Math Objectives

- Students will create a scale and measure so that the measurements on various images on the TI-Nspire pages will represent the True values.

- Students will use appropriate tools strategically and attend to precision (CCSS Mathematical Standard).

- Students will solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale (CCSS Mathematical Standard).

Vocabulary

- scale
- diameter
- circumference
- perimeter
- radius
- arc length

- millimeter
- centimeter
- milliliter
- degree Fahrenheit
- ratio
- proportion

About the Lesson

- This lesson involves scale drawings of actual images on the TI-Nspire handheld.

- As a result, students will:
  - Use the geometry tools to draw line segments or other items on the images of several objects.
  - Manipulate the scale on a Geometry page.
  - Adjust the measurements on the Geometry page to represent 'True' dimensions.

TI-Nspire™ Navigator™ System

- Send and Collect Files.
- Use Screen Capture to examine student work and responses.
- Use Quick Poll to collect different values for each scale.
- Use Live Presenter for students to show their work.

Activity Materials

- Rulers or other objects to measure – optional
- Camera or scanner to collect new images to measure and scale.
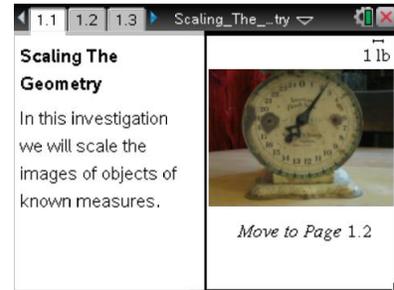
TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can hide the function entry line by pressing ctrl G.

Lesson Files:
Student Activity
Scaling_The_Geometry_Student.pdf
Scaling_The_Geometry_Student.doc

TI-Nspire document
Scaling_The_Geometry.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.

Discussion Points and Possible Answers

Tech Tip: You can grab the Scale bar in the upper right hand corner of the Geometry Page and stretch it to increase the scale.

However, an easier and more precise method is to click on the value and change the units and the value text. You can use no more than two letters for the units but they can be any units you choose.

The images are are locked on the page with the Pin. You can Unpin them with a right-click on the image.

When you have an image on your TI-Nspire, you might want to resize it. To do this on the Geometry Page, you need to right-click (〔ctrl〕〔menu〕) and then select the Image. Then grab one of the handles in a corner and resize. See the lower right-hand corner in the image below. Make sure you don't deform the image by grabbing the sides since this will destroy the scale measures.
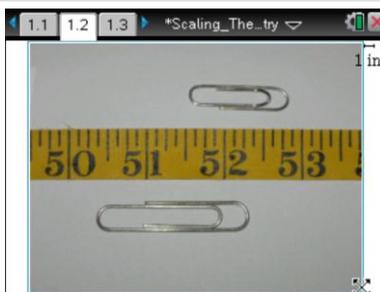
> **Teacher Tip:** You might want to assign some objects to scale to different students or group them and have them divide up the work. You also might want to save some of these for an assessment. Picking some shapes for certain students will help you differentiate the lesson for some.

Move to page 1.2.

1. On this page, the images of the two paperclips have a reference length from the image of the inch ruler. Your goal is to draw on the screen and then measure the length of what you draw.
    In the upper right corner of the screen, you can see that the Scale bar represents 1 inch.
    That is, the number of pixels on the screen represented by the horizontal I-Beam is scaled so that this length on the page represents one inch. If this scale works for you, then leave it as it is. If it is not good for you, you must adjust the scale.

2. Select **MENU > Points & Lines > Segment**. Click one point on the ruler and then another to make a line segment to be measured. Be careful to draw the shortest line segment between the chosen points.

