WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

AP STATISTICS (6239)

School……Westfield High School
Department ……... Mathematics
Length of Course …….Full year
Grade Levels ……... 11, 12
Prerequisite……..……Algebra II Honors or Precalculus Advanced[1]
Date ……

I. RATIONALE, DESCRIPTION AND PURPOSE

As the world becomes more quantitative, an understanding of statistical concepts will have real consequences for our decision-making processes. This course provides students with the tools needed to think statistically, collect data in reasonable ways, and to learn from data. Students interpret, explain, justify, and draw conclusions from the data. The ability to communicate effectively is an important aspect of solving statistical problems.

AP Statistics is taught as a college-level course and is intended for students who have a solid foundation in mathematics. This course follows the College Board syllabus, prepares students for success on the AP Statistics exam, and is equivalent to an introductory semester course at colleges and universities.

II. OBJECTIVES

The curriculum fulfills Westfield Board of Education expectations for student achievement. Course objectives are aligned with the New Jersey Student Learning Standards for Mathematics, English Language Arts, Science, Social Studies, Technology, and 21st Century Life and Careers.

Students:

A. Understand and use methods of summarizing univariate, bivariate, and categorical data
NJ Student Learning Standards for Mathematics S-ID NJ
Student Learning Standards for Science P1, P4, P5
NJ Student Learning Standards for Social Studies 6.3
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

[1] See Program of Studies for additional information.

B. Model and solve mathematical and real-world problems using statistical measures and procedures
NJ Student Learning Standards for Mathematics S-ID
NJ Student Learning Standards for Science P1, P2, P4
NJ Student Learning Standards for Social Studies 6.3
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

C. Apply the principles of experimental design
NJ Student Learning Standards for Mathematics S-IC NJ
Student Learning Standards for Science P1 – P8
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

D. Model and solve mathematical and real-world problems using the laws of probability
NJ Student Learning Standards for Mathematics S-CP, S-MD
NJ Student Learning Standards for Science P1, P5
NJ Student Learning Standards for Social Studies 6.3
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

E. Understand and use statistical procedures to make inferences and justify conclusions
NJ Student Learning Standards for Mathematics S-IC
NJ Student Learning Standards for English Language Arts A.R10
NJ Student Learning Standards for Science P1, P4, P5
NJ Student Learning Standards for Social Studies 6.3
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

F. Develop practices and dispositions that lead to mathematical proficiency.
NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8
NJ Student Learning Standards for English Language Arts A.R7, A.R10, A.W1, A.SL1, A.SL2, A.SL3, A.SL4, A.SL5
NJ Student Learning Standards for Science P1
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE AND SEQUENCE

The importance of mathematics in the development of all civilizations and cultures and its relevance to students' success, regardless of career path, is addressed throughout the secondary mathematics program. Emphasis is placed on the development of critical thinking and problem-solving skills, particularly through the use of everyday contexts and real-world applications.

A. Exploration of data by observing patterns and departures from patterns
   1. Graphical techniques for displaying univariate data
      a. Dotplots, stemplots, histograms, and boxplots
      b. Interpretation of graphical displays in terms of shape, center, spread, gaps, outliers
   2. Numerical techniques to describe univariate data
      a. Computation and interpretation of measures of center: mean and median
      b. Computation and interpretation of measures of spread: interquartile range and standard deviation

c. Computation and interpretation of measures of position: quartiles, percentiles, standardized scores (z-scores)
d. Examination of the effects of a linear transformation of a data set on measures of center and spread

3. Relationships between two quantitative variables
   a. Construction and interpretation of scatterplots for bivariate data
   b. Identification and interpretation of the least squares regression line
   c. Identification and interpretation of the correlation coefficient
   d. Construction and interpretation of residual plots to assess if a linear model is appropriate
   e. Determination of whether a point is influential
   f. Logarithmic and power transformations to re-express a nonlinear relationship as a linear one
4. Relationships between two categorical variables
   a. Construction of frequency tables and bar charts
   b. Computation of marginal and joint frequencies
   c. Computation of conditional relative frequencies and evaluating associations
   d. Comparison of distributions using bar charts

B. Planning and conducting a study
1. Overview of methods of data collection
   a. Distinction between a census and a sample survey
   b. Distinction between an experiment and an observational study
2. Planning and conducting surveys
   a. Types of sampling methods, including simple random sampling, stratified random sampling, and cluster sampling
   b. Identification of sources of bias in sample surveys
   c. Use of stratification to reduce variation
3. Planning and conducting experiments
   a. Identification of the three basic principles of experimental design
   b. Completely randomized design
   c. Randomized block design, including matched pairs design
   d. Distinction between the purposes of randomization and blocking in an experimental design
   e. Identification of sources of bias and confounding, including the placebo effect and blinding

C. Exploration of random phenomena using probability and simulation
1. Probability
   a. Simulation of random behavior using a table of random numbers or technology
   b. Interpretation of probability as a long-run relative frequency (the “law of large numbers”)
   c. Use of the addition and multiplication rules of probability
   d. Calculation of conditional probabilities
   e. Determination of disjoint or independent events
   f. Identification and definition of discrete and continuous random variables

g. Construction of a probability distribution for discrete and continuous random variables
h. Calculation of the mean (expected value) and standard deviation of a random variable, including binomial and geometric
i. Calculation of the mean (expected value) and standard deviation of transformations of a random variable
j. Calculation of probabilities of random variables, including binomial and geometric

2. Combinations of independent random variables
   a. Concept of independence versus dependence
   b. Calculation of the mean (expected value) and standard deviation for sums and differences of independent random variable
3. The Normal distribution
   a. Properties of a Normal distribution
   b. Use of tables and technology to find the proportion of values on an interval of the Normal distribution
   c. Use of tables and technology to find a value with a given proportion of observations above or below it
   d. Use of a variety of techniques, including construction of a normal probability plot, to assess the normality of a distribution
4. Sampling distributions
   a. Description of the sampling distribution of a sample mean (shape, center, spread)
   b. Implications of the Central Limit Theorem
   c. Description of the sampling distribution of a sample proportion
   d. Description of the sampling distribution of a difference between two independent sample means
   e. Description of the sampling distribution of a difference between two independent sample proportions

D. Statistical inference for estimating population parameters and testing hypotheses
1. Confidence intervals
   a. Description of the basic form and properties of all confidence intervals
   b. Construction and interpretation of a confidence interval for a population mean (including paired data)
   c. Construction and interpretation of a confidence interval for a population proportion
   d. Construction and interpretation of a confidence interval for a difference between two means (including paired data)
   e. Construction and interpretation of a confidence interval for a difference between two proportions
2. Tests of significance
   a. Explanation of the logic of significance testing
   b. Identification and explanation of the differences between a null hypothesis and an alternative hypothesis
   c. Use of a large sample test for a population mean
   d. Use of a large sample test for a population proportion

e. Use of a large sample test for a difference between two means (including paired data)
f. Use of a large sample test for a difference between two proportions
g. Use of the appropriate *chi-square* test for goodness of fit, homogeneity of proportions, and independence

3. Special case of normally-distributed data
   a. Understanding of a *t* distribution
   b. Use of a one-sample *t-test* and construction of a confidence interval
   c. Use of a two-sample (independent and matched pairs) *t-test* and construction of a confidence interval
   d. Construction and interpretation of a confidence interval and use of a test of significance for the slope of a least square

E. Optional advanced topics
1. Data analysis through graphical and numerical representations
2. Application of hypothesis tests to determine statistical significance of data
3. Presentation and reflection on the statistical process

IV. INSTRUCTIONAL TECHNIQUES

Various instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Typical teaching techniques include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction, and modeling of procedures
B. Mini-lessons or individualized instruction for reinforcement or re-teaching of concepts
C. Guided investigations/explorations
D. Problem-based learning
E. Modeling with manipulatives
F. Flexible grouping
G. Differentiated tasks
H. Spiral review
I. Independent practice
J. Use of technology
K. Integration of mathematics with other disciplines.

V. EVALUATION

Multiple techniques are employed to assess student understanding of mathematical concepts, skills, and thinking processes. These may include, but are not limited to, the following:

A. Written tests and quizzes, including baseline and benchmark assessments
B. Cumulative tests
C. Standardized tests
D. Electronic data-gathering and tasks
E. Homework
F. Independent or group projects
G. Presentations.

VI. PROFESSIONAL DEVELOPMENT

The following recommended activities support this curriculum:

A. Opportunities to learn from and share ideas about teaching and learning mathematics with colleagues through meetings and peer observations
B. Collaboration with colleagues and department supervisor to discuss and reflect upon unit plans, homework, and assessment practices
C. Planning time to develop and discuss the results of implementing differentiated lessons and incorporating technology to enhance student learning
D. Attendance at workshops, conferences and courses that focus on relevant mathematics content, pedagogy, alternate assessment techniques, or technology.

APPENDIX I

New Jersey Student Learning Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

SMP1 – Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

SMP2 – Reason abstractly and quantitatively.
Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

SMP3 – Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from hat which is flawed, and if there is a flaw in an argument explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

SMP4 – Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

SMP5 – Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

SMP6 – Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

SMP7 – Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

SMP8 – Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

New Jersey Student Learning Standards for Mathematical Content

Interpreting Categorical and Quantitative Data S-ID

Summarize, represent, and interpret data on a single count or measurement variable.

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) andspread (interquartile range, standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Summarize, represent, and interpret data on two categorical and quantitative variables.

5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
   a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.*
   b. Informally assess the fit of a function by plotting and analyzing residuals.
   c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models.

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.

Making Inferences and Justifying Conclusions S-IC

Understand and evaluate random processes underlying statistical experiments.

1. Understand statistics as a process for making inferences to be made about population parameters based on a random sample from that population.
2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
6. Evaluate reports based on data.

Conditional Probability and the Rules of Probability S-CP

Understand independence and conditional probability and use them to interpret data.

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. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

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

Calculate expected values and use them to solve problems.

1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*

Use probability to evaluate outcomes of decisions.

5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
   a. Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*
   b. Evaluate and compare strategies on the basis of expected values. *For example, compare a high- deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*
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).

(+) Denotes additional mathematics that students should learn in order to take advanced courses.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX II

New Jersey Student Learning Standards for English Language Arts

College and Career Readiness Anchor Standards for Reading:
NJSLSA.R7 – Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

NJSLSA.R10 – Read and comprehend complex literary and informational texts independently and proficiently.

College and Career Readiness Anchor Standard for Writing:
NJSLSA.W1 – Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

College and Career Readiness Anchor Standards for Speaking and Listening:
NJSLSA.SL1 – Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NJSLSA.SL2 – Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

NJSLSA.SL3 – Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

NJSLSA.SL4 – Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

NJSLSA.SL5 – Make strategic use of digital and visual displays of data to express information and enhance understanding of presentations.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX III

New Jersey Student Learning Standards for Science / Next Generation Science Standards: Science and Engineering Practices

Practice 1 – Asking questions and defining problems
Practice 2 – Developing and using models
Practice 3 – Planning and carrying out investigations
Practice 4 – Analyzing and interpreting data
Practice 5 – Using mathematics and computational thinking
Practice 6 – Constructing explanations and designing solutions
Practice 7 – Engaging in argument from evidence
Practice 8 – Obtaining, evaluating, and communicating information

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX IV

New Jersey Student Learning Standards for Social Studies

STANDARD 6.3 Active Citizenship in the 21st Century. All students will acquire the skills needed to be active, informed citizens who value diversity and promote cultural understanding by working collaboratively to address challenges that are inherent in living in an interconnected world.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX V

New Jersey Student Learning Standards for Technology

NJSLS 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX VI

New Jersey Student Learning Standards for 21st Century Life and Careers

STANDARD 9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.
The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX VII

Instructional Resources and Pacing Guides

Instructional resource for AP Statistics*:* *The Practice of Statistics,* Daniel S. Yates et al, WH Freeman and Company (2008).

