD.6(+) Random drawing
24.2: Analyzing Decisions **NONE**
S-CP.4 Derive and use Bayes' Theorem

IM2 2018-2019 Pacing Calendar (Reference Only)

Monday	Tuesday	Wednesday	Thursday	Friday
8/13	**8/14** **First Day for Teachers**	**8/15** **PD for Teachers**	**8/16** **PD for Teachers**	**8/17** **PD for teachers**
8/20 **First Day for Students** **Introduction and Syllabus**	**8/21** **Vocabulary** **Speaking & Listening** **Checking for Understanding** **ALEKS – Knowledge Check** **Inductive/Deductive Reasoning**	**8/22** **Vocabulary** **Speaking & Listening** **Checking for Understanding** **ALEKS – Knowledge Check** **Conditional Statements & Converse**	**8/23** **Vocabulary** **Speaking & Listening** **Checking for Understanding** **ALEKS – Knowledge Check** **Biconditionals & Definitions**	**8/24** **Vocabulary** **Speaking & Listening** **Checking for Understanding** **ALEKS – Knowledge Check** **Transitive, Reflexive, Symmetry**
8/27 Review - Cong. (SSS, SAS, ASA, AAS, HL)	**8/28** Review – Triangle Congruence (CPCTC)	**8/29** Proofs with Triangle Congruencies	**8/30** 14.1 Angles formed by Intersecting lines	**8/31** 14.1 Angles formed by Intersecting lines
9/3 **No School** **Labor Day**	**9/4** 14.2 Transversals and Parallel Lines	**9/5** 14.2 Transversals and Parallel Lines	**9/6** 14.3 Proving lines are Parallel Construction Days	**9/7** 14.3 Proving lines are Parallel Construction Days
9/10 14.4 Perpendicular Lines	**9/11** 14.4 Perpendicular Lines	**9/12** Review/Catch-up	**9/13** Review/Catch-up	**9/14** **Site Test Mod 14**
9/17 15.1 Interior and Exterior Angles	**9/18** 15.1 Interior and Exterior Angles	**9/19** 15.2 Isosceles and Equilateral Triangles	**9/20** 15.2 Isosceles and Equilateral Triangles	**9/21** **Performance Task #1**
9/24 15.3 Triangle Inequality	**9/25** 15.3 Triangle Inequality	**9/26** 15.4 Perpendicular Bisector of Triangles	**9/27** 15.4 Perpendicular Bisector of Triangles	**9/28** 15.5 Angle Bisectors of Triangles **1st Grading Period Ends**
10/1	**10/2**	**10/3**	**10/4**	**10/5**

15.5 Angle Bisectors of Triangles	15.6 Properties of Parallelograms	15.6 Properties of Parallelograms	Review/Catch-up	Review/Catch-up
10/8 **Site Test Mod 15**	**10/9** 16.1 Dilations	**10/10** 16.1 Dilations	**10/11** 16.2 Proving Figures are Similar Using Transformations	**10/12** 16.2 Proving Figures are Similar Using Transformations
10/15 16.2 Proving Figures are Similar Using Transformations	**10/16** 16.3 Corresponding Parts of Similar Figures	**10/17** 16.3 Corresponding Parts of Similar Figures	**10/18** 16.4 AA Similarities of Triangles	**10/19** Review/Catch-up
10/22 Review/Catch-up	**10/23** **Site Test Mod 16**	**10/24** 17.1 Triangle Proportionality Theorem	**10/25** 17.1 Triangle Proportionality Theorem	**10/26** 17.3 Using Proportional Relationships
10/29 17.3 Using Proportional Relationships	**10/30** 17.4 Similarity in Right Triangles	**10/31** 17.4 Similarity in Right Triangles	**11/1** 17.4 Similarity in Right Triangles	**11/2** **Performance Task #2**

11/5 Review/Catch-up	**11/6** Review/Catch-up	**11/7** **Site Test Mod 17**	**11/8** 3.1 Understanding Rational Exponents and radicals	**11/9** 3.1 Understanding Rational Exponents and radicals **2nd Grading Period Ends**
11/12 **No school Veteran's Day**	**11/13** 3.2 Simplifying Expressions with Rational Exponents and Radicals	**11/14** 3.2 Simplifying Expressions with Rational Exponents and Radicals	**11/15** 18.1 Tangent Ratios	**11/16** 18.1 Tangent Ratios 19.2 Angles in Inscribed Quadrilaterals
11/19 **Student/Teacher Free Day**	**11/20** **Student/Teacher Free Day**	**11/21** **Student/Teacher Free Day**	**11/22** **Thanksgiving**	**11/23** **Thanksgiving holiday**
11/26 18.2 Sine and Cos Ratios	**11/27** 18.2 Sine and Cos Ratios	**11/28** 18.3 Special Right Triangles	**11/29** 18.3 Special Right Triangles	**11/30** 18.4 Problem Solving with Trig.

