Wallingford Public Schools - HIGH SCHOOL COURSE OUTLINE

Course Title: Algebra 2	**Course Number:** G1324, A1323, H1322
Department: Mathematics	**Grade(s):** 10 -12
Level(s): General, Academic, and Honors *Objectives to be mastered at different levels may vary.* *Expectations for each level are clearly defined within each learning strand, but are not intended to be limiting.*	**Credit:** 1

Course Description:
Students will extend their algebraic thinking through the study of mathematical functions such as quadratic, rational, polynomial, exponential and logarithmic functions. Mathematical modeling, problem solving and multiple representations are used to develop relationships and connections among the various concepts. Other topics may include sequences and series, probability, rational exponents, and matrices. The extent and depth of the expectations for each level may vary. Technology is integrated throughout the course, primarily through the use of a graphing calculator. (Prerequisite: Geometry)

Required Instructional Materials	**Completion/Revision Date**
Algebra 2: An Integrated Approach, Larson, Kanold, Stiff, Heath, 1997 Calculators – graphingTI-83+ and scientific	Approved by Board of Education on December 19, 2005

Mission Statement of the Curriculum Management Team
The mission of the Wallingford K-12 mathematics program is to develop mathematical literacy in all students. Students will understand the importance of mathematics and become flexible and resourceful problem solvers. They will use a range of numerical, algebraic, geometrical and statistical concepts and skills to formulate and solve authentic problems, communicating their reasoning in oral and written form.

Enduring Understandings for the Course
- A problem solver understands what has been done, knows why the process was appropriate, and can support it with reasons and evidence.
- There can be different strategies to solve a problem, but some are more effective and efficient than others.
- The context of a problem determines the reasonableness of a solution.
- Real world situations can be represented symbolically and graphically.
- Patterns and relationships can be represented numerically, graphically, symbolically, and verbally.
- Patterns provide insights into potential relationships.
- Algebraic expressions and equations generalize relationships from specific cases.
- A function describes a relationship between an input and output.
- The quadratic formula provides a means for solving a quadratic equation.
- Multiplying and factoring polynomials are related.
- Factors are a subset of a product and with the distributive property allow options in solving

polynomials.
• Solving polynomials involves the reversal of operations, the distributive property and rules of exponents.
• Real world financial situations can be represented and evaluated using exponential and rational equations.
• All rational numbers can be used as exponents.
• Roots and powers have an inverse relationship.
• Linear functions have a constant difference, whereas exponential functions have a constant ratio.
• There exist numerous nonlinear functions that model real world situations.
• Logarithms have an inverse relationship with exponents.
• Operations with rational functions follow the same procedure as operations with rational numbers.
• Graphs are used to illustrate solutions and solve problems.
• Specific graphs represent specific functions.
• Formulas can be used to determine the probability of an event in a specific or non-specific order.
• The relationship among events and the interaction of events affects probability.
• Matrices provide an alternative means of representing and solving mathematical problems.

Learning Strand

1.0   Problem Solving

NOTE: This learning strand should be taught through the integration of the other learning strands. This learning strand is not meant to be taught in isolation as a separate unit.

ENDURING UNDERSTANDING(S)
- A problem solver understands what has been done, knows why the process was appropriate, and can support it with reasons and evidence.
- There can be different strategies to solve a problem, but some are more effective and efficient than others are.
- The context of a problem determines the reasonableness of a solution.

ESSENTIAL QUESTIONS
- How do I know where to begin when solving a problem?
- How does explaining my process help me to understand a problem's solution better?
- How do I decide what strategy will work best in a given problem situation?
- What do I do when I get stuck?
- How does finding the common characteristics among similar problems help me to be a more efficient problem solver?
- How do I know when a result is reasonable?
- What is the relationship between solving problems and computation?

