# Basic Concepts List

## Math

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<td>Intermediate Accounting</td>
<td>Intermediate Economics</td>
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## Technology

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<tr>
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## Foreign Languages

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Elementary (Grades 4-6)

**Algebraic Skills**
Equations
Functions
Patterns

**Geometry**
Composite and Real World Shapes
Coordinates
Lines and Angles
Perimeter, Area, Volume
Position and Direction
Similar, Congruent, Symmetric Shapes
Sorting and Classifying
Three Dimensional Shapes
Transformations
Two Dimensional Shapes

**Measurement**
Converting Units and Measurements
Estimates
Measuring
Time
Units and Tools

**Numbers**
Coins, Bills, and Collections of Money
Counting
Decimals - Read, Write, Place Value, Compare
Equivalent Numbers - Decimals and Fractions
Fractions - Compare and Order
Fractions - Read, Write, Model
Integers
Ordinal Numbers
Whole Number - Place Value
Whole Numbers - Compare and Order
Whole Numbers - Read, Write, Characteristics

**Operations and Number Relationships**
Decimals - Operations
Estimation
Fractions - Operations
Number Properties
Number Theory: Factors, Multiples, Primes, Divisibility
Order of Operations
Ratios, Rates, Proportions, Percents, Squares and Roots
Solving Real World Problems with Operations
Understanding Addition, Subtractions, Multiplication, and Division
Whole Number Addition and Subtraction
Whole Number Multiplication and Division

**Statistics and Probability**
Collect and Organize Data
Measures and Descriptions of Data
Probability
Read and Interpret Data
Mid-Level (Grades 7-8)

Algebra, Patterns and Relationships
- Algebraic Expressions
- Formulas
- Functions
- Graphing Relationships
- Inequalities
- Linear Relationships
- Number and Geometric Patterns
- Solving Equations
- Systems of Equations
- Variables and Substitution

Represent and Analyze Quantitative Relationships between Dependent and Independent Variables

Use Properties of Operations to Generate Equivalent Expressions

Work with Radicals and Integer Exponents

Understand the Connections between Proportional Relationships, Lines and Linear Equations

Analyze and Solve Linear Equations and Pairs of Simultaneous Linear Equations

Define, Evaluate and Compare Functions

Use Functions to Model Relationships between Quantities

Data and Graphs
- Experiments and Data Collection
- Infer, Predict, Evaluate, Compare Data
- Measures of Central Tendency and Variation
- Represent, Read, Interpret Data Displays

Geometry
- Circles and Pi
- Classify Two- and Three-Dimensional Figures
- Coordinate Plane
- Drawing, Modeling, and Constructing Figures and Describe the Relationships between them
- Formulas for Perimeter, Area, Surface Area, Volume
- Logic and Reasoning
- Points, Lines, and Planes
- Properties of Two-Dimensional Figures
- Understand and Apply the Pythagorean Theorem
- Similarity, Congruence, and Symmetry
- Transformations

Measurement
- Estimate and Measure
- Measurement Systems
- Measurement Tools
- Rates, Indirect Measurements, Proportion

Numbers
- Compare and Order Numbers
- Equivalent Forms of Rational Numbers
- Estimation and Rounding
- Exponents and Roots
- Number Properties
- Number Theory Concepts
- Operations to Solve Problems
- Operations with Integers and Absolute Value
Operations with Real Numbers
Order of Operations
Percents
Ratios, Rates, Proportions
Understand Ratio Concepts and Use Ratio Reasoning to Solve Problems
Real Number System

**Probability**
- Develop Understanding of Statistical Variability
- Summarize and Describe Distributions
- Sample Space, Combinations, Permutations
- Theoretical and Experimental Probability
- Use Random Sampling to Draw Inferences about a Population
- Draw Informal Comparative Inferences about Two Populations
- Investigate Chance Processes and Develop, Use, and Evaluate Probability Models
- Understand Patterns of Association in Bivariate Data
Algebra

Absolute Value Equations and Inequalities
   Graphing Absolute Value Equations and Inequalities
   Solving Absolute Value Equations and Inequalities

Algebraic Expressions
   Add, Subtract Expressions
   Multiply, Divide, Factor Expressions including Exponents
   Variables and Expressions

Linear Equations and Inequalities
   Slope, Intercepts, Points on a Line
   Solving Linear Equations
   Solving Linear Inequalities
   Solving Problems with Equations and Inequalities
   Systems of Equations and Inequalities
   Writing and Graphing Linear Equations
   Writing and Graphing Linear Inequalities

Numbers
   Exponents and Roots
   Number Properties
   Number Theory Concepts
   Operations with Real Numbers
   Ratios, Proportions, Percents and Rates

Patterns and Functions
   Composition and Operations on Functions
   Graphing Functions and Transformations
   Inverse of Function
   Patterns
   Properties of Functions - Domain and Range
   Properties of Functions - Zeros, End Behavior, Turning Points
   Relations and Functions
   Solving Problems with Functions
   Translate Between Forms

Probability
   Counting Principles and Sample Spaces
   Theoretical and Experimental Probability

Quadratic Equations, Inequalities, and Functions
   Factoring Quadratic Equations
   Graphing and Properties of Quadratic Equations
   Solving Quadratic Equations and Inequalities
   Systems of Nonlinear Equations and Inequalities

Radical, Exponential and Logarithmic Equations and Functions
   Graphing Exponential and Logarithmic Functions
   Properties of Exponents and Logarithms
   Radical Expressions, Equations and Rational Exponents
   Solving Exponential and Logarithmic Equations and Inequalities
   Solving Problems with Exponential and Logarithmic Functions

Statistics
   Data Analysis – Data Collection – Data Displays – Measures of Data
Geometry

Measurement
  Formulas and Measurement
  Indirect Measurements, Ratios, and Rates
  Units, Unit Conversions, and Error

Points, Lines, Angles, Planes
  Angle Relationships and Problems
  Coordinate Geometry - Slope, Distance, Midpoint
  Geometric Constructions

Proofs and Logic
  Conditional Statements
  Conjectures, Axioms, Theorems, Proofs
  Inductive and Deductive Reasoning

Two- and Three- Dimensional Shapes
  Congruency
  Relationship Between Plane and Solid Figures
  Right Triangles, Including Pythagorean Theorem
  Similarity
  Symmetry and Transformations
  Theorems and Problems with Circles
  Theorems and Problems with Polygons
  Theorems and Problems with Quadrilaterals
  Theorems and Problems with Triangles
  Three-Dimensional Figures
  Trigonometric Ratios in Right Triangles
Algebra II

Absolute Value Equations and Inequalities
- Graphing Absolute Value Equations and Inequalities
- Solving Absolute Value Equations and Inequalities

Conic Sections
- Properties of Conic Sections
- Solving Problems with Conic Sections

Linear Functions, Equations, and Inequalities
- Slope, Intercepts, Points on a Line
- Solving Linear Equations
- Solving Linear Inequalities
- Solving Problems with Equations and Inequalities
- Systems of Equations and Inequalities
- Writing and Graphing Linear Equations
- Writing and Graphing Linear Inequalities

Matrices
- Matrices Operations and Problems

Numbers
- Complex Numbers
- Number Properties
- Operations with Real Numbers

Patterns and Functions
- Composition and Operations on Functions
- Graphing Functions and Transformations
- Inverse of Function
- Patterns
- Properties of Functions - Domain and Range
- Properties of Functions - Zeros, End Behavior, Turning Points
- Relations and Functions
- Solving Problems with Functions
- Translate Between Forms

Polynomial, Rational Expressions, Equations and Functions
- Solving and Graphing Polynomial Equations
- Solving and Graphing Rational Equations

Probability
- Counting Principles and Sample Spaces
- Theoretical and Experimental Probability

Quadratic Equations, Inequalities, and Functions
- Complex Solutions to Quadratic Equations
- Factoring Quadratic Equations
- Graphing and Properties of Quadratic Equations
- Solving Quadratic Equations and Inequalities
- Systems of Nonlinear Equations and Inequalities

Radical, Exponential and Logarithmic Equations and Functions
- Graphing Exponential and Logarithmic Functions
- Properties of Exponents and Logarithms
- Radical Expressions, Equations and Rational Exponents
- Solving Exponential and Logarithmic Equations and inequalities
- Solving Problems with Exponential and Logarithmic Functions

Sequences and Series
Properties of Sequences and Series
Solving Problems with Sequences and Series

Statistics
Data Analysis
Data Collection
Data Displays
Measures of Data
Trigonometry

Complex Numbers
- Polar Coordinates, DeMoivre’s Theorem
- Trigonometric Form
- Complex Number

Introduction to Trigonometry: Linear Relationships and Functions
- Introduction to Trigonometry
- Introduction to Trigonometry: Linear Relationships and Functions
- Relations, Functions, and Graphs
- Defining and Finding Trigonometric Functions
- Slope, Linear Relations, Scatter Plots, and Piecewise Functions
- Introduction to Trigonometry: Linear Relationships and Functions Unit Review

Trigonometric Ratios
- Trigonometric Ratios
- Angles and Angle Measures
- Measuring angles using radian and degree measures
- Right Triangles and Trigonometric Ratios
- The Unit Circle
- Trigonometric Ratios Unit Review

Graphing Trigonometric Functions
- Introduction to Graphing Trigonometric Functions
- Graphing Trigonometric and Inverse Functions
- Inverse Trigonometric Functions
- Transformations of Trigonometric Functions
- Real-world Applications of Trigonometric Functions
- Vectors
- Graphing Trigonometric Functions Unit Review

Trigonometric Laws and Identities
- Trigonometric Laws and Identities
- Law of Sines and Law of Cosines
- Trigonometric Identities and Equations
- Area of Triangles
- Angular and Linear Velocities
- Trigonometric Laws and Identities Unit Review
- Modeling Periodic Phenomenon

Vectors
- Graphing and Operations with Vectors
- Solving problems with Vectors
Calculus

Limits of functions (including one-sided limits)
- Calculate limits using algebra
- Estimating limits from graphs or tables
- Limits proofs for linear functions
- Vertical asymptotes and infinite limits
- Horizontal asymptotes and limits to infinity
- L'Hospital's Rule

Continuity
- Understanding continuity in terms of limits
- Types of discontinuity (infinite, jump, removable)
- Determining continuity from a graph or rule for a function
- Intermediate Value Theorem

Derivatives
- Compute derivatives of functions: power, exponential, logarithmic, trigonometric, inverse trig
- Apply Product Rule, Quotient Rule, Chain Rule, etc.
- Understand the first and second derivative graphically
- Approximate derivative from graph or tables
- Interpretation of the derivative as a rate of change (limit of an average rate of change)
- Relationship between differentiability and continuity
- Tangent line to curve
- Linear approximation and differentials
- Relationship between increasing and decreasing behavior and the sign of the derivative
- Mean Value Theorem
- Relationship between concavity and the sign of the second derivative
- Inflection Points
- Optimization Problems
- Related Rates Problems
- Implicit differentiation
- Antiderivatives and initial value problems
- Particle motion (position, velocity, acceleration)
- Slope fields and solution curves for differential equations

Integrals
- Riemann sums
- Basic properties of definite integrals
- Applications of integrals (including areas, arc length, volumes for solids of revolution)
- Fundamental Theorem of Calculus, Parts I and II
- Definite and indefinite integrals of basic functions
- Techniques of Integration (Substitution, Parts, Partial Fractions, Trigonometric Substitution)
- Improper Integrals
- Numerical Approximation of Integrals
- Separable differential equations

Parametric and Polar Curves
- Graphs, derivatives, areas, arc length

Series and Sequences
- Sequence convergence
- Partial Sums and the definition of series convergence
- Geometric Series and their sums
- Tests for series convergence
- Test for divergence (nth term test)
- Integral test and p-Series
Alternating series
Comparison test and limit comparison test
Ratio and Root Test
Power series, radius and interval of convergence
Maclaurin and Taylor series

In addition, the concepts below are frequently seen by students in pre-Calculus courses and ones that all Calculus tutors are expected to know and be able to assist students with:

- Circle, ellipse, hyperbola, and parabola
- Perform translations for various conic sections
- Arithmetic and Geometric sequences
- Trigonometric Ratios and Identities
- Trigonometric graphs
- Law of Cosines and Law of Sines
- Functions and Graphs (Linear and Polynomial)
- Exponential and Logarithmic Functions
Calculus BC

Calculus Basics
- Combining Functions
- Patterns in Graphs

Limits and Continuity
- Finding Limits Analytically
- Asymptotes as Limits
- Relative Magnitudes for Limits
- When Limits Do and Don’t Exist
- Continuity
- Intermediate and Extreme Value Theorems

Derivatives
- Slope and Change
- Derivatives at a Point
- The Derivative
- The Power Rule
- Sums, Differences, Products and Quotients
- Graphs of Functions and Derivatives
- Continuity and Differentiability
- Rolles and Mean Value Theorems
- Higher Order Derivatives
- Concavity
- Chain Rule
- Implicit Differentiation

Rates of Change
- Extrema
- Optimization
- Tangent and Normal Lines
- Tangents to Polar Curves
- Tangent Line Approximation
- Rates and Derivatives
- Rectilinear Motion
- Motion with Vector Functions

Integrals
- Riemann’s Sums
- Area Approximations
- The Definite Integral
- Properties of Integrals
- Graphing Calculator Integration
- Application of Accumulated Change
- The Fundamental Theorem of Calculus
- Definite Integrals of Composite Functions
- Analyzing Functions and Integrals
- Area Between Curves
- Volumes of Revolution
- Cross Sections
- Arc Length

Inverse and Transcendental Functions
- Derivatives of Inverses
- Inverse Trigonometric Functions
- Logarithmic and Exponential Review
Transcendals and 1/x
Derivatives of Logarithms and Exponentials
L'Hopital's Rule
Analysis of Transcendental Curves
Integrating Transcendental Functions
Partial Fractions
Integration by Parts
Improper Integrals
Application of Transcendental Integrals
Derivatives of Parametric Functions
Integrating Parametric and Polar Functions

**Separable Differential Equations and Slope Field**
- Slope Fields
- Differential Equations and Models
- Euler's Method
- Exponential Growth
- Application of Differential Equations

**Sequences and Series**
- Sequences
- Series
- Convergence Tests
- Radius of Convergence
- Functions Defined by Power Series
- Taylor and Maclaurin Series
- Taylor's Theorem and Lagrange Error
Pre-Calculus

Functions
Know and use a definition of a function
Write a function that describes a relationship between two quantities
Perform algebraic operations on functions and apply transformations
Write an expression for the composition of one given function with another and find the domain, range, and graph of the composite function
Determine whether a function has an inverse and express the inverse, if it exist
Know and interpret the function notation for inverses
Identify and describe the discontinuities of a function and how these relate to the graph
Understand the concept of limit of a function as x approaches a number or infinity
Analyze a graph as it approaches an asymptote
Computer limits of simple functions
Explain how rates of change of functions in different families differ

Exponents and Logarithms
Use the inverse relationship between exponential and logarithmic functions to solve equations and problems
Graph logarithmic functions
Graph translations and reflections of functions
Compare the large-scale behavior of exponential and logarithmic functions with different bases and recognize that different growth rates are visible in the graphs of the functions
Solve exponential and logarithmic equations
Find an exponential or logarithmic function to model a given set of data or situation
Solve problems involving exponential growth and decay

Quadratic Functions
Solve quadratic type equations by substitution
Apply quadratic functions and their graphs in the context of motion under gravity and simple optimization problems
Find a quadratic function to model a given set of data or situation