Suggested pacing*:*

Unit	# teaching days
Exploring data	10
Describing location in a distribution	10
Examining relationships	12
More about relationships between two variables	13
Producing data	12
Probability and simulations	11
Random variables	11
Binomial and geometric distributions	9
Sampling distributions	12
Estimating with confidence	11
Testing a claim	6
Significance tests in practice	5
Comparing two population parameters	5
Inference for distributions of categorical variables	5
Inferences of regression	3
Applications	20

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

AP CALCULUS AB (6344)

School ……Westfield High School
Department ……Mathematics
Length of Course ……..Full year
Credit ……...5
Grade Level…..……...……... 12
Prerequisite ……...…...Pre-Calculus Advanced[1]
Date ……

I. RATIONALE, DESCRIPTION AND PURPOSE

Students explore concepts, methods and applications of single-variable calculus graphically, numerically and algebraically. Major topics include limits, derivatives, integrals, and the Fundamental Theorem of Calculus. Mathematical modeling is used to represent real-world situations and solve problems. Applications to science and technology emphasize the interdisciplinary nature of mathematics. Technology enables students to explore, experiment, interpret results, and justify conclusions.

AP Calculus AB is taught as a college-level course and is intended for students who have a solid foundation in algebra, geometry, trigonometry, analytic geometry and elementary functions. This course follows the College Board syllabus, prepares students for success on the AP Calculus AB exam, and is equivalent to an introductory semester course at colleges and universities.

II. OBJECTIVES

This curriculum fulfills Westfield Board of Education expectations for student achievement. Course objectives are aligned with the New Jersey Student Learning Standards for Mathematics, English Language Arts, Science, Technology, and 21st Century Life and Careers.

Students:

A. Identify and use characteristics of functions
NJ Student Learning Standards for Mathematics F-IF, F-BF, F-TF
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

[1] See Program of Studies for additional information.

B. Understand and apply the concepts of limits and continuity
NJ Student Learning Standards for Mathematics F-IF, F-BF, F-TF
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

C. Develop the concepts of derivatives
NJ Student Learning Standards for Mathematics F-IF, SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

D. Apply principles of derivatives to model and solve mathematical and real-world problems
NJ Student Learning Standards for Mathematics N-Q, A-CED, F-IF, F-LQE, F-TF, G-MG, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

E. Develop the concepts of integration
NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards Standards for 21st Century Life and Careers 9.1

F. Apply principles of integration to model and solve mathematical and real-world problems
NJ Student Learning Standards for Mathematics A-CED, G-MG, SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

G. Develop practices and dispositions that lead to mathematical proficiency.
NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8
NJ Student Learning Standards for English Language Arts A.R7, A.R10, A.W1, A.SL1, A.SL2, A.SL3, A.SL4, A.SL5
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE AND SEQUENCE

The importance of mathematics in the development of all civilizations and cultures and its relevance to students' success, regardless of career path, is addressed throughout the secondary mathematics program. Emphasis is placed on the development of critical thinking and problem- solving skills, particularly through the use of everyday contexts and real-world applications.

A. Functions, graphs and limits
   1. Characteristics of functions
      a. Overview of polynomial, piecewise, exponential, rational, logarithmic and trigonometric functions
      b. Relationship between geometric and analytic information
      c. Use of calculus to predict and explain local and global behavior of a function

2. Limits of functions
    a. Intuitive understanding of the limit process
    b. Utilization of limit laws
    c. Calculation of limits using algebra
    d. Estimation of limits from graphs or tables of data
    e. Understanding of asymptotes in terms of graphical behavior
    f. Description of asymptotic behavior in terms of limits involving infinity
3. Continuity as a property of functions
    a. Intuitive understanding of continuity
    b. Understanding of continuity in terms of limits
    c. Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)

B. Derivatives
1. Concept of the derivative
    a. Derivative presented graphically, numerically, and analytically
    b. Derivative interpreted as an instantaneous rate of change
    c. Derivative defined as the limit of the difference quotient
    d. Relationship between differentiability and continuity
2. Derivative at a point
    a. Slope of a curve at a point
    b. Tangent line to a curve at a point and local linear approximation
    c. Instantaneous rate of change as the limit of average rate of change
    d. Approximate rate of change from graphs and tables of values
3. Derivative as a function
    a. Derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions
    b. Derivative rules for sums, products, and quotients of functions
    c. Chain rule and implicit differentiation
    d. Corresponding characteristics of graphs of f and f'
    e. Relationship between the increasing and decreasing behavior of f and the sign of f'
    f. The Mean Value Theorem and its geometric interpretation
    g. Equations involving derivatives
4. Second derivatives
    a. Corresponding characteristics of the graphs of f, f', and f''
    b. Relationship between the concavity of f and the sign of f''
    c. Points of inflection as places where concavity changes
5. Applications of derivatives
    a. Analysis of curves
    b. Optimization, both absolute (global) and relative (local) extrema
    c. Models for rates of change, including related-rates problems
    d. Implicit differentiation to find the derivative of an inverse function
    e. Interpretation of the derivative as a rate of change in varied applied contexts, including motion, velocity, speed, and acceleration

f. Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations
g. Applications of L'Hopitals to evaluate limits in indeterminate form

C. Integrals
1. Interpretations and properties of definite integrals
a. Definite integral as a limit of Riemann sums
b. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval
c. Basic properties of definite integrals
2. Numerical approximations to definite integrals
a. Approximation of definite integrals of functions represented algebraically, graphically, and by tables of values
b. Riemann sums, using left, right, and midpoint evaluation points
c. Trapezoidal sums
3. Fundamental Theorem of Calculus
a. Use of the Fundamental Theorem to evaluate definite integrals
b. Use of the Fundamental Theorem to represent a particular anti-derivative, and the analytical and graphical analysis of functions
4. Techniques of anti-differentiation
a. Antiderivatives following directly from derivatives of basic functions
b. Antiderivatives by substitution of variables
c. Antiderivatives by integration of parts
5. Applications of integrals
a. Area of a region, volume of a solid of rotation and volume with known cross-sections
b. Average value of a function
c. Distance traveled by a particle along a line
d. Models of accumulation using Reimann sums and integrals
e. Specific antiderivatives using initial conditions, including applications to motion along a line
f. Solution of separable differential equations and use in modeling

D. Optional advanced topics
1. Integration by partial fractions
2. Integration by trig substitution
3. Sequences and series

IV. INSTRUCTIONAL TECHNIQUES

Various instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Typical teaching techniques include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction, and modeling of procedures
B. Mini-lessons or individualized instruction for reinforcement or re-teaching of concepts
C. Guided investigations/explorations
D. Problem-based learning

E. Modeling with manipulatives
F. Flexible grouping
G. Differentiated tasks
H. Spiral review
I. Independent practice
J. Use of technology
K. Integration of mathematics with other disciplines.

V. EVALUATION

Multiple techniques are employed to assess student understanding of mathematical concepts, skills, and thinking processes. These may include, but are not limited to, the following:

A. Written tests and quizzes, including baseline and benchmark assessments
B. Cumulative tests
C. Standardized tests
D. Electronic data-gathering and tasks
E. Homework
F. Independent or group projects
G. Presentations.

VI. PROFESSIONAL DEVELOPMENT

The following recommended activities support this curriculum:

A. Opportunities to learn from and share ideas about teaching and learning mathematics with colleagues through meetings and peer observations
B. Collaboration with colleagues and department supervisor to discuss and reflect upon unit plans, homework, and assessment practices
C. Planning time to develop and discuss the results of implementing differentiated lessons and incorporating technology to enhance student learning
D. Attendance at workshops, conferences and courses that focus on relevant mathematics content, pedagogy, alternate assessment techniques, or technology.

APPENDIX I

New Jersey Student Learning Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

SMP1 – Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

SMP2 – Reason abstractly and quantitatively.
Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

SMP3 – Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

SMP4 – Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

SMP5 – Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data.

Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

SMP6 – Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

SMP7 – Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

SMP8 – Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

New Jersey Student Learning Standards for Mathematical Content

Quantities N-Q

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

2. Define appropriate quantities for the purpose of descriptive modeling.

Creating Equations A-CED

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Interpreting Functions F-IF

Interpret functions that arise in applications in terms of the context.

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. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*
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.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
   b. Graph linear and quadratic functions and show intercepts, maxima, and minima.
   c. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
   d. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
   e. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
   f. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
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* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*

Building Functions F-BF

Build new functions from existing functions.

3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, 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,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x-1)$ *for* $x \neq 1$.
   b. (+) Verify by composition that one function is the inverse of another.
   c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
   d. (+) Produce an invertible function from a non-invertible function by restricting the domain.

Linear, Quadratic, and Exponential Models F-LQE

Construct and compare linear, quadratic, and exponential models and solve problems.

1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
   a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
   b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
   c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Trigonometric Functions F-TF

Extend the domain of trigonometric functions using the unit circle.

3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.

Model periodic phenomena with trigonometric functions.

7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

Modeling with Geometry G-MG

Apply geometric concepts in modeling situations.

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

(+) Denotes additional mathematics that students should learn in order to take advanced courses.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX II

New Jersey Student Learning Standards for English Language Arts

College and Career Readiness Anchor Standards for Reading:
NJSLSA.R7 – Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

NJSLSA.R10 – Read and comprehend complex literary and informational texts independently and proficiently.

College and Career Readiness Anchor Standard for Writing:
NJSLSA.W1 – Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

College and Career Readiness Anchor Standards for Speaking and Listening:
NJSLSA.SL1 – Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NJSLSA.SL2 – Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

NJSLSA.SL3 – Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

NJSLSA.SL4 – Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

NJSLSA.SL5 – Make strategic use of digital and visual displays of data to express information and enhance understanding of presentations.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX III

New Jersey Student Learning Standards for Science / Next Generation Science Standards: Science and Engineering Practices

Practice 1 – Asking questions and defining problems
Practice 2 – Developing and using models
Practice 3 – Planning and carrying out investigations
Practice 4 – analyzing and interpreting data
Practice 5 – Using mathematics and computational thinking
Practice 6 – Constructing explanations and designing solutions
Practice 7 – engaging in argument from evidence
Practice 8 – Obtaining, evaluating, and communicating information

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX IV

New Jersey Student Learning Standards for Technology

NJSLS 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX V

New Jersey Student Learning Standards for 21st Century Life and Careers

NJSLS Career Ready Practices: These practices outline the skills that all individuals need to have to be truly adaptable, reflective, and proactive in life and careers. These are researched practices that are essential to career readiness.

NJSLS 9.1 21st Personal Financial Literacy: This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX V

Instructional Resources and Pacing Guide

Instructional resource for AP Calculus AB: *Calculus Graphical, Numerical, Algebraic*, Finney et al, Pearson (2016)

Suggested pacing:

Unit	# teaching days
Prerequisites for calculus	11
Limits and continuity	23
Derivatives	39
Applications of derivatives	27
Definite integral	15
Indefinite integral and differential equations	26
Applications of integration	15

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

AP CALCULUS BC (6347)

School……Westfield High School
Department …… Mathematics
Length of Course ……..Full year
Credit ……5
Grade Level …….....12
Prerequisite ……...Pre-Calculus Honors[1]
Date …….

I. RATIONALE, DESCRIPTION AND PURPOSE

Students explore concepts, methods and applications of single-variable calculus graphically, numerically and algebraically. In addition to all topics covered in AP Calculus AB, the course includes additional topics such as parametric, polar, vector and logistic growth functions, more complex methods of integration, numerical solutions of differential equations, Taylor polynomials and infinite series. Mathematical modeling is used to represent real-world situations and solve problems. Applications to science and technology emphasize the interdisciplinary nature of mathematics. Technology is an essential component of the course, enabling students to explore, experiment, interpret results, and justify conclusions.

AP Calculus BC is taught as a college-level course and is intended for students who have demonstrated a high level of proficiency in algebra, geometry, trigonometry, analytic geometry and elementary functions. This course follows the College Board syllabus, prepares students for success on the AP Calculus BC exam, and is equivalent to an introductory two-semester course at colleges and universities.

II. OBJECTIVES

This curriculum fulfills Westfield Board of Education expectations for student achievement. Course objectives are aligned with the New Jersey Student Learning Standards for Mathematics, English Language Arts, Science, Technology, and 21st Century Life and Careers.

[1] See Program of Studies for additional information.

