# Basic Concepts List
for All Available Subjects

## Math
- **Elementary Math**
- **Algebra II**
- **Pre-Calculus**
- **Multivariable Calculus**
- **Statistics**
- **Quantitative Methods**

- **Mid-level Math**
- **Geometry**
- **Calculus**
- **Discrete Math**
- **Intermediate Statistics**
- **Linear Algebra**

- **Algebra**
- **Trigonometry**
- **Calculus BC**
- **Finite Math**
- **Quantitative Reasoning**
- **Ordinary Differential Equations**

## Science
- **Elementary Science**
- **Chemistry**
- **Anatomy & Physiology**
- **Health Administration**

- **Earth Science**
- **Physics – Algebra Based**
- **Microbiology**
- **Nursing**

- **Biology**
- **Physics – Calculus Based**
- **Organic Chemistry**
- **Nursing RN (Pediatrics)**

## Humanities
- **Social Studies**
- **Essay Writing**
- **Reading**
- **Symbolic Logic**

- **English**
- **College Essay Writing**
- **Primary ESL**

- **Literature**
- **Primary Reading**
- **ESL**

## Social Sciences
- **Introduction to Psychology**
- **Research Methods**
- **Introduction to Sociology**

## Business
- **Introductory Accounting**
- **Intermediate Accounting**
- **Introductory Economics**

- **Finance**

- **Principles of Management**

## Technology
- **MS Access**
- **MS Excel**
- **MS Word**
- **MS PowerPoint**
- **Windows**

- **C++**
- **Java**
- **Python**
- **Web Design**

## Foreign Languages
- **French**
- **German**
- **Italian**
- **Spanish**
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
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
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
Trigonometry

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

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

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

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

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

Vectors
   Graphing and Operations with Vectors
   Solving problems with Vectors
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

**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
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
- Trigonometric graphs
- Perform translations for various conic sections
- Law of Cosines and Law of Sines
- Arithmetic and Geometric sequences
- Functions and Graphs (Linear and Polynomial)
- Trigonometric Ratios and Identities
- 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'Hopital's Rule
- Analysis of Transcendental Curves
- Integrating Transcendental Functions
- Partial Fractions
- Integration by Parts
- Improper Integrals
- Application of Transcendental Integrals
- Derivatives of Transcendental 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
Multivariable Calculus

Vectors & Geometry of Space in Multiple Dimensions
- Two Dimensional Coordinate Systems
- Three Dimensional Coordinate Systems
- Vectors
- Cylindrical Coordinates
- Spherical Coordinates
- The Dot Product
- The Cross Product
- Equations of Lines and Planes
- Cylinders and Quadric Surfaces
- Functions of Several Variables

Vector Functions
- Vector Functions and Space Curves
- Derivatives of Vector Functions
- Integrals of Vector Functions
- Tangent, Normal, and Binormal Vectors
- Arc Length and Curvature
- Motion: Position, Velocity, and Acceleration

Multivariable Differentiation
- Limits and Continuity
- Partial Derivatives
- Differentials
- Chain Rule
- Tangent Planes and Linear Approximations
- The Gradient Vector Operator and Directional Derivative
- Critical Points: Relative and Absolute Extrema
- Lagrange Multipliers

Multivariable Integration
- Double Integrals over General Regions
- Double Integrals in Polar Coordinates
- Applications of Double Integrals
- Triple Integrals
- Triple Integrals in Cylindrical and Spherical Coordinates
- Applications of Triple Integrals
- Change of Variables: Jacobian of a Transformation

Vector Calculus: Line Integrals
- Vector Fields
- Line Integrals
- The Fundamental Theorem For Line Integrals
- Conservative Vector Fields
- Potential Functions of Vector Fields
- Green’s Theorem
- The Divergence and Curl Vector Operators

Vector Calculus: Surface Integrals
- Parametric Surfaces and Area
- Surface Integrals
- Stokes' Theorem
- Gauss' Divergence Theorem
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.
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
Quantitative Reasoning

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

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

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

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

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

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

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

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

Inference & Regression
- Central Limit Theorem
- Logic of Confidence Intervals
- Logic of Hypothesis Testing
- One Sample Inference About a Population Mean
- One Sample Inference About a Population Proportion
- Scatterplots & Correlation
- Simple Linear Regression
Quantitative Methods

