**Comprehensive Power Standards Curriculum for 6th Grade Math**

Below is a detailed curriculum with **power standards**, **review standards**, **supplementary standards**, **timeline**, **motivational strategies**, and **lessons** for each standard.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **Ratios and Proportional Relationships** | Understand ratios and unit rates | 6.RP.A.1, 6.RP.A.2 |
| **The Number System** | Divide fractions by fractions | 6.NS.A.1 |
|  | Fluently compute multi-digit decimals | 6.NS.B.3 |
|  | Understand integers and rational numbers | 6.NS.C.5, 6.NS.C.6, 6.NS.C.7 |
| **Expressions and Equations** | Write and evaluate expressions | 6.EE.A.2 |
|  | Solve equations and inequalities | 6.EE.B.5 |
| **Geometry** | Solve area, surface area, and volume problems | 6.G.A.1 |
|  | Represent 3D figures using nets | 6.G.A.4 |
| **Statistics and Probability** | Summarize and describe data sets | 6.SP.B.5 |

**Power Standards with Review Standards, Supplement Standards, Timeline, Motivation, and Lessons**

**1. Ratios and Proportional Relationships**

* **Power Standard**: Understand the concept of a ratio and use ratio reasoning to solve real-world problems. *(6.RP.A.1, 6.RP.A.2, 6.RP.A.3)*
* **Review Standards**:
  + 5.NF.B.6: Solve real-world problems involving multiplication of fractions.
  + 5.MD.C.5: Understand volume concepts for rectangular prisms.
* **Supplementary Standards**:
  + 6.NS.A.1: Interpret quotients of fractions in real-world problems.
  + 6.EE.B.6: Represent proportional relationships using equations.
* **Timeline**: Weeks 1-3
* **Motivation**:
  + Discuss real-world applications like recipes, scaling up/down, and comparing prices.
  + Use group activities like "Mixing Paint Ratios" or "Finding the Best Deal."
* **Lessons**:
  + **Introduction to Ratios**: Use visuals to identify part-to-part and part-to-whole relationships.
  + **Unit Rates**: Solve problems comparing speed or price per unit.
  + **Proportional Reasoning**: Create tables of equivalent ratios and solve cross-multiplication problems.

**2. The Number System**

* **Power Standard 1**: Divide fractions by fractions in real-world contexts. *(6.NS.A.1)*
  + **Review Standards**: 5.NF.B.7: Divide whole numbers by fractions.
  + **Supplementary Standards**: 6.EE.A.2: Write expressions to represent division scenarios.
  + **Timeline**: Weeks 4-5
  + **Motivation**: Discuss practical examples like cutting a recipe in half or splitting an amount into fractional parts.
  + **Lessons**:
    1. Visual Fraction Division: Use area models to explain division.
    2. Word Problems: Solve real-world examples like dividing a length of ribbon.
    3. Algorithm Practice: Transition to the "Keep-Change-Flip" method.
* **Power Standard 2**: Fluently compute multi-digit decimals. *(6.NS.B.3)*
  + **Review Standards**: 5.NBT.B.7: Add and subtract decimals.
  + **Supplementary Standards**: 6.EE.B.7: Solve equations involving decimals.
  + **Timeline**: Weeks 6-7
  + **Motivation**: Use contexts like shopping with money, distance in sports, or time calculations.
  + **Lessons**:
    1. Decimal Operations Review: Practice all four operations.
    2. Multi-Step Problems: Solve multi-step word problems involving decimals.
    3. Real-World Application: Budgeting activities.

**3. Expressions and Equations**

* **Power Standard**: Write and evaluate expressions with variables. *(6.EE.A.2, 6.EE.B.5)*
* **Review Standards**:
  + 5.OA.A.1: Use parentheses, brackets, and braces in numerical expressions.
  + 5.OA.A.2: Write simple expressions with variables.
* **Supplementary Standards**:
  + 6.EE.A.3: Apply properties of operations to generate equivalent expressions.
  + 7.EE.B.4: Solve multi-step equations and inequalities.
* **Timeline**: Weeks 8-11
* **Motivation**:
  + Relate to real-world situations, such as calculating costs or solving for unknowns in recipes or construction problems.
* **Lessons**:
  + Expressions with Variables: Write algebraic expressions from word problems.
  + Evaluating Expressions: Substitute values into expressions.
  + Solving Equations: Solve one-step and two-step equations.

**4. Geometry**

* **Power Standard**: Solve problems involving area, surface area, and volume. *(6.G.A.1, 6.G.A.4)*
* **Review Standards**:
  + 5.MD.C.5: Understand volume concepts.
  + 4.MD.C.7: Solve problems involving area and perimeter.
* **Supplementary Standards**:
  + 6.EE.A.2: Represent area and volume problems with expressions.
  + 7.G.B.6: Solve area, volume, and surface area problems for composite shapes.
* **Timeline**: Weeks 12-14
* **Motivation**:
  + Relate to real-life tasks, such as wrapping gifts (surface area) or designing a garden (area and volume).
* **Lessons**:
  + **Nets of 3D Shapes**: Use manipulatives to build and explore nets.
  + **Area Applications**: Calculate area for real-world objects like walls or floors.
  + **Volume Applications**: Solve problems involving packing or filling containers.

**5. Statistics and Probability**

* **Power Standard**: Summarize and describe distributions of data sets. *(6.SP.B.5)*
* **Review Standards**:
  + 5.MD.B.2: Create line plots with fractional data.
  + 4.MD.B.4: Interpret data in graphs.
* **Supplementary Standards**:
  + 6.EE.A.2: Use variables to summarize data sets.
  + 7.SP.B.4: Use measures of center and variability to compare data distributions.
* **Timeline**: Weeks 15-16
* **Motivation**:
  + Use real-world data, such as analyzing sports statistics or survey results, to create engaging discussions.
* **Lessons**:
  + **Dot Plots and Histograms**: Organize data into meaningful visualizations.
  + **Measures of Center**: Explore mean, median, and mode.
  + **Comparing Data**: Analyze variability and spread.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1-3 | Ratios and Proportional Relationships | 6.RP.A.1, 6.RP.A.2, 6.RP.A.3 |
| 4-5 | Dividing Fractions | 6.NS.A.1 |
| 6-7 | Decimal Fluency | 6.NS.B.3 |
| 8-11 | Expressions and Equations | 6.EE.A.2, 6.EE.B.5 |
| 12-14 | Geometry | 6.G.A.1, 6.G.A.4 |
| 15-16 | Statistics | 6.SP.B.5 |

**Comprehensive Power Standards Curriculum for 7th Grade Math**

This curriculum outlines the **power standards**, **review standards**, **supplementary standards**, a **timeline**, and **motivational strategies** for 7th-grade math. Detailed lessons for each standard are included.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **Ratios and Proportional Relationships** | Analyze proportional relationships and use them to solve problems | 7.RP.A.1, 7.RP.A.2, 7.RP.A.3 |
| **The Number System** | Apply and extend operations with rational numbers | 7.NS.A.1, 7.NS.A.2, 7.NS.A.3 |
| **Expressions and Equations** | Solve multi-step real-world and mathematical problems using numerical and algebraic expressions | 7.EE.B.3, 7.EE.B.4 |
| **Geometry** | Solve problems involving scale drawings, area, surface area, and volume | 7.G.A.1, 7.G.B.6 |
| **Statistics and Probability** | Investigate chance processes and draw inferences from data | 7.SP.A.2, 7.SP.B.4 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. Ratios and Proportional Relationships**

* **Power Standard**: Analyze proportional relationships and use them to solve problems. *(7.RP.A.1, 7.RP.A.2, 7.RP.A.3)*
* **Review Standards**:
  + 6.RP.A.1: Understand ratios and use ratio language to describe relationships.
  + 6.RP.A.3: Use ratio reasoning to solve real-world problems.
* **Supplementary Standards**:
  + 7.EE.B.3: Solve multi-step problems involving proportions.
  + 7.G.A.1: Solve problems involving scale drawings.
* **Timeline**: Weeks 1-4
* **Motivation**:
  + Use real-world applications like comparing prices, map reading, and recipes.
  + Engage students with activities like “Best Deals” or “Map Adventures.”
* **Lessons**:
  + **Understanding Proportions**: Use tables and graphs to analyze proportional relationships.
  + **Unit Rates and Applications**: Solve real-world problems involving speed, cost, and time.
  + **Constant of Proportionality**: Find and interpret the constant of proportionality in tables, graphs, and equations.