Polynomials
Given a polynomial function, find the intervals on which the function’s values are positive and those where it is negative
Solve polynomial equations and inequalities of degree of three or higher
Graph polynomial functions given in factored form using zeros and their multiplicities, testing the sign on intervals and analyzing the function’s large scale behavior
The Remainder Theorem
The Factor Theorem
Fundamental Theorem of Algebra

Rational Functions and Difference Quotients
Solve equations and inequalities involving rational functions
Graph rational functions; identify asymptotes, analyzing their behavior for large x values and testing intervals
Given vertical and horizontal asymptotes, find an expression for a rational function
Know and apply the definition and geometric interpretation of difference quotient
Simplify difference quotients
Interpret difference quotients as rates of change and slopes of secants lines

Trigonometric Functions
Define and graph and use all trigonometric functions of any angle
Convert between radian and degree measure
Calculate arc lengths in given circles
Graph transformations of the sine and cosine functions
Explain the relationship between constants in the formula and transformed graph
Know basic properties of the inverse trigonometric functions, including their domains and ranges. Recognize their graphs

Know the basic trigonometric identities for sine, cosine, and tangent

Pythagorean identities
Sum and difference formulas
Co-functions relationships
Double-angle and half angle formulas
Solve trigonometric equations using basic identities and inverse trigonometric functions
Prove and derive trigonometric identities
Find a sinusoidal function to model a given set of data or situation

Vectors, Matrices and Systems of Equations
Perform operations on vectors in the plan
Solve applied problems using vectors
Know and apply the algebraic and geometric definitions of the dot product of vectors
Know the definitions of matrix addition and multiplication
Add, subtract and multiply matrices
Multiply a vector by a matrix
Represent rotations of the plane as matrices and apply to find the equations of rotated conics
Define the inverse of a matrix and computer the inverse of two-by-two and three-by-three matrices
Computer determinants of two-by-two and three-by-three matrices
Write systems of two and three linear equations in matrix form
Solve systems using Gaussian elimination or inverse matrices
Represent and solve inequalities in two variables
Linear programming

Sequence, Series and Mathematical Induction
Know, explain and use sigma and factorial notation
Write an expression for the nth term
Write a particular term of a sequence when given the nth term
Understand, explain and use the formulas for the sums of finite arithmetic and geometric sequences
Compute the sums of infinite geometric series
Understand and apply the convergence criterion for geometric series
The principle of mathematical induction
Pascal’s triangle
Binomial theorem

Polar Coordinates, Parameterizations, and Conic Sections
Convert between polar and rectangular coordinates
Graph functions given in polar coordinates
Write complex numbers in polar form
De Moivre’s theorem
Evaluate parametric equations for given values of the parameter
Convert between parametric and rectangular forms of equations
Graph curves described by parametric equations
Use parametric equations in applied contexts to model situations
Identify parabolas, ellipses and hyperbolas from equations
Write the equation in standard form and graph parabolas, ellipses and hyperbolas
Derive the equation for a conic section from given geometric information
Identify key characteristics of a conic section from its equation or graph
Identify conic sections whose equations are in polar or parametric form

Modeling Mathematics
Construct a tangent from a point outside a given circle to a circle
Cavalieri’s principle
Identify the shapes of two dimensional cross sections of three dimensional objects
Identify three dimensional objects generated by rotations of two-dimensional objects
Statistics

Analyze Data
- Confidence Intervals
- Correlation
- Expected Values and Probability Distributions
- Hypothesis Testing
- Infer and Predict
- Regression
- Sample Distributions and Central Limit Theorem

Collect Data
- Experiments and Data Collection
- Sampling

Probability
- Computing Probability
- Counting - Combinations and Permutations

Summarize Data
- Data Distribution
- Display Data
- Measures of Data
- Read, Interpret, Classify Data
Intermediate Statistics

Describing Data
- Numerical summary measures
- The effect of changing units on summary measures
- Tabular and graphical methods (dotplots, stemplots, boxplots)
- Comparing distributions (back to back stemplots, parallel boxplots)
- Comparing center and spread: within group, between group variation
- Comparing shapes
- Comparing outliers and other unusual features (clusters, gaps)

Probability
- Interpreting probability, including long run relative frequency interpretation
- "Law of Large Numbers" concept
- Addition rule, multiplication rule, conditional probability and independence
- Discrete random variables and their probability distributions, including binomial and geometric
- Mean (expected value) and standard deviation of a random variable
- Linear transformation of a random variable
- Combining independent random variables
- Notion of independence versus dependence
- Mean and standard deviation for sums and differences of independent random variables
- Simulation of random behavior and probability distributions

The Normal Distribution
- Properties of the normal distribution
- Using tables of the normal distribution
- The normal distribution as a model for measurements

Sampling and Experimentation: Planning and conducting a study
- Methods of data collection (census, sample survey, experiment, observational study)
- Planning and Conducting Surveys
- Characteristics of a well-designed and well-conducted survey
- Populations, samples, and random selection
- Sources of bias in sampling and surveys
- Sampling methods, including simple random sampling, stratified random sampling and cluster sampling
- Planning and Conducting Experiments
- Characteristics of a well-designed experiment
- Treatments, control groups, experimental units, random assignments and replication
- Sources of bias and confounding, including placebo effect and blinding
- Completely randomized design
- Randomized block design, including matched pairs design
- Generalizability of results and types of conclusions that can be drawn from observational studies, experiments and surveys

Sampling distribution
- Sampling distribution of a sample proportion
- Sampling distribution of a sample mean
- Central Limit Theorem
- Sampling distribution of a difference between two independent sample proportions
- Sampling distribution of a difference between two independent sample means
- Simulation of sampling distributions
- t distributions
- Chi-square distributions
- F distributions

Statistical Inference: Estimating population parameters and testing hypotheses
Estimation (point estimators and confidence intervals)
Estimating population parameters and margin of error
Properties of point estimators, including unbiasedness and variability
Logic of confidence intervals, meaning of confidence level and confidence intervals, and properties of confidence intervals
Confidence interval for a mean
Confidence interval for a proportion
Confidence interval for a difference between two means (unpaired and paired)
Confidence interval for a difference between two proportions
Confidence interval for a variance
Confidence interval for a ratio of two variances
Test of significance
Logic of significance testing, null and alternative hypotheses; p-values; one and two sided tests; interpret the results; concepts of Type 1 and Types 2 errors; concept of power
Test for a mean
Test for a proportion
Test for a difference between two means (unpaired and paired)
Test for a difference between two proportions
Test for a variance
Test for a ratio of two variances
Effect sizes

**Anova**
One-way ANOVA
Two-way ANOVA
Factorial – interactions
Randomized block ANOVA
Repeated Measures
Post-hoc analysis/multiple comparisons (Bonferroni, Tukey, LSD)

**Exploring Categorical Data**
Frequency tables and bar charts
Marginal and joint frequencies for two way tables
Conditional relative frequencies and association
Comparing distributions using bar charts
Chi-square test for goodness of fit, test for homogeneity, and test of independence (one and two-way tables)

**Nonparametric tests** (sign test, Wilcoxon rank sum test, Wicoxon signed rank test)

**Regression and Correlation**
Exploring bivariate data - analyzing patterns in scatter plots
Correlation and linearity
Simple linear regression - least-squares regression
Interpreting intercept and slope
Confidence interval for the slope of a least squares regression line
Test for the slope of a least squares regression line
Coefficient of determination
Residual plots, outliers and influential points
Transformations to achieve linearity: logarithmic and power transformations
Multiple regression
Test and confidence interval for parameters in a multiple regression model
Interpreting parameters in a multiple regression model

**Determine the type of hypothesis test to use for different types of data**
Finite Math

Solve linear equations and inequalities.
Graph linear equations in two variables.
Use mathematical modeling and linear regression to make predictions.
Solve function problems.
Quadratic Functions
Polynomial and Rational Functions
Solve exponential function problems.
Solve logarithmic function problems.
Solve simple interest problems.
Solve compound interest problems.
Solve problems involving future and present value of annuities. (sinking funds and amortization)
Solve systems of linear equations.
Gauss Jordan Elimination
Perform operations on matrices.
Inverse of a square matrix
Solve matrix equations.
Apply matrices in a real world scenario.
Inequalities in two variables
Systems of linear inequalities in two variables
Solve linear programming problems geometrically
Geometric Introduction to the Simplex Method
Maximization and Minimization with Mixed Problem Constraints
Basic Counting Principles
Permutations and Combinations
Sample Spaces, Events and Probability
Apply counting principles to solve problems.
Conditional Probability, Intersection and Independence
Solve probability problems.
Random Variables, Probability Distribution and Expected Value
Solve problems involving discrete probability.
Solve problems involving discrete probability.
Make decisions by computing the expected value of random variables.
Summarize and present data using graphs, measures of central tendency, and measures of dispersion.
Bernoulli Trials and Binomial Distribution
Normal Distributions
Solve linear programming problems geometrically.
Solve linear programming problems by the simplex method.
Solve problems involving Markov chains.
Properties of Markov Chains
Regular Markov Chains
Absorbing Markov Chains
Solve problems involving game theory.
Strictly Determined Games
Mixed Strategies Games
Linear Programming and 2 x 2 games - geometric approach
Linear programming and m x n games - simplex method and the dual
Discrete Math

- Apply basic enumeration techniques.
- Simplify assertions and compound statements in first-order logic.
- Apply basic set-theoretic concepts.
- Apply the principles of mathematical induction and recursion.
- Apply the basic concepts of computational complexity and algorithmic analysis.
- Solve problems of iteration.
- Manipulate relations and simple functions and their inverses.
- Use the properties of relations.
- Apply the properties of equivalence relations and partitions.
- Use the Principle of Inclusion and Exclusion.
- Identify graph isomorphism, planarity, connected components, and chromatic numbers.
- Identify properties of a tree.
- Apply properties of general graphs.
- Apply the basic concepts of Boolean algebra.
- Use the basic laws of Boolean algebra.
- Convert Boolean expressions into a disjunctive or conjunctive normal form.
Linear Algebra

Systems of Linear Equations
- Homogeneous and non-homogeneous systems
- Matrix representation of system
- Row reduction and echelon forms
- Gaussian and Gauss-Jordan elimination
- Consistent and inconsistent systems

Matrix Properties and Arithmetic
- Addition, Subtractions, Scalar Multiplication
- Matrix multiplication
- Transpose of a matrix
- Special Matrices - Identity, zero, diagonal, etc.
- Elementary matrices and elementary row operations
- Row equivalence

Determinants
- Determinant of 2 x 2 and 3 x 3 matrices
- Co-factor expansion
- Cramer’s Rule
- Theorems involving determinants and invertibility
- Properties of determinants

Linear Transformations
- Properties of linear transformations
- Matrix representation of linear transformation
- Kernel
- Range
- Change of basis

Vector Spaces
- Linear dependence and independence
- Rank and nullity of a matrix
- Properties of vector spaces
- Subspaces
- Span of a vector space
- Basis of a vector space
- Properties of vectors and vector arithmetic

Eigenvalues and Eigenvectors
- Eigenvalues and Eigenvectors
- The Characteristic Equation

Matrix Decomposition
- LU decomposition
- QR decomposition
- Diagonalization
- Singular Value decomposition

Orthogonality/Least Squares
- Inner product spaces
- Orthogonality
- Orthonormal bases
- Gram-Schmidt orthonormalization
- Least squares regression
Quantitative Methods

Applications and Limitations of Quantitative Analysis
- Business and Decision Analysis
- Arts and Social Sciences
- Medical and Health Sciences

Data and Terms
- Data Quality and measures
- Multivariate data
- F Statistic
- Coefficient Interpretation
- Data Sensitivity
- Hypothesis Testing

Decision Models
- Maxmin and Maximax
- Hurwicz
- Expected Value and Expected Value Perfect Information
- Decision Tree
- Equal Likelihood
- Highest Value vs Lowest Cost

Forecasting
- Linear Regression
- Non-Linear Regression
- Moving Average
- Exponential Smoothing
- Seasonal Index

Linear Algebra
- Vector
- Matrix
- Determinant
- Solving systems

Calculus
- Functions
- Derivatives
- Optimization

Advanced Statistical Modeling
- Chi Square
- Data Clustering
- ANOVA
- Simulation
- Probability Modeling
Quantitative Reasoning

Logic/Critical Thinking
- Truth Tables
- Simple Statements
- Venn Diagrams
- Compound Statements
- Analyzing Arguments

Arithmetic Knowledge
- Fractions
- Decimals and Rounding
- Scientific Notation, Powers of 10, and Approximations
- Rate, Ratio and Proportion
- Percentages
- Uses and Abuses of Percentages
- Index Numbers
- Unit Conversions
- Interpretation of Graphs

Geometry/Trigonometry
- Perimeters and Areas of Basic Geometric Shapes
- Measures of Distance and the Pythagorean Theorem
- Volume and Surface Area
- Basic Trigonometry
- Graphs of the Trigonometric Functions
- Applications of Trigonometry

Functions
- Definition and the Vertical Line Test
- One-to-one and Inverse Functions, the Horizontal Line Test
- Linear Functions (Standard and Slope-Intercept Forms of Equations)
- Applications of Linear Models
- Linear Inequalities
- Nonlinear Models (Exponential, Power, Logarithmic)
- Graphing Functions (Excel or TI-84/83)
- Solving systems of equations (Linear & Nonlinear)
- Linear Programming (Graphical Method)
- Linear Programming (Simplex Method)

The Mathematics of Finance
- Simple Interest
- Compound Interest (Lump Sums and Annuities)
- Applications of Compound Interest
- Amortization Schedules

Descriptive Statistics
- Measures of Central Tendency
- Measures of Spread/Dispersion/Variation
- Percentiles & Z-scores
- Graphing Tools Used to Summarize Data

Designing & Analyzing Studies
- Observational vs Experimental Studies
- Sampling Methods (Strengths and Weaknesses)
- Critical Evaluation of Statistical Studies

Probability Rules & Simulation
- Counting Methods - Multiplication Principle, Permutations, Combinations
Probability Concepts and Rules
Independent vs. Dependent Events
Joint vs. Disjoint (Mutually Exclusive) Events
Law of Large Numbers
Simulation Using TI-84/83 or MS Excel
Probability Distributions
Discrete vs Continuous Distributions
Normal Distribution
Random Variables and Probability Distributions
Expected Value & Risk Assessment
Binomial and Geometric Distributions, including Normal Approximation to the Binomial Distribution

Inference & Regression
Central Limit Theorem
Logic of Confidence Intervals
Logic of Hypothesis Testing
One Sample Inference About a Population Mean
One Sample Inference About a Population Proportion
Scatterplots & Correlation
Simple Linear Regression
Science – Elementary (Grades 4-6)

5 Senses
Animals
Astronomy
Atmosphere
Atoms
Basic Needs for Living Organisms
Calendar
Carbon Cycle
Cells
Classifying Living Things
Earthquakes
Earth’s Resources
Earth’s Surface
Ecosystem
Electricity
Energy
Energy Conservation
Environment
Food Chain/Web
Forces and Motion
Fossils
Genetics
Heat
Insect Life Cycle
Invertebrates
Investigation
Light
Light Energy
Magnets
Matter
Nitrogen Cycle
Organ Systems
Plants
Reproduction
Resources
Rock Cycle
Rocks
Seasons
Simple Machines
Soil
States of Matter
Tools
Vertebrates
Volcanoes
Water
Weather
Work
Science – Middle Grades (Grades 7-8)

Astronomy
Cell Structure and Function
Earth
Ecology
Genetics
Human Body
Living Organisms
Matter
Metric system
Motion
Optics
Periodic Table
Scientific Method
Scientific Tools
Earth Science

Math basics
- Algebra
- Dimensional analysis
- Metric system
- Scientific notation
- Significant digits

