Wallingford Public Schools - HIGH SCHOOL COURSE OUTLINE

Course Title: PreCalculus	**Course Number:** 1523 (A) 1522 (H)
Department: Mathematics	**Grade(s):** 11-12
Level(s): Honors and Academic *Objectives that have an asterisk * are expected to be mastered by honors level students. Academic level students will be introduced to these concepts as appropriate.*	**Credit:** 1

Course Description:
Students develop proficiency in advanced algebra topics, trigonometry, analytic geometry and probability. Mathematical models are developed using functions, equations, and graphs to help improve the communication of mathematical ideas. Reasoning skills are developed by solving problems that connect mathematical ideas to each other and to other disciplines.

Required Instructional Materials	Completion/Revision Date
Honors Textbook: Advanced Mathematics: PreCalculus with Discrete Mathematics and Data Analysis Richard G. Brown Houghton Mifflin Company, 1997 Academic Textbook: PreCalculus with Limits: A Graphing Approach Roland E. Larson, Robert P. Hostetler, Bruce H. Edwards, David E. Heyd Houghton Mifflin Company, 1997 TI-83+ Graphing calculator	Revisions Approved by Board of Education on December 15, 2008

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 are.
- The context of a problem determines the reasonableness of a solution.
- Trigonometry is a discipline that is based on the study of triangles.
- Trigonometry is connected to other strands of mathematics
- Proportional relationships express how quantities change in relationship to each other.
- The trigonometric functions are ratios.

• Angles can be measured in different units.
• Real world situations can be represented symbolically and graphically.
• The trigonometric functions describe periodic phenomena.
• The graphs of sine and cosine model real-world phenomena.
• There are similarities and differences between the processes of solving algebraic and trigonometric equations.
• The trigonometric identities can be written in multiple equivalent forms.
• Conic sections are formed when a plane intersects a cone.
• Conic sections reflect real-world phenomena.
• The algebraic representations of vectors make them applicable to many situations.
• Parametric equations provide more information about mathematical relations over time.
• Vectors are used describe quantities that have both magnitude and direction.
• The probability of an event's occurrence can be predicted with varying degrees of confidence.
• Probability can be used to solve a variety of problems that occur in real life.
• There is a variety of ways to represent and analyze data.
• The way that data is collected, organized and displayed influences interpretation.
• Patterns provide insights into potential relationships.
• Sequences and series can solve a variety of real life problems, including compound interest and annuity accruals.
• A limit is the value a function approaches as the independent variable approaches a specific value.
• The polar coordinate system can be used to display data in a different format from the Cartesian system.
• Polar equations may be more useful in certain situations than rectangular equations.
• A limit is the value a function approaches as the independent variable approaches a specific value.

Learning Strand

0.0   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 do I know when a result is reasonable?
- What is the relationship between solving problems and computation?

LEARNING OBJECTIVES   *The students 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 (Q drive)

SUGGESTED INSTRUCTIONAL STRATEGIES

Each lesson throughout the course should begin with a problem solving experience that can integrate mathematical concepts.

- 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 Q drive)
- Pass a Problem (directions on Q 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 Angles and Basic Trigonometric Functions

ENDURING UNDERSTANDING(S)
- Trigonometry is a discipline that is based on the study of triangles.
- Proportional relationships express how quantities change in relationship to each other.
- The trigonometric functions are ratios.
- Angles can be measured in different units.
- Trigonometry is connected to other strands of mathematics.

ESSENTIAL QUESTION
- How does prior knowledge of ratios help in understanding the trigonometric functions?
- How does the process of measuring an angle in trigonometry differ from that in geometry?
- What connections can be made between geometry and trigonometry?
- How does the analysis of the unit circle generate right triangle ratios?

LEARNING OBJECTIVES   *The student will:*
2.1 Measure angles in degrees and radians
2.2 Identify coterminal angles.
2.3 Define the six trigonometric functions using the coordinate plane and the right triangle.
2.4 Determine the values of the six trigonometric functions of an angle with and without a calculator.
2.5 Identify the reference angle for any given angle in standard position.
2.6 Use the unit circle to determine special angle values.
2.7 Convert angle measures between degrees and radians.
2.8 Compute the measure of an angle given the value of a trigonometric function.