**2. The Number System**

* **Power Standard**: Apply and extend operations with rational numbers. *(7.NS.A.1, 7.NS.A.2, 7.NS.A.3)*
* **Review Standards**:
  + 6.NS.C.5: Understand and interpret positive and negative numbers.
  + 6.NS.C.6: Plot rational numbers on the number line.
  + 6.NS.B.3: Fluently compute with multi-digit decimals.
* **Supplementary Standards**:
  + 7.EE.B.3: Solve real-world problems involving rational numbers.
  + 7.SP.B.4: Analyze data involving rational numbers.
* **Timeline**: Weeks 5-8
* **Motivation**:
  + Use relatable contexts like temperatures, bank account balances, or sports scores.
  + Include challenges like “Real-Life Positive and Negative Scenarios.”
* **Lessons**:
  + **Adding and Subtracting Rational Numbers**: Use number lines and models for visual understanding.
  + **Multiplying and Dividing Rational Numbers**: Explore practical applications like calculating discounts or sharing costs.
  + **Word Problems with Rational Numbers**: Solve multi-step problems involving all four operations.

**3. Expressions and Equations**

* **Power Standard**: Solve multi-step real-world and mathematical problems using expressions and equations. *(7.EE.B.3, 7.EE.B.4)*
* **Review Standards**:
  + 6.EE.A.2: Write, read, and evaluate algebraic expressions.
  + 6.EE.B.5: Solve one-step equations.
* **Supplementary Standards**:
  + 7.RP.A.2: Represent proportional relationships with equations.
  + 8.EE.C.7: Solve linear equations in one variable.
* **Timeline**: Weeks 9-12
* **Motivation**:
  + Use real-world applications like budgeting, construction, or sports analysis.
  + Engage students with puzzles like “Find the Unknown.”
* **Lessons**:
  + **Multi-Step Equations**: Use inverse operations to solve equations.
  + **Inequalities**: Solve and graph solutions on number lines.
  + **Real-World Applications**: Solve problems involving taxes, discounts, and interest.

**4. Geometry**

* **Power Standard**: Solve problems involving scale drawings, area, surface area, and volume. *(7.G.A.1, 7.G.B.6)*
* **Review Standards**:
  + 6.G.A.1: Solve problems involving area, surface area, and volume.
  + 6.G.A.3: Understand two-dimensional cross-sections of three-dimensional objects.
* **Supplementary Standards**:
  + 7.RP.A.1: Use scale factors in real-world geometry problems.
  + 8.G.C.9: Solve volume problems for cones, cylinders, and spheres.
* **Timeline**: Weeks 13-16
* **Motivation**:
  + Relate to tasks like designing a room, packaging products, or creating models.
  + Use group projects like “Design Your Dream Room” or “Build the Perfect Box.”
* **Lessons**:
  + **Scale Drawings**: Create and interpret scale drawings of objects or maps.
  + **Surface Area**: Use nets and solve problems involving wrapping paper or paint.
  + **Volume**: Solve real-world problems involving liquid containers or storage boxes.

**5. Statistics and Probability**

* **Power Standard**: Investigate chance processes and draw inferences from data. *(7.SP.A.2, 7.SP.B.4)*
* **Review Standards**:
  + 6.SP.A.2: Understand data distributions.
  + 6.SP.B.5: Summarize and describe data sets.
* **Supplementary Standards**:
  + 7.EE.B.3: Solve equations involving statistical data.
  + 8.SP.A.3: Use scatterplots to analyze data.
* **Timeline**: Weeks 17-20
* **Motivation**:
  + Engage students with relatable topics like sports statistics or class surveys.
  + Include interactive activities like “Predict the Winner” or “Data Detectives.”
* **Lessons**:
  + **Sampling and Inferences**: Use random sampling to make predictions.
  + **Comparing Data Distributions**: Analyze and compare box plots and histograms.
  + **Probability Applications**: Conduct experiments to explore probability models.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1-4 | Ratios and Proportional Relationships | 7.RP.A.1, 7.RP.A.2, 7.RP.A.3 |
| 5-8 | Rational Numbers | 7.NS.A.1, 7.NS.A.2, 7.NS.A.3 |
| 9-12 | Expressions and Equations | 7.EE.B.3, 7.EE.B.4 |
| 13-16 | Geometry | 7.G.A.1, 7.G.B.6 |
| 17-20 | Statistics and Probability | 7.SP.A.2, 7.SP.B.4 |

**Comprehensive Power Standards Curriculum for 8th Grade Math**

This curriculum includes **power standards**, **review standards**, **supplementary standards**, a **timeline**, **motivational strategies**, and **lessons** for each standard.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **The Number System** | Understand and perform operations with irrational and rational numbers | 8.NS.A.1, 8.NS.A.2 |
| **Expressions and Equations** | Analyze and solve linear equations and systems of equations | 8.EE.B.5, 8.EE.C.8 |
|  | Work with radicals and integer exponents | 8.EE.A.1, 8.EE.A.2 |
| **Functions** | Define, evaluate, and compare functions | 8.F.A.1, 8.F.A.2, 8.F.B.5 |
| **Geometry** | Apply the Pythagorean Theorem | 8.G.B.6, 8.G.B.7, 8.G.B.8 |
| **Statistics and Probability** | Investigate patterns of association in bivariate data | 8.SP.A.1, 8.SP.A.2 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. The Number System**

* **Power Standard**: Understand and perform operations with irrational and rational numbers. *(8.NS.A.1, 8.NS.A.2)*
* **Review Standards**:
  + 7.NS.A.1: Add and subtract rational numbers.
  + 7.NS.A.2: Multiply and divide rational numbers.
* **Supplementary Standards**:
  + 8.EE.A.2: Work with square roots and cube roots.
  + 8.SP.A.3: Apply rational numbers in scatterplots.
* **Timeline**: Weeks 1–3
* **Motivation**:
  + Connect irrational numbers to real-world contexts, such as calculating diagonal distances or using π in circles.
  + Use hands-on activities, like estimating square roots or exploring repeating decimals.
* **Lessons**:
  + **Exploring Rational and Irrational Numbers**: Classify numbers using number lines.
  + **Approximating Irrational Numbers**: Estimate values of square roots and π.
  + **Real-World Applications**: Solve problems involving diagonal distances and measurements.

**2. Expressions and Equations**

* **Power Standard 1**: Analyze and solve linear equations and systems of equations. *(8.EE.B.5, 8.EE.C.8)*
* **Power Standard 2**: Work with radicals and integer exponents. *(8.EE.A.1, 8.EE.A.2)*
* **Review Standards**:
  + 7.EE.B.4: Solve two-step equations.
  + 6.EE.A.1: Understand whole-number exponents.
* **Supplementary Standards**:
  + 8.F.A.3: Use functions to model equations.
  + 8.SP.A.4: Interpret linear relationships in scatterplots.
* **Timeline**: Weeks 4–8
* **Motivation**:
  + Apply equations to real-world contexts like balancing budgets, population growth, or business profits.
  + Include games like “Equation Escape Room” or “Exponent War.”
* **Lessons**:
  + **Solving Systems by Graphing**: Visualize solutions on coordinate planes.
  + **Simplifying Expressions with Exponents**: Use the properties of exponents.
  + **Word Problems with Systems of Equations**: Solve real-world problems involving constraints.

**3. Functions**

* **Power Standard**: Define, evaluate, and compare functions. *(8.F.A.1, 8.F.A.2, 8.F.B.5)*
* **Review Standards**:
  + 7.RP.A.2: Represent proportional relationships with equations.
  + 6.EE.C.9: Represent relationships between dependent and independent variables.
* **Supplementary Standards**:
  + 8.EE.B.5: Understand the relationship between proportionality and linear functions.
  + 8.SP.A.1: Analyze functions in scatterplots.
* **Timeline**: Weeks 9–12
* **Motivation**:
  + Relate to real-world examples like tracking temperature over time, profit vs. cost, or speed vs. distance.
  + Include projects like “Graphing My Daily Activities” or “Tracking Expenses.”
* **Lessons**:
  + **Understanding Functions**: Define functions and compare them with non-functions.
  + **Comparing Functions**: Use tables, graphs, and equations to compare.
  + **Analyzing Word Problems**: Interpret the meaning of key features in graphs.