Nature of Science
- Accuracy and precision
- Bias and Ethics
- Communication
- Data collection and analysis
- Models
- Scientific Method
- Scientific Quantities
- Scientific Thinking
- Scientists and Discoveries
- Theories and Laws
- Tools and Measurement
- Graphical interpretations

Geology
- Time
  - Relative Time
  - Absolute Time
  - Divisions of Geologic Time
  - Origin of Earth
  - Evolution of life on Earth
- First Principle of Geology
- Principle of Uniform Process
- Law of Superposition
- Relative Age
- Unconformity
- Fossils
- Radioactive dating of rocks
- Plate Tectonics
  - Parts of the Earth – characteristics and classification
    - Chemical layers of the Earth
    - Physical layers of the Earth
  - Evidence and theories of Plate Tectonics
    - Alfred Wegener
    - Pangaea
    - Sea Floor Spreading
    - Tectonic Plates
    - Plate Boundaries
    - Subduction zones
    - Earthquakes
      - Richter Scale
      - Seismic Waves
  - Volcanoes
    - Ring of Fire
    - Hot Spots
Landforms
Paleomagnetism and Plate Dynamics

Minerals
Elements
Mineral composition of Earth
Identification
    Simple Identity Tests
Planetary composition and distribution

Types of Rock and the Rock Cycle
Chemical Cycles
    Nitrogen – Oxygen – Carbon
Erosion and Weathering
Glaciers
Soil
Water
    Water cycle
Biomes
Population
    Growth rate
    Food supply

Pollution
    Land – Water (sewage) – Air – Chemical -- Thermal

Ecosystems
Energy flow – Carbon cycle – Population Growth
Natural Resources
    Renewable/Non-renewable energy sources
    Green House Effect
    Acid Rain
    Management

Climate change
Human impact/changes to planet
Natural disasters – causes, effects, impact

**Meteorology**

Air
    Composition
    Smog
    Pressure
    Temperature
    Layers
    Energy Absorption/reflection
    Solar and Terrestrial Radiation
    Convection currents
    Moisture and Atmospheric stability
    Wind – local and global
    Convection Cell
    Coriolis Effect

Weather Conditions and how they are created
    Humidity
    Saturation
    Relative Humidity and calculations
    Dew Point
    Fronts
Jet Stream
Global Weather
Predication, forecast and measurement
Tools for measuring weather conditions
Weather map construction and interpretation
Clouds
Air Mass
Climates

Oceanography
Sea Floor Profile
Parts of the Ocean
Salinity
Contributories to the water in the ocean
Resources
Coriolis Effect
Major currents in the world and features
Waves
Tsunami characteristics

Astronomy
Earth, Sun, and Moon System
   Historical views of the solar system
      Geocentric (Ptolemy)
      Heliocentric (Copernicus)
   Time Zones
   Day Length
   Seasons
   Phases of the moon
   Eclipses - Lunar and Solar
   Tides
Features of the Moon
Theories of the creation of the moon
Sun
   Energy production - Fusion
   Life cycle
   Layers
   Sunspots
   Prominences – solar flares
   Auroras
Solar system
   Structure and composition
   Inner (Terrestrial) Planet characteristics and specifics
   Outer (Jovian) planet characteristics and specifics
   Motion
   Kepler’s Law
Stars
   Classifications
   Life span/cycle
   Creation of elements
   Spectroscopy
   H-R Diagram
   Distances
Galaxies
Distances
Amount
Types
Composition
Gravity
Formation of planets
Big Bang Theory and evidence
Space probes and exploration
Telescopes
Basic Chemistry
- Atoms
- Properties of Water Due to its Polarity and Hydrogen Bonding
- Molecular Movement, Osmosis and Diffusion
- Chemical Gradients
- Monomers and Polymers
- Carbohydrates, Lipids, Proteins, and Nucleic Acids

Cell Structure and Function
- Structure and Function of the following:
  - Cell Membrane, Cell Wall
  - Cytoplasm, Cytoskeleton, Centriole
  - Nucleus, Nuclear Membrane, Nucleolus
  - Golgi Apparatus, Endoplasmic Reticulum, Ribosome, Lysosome, Mitochondrium, Chloroplast
  - Vacuole, Vesicle
- Cellular Transport Across the Cell Membrane
- Fluid Mosaic Model of the Cell Membrane and Semipermiability
- Active Transport
- Facilitated Diffusion
- Passive Transport
- Receptor Proteins
- Signaling Molecules

Cell Energy & Related Processes
- Enzymes, Enzymatic Functions, and Enzymatic Pathways
- Autotrophs and Heterotrophs
- Glycolysis
- Kreb's Cycle
- Electron Transport Chain
- Fermentation
- ATP and Activation Energy
- Exergonic and Endergonic Reactions
- Light-Dependent Reactions of Photosynthesis
- Calvin Cycle
- Chemosynthesis

Cell Cycle
- Ploidy
- Mitosis/Meiosis
- G0, G1, S, G2, and M Phases of the Cell Cycle
- Cell Cycle Checkpoints
- Oncogenes and Tumor Suppressors in relation to cell cycle: p53, MLH1,BRCA1/2 etc.

Basic Genetics
- Inheritance
- Mendel's Law of Heredity
- Monohybrid, Dihybrid, and Trihybrid Crosses
- Probability of Genotypes or Phenotypes based on Genetic Crosses
- Sex-linked Traits
- Pedigree Analysis
- Mitochondrial DNA

Molecular Genetics
- Famous genetic experiments-Hershey/Chase, Fred Griffith, Avery, Meselson/Stahl, Chargaff, and Watson/Crick.
- Semi-conservative replication
Transcription
Translation and Protein Processing
Regulation of Gene Expression and Epigenetics
Mutations and Chromosomal Abnormalities
Genetic Engineering Techniques (PCR, Gel Electrophoresis, Restriction Enzymes, Cloning, and DNA Sequencing, and Gene Mapping) and Their Uses

**Evolution & Phylogeny**
Common Ancestry
Cell Theory and Characteristics of Life
Theory of Endosymbiosis
RNA World Hypothesis
Natural Selection and Fitness
Evidence Supporting Evolution (Fossil Record, DNA, Protein, Mathematical Models, etc.)
Examples of Selective Pressures and Their Effects on Population
Types of Selection
The Role of Genetic Drift, Mutation, and Sexual Reproduction in Evolution
Hardy-Weinberg Equilibrium
Phylogenetic Trees & Cladograms
Speciation & Extinction
Taxonomy

**Bacteria**
Characteristics
Basic Structures Including:
- Cell Wall, Cell Membrane, Ribosomes, Plasmids, Flagella
Bacterial Conjugation
Binary Fission

**Viruses**
Characteristics
Basic Structure Including:
- Capsid/Coat Proteins
- Genetic Material (including Reverse Transcriptase for RNA viruses)
Relationship of Cell Receptors to Entrance of Viruses into Host cells
Lytic and Lysogenic Stages of Virus Life Cycle
Relationship of Viruses to Cancer
Role of Mutation on the Evolution of Viruses

**Animal Form & Function**
Body Plan Development
Surface Area to Volume
Origin and Function of the Following Cell Types
- Epithelial
- Connective
- Muscle
- Nervous
Tissues, Organs and Organ Systems
Homeostasis, Feedback Loops, and Hormones
Animal Behavior
Animal Reproduction
Endotherms and Ectotherms
Characteristics of the Following Phyla...
- Protists, Porifera, Cnidaria, Nematoda, Mollusca, Annelida, Arthropoda, Echinodermata, Chordata

**Plant Form & Function**
Evolution of Plants from Algae
Adaptations of Plants to Land
  Vascular and Nonvascular Plants
  Pollen, Seeds, Flowers, and Fruit
Plant Reproduction
Alternation of Generations
Plant Structures Including...
  Leaf, Stomata, Cuticle
  Xylem, Phloem
  Rhizoids, Sporangium, Spores
  Roots, Meristem, Sepal, Petal
  Anther, Filament, Stamen, Stigma, Style, Ovary, Pistil, Fruit
  Pollen, Seed, Flower
Angiosperms (including Monocots and Dicots) and Gymnosperms (including Conifers)
Response to Stimuli (hormones involved) Including
  Auxins
  Phototropism
  Gravitropism

Fungi
  Role In Decomposition
  Reproduction
  Fungal Structures Including...
    Spores, Hyphae, Ascus, Stalk, Cap

Ecology
  Biomes
  Biodiversity
  Ecosystem Energy Flow
  Life History Strategies
  Producers, Consumers, and Decomposers
  Population Growth and Regulation
  Biotic and Abiotic Factors Affecting Environments
  All biogeochemical cycles including: Water, Carbon, Nitrogen, Sulfur, and Phosphorus Cycles
  Interactions between species and types of symbiosis

General Science
  Interpreting and Graphing Scientific Data
  Interpreting and Summarizing Information from Literature
  Development of Science Fair Projects
  Assistance with Lab-related Assignments
  Proofreading Reports for Science Content

Lab techniques
  Microscopy
  Serial dilution
  Gel electrophoresis
  Bacterial culturing
Anatomy & Physiology

Anatomical Terminology
Anatomical Regions, Cavities, Planes of Symmetry, and Directional Terms

General Chemistry
Protons, Neutrons, Electrons, Atoms, Elements, and Compounds
Bonding: Ionic, Covalent, and Hydrogen
pH scale, Acids and Bases
Organic and Inorganic Compounds
Macromolecules: Carbohydrates, Lipids, Proteins, and Nucleic Acids

Cellular Biology
Light and Electron Microscope Images and Uses
Cell Structure: Cell Membrane, Cytoplasm, Nucleus
Organelle Structure and Function
Protein Synthesis
Metabolism and Homeostasis
Mitosis and Meiosis

Histology
Structure, Function, Location, and Subtypes of Epithelial, Connective, Muscular, and Nervous Tissue

Embryology
Ectoderm, Mesoderm, and Endoderm and their derivatives

Organ Systems
Integumentary
Functions of the Integument
Layers composing the epidermis and dermis
Nutrient and Oxygen Supply to the epidermis and dermis
Subcutaneous layer
Accessory Organ Structure and Function: Hair, Nails, and Glands
Basic Knowledge skin cancer types and prognoses

Skeletal
Functions of the Skeletal System
Structure and Function of Cartilage
Bone Markings, Shapes, Matrix, Structures, and Names
Bone Cells Structure and Function: Osteocyte, Osteoclast, and Osteoblast
Differentiate between Compact & Spongy Bone
Differentiate between Endochondral and Intramembranous Ossification
Differentiate between Axial and Appendicular Skeleton
Basic knowledge of bone fractures and osteoporosis
Supporting Ligaments and discs
Types of Joints and their locations

Muscular
Functions of the Muscular System
Types and Locations of Muscular Tissue
Muscle Cell Structure and Function
Sliding Filament Theory & Excitation – Contraction Coupling
Sources of Energy for Muscle
Role of Exercise and Muscle Function
Knowledge of Names and Locations of muscles

Digestive
Structure and Function of Esophagus, Stomach, Small Intestines, Colon, Liver, Gall Bladder, Appendix and Rectum

Mechanical Digestion
Chemical Digestion
Absorption and transport of nutrients
pH balance and enzymatic function
Hormone regulation of digestive function and appetite
Extrinsic and Intrinsic Nervous function
Digestive Disease
Normal Flora of the gut

Nervous
Functions and Divisions of the Nervous System
Structure and Function of Neurons and Neuroglia
Generation and Propagation of an action potential
Synapses, Neurotransmitters, and Myelination
Brain Structure, Divisions, and Functions
Spinal Cord and Peripheral Nerve Structure and Function
Special Senses: Olfaction, Taste, Vision, Hearing, and Balance
Structure and Function of the Autonomic Nervous System

Endocrine
Second Messenger Pathways
Steroid production and function
Role of Hypothalamus
Structure & Function of Pituitary, Thyroid, Parathyroid, Adrenal, Pancreas, testes, Ovaries, and Pineal Glands
Hormones produced and their function

Cardiovascular
Functions and Composition of Blood
Clotting Cascade
Blood typing and diagnostic tests
Structure and Function of the heart
Electrical Activity of the Heart
Cardiac Cycle
Cardiac Output
Knowledge of Arteries and Veins that supply the body
Immunity & Lymphatic
Innate and Adaptive Immunity
Types and Functions of Immune Cells
Immunological Surveillance and Tolerance
Acquired Immunity
Structure and Function of Lymph Nodes, Spleen, Lymphoid Tissue, and Peyers Patches
Lymphatic Circulation

Respiratory
Functions of the Respiratory System
Anatomy and Histology of the Respiratory Tract and Lungs
Properties of Ventilation and Pulmonary Function Tests
Oxygen and Carbon Dioxide exchange and circulation

Urinary
Structure and Function of the kidney
Glomerular Filtration and Tubular Section & Reabsorption
Renin-Angiotensin Aldosterone Pathway
Function of Vasopressin (ADH) and Atrial Natriuretic Peptide
Structure and Function of the Ureter, Bladder, and Urethra

Reproductive
Meiosis and Gamete Production
Structure and Function of the Male & Female Reproductive System
Fertilization and Pregnancy
Chemistry

Math basics
Algebra – Dimensional analysis – Metric system – Scientific notation – Significant digits

Nature of Science
Accuracy and precision
Bias and Ethics
Communication
Data collection and analysis
Models
Pseudo Sciences
Safety
Science and Society
Scientific Method
Scientific Quantities
Scientific Thinking
Scientists and Discoveries
Theories and Laws
Tools and Measurement
Graphical interpretations
Basic laboratory equipment identification

Atoms, Molecules, and Compounds
Matter
Atoms
Molecules
Compounds
Mixture
Homogeneous and Heterogeneous
Chemical and Physical Properties
Symbols
Ions
Polyatomic ions
Isotopes
Elements
Atomic Mass
Atomic Number
Mass Number
Periodic Table
Law of Definite Proportions
Creating compound based on their charges
Mole Concept
Molar Mass
Determining of a formula of a compound ionic and covalent
Nomenclature for ionic and covalent compounds including the rules for transition metals
Hydrates
Atmospheric Chemistry

Using Chemical Equations in Calculations
Density
Avogadro’s number
Conversions between atoms, molecules, moles, and masses
Percent composition
Balancing Chemical Equations
Classification of Reactions

Single Displacement (replacement) – Double displacement (replacement) – Decomposition – Synthesis (composition) – Combustion

Stoichiometry
Empirical formula
Molecular formula
Limiting Reagent

Gas Laws and Kinetic Theory

Kinetic-Molecular Theory
Pressure and equivalent units (ex. atm, psi, kPa, Pa, etc)
Volume and equivalent units (ex. mmHg, Torr, etc)
Temperature and equivalent units
STP
Maxwell-Boltzman Distribution
Graham's Law
Diffusion
Effusion
Boyle's Law
Charles’ Law
Guy-Lussac’s Law
Combined gas Law
Ideal Gas Law
Determine density and molar mass from ideal gas law
Dalton’s Law
Collecting gas over water and partial pressures
Avogadro’s Principle
Gas Mixtures and Partial Pressure
Kinetic Molecular Theory
Non-ideal Gases

Atomic and Molecular Structure

Atomic Theories
Atomic Structure
Octet Rule
Electron Configurations
Lewis Dot Structure
Periodic Trends
  Ionization energies
  Electron Affinity
  Electronegativity
  Ionic Size
  Atomic Size
  Reactivity
Chemical Bonding
  Ionic – Covalent – Hydrogen – Metallic
Valence electrons
Orbitals
Orbital Geometry
Molecular Geometry
VSEPR theory
Quantum Theory
Polarity
Dipole moment
Hybridization
Sigma bond
Pi Bond
Resonance structures

