

## Mathematics in this Lesson

### Lesson 1

#### Lesson Description

As they make sense of terms like *equidistant*, *focus*, and *directrix*, Sasha and Keoni interpret the definition of a parabola. By asserting and examining claims about measuring the distances between points and lines, Keoni and Sasha develop a method to construct a parabola from its definition.

#### Targeted Understandings:

*This lesson can help students:*

- Internalize the relationship that the distance from a point on the parabola to the focus is the same as the distance from that point to the directrix.
- Isolate and analyze the constraint that the distance between a point on the parabola and the directrix has to be along a segment that is *perpendicular* to the directrix.
- Think of a line parallel to the directrix as consisting of all the points that are the same distance from the directrix.

#### Common Core Math Standards

- **CCSS.M.HSG.GPE.A.2: Derive the equation of a parabola given a focus and directrix.**

Lesson 1 provides a foundation for this Common Core Standard. As Sasha and Keoni construct a parabola from its geometric definition, they make sense of the terms ***focus*** and ***directrix***, as well as the relationship of points on the parabola to both. In Lesson 2, they connect the geometry 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.HSN.Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.**

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The number and quantity strand of the Common Core Standards emphasizes reasoning with measurable attributes in situations (such as length). In this lesson, Sasha and Keoni are able to construct points on a parabola and reject other potential points by measuring the distance from a potential point to the focus and to the directrix. A crucial part of their ability to create a general method for constructing points on the parabola involves Sasha’s quantitative insight that a line parallel to the directrix consists of a collection of points that are the same distance to the directrix.

## Common Core Math Practices

### [CCSS.Math.Practice.MP1](#) Make sense of problems and persevere in solving them.

According to the Common Core’s description of Math Practice 1, “students start by explaining to themselves the meaning of a problem.” Sasha and Keoni begin this lesson by interpreting the meaning of the geometric definition of a parabola. Initially they claim that if a point is to be the same distance from the focus and the directrix, then the focus has to be on the directrix. By analyzing what Math Practice 1 calls “givens, constraints, relationships, and goals,” Sasha and Keoni conjecture and then test different points to see if they fit the definition. Eventually, they realize that if the focus is on the directrix, then the points that fit the definition will form a line rather than a parabola [\[4:25 in Episode 1\]](#).

Math Practice 1 also speaks to the importance of persistence in problem solving. The raw footage that was filmed for Episode 1 (making sense of the problem statement) was over 20 minutes long, and the research team began to wonder if the students would succeed! But Sasha and Keoni’s persistence paid off in the clever methods they developed in Episode 2 to construct a parabola. An expression of Sasha’s delight in solving the problem and her subsequent confidence in their ability can be seen at [10:11 in Episode 2](#).

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