

Basic Concepts List

for All Available Subjects



Math

Elementary Math	Mid-level Math	Algebra
Algebra II	Geometry	Trigonometry
Pre-Calculus	Calculus	Calculus BC
Multivariable Calculus	Discrete Math	Finite Math
Statistics	Intermediate Statistics	Quantitative Reasoning
Quantitative Methods	Linear Algebra	Ordinary Differential Equations

Science

Elementary Science	Earth Science	Biology
Chemistry	Physics – Algebra Based	Physics – Calculus Based
Anatomy & Physiology	Microbiology	Organic Chemistry
Health Administration	Nursing	Nursing RN (Pediatrics)

Humanities

Social Studies	English	Literature
Essay Writing	College Essay Writing	Primary Reading
Reading	Primary ESL	ESL
Symbolic Logic		

Social Sciences

Introduction to Psychology	Research Methods	Introduction to Sociology
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Business

Introductory Accounting	Intermediate Accounting	Introductory Economics
Intermediate Economics	Finance	Principles of Management
Business Law		

Technology

MS Access	MS Excel	MS Word	MS PowerPoint	Windows
Principles of CS	C++	Java	Python	Web Design
Database Systems				

Foreign Languages

French	German	Italian	Spanish
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Algebraic Skills

- Equations
- Functions
- Patterns

Geometry

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

Measurement

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

Numbers

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

Operations and Number Relationships

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

Statistics and Probability

- Collect and Organize Data
- Measures and Descriptions of Data
- Probability
- Read and Interpret Data

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

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

<C:\Users\jboller\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\JJRIH1TK\2011-03-18 scope and sequence tree.xml>**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

Absolute Value Equations and Inequalities

Graphing Absolute Value Equations and Inequalities

Solving Absolute Value Equations and Inequalities

Conic Sections

Properties of Conic Sections

Solving Problems with Conic Sections

Linear Functions, Equations, and Inequalities

Slope, Intercepts, Points on a Line

Solving Linear Equations

Solving Linear Inequalities

Solving Problems with Equations and Inequalities

Systems of Equations and Inequalities

Writing and Graphing Linear Equations

Writing and Graphing Linear Inequalities

Matrices

Matrices Operations and Problems

Numbers

Complex Numbers

Number Properties

Operations with Real Numbers

Patterns and Functions

Composition and Operations on Functions

Graphing Functions and Transformations

Inverse of Function

Patterns

Properties of Functions - Domain and Range

Properties of Functions - Zeros, End Behavior, Turning Points

Relations and Functions

Solving Problems with Functions

Translate Between Forms

Polynomial, Rational Expressions, Equations and Functions

Solving and Graphing Polynomial Equations

Solving and Graphing Rational Equations

Probability

Counting Principles and Sample Spaces

Theoretical and Experimental Probability

Quadratic Equations, Inequalities, and Functions

Complex Solutions to Quadratic Equations

Factoring Quadratic Equations

Graphing and Properties of Quadratic Equations

Solving Quadratic Equations and Inequalities

Systems of Nonlinear Equations and Inequalities

Radical, Exponential and Logarithmic Equations and Functions

Graphing Exponential and Logarithmic Functions

Properties of Exponents and Logarithms

Radical Expressions, Equations and Rational Exponents

Solving Exponential and Logarithmic Equations and inequalities

Solving Problems with Exponential and Logarithmic Functions

Sequences and Series

Properties of Sequences and Series

Solving Problems with Sequences and Series

Statistics

Data Analysis

Data Collection

Data Displays

Measures of Data

Geometry

[\(Back to Math\)](#)

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

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

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
- Theorems: The Remainder Theorem, The Factor Theorem, The 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
Compute 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 n th term
Write a particular term of a sequence when given the n th 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

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 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
- Rolle's and Mean Value Theorems
- Higher Order Derivatives
- Concavity
- Chain Rule
- Implicit Differentiation

Rates of Change

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

Integrals

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

Inverse and Transcendental Functions

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

Vectors & Geometry of Space in Multiple Dimensions

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

Vector Functions

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

Multivariable Differentiation

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

Multivariable Integration

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

Vector Calculus: Line Integrals

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

Vector Calculus: Surface Integrals

- Parametric Surfaces and Area
- Surface Integrals
- Stokes' Theorem
- Gauss' Divergence Theorem

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

Discrete Math

[\(Back to Math\)](#)

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

Statistics

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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

Describing Data

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

Probability

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

The Normal Distribution

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

Sampling and Experimentation: Planning and conducting a study

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

Sampling distribution

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

Statistical Inference: Estimating population parameters and testing hypotheses

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

Anova

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

Exploring Categorical Data

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

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

Regression and Correlation

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

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

Quantitative Reasoning

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Logic/Critical Thinking

- Truth Tables
- Simple Statements
- Venn Diagrams
- Compound Statements
- Analyzing Arguments

Arithmetic Knowledge

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

Geometry/Trigonometry

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

Functions

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

The Mathematics of Finance

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

Descriptive Statistics

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

Designing & Analyzing Studies

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

Probability Rules & Simulation

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

Inference & Regression

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

Applications and Limitations of Quantitative Analysis

- Business and Decision Analysis
- Arts and Social Sciences
- Medical and Health Sciences

Data and Terms

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

Decision Models

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

Forecasting

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

Linear Algebra

- Vector
- Matrix
- Determinant
- Solving systems

Calculus

- Functions
- Derivatives
- Optimization

Advanced Statistical Modeling

- Chi Square
- Data Clustering
- ANOVA
- Simulation
- Probability Modeling

Systems of Linear Equations

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

Matrix Properties and Arithmetic

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

Determinants

- Determinant of 2×2 and 3×3 matrices
- Co-factor expansion
- Cramer's Rule
- Theorems involving determinants and invertibility
- Properties of determinants

Linear Transformations

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

Vector Spaces

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

Eigenvalues and Eigenvectors

- Eigenvalues and Eigenvectors
- The Characteristic Equation

Matrix Decomposition

- LU decomposition
- QR decomposition
- Diagonalization
- Singular Value decomposition

Orthogonality/Least Squares

- Inner product spaces
- Orthogonality
- Orthonormal bases
- Gram-Schmidt orthonormalization
- Least squares regression

Ordinary Differential Equations

[\(Back to Math\)](#)