**4. Geometry**

* **Power Standard**: Apply the Pythagorean Theorem. *(8.G.B.6, 8.G.B.7, 8.G.B.8)*
* **Review Standards**:
  + 7.G.B.6: Solve problems involving area, surface area, and volume.
  + 6.G.A.3: Understand slicing and cross-sections of solids.
* **Supplementary Standards**:
  + 8.EE.A.2: Work with square roots to calculate diagonal distances.
  + 8.SP.A.1: Apply the theorem in scatterplots.
* **Timeline**: Weeks 13–16
* **Motivation**:
  + Relate to real-world applications like navigation, construction, and design.
  + Include hands-on activities, such as “Find the Shortest Path” or “Design a Garden.”
* **Lessons**:
  + **Proving the Pythagorean Theorem**: Use area models to derive the theorem.
  + **Applying the Theorem**: Solve problems with diagonal distances in 2D and 3D.
  + **Real-World Problems**: Solve tasks involving navigation or architecture.

**5. Statistics and Probability**

* **Power Standard**: Investigate patterns of association in bivariate data. *(8.SP.A.1, 8.SP.A.2)*
* **Review Standards**:
  + 7.SP.A.2: Use data from a random sample to draw inferences.
  + 6.SP.B.4: Represent data in various plots.
* **Supplementary Standards**:
  + 8.F.B.4: Interpret the slope and intercept in linear models.
  + 8.EE.B.5: Understand the relationship between slope and proportionality.
* **Timeline**: Weeks 17–20
* **Motivation**:
  + Use real-world data, like sports stats, social media trends, or weather patterns.
  + Conduct experiments or surveys to generate bivariate data.
* **Lessons**:
  + **Creating Scatterplots**: Plot and interpret bivariate data.
  + **Line of Best Fit**: Use lines to make predictions.
  + **Analyzing Associations**: Interpret correlations and causations in real-world contexts.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1–3 | The Number System | 8.NS.A.1, 8.NS.A.2 |
| 4–8 | Expressions and Equations | 8.EE.A.1, 8.EE.A.2, 8.EE.B.5, 8.EE.C.8 |
| 9–12 | Functions | 8.F.A.1, 8.F.A.2, 8.F.B.5 |
| 13–16 | Geometry | 8.G.B.6, 8.G.B.7, 8.G.B.8 |
| 17–20 | Statistics and Probability | 8.SP.A.1, 8.SP.A.2 |

**Comprehensive Power Standards Curriculum for Algebra I**

This curriculum includes **power standards**, **review standards**, **supplementary standards**, a **timeline**, **motivational strategies**, and **lessons** for each standard.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **Seeing Structure in Expressions** | Interpret and rewrite expressions in context | A.SSE.A.1, A.SSE.B.3 |
| **Arithmetic with Polynomials and Rational Expressions** | Perform operations on polynomials | A.APR.A.1 |
| **Creating Equations** | Create equations that describe relationships | A.CED.A.1, A.CED.A.2 |
| **Reasoning with Equations and Inequalities** | Solve linear, quadratic, and exponential equations and inequalities | A.REI.A.1, A.REI.B.3 |
| **Interpreting Functions** | Analyze functions and their representations | F.IF.A.1, F.IF.B.4, F.IF.C.7 |
| **Linear, Quadratic, and Exponential Models** | Construct and interpret linear, quadratic, and exponential models | F.LE.A.1, F.LE.B.5 |
| **Statistics and Probability** | Summarize, represent, and interpret categorical and quantitative data | S.ID.A.1, S.ID.B.6 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. Seeing Structure in Expressions**

* **Power Standard**: Interpret and rewrite expressions in context. *(A.SSE.A.1, A.SSE.B.3)*
* **Review Standards**:
  + 8.EE.A.1: Use and interpret properties of exponents.
  + 8.EE.C.7: Solve linear equations.
* **Supplementary Standards**:
  + A.CED.A.1: Create equations to model scenarios.
  + F.IF.A.2: Use function notation.
* **Timeline**: Weeks 1–2
* **Motivation**:
  + Connect to real-life situations, such as analyzing business profits or predicting growth over time.
  + Engage students with problems like “Analyzing Ticket Sales” or “Predicting Expenses.”
* **Lessons**:
  + **Interpreting Expressions**: Decompose expressions and identify components like terms and coefficients.
  + **Rewriting Expressions**: Factor and expand expressions to reveal key features.
  + **Application Problems**: Solve problems involving profit, revenue, and costs.

**2. Arithmetic with Polynomials and Rational Expressions**

* **Power Standard**: Perform operations on polynomials. *(A.APR.A.1)*
* **Review Standards**:
  + 8.EE.A.3: Understand and apply the distributive property.
  + 8.NS.A.1: Simplify rational numbers.
* **Supplementary Standards**:
  + A.SSE.B.3: Rewrite polynomials in equivalent forms.
  + A.REI.B.4: Solve polynomial equations.
* **Timeline**: Weeks 3–4
* **Motivation**:
  + Relate polynomials to geometry and physics (e.g., area, velocity).
  + Include activities like “Exploring Polynomials in Sports Trajectories.”
* **Lessons**:
  + **Adding and Subtracting Polynomials**: Use visuals to combine like terms.
  + **Multiplying Polynomials**: Apply the distributive property to simplify.
  + **Factoring Polynomials**: Solve equations by factoring.

**3. Creating Equations**

* **Power Standard**: Create equations that describe relationships. *(A.CED.A.1, A.CED.A.2)*
* **Review Standards**:
  + 7.RP.A.2: Understand proportional relationships.
  + 8.EE.B.6: Solve slope-intercept form problems.
* **Supplementary Standards**:
  + F.IF.A.3: Represent functions with equations and tables.
  + F.LE.B.5: Interpret linear, quadratic, and exponential models.
* **Timeline**: Weeks 5–6
* **Motivation**:
  + Use real-world examples like predicting profits, modeling distances, or budgeting.
  + Engage students in projects like “Designing a Budget Plan.”
* **Lessons**:
  + **Writing Linear Equations**: Model real-world problems using slope-intercept form.
  + **Quadratic and Exponential Models**: Represent nonlinear relationships.
  + **Multi-Step Equations**: Solve contextual problems with multiple variables.

**4. Reasoning with Equations and Inequalities**

* **Power Standard**: Solve linear, quadratic, and exponential equations and inequalities. *(A.REI.A.1, A.REI.B.3)*
* **Review Standards**:
  + 8.EE.B.6: Solve linear systems of equations.
  + 7.EE.B.4: Solve multi-step inequalities.
* **Supplementary Standards**:
  + F.IF.C.7: Graph functions to show relationships.
  + A.CED.A.3: Represent constraints with inequalities.
* **Timeline**: Weeks 7–10
* **Motivation**:
  + Relate to real-world applications like determining constraints in manufacturing or calculating break-even points.
  + Include challenges like “Inequality Word Problem Scavenger Hunt.”
* **Lessons**:
  + **Linear Equations and Inequalities**: Solve and graph equations with multiple steps.
  + **Quadratic Equations**: Solve by factoring, completing the square, and using the quadratic formula.
  + **Exponential Equations**: Solve equations involving growth and decay.

**5. Interpreting Functions**

* **Power Standard**: Analyze functions and their representations. *(F.IF.A.1, F.IF.B.4, F.IF.C.7)*
* **Review Standards**:
  + 8.F.A.1: Understand the definition of a function.
  + 8.F.B.5: Analyze functions for key features.
* **Supplementary Standards**:
  + A.REI.D.11: Solve systems of equations graphically.
  + F.LE.A.2: Graph linear and exponential functions.
* **Timeline**: Weeks 11–14
* **Motivation**:
  + Use graphs to predict trends, such as stock prices or population growth.
  + Include projects like “Graphing and Analyzing Data from My Life.”
* **Lessons**:
  + **Graphing Linear and Quadratic Functions**: Identify intercepts and symmetry.
  + **Comparing Functions**: Use tables, graphs, and equations to interpret relationships.
  + **Real-World Applications**: Solve problems involving real-world data sets.