LEARNING OBJECTIVES   The student will :
1.1 Distinguish between given information, unknown information, and assumptions that may be necessary.
1.2 Devise a plan to solve the problem.
1.3 Identify different strategies to solve a problem (table, diagram, number pattern)
1.4 Apply an appropriate strategy(ies) to solve a problem.
1.5 Justify the strategy and solution with mathematical reasoning and evidence.
1.6 Analyze strategies used to solve a problem.
1.7 Judge the reasonableness of a solution for a problem.
1.8 Communicate the solution and the strategies used to solve the problem in oral and/or written form.
1.9 Pose problems from given situations

INSTRUCTIONAL SUPPORT MATERIALS
- CAPT sample items and released items
- Websites for problem solving
    - Math Forum
    - NCTM Standards and Illuminations
- CSDE Goals 2000 resources (W drive)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Peer editing of strategies and solutions
- Revise written solutions of problems
- Oral presentation of solution strategies
- Journal writing
- Modeling
- Think aloud
- Student inquiry through guided investigations
- Graphic organizers
- TNT strategy (directions on W drive)
- Pass a Problem (directions on W drive)
- Cooperative learning
- See other learning strands for integration

	SUGGESTED ASSESSMENTS • Open-ended questions included on tests and quizzes • Performance tasks • Teacher observations • Written explanation of strategy and solution for a problem • District rubric for assessing problem solving • Oral presentation of solution strategies • See other learning strands for integration

LEARNING STRAND

2.0 Functions & Graphs

ENDURING UNDERSTANDING(S)
- A function describes a relationship between an input and output.
- Patterns provide insights into potential relationships.
- Patterns and relationships can be represented numerically, graphically, symbolically, and verbally.
- Graphs are used to illustrate solutions and solve problems.
- Specific graphs represent specific functions.

ESSENTIAL QUESTIONS
- How can I determine if a relation is a function?
- How do the properties of a function contribute to ones understanding of a function?
- How does a change in the equation of a function transform its graph?

LEARNING OBJECTIVES
In General level the student will :
2.1 Define a function.
2.2 Identify the domain and range of a function.
2.3 Identify the dependent and independent variables.
2.4 Use functional notation.
2.5 Find the inverse of a function if it exists.
2.6 Use transformations to graph functions.
2.7 Solve and graph absolute value equations.
2.8 Examine the characteristics of an equation as they relate to the behavior of its graph.

In addition to the above, the Academic level student will :
2.9 Write the equation of a circle, given the graph.
2.10 Graph a circle, given the equation.
2.11 Construct graphs of composite and piecewise functions.
2.12 Write composite and piecewise functions to model real world situations.

In addition to the above, the Honors level student will :
2.9 Write the equation of a circle, ellipse and hyperbola given the graph.
2.10 Graph a circle, ellipse and hyperbola given the equation.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- Graphing calculators (and TI-83 View Screen)
- CAPT released items
  - Scattergrams
  - Car Rental
  - Double Discount

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class opener/ daily review
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Teacher directed classroom discussion
- Modeling
- Journals
- Student centered inquiry investigations
- Solve extended open-ended problems
- Written explanation of strategy and solution for a problem
- Group projects
- Graphing calculator lab on parabolic transformations

SUGGESTED ASSESSMENT METHODS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Notebook
- Writing assignments
- Teacher observation of group activity
- Self evaluation
- Graph sheets

	• Portfolios • Projects • Problem solving assessed with rubric • Create a flowchart and/or explain in words their problem solving steps

LEARNING STRAND

3.0   Systems of Equations & Inequalities

ENDURING UNDERSTANDING(S)
- There can be different strategies to solve a problem, but some are more effective and efficient than others.
- Real world situations can be represented symbolically and graphically.
- Matrices provide an alternative means of representing and solving mathematical problems.
- Graphs are used to illustrate solutions and solve problems.

ESSENTIAL QUESTIONS
- How do I decide which strategy is more appropriate for a specific problem?
- Why do we use linear programming for a given problem?
- How is a solution for an equation different from a solution for an inequality?

LEARNING OBJECTIVES
In General level the student will:
3.1 Solve systems of equations using graphing, substitution, and elimination.
3.2 Write systems of equations and inequalities to solve real world problems.
3.3 Graph a system of linear inequalities.

In addition to the above, the Academic level student will :
3.4 Use systems of inequalities to find the optimal conditions in real world situations.

In addition to the above, the Honors level student will :
3.5 Use matrices to solve equations in two and three variables.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- CAPT released items
    - Bicycle & Motorcycle
    - Milk Consumption
- Graphing calculators (and TI-83 view screen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Teacher directed class discussion
- Modeling
- Solve extended open-ended problems
- Journals
- Student centered inquiry investigations
- Solve extended open-ended problems
- Written explanation of strategy and solution for a problem
- Group projects

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Notebook
- Create a flowchart and/or explain in words their problem solving steps
- Problem solving assessed with rubric

	• Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter) • Graph sheet • Project: Electric Company

LEARNING STRAND

4.0   Quadratic Functions

ENDURING UNDERSTANDING(S)
- Real world situations can be represented symbolically and graphically.
- There exist numerous nonlinear functions that model real world situations.
- The quadratic formula provides a means for solving a quadratic equation.
- Graphs are used to illustrate solutions and solve problems.
- Specific graphs represent specific functions.
- There can be different strategies to solve a problem, but some are more effective and efficient than others.