Introduction to Ordinary Differential Equations

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

1st order Ordinary Differential Equations

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

Gaining information about ODEs without solving

- Identify autonomous 1st order ODEs
- Find and classify equilibrium solutions to autonomous 1st order ODEs with constant coefficients
- Predict end behavior of solution to autonomous ODE given initial condition
- Construct, identify, and interpret slope/direction fields
- Euler's method

Higher Order ODEs

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

Laplace Transforms

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

Power Series Solutions of ODEs

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

Systems of 1st Order Differential Equations

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

Elementary Science

[\(Back to Science\)](#)

Grades 4-6

5 Senses
Animals
Astronomy
Atmosphere
Atoms
Basic Needs for Living Organisms
Calendar
Carbon Cycle
Cells
Classifying Living Things
Earthquakes
Earth's Resources
Earth's Surface
Ecosystem
Electricity
Energy
Energy Conservation
Environment
Food Chain/Web
Forces and Motion
Fossils
Genetics
Heat

Insect Life Cycle
Invertebrates
Investigation
Light
Light Energy
Magnets
Matter
Nitrogen Cycle
Organ Systems
Plants
Reproduction
Resources
Rock Cycle
Rocks
Seasons
Simple Machines
Soil
States of Matter
Tools
Vertebrates
Volcanoes
Water
Weather
Work

(Grades 7-8)

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

Earth Science

[\(Back to Science\)](#)

Math basics

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

Nature of Science

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

Geology

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

Geology (cont'd)

- Hot Spots
- Landforms
- Paleomagnetism and Plate Dynamics
- Minerals
 - Elements
 - Mineral composition of Earth
 - Identification
 - Simple Identity Tests
 - Planetary composition and distribution
- Types of Rock and the Rock Cycle
- Chemical Cycles
 - Nitrogen – Oxygen – Carbon
- Erosion and Weathering
- Glaciers
- Soil
- Water
 - Water cycle
- Biomes
- Population
 - Growth rate
 - Food supply
- Pollution
 - Land – Water (sewage) – Air – Chemical -- Thermal
- Ecosystems
- Energy flow – Carbon cycle – Population Growth
- Natural Resources
 - Renewable/Non-renewable energy sources
 - Green House Effect
 - Acid Rain
 - Management
- Climate change
- Human impact/changes to planet
- Natural disasters – causes, effects, impact

Meteorology

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

Meteorology (cont'd)

Weather Conditions and how they are created

Humidity

Saturation

Relative Humidity and calculations

Dew Point

Fronts

Jet Stream

Global Weather

Predication, forecast and measurement

Tools for measuring weather conditions

Weather map construction and interpretation

Clouds

Air Mass

Climates

Oceanography

Sea Floor Profile

Parts of the Ocean

Salinity

Contributories to the water in the ocean

Resources

Coriolis Effect

Major currents in the world and features

Waves

Tsunami characteristics

Astronomy

Earth, Sun, and Moon System

Historical views of the solar system

Geocentric (Ptolemy)

Heliocentric (Copernicus)

Time Zones

Day Length

Seasons

Phases of the moon

Eclipses - Lunar and Solar

Tides

Features of the Moon

Theories of the creation of the moon

Sun

Energy production - Fusion

Life cycle

Layers

Sunspots

Prominences – solar flares

Auroras

Solar system

Structure and composition

Inner (Terrestrial) Planet characteristics and specifics

Outer (Jovian) planet characteristics and specifics

Motion

Kepler's Law

Stars

Classifications

Life span/cycle

Creation of elements

Spectroscopy

H-R Diagram

Distances

Galaxies

Distances

Amount

Types

Composition

Gravity

Formation of planets

Big Bang Theory and evidence

Space probes and exploration

Telescopes

Chemistry of Life

Atoms

Important properties of water

pH

Molecular Movement, Osmosis and Diffusion

Chemical Gradients

Monomers and Polymers

Carbohydrates, Lipids, Proteins, and Nucleic Acids

Origins of life

• Cell Structure and Function

Prokaryotic and eukaryotic cells

Structure and function of:

Cell Membrane, Cell Wall, Cytoplasm, Cytoskeleton, Centriole, Nucleus, Nuclear Membrane, Nucleolus, Golgi Apparatus, Endoplasmic Reticulum, Ribosome, Lysosome, Mitochondrion, Chloroplast, Vacuole, Vesicle

Cellular Transport Across the Cell Membrane

Fluid Mosaic Model of the Cell Membrane and Semi-permeability

Active Transport

Facilitated Diffusion

Passive Transport

Receptor Proteins

Signaling Molecules

Cell junctions

• Cellular Energetics

Autotrophs and Heterotrophs

Change in free energy

Exergonic and Endergonic Reactions

Enzymes, Enzymatic Functions, and Enzymatic Pathways

Coupled reactions, activation energy, and ATP

Light-Dependent Reactions of Photosynthesis

Calvin Cycle

Chemosynthesis

Glycolysis

Krebs Cycle

Electron Transport Chain

Fermentation

• Cell Reproduction

Ploidy

Cell cycle

Mitosis

Meiosis

G₀, G₁, S, G₂, and M Phases of the Cell Cycle

Cell Cycle Checkpoints

Oncogenes and Tumor Suppressors in relation to cell cycle: p53, MLH1, BRCA1/2 etc.

• Molecular Biology

Famous genetic experiments-Hershey/Chase, Fred Griffith, Avery, Meselson/Stahl, Chargaff, and Watson/Crick.

Semi-conservative replication

DNA and genome structure

Transcription

Introns and mRNA splicing

Translation and protein processing

Regulation of Gene Expression and Epigenetics

Mutations and Chromosomal Abnormalities

Genetic Engineering Techniques (PCR, Gel Electrophoresis, Restriction Enzymes, Cloning, and DNA Sequencing, and Gene Mapping) and Their Uses

• Heredity

Inheritance

Mendel's Law of Heredity

Dominance, co-dominance, and incomplete dominance

Monohybrid, Dihybrid, and Trihybrid Crosses

Probability of Genotypes or Phenotypes based on Genetic Crosses

Sex-linked Traits

Pedigree Analysis

Mitochondrial DNA

• Evolution and Phylogeny

Common Ancestry

Three-Domain Hypothesis

Cell Theory and Characteristics of Life

Theory of Endosymbiosis

RNA World Hypothesis

Natural Selection and Fitness

Evidence Supporting Evolution (Fossil Record, DNA, Protein, Mathematical Models, etc.)

