## Basic Concepts List

for All Available Subjects

### Math

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### Science

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### Social Sciences

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### Technology

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Elementary (Grades 4-6)

**Algebraic Skills**
- Equations
- Functions
- Patterns

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

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

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

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

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

**Algebra, Patterns and Relationships**
- Algebraic Expressions
- Formulas
- Functions
- Graphing Relationships
- Inequalities
- Linear Relationships
- Number and Geometric Patterns
- Solving Equations
- Systems of Equations
- Variables and Substitution
- Represent and Analyze Quantitative Relationships between Dependent and Independent Variables
- Use Properties of Operations to Generate Equivalent Expressions
- Work with Radicals and Integer Exponents
- Understand the Connections between Proportional Relationships, Lines and Linear Equations
- Analyze and Solve Linear Equations and Pairs of Simultaneous Linear Equations
- Define, Evaluate and Compare Functions
- Use Functions to Model Relationships between Quantities

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

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

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

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

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

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

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

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

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

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

Probability
  Counting Principles and Sample Spaces
  Theoretical and Experimental Probability

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

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

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

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

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

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

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

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

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

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

Matrices
- Matrices Operations and Problems

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

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

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

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

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

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

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

**Statistics**
- Data Analysis
- Data Collection
- Data Displays
- Measures of Data
Trigonometry

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

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

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

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

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

Vectors
  Graphing and Operations with Vectors
  Solving problems with Vectors
Calculus

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

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

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

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

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

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

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

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

Calculus Basics
  Combining Functions
  Patterns in Graphs

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

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

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

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

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

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

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

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

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

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

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

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

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

Pythagorean identities

Sum and difference formulas

Co-functions relationships

Double-angle and half angle formulas

Solve trigonometric equations using basic identities and inverse trigonometric functions.

Prove and derive trigonometric identities.

Find a sinusoidal function to model a given set of data or situation.

Vectors, Matrices and Systems of Equations

Perform operations on vectors in the plane.

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 compute the inverse of two-by-two and three-by-three matrices.

Computer determinants of two-by-two and three-by-three matrices.

Write systems of two and three linear equations in matrix form.

Solve systems using Gaussian elimination or inverse matrices.

Represent and solve inequalities in two variables.

Linear programming.

Sequence, Series and Mathematical Induction

Know, explain and use sigma and factorial notation.

Write an expression for the nth term.

Write a particular term of a sequence when given the nth term.

Understand, explain and use the formulas for the sums of finite arithmetic and geometric sequences.

Compute the sums of infinite geometric series.

Understand and apply the convergence criterion for geometric series.

The principle of mathematical induction.

Pascal’s triangle.

Binomial theorem.

Polar Coordinates, Parameterizations, and Conic Sections

Convert between polar and rectangular coordinates.

Graph functions given in polar coordinates.

Write complex numbers in polar form.

De Moivre’s theorem.

Evaluate parametric equations for given values of the parameter.

Convert between parametric and rectangular forms of equations.

Graph curves described by parametric equations.

Use parametric equations in applied contexts to model situations.

Identify parabolas, ellipses and hyperbolas from equations.

Write the equation in standard form and graph parabolas, ellipses and hyperbolas.

Derive the equation for a conic section from given geometric information.

Identify key characteristics of a conic section from its equation or graph.

Identify conic sections whose equations are in polar or parametric form.

Modeling Mathematics

Construct a tangent from a point outside a given circle to a circle.

Cavalieri’s principle.
Identify the shapes of two dimensional cross sections of three dimensional objects
Identify three dimensional objects generated by rotations of two-dimensional objects
Statistics

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

Collect Data
  Experiments and Data Collection
  Sampling

Probability
  Computing Probability
  Counting - Combinations and Permutations

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

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

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

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

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

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

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

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

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

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

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

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

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

Apply basic enumeration techniques.
Simplify assertions and compound statements in first-order logic.
Apply basic set-theoretic concepts.
Apply the principles of mathematical induction and recursion.
Apply the basic concepts of computational complexity and algorithmic analysis.
Solve problems of iteration.
Manipulate relations and simple functions and their inverses.
Use the properties of relations.
Apply the properties of equivalence relations and partitions.
Use the Principle of Inclusion and Exclusion.
Identify graph isomorphism, planarity, connected components, and chromatic numbers.
Identify properties of a tree.
Apply properties of general graphs.
Apply the basic concepts of Boolean algebra.
Use the basic laws of Boolean algebra.
Convert Boolean expressions into a disjunctive or conjunctive normal form.
Science – Elementary (Grades 4-6)