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

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

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

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

Linear Algebra
  Vector
  Matrix
  Determinant
  Solving systems

Calculus
  Functions
  Derivatives
  Optimization

Advanced Statistical Modeling
  Chi Square
  Data Clustering
  ANOVA
  Simulation
  Probability Modeling
Linear Algebra

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

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

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

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

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

Eigenvalues and Eigenvectors
- Eigenvalues and Eigenvectors
- The Characteristic Equation

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

Orthogonality/Least Squares
- Inner product spaces
- Orthogonality
- Orthonormal bases
- Gram-Schmidt orthonormalization
- Least squares regression
Ordinary Differential Equations

Introduction to Ordinary Differential Equations
- Define and classify differential equations
- Determine whether a function is a solution to a DE
- Existence and Uniqueness Theorem
- Principle of Superposition

1st order Ordinary Differential Equations
- Identify 1st order linear, separable, exact, Bernoulli, and homogeneous 1st order ODEs
- Find general solution for 1st order ODEs
- Solve 1st order initial value problems
- Construct and solve ODEs for applications such as mixtures, populations, and Newtonian Mechanics

Gaining information about ODEs without solving
- Identify autonomous 1st order ODEs
- Find and classify equilibrium solutions to autonomous 1st order ODEs with constant coefficients
- Predict end behavior of solution to autonomous ODE given initial condition
- Construct, identify, and interpret slope/direction fields
- Euler’s method

Higher Order ODEs
- Linear independence of solutions
- Construct and solve problems involving harmonic motion, electrical circuits, and projectile motion
- Solve linear higher order ODEs with constant coefficients using method of undetermined coefficients
- Find second solution to 2nd order ODE using method of Reduction of Order
- Find particular solution to 2nd order nonhomogeneous ODE using variation of parameters
- Solve Cauchy-Euler equations

Laplace Transforms
- Compute Laplace transforms of simple functions using definition of Laplace transform
- Compute Laplace transforms of polynomial, exponential, and trig functions using table
- Solve IVPs using Laplace transforms

Power Series Solutions of ODEs
- Manipulate power series
- Identify ordinary and singular points of ODEs
- Evaluate recurrence relations
- Find power series solutions of ODEs

Systems of 1st Order Differential Equations
- Use row operations to reduce matrices
- Compute eigenvalues and eigenvectors of square matrices
- Solve system of two 1st order linear ODEs with constant coefficients using matrix methods
- Convert 2nd order linear ODE to a system of two first order linear ODEs
- Orthogonality
- Orthonormal bases
- Gram-Schmidt orthonormalization
- Least squares regression
Elementary Science

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

(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

Geology (cont'd)
- 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
Meteorology (cont’d)
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

Chemistry of Life

- Atoms
- Important properties of water
- pH
- Molecular Movement, Osmosis and Diffusion
- Chemical Gradients
- Monomers and Polymers
- Carbohydrates, Lipids, Proteins, and Nucleic Acids
- Origins of life

• Cell Structure and Function
  - Prokaryotic and eukaryotic cells
  - Structure and function of:
    - Cell Membrane, Cell Wall, Cytoplasm, Cytoskeleton, Centriole, Nucleus, Nuclear Membrane, Nucleolus, Golgi Apparatus, Endoplasmic Reticulum, Ribosome, Lysosome, Mitochondrion, Chloroplast, Vacuole, Vesicle
  - Cellular Transport Across the Cell Membrane
  - Fluid Mosaic Model of the Cell Membrane and Semi-permeability
  - Active Transport
  - Facilitated Diffusion
  - Passive Transport
  - Receptor Proteins
  - Signaling Molecules
  - Cell junctions

• Cellular Energetics
  - Autotrophs and Heterotrophs
  - Change in free energy
  - Exergonic and Endergonic Reactions
  - Enzymes, Enzymatic Functions, and Enzymatic Pathways
  - Coupled reactions, activation energy, and ATP
  - Light-Dependent Reactions of Photosynthesis
  - Calvin Cycle
  - Chemosynthesis
  - Glycolysis
  - Krebs Cycle
  - Electron Transport Chain
  - Fermentation

• Cell Reproduction
  - Ploidy
  - Cell cycle
  - 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.