Students:

A. Demonstrate understanding of prerequisite concepts and skills
NJ Student Learning Standards for Mathematics F-IF, F-BF, F-TF
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

B. Understand and apply the concepts of limits and continuity
NJ Student Learning Standards for Mathematics F-IF, F-BF, F-TF
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

C. Develop the concept of a derivative and the skills needed to find the derivative of any function including polar and parametric functions
NJ Student Learning Standards for Mathematics F-IF, SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

D. Apply principles of derivatives to model and solve mathematical and real-world problems
NJ Student Learning Standards for Mathematics N-Q, A-CED, F-IF, F-LQE, F-TF, G-MG, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

E. Develop the concept of integration and the skills needed to find the integral of many functions including polar and parametric functions
NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

F. Apply principles of integration to model and solve mathematical and real-world problems
NJ Student Learning Standards for Mathematics A-CED, G-MG, SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

G. Develop the concept of an infinite series and apply the concept to the approximation of any function using polynomial functions
NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

H. Develop practices and dispositions that lead to mathematical proficiency.
NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8
NJ Student Learning Standards for English Language Arts A.R7, A.R10, A.W1, A.SL1, A.SL2, A.SL3, A.SL4, A.SL5
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III. CONTENT, SCOPE AND SEQUENCE

The importance of mathematics in the development of all civilizations and cultures and its relevance to students' success, regardless of career path, is addressed throughout the secondary mathematics program. Emphasis is placed on the development of critical thinking and problem- solving skills, particularly through the use of everyday contexts and real-world applications.

A. Prerequisites for calculus
   Precalculus topics, including parametric equations and exponential growth

B. Limits and continuity
   1. Definition of rates of change of a function, including velocity
   2. Determination of tangent and secant lines: average and instantaneous rates of change
   3. Use of technology to graph tangent lines
   4. Intuitive understanding of the limit of a function
   5. Graphical interpretation of limits
   6. Investigation of limits of functions involving infinity
   7. Investigation of limits of functions at a point
   8. Derivation of theorems about limits
   9. Use of technology to find limits
   10. Definition of the slope of a curve
   11. Definition of continuity and limits, including classification of discontinuities
   12. Connections between asymptotes of graphs and limits
   13. Connections between rates of change and tangent lines

C. Derivatives
   1. Definition of the derivative of a function; alternate forms of the difference quotient
   2. Graphical estimation of derivatives
   3. Relationship between the graphs of $f(x)$ and $f'(x)$
   4. Definition of differentiability
   5. Exploration of various cases of non-differentiability
   6. Definition of linearity and differential approximation
   7. Derivation and application of rules for derivatives, including constant functions, product and quotient rules
   8. Definition of second and higher-order derivatives
   9. Use of technology to find and graph derivatives
   10. Exploration of applications of rates of change, including position, velocity, acceleration, and simulation of particle motion
   11. Derivation and application of the derivatives of trigonometric functions
   12. Derivation of the derivative of the composition of functions: chain rule
   13. Slopes of parametrically-defined and polar functions
   14. Higher-order derivatives of parametric functions
   15. Definition of implicit differentiation and its relation to the chain rule and derivatives of inverse functions
   16. Higher-order derivatives of implicitly-defined functions
   17. Derivation and application of the derivatives of inverse trigonometric functions

18. Derivation and application of the derivatives of logarithmic and exponential functions
19. Investigation of the method of logarithmic differentiation

D. Applications of derivative
1. Exploration of extreme values of a function, local and global, including endpoints, using graphs and derivatives
2. Proof and application, analytically and graphically, of the Mean Value Theorem for Derivatives and Rolle's Theorem
3. Identification of the relationship between increasing, decreasing and derivatives
4. Use of technology to explore the relationship between a graph and the derivatives of a function
5. Intuitive understanding of the antiderivative, including exploration of multiple solutions and the genesis of "+*c*"
6. Use of technology to graph an antiderivative
7. Investigation of the relationship between graphs and derivatives, including differentiability, increasing and decreasing, concavity and extrema, with the Extreme Value Theorem
8. Application of graphing models to parametric and polar curves
9. Application of the derivative to optimization problems, including models from real-world applications and discrete data
10. Limits of indeterminate forms using L'Hopital's Rule
11. Use of linearization and function approximation
12. Use of the differential to approximate change, including real-world applications
13. Use of technology to explore linearization
14. Models for solving related-rate problems
15. Use of technology to simulate related-motion problems
16. Definition of vector-form position functions and their relationship to parametric equations, including velocity and acceleration vectors, magnitude of the velocity and slope of the path
17. Derivation of rates of change of polar functions

E. Definite integrals
1. Use of finite sums for estimation of areas, including RRAM, LRAM, MRAM and trapezoids
2. Use of technology to visualize and compute finite sums
3. Limit of an infinite (Riemann) sum to exactly represent area, including right, left and midpoint rectangles and trapezoids
4. Integral notation
5. Definition of the definite integral as the limit of the Riemann Sum
6. Relationship of the definite integral to actual *vs.* "signed" area
7. Evaluation of definite integrals using geometric and other visual methods
8. Definition of the definite integral of a rate of change function as the change in the function value over the definite interval
9. Use of technology to evaluate definite integrals
10. Relationship between the integral and the antiderivative
11. Derivation and application of the Average Value of a Function Theorem
12. Definition of the Fundamental Theorem of Calculus, Part I & Part II
13. Application of the Fundamental Theorem to modeling and area problems, and interpretation of the result

14. Models for discrete data problems using infinite sums and definite integrals

F. Differential equations and mathematical modeling
   1. Definition of antiderivatives and slope fields; models for initial-value problems
   2. Relationship of the slope field to the function; investigation of characteristics of the slope of the function
   3. Use of technology to create slope fields, including sketching a curve using an initial condition
   4. Connection between antiderivatives and the indefinite integral
   5. Use of technology to find indefinite integrals
   6. Development of properties of the indefinite integral, including extracting constant multiples and adding and subtracting integrals
   7. Solution of first- and second-order separable differential equations with/without initial conditions
   8. Application of differential equations to real-world problems
   9. Development of techniques of integration (substitution, integration by parts, partial fractions)
   10. Exploration of exponential growth and decay; characteristics of the growth rate and modeling, including population growth, interest problems, Newton's Law of Cooling and coasting problems, with continued application to data sets
   11. Models for population growth, including exponential and logistic growth
   12. Numerical solutions of differential equations using Euler's Method, including computational and visual interpretations
   13. Investigation of improper integrals and limits, including infinity and discontinuities, and applications
   14. Evaluation of improper integrals by direct and limit comparison

G. Applications of the definite integral
   1. Definition of the integral as the accumulation of change graphically, analytically and through technology
   2. Investigation of applications to distance and work problems, including problems defined by data sets
   3. Area between curves, including subdivision of the area and integration with respect to x and with respect to y
   4. Areas bounded by polar curves
   5. Application of the integral to volumes using discs, washers, cylindrical shells and cross-sections
   6. Application of the integral to curve length, including parametric and polar curves
   7. Investigation of the effect of discontinuities in the function and the derivative on the calculation of areas, volumes and curve length
   8. Investigation of further application of integrals as net change, including a more thorough investigation of work as the integral of force times distance

H. Infinite series
   1. Tests for convergence/divergence of infinite series (*nth* term test, direct comparison, limit comparison, ratio test, integral test, *p*-series, alternating signs test, *nth* root test, absolute and conditional convergence)

2. Definition of a power series and use of a power series to approximate a function
3. Definition of Taylor's Theorem for creating a power series centered at $x=a$, including Maclaurin Series
4. Use of a power series for $f(x)$ to create power series for other functions, using algebraic and calculus techniques
5. Use of technology to find a finite number of terms of a power series for a given function
6. Identification of the radius and interval of convergence for a power series, including the endpoint test
7. Graphical investigation of the significance of the interval of convergence
8. Application of power series to the estimation of function values, including the remainder or error estimate, using the Lagrange formula and alternating series formula for error boundaries

I. Optional advanced topics
1. Derivation of the method of Trigonometric Substitution as a technique of integration
2. Surface area of revolution as an application of integration
3. Investigation of simple linear differential equation models
4. Introduction to multivariable functions and their application
5. Introduction to the hyperbolic trigonometric functions

IV. INSTRUCTIONAL TECHNIQUES

Various instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Typical teaching techniques may include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction, and modeling of procedures
B. Mini-lessons or individualized instruction for reinforcement or re-teaching of concepts
C. Guided investigations/explorations
D. Problem-based learning
E. Modeling with manipulatives
F. Flexible grouping
G. Differentiated tasks
H. Spiral review
I. Independent practice
J. Use of technology
K. Integration of mathematics with other disciplines.

V. EVALUATION

Multiple techniques are employed to assess student understanding of mathematical concepts, skills, and thinking processes. These may include, but are not limited to, the following:

A. Written tests and quizzes, including baseline and benchmark assessments
B. Cumulative tests
C. Standardized tests
D. Electronic data-gathering and tasks
E. Homework
F. Independent or group projects
G. Presentations.

VI. PROFESSIONAL DEVELOPMENT

The following recommended activities support this curriculum:

A. Opportunities to learn from and share ideas about teaching and learning mathematics with colleagues through meetings and peer observations
B. Collaboration with colleagues and department supervisor to discuss and reflect upon unit plans, homework, and assessment practices
C. Planning time to develop and discuss the results of implementing differentiated lessons and incorporation technology to enhance student learning
D. Attendance at workshops, conferences and courses that focus on relevant mathematics content, pedagogy, alternate assessment techniques, or technology.

APPENDIX I

NJ Student Learning Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

SMP1 – Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

SMP2 – Reason abstractly and quantitatively.
Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

SMP3 – Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a

logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

SMP4 – Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

SMP5 – Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

SMP6 – Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

SMP7 – Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

SMP8 – Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

NJ Student Learning Standards for Mathematical Content

Quantities N-Q

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.

Creating Equations A-CED

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Interpreting Functions F-IF

Interpret functions that arise in applications in terms of the context.

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. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function*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.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
   b. Graph linear and quadratic functions and show intercepts, maxima, and minima.
   c. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
   d. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
   e. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
   f. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

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* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*

Building Functions F-BF

Build new functions from existing functions.

3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, 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, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.*
   b. (+) Verify by composition that one function is the inverse of another.
   c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
   d. (+) Produce an invertible function from a non-invertible function by restricting the domain.

Linear, Quadratic, and Exponential Models F-LQE

Construct and compare linear, quadratic, and exponential models and solve problems.

1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
   a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
   b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
   c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Trigonometric Functions F-TF

Extend the domain of trigonometric functions using the unit circle.

3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.

Model periodic phenomena with trigonometric functions.

7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

Modeling with Geometry G-MG

Apply geometric concepts in modeling situations.

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

(+) Denotes additional mathematics that students should learn in order to take advanced courses.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX II

NJ Student Learning Standards for English Language Arts

College and Career Readiness Anchor Standards for Reading:
NJSLSA.R7 – Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

NJSLSA.R10 – Read and comprehend complex literary and informational texts independently and proficiently.

College and Career Readiness Anchor Standard for Writing:
NJSLSA.W1 – Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

College and Career Readiness Anchor Standards for Speaking and Listening:
NJSLSA.SL1 – Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NJSLSA.SL2 – Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

NJSLSA.SL3 – Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

NJSLSA.SL4 – Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

NJSLSA.SL5 – Make strategic use of digital and visual displays of data to express information and enhance understanding of presentations.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX III

NJ Student Learning Standards for Science / Next Generation Science Standards: Science and Engineering Practices

Practice 1 – Asking questions and defining problems
Practice 2 – Developing and using models
Practice 3 – Planning and carrying out investigations
Practice 4 – analyzing and interpreting data
Practice 5 – Using mathematics and computational thinking
Practice 6 – Constructing explanations and designing solutions
Practice 7 – engaging in argument from evidence
Practice 8 – Obtaining, evaluating, and communicating information

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX IV

NJ Student Learning Standards for Technology

NJSLS 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX V

NJ Student Learning Standards for 21st Century Life and Careers

NJSLS Career Ready Practices: These practices outline the skills that all individuals need to have to be truly adaptable, reflective, and proactive in life and careers. These are researched practices that are essential to career readiness.

NJSLS 9.1 21st Personal Financial Literacy: This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX V

Instructional Resources and Pacing Guide

Instructional resource for AP Calculus AB: *Calculus Graphical, Numerical, Algebraic,* Finney et al, Pearson (2016)

Suggested pacing:

Unit	# teaching days
Prerequisites for calculus	3
Limits and continuity	5
Derivatives	15
Applications of derivatives	20
Definite integral	15
Differential equations and mathematical modeling	20
Applications of definite integrals	20
Sequences, L'Hospital's rule and improper integrals	15
Infinite series	15
Parametric, vector and polar functions	15
Introduction to multivariable calculus	10

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

CALCULUS (6341)

School…….Westfield High School
Department ……Mathematics
Length of Course ……..Full year
Credit ……. 5
Grade Level. 12
Prerequisite ……Pre-Calculus
Date……..