INSTRUCTIONAL SUPPORT MATERIALS
- TI-83+ Graphing calculator
- Graph paper
- Protractors
- Rulers
- String
- Compass

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Memory aids such as "SohCahToa"
- Modeling
- Cooperative learning
- Student-centered inquiry investigations
  - Special right triangle activity
  - String lesson to determine radian and degree measure
- Games for reinforcement and review
  - Trig BINGO
  - Trig Jeopardy
- Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENT METHODS
- Daily openers/warm-up
- Homework/Classwork
- Notebook
- Quizzes and tests
- Self-evaluation

	• Partner quizzes • Teacher observation of group activity • Problem solving assessed with rubric • Projects • Reflective journals • Teacher observations • Writing assignments

LEARNING STRAND

3.0 Solving Triangles

ENDURING UNDERSTANDING(S)	**ESSENTIAL QUESTIONS**
• Trigonometric ratios can be used to determine the parts of triangles. • Trigonometric ratios are important in construction, surveying and navigation. • Trigonometry is useful in solving real-world problems that use triangles. • Trigonometry can help us solve problems that cannot be solved in geometry.	• Why is it important to be able to solve for triangle measurements? • How can the trigonometric ratios be used to find heights or distances that cannot be measured geometrically? • How is trig useful in modeling real life situations that deal with right triangles?

LEARNING OBJECTIVES *The student will :*	**INSTRUCTIONAL SUPPORT MATERIALS**
3.1 Determine whether or not the triangle exists and whether the solution is unique when given selected measurements of a triangle. 3.2 Solve for triangle measurements using trigonometric ratios and the laws of sine and cosine. 3.3 Determine heights and distances that cannot be measured directly by using trigonometric functions. 3.4 Calculate the area of a polygon by breaking it into triangles.* 3.5 Apply trigonometric relationships to real world problems, including angles of elevation and depression, navigation, surveying, area and perimeter.	• TI-83+ Graphing calculator • Graph paper • Protractors • Rulers and tape measures • Inclinometer • Surveying and navigation tools **SUGGESTED INSTRUCTIONAL STRATEGIES** • Daily openers/warm-ups • Guided practice • Teacher directed class discussion • Small group discussion about strategies and solutions • Written explanation of strategy and solution for a problem • Think-alouds • Memory aids such as "SohCahToa" • Modeling • Cooperative learning • Student-centered inquiry investigations o Measuring heights and distances (i.e. flagpoles, buildings) • Application investigations in situations related to navigation and surveying • Oral presentation of solution strategies to class by individuals or pairs **SUGGESTED ASSESSMENTS** • Students find the height and inclination of objects – e.g., flagpole, tree, etc. • Daily openers/warm-up • Homework/Classwork • Notebook • Quizzes and tests

	• Self-evaluation • Partner quizzes • Teacher observation of group activity • Problem solving assessed with rubric • Projects • Reflective journals • Teacher observations • Writing assignments • Authentic writing assignments (e.g. letter to a company, brochure, cost estimate, persuasive letter)

LEARNING STRAND

4.0 Graphs of Trigonometric Functions and Inverse Trigonometric Functions

ENDURING UNDERSTANDING(S)
- Real world situations can be represented symbolically and graphically.
- The trigonometric functions describe periodic phenomena.
- The graphs of sine and cosine model real-world phenomena.

ESSENTIAL QUESTIONS
- What does it mean to have a periodic function?
- What kinds of information can be modeled using periodic graphs?
- How do the ratios that define the trig functions create the asymptotic behavior some trigonometric functions have?
- Why do some trigonometric functions have asymptotic behavior?

