Mathematics in this Lesson
Lesson 2

Lesson Description

Keoni and Sasha work with a parabola on the coordinate grid. They use the properties of the grid and the Pythagorean theorem to determine if the coordinates of a point are on a given parabola. They apply these methods to find the missing x-value of a point on the parabola for a given y-value.

Targeted Understandings:

This lesson can help students:

- Identify and apply key elements of the geometric definition of a parabola in the context of the Cartesian coordinate grid.
- Conceive of a point on a Cartesian coordinate grid, not only as a location, but also as representing distances in 2-dimensional space.
- Apply the Pythagorean Theorem in a new setting to measure distances

Common Core Math Standards

- **CCSS.M.HSG.GPE.A.2: Derive the equation of a parabola given a focus and directrix.**
  [http://www.corestandards.org/Math/Content/HSG/GPE/A/2/]

  Lesson 2 connects the geometric definition of a parabola from Lesson 1 with an algebraic coordinate grid, which makes the derivation of an equation of a parabola possible. Sasha and Keoni then derive the equation of:
  - particular parabolas in Lessons 3 and 4;
  - any parabola with vertex (0,0) in Lesson 5; and
  - any parabola with vertex (h,k) in Lesson 9.

- **CCSS.M.HSG.GPE.B.4: Use coordinates to prove simple geometric theorems algebraically.**
  [http://www.corestandards.org/Math/Content/HSG/GPE/B/4/]

Sasha and Keoni use the coordinates on an algebraic Cartesian grid, along with the definition of a parabola, to validate that three points are on the parabola.

- **CCSS.M.8.G.B.8: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.**
  [http://www.corestandards.org/Math/Content/8/G/B/8/]

  Keoni and Sasha use the Pythagorean theorem, along with the coordinate system and the definition of a parabola, to determine the x-value for a point on the parabola given its y-value.

Common Core Math Practices

CCSS.Math.Practice.MP5: Use appropriate tools strategically.
[http://www.corestandards.org/Math/Practice/MP5/]

In this lesson, Sasha and Keoni use an important mathematical tool— the Pythagorean theorem. A discussion in the lesson models an important habit of mind related to tool use. Specifically, when Keoni and Sasha are stumped about how to measure the length of a diagonal line segment from a point on the parabola to the focus [**1:46, Episode 2**], their teacher encourages them to write down everything they know [**1:56, Episode 2**] and articulate what they are trying to find [**2:53, Episode 2**]. In the process, a right triangle emerges on the grid, with two sides of known length and one of unknown length. This practice of analyzing the situation prepares Sasha and Keoni to strategically apply the Pythagorean theorem once the teacher suggests its use [**3:56, Episode 2**].