I. RATIONALE, DESCRIPTION AND PURPOSE

Students explore concepts, methods and applications of single-variable calculus graphically, numerically and algebraically. Major topics include limits, derivatives, integrals, and the Fundamental Theorem of Calculus. Mathematical modeling is used to represent real-world situations and solve problems. Applications to science and technology emphasize the interdisciplinary nature of mathematics. Technology enables students to explore, experiment, interpret results, and justify conclusions.

The Calculus course is intended for students who require a more methodical and investigative approach to learning mathematics. The content of Calculus mirrors that of AP Calculus AB while providing additional opportunities for review and support.

II. OBJECTIVES

This curriculum fulfills Westfield Board of Education expectations for student achievement. Course objectives are aligned with the New Jersey Student Learning Standards for Mathematics, English Language Arts, Science, Technology, and 21st Century Life and Careers.

Students:

A. Identify and use characteristics of functions
NJ Student Learning Standards for Mathematics F-IF, F-BF, F-TF NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

B. Understand and apply the concepts of limits and continuity
NJ Student Learning Standards for Mathematics F-IF, F-BF, F-TF
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

C. Develop the concepts of derivatives

NJ Student Learning Standards for Mathematics F-IF, SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

D. Apply principles of derivatives to model and solve mathematical and real-world problems

NJ Student Learning Standards for Mathematics N-Q, A-CED, F-IF, F-LQE, F-TF, G-MG, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

E. Develop the concepts of integration

NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

F. Apply principles of integration to model and solve mathematical and real-world problems

NJ Student Learning Standards for Mathematics A-CED, G-MG, SMP1, SMP2, SMP4, SMP5, SMP6
NJ Student Learning Standards for Science P2, P5
NJ Student Learning Standards for Technology 8.1
NJ Student Learning Standards for 21st Century Life and Careers 9.1

G. Develop practices and dispositions that lead to mathematical proficiency.

NJ Student Learning Standards for Mathematics SMP1, SMP2, SMP3, SMP4, SMP5, SMP6, SMP7, SMP8
NJ Student Learning Standards for English Language Arts A.R7, A.R10, A.W1, A.SL1, A.SL2, A.SL3, A.SL4, A.SL5
NJ Core Curriculum Content Standards for Science P2, P5
NJ Core Curriculum Content Standards for Technology 8.1
NJ Core Curriculum Content Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE AND SEQUENCE

The importance of mathematics in the development of all civilizations and cultures and its relevance to students' success, regardless of career path, is addressed throughout the secondary mathematics program. Emphasis is placed on the development of critical thinking and problem- solving skills, particularly through the use of everyday contexts and real-world applications.

A. Functions, graphs and limits
   1. Characteristics of functions
      a. Overview of polynomial, piecewise, exponential, logarithmic and trigonometric functions
      b. Function graphing
      c. Analysis of functions in table, equation, or graphic forms
      d. Simplification of algebraic functions
   2. Limits of functions
      a. Intuitive understanding of the limit process
      b. Calculation of limits using algebra
      c. Estimation of limits from graphs or tables of data
      d. Understanding of asymptotes in terms of graphical behavior
      e. Description of asymptotic behavior in terms of limits involving infinity
      f. Graphs of functions given limit condition

g. Application of limit laws

3. Continuity as a property of functions
   a. Intuitive understanding of continuity
   b. Understanding of continuity in terms of limits

B. Derivatives
   1. Concept of the derivative
      a. Derivative presented graphically, numerically, and analytically
      b. Derivative interpreted as an instantaneous rate of change
      c. Derivative defined as the limit of the difference quotient
   2. Derivative at a point
      a. Slope of a curve at a point
      b. Tangent line to a curve at a point and local linear approximation
      c. Instantaneous rate of change as the limit of average rate of change
      d. Approximate rate of change from graphs and tables of values
   3. Derivative as a function
      a. Derivatives of basic functions, including power, exponential, logarithmic, and trigonometric functions
      b. Derivative rules for sums, products, and quotients of functions
      c. Chain rule and implicit differentiation
      d. Corresponding characteristics of graphs of f and f'
      e. Relationship between the increasing and decreasing behavior of f and the sign of f'
      f. Equations involving derivatives
   4. Second derivatives
      a. Corresponding characteristics of the graphs of f, f', and f''
      b. Relationship between the concavity of f and the sign of f''
      c. Points of inflection as places where concavity changes
   5. Applications of derivatives
      a. Analysis of curves
      b. Optimization, both absolute (global) and relative (local) extrema
      c. Models for rates of change, including related-rates problems
      d. Interpretation of the derivative as a rate of change in varied applied contexts, including motion, velocity, speed, and acceleration

C. Integrals
   1. Interpretations and properties of definite integrals
      a. Definite integral as a limit of Riemann sums
      b. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval
      c. Basic properties of definite integrals
   2. Numerical approximations to definite integrals
      a. Approximation of definite integrals of functions represented algebraically, graphically, and by tables of values
      b. Riemann sums, using left, right, and midpoint evaluation points
      c. Trapezoidal sums

3. Fundamental Theorem of Calculus
    a. Use of the Fundamental Theorem to evaluate definite integrals
    b. Use of the Fundamental Theorem to represent a particular anti-derivative, and the analytical and graphical analysis of functions
4. Techniques of anti-differentiation
    a. Antiderivatives following directly from derivatives of basic functions
    b. Antiderivatives by substitution of variables
    c. Application of net change in economics
5. Applications of integrals
    a. Area of a region and volume of a solid of rotation
    b. Distance traveled by a particle along a line
    c. Solution of separable differential equations with and without initial conditions

IV. INSTRUCTIONAL TECHNIQUES

Various instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Typical teaching techniques include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction, and modeling of procedures
B. Mini-lessons or individualized instruction for reinforcement or re-teaching of concepts
C. Guided investigations/explorations
D. Problem-based learning
E. Modeling with manipulatives
F. Flexible grouping
G. Differentiated tasks
H. Spiral review
I. Independent practice
J. Use of technology
K. Integration of mathematics with other disciplines.

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G. Presentations.

VI. PROFESSIONAL DEVELOPMENT

The following recommended activities support this curriculum:

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B. Collaboration with colleagues and department supervisor to discuss and reflect upon unit plans, homework, and assessment practices
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New Jersey Student Learning Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

SMP1 – Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

SMP2 – Reason abstractly and quantitatively.
Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

SMP3 – Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

SMP4 – Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

SMP5 – Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

SMP6 – Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

SMP7 – Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

SMP8 – Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

New Jersey Student Learning Standards for Mathematical Content

Quantities N-Q
Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.

Creating Equations A-CED

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Interpreting Functions F-IF

Interpret functions that arise in applications in terms of the context.

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. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the functio*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.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
   b. Graph linear and quadratic functions and show intercepts, maxima, and minima.
   c. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
   d. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
   e. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
   f. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
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* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*

Building Functions F-BF

Build new functions from existing functions.

3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, 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,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x-1)$ *for* $x \neq 1$.
   b. (+) Verify by composition that one function is the inverse of another.
   c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
   d. (+) Produce an invertible function from a non-invertible function by restricting the domain.

Linear, Quadratic, and Exponential Models F-LQE

Construct and compare linear, quadratic, and exponential models and solve problems.

1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
   a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
   b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
   c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Trigonometric Functions F-TF

Extend the domain of trigonometric functions using the unit circle.

3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.

Model periodic phenomena with trigonometric functions.

7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

Modeling with Geometry G-MG

Apply geometric concepts in modeling situations.

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

(+) Denotes additional mathematics that students should learn in order to take advanced courses.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX II

New Jersey Student Learning Standards for English Language Arts

College and Career Readiness Anchor Standards for Reading:
NJSLSA.R7 – Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively as well as in words**.**

NJSLSA.R10 – Read and comprehend complex literary and informational texts independently and proficiently.

College and Career Readiness Anchor Standard for Writing:
NJSLSA.W1 – Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

College and Career Readiness Anchor Standards for Speaking and Listening:
NJSLSA.SL1 – Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NJSLSA.SL2 – Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

NJSLSA.SL3 – Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

NJSLSA.SL4 – Present information, findings and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

NJSLSA.SL5 – Make strategic use of digital and visual displays of data to express information and enhance understanding of presentations.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX III

New Jersey Student Learning Standards for Science/ Next Generation Science Standards: Science and Engineering Practices

Practice 1 – Asking questions and defining problems
Practice 2 – Developing and using models
Practice 3 – Planning and carrying out investigations
Practice 4 – Analyzing and interpreting data
Practice 5 – Using mathematics and computational thinking
Practice 6 – Constructing explanations and designing solutions
Practice 7 – Engaging in argument from evidence
Practice 8 – Obtaining, evaluating, and communicating information

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX IV

New Jersey Student Learning Standards for Technology

NJSLS 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/.

APPENDIX V

New Jersey Student Learning Standards for 21st Century Life and Careers

NJSLS Career Ready Practices: These practices outline the skills that all individuals need to have to be truly adaptable, reflective, and proactive in life and careers. These are researched practices that are essential to career readiness.

NJSLS 9.1 Personal Financial Literacy: This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs.

APPENDIX VI

Instructional Resources and Pacing Guides

Instructional resource for Calculus*: Single Variable Calculus: Early Transcendentals,* Stewart, Cengage Learning (2016).

Suggested pacing*:*

Unit	# teaching days
Functions and models	5
Limits and derivatives	28
Differentiation rules	38
Applications of differentiation	40
Integrals	23
Applications and techniques of integration	23

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

SPANISH CONVERSATION - 3468

Schools.....Westfield High School
Department.....World Languages
Length of course .....Semester
Credits.....2.5
Grade Level……11-12
Prerequisite ..... Spanish III or III-H
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

The Westfield Public Schools Department of World Languages provides a well-articulated program in order to prepare students to become responsible citizens in a multicultural and diverse global society. Language skills and cultural awareness stimulate cognitive development and academic achievement. The study of a world language promotes knowledge, understanding and respect for the perspectives, practices, and products of different cultures.

Spanish Conversation is designed for students who have successfully completed at least Spanish III, and want to further refine their language skills. Students in this course continue to develop the ability to understand, speak, read and write for self-expression in Spanish at a sophisticated level on a variety of topics. Students participate actively in conversation as they develop spontaneity in conversing using the language standards of communication, culture, connections, comparisons and communities. Students are given regular opportunities to react to an assortment of authentic sources, including news segments, recordings, films, e-mails, newspapers, and magazines. Group discussions are an essential part of the course and are considered necessary for improving oral communication in Spanish.

II. OBJECTIVES

This curriculum fulfills the Westfield Board of Education expectations for student achievement. The course objectives, divided by each of the communication modes, are aligned with the NJ Student Learning Standards for World Languages, English Language Arts, Social Studies, Visual and Performing Arts, Technology, and 21st Century Life and Careers.