LEARNING OBJECTIVES   *The students will :*
4.1 Sketch the graphs of the six trigonometric functions without a calculator, generated from knowledge of the unit circle. (*inverse functions)
4.2 Determine domain and range of the six trigonometric functions.
4.3 Translate graphs of sine, cosine and tangent using changes in amplitude, period, horizontal and vertical shifts.
4.4 Compare and contrast the graphs of the six trigonometric functions.
4.5 Write the equation of a trigonometric function from its graph.
4.6 *Simulate real-world, periodic phenomena, such as tides, sound waves, Ferris wheels, pendulums, and tuning forks using the graphs of sine and cosine functions.

INSTRUCTIONAL SUPPORT MATERIALS
- CBR equipment (Calculator based ranger)
- Graph paper
- Protractors
- Rulers

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Memory aids such as "SohCahToa"
- Modeling
- Cooperative learning
- Visual aids such as an overhead transparency to demonstrate the shifting of graphs
- Student-centered inquiry investigations
  o Generate the sine equation form the motion of a spring using the CBR unit
  o Use the TI-83+ to investigate the amplitude and period of sine and cosine functions
  o Use the TI-83+ to investigate the graphs of tangent, cotangent, secant, and cosecant functions
- Application investigations in situations related to periodic phenomena
- Oral presentation of solution strategies to class by individuals or pairs

	SUGGESTED ASSESSMENTS
	• Daily openers/warm-up
	• Homework/Classwork
	• Notebook
	• Quizzes and tests
	• Self-evaluation
	• Partner quizzes
	• Application problem on tidal motion and other real world periodic phenomena
	• Teacher observation of group activity
	• Problem solving assessed with rubric
	• Projects
	• Reflective journals
	• Teacher observations
	• Writing assignments
	• Authentic writing assignments (e.g. letter to a company, brochure, cost estimate, persuasive letter)

LEARNING STRAND

5. 0 Trigonometric Equations and Expressions

ENDURING UNDERSTANDING(S)	ESSENTIAL QUESTIONS
• There are similarities and differences between the processes of solving algebraic and trigonometric equations. • The trigonometric identities can be written in multiple equivalent forms.	• How does prior knowledge of algebraic techniques aid in solving trigonometric equations? • How can algebra be used to simplify trigonometric expressions? • How do the number of solutions to an algebraic equation compare to the number of solutions to a trigonometric equation?

LEARNING OBJECTIVES   *The student will :*

5.1 Calculate angle measures using inverse trigonometric notation
5.2 Distinguish between principal values and general values of inverse functions.
5.3 Derive trigonometric identities from the ratios they represent.
5.4 Solve trigonometric equations.
5.5 Evaluate inverse trigonometric expressions.
5.6 Apply the inverse function notation.
5.7 Simplify trigonometric expressions using identities, and Sum and Difference formulas (*double angles for sine and cosine only).
5.8 *Apply sum and difference and double angle identities to evaluate expressions.
5.9 Verify trigonometric equations using fundamental identities.

INSTRUCTIONAL SUPPORT MATERIALS

• Graph paper
• Protractors
• Rulers

SUGGESTED INSTRUCTIONAL STRATEGIES

• Daily openers/warm-ups
• Guided practice
• Teacher directed class discussion
• Small group discussion about strategies and solutions
• Written explanation of strategy and solution for a problem
• Think-alouds
• Modeling
• Cooperative learning
• Student-centered inquiry investigations
• Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENTS

• Daily openers/warm-up
• Homework/Classwork
• Notebook
• Quizzes and tests
• Self-evaluation
• Partner quizzes
• Teacher observation of group activity
• Problem solving assessed with rubric
• Projects
• Reflective journals
• Teacher observations
• Writing assignments

LEARNING STRAND

6.0 Conic Sections

ENDURING UNDERSTANDING(S)	ESSENTIAL QUESTIONS
- Conic sections are formed when a plane intersects a cone. - Conic sections reflect real-world phenomena.	- Where do conic sections appear in the real world? - How does the intersection of a plane and a cone create the different conic sections?

LEARNING OBJECTIVES   *The student will:*

6.1 Identify a conic from its equation.

6.2 State the domain, range, center, vertex, and foci of each conic as it applies.

6.3 Determine the significant lines associated with each conic – i.e., axis of symmetry, asymptotes, directrix, major and minor axes.