**Solids**
Crystalline Solids
Bragg’s Law
Unit cell
  
  **Simple – Face centered – Body centered – End-centered**

**Liquids and Changes of State**
Compressibility
Surface tension
Transition states

  Evaporation
  Evaporation
  Condensation
  Boiling
  Freezing
  Melting
  Fusion
  Sublimation
  Triple point
  Critical temperature
  Critical pressure

States of Matter
  Solids – Non-Newtonians – Liquids – Gases – Plasma

Phase Diagram
Kinetic Molecular Theory of Liquids

**Physical Chemistry**
  Colligative Properties of Solutions
  Enthalpy
  Hess’s Law

**Aqueous Solutions**
  Solution
  Solvent
  Solute
  Saturated
  Unsaturated
  Supersaturated
  Dilute
  Molarity
  Molality
  Normality
  Mole Fraction (X)
  Weight percent (wt%)
  Parts per million (ppm)

**Acids, Bases and Salts**
  Acid
  Base
  Salt
  Anion and Cation
Electrolyte
Non-electrolyte
Indicators
Neutralization
Dissociation
Conjugate acid
Conjugate base
Strong acids and bases
Weak acids and bases
Monoprotic
Polyprotic
Bronsted-Lowry Acid/Base
Lewis Acid/Base
pH and pOH
Hydrolysis

Kinetics
Chemical Reaction Rates
Rate Expressions
Reaction Mechanisms
Activation Energy

Chemical Equilibria
Le Chatelier Principle
The Equilibrium Constant
Equilibrium Calculations
Factors Affecting Equilibria
ICE Tables

Ionic Equilibrium: Acids and Bases
Lewis Concept
Strong Acids and Bases
Weak Acids and Bases
pKa and pKb
Hydrolysis

Aqueous Equilibria
Common Ion Effect and Buffer Solutions
Henderson-Hasselbach Equation
Titration
End Point
Equivalence point
Acid-Base Titration Curves
Acid-Base Indicators
The Solubility Product Ksp
Solubility and the Common Ion Effect
Solubility and Complex Ions

ReDox
Reduction – Oxidation – Oxidizing agent – Reducing agent – Oxidation numbers – Half reactions – Activity series

Chemical Thermodynamics
Heat of formation/reactions
Enthalpy
Spontaneity, Disorder and Entropy
Exothermic and Endothermic
Differentiate between heat and temperature
Calories vs calories
Specific heat capacity
Various temperature scales (Fahrenheit, Celsius, and Kelvin)
Entropy and the Second Law
Gibbs Free Energy
Equilibrium Constants

**Electrochemistry**
Electrochemical Cells and Potentials
Voltaic Cells at Nonstandard Conditions
Electrolytic Cells
Faraday’s Law

**Nuclear Chemistry**
Types of radiation
   - Alpha – Beta – Gamma
Radioactive Decay
Fission and Fusion
Nuclear equations
Half-life
Isotopes
Bohr equations
Rydberg equation
Energy relationship to wavelength, frequency and period
Heisenberg Uncertainty Principle
Electromagnetic Radiation
Sources of energy

**Basic Organic Chemistry**
Carbon groups
Polymers
Names and chemical composition of functional groups
Basic nomenclature of organic compounds
Alkanes – Alkenes – Alkynes
Saturated
Unsaturated
Cyclic hydrocarbons
Aromatic Hydrocarbons

**Biochemistry**
Proteins – Carbohydrates – Nucleic acids

**Lab techniques**
Synthesis of compounds (solid and gas)
Separation techniques
   - Precipitation
   - Filtration
   - Centrifugation
   - Distillation
   - Chromatography
Titration using indicators and meters
Spectrophotometry/calorimetry
Gravimetric Analysis
Organic Chemistry

Structure & Bonding
- Electron Configurations of Atoms
- Chemical Bonding & Valence
- Charge Distribution in Molecules
- The Shape of Molecules
- Isomers
- Analysis of Molecular Formulas
- Resonance
- Atomic and Molecular Orbitals

Intermolecular Forces
- Boiling & Melting Points
- Hydrogen Bonding
- Crystalline Solids
- Water Solubility

Functional Groups – Properties, Nomenclature, Synthesis, & Reactions of...
- Alkanes
- Alkenes
- Alkynes
- Alkyl halides
- Alcohols
- Aromatics
- Ketones
- Ethers
- Esters
- Carboxylic acids
- Amides
- Amines

Acids & Bases
- Arrhenius acids and bases
- Lowry-Brønsted Acids & Bases
- Lewis Acids and Bases
- Acid dissociation constants and pH
- Effect on acidity by...
  - Structure
  - Electronegativity effects
  - Hybridization effects
  - Resonance effects
  - Inductive effects

Stereochemistry
- Isomers
- Constitutional isomers
- Stereoisomers
- Chiral and achiral
- Enantiomers
- Optical activity
- R and S configurations
- Diastereomers
- Fischer projections
- Meso compounds
Nucleophilic Substitution, Elimination, and Addition reactions

Biochemicals – Structure & Function of...
  Carbohydrates
  Lipids
  Amino acids
  Proteins
  Enzymes
  Vitamins

Lab techniques
  Synthesis of compounds (solid and gas)
  Separation techniques
    Precipitation
    Filtration
    Centrifugation
    Distillation
    Chromatography
    Solubility
  Melting point determination
  Nuclear Magnetic Resonance (NMR) spectrometer operation and analysis
  Infrared (IR) spectrometer operation and analysis
  Gas chromatography and Mass Spectrometry (GC-MS) analysis
Physics – Algebra-based

Math basics
- Algebra and Trigonometry
- Dimensional analysis
- Metric system
- Scientific notation
- Significant digits
- Vectors and scalars
  - Addition using graphical methods
  - Addition using algebraic methods
  - Components of vectors
  - Equilibriants

Nature of Science
- Accuracy and precision
- Bias and Ethics
- Communication
- Data collection and analysis
- Models
- Pseudo Sciences
- Safety
- Science and Society
- Scientific Method
- Scientific Quantities
- Scientific Thinking
- Scientists and Discoveries
- Theories and Laws
- Tools and Measurement

Kinematics
- Position, Distance, and Displacement
- Speed and velocity
- Acceleration
- Position vs time graphs
- Velocity vs time graphs
- Kinetic equations under constant acceleration
- Free fall equations
- Projectiles
- Circular motion
- Center of mass

Dynamics
- Newton’s Laws
  - Static equilibrium (1st Law)
    - Translational equilibrium
    - Rotational equilibrium (torque)
  - Free Body Diagram
  - Dynamics of a single body (2nd law) -- Force
  - Systems of two or more bodies (3rd law)
- Weight and weightless
  - Universal Gravitation
  - Gravitational Fields
  - Orbits
  - Kepler’s Laws of Planetary Motion
Static and kinetic friction
Air resistance
Elevator problems
Incline planes
Atwood Machines
Circular motion and rotation
  Uniform circular motion
  Circular speed
  Centripetal Force
  Frequency and Period
  Vertical Circular motion
  Rotational Kinematics
  Moment of inertia
  Rotational Kinetic Energy

Work, energy and power
  Work and work-kinetic energy theorem
  Conservative forces and Potential energy
    Gravity – Springs
Conservation of mechanical energy
Power
Simple Harmonic motion
  Springs and Hooke’s Law
  Pendulums
  Energies of SHM
  Graphs of SHM
  Spring-mass system
Momentum
  Momentum definition
  Impulse
  Impulse-Momentum Theorem
  Non-constant force
  Conservation of linear momentum and collisions
    Inelastic and elastic collisions
    Two dimensional collisions
Angular momentum
  Conservation of angular momentum
Sources of energy on Earth
Fluid Mechanics
  Density and Pressure
    Density
    Specific gravity
    Pressure as a function of depth
    Pascal’s Law
  Buoyancy – Archimedes’ Principle
Fluid dynamics
  Fluid Flow continuity equation
  Bernoulli’s Equation
  Hydrostatics
  Fluid Pressure
Thermal Physics
  Heat
Temperature
Mechanical Equivalent of heat
Heat Transfer and thermal expansion
  Linear expansion of solids
  Volume expansion of solids and liquids
Calorimetry
Kinetic Theory
Ideal Gases
Gas laws
Thermodynamics
  Processes and PV diagrams
    Isothermal – Isobaric – Isometric -- Adiabatic – Cyclic
  Zeroth law of Thermodynamics
  First law of Thermodynamics
    Internal energy – Energy conservation – Molar heat capacity of a gas
  Second law of Thermodynamics
    Directions and processes
    Entropy
  Third Law of Thermodynamics
  Heat engines and Carnot engines
  Refrigerators
  Rms speed of gas molecules
  Avogadro’s number and Boltzmann’s constant

Electrostatics
  Electric charges
  Conductors, insulators and semi-conductors
  Charging by conduction
  Charging by induction
  Coulomb’s Law
  Electric fields
  Gauss’ Law
  Electric Potential Energy and Electric Potential
  Motion of charges particles in electric fields
  Capacitance
    Graphical description of capacitance (charge vs. voltage)
      Slope – capacitance
      Area – energy storage
    Capacitors in series and parallel
    Point charge distribution
    Parallel plates
    Cathode Ray tubes
    Millikan Oil Drop Experiment
    Condensers

Current Electricity
  EMF
  Circuits
  AC/DC
  Current
  Resistance
  Electric Power
  Electric Energy
  Resistors in series
Resistors in Parallel
Batteries and Internal Resistance
Kirkoff's Law
Ohm's Law
Voltmeters
Ammeters
RC circuits

**Electromagnetism**
- Force of a magnetic field on a moving charge
- Force of a magnetic field on a current carrying wire
- Torque on a current carrying loop
- Magnetic fields due to straight and coiled wires
- Electromagnetic Induction
- Magnetic flux
- Faraday's Law
- Lens's Law
- Motors
- Mass Spectrometers
- Generators

**Wave Motion and Sound**
- Description and characteristics of waves
- Types of waves
- Standing waves
- Beats
- Harmonics
- Wave on a string
- Wave in a tube
- Doppler Effect
- Sound intensity
- Sound Power
- Relative sound intensity

**Optics**
- Reflection
- Law of reflection
- Refraction
- Snell's Law
- Total Internal reflection
- Critical angle
- Images formed by plane mirrors
- Images formed by spherical mirrors
- Images formed by parabolic mirrors
- Images formed by lenses
- Ray-diagrams
- Thin lens
- Mirror equation
- Image formation by a two-lens system
- Interference
  - Superposition Principle
  - Double slit interference
  - Thin Film
  - Newton's Ring
Non-reflective coating for glass
Diffraction
  Single slit
  Superposition of double slit
  Diffraction gratings
  Interference and Diffraction patterns
Polarization
The electromagnetic spectrum
Inverse square law

**Modern Physics**
Atomic Physics and Quantum Effects
  Photons and photoelectric effect
  Energy and linear momentum of photons
  X-ray production
  Electron energy levels
    Ionization energy
    Emission spectrum
    Absorption spectrum
    Lasers
    Continual spectrum
  Compton Effect
  Wave nature of matter
  DeBroglie equation
  DeBroglie Hypothesis: Davisson-Germer experiment

**Nuclear Physics**
Atomic mass
Mass number
Atomic number
Mass defect and binding energy
Nuclear processed
  Modes of radioactive decay (alpha, beta, gamma)
  Fission
  Fusion
Mass-energy equivalence
Conservation of energy-mass
Nuclear symbols
Nuclear reactions
Neutrino
Chain reactions
Isotopes
States of matter
Atomic Models
Physics – Calculus-based

This subject covers the material from AP Physics C-Mechanics, AP Physics C-Electricity and Magnetism, and introductory college level physics courses that require calculus as a prerequisite.

Math Basics
- Algebra, trigonometry and calculus
- Dimensional analysis
- Units and unit conversions
  - The metric system
- Scientific notation
- Estimates and orders of magnitudes
- Significant figures
- Vectors and scalars
  - Addition using graphical methods
  - Addition using algebraic methods
  - Components of vectors
  - Unit vectors
  - Equilibrants
- Cross product
- Dot product
- Derivatives
- Integrals

Nature of Science
- Accuracy and precision
- Data collection via observation and measurement and the analysis of this data
- Error analysis
- Experimental design
- Models
- Scientific method
- Tools and measurement
- Communicating scientific results

Newtonian Mechanics

Kinematics (Motion Along a Straight Line)
- Position, distance, and displacement
- Average and instantaneous velocity
  - Difference between velocity and speed
- Average and instantaneous acceleration
- Position vs time graphs
- Velocity vs time graphs
- Acceleration vs time graphs
- Differential determination of position, velocity and acceleration as a function of time
- Kinematic equations under constant acceleration

Dynamics
- Newton’s Laws of Motion
  - Static equilibrium (1st Law)
    - Translational equilibrium
  - Free Body Diagram
  - Dynamics of a single body (2nd law) – Force
    - Write differential equation for velocity as a function of time
    - Method of separation of variables to derive the equation for velocity as a function of time
    - Expression of acceleration as a function of time while under the influence of drag
  - Systems of two or more bodies (3rd law)
Mass and weight
Fundamental forces of nature
Static and kinetic friction
Air resistance
Elevator problems
Incline planes
Atwood Machines
Dynamics of circular motion
  Centripetal force

**Work, energy and power**

Work and the work-kinetic energy theorem
Integrate to calculate the work performed by a varying force
Conservative forces and potential energy
  - Gravitational potential energy
  - Elastic potential energy (springs)
Non-conservative forces
Conservation of mechanical energy
Energy diagrams
Power

**Systems of particles, linear momentum, impulse and collisions**

Center of mass
  - Symmetrical object
Two object system
  Integration to determine for a thin rod of non-uniform density
  Linear momentum concerns
Momentum
  - Momentum definition
  - Impulse
  - Impulse-Momentum Theorem
  - Non-constant force
  - Conservation of linear momentum and collisions
    - Inelastic and elastic collisions
    - Two dimensional collisions

**Rocket Propulsion**

**Circular Motion and Rotations**

Uniform circular motion
Angular velocity and acceleration
Frequency and period
Vertical circular motion
Rotational kinematics
Moment of inertia
Rotational inertia
Parallel axis theorem
Rotational kinetic energy
Work and power in rotational motion
Torque
Torque and angular acceleration for a rigid object
Rotation of a rigid object around a fixed axis
  - Angular momentum
    - Conservation of angular momentum
    - Gyroscopes and precession

**Equilibrium and Elasticity**
Rotational equilibrium (torque)
Conditions for static equilibrium
Center of gravity
Stress, strain, and elastic moduli
Elasticity

**Fluid Mechanics**
Density and Pressure
  - Density
  - Specific gravity
  - Pressure as a function of depth
  - Pascal’s Law
Buoyancy – Archimedes’ Principle
Fluid dynamics
Fluid Flow continuity equation
Bernoulli’s Equation
Hydrostatics
Fluid Pressure
Viscosity and Turbulence

**Gravitation**
Universal Gravitation
Gravitational Fields
Orbits
Kepler’s Laws of Planetary Motion
The Motion of satellites
Apparent Weight
Oscillatory Motion
  - Springs and Hooke’s Law
  - Pendulums
  - Energies of simple harmonic motion
  - Graphs of simple harmonic motion
  - Spring-mass system
  - Resonance and sinusoidal external force
  - Damped oscillations
  - Parallel combinations of identical or differing lengths of springs
  - Torsional pendulum

**Thermal Physics**
Heat
Temperature
Mechanical Equivalent of heat
Heat Transfer and thermal expansion
  - Linear expansion of solids
  - Volume expansion of solids and liquids
Calorimetry
Kinetic Theory
Ideal Gases
Gas laws
Thermodynamics
  - Processes and PV diagrams
    - Isothermal
    - Isobaric
    - Isometric
    - Adiabatic
Cyclic