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

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

Math basics
    Algebra
    Dimensional analysis
    Metric system
    Scientific notation
    Significant digits

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

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

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

Types of Rock and the Rock Cycle
Chemical Cycles
Nitrogen – Oxygen – Carbon

Erosion and Weathering
Glaciers
Soil
Water
Water cycle

Biomes
Population
Growth rate
Food supply

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

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

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

Meteorology

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

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

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

Astronomy
Earth, Sun, and Moon System
   Historical views of the solar system
      Geocentric (Ptolemy)
      Heliocentric (Copernicus)
   Time Zones
   Day Length
   Seasons
   Phases of the moon
   Eclipses - Lunar and Solar
   Tides
Features of the Moon
Theories of the creation of the moon
Sun
   Energy production - Fusion
   Life cycle
   Layers
   Sunspots
   Prominences – solar flares
   Auroras
Solar system
   Structure and composition
   Inner (Terrestrial) Planet characteristics and specifics
   Outer (Jovian) planet characteristics and specifics
   Motion
   Kepler’s Law
Stars
   Classifications
   Life span/cycle
   Creation of elements
   Spectroscopy
   H-R Diagram
   Distances
   Galaxies
Distances
Amount
Types
Composition
Gravity
Formation of planets
Big Bang Theory and evidence
Space probes and exploration
Telescopes
Biology

Basic Chemistry
- Atoms
- Properties of Water Due to its Polarity and Hydrogen Bonding
- Molecular Movement, Osmosis and Diffusion
- Chemical Gradients
- Monomers and Polymers
- Carbohydrates, Lipids, Proteins, and Nucleic Acids

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

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

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

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

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

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

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

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

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

**Plant Form & Function**
Evolution of Plants from Algae
Adaptations of Plants to Land
  Vascular and Nonvascular Plants
  Pollen, Seeds, Flowers, and Fruit

Plant Reproduction
Alternation of Generations
Plant Structures Including...
  Leaf, Stomata, Cuticle
  Xylem, Phloem
  Rhizoids, Sporangium, Spores
  Roots, Meristem, Sepal, Petal
  Anther, Filament, Stamen, Stigma, Style, Ovary, Pistil, Fruit
  Pollen, Seed, Flower

Angiosperms (including Monocots and Dicots) and Gymnosperms (including Conifers)
Response to Stimuli (hormones involved) Including
  Auxins
  Phototropism
  Gravitropism

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

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

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

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

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

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

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

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

Embryology
Ectoderm, Mesoderm, and Endoderm and their derivatives

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

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

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

Digestive
Structure and Function of Esophagus, Stomach, Small Intestines, Colon, Liver, Gall Bladder, Appendix and Rectum
Mechanical Digestion
Chemical Digestion
Absorption and transport of nutrients
pH balance and enzymatic function
Hormone regulation of digestive function and appetite
Extrinsic and Intrinsic Nervous function
Digestive Disease
Normal Flora of the gut

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

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

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

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

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

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

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

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

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

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

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

Stoichiometry
Empirical formula
Molecular formula
Limiting Reagent

**Gas Laws and Kinetic Theory**

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

**Atomic and Molecular Structure**

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

**Solids**
Crystalline Solids
Bragg’s Law
Unit cell

Simple – Face centered – Body centered – End-centered

**Liquids and Changes of State**
Compressibility
Surface tension
Transition states
Evaporation
Evaporation
Condensation
Boiling
Freezing
Melting
Fusion
Sublimation
Triple point
Critical temperature
Critical pressure

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

Phase Diagram
Kinetic Molecular Theory of Liquids

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

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

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

Kinetics
Chemical Reaction Rates
Rate Expressions
Reaction Mechanisms
Activation Energy

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

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

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

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

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

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

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

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

**Biochemistry**
 Proteins – Carbohydrates – Nucleic acids

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

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

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

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

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

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

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

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

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

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

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

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

Work, energy and power
   Work and work-kinetic energy theorem
Conservative forces and Potential energy
   Gravity – Springs
Conservation of mechanical energy
Power
Simple Harmonic motion
   Springs and Hooke’s Law
   Pendulums
   Energies of SHM
   Graphs of SHM
   Spring-mass system
Momentum
   Momentum definition
Impulse
   Impulse-Momentum Theorem
Non-constant force
   Conservation of linear momentum and collisions
      Inelastic and elastic collisions
      Two dimensional collisions
Angular momentum
   Conservation of angular momentum
Sources of energy on Earth