12/3 18.3 Special Right Triangles	**12/4** Review/Catch-up	**12/5** Review/Catch-up	**12/6** **Site Test Mod 18**	**12/7** **Performance Task #3**
12/10 FINAL EXAM REVIEW	**12/11** FINAL EXAM REVIEW	**12/12** FINAL EXAM REVIEW	**12/13** FINAL EXAM REVIEW	**12/14** FINAL EXAM REVIEW
12/17 FINAL EXAM REVIEW	**12/18** **FINAL EXAMS**	**12/10** **FINAL EXAMS**	**12/20** **FINAL EXAMS**	**12/21** **Student/Teacher Free Day**
December 24 – January 4 WINTER VACATION				
1/7 **2nd Semester Begins** 19.1 Central Angles and Inscribed Angles	**1/8** 19.1 Central Angles and Inscribed Angles	**1/9** 19.2 Angles in Inscribed Quadrilaterals	**1/10** 19.2 Angles in Inscribed Quadrilaterals	**1/11** 19.3 Tangents and Circumscribed Angles
1/14 19.3 Tangents and Circumscribed Angles	**1/15** 19.4 Segments Relationship in Circles	**1/16** 19.4 Segments Relationship in Circles	**1/17** 19.5 Angle Relationship in Circle	**1/18** 19.5 Angle Relationship in Circle
1/21 **No School Martin Luther King Jr. Birthday**	**1/22** Review/Catch-up	**1/23** Review/Catch-up	**1/24** **Site Test Mod 19**	**1/25** 20.1 Justify Circumference/Area of a Circle
1/28 20.1 Justify Circumference/Area of a Circle	**1/29** 20.2 Arc Length and Radian Measure	**1/30** 20.2 Arc Length and Radian Measure	**1/31** 21.1 Volumes of Prisms and Cylinders	**2/1** 21.1 Volumes of Prisms and Cylinders
2/4 21.2 Volume of Pyramids	**2/5** 21.2 Volume of Pyramids	**2/6** 21.3 Volume of Cones	**2/7** 21.3 Volume of Cones	**2/8** 21.4 Volumes of Spheres
2/11 **No School Lincoln Birthday**	**2/12** 21.4 Volumes of Spheres	**2/13** Review/Catch-up	**2/14** Review/Catch-up	**2/15** **Site Test Mod 20-21**

2/18 **No School** **President's Day**	**2/19** **Performance Task #4**	**2/20** 2.1 Graphing Absolute Value Functions	**2/21** 2.1 Graphing Absolute Value Functions	**2/22** 2.2 Solving Absolute Value Equations **1st grading period ends**
2/25 2.2 Solving Absolute Value Equations Review/Catch-up	**2/26** 2.3 Solving Absolute Value Inequalities	**2/27** 2.3 Solving Absolute Value Inequalities	**2/28** Review/Catch-up	**3/1** Review/Catch-up
3/4 **Site Test Mod 2**	**3/5** **Interim SBAC Review**	**3/6** **Interim SBAC Review**	**3/7** **Interim SBAC Review**	**3/8** **Interim SBAC Review**
3/11 **Interim SBAC Review**	**3/12** **Interim SBAC Review**	**3/13** 4.1 Understand Polynomials	**3/14** 4.1 Understand Polynomials	**3/15** 4.2 Adding Polynomial Expressions
3/18 4.2 Adding Polynomial Expressions	**3/19** 4.3 Subtracting Polynomials	**3/20** 4.3 Subtracting Polynomials	**3/21** 5.1 Multiply Polynomial Expressions by Monomials	**3/22** 5.1 Multiply Polynomial Expressions by Monomials
3/25 5.2 Multiplying Polynomials Expressions	**3/26** 5.2 Multiplying Polynomials Expressions	**3/27** 5.3 Special Products of Binomials	**3/28** 5.3 Special Products of Binomials	**3/29** **Performance Task #5**
4/1 **Student/Teacher Free Day**	**4/2** Review/Catch-up	**4/3** Review/Catch-up	**4/4** **Site Test Mod 4-5**	**4/5** 6.1 Understanding Quadratic Functions

