## Basic Concepts List

**for All Available Subjects**

### Math

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sub-Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Math</td>
<td>Mid-level Math</td>
</tr>
<tr>
<td>Algebra II</td>
<td>Geometry</td>
</tr>
<tr>
<td>Pre-Calculus</td>
<td>Calculus</td>
</tr>
<tr>
<td>Discrete Math</td>
<td>Finite Math</td>
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<tr>
<td>Intermediate Statistics</td>
<td>Trigonometry</td>
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<tr>
<td></td>
<td>Calculus BC</td>
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<tr>
<td></td>
<td>Statistics</td>
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</tbody>
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### Science

<table>
<thead>
<tr>
<th>Subject</th>
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<tbody>
<tr>
<td>Elementary Science</td>
<td>Biology</td>
</tr>
<tr>
<td>Earth Science</td>
<td>Anatomy &amp; Physiology</td>
</tr>
<tr>
<td>Physics – Algebra Based</td>
<td>Physiology – Calculus Based</td>
</tr>
<tr>
<td>Nursing</td>
<td>Chemistry</td>
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<tr>
<td></td>
<td>Organic Chemistry</td>
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<tr>
<td></td>
<td>Microbiology</td>
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</tbody>
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### Humanities

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Social Studies</td>
<td>English</td>
</tr>
<tr>
<td>College Essay Writing</td>
<td>Literature</td>
</tr>
<tr>
<td>Primary Reading</td>
<td>ESL</td>
</tr>
<tr>
<td>Symbolic Logic</td>
<td>Essay Writing</td>
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<tr>
<td></td>
<td>Reading</td>
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<td></td>
<td>Primary ESL</td>
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### Social Sciences

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<tr>
<th>Subject</th>
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</tr>
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<tbody>
<tr>
<td>Introduction to Psychology</td>
<td>Research Methods</td>
</tr>
<tr>
<td></td>
<td>Introduction to Sociology</td>
</tr>
</tbody>
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### Business

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<th>Subject</th>
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<tbody>
<tr>
<td>Introductory Accounting</td>
<td>Introductory Economics</td>
</tr>
<tr>
<td>Intermediate Accounting</td>
<td>Intermediate Economics</td>
</tr>
<tr>
<td>Principles of Management</td>
<td>Finance</td>
</tr>
<tr>
<td></td>
<td>Business Law</td>
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</tbody>
</table>

### Technology

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<tbody>
<tr>
<td>MS Excel</td>
<td>MS Word</td>
</tr>
<tr>
<td>Principles of Computer Sci.</td>
<td>C++</td>
</tr>
<tr>
<td>Python</td>
<td>Visual Basic</td>
</tr>
<tr>
<td></td>
<td>MS PowerPoint</td>
</tr>
<tr>
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<td>Java</td>
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### Foreign Languages

<table>
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<tbody>
<tr>
<td>French</td>
<td>German</td>
</tr>
<tr>
<td>Spanish</td>
<td>Italian</td>
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</table>
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
  z Complex Number

Introduction to Trigonometry: Linear Relationships and Functions
  Introduction to Trigonometry
  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
- Riemanns 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
Transcendentals and 1/x
Derivatives of Logarithms and Exponentials
L’Hospital’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.
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
Biology

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 Semipermeability
- 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
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
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
Microbiology

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
- Antidyshrhythmic 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
- Ophthaminic 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
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
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
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
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
Primary ESL

Use of English
- Articles
- Comparisons and Superlatives
- Conditionals
- Countable and non-countable nouns
- Determiners
- Indirect speech
- Irregular verb forms
- Modal verbs
- Participle 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

Commerical 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, .xslm, etc.)
Sharing and Protecting Worksheets and Workbooks
Evaluating Changes in Shared Documents
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**

- Apply and change advanced options
- Customizing the ribbon
- Customizing the quick access toolbar
- Creating/using macros
- Using different view options
- Proofreading options
- Creating presenter notes
- Setting up a slideshow
- Adding animations
- Utilizing transitions
- Using & creating themes
- Inserting charts & graphs
- Inserting images
- Grouping shapes and pictures
- Creating tables
- Inserting text options
- Using audio & video in presentations
- Working with watermarks
- Creating and printing handouts
- Adding headers & footers
- Flowchart creation
- Using and creating templates
- Using drawing tools
- Adding, removing, publishing slides
- Creating layouts
- Save & send options
- Font options
- Print options
- Properties and Protecting File
**Principles of Computer Science**

**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 in addition to the Computer Science Principles list.

Namespaces
Functions
Control Structures
  Conditional (if, if else, else, switch statements)
  Iteration (for, while, do-while loops)
  Break and continue
Input/Output
  Standard (iostream)
  File I/O (fstream)
Strings
Pointers
Exception Handling
  Try/Catch blocks
  Throw statement
Arrays
Classes and Structs
Operator Overloading
Parameters
  Call by reference vs Call by value
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**
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
Visual Basic

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

- VB GUI Controls (text boxes, group boxes, check boxes, radio buttons, buttons)
- Objects and events
- Variables, Constants, and Calculations
- Menus, Subroutines, Functions
- Decision and Conditions (if/then/else, and/or/not, select case...)
- List, Loops, and Printing
- Arrays
- Files
- Exception Handling/Trapping Errors
- Database Access (e.g. record sets)
- Modules and Classes
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, zo, 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 composé, 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
da- & 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