Students:

A. Interpretive Communication Mode

Compare and contrast the main ideas, themes and supporting details taken from culturally authentic materials

New Jersey Student Learning Standards for World Languages 7.1.IM.A.6, 7.1.IH.A.6
New Jersey Student Learning Standards for ELA A.R2
New Jersey Student Learning Standards for Technology 8.1

Interpret the meaning of unfamiliar words and phrases in new formal and informal contexts

New Jersey Student Learning Standards for World Languages 77.1.IM.A.7, 7.1.IH.A.7
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Synthesize information from a conversation between speakers of Spanish on a variety of topics

New Jersey Student Learning Standards for World Languages 7.1.IM.A.5, 7.1.IH.A.5, 7.1.IM.A.4, 7.1.IH.A.4
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

Analyze the use of verbal and non-verbal etiquette to extrapolate meaning

New Jersey Student Learning Standards for World Languages 7.1.IM.A.3, 7.1.IH.A.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

B. Interpersonal Communication Mode

Engage in an oral exchange of information on familiar and some unfamiliar topics using culturally appropriate strategies

New Jersey Student Learning Standards for World Languages 7.1.IM.B.3, 7.1.IH.B.3
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Argue opinions and negotiate on a variety of topics

New Jersey Student Learning Standards for World Languages 7.1.IM.B.4, 7.1.IH.B.4, 7.1.IM.B.5, 7.1.IH.B.5
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Use language in a variety of settings (formal vs. informal)

New Jersey Student Learning Standards for World Languages 7.1.IH.B.6
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Initiate and sustain conversations on a variety of topics with increasing linguistic accuracy and correct pronunciation

New Jersey Student Learning Standards for World Languages 7.1.IM.B.3, 7.1.IH.B.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Use digital tools to extend conversations and to exchange information on familiar and unfamiliar topics using a variety of timeframes
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1, 7.1.IH.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Evaluate important information from a variety of audio and visual resources to participate in an exchange of information
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1, 7.1.IH.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Interpret information from a variety of authentic sources to formulate an appropriate response
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1, 7.1.IH.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

C. Presentational Communication Mode

Argue concepts and ideas with increasing fluency and confidence
New Jersey Student Learning Standards for World Languages 7.1.IM.C.1, 7.1.IH.C.1, 7.1.IM.C.2, 7.1.IH.C.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.3

Use language creatively for a variety of purposes
New Jersey Student Learning Standards for World Languages 7.1.IM.C.3, 7.1.IH.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.2
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Appropriately use advanced grammatical structures
New Jersey Student Learning Standards for World Languages 7.1.IM.C.3, 7.1.IH.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

D. Communities, Cultures, Comparisons, and Connections

Demonstrate an understanding of the similarities and differences of the target culture by making cultural comparisons and connections
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Compare and contrast the cultural perspectives of the target cultures with those of one's own culture, as evidenced through the cultural products and cultural practices associated with each
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1and 9.2

Synthesize information related to the cultural products, practices and perspectives associated with target culture to create a short presentation on specific themes with a target language audience.
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE, AND SEQUENCE

Spanish Conversation provides students with opportunities for an extensive use of the target language expressed exclusively in Spanish. This course seeks to develop language skills that can be applied to different formal and informal situations. The main focus of the course is on communication regarding a variety of topics affecting our world. Listening, speaking and reading are further developed as students take on more challenging tasks. Students are given regular opportunities to react to a variety of authentic sources, including news segments, recordings, films, e-mails, newspapers, and magazines. Students participate in verbal exchanges and react in written form as they synthesize and critically analyze content.

Themes

A. Current Challenges in Latin America (suggested time 6 - 7 weeks)
   1. examine poverty, drug trafficking, and violence as socio economic issues affecting Latin America and the United States
   2. compare/contrast historical and contemporary immigration laws and regulations in the United States
   3. describe social welfare in Latin American countries and Spain
   4. analyze the infrastructural pressures of rapidly growing cities in Latin America
   5. recognize the challenges American and Latino youth face in the U.S. and ways to overcome them

B. Ongoing Events Impacting Daily Life in Spanish-speaking Countries (suggested time 5 - 6 weeks)
   1. compare/contrast life in urban and rural areas in Spain and Latin American countries
   2. analyze the impact of social media in the societies of the target cultures
   3. explore the discoveries and advances in medicine and in the medical field
   4. compare/contrast food guidelines and nutrition in the U.S. and Latin American countries
   5. analyze the impact of Hispanics on employment and economic development in the United States

C. Modern Societies in Latin America and its Influences (suggested time 6 - 7 weeks)
   1. describe the underpinnings of Mayan culture on contemporary Mexican society
   2. explain the role of superstition in the shaping of Latin American societies
   3. explore the effects of the Spanish language and culture in shaping individual and group identities
   4. explore current events focusing on, but not limited to: arts, entertainment, sports, and politics

IV. INSTRUCTIONAL TECHNIQUES

Differentiated instruction creates a student-centered environment that seeks to accommodate diverse learners and provides multiple pathways to learning. A variety of instructional approaches are employed to involve all students in the learning process and to accommodate differences in readiness levels, interests and learning styles. The target language is used as the primary means of communication by providing an immersion setting in which both teachers and students use the target language at least 95% of the time. Instructional techniques include but are not limited to:

A. Teacher-directed, whole-group instruction
B. Small-group instruction
C. Flexible grouping
D. Technology-infused instruction
E. Hands-on activities
F. Research projects
G. Guided reading and discussion
H. Think-Pair-Share student partner activities
I. Total Physical Response (TPR).

V. EVALUATION

The purpose of assessment is to improve student learning, gauge student progress and make necessary adjustments in methodology when needed. Student assessment practices include but are not limited to:

A. Informal Assessments
    1. interviews
    2. oral presentations
    3. aural practice
    4. role-play
    5. classroom observations during coupled and group activities

B. Formal Assessments
    1. baseline assessments
    2. benchmark assessments
    3. short essays
    4. oral presentations
    5. written quizzes and tests
    6. aural assessments
    7. projects.

VI. PROFESSIONAL DEVELOPMENT

The following activities support this curriculum:

A. Collaboration with colleagues and supervisors to discuss and reflect upon unit plans, homework, and assessment
B. Department meetings to plan and coordinate curriculum and activities
C. Visitation to districts that implement innovative language programs
D. Professional development through courses or conferences.

APPENDIX I

New Jersey Student Learning Standards for World Languages

STANDARD 7.1 All students will be able to use a world language in addition to English to engage in meaningful conversation, to understand and interpret spoken and written language, and to present information, concepts, and ideas, while also gaining an understanding of the perspectives of other cultures. Through language study, they will make connections with other content areas, compare the language and culture studied with their own, and participate in home and global communities.

Strand A – Interpretive Mode

7.1.NM.A.1	Recognize familiar spoken or written words and phrases contained in culturally authentic materials using electronic information sources related to targeted themes.
7.1.NM.A.3	Recognize a few common gestures and cultural practices associated with the target culture(s).
7.1.NM.A.4	Identify familiar people, places, and objects based on simple oral and/or written descriptions.
7.1.NM.A.5	Demonstrate comprehension of brief oral and written messages using age and level appropriate, culturally authentic materials on familiar topics.
7.1.NH.A.2	Demonstrate comprehension of simple, oral and written directions, commands, and requests through appropriate physical response.

Strand B – Interpersonal Mode

7.1.NM.B.1	Use digital tools to exchange basic information at the word and memorized-phrase level related to self and targeted themes.
7.1.NM.B.2	Give and follow simple oral and written directions, commands, and requests when participating in age appropriate classroom and cultural activities.
7.1.NM.B.3	Imitate appropriate gestures and intonations of the target culture(s)/language during greetings, leave-, takings, and daily interactions.
7.1.NM.B.4	Ask and respond to simple questions, make requests, and express preferences using memorized words and phrases. Exchange information using words, phrases, and short sentences practiced in class on familiar topics or on topics studied in other content areas.

Strand C – Presentational Mode

7.1.NM.C.1	Use basic information at the word and memorized-phrase level to create a multimedia-rich presentation on targeted themes to be shared virtually with a target language audience.

7.1.NM.C.2	Imitate, recite, and/or dramatize simple poetry, rhymes, songs, and skits.
7.1.NM.C.3	Present information from age- and level-appropriate, culturally authentic materials orally or in writing.
7.1.NM.C.4	Name and label tangible cultural products and imitate cultural practices from the target culture(s).

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX II

New Jersey Student Learning Standards for Social Studies

STANDARD 6.1 All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions that reflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

STANDARD 6.2 All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

STANDARD 6.3 All students will acquire the skills needed to be active, informed citizens who value diversity and promote cultural understanding by working collaboratively to address challenges that are inherent in living in an interconnected world.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX III

New Jersey Student Learning Standards for English Language Arts

STANDARD NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX IV

New Jersey Student Learning Standards for Visual and Performing Arts

STANDARD 1.2. History of the Arts and Culture: All students will understand the role, development, and influence of the arts throughout history and across cultures.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX V

New Jersey Student Learning Standards for Technology

STANDARD 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

STANDARD 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX VI

New Jersey Student Learning Standards for 21st Century Life & Careers

STANDARD 9.1 All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

EXPLORATORY SPANISH I - 3416

Schools.....Westfield High School
Department.....World Languages
Length of course ..... Full Year
Credits.....5
Grade Level..... 9-12
Prerequisite ..... Counselor recommendation
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

The Westfield Public Schools Department of World Languages seeks to provide a well-articulated program in order to prepare students to become responsible citizens in a multicultural and diverse global society. Language skills and cultural awareness stimulate cognitive development and academic achievement. The study of a world language promotes knowledge, understanding and respect for the perspectives, practices, and products of different cultures.

Exploratory Spanish I is designed for students who have demonstrated the need for support in their first language. Moving at a modified pace, this foundation course develops the four basic skills of listening, speaking, reading and writing while focusing on the different cultures of Spanish-speaking countries. Students at this level begin to describe themselves and others, ask and answer questions, say what they are doing, and express preferences using memorized and rehearsed expressions. The understanding and appreciation of the Spanish-speaking world and its culture form an integral part of the learning experience thereby fostering the world languages standards of communication, culture, connections, comparisons and communities.

II. OBJECTIVES

This curriculum fulfills the Westfield Board of Education expectations for student achievement. The course objectives, divided by each of the communication modes, are aligned with the NJ Student Learning Standards for World Languages, English Language Arts, Social Studies, Visual and Performing Arts, Technology, and 21st Century Life and Careers.

Students:

A. Interpretive Communication Mode

Recognize familiar spoken and written words and phrases contained in culturally authentic materials related to targeted themes
New Jersey Student Learning Standards for World Languages 7.1.NM.A.1
New Jersey Student Learning Standards for ELA A.R2
New Jersey Student Learning Standards for Technology 8.1

Comprehend and respond to conversations by native speakers on a variety of topics
New Jersey Student Learning Standards for World Languages 7.1.NM.A.2
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Demonstrate comprehension of short conversations between speakers of the target language on familiar topics
New Jersey Student Learning Standards for World Languages 7.1.NM.A.1, 7.1.NM.A.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

B. Interpersonal Communication Mode

Ask and respond to simple questions using memorized words and expressions
New Jersey Student Learning Standards for World Languages 7.1.NM.B.4
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Use appropriate gestures and intonation in common daily interactions
New Jersey Student Learning Standards for World Languages 7.1.NM.B.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Use digital tools to exchange basic information about self and studied topics
New Jersey Student Learning Standards for World Languages 7.1.NM.B.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Identify words and expressions from audio and visual resources based on familiar topics to participate in an exchange of information
New Jersey Student Learning Standards for World Languages 7.1.NM.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Recognize key information from written sources to formulate an appropriate response
New Jersey Student Learning Standards for World Languages 7.1.NM.B.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Briefly respond in writing to oral, audio, visual, and written prompts on familiar topics using memorized words, phrases, and expressions
New Jersey Student Learning Standards for World Languages 7.1.NM.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

C. Presentational Communication Mode

Recite simple rhymes, dialogues, songs and skits
New Jersey Student Learning Standards for World Languages 7.1.NM.C.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Make presentations comparing/contrasting the target culture with their own
New Jersey Student Learning Standards for World Languages 7.1.NM.C.4
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.2
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Use familiar words and expressions to describe people, places, and things
New Jersey Student Learning Standards for World Languages 7.1.NM.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

D. Communities, Cultures, Comparisons, and Connections

Demonstrate an understanding of the similarities and differences of the target culture by making cultural comparisons and connections
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Identify tangible cultural products and imitate cultural customs from the target culture
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1and 9.2

Collect information related to the cultural products, practices and perspectives associated with target culture to create a short presentation on specific themes with a target language audience.
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE, AND SEQUENCE

Exploratory Spanish I provides students the opportunity to develop basic vocabulary and grammar. Students are given many opportunities to practice new vocabulary and expressions through interactive lessons. This course seeks to begin the development of language skills that can be applied in both formal and informal situations.

