



Unit 1: Transformations of Functions

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 5 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

This unit's focus is on using and analyzing transformations of mathematical functions and applying learning to a real world problem as a global climate analyst. Students will use knowledge of function transformations to model changes, predict future impacts, and propose a localized community action plan.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 - Interpret the effects transformations have on functions and find the inverses of functions. (CC.2.2.HS.C.4) Mathematical Practices - Look for and make use of structure. (MP7) Profile of a CV Learner - Global Citizenship: Students will be able to mindfully and respectfully seek to understand the ideas and perspectives of	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... Recognize Relationships: Identify patterns and relationships to make sense of mathematical and/or real world situations. (Global Citizen) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... - Recognize that patterns and structures foster efficiency in problem solving. (U1) - Every problem can be categorized based on a similar structure and set of characteristics. (U2)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... (9-12) How can I apply the properties of _____ (i.e exponents, equality, etc.) to solve problems? (U1,2) (Q1) (9+) What are the effects of transformations on functions?(U2) (Q2)

others to responsibly participate in all facets of local and global society. (PCVL.GC)

- Math is embedded across all disciplines and in the world around us. (U3)
- Math: Effective justifications are based on local mathematical thinking and appropriate representations/ vocabulary. (U4)

- (9+) How are functions represented graphically? What are the properties of these graphs? (U1,2) (Q3)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- The parent functions and the effects of horizontal and vertical translations on their graphs. (K1)
- The relationship between an equation and the graph of a translated function, including the effects of changes to the input and output. (K2)
- Function notation and the meaning of translations represented within function notation. (K3)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can graph parent functions and translated parent functions by hand and with a calculator. (S1)
- I can read composition functions with translations. (S2)



Unit 2: Conics

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 10 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

This unit's focus is on using and understanding how to use and develop the equations for conic sections. We will use conic sections to model a real world problem of creating a deep space satellite network.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 ■ Graph and analyze functions and use their properties to make connections between the different representations. (CC.2.2.HS.C.2) ■ Interpret functions in terms of the situation they model. (CC.2.2.HS.C.6) ■ Create and graph equations or inequalities to describe numbers or relationships. (CC.2.2.HS.D.7) ■ Translate between the geometric description and the equation for a conic section. (CC.2.3.HS.A.10) Mathematical Practices ■ Reason abstractly and quantitatively. (MP2)	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Work Together: Engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (Collaborator) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ Analyzing someone else's mathematical thinking creates clarity about a problem, its model, and the viability of a solution. (U1)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ (9+) How are functions represented graphically? What are the properties of these graphs? (U1,2) (Q1) ■ How do I determine how to solve this real world problem? How do I know? (U4) (Q2)

Look for and make use of structure. (MP7)		How can I use the information I have to determine unknown information? (U7) (Q3)
Pennsylvania Academic Standards Career Education and Work (2026): 9-12 Identify solutions to existing conditions or problems using critical thinking skills. (13.2.9-12.A)	Acquisition of Knowledge & Skill	
	Knowledge	Skills
	What facts and basic concepts should students know and be able to recall? Students will know... - The characteristics and structure of general form and standard form equations (K1) - The relationship between the general and standard forms of conic equations and the key features of their graphs (K2) - The characteristics and applications of conic sections in real-world contexts (K3)	What discrete skills and processes should students be able to use? Students can... - I can complete the square to convert between general and standard form. (S1) - I can identify the parts (vertex, center, foci, vertices/co-vertices, directrix, radius) of a conic section. (S2) - I can analyze an equation by converting to translated form to easily identify critical parts of the conic and use them to sketch the graph. (S3)
Profile of a CV Learner		
Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)		



Unit 3: Logarithms and Exponential Functions

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 13 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

This unit's focus is on using and understanding how to use logarithms and exponential functions. We will use exponential and logarithmic models to solve real world problems ie: virus outbreaks, compounding interest, and natural disasters.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 ■ Apply and extend the properties of exponents to solve problems with rational exponents (CC.2.1.HS.F.1) ■ Write expressions in equivalent forms to solve problems. (CC.2.2.HS.D.2) ■ Use reasoning to solve equations and justify the solution method. (CC.2.2.HS.D.9) Mathematical Practices ■ Make sense of problems and persevere in solving them. (MP1) ■ Model with mathematics. (MP4)	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Communicate Mathematically: Communicate effectively in a variety of ways based on purpose, task, and audience, using appropriate vocabulary. (Communicator) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ The language of mathematics allows us to communicate in a precise, efficient, and logical manner. (U1) ■ Knowing the properties of exponents supports modeling situations and simplifying expressions. (9-12) (U2)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q1) ■ How do I use labels, symbols, units of measure, tables, graphs, and