ESSENTIAL QUESTIONS
- How do I decide which strategy is more appropriate to solve a quadratic equation?
- How do I determine when a solution to a quadratic equation is acceptable in a real world situation?
- How can I use the graph of a quadratic equation to contribute to my understanding of quadratic functions?

LEARNING OBJECTIVES
In General level, the student will:
4.1 Solve a quadratic equation by finding square roots.
4.2 Use quadratic equations to model real world situations.
4.3 Graph a quadratic equation using the vertex, x-intercepts, and y-intercepts.
4.4 Solve a quadratic equation by factoring.
4.5 Solve a quadratic equation by using the quadratic formula involving real solutions
4.6 Justify which method is most appropriate when solving a given quadratic equation.
4.7 Sketch the graph of a quadratic inequality.

In addition to the above, the Academic level student will :
4.8 Use the discriminant to identify the number and type of solutions in a quadratic equation.
4.9 Solve a quadratic equation by completing the square.
4.10 Use completing the square to graph circles not in standard form.

In addition to the above, the Honors level student will :
4.10 Use completing the square to graph ellipses not in standard form.
4.11 Find imaginary and complex solutions to quadratic equations.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- CAPT released items
    - Forecasting Population Trends
    - Scented Candles
    - Grass Clippings
- Graphing calculators (and TI-83 view screen)
- Web sites for graphs

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Teacher directed discussions through questioning
- Guided practice
- Student centered inquiry investigations
- Modeling
- Solve extended open-ended problems
- Written explanation of strategy and solution for a problem

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Notebook
- Self-evaluation
- Writing assignments
- Graph sheet
- Projects

	○ Leaf/Compost ○ Quadratic Inequalities/Logos - Create a flowchart and/or explain in words their problem solving steps - Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter)

LEARNING STRAND

5.0   Polynomials

ENDURING UNDERSTANDING(S)
- There can be different strategies to solve a problem, but some are more effective and efficient than others.
- There exist numerous nonlinear functions that model real world situations.
- Algebraic expressions and equations generalize relationships from specific cases.
- Specific graphs represent specific functions.
- Multiplying and factoring polynomials are related.
- Factors are a subset of a product and with the distributive property allow options in solving polynomials.
- Solving polynomials involves the reversal of operations, the distributive property and rules of exponents.

ESSENTIAL QUESTIONS
- How do I decide which approach is best to solve a polynomial equation?
- How can I use the graph of a polynomial equation to better understand polynomial functions?
- How are polynomial functions used to model real world problems?
- Why are polynomials useful?
- How does adding and subtracting polynomials relate to combining like terms?
- Why don't all polynomials factor?

LEARNING OBJECTIVES   *The student will* :
In General level, the student will:
5.1 Perform operations (+,-,×) with polynomials.
5.2 Solve polynomial equations by factoring.
5.3 Solve polynomial equations that model real life situations.
5.4 Graph polynomial functions.
5.5 Find the rational zeros of a polynomial function in factored form.

In addition to the above, the Academic level student will :
5.6 Divide polynomials by using synthetic division.
5.7 Apply the remainder theorem and/or factor theorem when using synthetic division.

In addition to the above, the Honors level student will :
5.8 Factor polynomial expressions by grouping, including the sum or difference of cubes.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- Graphing calculators (and TI-83 view screen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily review
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Teacher directed classroom discussions
- Guided practice
- Modeling
- Journals

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Self-evaluation
- Projects
- Create a flowchart and/or explain in words their problem solving steps
- Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter)
- Graph sheet

LEARNING STRAND

6.0 Roots & Rational Exponents

ENDURING UNDERSTANDING(S)
- All rational numbers can be used as exponents.
- Roots and powers have an inverse relationship.
- Real world financial situations can be represented and evaluated using exponential and rational equations.
- Algebraic expressions and equations generalize relationships from specific cases.
- Graphs are used to illustrate solutions and solve problems.
- Specific graphs represent specific functions.