• Molecular Biology
Famous genetic experiments—Hershey/Chase, Fred Griffith, Avery, Meselson/Stahl, Chargaff, and Watson/Crick.

Semi-conservative replication
DNA and genome structure
Transcription
Introns and mRNA splicing
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

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

• Evolution and Phylogeny
  Common Ancestry
  Three-Domain Hypothesis
  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, Nucleoid
  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 Taxa:
    - 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
  - Spectrophotometry
  - Centrifugation
  - Serial dilution
  - Gel electrophoresis
  - Bacterial culturing
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
Atomic and Molecular Structure (Cont’d)
   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
   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
   Unsatuated
   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
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
  - Equilibrants

**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

**Dynamics (Cont’d)**
- 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
Fluid Mechanics (Cont’d)
Hydrostatics
Fluid Pressure

Thermal Physics
Heat
Temperature
Mechanical Equivalent of heat
Heat Transfer and thermal expansion
  Linear expansion of solids
  Volume expansion of solids and liquids
Calorimetry
Kinetic Theory
Ideal Gases
Gas laws
Thermodynamics
  Processes and PV diagrams
    Isothermal – Isobaric – Isometric --
    Adiabatic – Cyclic
  Zeroth law of Thermodynamics
  First law of Thermodynamics
    Internal energy – Energy conservation
    – Molar heat capacity of a gas
  Second law of Thermodynamics
    Directions and processes
    Entropy
  Third Law of Thermodynamics
  Heat engines and Carnot engines
  Refrigerators
  Rms speed of gas molecules
  Avogadro’s number and Boltzmann’s constant

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

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

Electromagnetism
Force of a magnetic field on a moving charge
Force of a magnetic field on a current carrying wire
Torque on a current carrying loop
Magnetic fields due to straight and coiled wires
Electromagnetic Induction
Magnetic flux
Faraday’s Law
Lens’ 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
**Optics (Cont’d)**
- 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

Dynamics (Cont’d)
- 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

Gravitation (cont’d)
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

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

Electromagnetism (Cont’d)
   RL circuits
   LC circuits
   LRC circuits
   Faraday’s Law
   Lenz’s Law
   Alternating current circuits
      Phasors and alternating currents
      RMS voltages and currents
      Resistance and reactance
      AC LRC circuits
      Power in AC circuits
      Resonance in AC circuits
   Displacement current
   Maxwell’s equations
   Motors
   Mass spectrometers
   Generators
   Transformer

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

Optics

Nature and Propagation of Light
   Reflection
   Law of reflection
   Refraction
   Snell’s Law
   Total internal reflection
   Critical angle
   Geometric Optics
      Images formed by plane mirrors
      Images formed by spherical mirrors
      Images formed by parabolic mirrors
      Images formed by lenses
      Ray-diagrams (Geometric Optics)
      Thin lens
      Mirror equation
      Image formation by a two-lens system

Physical Optics
   Interference
   Superposition principle
   Double slit interference
Nature and Propagation of Light (Cont’d)

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

Modern Physics (Cont’d)

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
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
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

Microbial Traits (Cont’d)
- 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
Pathogenicity (Cont’d)
  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
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
Health Administration

Governance and Organizational Structure
- Organizational structures, key players, and their impact on health care delivery system
- Responsibility, authority, and accountability at each level of an organization
- Developing, implementing, and updating strategic plans
- Accreditation, regulatory, licensing, and certification programs

Quality and Performance Improvement
- Quality assessment programs and procedures
- Importance of regulation in health care organizations and its impact on continuous quality improvement
- Processes of continuous quality improvement, including the cost-quality paradigm

Law, Ethics, and Professionalism
- Government regulations and laws affecting the healthcare environment
- Relationship between healthcare law and healthcare ethics
- Application of moral, ethical, and legal principles in the delivery of healthcare
- Role of healthcare workers in protecting patient rights

Human Resources
- Assessing personnel needs
- Recruitment, selection, compensation, and training of personnel
- Evaluation of personnel including disciplinary actions

Management
- General management principles
- Role of leadership in promoting organizational effectiveness
- Management change theories and strategic management