Zeroth law of Thermodynamics
First law of Thermodynamics
  Internal energy
  Energy conservation
  Molar heat capacity of a gas
Second law of Thermodynamics
  Directions and processes
  Entropy
Third Law of Thermodynamics
Heat engines and Carnot engines
Refrigerators
Rms speed of gas molecules
Avogadro’s number and Boltzmann’s constant

Electricity and Magnetism

Electrostatics
  Electric charges
  Conductors, insulators and semiconductors
  Charging by conduction
  Charging by induction
  Coulomb’s Law
  Electric fields
  Electric Field Lines
  Electric Dipoles
  Electric Flux
  Gauss’s Law
  Electric Potential Energy and Electric Potential
  Potentials of charge distributions

Conductors, Capacitors and Dielectrics
  Electrostatics with conductors
  Equipotential surfaces
  Capacitance
  Graphical description of capacitance (charge vs. voltage)
    Slope – capacitance
    Area – energy storage
  Capacitors in series and parallel
  Point charge distribution
  Parallel plates
  Cathode Ray tubes
  Millikan Oil Drop Experiment
  Condensers
  Voltage, charge and stored energy in a capacitor
  Cylindrical vs. Spherical capacitors

Dielectrics

Current and Resistance
  Current
  Resistivity
  Resistance

Direct Current Electric Circuits
  EMF
  Electric Power
  Electric Energy
Resistors in series
Resistors in Parallel
Batteries and Internal Resistance
Kirchhoff’s Law
Ohm’s Law
Voltmeters
Ammeters
RC circuits

**Magnetic Fields**
- Sources of magnetic fields
- Right-hand rule
- Left-hand rule
- Force of a magnetic field on a moving charge
- Force of a magnetic field on a current carrying wire
- Torque on a current carrying loop
- Magnetic fields due to straight and coiled wires
- Biot-Savart Law
- Ampère’s Law

**Electromagnetism**
- Motion of charged particles in electric and magnetic fields
- Electromagnetic induction
- Magnetic flux
- Inductance
- RL circuits
- LC circuits
- LRC circuits
- Faraday’s Law
- Lenz’s Law
- Alternating current circuits
  - Phasors and alternating currents
  - RMS voltages and currents
  - Resistance and reactance
  - AC LRC circuits
  - Power in AC circuits
  - Resonance in AC circuits
- Displacement current
- Maxwell’s equations
- Motors
- Mass spectrometers
- Generators
- Transformer

**Wave, Motion, and Sound**
- Description and characteristics of waves
- Types of waves
- Standing waves
- Beats
- Harmonics
- Wave on a string
- Wave in a tube
- Doppler Effect
- Sound intensity
Sound Power
Relative sound intensity

**Optics**

**Nature and Propagation of Light**
- Reflection
- Law of reflection
- Refraction
- Snell’s Law
- Total internal reflection
- Critical angle

**Geometric Optics**
- Images formed by plane mirrors
- Images formed by spherical mirrors
- Images formed by parabolic mirrors
- Images formed by lenses
- Ray-diagrams (Geometric Optics)
- Thin lens
- Mirror equation
- Image formation by a two-lens system

**Physical Optics**
- Interference
- Superposition principle
- Double slit interference
- Thin film
- Newton’s ring
- Non-reflective coating for glass

**Diffraction**
- Single slit
- Superposition of double slit
- Diffraction gratings
- Interference and diffraction patterns

**Huygen’s Principle**

**Polarization**

**The electromagnetic spectrum**

**Inverse square law**

**Modern Physics**

**Quantum Mechanics and the nature of light**

**Relativity**
- Frames of reference
- Time dilation
- Length Contraction
- Relativistic momentum
- Rest mass energy

**Atomic physics and quantum effects**
- Photons and photoelectric effect
- Energy and linear momentum of photons
- X-ray production

**Electron energy levels**
- Ionization energy
- Emission spectrum
- Absorption spectrum
- Lasers
Continuum spectrum

Compton Effect
Wave nature of matter
DeBroglie equation
DeBroglie Hypothesis: Davisson-Germer experiment

Nuclear physics
Atomic mass
Mass number
Atomic number
Mass defect and binding energy
Nuclear processed
   Modes of radioactive decay (alpha, beta, gamma)
Fission
Fusion

Mass-energy equivalence
Conservation of energy-mass
Nuclear symbols
Nuclear reactions
Neutrino
Chain reactions
Isotopes
States of matter
Atomic models
The microbiology course is considered an advanced science course. It is expected that tutors are knowledgeable in foundational biological, chemical and mathematical concepts as they underlie and relate to microbiology.

**Basic Biology**
- Eukaryotes
- Prokaryotes
- Cellular division of eukaryotic and prokaryotic cells
- Functional anatomy of various cells
- Whitaker Five Kingdoms
- Woese Three Domain clarification

**Microbial Traits**
- Types
  - Bacteria
  - Algae
  - Fungi
  - Protists
  - Helminthes
  - Viruses
  - Viroids
  - Prions
  - Archaea

- Nutrition
- Growth
- Control in various environments
  - Acidic
  - Basic
  - High temperature
  - Low temperature
  - Saline
  - Nutrient rich and nutrient poor

- Structure
- Metabolism
- Pathways
- Catabolism
- Anabolism
- Gram positive bacteria anatomy
  - Low G + C gram positives
  - High G + C gram positives
- Gram negative bacteria anatomy
  - Deinococci
  - Nonproteobacteria

- Biochemistry processes
- Recombinant DNA technology
  - Vectors
  - PCR
  - Restriction enzymes
  - Gene cloning
- Taxonomy and classification (Bergey)
Cytology
Cellular physiology

**Genetics**
Structure
Replication
Expression
Mechanisms of variation
Mapping of distances in genes
Lac operon
Lac repressor
Trp operon
Arabinose operon
Genetic recombination
Transformation
Conjugation
Transduction

**Ecology**
Biogeochemical cycling
  - Carbon cycle
  - Nitrogen cycle
  - Oxygen cycle
  - Phosphorous cycle
  - Sulfur cycle
  - Water cycle
  - Mercury cycle
  - Atrazine cycle
Microorganisms in marine and freshwater ecosystems
Microorganisms in terrestrial ecosystems
Symbiosis
Mutualism
Commensalism
Parasitism

**Pathogenicity**
Germ Theory
Infection and reproduction
Host and parasite relationship
Infectious disease
Disease transmission
Nosocomial infections
Mechanisms of pathogenicity
Antimicrobial drugs
Important pathogens and diseases
  - Respiratory system
  - Cardiovascular system
  - Lymphatic system
  - Nervous system
  - Gastrointestinal system
  - Endocrine system
  - Urinary and reproductive systems
  - Integument system and eyes
  - Immune system
Sterilization
Disinfection

**Immunization**
- Innate host resistance
- Adaptive Immunity
- Sanitation
- Hygiene

**Health**
- Epidemiology
- Antimicrobial chemotherapy
- Microbiology of food
- Industrial microbiology

**Laboratory Techniques**
- Basic laboratory equipment identification
- Guidelines for safe handling of microorganisms and infectious materials
- Microscope use including oil emersion
- Methods for taking clinical samples
- Incubation techniques
- Inoculation techniques
- Isolation techniques
- Identification techniques
  - Gram stain
  - ELISA
- Chromatography
- Spectrophotometry
- Serial dilution technique and calculations
Nursing Medical Surgical Fundamentals

Tutors must be knowledgeable about the fundamentals of nursing including nursing roles, settings, health care trends, all body systems and their disorders, emergency and disaster management, and mental health nursing. In particular, tutors should be familiar with nursing care in all of the following areas:

- Role of the medical-surgical nurse
- Nursing practice and interventions
- Health and nursing assessments
- Diagnostic testing and evaluation

Care of clients in the following areas:
- Pain Management
- Altered fluid electrolyte or acid-base balance
- Trauma and shock
- Pre- and post surgery
- Infections
- Altered immunity
- Cancer
- Loss, grief and death
- Problems with substance abuse
- Maternal-Child Health (OB)
- Pediatrics
- Psychiatric Nursing

Nursing Care Plans

Tutors must be familiar with all aspects of the creation of nursing care plans including:

- Assessment
- Nursing diagnosis
- Outcomes and Interventions
- Creating the Nursing Care Plan
- Documentation
- Implementation of the Nursing Care Plan
- Evaluation of the Nursing Care Plan

Nursing Pathophysiology:

Tutors must be knowledgeable of the following systems and associated disorders:

- Cardiovascular system
- Circulatory system
- Renal system
- Respiratory system
- Nervous system
- Gastrointestinal system
- Endocrine system
- Reproductive system
- Musculoskeletal system
- Integumentary system
- Cell and body tissue physiology
- Fluid and electrolyte balances
- Genetic and hereditary disorders
- Inflammation, infection and immune response systems
- Oncological diseases
Nursing Pharmacology

Nursing process in drug therapy
Pharmacologic principles
Principles and practices of administration of medication
Drug calculations
Dosage calculations
Legal and ethical requirements in drug therapy
Life span of pharmaceuticals
Gene therapy and pharmacogenetics
Medication error response and prevention

Essential knowledge of the following drug types:

- Analgesic drugs
- General and local anesthetics
- Depressants and muscle relaxants
- Stimulants and related drugs
- Antiepileptic drugs
- Psychotherapeutic drugs
- Antiparkinsonian drugs
- Adrenergic drugs
- Cholinergic drugs
- Heart failure drugs
- Antidyssrhythmic drugs
- Antianginal drugs
- Antihypertensive drugs
- Diuretic drugs
- Coagulation modifier drugs
- Antilipemic drugs
- Pituitary drugs
- Thyroid and antithyroid drugs
- Adrenal drugs
- Women’s health drugs
- Men’s Health drugs
- Antihistamines, decongestants and antitussives
- Bronchodilators and other respiratory drugs
- Antibiotics
- Antiviral drugs
- Antitubercular drugs
- Antifungal drugs
- Antimalarial, antiprotozoal, antihelmintic drugs
- Anti-inflammatory and antigout drugs
- Immunosuppressants
- Immunizing drugs
- Antineoplastic drugs
- Biologic response drugs
- Acid controlling drugs
- Bowel disorder drugs
- Antiemetic and antinausea drugs
- Anemia drugs
- Dermatologic drugs
- Ophthalmic and otic drugs
Hormones that regulate calcium and bone metabolism
Drugs used in oncologic disorders
OTC drugs, herbal and dietary supplements
Social Studies

Elementary (Grades 4-6)

- Africa
- American Historical Figures
- American Revolution
- China
- Citizenship
- Civil Rights
- Civil War
- Colonial Settlements in America
- Communities
- East Asia and Pacific
- Egypt
- Elections
- Europe
- Family and Authority
- French and Indian War
- Geography
- Government
- Greece
- Holidays and Diversity
- India
- Japan
- Latin America
- Louisiana Purchase
- Mesopotamia
- Middle East
- Native American Culture
- Religions of the World
- Rome
- Slavery in America
- South and Southeast Asia
- The Bill of Rights
- The Constitution
- The Declaration of Independence
- The Incas
- The Mayans
- Trade
- War of 1812
- Westward Expansion
- World Cultures
Social Studies
Middle Grades (Grades 7-8)

- Africa
- American Revolution
- Articles of Confederation
- Byzantine Empire
- Central and South America
- China
- Civil Rights
- Civil War
- Colonial Settlements in America
- Demographic Concepts
- Early American government and political systems
- Economics
- European History
- Exploration
- French and Indian War
- Geography
- India
- Japan
- Louisiana Purchase
- Mapping
- Middle East
- Monroe Doctrine
- Native Americans
- North America
- Religions of the World
- Slavery in America
- The Bill of Rights
- The Constitution
- The Declaration of Independence
- The Physical Environment
- War of 1812
- Westward Expansion
Social Studies
High School (Grades 9-12)

Africa
American Revolution
Ancient Civilizations
Articles of Confederation
Asia
Civil War
Cold War
Colonial Settlements in America
Contemporary World Events
Declaration of Independence
Early American Government and Political Systems
Economics
European History
Geography
Gulf War
Industrialism
Korean War
Latin America
Louisiana Purchase
Middle East
Native Americans
Prehistoric America
Reconstruction
Slavery in America
Soviet Union and Eastern Europe
The Bill of Rights
The Constitution
The Monroe Doctrine
Vietnam War
War of 1812
Westward Expansion
World War 1
World War 2
English

Elementary (Grades 4-6)

Adjectives
Adverbs
Antonyms
Contractions
Fiction
Grammar
Letter Writing
 Literary Analysis
 Literary Device
 Literary Themes
 Non-Fiction
 Nouns
 Paragraphs
 Parts of Speech
 Phonemes
 Plays and Theater
 Poetry
 Presentations
 Pronouns
 Punctuation and Capitalization
 Reading Comprehension
 Research Skills
 Sentence Structure
 Synonyms
 Verbs
 Vocabulary
 Writing Sentences
English

Middle Grades (Grades 7-8)

- American Literature
- Characterization
- Grammar
- Literary Analysis
- Literary Criticism
- Literary Devices
- Literary Themes
- Narrative
- Plays and Theater
- Point of View
- Prose and Poetry
- Punctuation and Capitalization
- Reading Comprehension
- Research Skills - Sources and Documentation
- Sentence Structure
- Setting
- Structural Elements of Plot
- Theme
- Vocabulary
- World Literature
English
High School (Grades 9-12)
  American Literature
  Grammar
  Literary Analysis
  Literary Criticism
  Literary Devices
  Literary Periods
  Literary Themes
  Plays and Theater
  Prose and Poetry
  Punctuation and Capitalization
  Reading Comprehension
  Research Skills - Sources and Documentation
  Vocabulary
  World Literature
Essay Writing

- Business Writing
- Citation and Documentation
- College and Job Application Writing
- Cover Letter Writing
- Creative Writing
- Descriptive Essay
- Editing and Proofreading
- Elements of Composition
- Expository Essay
- Five Paragraph Essay
- Grammar
- Journal Writing
- Literary Analysis Writing
- Organization and Outlining Essays
- Paragraphs
- Persuasive Essay
- Poetry Writing
- Pre-writing Skills
- Punctuation and Capitalization
- Research Paper Writing
- Research Skills and Resources
- Resume Writing
- Speech Writing
- Story Writing
- Technical Writing
- Thesis Statements
- Topic Sentences
- Transitions
- Use of Literary Devices
- Vocabulary and Word Choice
- Voice
- Writing Conclusions
- Writing for Standardized Tests
- Writing Leads, Introductory Paragraphs, Conclusions
- Writing Research Papers
- Writing Sentences
- Writing Strategies
- Writing Styles
College Essay Writing

- Business Writing
- Citation and Documentation
- Citation and Effective Content Analysis
- College and Job Application Writing
- Cover Letter Writing
- Creative Writing
- Descriptive Essay
- Editing and Proofreading
- Elements of Composition
- Expository Essay
- Five Paragraph Essay
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- Vocabulary and Word Choice
- Voice
- Writing Conclusions
- Writing for Standardized Tests
- Writing Leads, Introductory Paragraphs, Conclusions
- Writing Research Papers
- Writing Sentences
- Writing Strategies
- Writing Styles
Literature

Literary Periods and Movements
- Medieval Literature
- Renaissance Literature
- The Enlightenment
- Romanticism
- Transcendentalism
- Victorian Literature
- Realism
- Naturalism
- Modernism
- Post Modernism
- Existentialism
- Post-Colonial Literature

