

# Hands on Reflections



## AC8M7SP03

7 8 9 10 11 12



TI-Nspire



Student



120 min

## Objective

Describe translations, reflections in an axis, and rotations of multiples of  $90^\circ$  on the Cartesian plane using coordinates. Identify line and rotational symmetries

*There are other TI-Nspire activities that compliment this one including a teacher demonstration file where the teacher can poll students to measure their understanding of reflection, rotations and translations and also an assessment file (test) which can be done using Navigator where all the answers are automatically corrected.*

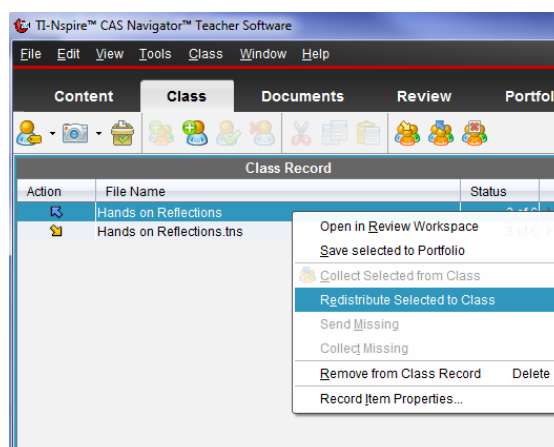
## Equipment

For this activity you will need:

- TI-Nspire
- TI-Nspire file: “Hands on Reflections” (tns)
- Printed Grid
- TI-Navigator system (Optional)

*Benefits of using Navigator with this activity:*

- *Distribute the TI-Nspire file “Hands on Reflections” to the entire class at once.*
- *Make a student the presenter to help illustrate the activity and work through the opening steps.*
- *Monitor student progress via the class screen capture tool and save these images for later reference and guide as to student progress over time.*
- *The activity will take more 50 minutes so student files need to be saved for later use. If Navigator was used to send the files (see below) then the files can also be retrieved. As the start of the next lesson ‘right click’ on the collected file and select **Redistribute Selected to Class**. This is the same as giving students back a physical copy of work they completed the previous lesson. It doesn’t matter which wireless adapter or calculator the student is using, each file is delivered to the original user defined by their user name. Now students can carry on from where they left off.*



## Instructions

Begin by tracing around your **right hand** using a pen and the grid paper supplied. Mark points around your hand (along the trace), these points will ultimately form a 'dot to dot' picture. More dots generate a better image, and more work.

Starting at the base of the thumb and working towards the base of your pointer finger, place approximately 7 dots along this section of your trace. The dots do not have to be equally spaced, but should represent any bumps or key points around your thumb. Write down the coordinates of these points on the grid, adjacent to each point.



Do not plot any more points until these ones have been tested on the calculator.

*Students use the graph as visual feedback to ensure they are plotting points the correct way. One of the aims of this exploration is to review and improve student knowledge of the Cartesian plane. Students will plot approximately 30 to 40 points so it is important with this level of rehearsal they are getting points correct at the start of the session.*

*More able students should take the time to plot extra points in order to generate a more accurate representation of their hand.*

Open the TI-Nspire file:

“Hands on Reflections”

Navigate to page 1.2.

Entering data:

xp = x coordinate

yp = y coordinate.

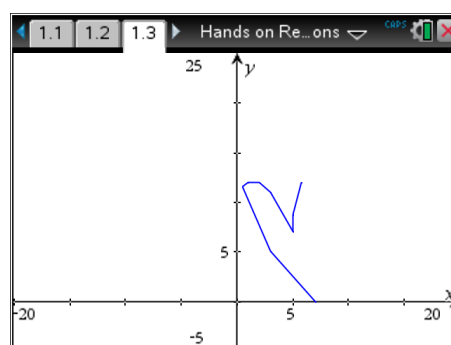
To begin with, enter only the first 5 to 7 coordinate pairs.

	A xp	B yp	C	D
1	7	0		
2	3	5		
3	0.5	11.5		
4	1	12		
5	2	12		

Navigate to page 1.3 and check the progress of your dot to dot image. This page has already been set up to draw the plot.