Pennsylvania Academic Standards

Career Education and Work (2026): 9-12

- Identify solutions to existing conditions or problems using critical thinking skills. (13.2.9-12.A)

Profile of a CV Learner

- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)

- (9+) Expressions, equations and inequalities can be used to represent and solve real-world problems. (U3)
- (9+) Expressions, equations and inequalities can be represented in multiple forms. (U4)
- (9+) Mathematical reasoning is used to solve equations. (U5)

vocabulary to analyze situations and/or share findings? (Q2)

- (9-12) How can I apply the properties of _____ (i.e exponents, equality, etc.) to solve problems? (U1,2) (Q3)
- (9+) How are functions represented graphically? What are the properties of these graphs? (U1,2) (Q4)
- (8+) How does evaluating a function show relationships between quantities? (U1) (Q5)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- The relationship between exponential and logarithmic forms of equivalent equations (K1)
- The properties of logarithms, including the product, quotient, and power properties (K2)
- The characteristics and relationships of exponential and logarithmic equations, including their solutions and restrictions (K3)
- The characteristics and applications of exponential and logarithmic functions in real-world contexts (K4)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can apply the properties of logs to simplify expressions and solve equations. (S1)
- I can change between exponential and logarithmic form. (S2)
- I can solve application problems involving exponential and logarithmic functions. (S3)



Unit 4: Sequences and Series / Binomial Theorem

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 20 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

This unit's focus is on using, applying, and understanding arithmetic, geometric, and recursive sequences and series, as well as the binomial theorem to expand a binomial. Students connect their learning in a real world application of an actuary helping clients plan for their future by modeling scenarios using arithmetic and geometric sequences and calculating long term risk using the binomial theorem.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 - Write functions or sequences that model relationships between two quantities. (CC.2.2.HS.C.3) - Write expressions in equivalent forms to solve problems. (CC.2.2.HS.D.2) - Extend the knowledge of arithmetic operations and apply to polynomials. (CC.2.2.HS.D.3) Mathematical Practices - Make sense of problems and persevere in solving them. (MP1) - Use appropriate tools strategically. (MP5)	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... Grow Confidence: Demonstrate perseverance and self-efficacy by making an attempt, using reflection, monitoring progress, and changing course as needed. (Lifelong Learner) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... - Mathematicians learn by doing – implementing a strategy and reworking as needed. (U1) - Making and growing through mistakes is fundamental to progressing as a	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... How do I get started when I am looking at this problem/challenge? What are some other ways I might think about this? (Q1)

■ Attend to precision (MP6) Pennsylvania Academic Standards Career Education and Work (2026): 9-12 ■ Identify solutions to existing conditions or problems using critical thinking skills. (13.2.9-12.A)	problem solver and deepening math knowledge. (U2) ■ (3+) Patterns can be identified, created, and analyzed to understand relationships. (U3) ■ (9+) Expressions, equations and inequalities can be represented in multiple forms. (U4)	■ (3+) What rule or pattern can be used to solve problems? How can I use a rule to generate patterns? (U3) (Q2) ■ (9+) How are solutions justified when solving a problem? (U2,3) (Q3) ■ (8+) What function best models this data? How do its characteristics help me make predictions? (U1,2) (Q4)
	Acquisition of Knowledge & Skill	
Profile of a CV Learner	Knowledge	Skills
■ Life-Long Learner: Students will be able to independently use their learning to analyze past and ongoing performance, adjust thinking processes to new contexts, and use information to make informed and conscientious decisions. (PCVL.LLL)	What facts and basic concepts should students know and be able to recall? Students will know... ■ The characteristics and structure of explicit and recursive formulas for sequences (K1) ■ The characteristics of arithmetic and geometric sequences and the formulas for their sums (K2) ■ The binomial theorem and the relationship between binomial coefficients, exponents, and terms in a binomial expansion (K3)	What discrete skills and processes should students be able to use? Students can... ■ I can use and understand how to use summation notation in a sequence. (S1) ■ I can recognize a pattern as an arithmetic, geometric, or recursive series. (S2) ■ I can substitute values in the appropriate arithmetic, geometric, or recursive formula. (S3) ■ I can determine a specific term of a series. (S4) ■ I can use the binomial theorem to expand a binomial. (S5) ■ I can use the binomial theorem to determine a specific term in a binomial expansion. (S6) ■ I can use the counting principle to determine outcomes. (S7) ■ I can use permutations and combinations to determine outcomes. (S8)