6.4 Sketch the conic given its equation.

6.5 Formulate the equation given either a sketch or verbal description.

6.6 *Analyze real world situations that are simulated by conic sections, such as roller coasters, planetary motion, satellite dish, headlights and construction models.

INSTRUCTIONAL SUPPORT MATERIALS
- Rulers
- Graph paper
- Protractors
- Physical models of cones

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Modeling
- Cooperative learning
- Student-centered inquiry investigations
- Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENTS
- Daily openers/warm-up
- Homework/Classwork
- Notebook
- Quizzes and tests
- Self-evaluation
- Partner quizzes
- Teacher observation of group activity
- Problem solving assessed with rubric
- Projects
- Reflective journals
- Teacher observations
- Writing assignments

LEARNING STRAND

7.0 Vectors and Parametric Equations – 2 Dimensions

ENDURING UNDERSTANDING(S)
- The algebraic representations of vectors make them applicable to many situations.
- Parametric equations provide more information about mathematical relations over time.
- Vectors are used to describe quantities that have both magnitude and direction.

ESSENTIAL QUESTIONS
- How are vectors and the concept of slope related?
- How are speed and velocity related?
- How do parametric equations and vectors solve real-world problems?

LEARNING OBJECTIVES   *The students will :*
7.1 Name a vector using a variety of formats.
7.2 Perform basic mathematical operations using vectors.
7.3 Identify parallel and orthogonal vectors.
7.4 Calculate the magnitude/norm of a vector.
7.5 Calculate and apply the dot product of vectors.
7.6 *Use parametric equations to describe a line.
7.7 *Use vectors and parametric equations to represent the movement of an object with constant velocity
7.8 *Simulate movement of an object using the TI-83+
7.9 *Write the vector equation of a line

INSTRUCTIONAL SUPPORT MATERIALS
- TI-83+ Graphing calculator
- Graph paper
- Protractors
- Rulers

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Modeling
- Cooperative learning
- Student-centered inquiry investigations
  - Calculator simulations of objects moving with constant velocity
- Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENTS
- Daily openers/warm-up
- Homework/Classwork
- Notebook
- Quizzes and tests
- Self-evaluation
- Partner quizzes
- Teacher observation of group activity
- Problem solving assessed with rubric
- Projects
  - Interdisciplinary National Parks project
- Reflective journals
- Teacher observations
- Writing assignments

LEARNING STRAND

8.0 Probability and Data Analysis

ENDURING UNDERSTANDING(S)
- The probability of an event's occurrence can be predicted with varying degrees of confidence.
- Probability can be used to solve a variety of problems that occur in real life.
- There is a variety of ways to represent and analyze data.
- The way that data is collected, organized and displayed influences interpretation.

ESSENTIAL QUESTIONS
- How does knowledge of probability help us make reasonable predictions?
- Why are different measures of central tendency used to represent data?
- How can mathematical modeling be used to represent information from a set of data?
- How do people use data to influence others?

LEARNING OBJECTIVES   *The student will :*
8.1 Determine the number of arrangements using combinations and permutations.
8.2 Calculate the probability of either of two events, conditional probabilities and independent probabilities.
8.3 Calculate probabilities using the Binomial Probability Theorem and combinations.
8.4 *Determine the expected value using a probability distribution table.
8.5 Evaluate data using measures of central tendency and measures of dispersion.
8.6 Analyze situations where statistics are used to mislead people.
8.7 Generate regression equations from data using the TI 83.
8.8 Determine the nth term of a binomial expansion.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- Protractors
- Rulers

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Modeling
- Cooperative learning
- Student-centered inquiry investigations
- Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENTS
- Daily openers/warm-up
- Homework/Classwork
- Notebook
- Quizzes and tests
- Self-evaluation
- Partner quizzes
- Teacher observation of group activity
- Problem solving assessed with rubric
- Projects
- Reflective journals
- Teacher observations
- Writing assignments

LEARNING STRAND

9.0 Sequences and Series

ENDURING UNDERSTANDING(S)
- Patterns provide insights into potential relationships.
- Sequences and series can solve a variety of real life problems, including compound interest and annuity accruals.

