

## Core Content

<b>Cluster Title: Use complex numbers in polynomial identities and equations.</b>
<b>Standard N.CN.7:</b> Solve quadratic equations with real coefficients that have complex solutions.
<b>Concepts and Skills to Master</b>
<ul style="list-style-type: none"> <li>Understand the meaning of a complex number.</li> <li>Solve a quadratic equation and understand the nature of the roots.</li> </ul>

## Supports for Teachers

<b>Critical Background Knowledge</b>	
<ul style="list-style-type: none"> <li>Understand the meaning of a complex number.</li> <li>Solve quadratic equations.</li> </ul>	
<b>Academic Vocabulary</b>	
complex number, imaginary number, roots, solutions, zeros	
<b>Suggested Instructional Strategies</b>	<b>Resources</b>
<ul style="list-style-type: none"> <li>Connect to quadratic functions that have no x-intercepts.</li> <li>Use the discriminant to describe the number and types of roots for a quadratic equation.</li> </ul>	
<b>Sample Formative Assessment Tasks</b>	
<b>Skill-Based Task:</b> Graph and find the solutions to the function $f(x) = (x - 3)^2 + 5$ . Reflect the parabola across the line $y = 5$ at the vertex. Compare and contrast the graphs and solutions.	<b>Problem Task:</b> Create a quadratic function without x-intercepts and verify that its solutions are complex.

## Core Content

<b>Cluster Title: Use complex numbers in polynomial identities and equations.</b>
<b>Standard N.CN.8:</b> Extend polynomial identities to the complex numbers. (For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$ .)
<b>Concepts and Skills to Master</b>
<ul style="list-style-type: none"> <li>Express a quadratic as a product of two complex factors.</li> </ul>

## Supports for Teachers

<b>Critical Background Knowledge</b>	
<ul style="list-style-type: none"> <li>Factor quadratics.</li> <li>Understand that some quadratic functions have complex solutions.</li> <li>Know the definition of <math>i</math>.</li> <li>Perform operations on complex numbers.</li> <li>Standard form of a complex number.</li> </ul>	
<b>Academic Vocabulary</b>	
conjugates, complex numbers, $i$ , factor	
<b>Suggested Instructional Strategies</b>	<b>Resources</b>
<ul style="list-style-type: none"> <li>Demonstrate that any binomial quadratic expression can be expressed as the difference of two squares (e.g., <math>x^2 + 16 = x^2 - 16i^2</math>).</li> </ul>	
<b>Sample Formative Assessment Tasks</b>	
<b>Skill-Based Task:</b> Factor over the complex number system. $x^2 + 16$ Answer: $(x + 4i)(x - 4i)$ $x^2 - 10x + 34$ Answer: $(x + 5i)(x - 5i)$	<b>Problem Task:</b> Expand the expression $(x + 3)(x - 5i)(x + 5i)$ two ways: A. $[(x + 3)(x - 5i)](x + 5i)$ B. $(x + 3)[(x - 5i)(x + 5i)]$ Compare and contrast the methods.

## Core Content

<b>Cluster Title: Use complex numbers in polynomial identities and equations.</b>
<b>Standard N.CN.9:</b> Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
<b>Concepts and Skills to Master</b>
<ul style="list-style-type: none"> <li>Know that the Fundamental Theorem of Algebra guarantees that any quadratic function will have a solution in the complex number system.</li> </ul>

## Supports for Teachers

<b>Critical Background Knowledge</b>	
<ul style="list-style-type: none"> <li>Solve quadratic equations.</li> <li>Know the definition of a complex number (Sec II:N.CN.1).</li> <li>Understand the mathematical definition of closure.</li> </ul>	
<b>Academic Vocabulary</b>	
Fundamental Theorem of Algebra, solutions, complex, roots, real number system, complex number system, algebraically closed, multiplicity	
<b>Suggested Instructional Strategies</b>	<b>Resources</b>
<ul style="list-style-type: none"> <li>Relate the types of solutions to the different number system.</li> <li>Connect to the need of different number systems.</li> </ul>	
<b>Sample Formative Assessment Tasks</b>	
<p><b>Skill-Based Task:</b> In the system of integer numbers, explain why there is no answer to the equation: <math>3x = 5</math>. In the system of rational numbers, explain why there is no answer to the equation: <math>x^2 + 5 = 0</math>.</p>	<p><b>Problem Task:</b> Why is it better to solve quadratic equations in the complex number system rather than in the real number system?</p>