Examples of Selective Pressures and Their Effects on Population

Types of Selection

The Role of Genetic Drift, Mutation, and Sexual Reproduction in Evolution

Hardy-Weinberg Equilibrium

Phylogenetic Trees & Cladograms

Speciation & Extinction

Taxonomy

• Bacteria

Characteristics

Basic Structures Including:

Cell Wall, Cell Membrane, Ribosomes, Plasmids, Flagella, Nucleoid

Bacterial Conjugation

Binary Fission

• Viruses

Characteristics

Basic Structure Including:

Capsid/Coat Proteins

Genetic Material (including Reverse Transcriptase for RNA viruses)

Relationship of Cell Receptors to Entrance of Viruses into Host cells

Lytic and Lysogenic Stages of Virus Life Cycle

Relationship of Viruses to Cancer

Role of Mutation on the Evolution of Viruses

- **Animal Form & Function**

- Body Plan Development

- Surface Area to Volume

- Origin and Function of the Following Cell Types

- Epithelial, Connective, Muscle, Nervous

- Tissues, Organs and Organ Systems

- Homeostasis, Feedback Loops, and Hormones

- Animal Behavior

- Animal Reproduction

- Endotherms and Ectotherms

- Characteristics of the Following Taxa:

- Protists, Porifera, Cnidaria, Nematoda, Mollusca, Annelida, Arthropoda, Echinodermata, Chordata

- **Plant Form & Function**

- Evolution of Plants from Algae

- Adaptations of Plants to Land

- Vascular and Nonvascular Plants

- Pollen, Seeds, Flowers, and Fruit

- Plant Reproduction

- Alternation of Generations

- Plant Structures Including...

- Leaf, Stomata, Cuticle

- Xylem, Phloem

- Rhizoids, Sporangium, Spores

- Roots, Meristem, Sepal, Petal

- Anther, Filament, Stamen, Stigma, Style, Ovary, Pistil, Fruit

- Pollen, Seed, Flower

- Angiosperms (including Monocots and Dicots) and Gymnosperms (including Conifers)

- Response to Stimuli (hormones involved) Including:

- Auxins, Phototropism, Gravitropism

- **Fungi**

- Role In Decomposition

- Reproduction

- Fungal Structures Including:

- Spores, Hyphae, Ascus, Stalk, Cap

- **Ecology**

- Biomes

- Biodiversity

- Ecosystem Energy Flow

- Life History Strategies

- Producers, Consumers, and Decomposers

- Population Growth and Regulation

- Biotic and Abiotic Factors Affecting

- Environments

- All biogeochemical cycles including:

- Water, Carbon, Nitrogen, Sulfur, and

- Phosphorus Cycles

- Interactions between species and types of symbiosis

- **General Science**

- Interpreting and Graphing Scientific Data

- Interpreting and Summarizing Information from Literature

- Development of Science Fair Projects

- Assistance with Lab-related Assignments

- Proofreading Reports for Science Content

- **Lab techniques**

- Microscopy

- Spectrophotometry

- Centrifugation

- Serial dilution

- Gel electrophoresis

- Bacterial culturing

Chemistry

[\(Back to Science\)](#)

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
Pseudo Sciences
Safety
Science and Society
Scientific Method
Scientific Quantities
Scientific Thinking
Scientists and Discoveries
Theories and Laws
Tools and Measurement
Graphical interpretations
Basic laboratory equipment identification

Atoms, Molecules, and Compounds

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

Using Chemical Equations in Calculations

Density
Avogadro's number
Conversions between atoms, molecules, moles, and masses
Percent composition
Balancing Chemical Equations
Classification of Reactions
 Single Displacement (replacement) –
 Double displacement (replacement) –
 Decomposition – Synthesis
 (composition) – Combustion
Stoichiometry
Empirical formula
Molecular formula
Limiting Reagent

Gas Laws and Kinetic Theory

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

Atomic and Molecular Structure

Atomic Theories
Atomic Structure
Octet Rule
Electron Configurations
Lewis Dot Structure
Periodic Trends
 Ionization energies
 Electron Affinity

Atomic and Molecular Structure (Cont'd)

- Electronegativity
- Ionic Size
- Atomic Size
- Reactivity
- Chemical Bonding
 - Ionic – Covalent – Hydrogen – Metallic
- Valence electrons
- Orbitals
- Orbital Geometry
- Molecular Geometry
- VSEPR theory
- Quantum Theory
- Polarity
- Dipole moment
- Hybridization
- Sigma bond
- Pi Bond
- Resonance structures

Solids

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

Liquids and Changes of State

- Compressibility
- Surface tension
- Transition states
 - Evaporation
 - 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 K_{sp}
- Solubility and the Common Ion Effect
- Solubility and Complex Ions

Redox

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

Chemical Thermodynamics

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

Electrochemistry

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

Nuclear Chemistry

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

Basic Organic Chemistry

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

Biochemistry

- Proteins – Carbohydrates – Nucleic acids

Lab techniques

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

Physics – Algebra-based

[\(Back to Science\)](#)

Math basics

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

Nature of Science

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

Kinematics

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

Dynamics

- Newton's Laws
 - Static equilibrium (1st Law)
 - Translational equilibrium
 - Rotational equilibrium (torque)
 - Free Body Diagram
 - Dynamics of a single body (2nd law) --
 - Force
 - Systems of two or more bodies (3rd law)
 - Weight and weightless
 - Universal Gravitation
 - Gravitational Fields
 - Orbits

Dynamics (Cont'd)

- Kepler's Laws of Planetary Motion
- Static and kinetic friction
- Air resistance
- Elevator problems
- Incline planes
- Atwood Machines
- Circular motion and rotation
 - Uniform circular motion
 - Circular speed
 - Centripetal Force
 - Frequency and Period
 - Vertical Circular motion
 - Rotational Kinematics
 - Moment of inertia
 - Rotational Kinetic Energy

Work, energy and power

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

Fluid Mechanics

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

Fluid Mechanics (Cont'd)

- Hydrostatics
- Fluid Pressure

Thermal Physics

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

Electrostatics

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

Current Electricity

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

Electromagnetism

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

Optics (Cont'd)

- Images formed by lenses
- Ray-diagrams
- Thin lens
- Mirror equation
- Image formation by a two-lens system
- Interference
 - Superposition Principle
 - Double slit interference
 - Thin Film
 - Newton's Ring
 - Non-reflective coating for glass
- Diffraction
 - Single slit
 - Superposition of double slit
 - Diffraction gratings
 - Interference and Diffraction patterns
- Polarization
- The electromagnetic spectrum
- Inverse square law