If the image appears correctly, continue plotting, recording and entering points whilst periodically checking the graph. (image)

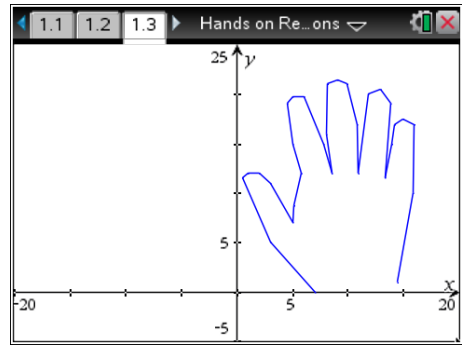
If your hand is not displaying correctly, check with a classmate or your teacher to help resolve the problem *before* continuing.



During the plotting process save the file occasionally by pressing:

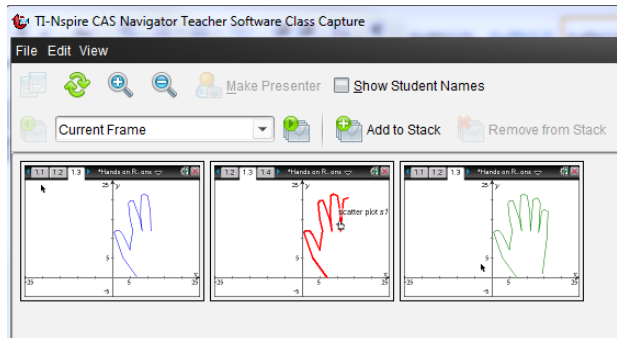
**Ctrl + S = Save**

When you have finished plotting points the graph or image should look similar to the one shown here.



*The class screen capture tool on Navigator is a wonderful way of sharing student hands. Save the images, additional screens can be obtained by selecting “Add to Stack”.*

*The files can be saved in a selected directory or the default. Each image includes the student user name in the file name so it is easy to locate.*



It is time to draw the left hand. No new points need to be collected; instead the originals will be ‘transformed’.

In the Spreadsheet application enter two new list names:

LHX (Left Hand X)

LHY (Left Hand Y)

In the formula bar (shown opposite) use the **VAR** key to access the current variable list. Select XP and then modify these values using an appropriate mathematical operation that will cause the x points to be reflected in the y axis.

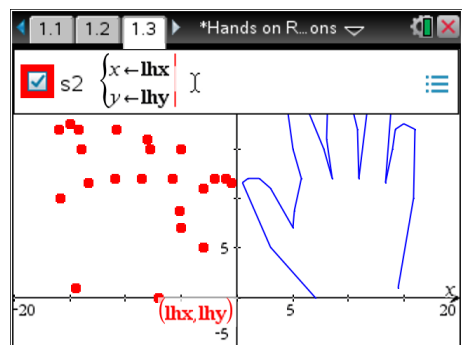
Populate the LHY list using an appropriate formula and list.

Navigate to graph application on page 1.3.

Press the **TAB** key to access the graph list or press Ctrl + G.

S2 represents the second scatterplot. Use this plot to graph LHX and LHY. Initially these points will be disconnected as shown.

	A xp	B yp	C lhx	D lhy
=			lhx: =	
1	7	0		
2	3	5		
3	0.5	11.5		
4	1	12		
5	2	12		

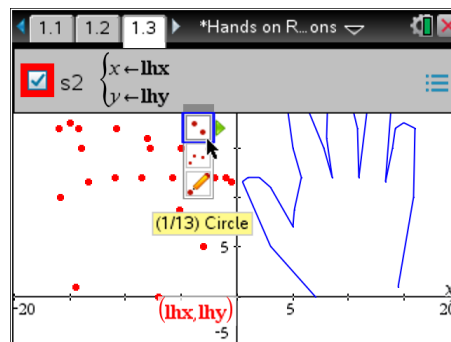


While the cursor on or in the second scatter plot press **Ctrl + Menu** (equivalent to a right mouse click on a computer) and select **attributes**.

There are 13 different options for the way the points are displayed. Option 7 is the best for blending points on a connected scatter plot.

