# Notes for the Teacher

Students estimate the location of an unlabeled point on a number line. After making their estimate, students magnify the interval containing the point to view a number line that is divided into ten smaller equal parts (tenths). Students then explore hundredths (by magnifying twice), thousandths (by magnifying three times), and then ten-thousandths (by magnifying four times). Finally, students think about place values smaller than ten-thousandths and discuss whether every point on a number line can be represented as a decimal with a finite number of digits.

This activity is a continuation of the Exploring Tenths activity. If you haven't done so already, have students complete the *Zooming Decimals—Exploring Tenths* activity prior to introducing this one.

### *Objectives:*

- Students will use a number line model to explore place value from tenths through and beyond ten-thousandths.
- Students will develop strategies for estimating the location of an unlabeled decimal-valued point (in tenths, hundredths, thousandths, and ten-thousandths) on a number line.
- Students will develop an understanding of the base-ten number system and place value.
- Students will develop an understanding that between any two distinct decimal-valued locations on a number line, there are more decimal-valued locations between them.

***Common Core Mathematical Practices:*** (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (7) Look for and make use of structure.

***Common Core State Content Standards:*** 4.NF6, 7; 5.NBT3; 6.NS6

***Grade Range:*** Grades 4–6

### *Introduce:*

Open **Zooming Decimals--Tenths Hundredths and Beyond.gsp** and distribute the worksheet. Use a projector to show sketch page "Tenths." Use the **Arrow** tool to drag the red point to a location between two whole numbers, such as 3 and 4. Explain

 

that the number line for the Tenths model was built so that the location of the point is always an exact tenth. Ask, "What is the location of the point?" Students' estimates may range from "It's a little more than 3, so it's about 3.2" to "It looks about 1/3 the distance from 3 to 4, so it's about 3.3." Be sure to have students explain their thinking.

Now use the **Arrow** tool to press the *Zoom* button. The interval between 3 and 4 on the Units number line will be magnified, and shown on another number line divided into tenths. Remind students that the red point on the Units line has the same value as the point on the magnified Tenths number line. Ask, "What is the location of the red point?" Press the *Show Location* button to check.

Now go to page "Hundredths." Ask, "What is the location of the point?" Students will likely name a location in tenths. Then, press the *Zoom* button to magnify the interval between 3 and 4, and to display it on another number line divided into tenths. Ask, "Is the location of the point an exact tenth?" (no) Have students make another estimate. They might say, "It's between 3.1 and 3.2. It looks like 3.15."

Then ask, "How can we get a better approximation of the point's location?" Students will likely suggest that you magnify the number line again. Ask, "If we magnify again, what do you predict we'll see?" Students' responses will vary. Some may predict that the interval from 3.1 to 3.2 will be divided into ten equal divisions, just like what happened when they magnified the Units number line. Other students may predict that the interval from 3.1 and 3.2 will be divided into hundredths.

Press the *Zoom* button to show the Hundredths number line. Have students name the location of each hundredths tick mark and identify the point's location (3.14). Press *Show Location* to check.

Discuss how the Tenths number line showed the interval between 3 and 4 divided into ten even divisions, each of length one tenth. The Hundredths number line also divided an interval into ten even divisions, but those divisions are each of length one hundredth.

Now press the *Animate Point* button. Have students look at the point's location on the Units number line, the Tenths number line, and the Hundredths number line as the red point moves. Ask students to describe what they notice. Students might notice that each small discrete shift of the red point represents an increase of 0.o1. Other students may notice that a movement by ten hundredths corresponds to a movement of 0.1, or that a movement by ten tenths corresponds to a movement of 1. By understanding the relationship between the number lines, students will develop a better sense of the relationships between hundredths, tenths, and units.

Now go to page "Thousandths" and repeat this process, having students estimate the location of the point three times: on the Units number line, the Tenths number line, and

 

the Hundredths number line. The point will be an exact thousandth. Students will develop an understanding of the relationships between thousandths, hundredths, tenths, and units.

### *Explore:*

Assign students to partners and send them in pairs to the computers. Have students open **Zooming Decimals--Tenths Hundredths and Beyond.gsp** and go to pages "Tenths," "Hundredths," and "Thousandths" in order. Ask students to take turns either dragging the point to a new location or estimating the location of the point. Students should record their estimates and their exact locations on their worksheets. Make sure students understand how to record the results on the worksheet.

As you circulate, observe students as they work. What strategies do students use to estimate the point's location? What terminology do students use to describe their estimates? Are students able to refine their estimates after looking at a magnified number line? Listening to students as they estimate will give you insight into their understanding of decimals and how they are represented on a number line.

### *Discuss:*

Call students together to discuss and summarize what they have learned. Discuss the different strategies students used to make estimates and how looking at a magnification of the number line helped them refine their estimates.

Then open **Zooming Decimals--Tenths Hundredths and Beyond.gsp** and go to page "Beyond." Ask, "What is the location of the point?" Have students estimate the location of the point on the Units number line. Then press *Zoom* and have students refine their estimates. Continue magnifying and having students refine their estimates through the Ten Thousandths number line. Unlike on previous pages, the red point will not be located on a tick mark. Ask, "How could we keep improving our estimate of this point's location? "(by zooming in even more) "Suppose we could keep magnifying. Do you think we would eventually find the point's exact location? Will the point ever be on a tick mark?"

Let students debate this question. Students may reply:

- *Yes, eventually the point will be on a tick mark if you zoom in far enough.*
- *It's possible the point will be on a tick mark, but we don't know for sure. Maybe the point will always lie between two tick marks.*

Press the *Show Location* button to show the location of the point given to an accuracy of a whopping eight digits to the right of the decimal point. Remind students, if needed,

 

that the three points (ellipses) mean that there are more digits to the right of the decimal point that are not shown.

Help students understand that it is always possible to magnify an interval on the number line further. Between any two distinct decimals, there are always more decimals.

For some locations of the point, it is possible to zoom in and eventually discover that the point sits directly on a tick mark. Explain that further magnifications will show the point still on this tick mark, but with another zero in the new place value to the right with each magnification. For other locations of the point, no matter how many times you zoom in, the point will continue to lie between two tick marks. In those cases, more and more digits can be added to the right of the decimal point (indeed an infinite number of digits) to obtain ever-finer estimates of the point's location.

### *Related Activities:*

- *Color Calculator—Decimal Representations of Fractions*
- *Zooming Integers—Hundreds, Thousands, and Beyond*
- *Zooming Decimals—Exploring Tenths*
- *Reach the Target—Decimals and Place Value*

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