Healthcare Finance, Technology, and Information Management
- Common financial tools, processes, and techniques used in healthcare
- Revenue cycle & reimbursement
- Financial considerations in the provision of health services (e.g. admitting and registration, case management/denials, credit and collections)
- Management and clinical information systems
- Electronic health records including legal and ethical issues

Healthcare
- Trends that are likely to shape the future of healthcare
- Role, structure, and funding of various health care organizations (e.g. physician’s office, walk-in clinic, hospital, ambulatory surgery center, rehabilitation center, etc.), community health services, and public health
- Patient relations
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 Pathophysiology (Cont’d)
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
Otolarynchology
Ophthalmology

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
- Anti-dysrhythmic drugs
- Anti-anginal drugs
- Anti-hypertensive 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

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
Nursing Pharmacology (Cont’d)

Antibiotics
Antiviral drugs
Antitubercular drugs
Antifungal drugs
Antimalarial, antiprotozoal, antihelmintic drugs
Anti-inflammatory and antigout drugs
Immunosuppressants
Immunizing drugs
Antineoplastic drugs
Biologic response drugs
Acid controlling drugs
Bowel disorder drugs
Antiemetic and antinausea drugs
Anemia drugs
Dermatologic drugs
Ophthalmic and otic drugs
Hormones that regulate calcium and bone metabolism
Drugs used in oncologic disorders
OTC drugs, herbal and dietary supplements
Nursing RN (Pediatrics)

• Systems and Associated Disorders
  Cardiovascular and circulatory
  Endocrine
  Excretory
  Gastrointestinal
  Immune
  Integumentary
  Musculoskeletal
  Nervous and sensory
  Reproductive
  Respiratory

• Health Assessments
  Communication with patients and family
  Diagnostic testing and evaluation
  Physical and developmental assessments

• Health Promotion
  Health promotion for pediatric patients
  Health promotion for the families of pediatric patients
  Influences of family on child health promotion
  Influences of socioeconomics, culture, and religion on child health promotion

• Nursing Care
  Chronic illness
  Cognitive and sensory impairment
  Community-based nursing care
  Disability
  End-of-life care
  Family-centered care

• Interventions
  Behavioral
  Community
  Family
  Health System

Physiological
Safety

• Professional Performance
  Advocacy
  Ethics
  Evidence-based practice and research
  Law and regulation

Tutors must be knowledgeable about the fundamentals of nursing including nursing roles, settings, and health care trends.

Tutors must be knowledgeable of the following systems, and of associated disorders seen in all stages of childhood (newborn, infant, toddler, preschooler, school-age, and adolescent):
  Cardiovascular system
  Circulatory system
  Excretory system
  Respiratory system
  Nervous system
  Gastrointestinal system
  Endocrine system
  Reproductive system
  Musculoskeletal system
  Integumentary system
  Immune system
  Otolaryngology
  Ophthalmology

Tutors should be familiar with nursing care as it applies to pediatric patients in all of the following areas:
  Communication with the patient and family
  Pediatric nursing skills
  Physical and developmental assessments
  Diagnostic testing and evaluation
Health promotion for patients in all stages of childhood (newborn, infant, toddler, preschooler, school-age, and adolescent) and their families

Family, social, cultural, and religious influences on child health promotion

Community-based nursing care

Family-centered care at home and during hospitalization

Care of the child and family in the following contexts:
   Chronic illness
   Disability
   Cognitive and sensory impairment
   End-of-life care

Tutors should be familiar with pediatric variations of standard nursing practices and interventions, including those in the following areas:
   Pain assessment and management
   Altered fluid electrolyte or acid-base balance
   Medication administration
   Trauma and shock
   Pre- and post-surgery
   Infections
   Altered immunity
   Cancer
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

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

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
- Compare/Contrast
- Connotation
- Contractions
- Cross-Curricular
  - Reading/Writing
- Denotation
- Extract ideas from a variety of texts
- Fiction
- Grammar
- Graphemes
- Letter Writing
- Literary Analysis
- Literary Device
- Literary Themes
- Non-Fiction
- Nouns
- Paragraphs
- Parts of Speech
- Phonemes
- Plays and Theater
- Poetry
- Point of View
- Prefix/Suffix
- Presentations
- Pronouns
- Punctuation and Capitalization
- Reading Comprehension
- Research Skills
- Root Words
- Sentence Structure
- Synonyms
- Verbs
- Vocabulary
- Writing Sentences