Literary Criticism
- Formalism
- Historical Criticism and New Historicism
- Feminist and Gender Criticism
- Psychological/Sociological Criticism
- Reader Response Criticism
- Structuralism/ Deconstruction
- Mythological Criticism
- Marxist Criticism

Prose Nonfiction
- Essay
- Biography
- Creative Nonfiction

Dramatic Elements/Genres
- Drama: Tragedy / Comedy / Tragicomedy / Heroic
- Classical Drama
- Medieval Mystery/Miracle Plays
- Renaissance Theater
- Comedy of Manners/Farce/Satire
- World Drama Traditions

Prose Fiction
- Short stories
- Novellas
- Novels
- World Fiction Traditions
- Poetry
- Epic
- Elegy
- Ballad
- Lyric
- Sonnet Italian / English
- Prosody: Rhyme / Meter / Rhythm / Stanza
- World Poetry Traditions

Literary Elements
- Character Types / Development
- Plot Structure
- Theme
Narrative Point of View: First, Second, Third Person
Setting: Geographic, Historical, Socio-Economic
Versification

**Literary Devices**
- Symbolism/ Metaphor/ Simile
- Hyperbole and Synecdoche
- Allegory
- Irony: Verbal / Dramatic
- Figurative Language: Imagery
- Mimesis/ Metonymy
Symbolic Logic

Inferences and Arguments (Premises and Conclusions)
- Recognition of argument
- Validity
- Soundness
- Contingency
- Factual Statements
- Invalidity
- Form versus Content
- Statements and Propositions
- Deductive versus inductive logic
- Sentential logic
- Terms, predicates, variables, and pronouns
- Compound formals
- Necessary versus sufficient conditions
- Statement connectives
- Truth-functional derivations

Categorical Propositions
- Components of a Categorical Proposition
- Venn diagrams and the square of opposition
- Aristotelian versus Boolean logic

Categorical Syllogisms
- Standard form, mood and figure
- Venn diagrams applied to syllogisms
- Rules
- Fallacies of Relevance
- Fallacies of Ambiguity

Propositional Logic
- Symbols and translation
- Truth functions
- Truth tables
- Tautology, contradiction, contingency, and replacement
- Complex truth-functional formals
- If statements versus Only if statements
- Symbolizing the statement form

Natural deduction in propositional logic
- Rules of implication and replacement
- Proving logical truths
Predicate Logic
Symbols and translation
Change of Quantifier
Relational and Overlapping Quantifiers
Translations in monadic predicate logic
Translations in polyadic predicate logic
Complex predicates
Wide-scope quantifiers
Derivations in predicate logic
Symbolizing the statement form

Logic Truth Trees
Propositional Logic
Predicate Logic
Describe features of different genres of writing or poetry. Apply suitable analysis strategies.

- Fiction - narrative - identify features and analyze
- Fiction - mystery/suspense - identify features and analyze
- Poetry - identify features and analyze
- Nonfiction - informational - identify features and analyze
- Nonfiction - persuasive - identify features and analyze
- Biography - identify features and analyze
- Other

Identify main ideas and details, both explicit and implied, within a text.

- Main idea - explicitly stated
- Main idea - implied
- Locating details

Draw valid inferences from a written text and be able to identify supporting text evidence.

- Create valid inferences
- Locate text evidence to support an inferred claim

Correctly identify point of view (first person, second person, third, etc.) and analyze for potential bias within a text.

- First person point of view features and characteristics
- Second person point of view features and characteristics
- Third person point of view features and characteristics
- Omniscient and Limited Omniscient Points of View
- Reliable/Unreliable point of view narration

Identify text structures (cause and effect, chronological order, etc.) within a given text.

- Cause and Effect
- Problem solution
- Compare/Contrast
- Description
- Main idea and Details
- Chronological Order (Sequence)

Use an appropriate graphic organizer or other systematic approach (i.e. note-taking) to demonstrate conceptual understanding of a text.

- Venn Diagram
- Identify an Author's purpose for writing
- Alphanumeric/Structured outline format
- Timeline
- Concept Web
- T-chart
- Other

Draw valid generalizations from a given text.

- Create and/or identify valid generalizations from a text.
- Locate text evidence to support a generalization

Correctly establish facts from opinions within a text.

- Identify facts from a text
- Identify opinions from a text

Evaluate how graphic sources such as graphs, tables, charts, and other visual images increase understanding of a text.

- Analysis - graph, chart or table in a text
- Analysis - picture
- Other graphics in text context
Integrate main ideas and key details or events to create an effective summary of a text, passage, or book.

- Summarizing a passage
- Details in a summary
- Evaluate a given summary for completeness

**Evaluate word meaning within a passage context, or in isolation.**

- Vocabulary in isolation
- Vocabulary in context

**Assess an author's purpose, use of tone, and theme based on a given text.**

- Identify an Author's purpose for writing
- Identify tone of a given text
- Identify theme of a given text

**Evaluate reliability of sources, giving consideration to tone, mood or potential bias of the author.**

- Tone of text/effect on reliability
- Mood of text/effect on reliability
- Potential bias of author/effect on reliability

**Evaluate persuasive writing to determine if an argument is presented logically, clearly, and adequately to influence the reader.**

- Text features of persuasive writing
- Argument effectiveness

**Formulate connections between texts, compare and contrast two texts on related topics.**

- Text connections
- Compare/contrasts related texts

**Explain pre-reading activities that increase comprehension.**

- Justify pre-reading strategies
- Analyze effective pre-reading activities

**Utilize figurative language and textual elements to gain a better understanding of literature.**
Primary Reading

Comprehension
- Main idea and supporting details
- Synthesizing
- Summarizing
- Making predictions and inferences
- Questioning

Vocabulary and Word Recognition
- Root words and affixes
- Syllabication patterns
- Spelling patterns
- Context clues
- Phonemic awareness

Author’s Craft
- Tone and mood
- Figurative language
- Point of view
- Author’s purpose
- Theme
- Literary devices
- Types of genres

Text Structure
- Literary elements
- Cause and effect
- Problem / solution
- Compare and contrast
- Order and sequence
- Description
- Summarization

Understanding Features of Genres
- Poetry
- Fictional narratives
- Drama
- Informational texts
- Non-fiction
**ESL**

**English Language Use**
- Word form
- Verbs followed by gerunds or infinitives
- Verb tense formation and uses
- Time expressions
- Tag questions
- Subjunctive mood
- Subject-verb agreement
- Relative clauses
- Pronouns
- Prepositions
- Phrase usage: Neither, nor, such, so
- Phrasal verbs
- Passive causatives
- Passive and active voice
- Parts of a sentence
- Participial adjectives
- Modal verbs
- Irregular verb forms
- Indirect speech
- Countable and non-countable nouns
- Conditionals
- Comparisons
- Articles
- Sentence Diagramming
- Vocabulary--finding meaning in context
- Vocabulary--dictionary definitions, appropriate usage, collocations, word families, and connotations
- Using dictionaries

**English Writing**
- Conventions of standard written English syntax
- Inversion
- Linking words and text organizers
- Parallel structure
- Prewriting--Brainstorming, outlining
- Finishing the writing process--revising & editing
- Avoiding Plagiarism
- Using sources--credibility, citation, synthesizing info
- Introductions and thesis statements
- Conclusions
- Paragraph construction (topic sentence, body, concluding sentence)

**Types of Writing**
- Critical Response
- Synthesis
- Argumentative
- Analysis
- Compare/contrast
- Narrative
- Descriptive
- Opinion
- Process

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Summary/paraphrase
Research Papers

**Speaking**
- Presentations
- Daily communication—giving directions, giving advice, etc.
- Pronunciation—Stress and intonation patterns
- Pronunciation—Phonetic (International Phonetic Alphabet) transcription
- Pronunciation—Identification of cause of pronunciation errors

**Listening**
- Note taking
- Processing academic discourse (lectures, presentations, videos, etc.)
- Identifying main ideas vs. details
- Visual Organizers (Venn diagrams, concept maps, etc.)
- Predicting

**Reading**
- Note taking
- Reading and processing academic texts
- Identifying main ideas vs. details
- Visual Organizers (Venn diagrams, concept maps, etc.)
- Skimming/scanning
- Predicting
Use of English
   Articles
   Comparisons and Superlatives
   Conditionals
   Countable and non-countable nouns
   Determiners
   Indirect speech
   Irregular verb forms
   Modal verbs
   Participial adjectives
   Parts of a sentence
   Passive and active voice
   Passive causatives
   Phrasal verbs
   Phrase usage: Neither, nor, such, so
   Prepositions
   Question formation
   Relative clauses
   Subject-verb agreement
   Tag questions
   Time expressions
   Uses of gerunds and infinitives
   Using dictionaries
   Verb tense formation and uses
   Vocabulary: definitions, usage, collocations, word families, and connotations.
   Vocabulary--finding meaning in context
   Word form/Morphology

English Writing
   Conventions of standard written English syntax
   Linking words and text organizers
   Essay structure and development
   Parallel structure
   Word order

Speaking
   Daily communication--giving directions, giving advice, etc.
   Differences between English pronunciation and spelling
   Presentations
   Pronunciation - Phonics as used in Primary ESL
   Pronunciation: Identification of cause of pronunciation errors
   Pronunciation: Phonetic (International Phonetic Alphabet) transcription
   Pronunciation: Stress and intonation patterns

Listening
   Identifying main ideas vs. details
   Listening comprehension strategies (scaffolding, note taking, predicting, etc)
   Processing contextual audio (lectures, presentations, videos, etc.)
   Visual Organizers (Venn diagrams, concept maps, etc.)

Reading
   Analysis of figurative language
   Identifying main ideas vs. details
Reading comprehension strategies (note taking, predicting, skimming, etc)
Visual Organizers (Venn diagrams, picture-walks, concept maps, etc)

**Pedagogy of ESL**
Error correction strategies (response-repetition, prompting, recasting, integration, metalinguistic information, etc).
Concept of communicative competence
Differences among languages (phonology, morphology, syntax, and semantics)
Literacy learning strategies
Accounting

Financial Reporting and Accounting Cycle
- Accrual vs. cash accounting
- Worksheets and t-accounts
- Adjusting Entries
- Financial Statement Preparation (including direct/indirect statement of cash flows)
- Closing Entries

Accounting for Service and Merchandising Companies
- Journal Entries
- Multi-step income statements
- Perpetual vs. periodic
- LIFO, FIFO, & weighted average
- Accounting for uncollectible accounts (allowance method vs. direct write off method)

Internal Controls & Cash
- Bank reconciliations
- Petty cash

Accounting for Property, Plant, and Equipment
- Entries for PPE purchases
- Entries for PPE sales/disposal
- Depreciation (straight-line, double-declining-balance, units-of-production)

Accounting for Partnerships
- Forming a partnership
- Income allocation
- Partner admission/withdrawal
- Partnership liquidation

Accounting for Corporations
- Entries for stock
- Entries for dividends
- Stock splits
- Financial ratio analysis
- Treasury stock

Accounting for Investments
- Accounting for investments in stocks (purchase, sale, equity method, fair value method, etc.)
- Accounting for investments in bonds

Bonds Payable
- Accounting for bonds
- TVM Analysis for bonds
- Amortization & amortization tables

Payroll and Taxes
- Accounting for taxes
- Accounting for payroll

Managerial Accounting
- Job order costing
- Process costing
- Activity-based costing
- Cost-volume-profit analysis
- Variable vs. absorption costing
- Budgets

Planning, control, and performance evaluation
Differential analysis
Capital investment decisions
Economics

Intro Microeconomics

Comparative Advantage
  - Opportunity Cost
  - Production Possibilities Curve

Supply and Demand
  - Market Equilibrium
  - Income effect and substitution effect
  - Price ceilings and floors

Elasticity
  - Price Elasticity of Demand
  - Income Elasticity and Cross-Price Elasticity of Demand
  - Price Elasticity of Supply
  - Taxes

Demand
  - Marginal Utility
  - Consumer Surplus

Perfectly Competitive Supply
  - Short-Run Costs
  - Long-Run Costs
  - Profit maximization
  - Producer Surplus

Monopoly, Oligopoly, and Monopolistic Competition
  - Market power
  - Economies of Scale
  - Monopoly Marginal Revenue
  - Price Discrimination
  - Regulation

Game Theory
  - Nash Equilibrium
  - Prisoner's Dilemma
  - Cartels

Market Failure
  - Efficiency
  - Adverse Selection
  - Moral Hazard
  - Externalities
  - Coase Theorem
  - Tragedy of the Commons

Intro Macroeconomics

Comparative Advantage
  - Production Possibilities Curve
  - Specialization
  - International Trade
  - Exchange Rates

Supply and Demand
  - Market Equilibrium
GDP and Unemployment
- National Income Measures
- Measuring GDP
- Nominal vs. Real GDP
- Measuring Unemployment Rate

Price Level and Inflation
- Consumer Price Index
- Adjusting for Inflation
- True Costs of Inflation
- Aggregate Demand

Economic Growth and Productivity
- Business Cycles
- Labor Productivity
- Capital
- Human Capital
- Technology

Labor and Wages
- Real Wages
- Demand for Labor
- Supply of Labor

Saving and Capital Formation
- Real Interest Rate
- Stocks and Flows
- National Saving
- Fiscal Policy
- Investment

Money and Prices
- Money Supply
- Federal Reserve System
- Monetary Policy
- Interest Rates
- Velocity
Finance

Role and objective of financial management
Review of the four basic financial statements
Analysis of financial statements and financial performance
Markets and Financial Institutions
Stock and Bond Valuation
Time Value of Money
Techniques of Analysis (cash flow valuation; capital budgeting and risk analysis)

Financial Choices of Firms

Distributions to shareholders
Dividends and share repurchases/treasury stock
Managing current assets/working capital
Financing current assets/managing current liabilities

The Financial Environment

Markets, institutions, interest rates, and taxes
Risk and rates of return
Bonds and their valuation
Stocks and their valuation
Cost of capital
Capital budgeting, including cash flow estimation, decision criteria, and risk analysis
Capital structure and leverage
Distributions to shareholders
Dividends and share repurchases/treasury stock
Managing current assets/working capital
Financing current assets/managing current liabilities
Financial planning, budgeting, and forecasting.
Intermediate Accounting

Accounting Cycle, Income Statement, Balance Sheet
- Accrual vs cash
- Adjusting entries
- Extraordinary items
- Financial statement presentation and disclosures

Statement of Cash Flows
- Indirect method of cash flows
- Direct method of cash flows
- Investing & financing cash flows

Time value of money
- PV and FV of lump sum
- PV and FV of annuities
- Deferred annuities

Revenue recognition issues
- General criteria for recognizing revenue
- Long term contracts
- Installment sales
- Multi-component contracts

Revenue, Receivables and Cash Cycle
- Sales adjustments (discounts, returns, allowances)
- Notes receivable
- Sale of receivables
- Cash equivalents
- Estimating uncollectible accounts & net realizable value

Inventory & Cost of Goods Sold
- Perpetual vs periodic systems
- Inventory valuation methods
- Lower of cost or market
- Special issues: in transit, consignment, purchase adjustments

Noncurrent operating assets
- Establishing asset cost
- Valuation of assets and impairment
- Depreciation and amortization methods
- Retirement, sale or exchange of assets

Debt
- Short term liabilities
- Bond pricing
- Bond issues and retirements

Equity
- Issuance of capital stock
- Treasury stock transactions
- Cash and stock dividends
- Accounting for share-based compensation

Investment in Debt & Equity Securities
- Classification of investment securities
- Recognition of revenue from investment securities
- Accounting for the change in value of securities
- Sale of securities

Leases
Lease classification criteria
Accounting for capital leases
Accounting for operating leases

