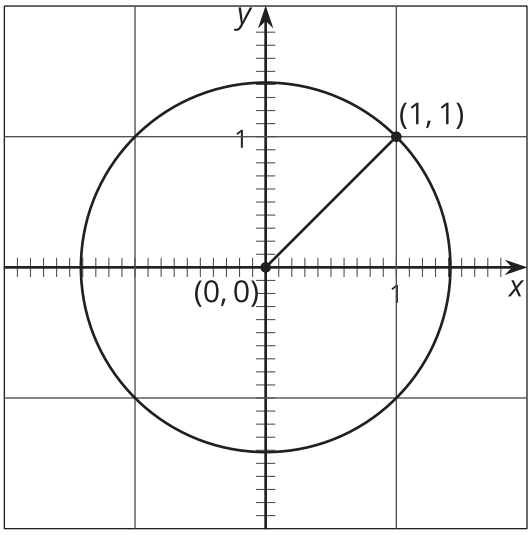
Unit 8, Lesson 5

Square Roots on the Number Line

Let's approximate square roots.

5.1 Notice and Wonder: Diagonals

What do you notice? What do you wonder?



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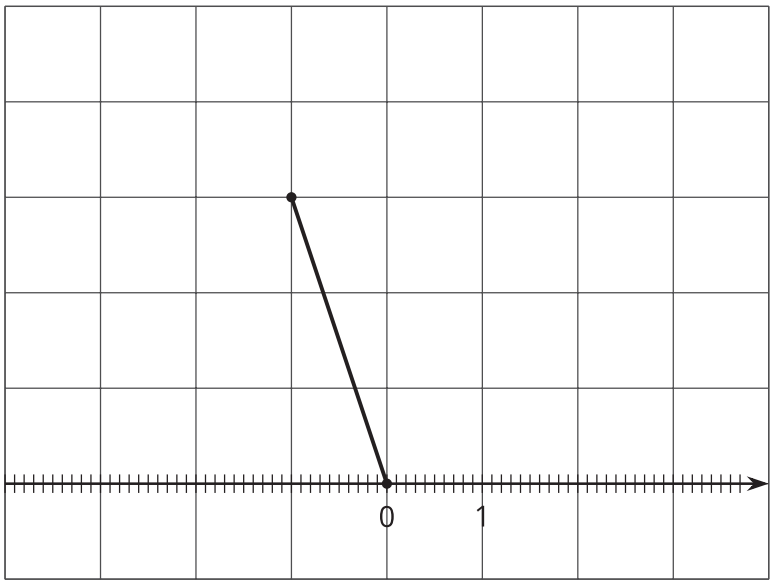
5.2 Squaring Lines

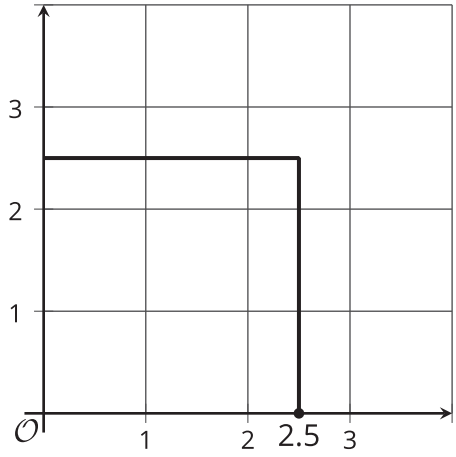
Find the length of the segment.



5.3 Square Root of 3

1. Diego says that $\sqrt{3} \approx 2.5$.

   Use the square to explain why 2.5 is not a very good approximation for $\sqrt{3}$.

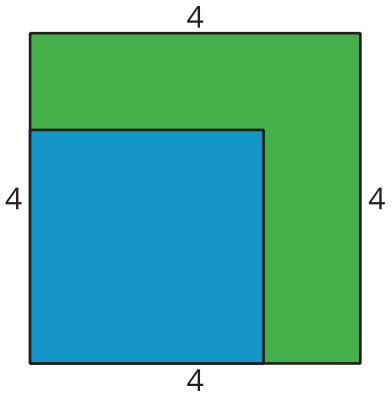


2. Find a point on the number line that is closer to $\sqrt{3}$. Draw a new square on the coordinate plane and use it to explain how you know the point you plotted is a good approximation for $\sqrt{3}$.