**6. Linear, Quadratic, and Exponential Models**

* **Power Standard**: Construct and interpret linear, quadratic, and exponential models. *(F.LE.A.1, F.LE.B.5)*
* **Review Standards**:
  + 8.F.B.5: Interpret functions in terms of relationships.
  + 8.SP.A.2: Analyze scatterplots.
* **Supplementary Standards**:
  + F.IF.C.8: Write equations for specific situations.
  + F.BF.A.1: Build functions from relationships.
* **Timeline**: Weeks 15–16
* **Motivation**:
  + Relate to real-world problems like calculating savings, predicting sports performance, or analyzing natural growth.
  + Engage students in experiments like “Growth of a Plant Over Time.”
* **Lessons**:
  + **Constructing Linear Models**: Create equations from data.
  + **Exponential Growth and Decay**: Explore real-world applications.
  + **Comparing Models**: Determine which model best fits a scenario.

**7. Statistics and Probability**

* **Power Standard**: Summarize, represent, and interpret categorical and quantitative data. *(S.ID.A.1, S.ID.B.6)*
* **Review Standards**:
  + 7.SP.B.4: Use measures of center and variability to interpret data.
  + 8.SP.A.1: Interpret scatterplots.
* **Supplementary Standards**:
  + F.IF.B.6: Analyze average rates of change.
  + F.BF.A.2: Analyze data to build functions.
* **Timeline**: Weeks 17–18
* **Motivation**:
  + Relate to real-world data like survey results, sports statistics, or business trends.
  + Conduct surveys and experiments to generate data.
* **Lessons**:
  + **Creating Graphs**: Construct scatterplots and histograms.
  + **Interpreting Data**: Analyze trends and correlations.
  + **Modeling Data**: Fit a line or curve to a data set and interpret.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1–2 | Structure in Expressions | A.SSE.A.1, A.SSE.B.3 |
| 3–4 | Polynomials and Rational Expressions | A.APR.A.1 |
| 5–6 | Creating Equations | A.CED.A.1, A.CED.A.2 |
| 7–10 | Equations and Inequalities | A.REI.A.1, A.REI.B.3 |
| 11–14 | Functions | F.IF.A.1, F.IF.B.4, F.IF.C.7 |
| 15–16 | Linear, Quadratic, and Exponential | F.LE.A.1, F.LE.B.5 |
| 17–18 | Statistics and Probability | S.ID.A.1, S.ID.B.6 |

**Comprehensive Power Standards Curriculum for Geometry**

This curriculum includes **power standards**, **review standards**, **supplementary standards**, a **timeline**, **motivational strategies**, and **lessons** for each standard.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **Congruence** | Prove and apply geometric theorems using transformations | G.CO.A.1, G.CO.B.6, G.CO.C.9 |
| **Similarity, Right Triangles, and Trigonometry** | Prove similarity and apply trigonometric ratios | G.SRT.A.2, G.SRT.C.6, G.SRT.C.8 |
| **Circles** | Understand and apply theorems about circles | G.C.A.1, G.C.A.2, G.C.A.3 |
| **Expressing Geometric Properties with Equations** | Solve problems using coordinates and algebraic representations of geometry | G.GPE.B.4, G.GPE.B.7 |
| **Geometric Measurement and Dimension** | Apply volume and surface area formulas for 3D objects | G.GMD.A.1, G.GMD.A.3 |
| **Modeling with Geometry** | Apply geometry concepts to solve real-world problems | G.MG.A.1, G.MG.A.3 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. Congruence**

* **Power Standard**: Prove and apply geometric theorems using transformations. *(G.CO.A.1, G.CO.B.6, G.CO.C.9)*
* **Review Standards**:
  + 8.G.A.1: Verify properties of rotations, reflections, and translations.
  + 8.G.A.2: Understand congruence through transformations.
* **Supplementary Standards**:
  + G.SRT.A.1: Verify similarity using transformations.
  + G.CO.D.12: Create geometric constructions.
* **Timeline**: Weeks 1–3
* **Motivation**:
  + Connect to real-world tasks like designing symmetrical patterns or analyzing sports fields.
  + Engage students with activities like “Symmetry Scavenger Hunt” or “Create Your Own Logo.”
* **Lessons**:
  + **Understanding Transformations**: Explore translations, rotations, and reflections using graph paper.
  + **Proving Congruence**: Use transformation rules to prove triangles are congruent.
  + **Application Problems**: Solve problems involving congruent figures in architecture or design.

**2. Similarity, Right Triangles, and Trigonometry**

* **Power Standard**: Prove similarity and apply trigonometric ratios. *(G.SRT.A.2, G.SRT.C.6, G.SRT.C.8)*
* **Review Standards**:
  + 8.G.A.4: Understand similarity through transformations.
  + 7.RP.A.2: Use proportional reasoning to solve problems.
* **Supplementary Standards**:
  + G.SRT.B.5: Prove theorems involving similarity.
  + G.CO.C.10: Apply triangle congruence and similarity in proofs.
* **Timeline**: Weeks 4–7
* **Motivation**:
  + Relate to real-world contexts like navigation, surveying, or building design.
  + Engage students with projects like “Design a Miniature Model” or “Trigonometry in Sports.”
* **Lessons**:
  + **Proving Similarity**: Use dilation and proportional reasoning.
  + **Trigonometric Ratios**: Solve for sides and angles in right triangles.
  + **Real-World Applications**: Solve problems involving ramps, ladders, and shadows.

**3. Circles**

* **Power Standard**: Understand and apply theorems about circles. *(G.C.A.1, G.C.A.2, G.C.A.3)*
* **Review Standards**:
  + 7.G.B.4: Understand and apply formulas for the area and circumference of a circle.
  + 8.G.C.9: Solve problems involving volume of cylinders and spheres.
* **Supplementary Standards**:
  + G.GPE.B.4: Use the equation of a circle to solve problems.
  + G.CO.D.13: Construct inscribed and circumscribed circles.
* **Timeline**: Weeks 8–10
* **Motivation**:
  + Relate circles to everyday objects like wheels, clocks, and crop circles.
  + Include activities like “Design a Ferris Wheel” or “Explore Circular Paths.”
* **Lessons**:
  + **Understanding Circle Theorems**: Explore central and inscribed angles.
  + **Using Equations of Circles**: Solve problems involving radius and diameter.
  + **Applications**: Analyze real-world problems like designing circular tracks.

**4. Expressing Geometric Properties with Equations**

* **Power Standard**: Solve problems using coordinates and algebraic representations of geometry. *(G.GPE.B.4, G.GPE.B.7)*
* **Review Standards**:
  + 8.G.B.8: Use the Pythagorean Theorem to find distances.
  + 8.EE.C.8: Solve systems of equations graphically.
* **Supplementary Standards**:
  + G.SRT.C.8: Use the Pythagorean Theorem to solve problems in coordinate geometry.
  + A.CED.A.2: Create equations to model geometric relationships.
* **Timeline**: Weeks 11–13
* **Motivation**:
  + Use real-world contexts like designing blueprints or analyzing maps.
  + Include hands-on activities like “Mapping a Treasure Hunt.”
* **Lessons**:
  + **Distance and Midpoint Formulas**: Solve problems involving line segments.
  + **Equations of Circles**: Derive equations and apply them to solve problems.
  + **Area and Perimeter in the Coordinate Plane**: Solve complex geometric problems.

**5. Geometric Measurement and Dimension**

* **Power Standard**: Apply volume and surface area formulas for 3D objects. *(G.GMD.A.1, G.GMD.A.3)*
* **Review Standards**:
  + 7.G.B.6: Solve volume problems for composite 3D figures.
  + 8.G.C.9: Solve problems involving volumes of cylinders, cones, and spheres.
* **Supplementary Standards**:
  + G.MG.A.1: Model real-world objects using geometric shapes.
  + G.MG.A.3: Apply volume formulas in practical contexts.
* **Timeline**: Weeks 14–16
* **Motivation**:
  + Relate to real-world scenarios like packaging design or construction.
  + Include projects like “Design a Storage Box” or “Plan a Water Tank.”
* **Lessons**:
  + **Volume Formulas**: Derive and apply formulas for cones, cylinders, and spheres.
  + **Surface Area Problems**: Solve real-world problems involving wrapping or painting.
  + **Composite Figures**: Calculate volumes and surface areas of complex objects.