**Income Taxes**
Computation of deferred assets and liabilities
Carryback and carryforward of operating losses

**Earnings Per Share**
Basic EPS
Diluted EPS

**Pensions**

**Contingencies**

**Accounting Changes and Error Corrections**
Changes in accounting principle
Changes in accounting estimate
Error corrections
Intermediate Economics

Macroeconomics
- RBC, Keynesian, New Keynesian, and Fischer Models
- Equilibrium in Endowment and Production Economies
- Consumption, Savings, Capital and Investment
- GDP and National Accounts
- IS-LM/AS-AD Model & Framework
- Output and Employment
- Uncertainty and Expectations
- Unemployment Modeling
- Fiscal Policy
- Money and Inflation

Microeconomics
- Consumer Theory
  - Preferences, Utility, Choice (Revealed Preference)
  - The Slutsky Equation
  - Compensating Variation
  - Budget Constraints
  - Demand
  - Consumer Surplus
- Theory of the Firm
  - Technology and Production Functions
  - Profit Maximization (Profit Function, Cost Minimization)
- Market Theory
  - Industry Supply under perfect competition
  - Monopoly/Oligopoly Behavior
  - Price Discrimination, Market Power, Tariffs
  - General Equilibrium and Efficiency
  - Externalities, Public Good
  - Market Failures and Corrections
- Game Theory
  - Game Theory Application
  - Monopoly and Oligopoly: Cournot and Stackleberg
  - Nash Equilibrium, Mixed Strategies
  - Sequential Games: Subgame Perfection
  - Adverse Selection, Bayesian Equilibrium, Signaling Equilibria
  - Moral Hazard: Insurance, Wages
Business Law

Foundations of Law
- Criminal vs. Civil Law
- Substantive vs. Procedural Law
- Sources of Law
- Administrative Law & Regulation
- Consumer Protection Laws
- Anti-Trust Regulations
- Unfair Trade Practices
- Employment Law & Labor Relations
- Professional Liability and Accountability
- Environmental Law

Dispute Settlement
- Means of Dispute Settlement
- State and Federal Court Organization
- Alternative Dispute Resolution
- Court Procedure
- Criminal Concerns
- Intentional Torts
- Liability

Contracts & E-Contracts
- Elements of Contracts
- Offer & Acceptance (Agreement)
- Consideration
- Form and Meaning
- Capacity
- Consent, Mistakes, Fraud, Undue influence & Duress
- Statute of Frauds & Writing Requirement
- Third Party Rights
- Performance and Discharge
- Breach & Remedies

Sales & Lease Contract Formation
- Uniform Commercial Code (UCC)
- Title
- Risk
- Insurable Interest
- Performance, Breach and Remedies
- Warranties & Limitations
- Products Liability

Agency and Employment
- Agency Formation and Duties
- Agency Rights and Remedies
- Agency Liability and Termination
- Employment at Will
- Employment Discrimination
- Employment & Immigration

Business Organization
- Partnerships
- Hybrid Business Forms
- Corporations Formation
- Management of Corporations

Property
Personal Property vs. Real Property
Landlord-Tenant Relationships
Zoning & Government Regulations
Estates and Trusts
Insurance Terms, Concepts & Types
Intellectual Property

**Commercial Paper**
- Negotiable Instruments Definition
- Transferability & Holder in Due Course
- Liability of Parties
- Checks and Electronic Fund Transfers
- E-money & Online Banking

**Creditor Rights**
- Creditor Rights and Remedies
- Debtor Protections
- Surety & Guarantees
- Bankruptcy Concepts
- Mortgage and Foreclosure
Principles of Management

History and Theories of Management
  Scientific Management
  Organizational Developments
  Sociotechnical Theory
  Hierarchy of Needs
  Five disciplines of the Learning Organization

The Role of Customer Relations
  Building customer relationships
  Promotions, Pricing & Credit
  Environmentalism (burdens and potentials)
  Psychological & Sociological influences

Professional Management & Managing Growth
  Managing Human Resources
  Managing Operations
  Managing Risk
  Leadership & Authority
  Time management

Entrepreneurial Opportunities
  Small Businesses Concepts

Ethics in Business
  Integrity framework
  Supporting Organizational Culture

Business Analysis
  SWOT
  Internal & External (outside-in analysis & inside-out analysis)

The Business Plan
  Function of and formatting plan
  Main types of plans

Employee Relations & Leadership
  Roles in motivation
  Specifying structure and creating balance

Legal forms of Organizations
  Sole proprietorship, partnerships, C corp, LLC, etc.

Financial Planning
  Income statement
  Balance sheet
  Cash Flow statement
  Financial forecasting
  Debt & Equity

Product & Supply Chain Management
  Product lifecycle
  Branding, labeling, strategies
Psychology

History and Research
Approaches/schools of psychology
  Biological approach
  Structuralism
  Functionalism
  Gestalt
  Freud & psychoanalysis
  Behaviorism
  Cognitive revolution
Research approaches:
  Experimental approach (scientific method)
  Correlational research
  Clinical research
Ethics in research, clinical and applied psychology

Biopsychology
Physiological research techniques
Nervous system – functional organization
Neurons, electrical and chemical signaling
Neuroanatomy
Endocrine system
Animal models in psychology, evolution
Genetics
Neuroplasticity

Sensation and Perception
Sensory systems & receptors
  Vision
  Audition
  Olfaction
  Gustatory
  Tactile
  Proprioception
Attention
Perceptual processes
Psychophysical mechanisms
  Adaptation
  Threshold
  Signal detection

Consciousness
Sleep and dreaming
Meditation
Psychoactive drugs and consciousness

Conditioning and Learning
Biological (neural) basis for learning
Classical conditioning
Operant conditioning
Observational learning
Cognitive processes in learning
Constructivism
Social learning
Implicit learning
Cognition
Memory
  Working memory
  Memory storage and retrieval
  Long & short term memory
  Semantic/episodic
  Implicit/explicit
  Forgetting
  Memory errors
Language
  Development
  Speech
  Reading
Thinking
  Concepts
  Categories
Problem solving
  Decision making
  Analogical problem solving
  Creativity
  Insight
Intelligence
  IQ
  Intelligence testing
  General/specific intelligences
  Cultural impact
Motivation, emotion
  Biological basis
  Emotion and the brain
  Hunger
  Thirst
  Sex
  Pain
Social motivation
  Theories of emotion
  Stress
Developmental
  Types of development
    Physical
    Cognitive
    Social
    Moral
  Gender, sex, and sexuality
  Heredity and environment
  Lifespan: prenatal through geriatric
  Developmental research methods
    Longitudinal
    Cross-sectional
Personality
  Assessment: measuring personality
  Theories of personality
Type
Trait
Behaviorist
Biopsychological
Psychodynamic
Humanistic
Social cognitive
Self-concept and self-esteem

Psychological disorders
Defining “normality” and “abnormality”
Anxiety disorders
Dissociative disorders
Mood disorders
Neurocognitive disorders
Personality disorders
Psychoses
Somatoform disorders
Health, stress, coping

Treatment
Psychological therapies
Behavioral
Cognitive
Humanistic
Group
Psychodynamic
Medical therapies, psychopharmacology
Community psychology

Social psychology
Aggression & antisocial behavior
Attitudes, attitude change
Attribution processes
Conformity, compliance & obedience
Group dynamics
Interpersonal perception
Cultural influences

Statistics, tests, measurement
Descriptive & inferential statistics (definitions)
Measurement, operational definitions
Reliability and validity
Samples, populations, standardization & norms
Research Methods

Scientific Method
- Cause and effect
- Research hypotheses
- Testability

Developing research ideas
- Defining and using constructs
- Theories, models, and hypotheses
- Pilot research

Literature searches
- Conducting a literature search
- Evaluating quality of sources
- Peer review
- Reading journal articles

Research ethics
- Belmont report
- Deception
- Institutional Review Boards and human-subjects research
- Animal Care and Use Committees and non-human subjects

Bias
- Experimenter bias
- Participant bias
- Research and Culture

Sampling
- Populations and samples
- Probability sampling methods
- Nonprobability sampling
- Sampling Error

Validity and Reliability
- Internal validity
- External validity
- Threats to validity
- Measurement
- Inter-rater reliability

Non-Experimental & Quasi-Experimental Research
- Correlational studies
- Pre-Post, time-series, and longitudinal designs
- Quasi-independent variables
- Ex Post Facto research
- Survey construction and administration
- Likert scale questions
- Tests, Inventories, and self-report

Qualitative research
- Naturalistic observation
- Case study
- Focus groups
- Coding and categorizing

Small-N and single-subject designs
- Phases and phase changes
- Reversal designs
- Multiple baseline designs
- Evaluating single-subject research
Quantitative research and Experimental Design
- Independent variables
- Dependent variables and measurement choices
- Control
- Counterbalancing
- Extraneous variables
- Confounding variables
- Group selection
- One factor, two or more groups
- Factorial designs
- Interaction
- Sample size and power

Evaluating Research
- Hypothesis testing
- Appropriate statistical tests for experimental design
- Interpreting statistical results
- Effect size
- Drawing conclusions
- Generalizability
- Causality

Tutors should be familiar with parametric and nonparametric hypothesis tests included in the College Statistics subject.
Introduction to Sociology

History and Theory
- Purpose of Sociology
- Sociological Imagination
- Structural Functionalism
- Conflict Theory
- Symbolic Interactionism
- Social Exchange Theory
- Ethnomethodology
- Individual and Society
- Social Context of Time, Place, and Location
- Macro- and Micro- Approaches

Theories of Self
- Socialization and the Self
- Looking Glass
- “I” and “Me”
- Dramaturgy
- Status
- Role Conflict, Strain, Performance, and Expectation
- Emotions

Culture and Society
- Norms, Customs, Traditions, Values, Symbols, and Language
- Ethnocentrism
- Cultural Relativism
- Group Behavior
- Power
- Authority
- Leadership

Social Class
- Class Systems
- Inequality
- Income and Wealth
- Subcultures
- Labor Market
- Division of Labor
- Economic Systems
- Privilege and Oppression
- Social Mobility

Deviance and Social Control
- Deviance
- Labelling
- Misdemeanor and Felony
- Group Dynamics
- Criminal Justice
- Punishment
- Social Control
- Stigma

Race/Ethnicity
- Common Culture
- Shared Experience
- Divisions
- Inequalities
Dominant Group
Minority Group(s)
Discrimination
Prejudice
Racism
Homogeneity and Heterogeneity

**Gender/Sex**
- Biological Traits
- Gender Norms
- Gender Orders
- Masculinity/Femininity
- Personal Identity
- Feminism
- Heterosexism

**Sexuality**
- Sexual Attraction
- Relationship with Sex and Gender
- Non-binary sexuality
- Sexual Harrasment
- Homophobia

**Social Institutions and the Family**
- Education
- Schooling and Social Class
- Types of Families
- Nuclear/Extended
- Types of Marriage
- Religion
- Protestant Work Ethic
- Religious Organization - Denominations, Cult, Church, Sect
- Types of Politics
- Capitalism, Socialism, and Communism
- Demography
- Deindustrialization
- Migration
- Health
- Morbidity and Mortality

**Social Change**
- Social Change and Dilemmas
- Threat to Social Order
- Group Reluctance
- Social Change and Movements

**Research Methods**
- Qualitative Methods
- Quantitative Methods
- Mixed Methods
- Independent and Dependent Variables
- Mean/Median/Mode
- Sample
- Hypothesis
Proficiency with Excel 2010 required, preferably older versions as well.

**Environment & Capabilities**
- File Tab
- Excel Options – including finding and customizing
- Templates – including finding and implementing
- Add-Ins – including finding and installing

**Toolbars**
- Ribbon – including identification, usage, customization, etc.
- Quick Access Toolbar – including identification, usage, customization, etc.
- Custom Tabs – including creation and arrangement of custom tabs, custom groups, etc.
- Formula Bar and Name Box

**Spreadsheet Basics**
- Rows and Columns
- Ranges – including selecting, naming, finding, using named ranges, etc.
- Views – including page layout, page break, custom, etc.
- Entering Data
- Printing
- Worksheet Management – including inserting, deleting, hiding, unhiding, moving, copying, etc.
- Panes and Page Breaks
- Headers and Footers – inserting, using templates, customizing, etc.
- Keyboard Shortcuts

**Formatting**
- Formatting Cells, Worksheets, Workbooks
- Format Painter
- Paste Special
- Conditional Formatting – including built-in styles and formula-based styles

**Filtering & Sorting**
- Filters – including implementing, using, customizing, etc.
- Sorting – including basic and custom sorts

**Formulas & Functions**
- Entering Formulas – including basic formula syntax, etc.
- Using Functions – including commonly used functions, using function helper, etc.
- Evaluating Formulas and Function Results – including tracing formulas/precedents, error checking, etc.
- Interpreting and Troubleshooting Formulas and Functions
- Calculation Operations – including manual vs. automatic

**Charts, Tables, & PivotTables**
- Creating, Using, and Formatting Charts
- Creating, Using, and Formatting Tables
- Creating, Using, and Formatting PivotTables
- Smart Art and Illustrations
- Sparklines

**Importing & Exporting**
- Importing and Exporting Data/Documents
- Importing and Exporting Pictures
- Picture Editing

**Macros**
- Recording Macros
- Running Macros

**Saving, Sharing & Protecting**
- Auto-Save – including default settings and customizing
Recovery
File Types (e.g., .xls, .xlsx, .xlsm, etc.)
Sharing and Protecting Worksheets and Workbooks
Evaluating Changes in Shared Documents
MS Word

Proficiency with Word 2010 required, preferably older versions as well.