ESSENTIAL QUESTIONS
- How do exponential models differ from other algebraic models?
- How can exponents be used to model financial situations?
- Why are rational exponents necessary for solving equations with roots?
- How can I use the graph of an equation to better understand the function?

LEARNING OBJECTIVES
In General level, the student will:
6.1 Apply the properties of exponents to evaluate and simplify expressions.
6.2 Simplify expressions containing radicals and rational exponents.
6.3 Restate a radical expression using rational exponents (vice versa).
6.4 Solve equations containing radicals and rational exponents.
6.5 Solve real life problems modeled by exponential growth/decay equations.

In addition to the above, the Academic level student will :
6.6 Graph square root and cube root functions
6.7 Graph other related functions with rational exponents such as:

$$y = x^{\frac{m}{n}}$$

In addition to the above, the Honors level student will :
6.7 Graph other related functions with rational exponents such as:

$$y = x^{\frac{m}{n}}$$

$$y = \sqrt{ax^2 + bx + c}$$

6.8 Evaluate nth roots of real numbers using radical notation and rational exponents.

INSTRUCTIONAL SUPPORT MATERIALS
- Graphing calculators (and TI-83 View Screen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Teacher directed classroom discussions
- Small group discussion about strategies and solutions
- Guided practice
- Modeling
- Journals
- Written explanation of strategy and solution for a problem
- Student-centered inquiry investigations

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open ended questions included on tests and quizzes
- Create a flowchart and/or explain in words their problem solving steps
- Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter)
- Graph sheet

LEARNING STRAND

7.0   Exponential & Logarithmic Functions

ENDURING UNDERSTANDING(S)
- Patterns and relationships can be represented numerically, graphically, symbolically, and verbally.
- Real world situations can be represented symbolically and graphically.
- Linear functions have a constant difference, whereas exponential functions have a constant ratio.
- Logarithms have an inverse relationship with exponents.
- Graphs are used to illustrate solutions and solve problems.
- Specific graphs represent specific functions.

ESSENTIAL QUESTIONS
- How is the rate of an exponential function different than a linear equation?
- How do the graphs of a logarithmic and an exponential function show the inverse relationship?
- How can exponential/logarithmic functions be used to model real world situations?

LEARNING OBJECTIVES
In General level, the student will:
7.1 Solve exponential equations.
7.2 Graph exponential functions.
7.3 Use exponential equations to model and solve real life problems.
7.4 Describe how logarithms are related to exponents.
7.5 Evaluate simple logarithmic expressions.

In addition to the above, the Academic and Honors level student will :
7.6 Use the natural base *e* for an exponential function.
7.7 Evaluate natural log expressions.
7.8 Solve logarithmic equations.
7.9 Graph logarithmic functions.
7.10 Use exponential and logarithmic equations to model and solve real life problems.
7.11 Apply the properties of logarithms to simplify expressions.
7.12 Analyze a logistic growth function to predict the limiting factor in a real life situation.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- CAPT released items
  - US population
- Graphing calculators (and TI-83 viewscreen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Modeling
- Teacher directed classroom discussion
- Journals
- Written explanation of strategy and solution for a problem
- Student centered inquiry labs/Investigations:
  - Interest
  - Rich Aunt Problem
  - Simulating A Flu Virus – Logistics Growth

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Self evaluation
- Notebooks
- Create a flowchart and/or explain in words their problem solving steps

	• Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter) • Graph sheet

LEARNING STRAND

8.0 Rational Functions

ENDURING UNDERSTANDING(S)
- Operations with rational functions follow the same procedure as operations with rational numbers.
- Real world financial situations can be represented and evaluated using exponential and rational equations.
- There exist numerous nonlinear functions that model real world situations.
- Graphs are used to illustrate solutions and solve problems.
- Specific graphs represent specific functions.

ESSENTIAL QUESTIONS
- How is a rational function related to a polynomial function?
- How does the graph of a rational function behave as the function approaches infinite bounds?
- How can rational functions be used to model real world situations?

LEARNING OBJECTIVES
In General and Academic levels, the student will:
8.1 Graph rational functions using asymptotes.
8.2 Solve problems demonstrating indirect variation.
8.3 Perform operations (+, -, ×,÷) with rational expressions.
8.4 Solve equations that contain rational expressions.