Middle Grades (Grades 7-8)
- Characterization
- Connotation
- Content Area Literacy
- Contextual Analysis
- Denotation
- Elements of a Story
- Grammar
- Interdisciplinary Subjects
- Interpreting Graphs in Text
- Literary Analysis
- Literary Criticism
- Literary Devices
- Literary Themes
- Modes of Persuasion
- Narrative
- Non-Fiction
- Oral Communication
- Plays and Theater
- Point of View
- Prose and Poetry
- Punctuation and Capitalization
- Reading Comprehension
- Research Skills - Sources and Documentation
- Sentence Structure
- Subject Area Themes
- Theme
- Vocabulary

High School (Grades 9-12)
- Argument
- Copyright
- Exposition
- Expression through writing and presenting
- Figures of Speech
- Functional Texts
- Grammar
- Literary Analysis
- Literary Criticism
- Literary Devices
- Literary Periods
- Literary Themes
- Logical Development of Ideas
- Multimedia Communication
- Oral Communication
- Organizational Features of Text
- Persuasion
- Plays and Theater
- Point of View
- Presenting Media
- Prose and Poetry
- Punctuation and Capitalization
- Reading Comprehension
- Research Skills - Sources and Documentation
- Viewing Media
- Visual Communication
- Vocabulary
Literature

Literary Periods and Movements
- British Literature
- The Enlightenment
- Existentialism
- Medieval Literature
- Modernism
- Multi-Media
- Naturalism
- Post-Colonial Literature
- Post Modernism
- Realism
- Religious Texts
- Renaissance Literature
- Romanticism
- Transcendentalism
- Victorian Literature

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

Prose Non-Fiction
- Biography
- Creative Non-Fiction
- Essay
- News Media
- Non-Fiction

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

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

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

Literary Devices
- Allegory
- Irony: Verbal/Dramatic
- Figurative Language: Imagery
- Hyperbole and Synecdoche
- Mimesis/Metonymy
- Symbolism/Metaphor/Simile
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
Functional Writing
Grammar
Interdisciplinary Writing
Journal Writing
Literary Analysis Writing
Narrative
Organization and Outlining Essays
Paragraphs
Persuasive Essay
Poetry Writing
Pre-writing Skills
Punctuation and Capitalization
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 Process
Writing Sentences
Writing Strategies
Writing Styles
College Essay Writing

Argument
Business Writing
Citation and Documentation
College and Job Application Writing
Cover Letter Writing
Creative Writing
Descriptive Essay
Editing and Proofreading
Effective Content Analysis
Elements of Composition
Expository Essay
Grammar
Interdisciplinary Writing
Journal Writing
Lab Reports
Literary Analysis Writing
Narrative
Oral Communication
Organization and Outlining Essays
Paragraphs
Performance Pieces
Persuasive Essay
Poetry Writing
Pre-writing Skills
Punctuation and Capitalization
Research Skills and Resources
Resume Writing
Speech Writing
Story Writing
Technical Writing
Thesis Statements
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 Strategies
Writing Styles
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
Reading

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 ESL

Use of English
- Articles
- Comparisons and Superlatives
- Conditionals
- Countable and non-countable nouns
- Determiners
- Indirect speech
- Irregular verb forms
- Modal verbs
- Participial adjectives
- Parts of a sentence
- Passive and active voice
- Passive causatives
- Phrasal verbs
- Phrase usage: Neither, nor, such, so
- Prepositions
- Pronouns
- 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
ESL

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

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

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

**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
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
Introduction to 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
- 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

Race/Ethnicity (Cont’d)
- 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 Harassment
- 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
Introductory 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
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
Introductory 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
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
Choice Under Uncertainty: Expected Utility, Insurance, Lotteries, Risk Aversion
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
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.
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
Business Law

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

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

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

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

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

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

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

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

Creditor Rights
- Creditor Rights and Remedies
- Debtor Protections
- Surety & Guarantees
- Bankruptcy Concepts
- Mortgage and Foreclosure
MS Access

Database Relations and Development
- Database Terminology
- Primary and Secondary Keys - Creating Relationships
- Enforcing Referential Integrity in Key Relationships
- Creating a Database
- Creating a Database from a Template

