

NHU/NASA Summer Institute

Lesson Plan

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Lesson Plan Title	Ellipse and the Mars Orbital Path
Grade Level	Algebra II, 8 th to 12 th grade
Concept/Topic to Teach	The characteristic of the ellipse formula will be presented. Transforming the elliptical quadratic formula to the standard elliptical equation will be presented by completing the square.
Content Standards	17.0 Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, students can use the method for completing the square to put the equation into standard form and can recognize whether the graph of the equation is a circle, ellipse, parabola, or hyperbola. Students can then graph the equation
General Goals	Students will learn the geometric characteristic and features of the ellipse equation. Some of the characteristics will be the elliptical focus points, eccentricity, and extremities.
Specific Objectives	Students will learn that when the eccentricity (e) is between 0 and one, it is an ellipse. If $e = 0$, it is a circle. The student will learn to convert an elliptical quadratic formula to a more visual equation by completing the square. The student will see the minor differences of the equation from a circle equation. The student will also learn about the other parameters of the elliptical polynomial equation. For a real life application, the student will go through an exercise of determining the Mars' elliptical orbit.
Required Materials	Algebra Textbook. Pictures of Elliptical shapes. Internet access for student research. The student will go to the following Internet sites to view the technical orbital and eccentricity data for Mars: http://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html

	<p>The next Internet site provides educational information of elliptical orbit mechanics of planets.</p> <p>http://aerospacescholars.jsc.nasa.gov/HAS/cirr/ss/2/4.cfm</p> <p>The next Internet site is for the GATE students to study to determine the intercontinental orbit use for a space vehicle from Earth to Mars.</p> <p>http://www2.jpl.nasa.gov/basics/bsf4-1.html</p> <p>The last Internet site provides information for the GATE students to calculate the orbit of Halley's comet.</p> <p>http://nssdc.gsfc.nasa.gov/planetary/factsheet/cometfact.html</p>
Anticipatory Set	<p>The teacher will give a string that is longer than the width of the focus points. Students are to pair up and use the string and a writing instrument to draw an elliptical shape. Students will write down objects have the elliptical shapes</p>
Step-by-Step Procedures	<p>Teacher will review the quadratic equation. The teacher will review how to represent it with polynomials by completing the square. The teacher will review the quadratic equation of a circle and parabola. The teacher will show a picture of ellipse. The teacher will squeeze a circle to an elliptical shape. The teacher will give the quadratic equation (using the polynomial format) of an ellipse and its characteristics: eccentricity, focus, and extremities.</p>
Plan for Guided Practice	<p>The teacher will go through an example of translating a quadratic formula into its polynomial format. The teacher will point out the characteristics of the elliptical polynomial quadratic equation. The teacher will calculate the eccentricity,</p>
Plan for Independent Practice	<p>The students will break into groups of three to four and work on textbook problems. They will work on exercises to convert elliptical quadratic equations to its polynomial format. They will identify the focus, extremities of the minor axis, and vertices. They will draw the elliptical shape. They will work as a group to determine the elliptical polynomial equation on the orbital path of Mars. They should seek assistance from their peers first. If they need help outside of</p>

	<p>their group, the teacher can assist or an advanced student will be asked to help. If they finish early, they can start on their homework assignments.</p>
<p>Assessment (based on objectives)</p>	<p>The student will be given equations, eccentricity numbers, and geometric figures in a test. The student will be asked to determine which are associated to an ellipse. Quadratic formulas will be given. The student will be asked to translate it to the quadratic polynomial equation of an ellipse. The student will be asked what the eccentricity, the foci, and other elliptical parameters are. The students will be asked to derive the orbital path of Mars given different orbital parameters that differ from its real parameters..</p>
<p>Adaptations (ELL students or special populations)</p>	<p>Students will enter in their journal the definition(s) of eccentricity, axis, axes, focal point, focus, and other words they don't know. They are to write down their questions. The teacher or their peers will answer the questions. They will write down the answers in their journal. They are advise to use the free tutoring classes or come in early or after school for sessions with the teacher</p>
<p>Extensions (for gifted students)</p>	<p>Students will go on the Internet and research Kepler's discovery that the Mars orbital path was elliptical with the Sun being at one of the focus. Students will investigate the orbits of Halley's comet which has a more elongated elliptical orbit. The students will determine when we will see Halley's comet again. The students can also determine the intercontinental orbit used for a space vehicle to travel from Earth to Mars.</p>