Modern Physics

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

Nuclear Physics

- Atomic mass
- Mass number
- Atomic number
- Mass defect and binding energy
- Nuclear processes
 - 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

[\(Back to Science\)](#)

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

Math Basics

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

Nature of Science

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

Newtonian Mechanics

Kinematics (Motion Along a Straight Line)

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

Dynamics

- Newton's Laws of Motion
 - Static equilibrium (1st Law)
 - Translational equilibrium
 - Free Body Diagram
 - Dynamics of a single body (2nd law) – Force

Dynamics (Cont'd)

- Write differential equation for velocity as a function of time
- Method of separation of variables to derive the equation for velocity as a function of time
- Expression of acceleration as a function of time while under the influence of drag

- Systems of two or more bodies (3rd law)

- Mass and weight
- Fundamental forces of nature
- Static and kinetic friction
- Air resistance
- Elevator problems
- Incline planes
- Atwood Machines
- Dynamics of circular motion
 - Centripetal force

Work, energy and power

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

Systems of particles, linear momentum, impulse and collisions

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

Circular Motion and Rotations

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

Equilibrium and Elasticity

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

Fluid Mechanics

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

Gravitation

- Universal Gravitation
- Gravitational Fields
- Orbits
- Kepler's Laws of Planetary Motion
- The Motion of satellites
- Apparent Weight
- Oscillatory Motion
 - Springs and Hooke's Law
 - Pendulums
 - Energies of simple harmonic motion
 - Graphs of simple harmonic motion
 - Spring-mass system
 - Resonance and sinusoidal external force
 - Damped oscillations

Gravitation (cont'd)

- Parallel combinations of identical or differing lengths of springs
- Torsional pendulum

Thermal Physics

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

Electricity and Magnetism

Electrostatics

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

Conductors, Capacitors and Dielectrics

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

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

Electromagnetism (Cont'd)

- RL circuits
- LC circuits
- LRC circuits
- Faraday's Law
- Lenz's Law
- Alternating current circuits
 - Phasors and alternating currents
 - RMS voltages and currents
 - Resistance and reactance
 - AC LRC circuits
 - Power in AC circuits
 - Resonance in AC circuits
- Displacement current
- Maxwell's equations
- Motors
- Mass spectrometers
- Generators
- Transformer

Wave, Motion, and Sound

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

Optics

Nature and Propagation of Light

- Reflection
- Law of reflection
- Refraction
- Snell's Law
- Total internal reflection
- Critical angle
- Geometric Optics
 - Images formed by plane mirrors
 - Images formed by spherical mirrors
 - Images formed by parabolic mirrors
 - Images formed by lenses
 - Ray-diagrams (Geometric Optics)
 - Thin lens
 - Mirror equation
 - Image formation by a two-lens system
- Physical Optics
 - Interference
 - Superposition principle
 - Double slit interference

Nature and Propagation of Light (Cont'd)

- Thin film
- Newton's ring
- Non-reflective coating for glass
- Diffraction
 - Single slit
 - Superposition of double slit
 - Diffraction gratings
 - Interference and diffraction patterns
- Huygen's Principle
- Polarization
- The electromagnetic spectrum
- Inverse square law

Modern Physics

- Quantum Mechanics and the nature of light
- Relativity
 - Frames of reference
 - Time dilation
 - Length Contraction
 - Relativistic momentum
 - Rest mass energy
- Atomic physics and quantum effects
 - Photons and photoelectric effect
 - Energy and linear momentum of photons
 - X-ray production
 - Electron energy levels
 - Ionization energy
 - Emission spectrum

Modern Physics (Cont'd)

- Absorption spectrum
- Lasers
- Continuum spectrum
- Compton Effect
- Wave nature of matter
- DeBroglie equation
- DeBroglie Hypothesis: Davisson-Germer experiment
- Nuclear physics
 - Atomic mass
 - Mass number
 - Atomic number
 - Mass defect and binding energy
 - Nuclear processes
 - 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

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 Peyer's 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

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

Basic Biology

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

Microbial Traits

- Types
 - Bacteria
 - Algae
 - Fungi
 - Protists
 - Helminthes
 - Viruses
 - Viroids
 - Prions
 - Archaea
- Nutrition
- Growth
- Control in various environments
 - Acidic
 - Basic
 - High temperature
 - Low temperature
 - Saline
 - Nutrient rich and nutrient poor
- Structure
- Metabolism
- Pathways
- Catabolism
- Anabolism
- Gram positive bacteria anatomy
 - Low G + C gram positives
 - High G + C gram positives
- Gram negative bacteria anatomy
 - Deinococci
 - Nonproteobacteria
- Biochemistry processes
- Recombinant DNA technology
 - Vectors
 - PCR
 - Restriction enzymes
 - Gene cloning

Microbial Traits (Cont'd)

- Taxonomy and classification (Bergey)
- Cytology
- Cellular physiology

Genetics

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

Ecology

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

Pathogenicity

- Germ Theory
- Infection and reproduction
- Host and parasite relationship
- Infectious disease
- Disease transmission
- Nosocomial infections
- Mechanisms of pathogenicity
- Antimicrobial drugs
- Important pathogens and diseases

Pathogenicity (Cont'd)

- Respiratory system
- Cardiovascular system
- Lymphatic system
- Nervous system
- Gastrointestinal system
- Endocrine system
- Urinary and reproductive systems
- Integument system and eyes
- Immune system

Sterilization

Disinfection

Immunization

Innate host resistance

Adaptive Immunity

Sanitation

Hygiene

Health

Epidemiology

Antimicrobial chemotherapy

Microbiology of food

Industrial microbiology

Laboratory Techniques

Basic laboratory equipment identification

Guidelines for safe handling of

microorganisms and infectious materials

Microscope use including oil emersion

Methods for taking clinical samples

Incubation techniques

Inoculation techniques

Isolation techniques

Identification techniques

Gram stain

ELISA

Chromatography

Spectrophotometry

Serial dilution technique and calculations

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

Governance and Organizational Structure

Organizational structures, key players, and their impact on health care delivery system

Responsibility, authority, and accountability at each level of an organization

Developing, implementing, and updating strategic plans

Accreditation, regulatory, licensing, and certification programs

Quality and Performance Improvement

Quality assessment programs and procedures

Importance of regulation in health care organizations and its impact on continuous quality improvement