**6. Modeling with Geometry**

* **Power Standard**: Apply geometry concepts to solve real-world problems. *(G.MG.A.1, G.MG.A.3)*
* **Review Standards**:
  + 7.G.A.1: Solve problems involving scale drawings.
  + 8.G.A.4: Understand similarity to solve real-world problems.
* **Supplementary Standards**:
  + G.GMD.A.1: Apply measurement concepts in modeling tasks.
  + G.CO.A.1: Use transformations to model geometric designs.
* **Timeline**: Weeks 17–18
* **Motivation**:
  + Highlight real-world uses like urban planning, architecture, or physics.
  + Include challenges like “Design a Playground” or “Plan a City Block.”
* **Lessons**:
  + **Scaling and Proportionality**: Model objects using scale drawings.
  + **Real-World Geometry**: Solve problems involving roads, buildings, and parks.
  + **Optimization Problems**: Maximize or minimize areas and volumes.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1–3 | Congruence | G.CO.A.1, G.CO.B.6, G.CO.C.9 |
| 4–7 | Similarity and Trigonometry | G.SRT.A.2, G.SRT.C.6, G.SRT.C.8 |
| 8–10 | Circles | G.C.A.1, G.C.A.2, G.C.A.3 |
| 11–13 | Properties with Equations | G.GPE.B.4, G.GPE.B.7 |
| 14–16 | Measurement and Dimension | G.GMD.A.1, G.GMD.A.3 |
| 17–18 | Modeling with Geometry | G.MG.A.1, G.MG.A.3 |

**Comprehensive Power Standards Curriculum for Algebra II**

This curriculum includes **power standards**, **review standards**, **supplementary standards**, a **timeline**, **motivational strategies**, and **lessons** for each standard.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **The Real Number System** | Extend the properties of exponents to rational exponents | N.RN.A.1, N.RN.A.2 |
| **Seeing Structure in Expressions** | Interpret and rewrite expressions involving quadratic, exponential, and logarithmic functions | A.SSE.A.1, A.SSE.B.3 |
| **Arithmetic with Polynomials and Rational Expressions** | Perform arithmetic with polynomials and solve rational expressions | A.APR.A.1, A.APR.B.3 |
| **Creating Equations** | Create and solve equations and inequalities in one or more variables | A.CED.A.1, A.CED.A.2 |
| **Reasoning with Equations and Inequalities** | Solve systems of nonlinear equations and inequalities | A.REI.C.7, A.REI.D.11 |
| **Interpreting Functions** | Analyze functions and their transformations, including exponential, logarithmic, and polynomial functions | F.IF.B.4, F.IF.B.6, F.IF.C.7 |
| **Statistics and Probability** | Make inferences and justify conclusions based on data | S.IC.A.1, S.IC.A.2 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. The Real Number System**

* **Power Standard**: Extend the properties of exponents to rational exponents. *(N.RN.A.1, N.RN.A.2)*
* **Review Standards**:
  + 8.EE.A.1: Apply properties of integer exponents.
  + N.Q.A.1: Use units in problems to guide interpretation.
* **Supplementary Standards**:
  + N.CN.A.1: Understand complex numbers.
  + A.SSE.B.3: Rewrite expressions involving exponents.
* **Timeline**: Weeks 1–2
* **Motivation**:
  + Relate rational exponents to real-world contexts, such as calculating interest or compound growth.
  + Use activities like “How Do Bacteria Grow?” to connect exponential growth to practical examples.
* **Lessons**:
  + **Understanding Rational Exponents**: Rewrite expressions with rational exponents as radicals and vice versa.
  + **Simplifying Expressions**: Apply the laws of exponents to simplify.
  + **Application Problems**: Solve problems involving exponential growth and decay.

**2. Seeing Structure in Expressions**

* **Power Standard**: Interpret and rewrite expressions involving quadratic, exponential, and logarithmic functions. *(A.SSE.A.1, A.SSE.B.3)*
* **Review Standards**:
  + A.SSE.A.2: Use factoring techniques to simplify expressions.
  + A.CED.A.1: Create equations and inequalities in one variable.
* **Supplementary Standards**:
  + F.IF.C.8: Write expressions in equivalent forms to reveal properties.
  + F.LE.A.4: Solve exponential and logarithmic equations.
* **Timeline**: Weeks 3–5
* **Motivation**:
  + Connect expressions to real-world contexts like profit, cost, or population dynamics.
  + Include activities like “Breaking Down Big Numbers” or “Real-World Quadratic Problems.”
* **Lessons**:
  + **Factoring and Expanding**: Factor and expand expressions to reveal properties.
  + **Analyzing Growth Models**: Rewrite exponential expressions to interpret rates of change.
  + **Quadratic Applications**: Solve area and revenue problems involving quadratics.

**3. Arithmetic with Polynomials and Rational Expressions**

* **Power Standard**: Perform arithmetic with polynomials and solve rational expressions. *(A.APR.A.1, A.APR.B.3)*
* **Review Standards**:
  + A.SSE.A.2: Understand factoring and distributing.
  + A.APR.A.2: Understand polynomial division.
* **Supplementary Standards**:
  + A.REI.D.11: Solve equations graphically.
  + F.IF.C.7: Graph polynomial functions and analyze key features.
* **Timeline**: Weeks 6–8
* **Motivation**:
  + Relate to real-world applications such as calculating trajectories or optimizing profit.
  + Engage students with tasks like “Polynomial Games” or “Dividing Polynomials Challenge.”
* **Lessons**:
  + **Operations on Polynomials**: Add, subtract, and multiply polynomials.
  + **Dividing Polynomials**: Use synthetic and long division techniques.
  + **Rational Expressions**: Simplify, multiply, and divide rational expressions.

**4. Creating Equations**

* **Power Standard**: Create and solve equations and inequalities in one or more variables. *(A.CED.A.1, A.CED.A.2)*
* **Review Standards**:
  + A.CED.A.3: Solve linear equations in context.
  + 8.EE.C.8: Solve systems of linear equations.
* **Supplementary Standards**:
  + A.REI.C.7: Solve nonlinear systems of equations.
  + F.IF.A.2: Use function notation.
* **Timeline**: Weeks 9–11
* **Motivation**:
  + Apply to practical problems such as budgeting, optimizing resources, and analyzing business constraints.
  + Include group projects like “Design a Business Model.”
* **Lessons**:
  + **Linear Systems**: Solve and graph systems of equations.
  + **Nonlinear Systems**: Use substitution and elimination methods.
  + **Modeling with Inequalities**: Represent constraints in practical scenarios.

**5. Interpreting Functions**

* **Power Standard**: Analyze functions and their transformations, including exponential, logarithmic, and polynomial functions. *(F.IF.B.4, F.IF.B.6, F.IF.C.7)*
* **Review Standards**:
  + F.IF.A.1: Understand the concept of a function.
  + F.IF.B.5: Interpret key features of graphs.
* **Supplementary Standards**:
  + F.LE.A.2: Construct linear, quadratic, and exponential functions.
  + F.IF.C.9: Compare properties of functions represented in different forms.
* **Timeline**: Weeks 12–15
* **Motivation**:
  + Relate functions to contexts like predicting profits, modeling population growth, or analyzing savings.
  + Use activities like “Graphing Transformations Game” or “Explore the Logarithmic World.”
* **Lessons**:
  + **Function Transformations**: Explore translations, reflections, and dilations.
  + **Graphing Exponential and Logarithmic Functions**: Identify asymptotes and intercepts.
  + **Applications**: Solve real-world problems using transformed functions.

**6. Statistics and Probability**

* **Power Standard**: Make inferences and justify conclusions based on data. *(S.IC.A.1, S.IC.A.2)*
* **Review Standards**:
  + S.ID.A.1: Interpret data using measures of center and spread.
  + 8.SP.A.1: Understand patterns of association in bivariate data.
* **Supplementary Standards**:
  + S.ID.B.6: Fit a function to data.
  + F.IF.B.6: Calculate average rate of change of a function.
* **Timeline**: Weeks 16–18
* **Motivation**:
  + Relate to real-world scenarios like polling, sports analysis, or business trends.
  + Include projects like “Conduct a Survey” or “Analyze Sports Data.”
* **Lessons**:
  + **Designing a Statistical Study**: Collect and analyze real-world data.
  + **Interpreting Correlation**: Analyze scatterplots and correlation coefficients.
  + **Making Predictions**: Use lines of best fit to interpret trends.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1–2 | Real Number System | N.RN.A.1, N.RN.A.2 |
| 3–5 | Expressions and Functions | A.SSE.A.1, A.SSE.B.3 |
| 6–8 | Polynomials and Rational Expressions | A.APR.A.1, A.APR.B.3 |
| 9–11 | Creating Equations | A.CED.A.1, A.CED.A.2 |
| 12–15 | Interpreting Functions | F.IF.B.4, F.IF.B.6, F.IF.C.7 |
| 16–18 | Statistics and Probability | S.IC.A.1, S.IC.A.2 |