Unit 5: Right and Oblique Triangle Trigonometry

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 10 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

This unit's focus is on using and understanding right and oblique triangle trigonometry and connecting learning to a real world application about an island in need of supplies after a natural disaster. Because the points form a triangle, fundamental right trigonometry is used to determine missing distances.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 ■ Prove the Pythagorean identity and use it to calculate trigonometric ratios. (CC.2.2.HS.C.9) ■ Write expressions in equivalent forms to solve problems. (CC.2.2.HS.D.2) ■ Apply trigonometric ratios to solve problems involving right triangles. (CC.2.3.HS.A.7) Mathematical Practices ■ Make sense of problems and persevere in solving them. (MP1) ■ Look for and make use of structure. (MP7)	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Solve Problems Efficiently: Use skills, strategies, models, or manipulatives to increase efficiency and accuracy. (Innovative Problem Solver) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ Recognize that patterns and structures foster efficiency in problem solving. (U1)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ What do I know? What do I need to find out? How does that help me? (Q1) ■ What is the best/most efficient way to solve this type of problem? (Q2) ■ (9+) How are solutions justified when solving a problem? (U2,3) (Q3)

Pennsylvania Academic Standards Career Education and Work (2026): 9-12 Identify solutions to existing conditions or problems using critical thinking skills. (13.2.9-12.A)		- How do I determine how to solve this real world problem? How do I know? (U4) (Q4) - How can I use the information I have to determine unknown information? (U7) (Q5)
	Acquisition of Knowledge & Skill	
Profile of a CV Learner	Knowledge	Skills
Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)	What facts and basic concepts should students know and be able to recall? Students will know... - The relationship among the sides and angles of right triangles, including the trigonometric ratios sine, cosine and tangent (K1) - The Law of Sines, Law of Cosines, and their relationships to the sides and angles of oblique triangles (K2) - The relationships among trigonometric ratios, triangle measurements, and real-world applications (K3)	What discrete skills and processes should students be able to use? Students can... - I can find missing sides and angles of right triangles using Trig Ratios. (S1) - I can find missing sides and angles using Law of Sines and Law of Cosines. (S2) - I can solve application problems using trigonometry. (S3)



Unit 6: Circular Trigonometry

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 15 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

Circular trigonometry expands our understanding of trigonometric functions from rigid, static right triangles to dynamic, repeating motion along a coordinate plane. By utilizing the unit circle, we can model real-world phenomena that fluctuate in predictable, periodic cycles—such as the changing of tides, sound waves, planetary orbits, and the rotation of mechanical wheels. Rather than focusing solely on static degrees, circular trigonometry introduces radian measures, an intrinsic unit of measurement that directly couples an angle's rotation with physical distance (arc length) and angular velocity. How can we use circular trigonometry to find heights and movements of real life circular examples?

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 ■ Apply radian measure of an angle and the unit circle to analyze the trigonometric functions. (CC.2.2.HS.C.7) ■ Choose trigonometric functions to model periodic phenomena and describe the properties of the graphs. (CC.2.2.HS.C.8) ■ Create and graph equations or inequalities to describe numbers or relationships. (CC.2.2.HS.D.7)	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Communicate Mathematically: Communicate effectively in a variety of ways based on purpose, task, and audience, using appropriate vocabulary. (Communicator) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ Mathematicians work to understand the problem by picturing what is happening and figuring out relevant information and unknowns. (U1)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ When I'm listening to an idea or approach, what questions do I have? How do I share them to grow my own and other's thinking? (Q1)