Themes

A. The Spanish-speaking World (suggested time 4 - 5 weeks)
   1. identify countries and capitals in Latin America and Spain
   2. recognize famous Hispanic and Hispanic-American people
   3. discuss Spanish-speakers in the United States

B. All about Me (suggested time 4 - 5 weeks)
   1. imitate basic introductions and greetings
   2. express preferences
   3. describe oneself

C. My Family and Friends (suggested time 5 - 6 weeks)
   1. identify kinship terms
   2. create a family tree
   3. recognize family relationships
   4. describe others and their preferences

D. My School (suggested time 4 - 5 weeks)
   1. identify subjects, supplies and classrooms
   2. express time
   3. describe school schedule

E. My Home (suggested time 5 - 6 weeks)
   1. identify rooms and furniture
   2. describe activities and chores
   3. describe a house

F. My Clothing and Shopping (suggested time 4 - 5 weeks)
   1. state preferences
   2. describe clothing, including styles and trends

G. The Seasons (suggested time 5 - 6 weeks)
   1. identify weather conditions
   2. describe activities according to weather
   3. recognize geographical differences

Grammatical Structures

A. Articles
B. Gender and number
C. Adjective agreement
D. Reflexive verbs
E. Possessive adjectives
F. Personal “a”; contractions “al” and “del”
G. Present tense and present progressive (introduction)
H. Most commonly used irregular verbs (ser, estar, ir, gustar, irregular “yo”, stem-changing verbs, saber vs. conocer)
I. Expressions of courtesy

IV. INSTRUCTIONAL TECHNIQUES

Differentiated instruction creates a student-centered environment that seeks to accommodate diverse learners and provides multiple pathways to learning. A variety of instructional approaches are employed to involve all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Instructional techniques include but are not limited to the following:

A. Teacher-directed, whole-group instruction
B. Small-group instruction
C. Flexible grouping
D. Technology-based instruction
E. Hands-on activities
F. Research projects
G. Guided reading and discussion
H. Think-Pair-Share student partner activities
I. Total Physical Response (TPR).

V. EVALUATION

The purpose of assessment is to improve student learning, gauge student progress and make necessary adjustments in methodology when needed. Student assessment practices include but are not limited to the following:

A. Informal Assessments
    1. interviews
    2. oral presentations
    3. aural practice
    4. role-play
    5. classroom observations during coupled and group activities

B. Formal Assessments
    1. baseline assessments
    2. benchmark assessments
    3. short essays
    4. oral presentations
    5. written quizzes and tests
    6. aural assessments
    7. projects.

VI. PROFESSIONAL DEVELOPMENT

The following activities support this curriculum:

A. Collaboration with colleagues through discussion and observation
B. Department meetings to plan and coordinate curriculum and activities
C. Visitation to districts that implement innovative language programs
D. Professional development through courses or conferences.

APPENDIX I

New Jersey Student Learning Standards for World Languages

STANDARD 7.1 All students will be able to use a world language in addition to English to engage in meaningful conversation, to understand and interpret spoken and written language, and to present information, concepts, and ideas, while also gaining an understanding of the perspectives of other cultures. Through language study, they will make connections with other content areas, compare the language and culture studied with their own, and participate in home and global communities.

Strand A – Interpretive Mode

7.1.NM.A.1	Recognize familiar spoken or written words and phrases contained in culturally authentic materials using electronic information sources related to targeted themes.
7.1.NM.A.3	Recognize a few common gestures and cultural practices associated with the target culture(s).
7.1.NM.A.4	Identify familiar people, places, and objects based on simple oral and/or written descriptions.
7.1.NM.A.5	Demonstrate comprehension of brief oral and written messages using age and level appropriate, culturally authentic materials on familiar topics.
7.1.NH.A.2	Demonstrate comprehension of simple, oral and written directions, commands, and requests through appropriate physical response.

Strand B – Interpersonal Mode

7.1.NM.B.1	Use digital tools to exchange basic information at the word and memorized-phrase level related to self and targeted themes.
7.1.NM.B.2	Give and follow simple oral and written directions, commands, and requests when participating in age appropriate classroom and cultural activities.
7.1.NM.B.3	Imitate appropriate gestures and intonations of the target culture(s)/language during greetings, leave-, takings, and daily interactions.
7.1.NM.B.4	Ask and respond to simple questions, make requests, and express preferences using memorized words and phrases. Exchange information using words, phrases, and short sentences practiced in class on familiar topics or on topics studied in other content areas.

Strand C – Presentational Mode

7.1.NM.C.1	Use basic information at the word and memorized-phrase level to create a multimedia-rich presentation on targeted themes to be shared virtually with a target language audience.
7.1.NM.C.2	Imitate, recite, and/or dramatize simple poetry, rhymes, songs, and skits.

7.1.NM.C.3 Present information from age- and level-appropriate, culturally authentic materials orally or in writing

7.1.NM.C.4 Name and label tangible cultural products and imitate cultural practices from the target culture(s).

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX II

New Jersey Student Learning Standards for Social Studies

STANDARD 6.1 All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions that reflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

STANDARD 6.2 All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

STANDARD 6.3 All students will acquire the skills needed to be active, informed citizens who value diversity and promote cultural understanding by working collaboratively to address challenges that are inherent in living in an interconnected world.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX III

New Jersey Student Learning Standards for English Language Arts

STANDARD NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX IV

New Jersey Student Learning Standards for Visual and Performing Arts

STANDARD 1.2. History of the Arts and Culture: All students will understand the role, development, and influence of the arts throughout history and across cultures.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX V

New Jersey Student Learning Standards for Technology

STANDARD 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

STANDARD 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX VI

New Jersey Student Learning Standards for 21st Century Life & Careers

STANDARD 9.1 All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

EXPLORATORY SPANISH II - 3426

Schools.....Westfield High School
Department.....World Languages
Length of course ..... Full Year
Credits.....5
Grade Level..... 9-12
Prerequisite ..... Exploratory Spanish I
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

The Westfield Public Schools Department of World Languages seeks to provide a well-articulated program in order to prepare students to become responsible citizens in a multicultural and diverse global society. Language skills and cultural awareness stimulate cognitive development and academic achievement. The study of a world language promotes knowledge, understanding and respect for the perspectives, practices, and products of different cultures.

Exploratory Spanish II is designed for students who have demonstrated the need for support in their first language and who have completed Exploratory Spanish I. This course builds on the concepts and skills explored during Exploratory Spanish I. It enhances the language foundation that supports the development of the four basic skills of listening, speaking, reading and writing. Students at this level begin to discuss favorite foods, describe their preferences while discussing food, travel, professions and daily life. The understanding and appreciation of the Spanish-speaking world and its culture form an integral part of the learning experience thereby fostering the world languages standards of communication, culture, connections, comparisons and communities.

II. OBJECTIVES

This curriculum fulfills the Westfield Board of Education expectations for student achievement. The course objectives, divided by each of the communication modes, are aligned with the NJ Student Learning Standards for World Languages, English Language Arts, Social Studies, Visual and Performing Arts, Technology, and 21st Century Life and Careers.

Students:

A. Interpretive Communication Mode

Recognize familiar spoken and written words and phrases contained in culturally authentic materials related to targeted themes
New Jersey Student Learning Standards for World Languages 7.1.NM.A.1, 7.1.NH.A.3
New Jersey Student Learning Standards for ELA A.R2
New Jersey Student Learning Standards for Technology 8.1

Comprehend and respond to conversations by native speakers on a variety of topics
New Jersey Student Learning Standards for World Languages 7.1.NM.A.2, 7.1.NH.A.2
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Demonstrate comprehension of short conversations between speakers of the target language on familiar topics
New Jersey Student Learning Standards for World Languages 7.1.NM.A.1, 7.1.NM.A.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

B. Interpersonal Communication Mode

Ask and respond to simple questions using memorized words and expressions
New Jersey Student Learning Standards for World Languages 7.1.NM.B.4
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Use appropriate gestures and intonation in common daily interactions
New Jersey Student Learning Standards for World Languages 7.1.NM.B.3, 7.1.NH.B.1
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Use digital tools to exchange basic information about self and studied topics
New Jersey Student Learning Standards for World Languages 7.1.NH.B.2
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Identify words and expressions from audio and visual resources based on familiar topics to participate in an exchange of information
New Jersey Student Learning Standards for World Languages 7.1.NM.B.1, 7.1.NH.B.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Recognize key information from written sources to formulate an appropriate response
New Jersey Student Learning Standards for World Languages 7.1.NM.B.2, 7.1.NH.B.4
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Briefly respond in writing to oral, audio, visual, and written prompts on familiar topics using memorized words, phrases, and expressions
New Jersey Student Learning Standards for World Languages 7.1.NM.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

C. Presentational Communication Mode

Recite simple rhymes, dialogues, songs and skits
New Jersey Student Learning Standards for World Languages 7.1.NM.C.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Make presentations comparing/contrasting the target culture with their own
New Jersey Student Learning Standards for World Languages 7.1.NM.C.4, 7.1.NH.C.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.2
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Use familiar words and expressions to describe people, places, and things
New Jersey Student Learning Standards for World Languages 7.1.NM.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

D. Communities, Cultures, Comparisons, and Connections

Demonstrate an understanding of the similarities and differences of the target culture by making cultural comparisons and connections
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Identify tangible cultural products and imitate cultural customs from the target culture
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1and 9.2

Collect information related to the cultural products, practices and perspectives associated with target culture to create a short presentation on specific themes with a target language audience.
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE, AND SEQUENCE

Exploratory Spanish II provides students the opportunity to develop basic vocabulary and grammar. Students are given many opportunities to practice new vocabulary and expressions through interactive lessons. The course aims to continue the development of language skills that can be applied in both formal and informal situations.

Themes

A. Sports (suggested time 5 - 6 weeks)
   1. identify weather, equipment, and venues
   2. explain the rules of various sports
   3. describe various sporting events

B. Professions (suggested time 5 - 6 weeks)
   1. name different professions
   2. express professional activities
   3. describe responsibilities of various professions

C. Food (suggested time 5 - 6 weeks)
   1. identify foods and food groups
   2. recognize My Plate guidelines for a healthy lifestyle
   3. recognize typical foods from the U.S. and Spanish-speaking countries

D. Travel (suggested time 6 - 7 weeks)
   1. describe travel planning
   2. describe airport procedures
   3. recognize identification, passports and money
   4. describe public transportation

E. Communities (suggested time 6 - 7 weeks)
   1. describe your surroundings
   2. ask/give directions
   3. describe activities in the neighborhood
   4. compare/contrast suburbs vs. city life

F. Environment (suggested time 5 - 6 weeks)
   1. identify animals and animal classifications
   2. describe animal habitats
   3. describe activities at the zoo

<u>Grammatical Structures</u>

A. Articles
B. Gender and number
C. Adjective agreement
D. Reflexive verbs
E. Possessive adjectives
F. Personal “a”; contractions “al” and “del”
G. Present tense and present progressive (introduction)
H. Most commonly used irregular verbs (ser, estar, ir, gustar, irregular “yo”, stem-changing verbs, saber vs. conocer)
I. Expressions of courtesy

IV. INSTRUCTIONAL TECHNIQUES

Differentiated instruction creates a student-centered environment that seeks to accommodate diverse learners and provides multiple pathways to learning. A variety of instructional approaches are employed to involve all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Instructional techniques include but are not limited to the following:

A. Teacher-directed, whole-group instruction
B. Small-group instruction
C. Flexible grouping
D. Technology-based instruction
E. Hands-on activities
F. Research projects
G. Guided reading and discussion
H. Think-Pair-Share student partner activities
I. Total Physical Response (TPR).

V. EVALUATION

The purpose of assessment is to improve student learning, gauge student progress and make necessary adjustments in methodology when needed. Student assessment practices include but are not limited to the following:

A. Informal Assessments
    1. interviews
    2. oral presentations
    3. aural practice
    4. role-play
    5. classroom observations during coupled and group activities

B. Formal Assessments
    1. baseline assessments
    2. benchmark assessments
    3. short essays
    4. oral presentations
    5. written quizzes and tests
    6. aural assessments
    7. projects.

VI. PROFESSIONAL DEVELOPMENT

The following activities support this curriculum:

A. Collaboration with colleagues through discussion and observation
B. Department meetings to plan and coordinate curriculum and activities
C. Visitation to districts that implement innovative language programs
D. Professional development through courses or conferences.

APPENDIX I

New Jersey Student Learning Standards for World Languages

STANDARD 7.1 All students will be able to use a world language in addition to English to engage in meaningful conversation, to understand and interpret spoken and written language, and to present information, concepts, and ideas, while also gaining an understanding of the perspectives of other cultures. Through language study, they will make connections with other content areas, compare the language and culture studied with their own, and participate in home and global communities.

Strand A – Interpretive Mode

7.1.NM.A.1	Recognize familiar spoken or written words and phrases contained in culturally authentic materials using electronic information sources related to targeted themes.
7.1.NM.A.3	Recognize a few common gestures and cultural practices associated with the target culture(s).
7.1.NM.A.4	Identify familiar people, places, and objects based on simple oral and/or written descriptions.
7.1.NM.A.5	Demonstrate comprehension of brief oral and written messages using age and level appropriate, culturally authentic materials on familiar topics.
7.1.NH.A.2	Demonstrate comprehension of simple, oral and written directions, commands, and requests through appropriate physical response.