Processes of continuous quality improvement, including the cost-quality paradigm

Law, Ethics, and Professionalism

Government regulations and laws affecting the healthcare environment

Relationship between healthcare law and healthcare ethics

Application of moral, ethical, and legal principles in the delivery of healthcare

Role of healthcare workers in protecting patient rights

Human Resources

Assessing personnel needs

Recruitment, selection, compensation, and training of personnel

Evaluation of personnel including disciplinary actions

Management

General management principles

Role of leadership in promoting organizational effectiveness

Management change theories and strategic management

Healthcare Finance, Technology, and Information Management

Common financial tools, processes, and techniques used in healthcare

Revenue cycle & reimbursement

Financial considerations in the provision of health services (e.g. admitting and registration, case management/denials, credit and collections)

Management and clinical information systems

Electronic health records including legal and ethical issues

Healthcare

Trends that are likely to shape the future of healthcare

Role, structure, and funding of various health care organizations (e.g. physician's office, walk-in clinic, hospital, ambulatory surgery center, rehabilitation center, etc.), community health services, and public health

Patient relations

Nursing Medical Surgical Fundamentals

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

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

Nursing Care Plans

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

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

Nursing Pathophysiology:

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

- Cardiovascular system
- Circulatory system
- Renal system
- Respiratory system
- Nervous system
- Gastrointestinal system
- Endocrine system

Nursing Pathophysiology (Cont'd)

- Reproductive system
- Musculoskeletal system
- Integumentary system
- Cell and body tissue physiology
- Fluid and electrolyte balances
- Genetic and hereditary disorders
- Inflammation, infection and immune response systems
- Oncological diseases
- Otolaryngology
- Ophthalmology

Nursing Pharmacology

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

- Analgesic drugs
- General and local anesthetics
- Depressants and muscle relaxants
- Stimulants and related drugs
- Antiepileptic drugs
- Psychotherapeutic drugs
- Antiparkinsonian drugs
- Adrenergic drugs
- Cholinergic drugs
- Heart failure drugs
- Antdysrhythmic 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

Nursing Pharmacology (Cont'd)

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

Nursing RN (Pediatrics)

[\(Back to Science\)](#)

- Systems and Associated Disorders
 - Cardiovascular and circulatory
 - Endocrine
 - Excretory
 - Gastrointestinal
 - Immune
 - Integumentary
 - Musculoskeletal
 - Nervous and sensory
 - Reproductive
 - Respiratory
- Health Assessments
 - Communication with patients and family
 - Diagnostic testing and evaluation
 - Physical and developmental assessments
- Health Promotion
 - Health promotion for pediatric patients
 - Health promotion for the families of pediatric patients
 - Influences of family on child health promotion
 - Influences of socioeconomics, culture, and religion on child health promotion
- Nursing Care
 - Chronic illness
 - Cognitive and sensory impairment
 - Community-based nursing care
 - Disability
 - End-of-life care
 - Family-centered care
- Interventions
 - Behavioral
 - Community
 - Family
 - Health System

Physiological
Safety

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

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

Tutors must be knowledgeable of the following systems, and of associated disorders seen in all stages of childhood (newborn, infant, toddler, preschooler, school-age, and adolescent):

- Cardiovascular system
- Circulatory system
- Excretory system
- Respiratory system
- Nervous system
- Gastrointestinal system
- Endocrine system
- Reproductive system
- Musculoskeletal system
- Integumentary system
- Immune system
- Otolaryngology
- Ophthalmology

Tutors should be familiar with nursing care as it applies to pediatric patients in all of the following areas:

- Communication with the patient and family
- Pediatric nursing skills
- Physical and developmental assessments
- Diagnostic testing and evaluation

Health promotion for patients in all stages of childhood (newborn, infant, toddler, preschooler, school-age, and adolescent) and their families

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

Community-based nursing care

Family-centered care at home and during hospitalization

Care of the child and family in the following contexts:

Chronic illness

Disability

Cognitive and sensory impairment

End-of-life care

Tutors should be familiar with pediatric variations of standard nursing practices and interventions, including those in the following areas:

Pain assessment and management

Altered fluid electrolyte or acid-base balance

Medication administration

Trauma and shock

Pre- and post-surgery

Infections

Altered immunity

Cancer

Social Studies

[\(Back to Humanities\)](#)

Elementary (Grades 4-6)

Africa
American Historical Figures
American Revolution
China
Citizenship
Civil Rights
Civil War
Colonial Settlements in America
Communities
East Asia and Pacific
Egypt
Elections
Europe
Family and Authority

French and Indian War
Geography
Government
Greece
Holidays and Diversity
India
Japan
Latin America
Louisiana Purchase
Mesopotamia
Middle East
Native American Culture
Religions of the World
Rome

Slavery in America
South and Southeast Asia
The Bill of Rights
The Constitution
The Declaration of
Independence
The Incas
The Mayans
Trade
War of 1812
Westward Expansion
World Cultures

Middle Grades (Grades 7-8)

Africa
American Revolution
Articles of Confederation
Byzantine Empire
Central and South America
China
Civil Rights
Civil War
Colonial Settlements in America
Demographic Concepts
Early American government
and political systems

Economics
European History
Exploration
French and Indian War
Geography
India
Japan
Louisiana Purchase
Mapping
Middle East
Monroe Doctrine
Native Americans

North America
Religions of the World
Slavery in America
The Bill of Rights
The Constitution
The Declaration of
Independence
The Physical Environment
War of 1812
Westward Expansion

High School (Grades 9-12)

Africa
American Revolution
Ancient Civilizations
Articles of Confederation
Asia
Civil War
Cold War
Colonial Settlements in America
Contemporary World Events
Declaration of Independence
Early American Government
and Political Systems

Economics
European History
Geography
Gulf War
Industrialism
Korean War
Latin America
Louisiana Purchase
Middle East
Native Americans
Prehistoric America
Reconstruction
Slavery in America

Soviet Union and Eastern
Europe
The Bill of Rights
The Constitution
The Monroe Doctrine
Vietnam War
War of 1812
Westward Expansion
World War 1
World War 2

English

[\(Back to Humanities\)](#)

Elementary (Grades 4-6)

Adjectives
Adverbs
Antonyms
Compare/Contrast
Connotation
Contractions
Cross-Curricular
 Reading/Writing
Denotation
Extract ideas from a variety of
 texts
Fiction
Grammar