**Common Core Power Standards for Trigonometry**

Trigonometry involves key concepts tied to the Common Core State Standards (CCSS) in high school Geometry (G) and Functions (F). Below is a comprehensive outline of **power standards**, **review standards**, **supplementary standards**, **timeline**, **motivational strategies**, and **lessons**.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **Similarity, Right Triangles, and Trigonometry** | Define trigonometric ratios and solve problems involving right triangles | G.SRT.C.6, G.SRT.C.7, G.SRT.C.8 |
| **Trigonometric Functions** | Extend trigonometric functions to the unit circle | F.TF.A.1, F.TF.A.2 |
| **Trigonometric Applications** | Model periodic phenomena with trigonometric functions | F.TF.B.5 |
| **Geometric Measurement and Dimension** | Derive and apply the Law of Sines and Cosines | G.SRT.D.9, G.SRT.D.10 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. Define Trigonometric Ratios and Solve Right Triangle Problems**

* **Power Standard**: Define trigonometric ratios (sine, cosine, tangent) and solve right triangle problems. *(G.SRT.C.6, G.SRT.C.7, G.SRT.C.8)*
* **Review Standards**:
  + G.SRT.A.1: Understand and use the concept of similarity in triangles.
  + G.CO.C.9: Prove theorems about triangles.
* **Supplementary Standards**:
  + A.CED.A.1: Create equations to model relationships.
  + F.IF.B.4: Interpret functions in terms of relationships.
* **Timeline**: Weeks 1–3
* **Motivation**:
  + Relate to real-world applications like measuring heights of buildings, navigation, and engineering designs.
  + Include activities like “Find the Height of a Flagpole” or “Navigation with Angles.”
* **Lessons**:
  + **Defining Trigonometric Ratios**: Explore sine, cosine, and tangent using right triangles.
  + **Solving Right Triangles**: Use trigonometric ratios to find unknown side lengths and angles.
  + **Applications**: Solve real-world problems involving angles of elevation and depression.

**2. Extend Trigonometric Functions to the Unit Circle**

* **Power Standard**: Extend trigonometric functions to include angles greater than 90° using the unit circle. *(F.TF.A.1, F.TF.A.2)*
* **Review Standards**:
  + G.CO.A.1: Use transformations to explore the rotation of figures.
  + 8.G.A.1: Verify properties of rotations and reflections.
* **Supplementary Standards**:
  + F.IF.C.7: Graph trigonometric functions.
  + F.TF.A.3: Use the unit circle to explain symmetry.
* **Timeline**: Weeks 4–6
* **Motivation**:
  + Connect to periodic phenomena like sound waves, tides, and circular motion.
  + Include challenges like “Explore Symmetry in the Unit Circle” or “Predicting Periodic Patterns.”
* **Lessons**:
  + **Introducing the Unit Circle**: Define coordinates on the unit circle.
  + **Angles Beyond 90°**: Use reference angles to find sine and cosine for angles up to 360°.
  + **Applications**: Solve problems involving periodic motion and circular paths.

**3. Model Periodic Phenomena with Trigonometric Functions**

* **Power Standard**: Model periodic phenomena with sine and cosine functions. *(F.TF.B.5)*
* **Review Standards**:
  + F.IF.B.5: Relate domain and range to real-world contexts.
  + F.LE.B.5: Interpret models of exponential growth and decay.
* **Supplementary Standards**:
  + F.IF.C.8: Write equations for periodic functions.
  + S.ID.B.6: Fit functions to data and justify the choice of model.
* **Timeline**: Weeks 7–10
* **Motivation**:
  + Highlight real-world phenomena like tides, seasonal patterns, and sound waves.
  + Include projects like “Modeling Daylight Hours” or “Analyzing Sound Waves.”
* **Lessons**:
  + **Graphing Sine and Cosine Functions**: Explore amplitude, period, and phase shifts.
  + **Writing Equations for Periodic Functions**: Model periodic data with sine and cosine.
  + **Real-World Applications**: Analyze problems involving waves and oscillations.

**4. Apply the Law of Sines and Cosines**

* **Power Standard**: Apply the Law of Sines and Cosines to solve triangles. *(G.SRT.D.9, G.SRT.D.10)*
* **Review Standards**:
  + G.SRT.C.8: Solve right triangles using trigonometric ratios.
  + 8.G.C.9: Solve volume problems involving spheres and cones.
* **Supplementary Standards**:
  + A.REI.D.11: Solve systems of equations graphically.
  + G.MG.A.1: Use geometry to model real-world objects.
* **Timeline**: Weeks 11–13
* **Motivation**:
  + Relate to navigation, astronomy, and architecture.
  + Include tasks like “Navigating a Triangle Course” or “Using Triangulation to Map a Location.”
* **Lessons**:
  + **Deriving the Laws of Sines and Cosines**: Explore the relationships in non-right triangles.
  + **Solving Triangles**: Apply the laws to find unknown sides and angles.
  + **Applications**: Solve real-world problems like determining distances and angles in navigation.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1–3 | Trigonometric Ratios and Right Triangles | G.SRT.C.6, G.SRT.C.7, G.SRT.C.8 |
| 4–6 | Trigonometric Functions on the Unit Circle | F.TF.A.1, F.TF.A.2 |
| 7–10 | Modeling with Trigonometric Functions | F.TF.B.5 |
| 11–13 | Law of Sines and Cosines | G.SRT.D.9, G.SRT.D.10 |

**Motivational Activities for Each Unit**

* **Interactive Applications**:
  + Use technology (e.g., Desmos, Geogebra) to explore trigonometric graphs and unit circle properties.
* **Project-Based Learning**:
  + Design real-world applications, like predicting tides or modeling sound waves.
* **Hands-On Activities**:
  + Use protractors, rulers, and string to measure angles and distances in physical spaces.
* **Group Challenges**:
  + Create group tasks like solving navigation problems or designing structures with trigonometric tools.

**Comprehensive Power Standards Curriculum for Trigonometry**

Below is a detailed curriculum with **power standards**, **review standards**, **supplementary standards**, **timeline**, **motivational strategies**, and **lessons** for teaching Trigonometry effectively.

**Power Standards Overview**

| **Domain** | **Power Standard** | **Code** |
| --- | --- | --- |
| **Right Triangle Trigonometry** | Define and apply trigonometric ratios to solve right triangle problems | G.SRT.C.6, G.SRT.C.7, G.SRT.C.8 |
| **Trigonometric Functions** | Extend the domain of trigonometric functions to include all real numbers | F.TF.A.1, F.TF.A.2 |
| **Periodic Phenomena** | Model periodic phenomena with trigonometric functions | F.TF.B.5 |
| **Laws of Sines and Cosines** | Apply the Law of Sines and Cosines to solve triangles | G.SRT.D.9, G.SRT.D.10 |
| **Trigonometric Identities** | Prove and apply trigonometric identities | F.TF.C.8 |

**Power Standards with Review Standards, Supplementary Standards, Timeline, Motivation, and Lessons**

**1. Right Triangle Trigonometry**

* **Power Standard**: Define and apply trigonometric ratios to solve right triangle problems. *(G.SRT.C.6, G.SRT.C.7, G.SRT.C.8)*
* **Review Standards**:
  + 8.G.B.6: Explain the Pythagorean Theorem and its converse.
  + 8.G.A.4: Understand similarity in triangles to establish trigonometric ratios.
* **Supplementary Standards**:
  + A.CED.A.1: Create equations to represent real-world relationships.
  + F.IF.B.4: Interpret functions in terms of relationships.
* **Timeline**: Weeks 1–3
* **Motivation**:
  + Use real-world problems like finding the height of a building using angles or determining distances in navigation.
  + Include activities like “How Tall is That Tree?” or “Angle of Elevation Challenges.”
* **Lessons**:
  + **Defining Trigonometric Ratios**: Introduce sine, cosine, and tangent using a right triangle.
  + **Solving Right Triangles**: Use trigonometric ratios to solve for missing sides and angles.
  + **Real-World Applications**: Solve problems involving angles of elevation and depression.