				2nd grading period ends
4/8 6.1 Understanding Quadratic Functions	**4/9** 6.2 Transforming Quadratic Functions	**4/10** 6.2 Transforming Quadratic Functions	**4/11** 6.3 Interpreting Vertex and Standard Form	**4/12** 6.3 Interpreting Vertex and Standard Form
4/15 7.1 Connecting Intercepts and Zeros	**4/16** 7.1 Connecting Intercepts and Zeros	**4/17** 7.3 Applying the Zero Property to Solve Eq.	**4/18** 7.3 Applying the Zero Property to Solve Eq.	**4/19** **Student/Teacher Free Day**
April 22-26 Spring Break				
4/29 Review/Catch-up	**4/30** Review/Catch-up	**5/1** **Site Test Mod 6-7**	**5/2** 8.1 Solving Equations by Factoring a=1	**3/3** 8.1 Solving Equations by Factoring a=1
5/6 8.2 Solving Equations by Factoring a>1 **AP US Government, Chinese, Environmental Science**	**5/7** 8.2 Solving Equations by Factoring a>1 **AP Spanish language and Culture, Japanese Lang, Physics 1**	**5/8** 8.3 Using Special Factors **AP English Lit and Comp., European History, French**	**5/9** 8.3 Using Special Factors **AP Chemistry, Spanish Lit and Cult. German Lang and Cult, Psychology**	**5/10** 9.1 Solving Eq. by Taking Square Root **AP US History, Computer Science Princ., Physics 2**
5/13 9.1 Solving Eq. by Taking Square Root **AP Biology, Physics C (Mech, Electr. And Mag.)**	**5/14** 9.2 Solving Equations by Completing the Square **AP Calculus AB/BC, Art History, Human Geo.**	**5/15** 9.2 Solving Equations by Completing the Square **AP English Lang and Comp, Italian Lang, Macroeconomics**	**5/16** 9.2 Solving Equations by Completing the Square **AP Comparative, Government and Politics, World History, Statistics**	**5/17** 9.3 Using Quadratic Formula to Solve **AP Microeconomics, Music Theory, Computer Science A, Latin**
5/20 9.3 Using Quadratic Formula to Solve	**5/21** Review/Catch-up	**5/22** Review/Catch-up	**5/23** **Site Test Mod 8-9**	**5/24** **Performance Task #6**
5/27 **No School Memorial Day Holiday**	**5/28** FINAL EXAM REVIEW	**5/29** FINAL EXAM REVIEW	**5/30** FINAL EXAM REVIEW	**5/31** FINAL EXAM REVIEW

6/3 FINAL EXAM REVIEW	**6/4** **FINAL EXAMS**	**6/5** **FINAL EXAMS**	**6/6** **FINAL EXAMS**	**6/7** **Last Day for Teachers**

Mathematics II

The focus of the Mathematics II course is on quadratic expressions, equations, and functions; comparing their characteristics and behavior to those of linear and exponential relationships from Mathematics I. This course includes standards from the conceptual categories of Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability. Some standards are repeated in multiple higher mathematics courses; therefore instructional notes, which appear in brackets, indicate what is appropriate for study in this particular course. For example, the scope of Mathematics II is limited to quadratic expressions and functions, and some work with absolute value, step, and functions that are piecewise-defined. Therefore, although a standard may include references to logarithms or trigonometry, those functions should not be included in course work for Mathematics II; they will be addressed in Mathematics III.

For the Mathematics II course, instructional time should focus on five critical areas: (1) extend the laws of exponents to rational exponents; (2) compare key characteristics of quadratic functions with those of linear and exponential functions; (3) create and solve equations and inequalities involving linear, exponential, and quadratic expressions; (4) extend work with probability; and (5) establish criteria for similarity of triangles based on dilations and proportional reasoning.

(1) Students extend the laws of exponents to rational exponents and explore distinctions between rational and irrational numbers by considering their decimal representations. Students learn that when quadratic equations do not have real solutions, the number system must be extended so that solutions exist, analogous to the way in which extending the whole numbers to the negative numbers allows $x + 1 = 0$ to have a solution. Students explore relationships between number systems: whole numbers, integers, rational numbers, real numbers, and complex numbers. The guiding principle is that equations with no solutions in one number system may have solutions in a larger number system.

(2) Students consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. When quadratic equations do not have real solutions, students learn that that the graph of the related quadratic function does not cross the horizontal axis. They expand their experience with functions to include more specialized functions—absolute value, step, and those that are piecewise-defined.