Mathematical Practices ■ Model with mathematics. (MP4) ■ Use appropriate tools strategically. (MP5)	■ Mathematicians learn by doing – implementing a strategy and reworking as needed. (U2) ■ Recognize that patterns and structures foster efficiency in problem solving. (U3) ■ The language of mathematics allows us to communicate in a precise, efficient, and logical manner. (U4) ■ 5+ Geometric concepts and tools can be used to describe or solve real world problems. (U5) ■ 5+ mathematical relationships exist within a shape (ex: pythagorean theorem). (U6)		■ What makes a group effective? How are we working together right now? How can we continue to improve? (Q2) ■ How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q3) ■ How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q4) ■ (6-7) How do I use mathematics to model this situation? (U1) (Q5) ■ (6-7) How do I know my answer is reasonable? (U1) (Q6)
Profile of a CV Learner ■ Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)	Acquisition of Knowledge & Skill		
	Knowledge	Skills	
	What facts and basic concepts should students know and be able to recall? Students will know... ■ The structure and key components of the unit circle, including the coordinate axes, quadrants, angles, and reference angles (K1) ■ The relationship between angles on the unit circle and their corresponding sine, cosine, and tangent values (K2) ■ The fundamental trigonometric identities and the relationships among trigonometric functions and their values (K3) ■ The characteristics and key features of the graphs of trigonometric functions (K4)	What discrete skills and processes should students be able to use? Students can... ■ I can write the equation for the unit circle. (S1) ■ I can evaluate the cosine, sine, tangent, secant, cosecant, and cotangent for angle measurements on the unit circle. (S2) ■ I can simplify trigonometric expressions using trigonometric identities. (S3) ■ I can solve trigonometric equations. (S4) ■ I can graph trigonometric equations with translations. (S5)	

■ The relationship among trigonometric functions, geometric measurements, and real-world applications (K5)

■ I can solve trigonometric application problems. (S6)



Unit 7: Limits

Draft Date 09-19-2025	Course HS CP Pre-Calculus	Duration 11 Day(s)	Grades 10, 11, 12	Subjects Mathematics	Team Bethany Hovan, Amanda Manuel, Mark Pieters, CHRIS HIGH, Theodora Bevan-Xenelis, Hanna Garber, Brittany Torres, William Graber, Makenna Nicarry, Dana Keares
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Focus

In Unit 7 we will learn how to evaluate limits in multiple ways such as graphically, numerically, and algebraically. Limits take us to the edge of the mathematical universe. Instead of asking "*What happens exactly at this point?*"—which often leads to a dead-end of dividing by zero—limits ask the much more profound question: "*What happens as we get infinitely close?*" It is the mathematics of boundaries, trends, and extreme conditions. By studying limits, we unlock the ability to analyze instantaneous change, predict long-term stability, and bridge the gap between static algebra and dynamic calculus.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Core Standards Mathematics (2014): 9 ■ Graph and analyze functions and use their properties to make connections between the different representations. (CC.2.2.HS.C.2) ■ Write expressions in equivalent forms to solve problems. (CC.2.2.HS.D.2) ■ Extend the knowledge of rational functions to rewrite in equivalent forms. (CC.2.2.HS.D.6)	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Solve Problems Effectively: Based on an examination of the problem/situation, initiate a plan, execute it, evaluate and explain the reasonableness of the solution. (Innovative Problem Solver) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ Mathematicians work to understand the problem by picturing what is	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ (9-12) How can I apply the properties of _____ (i.e exponents, equality, etc.) to solve problems? (U1,2) (Q1)

Mathematical Practices ■ Construct viable arguments and critique the reasoning of others. (MP3) ■ Use appropriate tools strategically. (MP5) ■ Look for and make use of structure. (MP7) Pennsylvania Academic Standards Career Education and Work (2026): 9-12 ■ Identify solutions to existing conditions or problems using critical thinking skills. (13.2.9-12.A)	happening and figuring out relevant information and unknowns. (U1) ■ Mathematicians learn by doing – implementing a strategy and reworking as needed. (U2)	■ (5+) How can I simplify algebraic expressions? How does this make the problem more doable? (U1,2) (Q2) ■ (3+) What rule or pattern can be used to solve problems? How can I use a rule to generate patterns? (U3) (Q3) ■ (9+) How do I use what I know about operations, factors, and graphs when making sense of polynomials? (U1,2,3) (Q4) ■ (9+) How are functions represented graphically? What are the properties of these graphs? (U1,2) (Q5)
Profile of a CV Learner	Acquisition of Knowledge & Skill	
	Knowledge What facts and basic concepts should students know and be able to recall? Students will know... ■ The concept of a limit and the relationship between graphical, numerical, and algebraic representations of limits (K1) ■ The relationship between limits and the key features of rational function graphs, including holes, vertical asymptotes, and horizontal asymptotes. (K2) ■ The structure of piecewise functions and the relationship between their graphs, function rules, and limits at a boundary point. (K3)	Skills What discrete skills and processes should students be able to use? Students can... ■ Evaluate limits graphically, numerically, algebraically (S1) ■ Graph rational functions using limits (S2) ■ Graph piecewise functions and evaluate limits from their graphs (S3)