Are you ready for more?

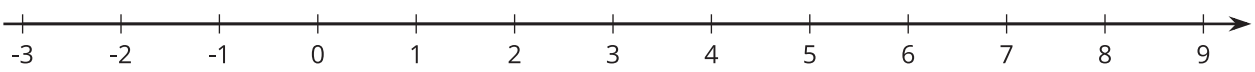
A farmer has a grassy patch of land enclosed by a fence in the shape of a square with a side length of 4 meters. To make it a suitable home for some animals, the farmer would like to carve out a smaller square to be filled with water, as shown in the figure.

What should the side length of the smaller square be so that half of the area is grass and half is water?



5.4 Solutions on a Number Line

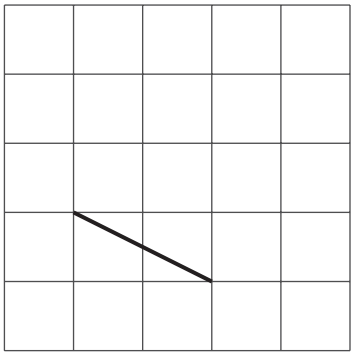
The numbers x, y, and z are positive, and $x^2 = 3$, $y^2 = 16$, and $z^2 = 30$.



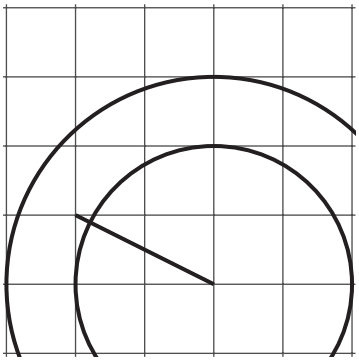
1. Plot x, y, and z on the number line. Be prepared to share your reasoning with the class.
2. Plot $-\sqrt{2}$ on the number line.

Lesson 5 Summary

Here is a line segment on a grid. How can we determine the length of this line segment?

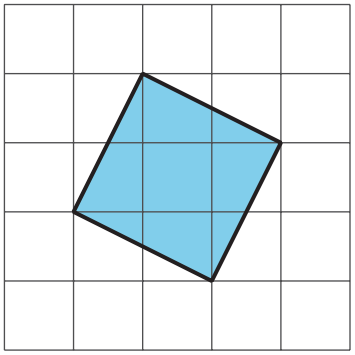


By drawing some circles, we can tell that it's longer than 2 units, but shorter than 3 units.



To find an exact value for the length of the segment, we can build a square on it, using the segment as one of the sides of the square.

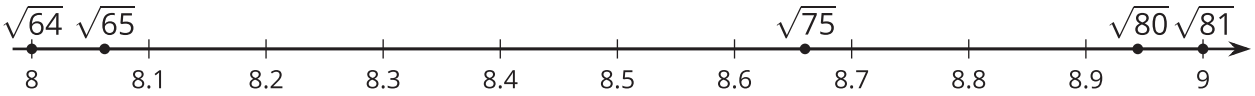
The area of this square is 5 square units. That means the exact value of the length of its side is $\sqrt{5}$ units.



Notice that 5 is greater than 4, but less than 9. That means that $\sqrt{5}$ is greater than 2, but less than 3. This makes sense because we already saw that the length of the segment is between 2 and 3 units.

We can approximate the value of a square root by observing the whole numbers around it and remembering the relationship between square roots and squares. Here are some examples:

- $\sqrt{65}$ is a little more than 8 because $\sqrt{65}$ is a little more than $\sqrt{64}$, and $\sqrt{64} = 8$.
- $\sqrt{80}$ is a little less than 9 because $\sqrt{80}$ is a little less than $\sqrt{81}$, and $\sqrt{81} = 9$.
- $\sqrt{75}$ is between 8 and 9 (it's 8 point something) because 75 is between 64 and 81.
- $\sqrt{75}$ is approximately 8.67 because $8.67^2 = 75.1689$.



If we want to find the square root of a number between two whole numbers, we can work in the other direction. For example, since $22^2 = 484$ and $23^2 = 529$, then we know that $\sqrt{500}$ (to pick one possibility) is between 22 and 23. Many calculators have a square root command, which makes it simple to find an approximate value of a square root.