3. Now measure the length of your segment. Select **MENU > Measurement > Length**, point the cursor at the line segment, and click to get the measure. Click again when you have the number on the screen where you want it.
    *   You might need to use [tab] to get to the item you want to measure.
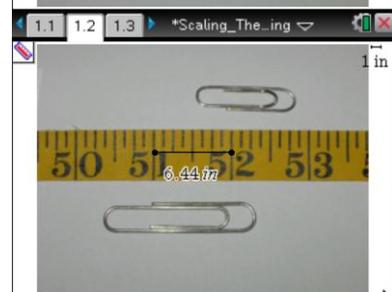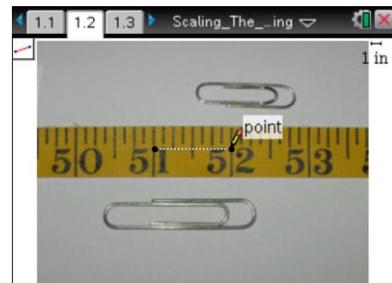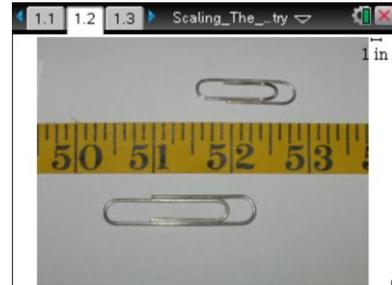
4. Now adjust the Scale, if needed, so that the measure shown is correct. Determine the value needed for the scale (create a proportion and calculate) and move your cursor to the scale. Click once on the scale, and move your cursor to change the value to what to show on the new scale.

    *   In this case, the distance from 51 inches to 52 inches should be one inch. However, the TI-Nspire is showing 6.44 inches.

    *   Add a Calculator page by pressing `ctrl` `I` `1` or use the ScratchPad by pressing `⌂ on` `A` to determine the scale needed. To return to the document from the ScrachPad, press `⌂ on` `4`.

Sample Answers:
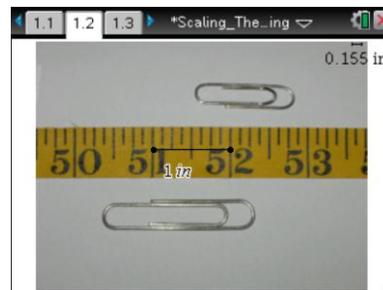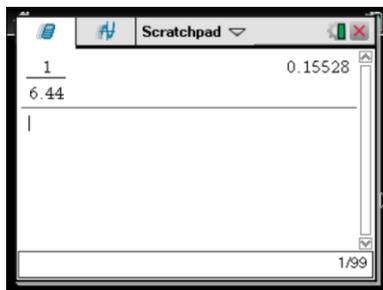
TI-Nspire Navigator Opportunity: *Screen Capture and Live Presenter*
See Note 1 at the end of this lesson.

5. Now measure the small and then the large paperclip. Compare the values, using your scale from above with the True lengths of the two paperclips.

Hint: Draw vertical segments from the ends of the clips to the tape measure to help avoid any errors.

> **Teacher Tip:** The small paperclip is 1 and 5/16th of an inch, and the large clip is 2 inches. You might want to make the students select another length on the tape measure, to differentiate.

> **Teacher Tip:** If a student uses the Scratchpad, you might not have the
> work they did included in the document when they submit it. If they add a
> Calculator page, the page numbers will be off as you move through the rest
> of the lesson. Speaking of looking at the coin, or the ruler, might better
> facilitate directing students to the appropriate page in this lesson and in the
> use of the TI-Nspire in general.

Move to page 1.3.

6. Page 1.3. shows a different ruler. Examine the bottom part of
    the ruler. The small marks here are millimeters. Select a length
    more than 2 cm, and carefully draw a line segment on the ruler.
    Then measure it as before and adjust the scale until the line
    segment you measured is correct in length.
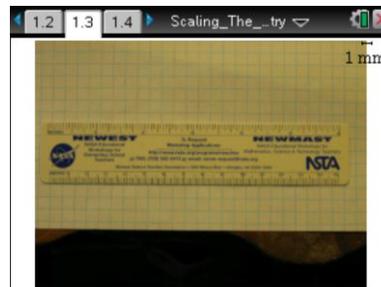
> **Tech Tip:** Once the student draws the segment, they can grab it and
> adjust as needed before measuring.