ESSENTIAL QUESTIONS
- What are some of the different relationships between patterns?
- Do all series have a finite solution?
- How can sequences and series be used to model compound interest and annuity accruals?

LEARNING OBJECTIVES   *The students will :*
9.1 Justify whether a sequence is arithmetic, geometric or neither.
9.2 Write a formula for the nth term of a given sequence.
9.3 Use summation notation to represent a series.
9.4 Calculate the nth term of a given sequence.
9.5 Compute the sum of a series, if it exists.
9.6 Calculate the sum of an infinite sequence or determine that the infinite sequence does not have a sum.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- Protractors
- Rulers

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Modeling
- Cooperative learning
- Student-centered inquiry investigations
- Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENTS
- Daily openers/warm-up
- Homework/Classwork
- Notebook
- Quizzes and tests
- Self-evaluation
- Partner quizzes
- Teacher observation of group activity
- Problem solving assessed with rubric
- Projects
- Reflective journals
- Teacher observations
- Writing assignments

LEARNING STRAND

10.0 Polar Coordinates

ENDURING UNDERSTANDING(S)
- The polar coordinate system can be used to display data in a different format from the Cartesian system.
- Polar equations may be more useful in certain situations than rectangular equations.

ESSENTIAL QUESTIONS
- What is the relationship between the ordered pairs in the Cartesian coordinate system versus a polar system?

LEARNING OBJECTIVES   *The students will :*
10.1 Plot points on the polar coordinate system.
10.2 Convert between the polar and rectangular coordinates.
10.3 Sketch graphs of polar equations.
10.4 Identify the graph of a conic section given its equation.
10.5 Formulate the polar equation of a conic given a verbal description.

INSTRUCTIONAL SUPPORT MATERIALS
- Graph paper
- Protractors
- Rulers

SUGGESTED INSTRUCTIONAL STRATEGIES
- Daily openers/warm-ups
- Guided practice
- Teacher directed class discussion
- Small group discussion about strategies and solutions
- Written explanation of strategy and solution for a problem
- Think-alouds
- Modeling
- Cooperative learning
- Student-centered inquiry investigations
- Oral presentation of solution strategies to class by individuals or pairs

SUGGESTED ASSESSMENTS
- Daily openers/warm-up
- Homework/Classwork
- Notebook
- Quizzes and tests
- Self-evaluation
- Partner quizzes
- Teacher observation of group activity
- Problem solving assessed with rubric
- Projects
- Reflective journals
- Teacher observations
- Writing assignments

LEARNING STRAND

11.0 Limits

ENDURING UNDERSTANDING(S)	ESSENTIAL QUESTIONS
• A limit is the value a function approaches as the independent variable approaches a specific value.	• What is a limit? • What are the conditions under which a limit does not exist?

LEARNING OBJECTIVES *The students will :*	INSTRUCTIONAL SUPPORT MATERIALS
11.1 Evaluate the limit of a function using direct substitution, cancellation, one-sided limits, approximating, and the TI-83 calculator. 11.2 Evaluate the limit of a function using the difference quotient.	• Graph paper • Protractors • Rulers **SUGGESTED INSTRUCTIONAL STRATEGIES** • Daily openers/warm-ups • Guided practice • Teacher directed class discussion • Small group discussion about strategies and solutions • Written explanation of strategy and solution for a problem • Think-alouds • Modeling • Cooperative learning • Student-centered inquiry investigations • Oral presentation of solution strategies to class by individuals or pairs **SUGGESTED ASSESSMENTS** • Daily openers/warm-up • Homework/Classwork • Notebook • Quizzes and tests • Self-evaluation • Partner quizzes • Teacher observation of group activity • Problem solving assessed with rubric • Projects • Reflective journals • Teacher observations • Writing assignments