Graphemes
Letter Writing
Literary Analysis
Literary Device
Literary Themes
Non-Fiction
Nouns
Paragraphs
Parts of Speech
Phonemes
Plays and Theater
Poetry
Point of View

Prefix/Suffix
Presentations
Pronouns
Punctuation and Capitalization
Reading Comprehension
Research Skills
Root Words
Sentence Structure
Synonyms
Verbs
Vocabulary
Writing Sentences

Middle Grades (Grades 7-8)

Characterization
Connotation
Content Area Literacy
Contextual Analysis
Denotation
Elements of a Story
Grammar
Interdisciplinary Subjects
Interpreting Graphs in Text
Literary Analysis

Literary Criticism
Literary Devices
Literary Themes
Modes of Persuasion
Narrative
Non-Fiction
Oral Communication
Plays and Theater
Point of View
Prose and Poetry

Punctuation and Capitalization
Reading Comprehension
Research Skills - Sources and
Documentation
Sentence Structure
Subject Area Themes
Theme
Vocabulary

High School (Grades 9-12)

Argument
Copyright
Exposition
Expression through writing and
 presenting
Figures of Speech
Functional Texts
Grammar
Literary Analysis
Literary Criticism

Literary Devices
Literary Periods
Literary Themes
Logical Development of Ideas
Multimedia Communication
Oral Communication
Organizational Features of Text
Persuasion
Plays and Theater
Point of View

Presenting Media
Prose and Poetry
Punctuation and Capitalization
Reading Comprehension
Research Skills - Sources and
Documentation
Viewing Media
Visual Communication
Vocabulary

Literature

[\(Back to Humanities\)](#)

Literary Periods and Movements

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

Literary Criticism

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

Prose Non-Fiction

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

Dramatic Elements/Genres

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

Prose Fiction

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

Literary Elements

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

Literary Devices

- Allegory
- Irony: Verbal/Dramatic
- Figurative Language: Imagery
- Hyperbole and Synecdoche
- Mimesis/Metonymy
- Symbolism/Metaphor/Simile

Essay Writing

[\(Back to Humanities\)](#)

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

College Essay Writing

[\(Back to Humanities\)](#)

Argument
Business Writing
Citation and Documentation
College and Job Application Writing
Cover Letter Writing
Creative Writing
Descriptive Essay
Editing and Proofreading
Effective Content Analysis
Elements of Composition
Expository Essay
Grammar
Interdisciplinary Writing
Journal Writing
Lab Reports
Literary Analysis Writing
Narrative
Oral Communication
Organization and Outlining Essays
Paragraphs
Performance Pieces
Persuasive Essay
Poetry Writing
Pre-writing Skills
Punctuation and Capitalization
Research Skills and Resources
Resume Writing
Speech Writing
Story Writing
Technical Writing
Thesis Statements
Transitions
Use of Literary Devices
Vocabulary and Word Choice
Voice
Writing Conclusions
Writing for Standardized Tests
Writing Leads, Introductory Paragraphs, Conclusions
Writing Research Papers
Writing Strategies
Writing Styles

Primary Reading

[\(Back to Humanities\)](#)

Comprehension

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

Vocabulary and Word Recognition

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

Author's Craft

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

Text Structure

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

Understanding Features of Genres

- Poetry
- Fictional narratives
- Drama
- Informational texts
- Non-fiction

Reading

[\(Back to Humanities\)](#)

Describe features of different genres of writing or poetry. Apply suitable analysis strategies.

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

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

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

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

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

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

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

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

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

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

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

Draw valid generalizations from a given text.

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

Correctly establish facts from a opinions within a text.

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

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

- Analysis- graph, chart or table in a text
- Analysis- picture
- Other graphics in text context

Integrate main ideas and key details or events to create an effective summary of a text, passage, or book.

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

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

- Vocabulary in isolation
- Vocabulary in context

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

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

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

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

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

- Text features of persuasive writing
- Argument effectiveness

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

- Text connections
- Compare/contrasts related texts

Explain pre-reading activities that increase comprehension.

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

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

Use of English

- Articles
- Comparisons and Superlatives
- Conditionals
- Countable and non-countable nouns
- Determiners
- Indirect speech
- Irregular verb forms
- Modal verbs
- Participial adjectives
- Parts of a sentence
- Passive and active voice
- Passive causatives
- Phrasal verbs
- Phrase usage: Neither, nor, such, so
- Prepositions
- Pronouns
- Question formation
- Relative clauses
- Subject-verb agreement
- Tag questions
- Time expressions
- Uses of gerunds and infinitives
- Using dictionaries
- Verb tense formation and uses
- Vocabulary: definitions, usage, collocations, word families, and connotations.
- Vocabulary--finding meaning in context
- Word form/Morphology

English Writing

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

Speaking

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

Listening

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

Reading

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

Pedagogy of ESL

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

English Language Use

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

English Writing

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

Types of Writing

Critical Response
 Synthesis
 Argumentative
 Analysis
 Compare/contrast
 Narrative
 Descriptive
 Opinion
 Process
 Summary/paraphrase
 Research Papers

Speaking

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

Listening

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

Reading

Note taking
 Reading and processing academic texts
 Identifying main ideas vs. details
 Visual Organizers (Venn diagrams, concept maps, etc.)
 Skimming/scanning
 Predicting

Symbolic Logic

[\(Back to Humanities\)](#)

Inferences and Arguments (Premises and Conclusions)

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

Categorical Propositions

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

Categorical Syllogisms

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

Propositional Logic

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

Natural deduction in propositional logic

- Rules of implication and replacement
- Proving logical truths

Predicate Logic

- Symbols and translation
- Change of Quantifier
- Relational and Overlapping Quantifiers
- Translations in monadic predicate logic
- Translations in polyadic predicate logic
- Complex predicates
- Wide-scope quantifiers
- Derivations in predicate logic
- Symbolizing the statement form

Logic Truth Trees

- Propositional Logic
- Predicate Logic

Introduction to Psychology

[\(Back to Social Sciences\)](#)

History and Research

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

Biopsychology

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

Sensation and Perception

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

Consciousness

- Sleep and dreaming
- Sleep and dreaming
- Meditation
- Psychoactive drugs and consciousness