Mathematics II

(3) Students begin by focusing on the structure of expressions, rewriting expressions to clarify and reveal aspects of the relationship they represent. They create and solve equations, inequalities, and systems of equations involving exponential and quadratic expressions.

(4) Building on probability concepts that began in the middle grades, students use the language of set theory to expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability. Students should make use of geometric probability models wherever possible. They use probability to make informed decisions.

(5) Students apply their earlier experience with dilations and proportional reasoning to build a formal understanding of similarity. They identify criteria for similarity of triangles, use similarity to solve problems, and apply similarity in right triangles to understand right triangle trigonometry, with particular attention to special right triangles and the Pythagorean Theorem. Students develop facility with geometric proof. They use what they know about congruence and similarity to prove theorems involving lines, angles, triangles, and other polygons. They explore a variety of formats for writing proofs.

The Standards for Mathematical Practice complement the content standards so that students increasingly engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years.

Note: The source of this introduction is the *Massachusetts Curriculum Framework for Mathematics* (Malden: Massachusetts ent of Elementary and Secondary Education, 2011), 137–8.

Mathematics II Overview

Number and Quantity

The Real Number System

- Extend the properties of exponents to rational exponents.
- Use properties of rational and irrational numbers.

The Complex Number Systems

- Perform arithmetic operations with complex numbers.
- Use complex numbers in polynomial identities and equations.

Algebra

Seeing Structure in Expressions

- Interpret the structure of expressions.
- Write expressions in equivalent forms to solve problems.

Arithmetic with Polynomials and Rational Expressions

- Perform arithmetic operations on polynomials.

Creating Equations

- Create equations that describe numbers or relationships.

Reasoning with Equations and Inequalities

- Solve equations and inequalities in one variable.
- Solve systems of equations.

Functions

Interpreting Functions

- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

Building Functions

- Build a function that models a relationship between two quantities.
- Build new functions from existing functions.

Linear, Quadratic, and Exponential Models

- Construct and compare linear, quadratic, and exponential models and solve problems.
- Interpret expressions for functions in terms of the situation they model.

Mathematics II Overview

Trigonometric Functions

- Prove and apply trigonometric identities.

Geometry

Congruence

- Prove geometric theorems.

Similarity, Right Triangles, and Trigonometry

- Understand similarity in terms of similarity transformations.
- Prove theorems involving similarity.
- Define trigonometric ratios and solve problems involving right triangles.

Circles

- Understand and apply theorems about circles.
- Find arc lengths and areas of sectors of circles.

Expressing Geometric Properties with Equations

- Translate between the geometric description and the equation for a conic section.
- Use coordinates to prove simple geometric theorems algebraically.

Geometric Measurement and Dimension

- Explain volume formulas and use them to solve problems.

Statistics and Probability

Conditional Probability and the Rules of Probability

- Understand independence and conditional probability and use them to interpret data.
- Use the rules of probability to compute probabilities of compound events in a uniform probability model.

Using Probability to Make Decisions

- Use probability to evaluate outcomes of decisions.

Mathematics II

Number and Quantity

The Real Number System N-RN

Extend the properties of exponents to rational exponents.

1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Use properties of rational and irrational numbers.

3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

The Complex Number System N-CN

Perform arithmetic operations with complex numbers. [i^2 as highest power of i]

1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

Use complex numbers in polynomial identities and equations. [Quadratics with real coefficients]

7. Solve quadratic equations with real coefficients that have complex solutions.
8. (+) Extend polynomial identities to the complex numbers. *For example, rewrite $x^2 + 4$ as $(x + 2i)(x – 2i)$.*
9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Algebra

Seeing Structure in Expressions A-SSE

Interpret the structure of expressions. [Quadratic and exponential]

1. Interpret expressions that represent a quantity in terms of its context. ★
    a. Interpret parts of an expression, such as terms, factors, and coefficients. ★
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.* ★
2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$.*

Write expressions in equivalent forms to solve problems. [Quadratic and exponential]

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★
    a. Factor a quadratic expression to reveal the zeros of the function it defines. ★

Note: ★ Indicates a modeling standard linking mathematics to everyday life, work, and decision-making. (+) Indicates additional mathematics to prepare students for advanced courses.

b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.★
c. Use the properties of exponents to transform expressions for exponential functions. *For example, the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*★

Arithmetic with Polynomials and Rational Expressions A-APR

Perform arithmetic operations on polynomials. [Polynomials that simplify to quadratics]

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Creating Equations A-CED

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable **including ones with absolute value** and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* **CA**★
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ★
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.★ [Include formulas involving quadratic terms.]

