Unit 06: Conics

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **1 week**
Status: **Published**

Brief Summary of Unit

Students will review the basic graphs of ellipses, circles, parabolas, and hyperbolas. Students will discuss the connections between the conics, both algebraically and geometrically.

Revised Date: July 2025

Standards

Students will analyze geometric designs which connect to various cultures. Embracing the diversity within society incorporates the following:

Amistad Commission

This unit also reflects the goals of the Department of Education and the Amistad Commission including the infusion of the history of Africans and African-Americans into the curriculum in order to provide an accurate, complete, and inclusive history regarding the importance of of African-Americans to the growth and development of American society in a global context.

Asian American and Pacific Islander History Law

This unit includes instructional materials that highlight the history and contributions of Asian Americans and Pacific Islanders in accordance with the New Jersey Student Learning Standards in Social Studies.

New Jersey Diversity and Inclusion Law

In accordance with New Jersey's Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity, including:

economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance.

MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
MA.A-SSE.B.3a	Factor a quadratic expression to reveal the zeros of the function it defines.
MA.A-SSE.B.3b	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
MA.A-SSE.B.3c	Use the properties of exponents to transform expressions for exponential functions.
MA.F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
MA.G-GPE.A.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
MA.G-GPE.A.2	Derive the equation of a parabola given a focus and directrix.
LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
MA.G-GPE.A.3	Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
TEC.K-12.8.1	All students will use computer applications to gather and organize information and to solve problems.
TEC.K-12.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment.
WORK.K-12.9.1	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
WORK.K-12.9.2	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.

Transfer

- Depending on the situation, understanding the meaning of a maximum or minimum value.
- Noticing the parabolic effect in physic applications.
- Using function transformation knowledge to impact a parabolic movement.

Essential Questions

- How are all the different conic shapes connected both geometrically (through the cross-sections of a cone) and algebraically (through the general equation: Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0)?

- How are circles related to conics?

- What are the similarities between circles and ellipses?

Essential Understandings

- A circle is a specialized ellipse with the major axis = the minor axis = the diameter.

- For the general form $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$: If A = C, then the graph is a circle; if AC>0, then the graph is an ellipse; if AC<0, then the graph is a hyperbola; if A=0 or C=0, then the graph is a parabola.

- The asymptotes of a function, such as a hyperbola, are related to the limit properties of calculus.

- The equation of a circle is just a generalization of the distance formula.

- The equation of a parabola is directly related to the graphs of the form: $Ax^2 + Bxy + Dx + Ey + F = 0$ or $Bxy + Cy^2 + Dx + Ey + F = 0$

- The equation of a semicircle is directly related to the equation of a circle.

- The rules of symmetry can be used to understand conics better.

Students Will Know

- How to determine if a graph is an ellipse, hyperbola, circle, or parabola, just by analyzing its equation.

- How to find equations of circles and how to use these equations to graph and analyze circles.

- How to find equations of ellipses and how to graph them.

- How to find equations of hyperbolas and how to graph them.

- How to find equations of parabolas and how to graph them.

- How to find the vertex, focus, and directrix of a parabola.

- How to find vertices, foci, and asymptotes for hyperbolas.

- How to solve systems of second-degree equations.

- How to use completing the square to put conics in general form.

- If $y = a(x - h)^2 + k$, then the graph is a parabola with vertex (h, k).

Students Will Be Skilled At

- Analyzing a circle equation and the information it can give.

- Graphing parabolas, circles, ellipses, and hyperbolas based on equations.

- Mathematically completing the square.

- Solving for the vertex, focus, and directrix of parabolas.

- Solving for vertices, foci, and asymptotes for hyperbolas.

Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments

- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments

- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math

- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions

- Class discussion of daily topic

- Classwork and homework that assess the essential questions

- Distinguish between the different conics by either its graph or its equation.

- Find important components of conics, such as foci, directrix, vertices and asymptotes.

- Graph, define and apply circles, ellipses, parabolas and hyperbolas.

- Performance task: Have students investigate "whispering galleries". They can find famous galleries and discuss why the location of foci of ellipses is important in these galleries.

- Performance task: Have students investigate where parabolas can be found in real life. For example, students could investigate satellite dishes, telescopes, reflectors, and contact lenses, and prepare a class presentation.

- Provide alternative means of assessments for certain students

- Solve systems of equations involving conics algebraically and graphically.

- Teacher Observation

- Tests and quizzes that assess the essential questions

- Utilize algebraic techniques such as distributing, factoring and completing the square to put conics in general form.

- Written assignments that assess the essential questions that involves providing explanations

Learning Plan

- Circles.

- Differentiating between each conic using just the equation.

- Ellipses.

- Hyperbolas.

- Parabolas.

- Preview the essential questions and connect to learning throughout the unit

- Solving second-degree systems.

- Use of the graphing calculator to sketch the conics.

Materials

Core instructional materials: [Core Book List](#) including PreCalculus Enhanced with Graphing Utilities, Sullivan, Savvas

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes
- Whiteboard tables

Suggested Strategies for Modifications

[Possible accommodations/modification for CP PreCalc & Trig](#)