Tables
- Types of Tables within a DB
- Creating Tables
- Creating Linked Tables
- Changing Tables
- Entering New Data
- Adding Descriptions
- Indexing a field
- Data Validation
- Hiding Fields
- Validating and Managing Records within a Table - Adding and Updating

Queries
- Using Queries within a Database
- Running a Query
- Creating a Simple Query
- Creating a Crosstab Query
- Creating a Parameter Query
- Operations and Expressions in a Query
- Creating an Aggregate Query
- Create an Action Query
- Create a Multiple Table Query
- Saving Queries

Forms
- Using Forms within a Database
- Creating a Blank Form
- Creating a Form from a Template
- Saving Forms
- Adding and Moving Form Controls
- Managing Labels
- Adding Sub-Forms
- Working with Data on Forms
- Modifying Print Settings
- Inserting backgrounds, headers, and footers

Reports and Reporting Tools
- Creating a New Report
- Creating a Report Based on a Query
- Creating a Report Using a Wizard
- Selecting Summary options
- Group and Sort Report Fields
- Report Text Box Controls
- Modify Data Sources
- Inserting headers, footers, and applying themes
- Formatting Reports

Macros
- Using Macros
- Understanding Security
- Creating a Macro
- SubMacros
- Handling Macro Errors

Importing/Exporting
- Creating a DB by importing
- Importing Data into Tables
- Exporting Data

Data Analysis
- Transforming Data
- Calculations and Dates
- Parametrized Queries
- Entering SQL
- Subqueries and Aggregation
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
MS Word

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

*Note: Those wanting to tutor MS Windows must be proficient with BOTH the user side of Windows and the admin side of Windows.*

**Windows Installation and Setup**
- Preparing for Installation
- Adding/Managing User Accounts
- Display Settings & Personalization Options
- Power Settings
- Privacy / Security Settings
- Accessibility Options

**File and Folder Operations**
- Desktop, Start Menu & Taskbar
- Navigating with File Explorer
- Creating Folders and Saving Files
- Move, Copy, Delete, and Rename Files/Folders
- Folder Views and Settings
- File/Folder Searches
- Managing Hard Drives and Storage - Local, Removable, and Cloud

**Windows Utilities**
- Desktop Accessories
- Control Panel
- Backup and Recovery Tools
- Security - Antivirus, Antimalware, and Firewall Tools
- Windows Update

**Basic Software & Hardware Management**
- Windows Apps & Microsoft Store
- Adding/Removing Programs
- Adding/Removing/Managing Printers
- Adding/Removing/Managing Bluetooth Devices
- Locating and Running Programs

**Accessing the Internet**
- Connecting to a Network - Ethernet & WiFi
- Accessing the Internet with Internet Explorer, Microsoft Edge
- Email and the Mail app
- Searching the Internet/Default Search Engine

**Basic Troubleshooting**
- Viewing System Information
- Task Manager - Monitoring System Performance
- Windows Troubleshooter
- Safe Mode
Principles of CS

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**
Python

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

Lists
Control Flow and Looping (while/for, use of the range() function instead of traditional for loop)
Tuples (relation to lists, unpacking)
List/Dictionary/Generator comprehensions
“Dunder” methods ().__init__, __plus__, etc
Variadic arguments (*args)
Keyword arguments (**kwargs)
List slices
Generators (yield)
Lambda functions
Dictionaries
Functions (including map, filter, reduce)
Files
Web Design

Internet Fundamentals
- Layers of the Internet (application, transport, etc..)
- URL
- Pathway
- FTP and File Management
- Protocols (HTTP, HTTPS)

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

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

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

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

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

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

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

Advanced Queries
- Designing Advanced queries
- Query optimization
- Common Table Elements
- Joins

Filtering Query Output
- WHERE Statement
- ORDER BY Statement
- Applying logical filters

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

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

Database Management Systems
- SQL Server
- Oracle
- MS Access
Spanish

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

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

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

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

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

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

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

Basic Sentence Structure
Gender & Number of Nouns

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

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

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

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

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

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

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

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

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

Adverbs
- Expressions of Time
- Negation

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

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

Prepositions
- Accusative, Dative, Genitive, & Two-way
- 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