

## Notes for the Teacher

Students estimate the locations of unmarked points that sit at whole-number locations on number lines. Students begin by making an initial estimate of a point's location and then “zoom in” on the interval containing the point. Doing so reveals a magnified view of the number line that is divided into ten smaller equal parts. Students use this information to refine their estimate and continue to magnify the number line until they are able to identify the precise location of the point. Challenges range from estimating the location of a point on a 0–100 number line to estimating the location on a 0–100,000 number line.

### **Objectives:**

- *Students will use a number line model to explore place value from tens through ten thousands.*
- *Students will develop strategies for estimating the location of an unmarked point on a number line.*

**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.NBT1, 2; 5.NBT1

**Grade Range:** Grades 3–5

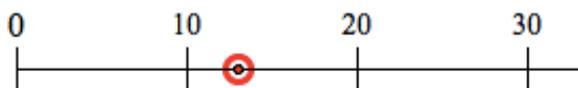
### **Introduce:**

Open **Zooming Integers--Hundreds, Thousands, and Beyond.gsp** and distribute the worksheet. Use a projector to show sketch page “0–100.” Use the **Arrow** tool to drag the red point to a labeled tick mark, such as 10, 20, 30, or 40. Ask, “What is the location of the point?” Students should be able to identify the point's location easily.

Then, use the **Arrow** tool to drag the red point to an unmarked location between two tick marks, such as 10 and 20. Explain that the location of the point is always an integer. Ask, “What do you think is the location of the point?” In the example below, students might say:

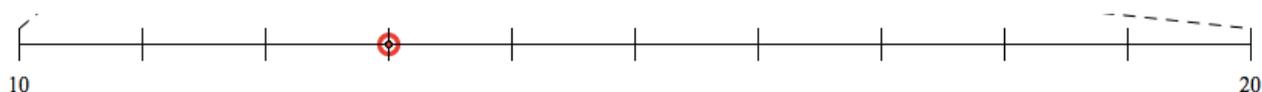
- *The point is between 10 and 20.*
- *The location of the point is definitely less than 15 since 15 is halfway between 10 and 20.*

- *The point looks like it is closer to 10 than 20, so I'll guess 12.*



Continue, “It’s hard to give an exact answer, because we can’t see clearly what’s happening between 10 and 20. But if we magnify that interval, perhaps we could get a better view. Let’s press the *Zoom* button and watch what happens.”

Use the **Arrow** tool to press the *Zoom* button. The portion of the number line between 10 and 20 on the number line will be magnified, revealing a new number line divided into ten equal parts. Explain that the red point on the “Second” number line has the same value as the point on the “First” number line.



Ask, “How many equal parts is the interval from 10 to 20 divided into?” (ten equal parts) “What are the locations of the unlabeled tick marks between 10 and 20?” (11, 12, 13, 14, 15, 16, 17, 18, and 19). “What is the location of the red point? (In this example, 13). Press the *Show Location* button to check.

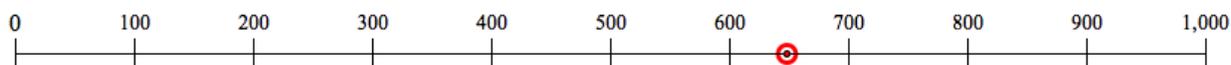
To make a new challenge, press *Reset* and then drag the red point to a new location. Alternatively, press *New Random Point*, and Sketchpad will pick a new location.

When students are comfortable with the model, press *Animate Point* with both the first and second number lines are visible. Let the animation run for a while and ask students to observe the motion of the points. Ask them to describe what they see. Possible responses include:

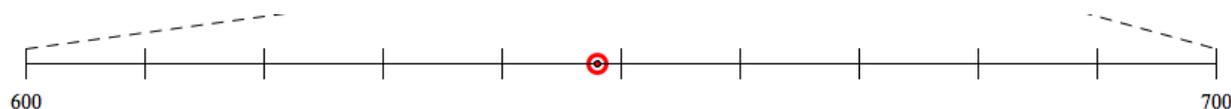
- *The point moves by ones on both number lines, but it’s easier to read its location on the second number line because you can see its actual location on a tick mark.*
- *Every time the point reaches a multiple of 10, the interval on the second number line changes. For example, when the point is at 36, the interval on the second number line goes from 30 to 40. But when the point reaches 40, the interval on the second number line changes to go from 40 to 50.*
- *In the time it takes the point on the second number line to move all the way from one endpoint to the other, the point on the first number line moves from one tick mark to the next tick mark.*

- *When the red point reaches 100, the motion is reversed and the location of the red point decreases by one on its way from 100 back to 0.*

When students are ready, go to the “0–1,000” page. This number line model is similar to the 0–100 model, but now, the number line extends from 0 to 1,000. Ask students to estimate the location of the point. Many students might guess 650 since it appears the point is midway between 600 and 700.



After students have made their estimate, press the *Zoom* button below the number line. Ask, “How many equal parts is the interval from 600 to 700 on this new number line divided into?” (ten equal parts) “What are the locations of the unlabeled tick marks between 600 and 700?” (610, 620, 630, 640, 650, 660, 670, 680, and 690).



Continue, “Now that you can see this magnified view of the number line, would you like to revise your estimate of the point’s location?” Students may propose that the location of the point is 647, 648, or 649.

Ask, “How can we improve our estimate even more?” Students will likely suggest magnifying again, this time on the interval between 640 and 650. Press the second *Zoom* button to reveal that the location of the point is 648.

### ***Explore:***

Assign students to partners and send them in pairs to the computers. Have students open **Zooming Integers--Hundreds, Thousands, and Beyond.gsp** and go to page “0–100.” Ask students to take turns in one of two roles: either dragging the red point to a new location or estimating the location of the point. Students should record their estimates and the exact locations on their worksheets.

When students are ready for more advanced challenges, recommend that they move to the “0–1,000” page.

As before, encourage students to press the *Animate Point* button and observe/describe what happens as the point moves simultaneously on the three number lines. The third number line shows the most magnified view of the point’s movement whereas the movement of the point on the first number line is harder to detect because that same interval is much smaller.

Students may also note that in the time it takes the point on the third number line to move from one endpoint to the other, the point on the second number line moves from one tick mark to the next consecutive tick mark. This same relationship holds between the movement of the point on the second number line and the point on the first number line.

To have students hone their estimation skills further, suggest that they try to identify the locations of the points on the “0–10,000” page and the “0–100,000” page. While students’ attention will be on the accuracy of their estimates, the actual focuses of this activity is on making reasonable estimates and on improving the ability to read and comprehend large numbers.

To help students practice reading large numbers, ask them to explain aloud the thinking behind their estimates. For example, a student might say, “I think the location of the point is 82,000 because the point is closer to 80,000 than 90,000.”

### ***Discuss:***

Call students together to discuss and summarize what they have learned. Ask students to explain how magnifying an interval of a number line helped them to refine their estimates of the points’ locations.

You might also try the following: Go to a sketch page like “0–1,000” and ask students to predict the appearance of the number line they will see when they magnify an interval of interest. So, for example, if the red point sits on the interval between 200 and 300, students might predict that the magnified view of the number line will extend from 200 to 300 with tick marks at 210, 220, 230, etc. Press the *Zoom* button to confirm students’ predictions and then ask them to predict what the next level of magnification will reveal.

### ***Related Activities:***

- *Zooming Decimals—Exploring Tenths*
- *Zooming Decimals—Tenths, Hundredths, and Beyond*
- *Reach the Target—Decimals and Place Value*
- *Find the Secret Number—Developing a Search Strategy*

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