Program Fundamentals
- Giving Commands in Word
- Using Command Shortcuts
- Creating, Opening, Previewing, Printing, Saving, and Closing a Document
- Using Help

Getting Started with Documents
- Entering, Deleting, Selecting, and Replacing Text
- Navigating, Browsing, and Viewing a Document
- Working with the Document Window and Viewing Multiple Document Windows

Working With and Editing Text
- Checking Spelling and Grammar
- Finding and Replacing Text
- Using Word Count and the Thesaurus
- Inserting Symbols and Special Characters
- Copying and Moving Text
- Collecting Multiple Items to Move or Copy
- Using Undo, Redo, and Repeat

Formatting Characters and Paragraphs
- Changing Font Type, Size, Color, Highlighting, Styles, and Effects
- Applying Spacing and Ligatures
- Creating Lists
- Changing Paragraph Alignment, Paragraph Spacing, and Line Spacing
- Adding Paragraph Borders and Shading
- Copying Formatting
- Setting, Adjusting, and Removing Tab Stops
- Using Left and Right Indents, and First Line and Hanging Indents

Formatting the Page
- Adjusting Margins, Page Orientation, and Size
- Using Columns, Page Breaks, Section Breaks, Line Numbers, and Hyphenations
- Working with the Page Background
- Rearranging, Numbering, and Viewing an Outline
- Rearranging and Navigating Long Documents
- Using Headers, Footers, Bookmarks, Cross-references, Footnotes, Endnotes, Citations, and Bibliographies
- Working with Picture Captions
- Adding a Table of Contents, Index, Cover Page, and Page Numbers

Working with Themes and Styles
- Creating, Modifying, Applying, and Deleting a Style
- Working with the Styles Gallery
- Creating a New Quick Style Set
- Selecting, Removing, and Printing Styles
- Comparing and Cleaning Up Styles
- Applying Document Themes
- Creating and Saving New Theme Colors and Fonts

Working with Shapes and Pictures
- Inserting and Formatting Clip Art, Screenshots, Pictures, Text Boxes, Shapes, and Graphics Files
- Removing a Picture’s Background
- Formatting and Otherwise Altering the Look of Pictures and Graphics
- Resizing, Moving, Copying, Positioning, Grouping, and Deleting Objects
- Applying Special Effects
Aligning, Distributing, Flipping, Rotating, and Layering Objects

**Working with WordArt, SmartArt, and Charts**
- Inserting, Editing, and Formatting WordArt
- Inserting and Formatting SmartArt
- Working with SmartArt Elements
- Inserting, Editing, and Formatting a Chart
- Working with Labels
- Using Chart Templates

**Working with Tables**
- Creating, Resizing, Moving, and Manipulating a Table
- Adjusting Table Alignment and Text Wrapping
- Working with Cell Formatting
- Merging and Splitting Cells and Tables
- Inserting and Deleting Rows and Columns
- Adjusting Row Height and Column Width
- Using Table Drawing Tools
- Working with Sorting and Formulas
- Working with Borders and Shading
- Using Table Styles and Table Style Options
- Converting or Deleting a Table
- Using Quick Tables

**Working with Mailings**
- Setting Up the Main Document for Mail Merge
- Creating and Editing a Data Source
- Selecting an Existing Data Source
- Inserting Merge and Rules Fields
- Previewing and Completing a Mail Merge
- Creating Labels and Envelopes

**Using Collaborative Editing Tools**
- Tracking, Accepting, and Rejecting Revisions
- Using Comments
- Comparing and Combining Documents
- Protecting a Document (with or without password)

**Working with Templates**
- Creating and using a Document Template
- Creating and Using Building Blocks and AutoText
- Attaching a Different Template to a Document
- Copying Styles between Documents and Templates

**Working with Forms**
- Creating a New Form
- Adding Content Controls
- Assigning Help to Form Content Controls
- Preparing the Form for Distribution
- Filling Out a Form

**Customizing Word**
- Customizing the Ribbon and Quick Access Toolbar
- Using and Customizing AutoCorrect
- Changing Word’s Default Options

**More Topics**
- Converting an Older Document to Word 2010
- Translating Text
- Publishing a Blog Entry
Using Hyperlinks
Viewing Document Properties and Finding a File
Recovering Your Documents
Managing Versions
Recording, Playing, and Deleting a Macro
MS PowerPoint

Explore advanced options
Customize the ribbon
Customize the quick access toolbar
Create/modify macros
Use different view options
Proofread your work
Create presenter notes
Set up a slideshow
Add animations
Utilize transitions
Create and utilize themes
Insert charts and graphs
Insert images
Group shapes and pictures
Create tables
Insert text options
Use audio & video in presentations
Work with watermarks
Create and print handouts
Add headers & footers
Create flowcharts
Use and create templates
Use drawing tools
Add, remove, and publish slides
Create layouts
Save and send options
Font options
Print options
Properties and Protect File

(Back to Technology)
NOTE: Computer Science tutors are expected to be familiar with all concepts on this list in addition to the language-specific list of the subject(s) they would like to tutor.

Object-Oriented Program Design
- Program design
- Read and understand a problem description, purpose, and goals
- Apply data abstraction and encapsulation.
- Read and understand class specifications and relationships among the classes ("is-a," "has-a" relationships).
- Understand and implement a given class hierarchy.
- Identify reusable components from existing code using classes and class libraries.
- Class design
- Design and implement a class.
- Choose appropriate data representation and algorithms.
- Apply functional decomposition.
- Extend a given class using inheritance.

Program Implementation
- Implementation techniques
  - Backtracking
  - Greedy algorithms
  - Divide and conquer
  - Modular programming
- Methodology
  - Object-oriented development
  - Top-down development
  - Encapsulation and information hiding
  - Procedural abstraction
  - Programming constructs
  - Primitive types vs. objects
  - Declaration
  - Constant declarations
  - Variable declarations
  - Class declarations
  - Interface declarations
  - Method declarations
  - Parameter declarations
  - Console output (System.out.print/println)
- Control
  - Methods
  - Sequential
  - Conditional
  - Iteration
  - Understand and evaluate recursive methods
- Java library classes
- C++ library classes

Program Analysis
- Testing
  - Test classes and libraries in isolation.
  - Identify boundary cases and generate appropriate test data.
  - Perform integration testing.
Debugging
Categorize errors: compile-time, run-time, logic.
Identify and correct errors.
Employ techniques such as using a debugger, adding extra output statements, or hand-tracing code.
Understand and modify existing code
Extend existing code using inheritance
Understand error handling
Understand runtime exceptions.
Reason about programs
Pre- and post-conditions
Assertions
Analysis of algorithms
Informal comparisons of running times
Exact calculation of statement execution counts
Basic big-O questions
Numerical representations and limits
Representations of numbers in different bases
Limitations of finite representations (e.g., integer bounds, imprecision of floating-point representations, and round-off error)

Standard Data Structures
Simple data types (int, boolean, double)
Classes
Lists
Arrays
Sets and Multisets
Stacks
Dictionaries
Queues
Trees, binary trees, and binary search trees

Standard Algorithms
Operations on data structures previously listed
Traversals
Insertions
Deletions
Searching
Sequential
Binary
Bubble Sort
Selection Sort
Insertion Sort
Mergesort

Computing in Context
System reliability
Privacy
Legal issues and intellectual property
Social and ethical ramifications of computer use
Software Methodology
NOTE: Computer Science tutors wishing to tutor C++ are expected to be familiar with all concepts on this list \textit{in addition to} the Computer Science Principles list.

- Namespaces
- Functions
- \textbf{Control Structures}
  - Conditional (if, if else, else, switch statements)
  - Iteration (for, while, do-while loops)
  - Break and continue
- \textbf{Input/Output}
  - Standard (iostream)
  - File I/O (fstream)
- \textbf{Strings}
- \textbf{Pointers}
- \textbf{Exception Handling}
  - Try/Catch blocks
  - Throw statement
- \textbf{Arrays}
- \textbf{Classes and Structs}
- \textbf{Operator Overloading}
- \textbf{Parameters}
  - Call by reference vs Call by value
- \textbf{Inheritance}
NOTE: Computer Science tutors wishing to tutor Java are expected to be familiar with all concepts on this list in addition to the Computer Science Principles list.

**Primitive Data Types**
- Integers
- Floating Point Types
  - Characters
  - Boolean

**Literals**

**Variables**
- Variable Scope
- Initializing Variables

**Operators**

**Type Casting and Conversion**

**Control Statements**
- For loops
- While Loops
- If-Else Statements
- Switch Statements

**Classes**
- Constructors
- Class Definitions
- Object Instantiation

**Methods**
- Using Parameters
- Method Overloading
- Returning Values

**Arrays**
- Multidimensional Arrays
- Irregular Arrays

**Strings**
- Constructing Strings
- Operating on Strings

**Bitwise Operators**

**Static Keyword**

**File I/O**

**Inheritance and Polymorphism**
- Superclasses and Subclasses
- Abstract Classes
- Method Overriding

**Packages and Interfaces**
- Packages and Member Access
- Implementing Interfaces

**Exception Handling**
- Using Try-Catch-Finally
- The Exception Hierarchy

**Enumerations**

**Generics Fundamentals**
Python

**NOTE:** Computer Science tutors wishing to tutor Python are expected to be familiar with all concepts on this list *in addition to* the Computer Science Principles list.

- Lists
- Control Flow and Looping (while/for, use of the range() function instead of traditional for loop)
- Tuples (relation to lists, unpacking)
- List/Dictionary/Generator comprehensions
- “Dunder” methods (__init__, __plus__, etc)
- Variadic arguments (*args)
- Keyword arguments (**kwargs)
- List slices
- Generators (yield)
- Lambda functions
- Dictionaries
- Functions (including map, filter, reduce)
- Files
Internet Fundamentals
- Layers of the Internet (application, transport, etc.)
- URL
- Pathway
- FTP and File Management
- Protocols (HTTP, HTTPS)

HTML
- Basic XML
- HTML Structure
- Lists
- Classes and IDs
- Tables
- Linking Resources
- Special Tags
- Div and Span
- Forms

CSS
- Selectors
- Alignment
- Element Position
- Padding and Margins
- Content Decoration
- Variables
- Layout
- Multiple Browser Support

Fundamental Javascript
- Basic programming concepts (functions, loops, etc.)
- DOM
- Events

PHP
- Variables, including PHP Reserved Variables
- Control Structures
- Functions
- Mixing HTML and PHP
- Handling Input (e.g. GET, POST, PUT, DELETE)
- REGEX for PHP
- php.ini

Accessibility
- Web Accessibility Standards
- Presentation of content
- Operable and understandable user interfaces
- Different web browsers and devices like mobile
Database Systems

Database Design
   Primary Keys and Foreign Keys
   Indexes
   Views
   Creation of ERD
   1NF, 2NF and 3NF

CRUD Statements
   INSERT Statement
   SELECT Distinct Statement
   SELECT TOP statement
   UPDATE Statement
   DELETE Statement

Advanced Queries
   Designing Advanced queries
   Query optimization
   Common Table Elements
   Joins

Filtering Query Output
   WHERE Statement
   ORDER BY Statement
   Applying logical filters

Hosting Databases
   Connection Strings
   Database IP
   IOPS Limits and Storage limits
   Monitor Database Health

Remote Database Access
   Designing a client application
   Result Sets
   Designing a Report

Database Management Systems
   SQL Server
   Oracle
   MS Access
Spanish

Basic Sentence Structure
- Gender & Number of Nouns
- Definite Articles
- Indefinite Articles
- Noun-Adjective Agreement
- Negation (& Double Negatives)
- Contractions Al / Del
- Questions and Exclamations

Advanced Sentence Structure
- Direct and Indirect Object Pronouns
- Relative Pronouns & Adjectives
- Possessive Pronouns
- Superlatives
- Demonstratives
- Comparisons of Quantity and Number
- The Personal “a”
- Por vs. Para
- Pero / Sino / Sino Que

Basic Verb Forms
- Present Indicative
- Stem Changing Verbs
- Gustar Type Verbs
- Irregular 1st Person Verbs ("go, zco, jo, oy, eo "verbs)
- Present Progressive
- Ser vs. Estar
- Saber vs. Conocer

Intermediate Verb Forms
- Preterit (Definite Past)
- Imperfect (Undefined Past)
- Reflexive Verbs
- Conditional Tense
- Future Tense
- Irregular Preterit Verbs

Advanced Verb Forms
- Subjunctive Tenses & Conditions
- Perfect Tenses
- Past Participles
- Formal Commands
- Informal (tú) Commands
- Negative Commands

Idiomatic Expressions
- Acabar de
- Hay / Hay que
- Hace... (To indicate time that has passed)
- Valer la Pena

Basic Vocabulary Units
- Ordinal Numbers
- Telling Time
- Expressions for Weather
Sports & Recreation
Science & Technology
Animals
Home Decor and Furnishings
Food & Kitchen
School & Office
Family Expressions & Relationships
Clothing
Medical Care & Human Physiology
Feelings & Emotions
Travel (Train & Air)
Customary Greetings & Protocol
French

Basic Sentence Structure
Gender & Number of Nouns

Vocabulary (including but not limited to...)
Numbers and time
Greetings, letter writing, speaking on the phone
Food and drink
Marketplace
Clothing
Education and careers
Personal relationships, friends, family
Emotions
Hobbies, sports, leisure, travel
Animals, plants, scenery, weather
Body parts, illnesses, basic medical terms
Residences, rooms, furniture
Government, public institutions, infrastructure, news
French/English faux amis
Common French idioms

Grammar and Style
Verb conjugations, tenses, and moods
Indicative present and imperative
Passé compose, including which verbs take avoir and être
Imperfect (imparfait), including when to use it instead of passé composé
Literary use of passé simple
Indicative future
Conditional present and past
Pluperfect (plus-que-parfait)
Subjunctive present and past, including when to use subjunctive instead of indicative
Past participle (e.g. mangé) and present participle (e.g. mangeant)

Pronouns
Subject pronouns (je, tu, il...)
Direct object pronouns (me, te, le...)
Indirect object pronouns (me, te, lui...)
Stressed pronouns (moi, toi, lui...)
Possessive pronouns (le mien, le tien...)
Demonstrative pronouns (celui, celle...)
Relative pronouns (que, qui, lequel...)
y and en
Order of pronouns in sentence

Determiners
Definite articles (le, la, les)
Indefinite articles (un, une, des)
Partitive articles (du, de la)
Possessive articles (mon, ton, son...)
Demonstrative articles (ce, cette, ces)

Other grammatical components
Adjectives, including comparative and superlative adjectives (e.g. meilleur)
Adjective placement relative to noun
Adverbs, including comparative and superlative adverbs (e.g. bien, mieux)
Prepositions
Sentence structures
   Negation
   Interrogative sentences
   Passive voice
   Conditional constructions
   Compound and complex sentences with independent and dependent clauses

**Literature (including but not limited to...)**
   Louise Labé
   Jean-Jacques Rousseau
   Guy de Maupassant
   Paul Verlaine
   Jules Verne
   Victor Hugo
   Albert Camus

**Pronunciation and Phonetics**
   Describe how French vowels and certain French consonants differ from their English counterparts
   Identify silent consonants and vowels
   Identify and pronounce nasalized vowels
   Use *liaison* and *enchaînement* to enhance euphony
   Describe how stress functions in words and sentences
   Describe how pronunciation and stress differ in poetry

**French History and Culture**
   Basic history of France, from Roman Gaul to modern times
   Basic geography of France, French territories, and other French-speaking nations
   French education system
   Present-day government of France
   French holidays and customs
German

Adjectives
- Adjective Endings
- Comparative & Superlative
- Definite & Indefinite Articles
  - Der- & ein-Words
- Extended Adjective Modifiers
- Present & Past Participles

Adverbs
- Expressions of Time
- Negation

Conjunctions
- Coordinating Conjunctions
- Subordinating Conjunctions
- Main and Subordinate Clauses

Nouns
- Appositives
- Case: Nominative, Accusative, Dative, & Genitive
- Gender

Prepositions
- Accusative, Dative, Genitive, & Two-way
d- & wo-compounds
- Idiomatic Use of Prepositions

Pronouns
- Personal, Interrogative, Demonstrative, Indefinite, Possessive, Relative, & Reflexive

Punctuation
- Comma Rules

Verbs
- Conjugation
- Imperative
- Indirect Discourse & Subjunctive I
- Infinitival Constructions (um...zu, (an)statt...zu, ohne...zu)
- Modal Verbs
- Passive Voice, Statal Passive, Alternatives to Passive
- Regular & Irregular Verbs
- Subjunctive II
- Tense: Present, Present Perfect, Simple Past, Past Perfect, Future & Future Perfect
- Verbs with Separable & Inseparable Prefixes

Word Order
Italian

Basic Sentence Structure
  Italian alphabet, special characteristics
  Regular verbs
  Greetings
  Common salutations
  Expressing opinions
  Masculine versus feminine nouns
  Pronouns

Numbers/currency
  Date
  Time

Weather/seasons

Action verbs
  Direction, travel

Culinary, food

Advances sentence structure
  Irregular verbs
  Direct pronouns
  Indirect-object pronouns
  Reflexive verbs
  Adjectives
  Using prepositions
  Imperfect subjunctive
  Il congiuntivo trapassato
  Il congiuntivo passato
  Il congiuntivo futuro
  Modal verbs
  Articulated prepositions
  Double object pronouns
  Future perfect
  Words with dual meaning
  Adverb
  Negative statements
  Conosce/Sapere
  Prepositions

Anatomy/Medical/Dental
  Body parts
  Symptoms
  Study of

Italian lifestyle
  Culture
  Politics
  Current affairs
  Business
  Professional writing
  Culinary, food