Strand B – Interpersonal Mode

7.1.NM.B.1	Use digital tools to exchange basic information at the word and memorized-phrase level related to self and targeted themes.
7.1.NM.B.2	Give and follow simple oral and written directions, commands, and requests when participating in age appropriate classroom and cultural activities.
7.1.NM.B.3	Imitate appropriate gestures and intonations of the target culture(s)/language during greetings, leave-, takings, and daily interactions.
7.1.NM.B.4	Ask and respond to simple questions, make requests, and express preferences using memorized words and phrases. Exchange information using words, phrases, and short sentences practiced in class on familiar topics or on topics studied in other content areas.

Strand C – Presentational Mode

7.1.NM.C.1	Use basic information at the word and memorized-phrase level to create a multimedia-rich presentation on targeted themes to be shared virtually with a target language audience.
7.1.NM.C.2	Imitate, recite, and/or dramatize simple poetry, rhymes, songs, and skits.

7.1.NM.C.3 Present information from age- and level-appropriate, culturally authentic materials orally or in writing

7.1.NM.C.4 Name and label tangible cultural products and imitate cultural practices from the target culture(s).

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX II

New Jersey Student Learning Standards for Social Studies

STANDARD 6.1 All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions that reflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

STANDARD 6.2 All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

STANDARD 6.3 All students will acquire the skills needed to be active, informed citizens who value diversity and promote cultural understanding by working collaboratively to address challenges that are inherent in living in an interconnected world.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX III

New Jersey Student Learning Standards for English Language Arts

STANDARD NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX IV

New Jersey Student Learning Standards for Visual and Performing Arts

STANDARD 1.2. History of the Arts and Culture: All students will understand the role, development, and influence of the arts throughout history and across cultures.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX V

New Jersey Student Learning Standards for Technology

STANDARD 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

STANDARD 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX VI

New Jersey Student Learning Standards for 21st Century Life & Careers

STANDARD 9.1 All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

SPANISH FOR TRAVELERS - 3478

Schools.....Westfield High School
Department.....World Languages
Length of course .....Semester
Credits.....2.5
Grade Level..... 11-12
Prerequisite ..... Spanish III or III-H
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

The Westfield Public Schools Department of World Languages provides a well-articulated program in order to prepare students to become responsible citizens in a multicultural and diverse global society. Language skills and cultural awareness stimulate cognitive development and academic achievement. The study of a world language promotes knowledge, understanding and respect for the perspectives, practices, and products of different cultures.

Spanish for Travelers is designed for students who have successfully completed at least Spanish III and want to further refine their language skills. Students in this course continue to develop the ability to understand, speak, read, and write for self-expression in Spanish at a sophisticated level on topics that help them when traveling to a Spanish-speaking country. Through research, students learn places of interest, colloquial expressions, and cultural aspects of various Spanish-speaking countries. The main focus of the course is on the acquisition of essential skills and language necessary when traveling abroad such as planning and following an itinerary, negotiating for goods, keeping a budget, and eliciting assistance in cases of emergency. The use of technological resources for planning travel and researching places of interest form an integral part of this course.

II. OBJECTIVES

This curriculum fulfills the Westfield Board of Education expectations for student achievement. The course objectives, divided by each of the communication modes, are aligned with the NJ Student Learning Standards for World Languages, English Language Arts, Social Studies, Visual and Performing Arts, Technology, and 21st Century Life and Careers.

Students:

A. Interpretive Communication Mode

Compare and contrast the main ideas, themes and supporting details taken from culturally authentic materials

New Jersey Student Learning Standards for World Languages 7.1.IM.A.6, 7.1.IH.A.6
New Jersey Student Learning Standards for ELA A.R2
New Jersey Student Learning Standards for Technology 8.1

Interpret the meaning of unfamiliar words and phrases in new formal and informal contexts

New Jersey Student Learning Standards for World Languages 77.1.IM.A.7, 7.1.IH.A.7
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Synthesize information from a conversation between speakers of Spanish on a variety of topics

New Jersey Student Learning Standards for World Languages 7.1.IM.A.5, 7.1.IH.A.5, 7.1.IM.A.4, 7.1.IH.A.4
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

Analyze the use of verbal and non-verbal etiquette to extrapolate meaning

New Jersey Student Learning Standards for World Languages 7.1.IM.A.3, 7.1.IH.A.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

B. Interpersonal Communication Mode

Engage in an oral exchange of information on familiar and some unfamiliar topics using culturally appropriate strategies

New Jersey Student Learning Standards for World Languages 7.1.IM.B.3, 7.1.IH.B.3
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Argue opinions and negotiate on a variety of topics

New Jersey Student Learning Standards for World Languages 7.1.IM.B.4, 7.1.IH.B.4, 7.1.IM.B.5, 7.1.IH.B.5
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Use language in a variety of settings (formal vs. informal)

New Jersey Student Learning Standards for World Languages 7.1.IH.B.6
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Initiate and sustain conversations on a variety of topics with increasing linguistic accuracy and correct pronunciation

New Jersey Student Learning Standards for World Languages 7.1.IM.B.3, 7.1.IH.B.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Use digital tools to extend conversations and to exchange information on familiar and unfamiliar topics using a variety of timeframes
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1, 7.1.IH.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Evaluate important information from a variety of audio and visual resources to participate in an exchange of information
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1, 7.1.IH.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Interpret information from a variety of authentic sources to formulate an appropriate response
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1, 7.1.IH.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

C. Presentational Communication Mode

Argue concepts and ideas with increasing fluency and confidence
New Jersey Student Learning Standards for World Languages 7.1.IM.C.1, 7.1.IH.C.1, 7.1.IM.C.2, 7.1.IH.C.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.3

Use language creatively for a variety of purposes
New Jersey Student Learning Standards for World Languages 7.1.IM.C.3, 7.1.IH.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.2
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Appropriately use advanced grammatical structures
New Jersey Student Learning Standards for World Languages 7.1.IM.C.3, 7.1.IH.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

D. Communities, Cultures, Comparisons, and Connections

Demonstrate an understanding of the similarities and differences of the target culture by making cultural comparisons and connections
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Compare and contrast the cultural perspectives of the target cultures with those of one's own culture, as evidenced through the cultural products and cultural practices associated with each
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1and 9.2

Synthesize information related to the cultural products, practices and perspectives associated with target culture to create a short presentation on specific themes with a target language audience.
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE, AND SEQUENCE

Spanish for Travelers provides students with opportunities for extensive use of the target language and expects expression to occur exclusively in Spanish. This course seeks to engage students in the world of tourism and travel within Spanish-speaking countries. Students learn important information that serves to help them when traveling abroad. Each unit focuses on a different Spanish-speaking country and introduces students to historical and cultural sites that are significant to the members of each nation. Students are expected to plan a seven-day itinerary for each unit presented through the interpersonal and presentational modes of communication.

Themes

A. Spain (suggested time 3 - 4 weeks)
   1. interpret cultural aspects such as fiestas, cuisine, and society of a target culture
   2. identify geographical differences between the north and south of the country
   3. compare/contrast regional diversity
   4. describe the pilgrimage of El Camino de Santiago

B. Puerto Rico (suggested time 4 - 5 weeks)
   1. recognize the influence of the Taino, Spanish, and African peoples on cultural customs
   2. identify geographical features including rain forest, deserts, beaches, caves, oceans, and rivers
   3. describe and explain architecture of Old San Juan
   4. compare/contrast tourist destinations vs. local living
   5. explain the topography of El Yunque

C. Dominican Republic (suggested time 3 - 4 weeks)
   1. discuss the importance of rituals
   2. explain the impact of Merengue and Bachata on the island's culture
   3. describe Dominican Republic's main resources and industries (cocoa bean, tobacco, sugar cane, etc.)
   4. explore colonial Santo Domingo and major landmarks
   5. describe the role baseball plays in specific towns, specifically San Pedro de Macoris

D. Mexico (suggested time 3 - 4 weeks)
   1. evaluate cultural and industrial resources, including the silver industry
   2. identify major regions of Mexico
   3. explore Mexico D.F. and relevant landmarks
   4. describe the diversity of Yucatan's geology as well as the impact of the Mayan culture

E. Chile (suggested time 3 - 4 weeks)
   1. discuss the importance of the oenological and produce industries in Chile's economy
   2. compare/contrast diverse landscapes including glaciers, volcanoes, rainforests, deserts, and grasslands

3. explore the Patagonia region, its beauty and outdoor activities for adventure lovers
4. explore Santiago de Chile including information on modern attractions, hotels, restaurants, and nightlife
5. describe Viña del Mar

IV. INSTRUCTIONAL TECHNIQUES

Differentiated instruction creates a student-centered environment that seeks to accommodate diverse learners and provides multiple pathways to learning. A variety of instructional approaches are employed to involve all students in the learning process and to accommodate differences in readiness levels, interests and learning styles. The target language is used as the primary means of communication by providing an immersion setting in which both teachers and students use the target language at least 95% of the time. Instructional techniques include but are not limited to:

A. Teacher-directed, whole-group instruction
B. Small-group instruction
C. Flexible grouping
D. Technology-infused instruction
E. Hands-on activities
F. Research projects
G. Guided reading and discussion
H. Think-Pair-Share student partner activities
I. Total Physical Response (TPR).

V. EVALUATION

The purpose of assessment is to improve student learning, gauge student progress and make necessary adjustments in methodology when needed. Student assessment practices include but are not limited to:

A. Informal Assessments
   1. interviews
   2. oral presentations
   3. aural practice
   4. role-play
   5. classroom observations during coupled and group activities

B. Formal Assessments
   1. baseline assessments
   2. benchmark assessments
   3. short essays
   4. oral presentations
   5. written quizzes and tests
   6. aural assessments
   7. projects.

VI. PROFESSIONAL DEVELOPMENT

The following activities support this curriculum:

A. Collaboration with colleagues and supervisors to discuss and reflect upon unit plans, homework, and assessment
B. Department meetings to plan and coordinate curriculum and activities
C. Visitation to districts that implement innovative language programs
D. Professional development through courses or conferences.

APPENDIX I

New Jersey Student Learning Standards for World Languages

STANDARD 7.1 All students will be able to use a world language in addition to English to engage in meaningful conversation, to understand and interpret spoken and written language, and to present information, concepts, and ideas, while also gaining an understanding of the perspectives of other cultures. Through language study, they will make connections with other content areas, compare the language and culture studied with their own, and participate in home and global communities.

Strand A – Interpretive Mode

7.1.NM.A.1	Recognize familiar spoken or written words and phrases contained in culturally authentic materials using electronic information sources related to targeted themes.
7.1.NM.A.3	Recognize a few common gestures and cultural practices associated with the target culture(s).
7.1.NM.A.4	Identify familiar people, places, and objects based on simple oral and/or written descriptions.
7.1.NM.A.5	Demonstrate comprehension of brief oral and written messages using age and level appropriate, culturally authentic materials on familiar topics.
7.1.NH.A.2	Demonstrate comprehension of simple, oral and written directions, commands, and requests through appropriate physical response.

Strand B – Interpersonal Mode

7.1.NM.B.1	Use digital tools to exchange basic information at the word and memorized-phrase level related to self and targeted themes.
7.1.NM.B.2	Give and follow simple oral and written directions, commands, and requests when participating in age appropriate classroom and cultural activities.
7.1.NM.B.3	Imitate appropriate gestures and intonations of the target culture(s)/language during greetings, leave-, takings, and daily interactions.
7.1.NM.B.4	Ask and respond to simple questions, make requests, and express preferences using memorized words and phrases. Exchange information using words, phrases, and short sentences practiced in class on familiar topics or on topics studied in other content areas.

Strand C – Presentational Mode

7.1.NM.C.1	Use basic information at the word and memorized-phrase level to create a multimedia-rich presentation on targeted themes to be shared virtually with a target language audience.

7.1.NM.C.2	Imitate, recite, and/or dramatize simple poetry, rhymes, songs, and skits.
7.1.NM.C.3	Present information from age- and level-appropriate, culturally authentic materials orally or in writing.
7.1.NM.C.4	Name and label tangible cultural products and imitate cultural practices from the target culture(s).