Conditioning and Learning

- Biological (neural) basis for learning
- Classical conditioning
- Operant conditioning
- Observational learning
- Cognitive processes in learning
- Constructivism
- Social learning, Implicit learning

Cognition

- Memory
 - Working memory
 - Memory storage and retrieval
 - Long & short term memory
 - Semantic/episodic
 - Implicit/explicit
 - Forgetting
 - Memory errors
- Language
 - Development
 - Speech
 - Reading
- Thinking
 - Concepts
 - Categories
- Problem solving
 - Decision making
 - Analogical problem solving
 - Creativity
 - Insight
- Intelligence
 - IQ
 - Intelligence testing
 - General/specific intelligences
 - Cultural impact

Motivation, emotion

- Biological basis
 - Emotion and the brain
 - Hunger
 - Thirst
 - Sex
 - Pain
- Social motivation
- Theories of emotion
- Stress

Developmental

- Types of development
 - Physical
 - Cognitive
 - Social
 - Moral
- Gender, sex, and sexuality
- Heredity and environment
- Lifespan: prenatal through geriatric
- Developmental research methods
 - Longitudinal
 - Cross-sectional

Personality

Assessment: measuring personality

Theories of personality

Type

Trait

Behaviorist

Biopsychological

Psychodynamic

Humanistic

Social cognitive

Self-concept and self-esteem

Psychological disorders

Defining "normality" and "abnormality"

Anxiety disorders

Dissociative disorders

Mood disorders

Neurocognitive disorders

Personality disorders

Psychoses

Somatoform disorders

Health, stress, coping

Treatment

Psychological therapies

Behavioral

Cognitive

Humanistic

Group

Psychodynamic

Medical therapies, psychopharmacology

Community psychology

Social psychology

Aggression & antisocial behavior

Attitudes, attitude change

Attribution processes

Conformity, compliance & obedience

Group dynamics

Interpersonal perception

Cultural influences

Statistics, tests, measurement

Descriptive & inferential statistics (definitions)

Measurement, operational definitions

Reliability and validity

Samples, populations, standardization & norms

Research Methods

[\(Back to Social Sciences\)](#)

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

[\(Back to Social Sciences\)](#)

History and Theory

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

Theories of Self

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

Culture and Society

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

Social Class

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

Deviance and Social Control

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

Race/Ethnicity

- Common Culture
- Shared Experience
- Divisions

Race/Ethnicity (Cont'd)

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

Gender/Sex

- Biological Traits
- Gender Norms
- Gender Orders
- Masulinity/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

Financial Reporting and Accounting Cycle

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

Accounting for Service and Merchandising Companies

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

Internal Controls & Cash

- Bank reconciliations
- Petty cash

Accounting for Property, Plant, and Equipment

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

Accounting for Partnerships

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

Accounting for Corporations

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

Accounting for Investments

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

Bonds Payable

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

Payroll and Taxes

- Accounting for taxes
- Accounting for payroll

Managerial Accounting

- Job order costing
- Process costing
- Activity-based costing
- Cost-volume-profit analysis
- Variable vs. absorption costing
- Budgets
- Planning, control, and performance evaluation
- Differential analysis
- Capital investment decisions

Intermediate Accounting

[\(Back to Business\)](#)

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

Error corrections

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

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

Macroeconomics

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

Microeconomics

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

Finance

[\(Back to Business\)](#)

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

Financial Choices of Firms

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

The Financial Environment

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

Principles of Management

[\(Back to Business\)](#)

History and Theories of Management

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

The Role of Customer Relations

- Building customer relationships
- Promotions, Pricing & Credit
- Environmentalism (burdens and potentials)
- Psychological & Sociological influences

Professional Management & Managing Growth

- Managing Human Resources
- Managing Operations
- Managing Risk
- Leadership & Authority
- Time management

Entrepreneurial Opportunities

- Small Businesses Concepts

Ethics in Business

- Integrity framework
- Supporting Organizational Culture

Business Analysis

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

The Business Plan

- Function of and formatting plan
- Main types of plans

Employee Relations & Leadership

- Roles in motivation
- Specifying structure and creating balance

Legal forms of Organizations

- Sole proprietorship, partnerships, C corp, LLC, etc.

Financial Planning

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

Product & Supply Chain Management

- Product lifecycle
- Branding, labeling, strategies

Business Law

[\(Back to Business\)](#)

Foundations of Law

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

Dispute Settlement

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

Contracts & E-Contracts

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

Sales & Lease Contract Formation

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

Agency and Employment

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

Business Organization

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

Property

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

Commerical Paper

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

Creditor Rights

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

Database Relations and Development

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

Tables

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

Queries

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

Forms

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

Reports and Reporting Tools

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

Macros

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

Importing/Exporting

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

Data Analysis

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

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

Environment & Capabilities

- File Tab
- Excel Options – including finding and customizing
- Templates – including finding and implementing
- Add-Ins – including finding and installing

Toolbars

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

Spreadsheet Basics

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

Formatting

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

Filtering & Sorting

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

Formulas & Functions

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

Charts, Tables, & PivotTables

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

Importing & Exporting

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

Macros

- Recording Macros
- Running Macros

Saving, Sharing & Protecting

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

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

Program Fundamentals

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

Getting Started with Documents

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

Working With and Editing Text

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

Formatting Characters and Paragraphs

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

Formatting the Page

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

Working with Themes and Styles

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

Working with Shapes and Pictures

- Inserting and Formatting Clip Art, Screenshots, Pictures, Text Boxes, Shapes, and Graphics Files
- Removing a Picture's Background
- Formatting and Otherwise Altering the Look of Pictures and Graphics
- Resizing, Moving, Copying, Positioning, Grouping, and Deleting Objects
- Applying Special Effects

Aligning, Distributing, Flipping, Rotating, and Layering Objects

Working with WordArt, SmartArt, and Charts

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

Working with Tables

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

Working with Mailings

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

Using Collaborative Editing Tools

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

Working with Templates

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

Working with Forms

Creating a New Form
Adding Content Controls
Assigning Help to Form Content Controls
Preparing the Form for Distribution
Filling Out a Form

Customizing Word

Customizing the Ribbon and Quick Access Toolbar
Using and Customizing AutoCorrect
Changing Word's Default Options

More Topics

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

MS PowerPoint

[\(Back to Technology\)](#)

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

Windows Installation and Setup

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

File and Folder Operations

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

Windows Utilities

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

Basic Software & Hardware Management

- Windows Apps & Microsoft Store
- Adding/Removing Programs
- Adding/Removing/Managing Printers
- Adding/Removing/Managing Bluetooth Devices
- Locating and Running Programs

Accessing the Internet

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

Basic Troubleshooting

- Viewing System Information
- Task Manager - Monitoring System Performance
- Windows Troubleshooter
- Safe Mode

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

Object-Oriented Program Design

Program design

Read and understand a problem description, purpose, and goals

Apply data abstraction and encapsulation.