**2. Trigonometric Functions**

* **Power Standard**: Extend the domain of trigonometric functions to include all real numbers. *(F.TF.A.1, F.TF.A.2)*
* **Review Standards**:
  + G.SRT.C.6: Define trigonometric ratios using right triangles.
  + G.CO.A.2: Understand rotations as transformations in the coordinate plane.
* **Supplementary Standards**:
  + F.IF.C.7: Graph trigonometric functions and identify key features.
  + F.TF.A.3: Use the unit circle to explain symmetry and periodicity.
* **Timeline**: Weeks 4–6
* **Motivation**:
  + Relate to real-world periodic phenomena like circular motion, tides, or sound waves.
  + Include activities like “Explore the Unit Circle” or “Predict the Next Wave.”
* **Lessons**:
  + **Introducing the Unit Circle**: Define sine, cosine, and tangent for angles beyond 90°.
  + **Graphing Trigonometric Functions**: Explore periodicity, amplitude, and phase shifts.
  + **Symmetry and Transformations**: Use symmetry to solve problems involving trigonometric functions.

**3. Modeling Periodic Phenomena**

* **Power Standard**: Model periodic phenomena with trigonometric functions. *(F.TF.B.5)*
* **Review Standards**:
  + F.IF.A.2: Interpret graphs to represent relationships between quantities.
  + S.ID.B.6: Fit a function to data to justify a model.
* **Supplementary Standards**:
  + F.IF.C.8: Write equations for periodic functions to reveal key features.
  + F.BF.B.3: Explore transformations of functions.
* **Timeline**: Weeks 7–9
* **Motivation**:
  + Highlight practical applications such as seasonal patterns, sound waves, and Ferris wheels.
  + Include projects like “Modeling Daylight Hours” or “Analyzing Sound Waves.”
* **Lessons**:
  + **Periodic Behavior in Data**: Recognize periodicity in real-world contexts.
  + **Graphing Sine and Cosine Functions**: Interpret amplitude, period, and phase shifts.
  + **Applications**: Use trigonometric models to solve real-world problems.

**4. Laws of Sines and Cosines**

* **Power Standard**: Apply the Law of Sines and Cosines to solve triangles. *(G.SRT.D.9, G.SRT.D.10)*
* **Review Standards**:
  + G.SRT.C.8: Solve right triangles using trigonometric ratios.
  + 8.G.C.9: Solve volume problems involving cones, cylinders, and spheres.
* **Supplementary Standards**:
  + G.GPE.B.7: Use coordinates to calculate perimeters and areas.
  + A.REI.C.6: Solve systems of equations algebraically.
* **Timeline**: Weeks 10–12
* **Motivation**:
  + Relate to navigation, astronomy, and engineering.
  + Include tasks like “Find Your Location Using Triangulation” or “Measure Distances Without Measuring Tools.”
* **Lessons**:
  + **Deriving the Laws**: Explore the Law of Sines and Cosines through geometry.
  + **Solving Triangles**: Apply the laws to find missing sides and angles in non-right triangles.
  + **Applications**: Solve navigation and surveying problems.

**5. Trigonometric Identities**

* **Power Standard**: Prove and apply trigonometric identities. *(F.TF.C.8)*
* **Review Standards**:
  + F.TF.A.1: Understand definitions of trigonometric functions.
  + A.SSE.B.3: Manipulate expressions to simplify equations.
* **Supplementary Standards**:
  + F.IF.C.9: Compare properties of functions algebraically and graphically.
  + F.TF.C.9: Derive double-angle and half-angle identities.
* **Timeline**: Weeks 13–15
* **Motivation**:
  + Use identities to simplify complex problems and create efficiency in solving equations.
  + Include challenges like “Prove It” or “Simplify and Solve.”
* **Lessons**:
  + **Fundamental Identities**: Prove and use the Pythagorean, reciprocal, and quotient identities.
  + **Simplifying Expressions**: Solve equations using trigonometric identities.
  + **Applications**: Apply identities to simplify real-world periodic problems.

**Timeline Overview**

| **Weeks** | **Topic** | **Standards** |
| --- | --- | --- |
| 1–3 | Right Triangle Trigonometry | G.SRT.C.6, G.SRT.C.7, G.SRT.C.8 |
| 4–6 | Trigonometric Functions | F.TF.A.1, F.TF.A.2 |
| 7–9 | Modeling Periodic Phenomena | F.TF.B.5 |
| 10–12 | Laws of Sines and Cosines | G.SRT.D.9, G.SRT.D.10 |
| 13–15 | Trigonometric Identities | F.TF.C.8 |

**Motivational Strategies**

1. **Interactive Tools**:
   * Use graphing calculators or apps like Desmos to visualize trigonometric functions and their transformations.
2. **Project-Based Learning**:
   * Create real-world projects, such as modeling Ferris wheels or solving navigation problems.
3. **Hands-On Applications**:
   * Use tools like protractors and clinometers to measure angles and distances in real-world environments.
4. **Collaborative Challenges**:
   * Engage students with group problem-solving tasks, such as proving trigonometric identities or designing models.

The **Common Core State Standards (CCSS)** do not explicitly outline a separate set of standards for Precalculus as it falls outside the high school core standards focus. However, Precalculus typically extends and deepens topics from the CCSS for high school mathematics, particularly in **Functions**, **Geometry**, and **Statistics and Probability**, and includes additional content in **Trigonometry** and **Limits** as preparation for Calculus.

Below is a list of **relevant CCSS-aligned standards** that are foundational for a Precalculus course, organized by domain:

**Common Core-Aligned Standards for Precalculus**

**1. Functions**

* **Standards**:
  + **F.IF.7**: Graph functions expressed symbolically and show key features, including exponential, logarithmic, and trigonometric functions.
  + **F.IF.8**: Write a function in equivalent forms to reveal properties (e.g., completing the square, factoring).
  + **F.IF.9**: Compare properties of two functions represented in different forms (e.g., algebraic, graphical).
  + **F.BF.1**: Build new functions from existing functions, including transformations.
  + **F.BF.4**: Find the inverse of a function algebraically and graphically.
  + **F.LE.4**: Understand and use logarithms to solve exponential equations.
  + **F.TF.1**: Understand radian measure of angles as the length of the arc on the unit circle.
  + **F.TF.2**: Explain how the unit circle defines the values of sine, cosine, and tangent for all real numbers.
  + **F.TF.5**: Choose trigonometric functions to model periodic phenomena.
  + **F.TF.7**: Use inverse trigonometric functions to solve equations in real-world contexts.

**2. Algebra**

* **Standards**:
  + **A.SSE.1**: Interpret expressions that represent a quantity in terms of its context.
  + **A.SSE.2**: Use the structure of an expression to rewrite it (e.g., factoring polynomials, simplifying rational expressions).
  + **A.APR.6**: Rewrite simple rational expressions in different forms.
  + **A.APR.7**: Understand that rational expressions form a system analogous to rational numbers.
  + **A.REI.11**: Solve systems of equations, including linear and nonlinear systems.

**3. Trigonometry**

* **Standards**:
  + **F.TF.3**: Use special triangles to determine values of sine, cosine, and tangent.
  + **F.TF.4**: Use trigonometric identities to simplify expressions and solve equations.
  + **F.TF.6**: Understand and apply the Law of Sines and Cosines.
  + **G.SRT.9**: Derive the Law of Sines and Cosines and use them to solve problems.

**4. Geometry**

* **Standards**:
  + **G.GPE.1**: Derive the equation of a circle using the Pythagorean Theorem.
  + **G.GPE.2**: Derive the equation of a parabola given a focus and directrix.
  + **G.MG.1**: Use geometric shapes to model real-world objects.

**5. Limits and Introductory Calculus Concepts**

Though not explicitly covered in CCSS, the following topics are often included in Precalculus:

* Evaluate limits graphically and numerically.
* Understand the concept of a derivative as a rate of change.
* Explore continuity and asymptotic behavior.

**6. Statistics and Probability**

* **Standards**:
  + **S.ID.6**: Fit a function to data (linear, exponential, or trigonometric).
  + **S.IC.6**: Evaluate reports based on data for accuracy and context.

**Additional Topics Covered in Precalculus**

In addition to the Common Core standards, Precalculus often includes:

1. **Polar Coordinates and Complex Numbers**:
   * Graph polar equations.
   * Represent complex numbers in polar form.
   * Perform operations on complex numbers using De Moivre’s Theorem.
2. **Sequences and Series**:
   * Analyze arithmetic and geometric sequences.
   * Derive and use formulas for the sum of finite and infinite series.
3. **Conic Sections**:
   * Explore parabolas, ellipses, and hyperbolas algebraically and graphically.