<u>Sample Answers:</u> For 85 mm we have:
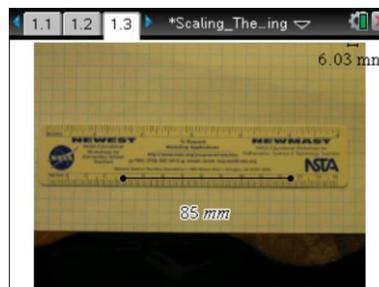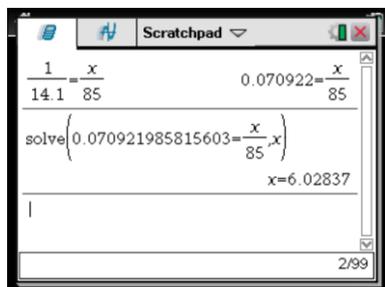
> **Teacher Tip:** In this situation, the students should set up a proportion for
> comparing as shown above in the sample answer.

TI-Nspire Navigator Opportunity: *Screen Capture, Live Presenter, and Quick Poll*
See Note 2 at the end of this lesson.

Move to page 1.4.

7. The True width and height of the TI-Nspire CX handheld is
    shown on this page. Draw around the image (using the
    Segment or the Rectangle tools) and measure as before. Then
    adjust the scale so that the two measures are represented.
    Remember, if the Tab option appears, select the item you want
    to measure—perimeter or length. Recall the formula for the
    perimeter of a rectangle.

> **Teacher Tip:** You might want the students to draw a rectangle around the
> calculator.

TI-Nspire Navigator Opportunity: *Screen Capture*
See Note 3 at the end of this lesson.

<u>**Sample Answers**</u>:

Move to page 1.5.

8. On this page, we want to draw a circle that represents the
    quarter and then create a scale with some measurements to
    get the True value(s). Recall the relationship between
    circumference, diameter, and radius and feel free to draw and
    measure these parts of a circle.

Tech Tips: Use tab to switch the focus of your action if you don't see what you want.
            You might see the Graph Entry line; press ctrl G to hide it.
            Press esc to exit the tool you are using when you don't need it anymore.
            You can grab and adjust the circle after you draw it, if you have dismissed the circle
            drawing tool.

<u>**Sample Answers**</u>: If the students draw a circle and then get the circumference:
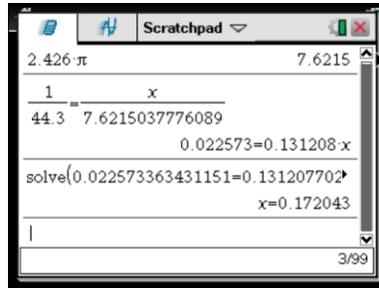
They could also draw a diameter or a radius, either on the circle or not, and get the lengths.

Move to page 1.6.

9. On this page, we have a graduated cylinder marked in milliliters. Just as with the ruler, we can scale this image using the tick marks on the cylinder. There are 10 ml between the numbered lines. Make your line segment as short as possible but cover more than 10 ml. Measure and adjust the scale as before, but note that the units are now in milliliters and you are just simulating the reading of a scale to get a value.

> **Teacher Tip:** Make sure the students don't come to believe that milliliters are anything more than the distance on the scale. Take care on the other measures shown later in the document as well.

<u>**Sample Answers**</u>:
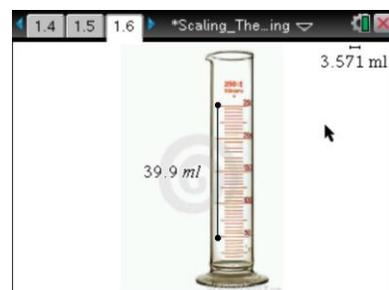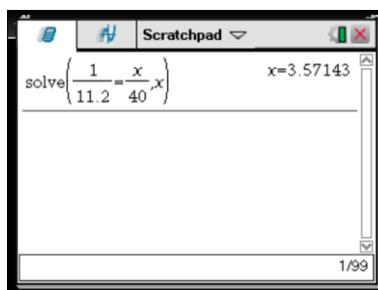
Move to page 1.7.