Read and understand class specifications and relationships among the classes ("is-a," "has-a" relationships).

Understand and implement a given class hierarchy.

Identify reusable components from existing code using classes and class libraries.

Class design

Design and implement a class.

Choose appropriate data representation and algorithms.

Apply functional decomposition.

Extend a given class using inheritance.

Program Implementation

Implementation techniques

[Backtracking](#)

[Greedy algorithms](#)

[Divide and conquer](#)

[Modular programming](#)

Methodology

Object-oriented development

Top-down development

Encapsulation and information hiding

Procedural abstraction

Programming constructs

Primitive types vs. objects

Declaration

Constant declarations

Variable declarations

Class declarations

Interface declarations

Method declarations

Parameter declarations

Console output (System.out.print/println)

Control

Methods

Sequential

Conditional

Iteration

Understand and evaluate recursive methods

Java library classes

C++ library classes

Program Analysis

Testing

Test classes and libraries in isolation.

Identify boundary cases and generate appropriate test data.

Perform integration testing.

Debugging

Categorize errors: compile-time, run-time, logic.

Identify and correct errors.

Employ techniques such as using a debugger, adding extra output statements, or hand-tracing code.

Understand and modify existing code

Extend existing code using inheritance

Understand error handling

Understand runtime exceptions.

Reason about programs

Pre- and post-conditions

Assertions

Analysis of algorithms

Informal comparisons of running times

Exact calculation of statement execution counts

Basic big-O questions

Numerical representations and limits

Representations of numbers in different bases

Limitations of finite representations (e.g., integer bounds, imprecision of floating-point representations, and round-off error)

Standard Data Structures

Simple data types (int, boolean, double)

Classes

Lists

Arrays

Sets and Multisets

Stacks

Dictionaries

Queues

Trees, binary trees, and binary search trees

Standard Algorithms

Operations on data structures previously listed

Traversals

Insertions

Deletions

Searching

Sequential

Binary

Bubble Sort

Selection Sort

Insertion Sort

Mergesort

Computing in Context

System reliability

Privacy

Legal issues and intellectual property

Social and ethical ramifications of computer use

Software Methodology

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

Namespaces**Functions****Control Structures**

- Conditional (if, if else, else, switch statements)

- Iteration (for, while, do-while loops)

- Break and continue

Input/Output

- Standard (iostream)

- File I/O (fstream)

Strings**Pointers****Exception Handling**

- Try/Catch blocks

- Throw statement

Arrays**Classes and Structs****Operator Overloading****Parameters**

- Call by reference vs Call by value

Inheritance

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

Primitive Data Types

- Integers
- Floating Point Types
- Characters
- Boolean

Literals

Variables

- Variable Scope
- Initializing Variables

Operators

Type Casting and Conversion

Control Statements

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

Classes

- Constructors
- Class Definitions
- Object Instantiation

Methods

- Using Parameters
- Method Overloading
- Returning Values

Arrays

- Multidimensional Arrays
- Irregular Arrays

Strings

- Constructing Strings
- Operating on Strings

Bitwise Operators

Static Keyword

File I/O

Inheritance and Polymorphism

- Superclasses and Subclasses
- Abstract Classes
- Method Overriding

Packages and Interfaces

- Packages and Member Access
- Implementing Interfaces

Exception Handling

- Using Try-Catch-Finally
- The Exception Hierarchy

Enumerations

Generics Fundamentals

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

Lists

Control Flow and Looping (while/for, use of the range() function instead of traditional for loop)

Tuples (relation to lists, unpacking)

List/Dictionary/Generator comprehensions

"Dunder" methods (__init__, __plus__, etc)

Variadic arguments (*args)

Keyword arguments (kwargs)**

List slices

Generators (yield)

Lambda functions

Dictionaries

Functions (including map, filter, reduce)

Files

Internet Fundamentals

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

HTML

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

CSS

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

Fundamental Javascript

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

PHP

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

Accessibility

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

Database Design

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

CRUD Statements

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

Advanced Queries

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

Filtering Query Output

- WHERE Statement
- ORDER BY Statement
- Applying logical filters

Hosting Databases

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

Remote Database Access

- Designing a client application
- Result Sets
- Designing a Report

Database Management Systems

- SQL Server
- Oracle
- MS Access

Spanish

[\(Back to Languages\)](#)

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

Basic Sentence Structure

Gender & Number of Nouns

Vocabulary (including but not limited to...)

Numbers and time
Greetings, letter writing, speaking on the phone
Food and drink
Marketplace
Clothing
Education and careers
Personal relationships, friends, family
Emotions
Hobbies, sports, leisure, travel
Animals, plants, scenery, weather
Body parts, illnesses, basic medical terms
Residences, rooms, furniture
Government, public institutions, infrastructure, news
French/English *faux amis*
Common French idioms

Grammar and Style

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

Pronouns

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

Determiners

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

Other grammatical components

Adjectives, including comparative and superlative adjectives (e.g. *meilleur*)
Adjective placement relative to noun
Adverbs, including comparative and superlative adverbs (e.g. *bien, mieux*)
Prepositions

Sentence structures

Negation

Interrogative sentences

Passive voice

Conditional constructions

Compound and complex sentences with independent and dependent clauses

Literature (including but not limited to...)

Louise Labé

Jean-Jacques Rousseau

Guy de Maupassant

Paul Verlaine

Jules Verne

Victor Hugo

Albert Camus

Pronunciation and Phonetics

Describe how French vowels and certain French consonants differ from their English counterparts

Identify silent consonants and vowels

Identify and pronounce nasalized vowels

Use *liaison* and *enchaînement* to enhance euphony

Describe how stress functions in words and sentences

Describe how pronunciation and stress differ in poetry

French History and Culture

Basic history of France, from Roman Gaul to modern times

Basic geography of France, French territories, and other French-speaking nations

French education system

Present-day government of France

French holidays and customs

German

[\(Back to Languages\)](#)

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

[\(Back to Languages\)](#)

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