

# 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
Nursing		

## 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 Windows	MS Access	MS Excel	MS Word	MS PowerPoint
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

## **Linear Equations and Inequalities**

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

## **Numbers**

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

## **Patterns and Functions**

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

## **Probability**

Counting Principles and Sample Spaces  
Theoretical and Experimental Probability

## **Quadratic Equations, Inequalities, and Functions**

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

## **Radical, Exponential and Logarithmic Equations and Functions**

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

## **Statistics**

Data Analysis – Data Collection – Data Displays – Measures of Data

# Algebra II

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## 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

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## Measurement

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

## Points, Lines, Angles, Planes

- Angle Relationships and Problems
- Coordinate Geometry - Slope, Distance, Midpoint
- Geometric Constructions

## Proofs and Logic

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

## Two- and Three- Dimensional Shapes

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

# Trigonometry

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## 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

# Calculus

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## Limits of functions (including one-sided limits)

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

## Continuity

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

## Derivatives

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

## Integrals

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

## Parametric and Polar Curves

- Graphs, derivatives, areas, arc length

## Series and Sequences

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

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

- Circle, ellipse, hyperbola, and parabola
- Perform translations for various conic sections
- Arithmetic and Geometric sequences
- Trigonometric Ratios and Identities

- Trigonometric graphs
- Law of Cosines and Law of Sines
- Functions and Graphs (Linear and Polynomial)
- Exponential and Logarithmic Functions

# Calculus BC

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## 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

# Multivariable Calculus

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## 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  $2 \times 2$  games - geometric approach  
Linear programming and  $m \times n$  games - simplex method and the dual

## Discrete Math

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- 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

# Quantitative Methods

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

## Applications and Limitations of Quantitative Analysis

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

## Data and Terms

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

## Decision Models

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

## Forecasting

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

## Linear Algebra

- Vector
- Matrix
- Determinant
- Solving systems

## Calculus

- Functions
- Derivatives
- Optimization

## Advanced Statistical Modeling

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

# Linear Algebra

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

## 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  $2 \times 2$  and  $3 \times 3$  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

G<sub>0</sub>, G<sub>1</sub>, S, G<sub>2</sub>, 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 (1<sup>st</sup> Law)
    - Translational equilibrium
    - Rotational equilibrium (torque)
  - Free Body Diagram
  - Dynamics of a single body (2<sup>nd</sup> law) --
    - Force
  - Systems of two or more bodies (3<sup>rd</sup> 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

# Microbiology

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

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

## Basic Biology

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

## Microbial Traits

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

## Microbial Traits (Cont'd)

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

## Genetics

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

## Ecology

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

## Pathogenicity

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



## **Pathogenicity (Cont'd)**

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

Sterilization

Disinfection

## **Immunization**

Innate host resistance

Adaptive Immunity

Sanitation

Hygiene

## **Health**

Epidemiology

Antimicrobial chemotherapy

Microbiology of food

Industrial microbiology

## **Laboratory Techniques**

Basic laboratory equipment identification

Guidelines for safe handling of

microorganisms and infectious materials

Microscope use including oil emersion

Methods for taking clinical samples

Incubation techniques

Inoculation techniques

Isolation techniques

Identification techniques

Gram stain

ELISA

Chromatography

Spectrophotometry

Serial dilution technique and calculations

# Organic Chemistry

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

## 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

# Nursing

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

## 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

# 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

# Introductory Accounting

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

## 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

## Commercial Paper

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

## Creditor Rights

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

# MS Windows

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***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

# MS Access

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## 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

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



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

## Object-Oriented Program Design

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

## Program Implementation

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

## Program Analysis

- Testing
- Test classes and libraries in isolation.
- Identify boundary cases and generate appropriate test data.
- Perform integration testing.

Debugging

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

Identify and correct errors.

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

Understand and modify existing code

Extend existing code using inheritance

Understand error handling

Understand runtime exceptions.

Reason about programs

Pre- and post-conditions

Assertions

Analysis of algorithms

Informal comparisons of running times

Exact calculation of statement execution counts

Basic big-O questions

Numerical representations and limits

Representations of numbers in different bases

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

### **Standard Data Structures**

Simple data types (int, boolean, double)

Classes

Lists

Arrays

Sets and Multisets

Stacks

Dictionaries

Queues

Trees, binary trees, and binary search trees

### **Standard Algorithms**

Operations on data structures previously listed

Traversals

Insertions

Deletions

Searching

Sequential

Binary

Bubble Sort

Selection Sort

Insertion Sort

Mergesort

### **Computing in Context**

System reliability

Privacy

Legal issues and intellectual property

Social and ethical ramifications of computer use

Software Methodology

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

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

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

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

- Break and continue

**Input/Output**

- Standard (iostream)

- File I/O (fstream)

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

- Try/Catch blocks

- Throw statement

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

- Call by reference vs Call by value

**Inheritance**

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

## **Primitive Data Types**

- Integers
- Floating Point Types
- Characters
- Boolean

## **Literals**

## **Variables**

- Variable Scope
- Initializing Variables

## **Operators**

## **Type Casting and Conversion**

## **Control Statements**

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

## **Classes**

- Constructors
- Class Definitions
- Object Instantiation

## **Methods**

- Using Parameters
- Method Overloading
- Returning Values

## **Arrays**

- Multidimensional Arrays
- Irregular Arrays

## **Strings**

- Constructing Strings
- Operating on Strings

## **Bitwise Operators**

## **Static Keyword**

## **File I/O**

## **Inheritance and Polymorphism**

- Superclasses and Subclasses
- Abstract Classes
- Method Overriding

## **Packages and Interfaces**

- Packages and Member Access
- Implementing Interfaces

## **Exception Handling**

- Using Try-Catch-Finally
- The Exception Hierarchy

## **Enumerations**

## **Generics Fundamentals**

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

## Lists

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

**Tuples (relation to lists, unpacking)**

**List/Dictionary/Generator comprehensions**

**"Dunder" methods (\_\_init\_\_, \_\_plus\_\_, etc)**

**Variadic arguments (\*args)**

**Keyword arguments (\*\*kwargs)**

**List slices**

**Generators (yield)**

**Lambda functions**

**Dictionaries**

**Functions (including map, filter, reduce)**

**Files**

## **Internet Fundamentals**

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

## **HTML**

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

## **CSS**

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

## **Fundamental Javascript**

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

## **PHP**

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

## **Accessibility**

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

# Database Systems

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## 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

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## 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

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## 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