The entire standards document may be viewed at http://www.state.nj.us/education/cccs

APPENDIX II

New Jersey Student Learning Standards for Social Studies

STANDARD 6.1 All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions that reflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

STANDARD 6.2 All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

STANDARD 6.3 All students will acquire the skills needed to be active, informed citizens who value diversity and promote cultural understanding by working collaboratively to address challenges that are inherent in living in an interconnected world.

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APPENDIX III

New Jersey Student Learning Standards for English Language Arts

STANDARD NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

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APPENDIX IV

New Jersey Student Learning Standards for Visual and Performing Arts

STANDARD 1.2. History of the Arts and Culture: All students will understand the role, development, and influence of the arts throughout history and across cultures.

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APPENDIX V

New Jersey Student Learning Standards for Technology

STANDARD 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

STANDARD 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

The entire standards document may be viewed at http://www.state.nj.us/education/cccs/

APPENDIX VI

New Jersey Student Learning Standards for 21st Century Life & Careers

STANDARD 9.1 All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

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WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

WORLD LANGUAGES - LEVEL III AND III HONORS

Schools.....Westfield High School
Department.....World Languages
Length of course ..... Full Year
Credits.....5
Grade Level..... 9-12
Prerequisite .....WL-Level II/WL-Level II H
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

The Westfield Public Schools Department of World Languages provides a well-articulated program in order to prepare students to become responsible citizens in a multicultural and diverse global society. Language skills and cultural awareness stimulate cognitive development and academic achievement. The study of a world language promotes knowledge, understanding and respect for the perspectives, practices, and products of different cultures.

The World Languages Level III course in French, Italian and Spanish aims to further develop the four basic skills of listening, speaking, reading and writing. Students at this level continue to be exposed to an immersion classroom setting where the target language is used almost exclusively and oral production as well as peer-to-peer interaction are a focus. Students express themselves on familiar topics using learned vocabulary and expressions as they move toward developing spontaneity. Students in Level III Honors experience a more rigorous course as thematic units are extended and instruction is delivered at a faster pace. All students are exposed to level-appropriate language functions and grammatical structures that enhance a natural communicative approach to language learning. Proficiency in a language other than English enables students to make meaningful connections with the world around them and allows for a greater understanding of the beliefs and perspectives represented in the target language and cultures.

II. OBJECTIVES

This curriculum fulfills the Westfield Board of Education expectations for student achievement. The course objectives, divided by each of the communication modes, are aligned with the NJ Student Learning Standards for World Languages, English Language Arts, Social Studies, Visual and Performing Arts, Technology, and 21st Century Life and Careers.

Students:

A. Interpretive Communication Mode

Identify main ideas and supporting details taken from culturally authentic material
New Jersey Student Learning Standards for World Languages 7.1.IM.A.4, 7.1.IM.A.6
New Jersey Student Learning Standards for ELA A.R2
New Jersey Student Learning Standards for Technology 8.1

Demonstrate comprehension of conversations on familiar topics between speakers of the target language
New Jersey Student Learning Standards for World Languages 7.1.IL.A.3, 7.1.IM.A.3, 7.1.IL.A.5, 7.1.IM.A.5
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Compare and contrast the use of verbal and non-verbal etiquette (i.e. the use of gestures, intonation, and cultural practices) in the target culture and in one's own culture
New Jersey Student Learning Standards for World Languages 7.1.NM.A.3, 7.1.IL.A.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1, 9.2

B. Interpersonal Communication Mode

Participate in an oral exchange of information on familiar topics
New Jersey Student Learning Standards for World Languages 7.1.IL.B.4
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Use proper register (formal vs. informal)
New Jersey Student Learning Standards for World Languages 7.1.IM.B.3
New Jersey Student Learning Standards for 21st Century Life & Careers 9.1

Use digital tools to participate in short conversations and to exchange information on familiar topics
New Jersey Student Learning Standards for World Languages 7.1.IM.B.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Demonstrate comprehension of audio and visual resources based on familiar topics to participate in an exchange of information
New Jersey Student Learning Standards for World Languages 7.1.IL.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

Collect and organize information from a variety of authentic sources to formulate an appropriate response
New Jersey Student Learning Standards for World Languages 7.1.IL.B.2, 7.1.IM.B.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

Respond to oral, audio, visual and written prompts on familiar topics
New Jersey Student Learning Standards for World Languages 7.1.IL.B.1, 7.1.IM.B.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3
New Jersey Student Learning Standards for Technology 8.1

C. Presentational Communication Mode

Present short authentic creations with increasing fluency
New Jersey Student Learning Standards for World Languages 7.1.IL.C.2, 7.1.IM.C.2
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.3

Use language creatively to respond to a variety of oral or visual prompts about familiar situations
New Jersey Student Learning Standards for World Languages 7.1.IL.C.3, 7.1.IM.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Visual and Performing Arts 1.2
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Compare and contrast cultural products and practices
New Jersey Student Learning Standards for World Languages 7.1.IL.C.3, 7.1.IM.C.3
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

D. Communities, Cultures, Comparisons, and Connections

Demonstrate an understanding of the similarities and differences of the target culture by making cultural comparisons and connections
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1
New Jersey Student Learning Standards for Social Studies 6.2 and 6.3

Compare and contrast the cultural perspectives of the target cultures with those of one's own culture, as evidenced through the cultural products and cultural practices associated with each
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1and 9.2

Synthesize information related to the cultural products, practices and perspectives associated with target culture to create a short presentation on specific themes with a target language audience.
New Jersey Student Learning Standards for World Languages 7.1
New Jersey Student Learning Standards for 21st Century Life and Careers 9.1

III. CONTENT, SCOPE, AND SEQUENCE

The following themes are interwoven to provide the framework by which students communicate as they explore cultural perspectives, make connections and comparisons, and prepare to participate in local and global communities. The grammatical structures presented following the themes and topics below are offered as an important component to the logical

continuum of the language acquisition process, but they are not the focus of instruction in the world languages classroom. Students explore grammar through context, with an emphasis on its functionality within the communicative approach. All themes and topics are extended for III Honors.

Cultural Perspectives, Products, and Practices

1. Describing cultural differences in holidays celebrated in target language countries
2. Demonstrating increased awareness of and appreciation for the diversity of cultures including people, traditions, food, architecture, languages, poetry, art, music, dance, and handicrafts
3. Developing an awareness of and appreciation for the differences between one's own culture and the target culture.

Themes

A. My Identity (suggested time 6 - 7 weeks)
    1. identify personality traits
    2. discuss personal beliefs and values
    3. compare/contrast social persona vs. real life persona
    4. recognize the uses of technology in everyday life
    5. describe on-line language and identity

B. Global Challenges (suggested time 6 - 7 weeks)
    1. identify current environmental and social issues
    2. explore current environmental initiatives
    3. describe social conscience
    4. compare/contrast social welfare programs in the U.S and other target countries
    5. explain volunteerism
    6. discuss health issues around the world

C. Contemporary Life (suggested time 5 - 6 weeks)
    1. identify different holidays and celebrations
    2. compare/contrast different leisure activities
    3. describe how contemporary life is influenced by cultural products/practices
    4. explore education and careers in the U.S. and other target countries
    5. describe leisure activities and travel

D. Families and Communities
    1. Family (suggested time 4 - 5 weeks)
        a. identify family structures
        b. explain different cultural traditions
        c. identify cultural celebrations specific to the target cultures
        d. describe traditional foods and meals

2. Friendship and love (suggested time 3 - 4 weeks)
   a. describe different kinds of relationships
   b. compare/contrast friendship and love
   c. explain the influence of American pop culture on the target cultures

E. Beauty and Aesthetics (WL III Honors)
   1. Famous people (suggested time (3 - 4 weeks)
      a. define beauty and creativity
      b. identify famous artists from the target cultures

   2. Arts and Literature (suggested time 3 - 4 weeks)
      a. identify literary terms and genres
      b. compare and contrast artistic movements/types of works
      c. convey the value of authentic art and literature

<u>Grammatical Structures</u>

1. French
   a. Reflexive verbs
   b. Present tense
   c. Commands
   d. Preterit tense
   e. Imperfect tense
   f. Pluperfect tense
   g. Future perfect tense
   h. Present conditional tense
   i. *Si* clauses with the present, future perfect, imperfect, present conditional
   j. Subjunctive mood with several expressions
   k. Negative expressions
   l. Direct and indirect pronouns
   m. Order of pronouns
   n. Comparisons of adjectives and adverbs

2. Italian
   a. Imperfect tense
   b. Impersonal *si*
   c. Commands
   d. Commands with direct and indirect object pronouns (III-H only)
   e. Direct and indirect object pronouns
   f. Pluperfect tense
   g. Future perfect tense
   h. Present and past conditional tense
   i. Subjunctive mood – present, past and imperfect (imperfect III-H only)
   j. Indefinite adjectives
   k. Present and past progressive
   l. Combined pronouns
   m. Irregular comparatives and superlatives

3. Spanish
    a. Present tense
    b. Preterite vs imperfect tenses
    c. Future tenses
    d. Conditional tenses
    e. Progressive tenses
    f. Perfect tenses
    g. *Si* clauses
    h. Ser vs. Estar
    i. Por vs. Para
    j. Commands
    k. Subjunctive

IV. INSTRUCTIONAL TECHNIQUES

Differentiated instruction creates a student-centered environment that seeks to accommodate diverse learners and provides multiple pathways to learning. A variety of instructional approaches are employed to involve all students in the learning process and to accommodate differences in readiness levels, interests and learning styles. The target language is used as the primary means of communication by providing an immersion setting in which both teachers and students use the target language at least 95% of the time. Instructional techniques include but are not limited to:

A. Teacher-directed, whole-group instruction
B. Small-group instruction
C. Flexible grouping
D. Technology-infused instruction
E. Hands-on activities
F. Research projects
G. Guided reading and discussion
H. Think-Pair-Share student partner activities
I. Total Physical Response (TPR).

V. EVALUATION

The purpose of assessment is to improve student learning, gauge student progress and make necessary adjustments in methodology when needed. Student assessment practices include but are not limited to:

A. Informal Assessments
    1. interviews
    2. oral presentations
    3. aural practice
    4. role-play
    5. classroom observations during coupled and group activities

B. Formal Assessments
    1. baseline assessments
    2. benchmark assessments
    3. short essays
    4. oral presentations
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    7. projects.

VI. PROFESSIONAL DEVELOPMENT

The following activities support this curriculum:

A. Collaboration with colleagues and supervisors to discuss and reflect upon unit plans, homework, and assessment
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Strand A – Interpretive Mode

7.1.NM.A.1	Recognize familiar spoken or written words and phrases contained in culturally authentic materials using electronic information sources related to targeted themes.
7.1.NM.A.3	Recognize a few common gestures and cultural practices associated with the target culture(s).
7.1.NM.A.4	Identify familiar people, places, and objects based on simple oral and/or written descriptions.
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7.1.NH.A.2	Demonstrate comprehension of simple, oral and written directions, commands, and requests through appropriate physical response.

Strand B – Interpersonal Mode

7.1.NM.B.1	Use digital tools to exchange basic information at the word and memorized-phrase level related to self and targeted themes.
7.1.NM.B.2	Give and follow simple oral and written directions, commands, and requests when participating in age appropriate classroom and cultural activities.
7.1.NM.B.3	Imitate appropriate gestures and intonations of the target culture(s)/language during greetings, leave-, takings, and daily interactions.
7.1.NM.B.4	Ask and respond to simple questions, make requests, and express preferences using memorized words and phrases. Exchange information using words, phrases, and short sentences practiced in class on familiar topics or on topics studied in other content areas.

Strand C – Presentational Mode

7.1.NM.C.1	Use basic information at the word and memorized-phrase level to create a multimedia-rich presentation on targeted themes to be shared virtually with a target language audience.

7.1.NM.C.2	Imitate, recite, and/or dramatize simple poetry, rhymes, songs, and skits.
7.1.NM.C.3	Present information from age- and level-appropriate, culturally authentic materials orally or in writing.
7.1.NM.C.4	Name and label tangible cultural products and imitate cultural practices from the target culture(s).

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APPENDIX II

New Jersey Student Learning Standards for Social Studies

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APPENDIX III

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STANDARD NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

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APPENDIX IV

New Jersey Student Learning Standards for Visual and Performing Arts

STANDARD 1.2. History of the Arts and Culture: All students will understand the role, development, and influence of the arts throughout history and across cultures.

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APPENDIX V

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STANDARD 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

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APPENDIX VI

New Jersey Student Learning Standards for 21st Century Life & Careers

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