The College Board's **AP Precalculus** course framework is structured into four comprehensive units, each encompassing specific topics and associated learning objectives. Below is an overview of each unit, detailing the key topics and the suggested instructional periods:

**Unit 1: Polynomial and Rational Functions (6–6.5 weeks)**

* **Key Topics**:
  + Change in Tandem
  + Rates of Change
  + Rates of Change in Linear and Quadratic Functions
  + Polynomial Functions and Complex Zeros
  + Polynomial Functions and End Behavior
  + Rational Functions: Zeros, Vertical Asymptotes, and Holes
  + Equivalent Representations of Polynomial and Rational Expressions
  + Transformations of Functions
  + Function Model Selection, Assumption Articulation, Construction, and Application

**Unit 2: Exponential and Logarithmic Functions (6–6.5 weeks)**

* **Key Topics**:
  + Change in Arithmetic and Geometric Sequences
  + Change in Linear and Exponential Functions
  + Exponential Functions and Their Manipulations
  + Exponential Function Context and Data Modeling
  + Competing Function Model Validation
  + Composition and Inverse Functions
  + Logarithmic Expressions and Functions
  + Logarithmic Function Manipulation
  + Exponential and Logarithmic Equations and Inequalities
  + Logarithmic Function Context and Data Modeling
  + Semi-log Plots

**Unit 3: Trigonometric and Polar Functions (7–7.5 weeks)**

* **Key Topics**:
  + Periodic Phenomena
  + Sine, Cosine, and Tangent Functions
  + Sine and Cosine Function Values and Graphs
  + Sinusoidal Functions and Their Transformations
  + Sinusoidal Function Context and Data Modeling
  + The Tangent Function
  + Inverse Trigonometric Functions
  + Trigonometric Equations and Inequalities
  + The Secant, Cosecant, and Cotangent Functions
  + Equivalent Representations of Trigonometric Functions
  + Trigonometry and Polar Coordinates
  + Polar Function Graphs
  + Rates of Change in Polar Functions

**Unit 4: Functions Involving Parameters, Vectors, and Matrices (7–7.5 weeks)**

* **Key Topics**:
  + Parametric Functions
  + Parametric Functions Modeling Planar Motion
  + Parametric Functions and Rates of Change
  + Parametrically Defined Circles and Lines
  + Implicitly Defined Functions
  + Conic Sections
  + Parametrization of Implicitly Defined Functions
  + Vectors and Vector-Valued Functions
  + Matrices: Operations, Inverses, Determinants, and Linear Transformations
  + Matrices as Functions
  + Matrices Modeling Contexts

*Note: Units 1, 2, and 3 are assessed in the AP Precalculus Exam. Unit 4 is included in the course framework but is not assessed on the exam.*

The **Common Core State Standards (CCSS)** do not explicitly include standards for Calculus, as Calculus is typically considered a college-level course. However, many high school Calculus courses build on the **high school CCSS for mathematics**, particularly from the domains of **Functions**, **Geometry**, and **Statistics and Probability**. Below is an outline of relevant Common Core standards foundational to Calculus, grouped by their domains, along with typical Calculus topics that expand on these concepts.

**Relevant Common Core-Aligned Standards for Calculus**

**1. Functions**

* **F.IF.4**: Interpret key features of graphs in terms of their contexts, such as intercepts, intervals of increase or decrease, and end behavior.
* **F.IF.7**: Graph functions expressed symbolically and show key features, including polynomials, exponentials, logarithms, and trigonometric functions.
* **F.IF.8**: Write functions in equivalent forms to reveal key properties, such as completing the square or factoring polynomials.
* **F.BF.1**: Build new functions from existing ones, including transformations, inverses, and compositions.
* **F.LE.4**: Solve exponential equations using logarithms.
* **F.TF.5**: Model periodic phenomena using trigonometric functions.

**2. Algebra**

* **A.SSE.1**: Interpret the structure of expressions, including identifying terms, factors, and coefficients.
* **A.CED.1**: Create equations and inequalities in one variable and use them to solve problems.
* **A.REI.4**: Solve quadratic equations by inspection, factoring, completing the square, and using the quadratic formula.

**3. Geometry**

* **G.GPE.1**: Derive the equation of a circle using the Pythagorean Theorem.
* **G.MG.1**: Use geometric shapes, their measures, and their properties to model real-world objects.
* **G.MG.2**: Apply concepts of density using area and volume.

**4. Statistics and Probability**

* **S.ID.6**: Fit a function to data; use functions fitted to data to solve problems in the context of the data.

**Common Topics in Calculus**

In addition to the foundational CCSS topics, Calculus includes the following content areas:

**Limits and Continuity**

* Understand the concept of a limit and use limits to define continuity.
* Analyze limits graphically, numerically, and algebraically.
* Explore infinite limits and limits at infinity.

**Differentiation**

* Define the derivative as the limit of the average rate of change.
* Apply rules of differentiation (e.g., power, product, quotient, chain rules).
* Analyze the relationship between the derivative and the graph of a function (e.g., critical points, increasing/decreasing intervals, concavity).
* Apply derivatives to real-world problems, such as optimization and related rates.

**Integration**

* Define the definite integral as the limit of Riemann sums.
* Apply the Fundamental Theorem of Calculus to evaluate definite integrals.
* Use techniques of integration (e.g., substitution, integration by parts).
* Solve problems involving area under a curve, accumulation functions, and volumes of solids of revolution.

**Applications of Calculus**

* Use derivatives and integrals to solve problems in physics, biology, economics, and engineering.
* Model growth and decay using exponential and logistic models.
* Analyze differential equations and slope fields.

**Sequences and Series**

* Explore the concepts of convergence and divergence.
* Analyze infinite series and apply tests for convergence.
* Represent functions as Taylor and Maclaurin series.

**Connecting CCSS to Calculus**

Although Calculus extends beyond the CCSS, high school standards in algebra, geometry, and functions provide a critical foundation. For example:

1. **Functions**: Understanding function transformations, inverses, and modeling prepares students for concepts like limits and derivatives.
2. **Algebra**: Factoring, completing the square, and working with rational expressions provide the skills needed for differentiation and integration.
3. **Geometry**: Concepts like slopes, areas, and volumes lay the groundwork for calculus applications.

The College Board's **AP Calculus** program offers two distinct courses: **AP Calculus AB** and **AP Calculus BC**. Each course is structured into specific units, encompassing key concepts and skills essential for understanding calculus. Below is an overview of the units for each course, along with their respective exam weightings:

**AP Calculus AB Course Framework**

AP Calculus AB is organized into eight units, each focusing on fundamental calculus concepts:

1. **Limits and Continuity**: Understanding the behavior of functions as inputs approach certain values.
2. **Differentiation: Definition and Fundamental Properties**: Introduction to derivatives and their basic properties.
3. **Differentiation: Composite, Implicit, and Inverse Functions**: Techniques for differentiating complex functions.
4. **Contextual Applications of Differentiation**: Applying derivatives to real-world problems.
5. **Analytical Applications of Differentiation**: Using derivatives to analyze functions and their graphs.
6. **Integration and Accumulation of Change**: Introduction to integrals and their applications.
7. **Differential Equations**: Solving equations involving derivatives.
8. **Applications of Integration**: Applying integrals to compute areas, volumes, and other quantities.

The AP Calculus AB Exam assesses students' understanding of these units, with each unit contributing to the overall exam score.

**AP Calculus BC Course Framework**

AP Calculus BC includes all topics from AP Calculus AB and extends into additional concepts, organized into ten units:

1. **Limits and Continuity**: As in AB, understanding function behavior near specific inputs.
2. **Differentiation: Definition and Fundamental Properties**: Foundational derivative concepts.
3. **Differentiation: Composite, Implicit, and Inverse Functions**: Advanced differentiation techniques.
4. **Contextual Applications of Differentiation**: Real-world applications of derivatives.
5. **Analytical Applications of Differentiation**: In-depth function analysis using derivatives.
6. **Integration and Accumulation of Change**: Comprehensive study of integrals.
7. **Differential Equations**: Advanced methods for solving differential equations.
8. **Applications of Integration**: Further applications of integrals in various contexts.
9. **Parametric Equations, Polar Coordinates, and Vector-Valued Functions**: Exploring different function representations and their calculus.
10. **Infinite Sequences and Series**: Analyzing sequences and series, including convergence and divergence.

The AP Calculus BC Exam evaluates students on these units, with each unit contributing to the final exam score.