10. On this page, we have a thermometer with a scale in degrees Fahrenheit (°F). Draw a line segment on the figure "longer" than 10 degrees. Measure and scale as before.
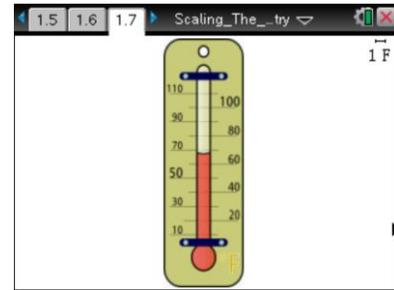
Sample answers:
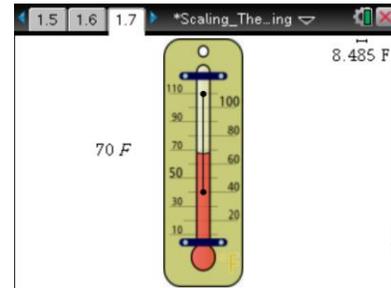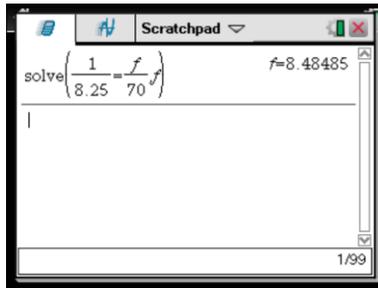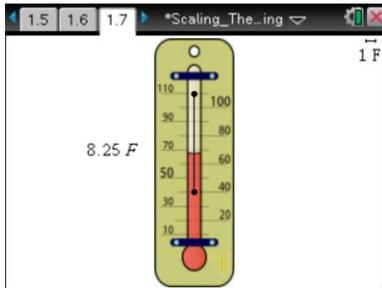
Optional

Move to page 1.8.

11. The clock has a measurement in seconds. We will use an arc length to model a scale, assuming that the tip of the second hand moves a given distance in a given number of seconds.
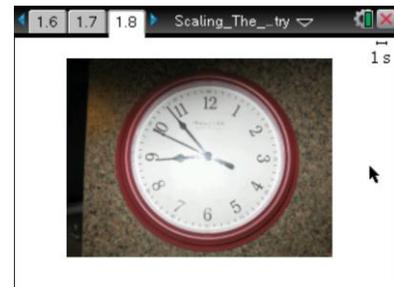
Move to page 1.9.

12. With the scale now in ounces, measure the arc of a circle to model a given weight.

Move to page 1.10.

13. Take a photo and a known measurement. Then have your teacher insert the image onto this page so you can measure it and scale as you have done before.

Wrap Up

Upon completion of the lesson, the teacher should ensure that students are able to understand:

- How to create a scale for a given image if they are given a measure of the object before it was resized.
- Some scales are easier to determine than others and that the scales could apply in situations different from just lengths.

TI-Nspire Navigator

Note 1

Name of Feature: Screen Capture and Live Presenter

Take a Screen Capture, with or without Auto-Refresh, of all student screens to see how they are determining the scale, getting the measure, adjusting the scale, and/or drawing the line segments. Also use Screen Capture for Formative Assessment. Make a student the Live Presenter and have her show the class how to do any or all parts.

Note 2

Name of Feature: Screen Capture, Live Presenter, and Quick Poll

Collect Screen Captures of the class to help others see what and how. Make a student the Live Presenter to show the class how he/she attacked the problem. Take a Quick Poll to collect the scale values being used.

Note 3

Name of Feature: Screen Capture

Screen Captures can be used with auto-refresh so the class can see what others are doing and where they are relative to the class.