In addition to the above, the Honors level student will :
8.5 Simplify complex fractions.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- CAPT released items
    - Bloodstream (32,33)
- Graphing calculators (and TI-83 viewscreen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Modeling
- Journals
- Written explanation of strategy and solution for a problem
- Teacher directed classroom discussions
- Constructing amortization tables and monthly payment plans

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Create a flowchart and/or explain in words their problem solving steps
- Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter)
- Graph sheet

LEARNING STRAND

9.0   Sequences and Series

ENDURING UNDERSTANDING(S)
- Patterns provide insights into potential relationships.
- Patterns and relationships can be represented numerically, graphically, symbolically, and verbally.
- Real world situations can be represented symbolically and graphically.
- There can be different strategies to solve a problem, but some are more effective and efficient than others.

ESSENTIAL QUESTIONS
- How are patterns related?
- How are patterns different?
- How can a pattern be represented using an algebraic formula?
- How is it possible for a sequence to have a sum?

LEARNING OBJECTIVES
In General and Academic levels, the student will:
9.1 Justify whether a sequence is arithmetic, geometric, or neither.
9.2 Write an expression for a given sequence.
9.3 Determine the nth term of a sequence.
9.4 Calculate the sum of a series if it exists.
9.5 Use sequences and series to model real life problems.

In addition to the above, the Honors level student will :
9.6 Use the Binomial Theorem to expand a binomial raised to a power.

INSTRUCTIONAL SUPPORT MATERIALS
- Graphing calculators (and TI-83 viewscreen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/ daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Modeling
- Teacher directed classroom discussion
- Journals
- Written explanation of strategy and solution for a problem
    - $100 per day problem (sum of geo series)
    - Bouncing Ball problem (sum infinite series)

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on tests and quizzes
- Writing assignments
- Graph sheet

LEARNING STRAND

10.0   Probability

ENDURING UNDERSTANDING(S)
- Formulas can be used to determine the probability of an event in a specific or non-specific order.
- The relationship among events and the interaction of events affects probability.
- There can be different strategies to solve a problem, but some are more effective and efficient than others.
- Patterns provide insights into potential relationships.

ESSENTIAL QUESTIONS
- How can I find the likelihood of an event?
- How do compound events affect probability?
- How does geometry allow me to calculate probability?
- What factors play a role in determining the number of possible outcomes of an event?

LEARNING OBJECTIVES
In General level, the student will:
10.1 Use permutations to find the probability of an event.
10.2 Use combinations to find the probability of an event.
10.3 Use area to determine the probability of an event.

In addition to the above, the Academic and Honors level student will :
10.4 Determine the probability of the union of two events.
10.5 Determine the probability of the intersection of two events.

INSTRUCTIONAL SUPPORT MATERIALS
- Graphing calculators (and TI-83 viewscreen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Teacher directed class discussions
- Modeling
- Student centered inquiry investigations
  - Simulations using experimental data

SUGGESTED ASSESSMENTS
- Homework
- Quizzes and tests
- Open-ended questions included on test s and quizzes
- Writing assignments
- Authentic writing assignments using mathematics (e.g. letter to a company, a brochure, cost estimate, persuasive letter)

LEARNING STRAND

11.0 Matrices   **Honors Level**

ENDURING UNDERSTANDING(S)
- Matrices provide an alternative means of representing and solving mathematical problems.
- There can be different strategies to solve a problem, but some are more effective and efficient than others.

ESSENTIAL QUESTIONS
- How can we use matrices to solve mathematical problems?
- What are the advantages to using matrices?
- When is it appropriate to use the graphing calculator when solving problems involving matrices?

LEARNING OBJECTIVES
In Honors level, the student will:
11.1 Perform operations (+, -, scalar ×) on matrices.
11.2 Calculate the product of two matrices if it exists.
11.3 Use matrices to set up and solve real world situations.
11.4 Evaluate the determinant of a 2×2 and 3×3 matrix.
11.5 Use the determinant of a matrix to find the area of a triangle given its vertices.

INSTRUCTIONAL SUPPORT MATERIALS
- CAPT released items
  - Colin's Columns
- Graphing calculators (and TI-83 view screen)

SUGGESTED INSTRUCTIONAL STRATEGIES
- Class openers/daily reviews
- Homework
- Cooperative learning
- Small group discussion about strategies and solutions
- Guided practice
- Teacher guided classroom discussions
- Modeling
- Solve extended open-ended problems

SUGGESTED ASSESSMENT METHODS
- Homework
- Quizzes and tests
- Writing assignments
- Graph sheet