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

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

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

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

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

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

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

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

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

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

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

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

Newtonian Mechanics

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

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

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

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

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

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

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

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

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

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

Electricity and Magnetism

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

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

Dielectrics

Current and Resistance
  Current
  Resistivity
  Resistance

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

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

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

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

**Relative sound intensity**

**Optics**

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

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

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

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

**Huygen’s Principle**

**Polarization**

**The electromagnetic spectrum**

**Inverse square law**

**Modern Physics**

**Quantum Mechanics and the nature of light**

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

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

**Electron energy levels**
- Ionization energy
- Emission spectrum
- Absorption spectrum
- Lasers
Continuum spectrum
Compton Effect
Wave nature of matter
DeBroglie equation
DeBroglie Hypothesis: Davisson-Germer experiment

Nuclear physics
Atomic mass
Mass number
Atomic number
Mass defect and binding energy
Nuclear processed
  Modes of radioactive decay (alpha, beta, gamma)
  Fission
  Fusion
Mass-energy equivalence
Conservation of energy-mass
Nuclear symbols
Nuclear reactions
Neutrino
Chain reactions
Isotopes
States of matter
Atomic models
Microbiology

The microbiology course is considered an advanced science course. It is expected that tutors are knowledgeable in foundational biological, chemical and mathematical concepts as they underlie and relate to microbiology.

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

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

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

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

Biochemistry processes
Recombinant DNA technology
  - Vectors
  - PCR
  - Restriction enzymes
  - Gene cloning

Taxonomy and classification (Bergey)
Cytology
Cellular physiology

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Elementary (Grades 4-6)

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

Middle Grades (Grades 7-8)

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

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

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

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

Internal Controls & Cash
  Bank reconciliations
  Petty cash

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

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

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

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

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

Payroll and Taxes
  Accounting for taxes
  Accounting for payroll

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

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

Intro Microeconomics

Comparative Advantage
- Opportunity Cost
- Production Possibilities Curve

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

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

Demand
- Marginal Utility
- Consumer Surplus

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

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

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

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

Intro Macroeconomics

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

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

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

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

Labor and Wages
   Real Wages
   Demand for Labor
   Supply of Labor

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

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

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

Financial Choices of Firms

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

The Financial Environment

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

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

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

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

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

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

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

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

Debt
  Short term liabilities
  Bond pricing
  Bond issues and retirements

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

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

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

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

**Earnings Per Share**
Basic EPS
Diluted EPS

**Pensions**

**Contingencies**

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

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

Microeconomics
Consumer Theory
Preferences, Utility, Choice (Revealed Preference)
The Slutsky Equation
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
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
Estate and Trusts
Insurance Terms, Concepts & Types
Intellectual Property

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

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

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

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

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

Entrepreneurial Opportunities
- Small Businesses Concepts

Ethics in Business
- Integrity framework
- Supporting Organizational Culture

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

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

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

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

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

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

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

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

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

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

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

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

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

Scientific Method
  Cause and effect
  Research hypotheses
  Testability

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

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

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

Bias
  Experimenter bias
  Participant bias
  Research and Culture

Sampling
  Populations and samples
  Probability sampling methods
  Nonprobability sampling
  Sampling Error

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

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

Qualitative research
  Naturalistic observation
  Case study
  Focus groups
  Coding and categorizing

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

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

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

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

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

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

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

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

Race/Ethnicity
- Common Culture
- Shared Experience
- Divisions
- Inequalities

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Dominant Group
Minority Group(s)
Discrimination
Prejudice
Racism
Homogeneity and Heterogeneity

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

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

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

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

Research Methods
Qualitative Methods
Quantitative Methods
Mixed Methods
Independent and Dependent Variables
Mean/Median/Mode
Sample
Hypothesis
MS Excel

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

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

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

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

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

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

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

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

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

**Macros**
- Recording Macros
- Running Macros

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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
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
Visual Basic

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

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

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

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

Basic Verb Forms
  - Present Indicative
  - Stem Changing Verbs
  - Gustar Type Verbs
  - Irregular 1st Person Verbs (“go, 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