Reasoning with Equations and Inequalities A-REI

Solve equations and inequalities in one variable. [Quadratics with real coefficients]

4. Solve quadratic equations in one variable.
   a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
   b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Solve systems of equations. [Linear-quadratic systems]

7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line* $y = –3x$ *and the circle* $x^2 + y^2 = 3$.

Functions

Interpreting Functions F-IF

Interpret functions that arise in applications in terms of the context. [Quadratic]

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of

the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★

5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.★
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ★

Analyze functions using different representations. [Linear, exponential, quadratic, absolute value, step, piecewise-defined]

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★
    a. Graph linear and quadratic functions and show intercepts, maxima, and minima. ★
    b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ★
8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
    a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
    b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, *and* $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*
9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Building Functions F-BF

Build a function that models a relationship between two quantities. [Quadratic and exponential]

1. Write a function that describes a relationship between two quantities. ★
    a. Determine an explicit expression, a recursive process, or steps for calculation from a context. ★
    b. Combine standard function types using arithmetic operations. ★

Build new functions from existing functions. [Quadratic, absolute value]

3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
4. Find inverse functions.
    a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example,* $f(x) = 2x^3$.

Linear, Quadratic, and Exponential Models F-LE

Construct and compare linear, quadratic, and exponential models and solve problems. [Include quadratic]

3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. ★

Mathematics II

Interpret expressions for functions in terms of the situation they model.

6. **Apply quadratic functions to physical problems, such as the motion of an object under the force of gravity. CA★**

Trigonometric Functions F-TF

Prove and apply trigonometric identities.

8. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.

Geometry

Congruence G-CO

Prove geometric theorems. [Focus on validity of underlying reasoning while using variety of ways of writing proofs.]

9. Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints*
10. Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*
11. Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*

Similarity, Right Triangles, and Trigonometry G-SRT

Understand similarity in terms of similarity transformations.

1. Verify experimentally the properties of dilations given by a center and a scale factor:
    a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
    b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
3. Use the properties of similarity transformations to establish the Angle-Angle (AA) criterion for two triangles to be similar.

Prove theorems involving similarity. [Focus on validity of underlying reasoning while using variety of formats.]

4. Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.*
5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Define trigonometric ratios and solve problems involving right triangles.

6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

7. Explain and use the relationship between the sine and cosine of complementary angles.
8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★

8.1 Derive and use the trigonometric ratios for special right triangles (30°, 60°, 90°and 45°, 45°, 90°). CA

Circles G-C

Understand and apply theorems about circles.

1. Prove that all circles are similar.
2. Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.*
3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
4. (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles. [Radian introduced only as unit of measure]

5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. **Convert between degrees and radians. CA**

Expressing Geometric Properties with Equations G-GPE

Translate between the geometric description and the equation for a conic section.

1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
2. Derive the equation of a parabola given a focus and directrix.

Use coordinates to prove simple geometric theorems algebraically.

4. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).* [Include simple circle theorems.]
6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

Geometric Measurement and Dimension G-GMD

Explain volume formulas and use them to solve problems.

1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.*
3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. ★
5. **Know that the effect of a scale factor *k* greater than zero on length, area, and volume is to multiply each by *k*, k^2, and k^3, respectively; determine length, area and volume measures using scale factors. CA★**

6. **Verify experimentally that in a triangle, angles opposite longer sides are larger, sides opposite larger angles are longer, and the sum of any two side lengths is greater than the remaining side length; apply these relationships to solve real-world and mathematical problems. CA**

Statistics and Probability

Conditional Probability and the Rules of Probability S-CP

Understand independence and conditional probability and use them to interpret data. [Link to data from simulations or experiments.]

1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). ★
2. Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent. ★
3. Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*. ★
4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* ★
5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.★

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

6. Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. ★
7. Apply the Addition Rule, *P*(*A* or *B*) = *P*(*A*) + *P*(*B*) – *P*(*A* and *B*), and interpret the answer in terms of the model. ★
8. (+) Apply the general Multiplication Rule in a uniform probability model, *P*(*A* and *B*) = *P*(*A*)*P*(*B*|*A*) = *P*(*B*)*P*(*A*|*B*), and interpret the answer in terms of the model. ★
9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems. ★

Using Probability to Make Decisions S-MD

Use probability to evaluate outcomes of decisions. [Introductory; apply counting rules.]

6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). ★
7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). ★