Use the right arrow key to move across to option 7.

Use the down arrow to move to option 2 and then move across to make the points connected; press **Enter** to verify the changes.



### Question: 1.

Explain how the original points were modified to produce an image of the left hand.

*The left hand is a reflection of the right hand in the y axis. The y coordinates remain the same and the x coordinates are multiplied by negative one.*

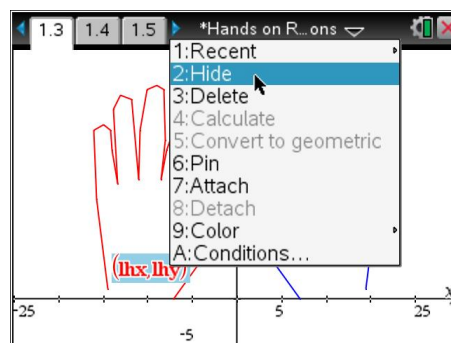
$$lhx = -1 \times xp$$

$$(Mapping: x' = -x \ \& \ y' = y)$$

$$lhy = yp$$



As more graphs are added, graph labels may start to clutter. The labels can be hidden using a variety of methods, one way is to use a right click (Ctrl + Menu) while the mouse is hovering over the graph label, then select **Hide**.



Two more images have been added to the page, shown opposite.

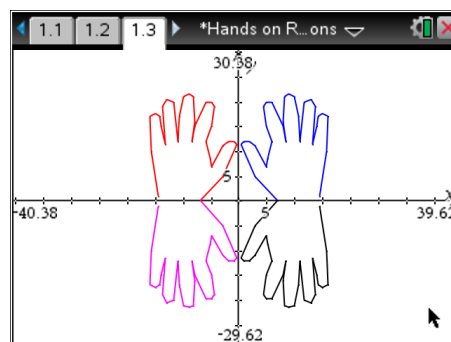
The window settings were changed using the **menu** option **Window/Zoom** followed by **Zoom Out**.

The mouse changes to a magnifying glass (with a minus sign) prompting for the 'centre'. Place the magnifying glass at the origin and press **Enter** to zoom out.

Return to the Spreadsheet application, add two more lists:

XPRH4 (X Points for the Right Hand in quadrant 4)

YPRH4 (Y Points for the Right Hand in quadrant 4)



Use appropriate formulas to transform the lists then introduce additional scatterplots as before.

### Question: 2.

Explain how the original points were modified to produce a reflection of the right hand in the x axis.

*The original points were for the right hand, therefore the x coordinates remain the same but the y coordinates are multiplied by negative one.*

$$xprh4 = xp$$

$$(Mapping: x' = x \ \& \ y' = -y)$$

$$yprh4 = -1 \times yp$$

Return to the Spreadsheet application, add two more lists:

XPLH3 (X Points for the Left Hand in quadrant 3)

YPLH3 (Y Points for the Left Hand in quadrant 3)

### Question: 3.

Explain how the image in the third quadrant (bottom left) was produced.

*This question is left open. If the original points were used:*

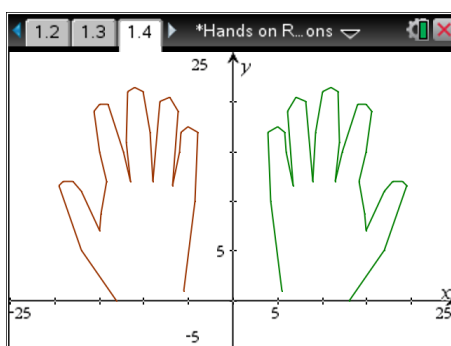
$$xplh3 = -1 \times xp \quad (\text{Mapping: } x' = -x \text{ \& } y' = -y)$$

$$yplh3 = -1 \times yp$$

*Answers will vary if different starting points were used.*

A Graph application has been included on page 1.4. Add new lists to page 1.2 with appropriate names and formulas to produce the images shown below.

Note that list names cannot contain any spaces or special characters such as mathematical symbols.



### Question: 4.

Explain how you achieved each of the images above.

*This question is left open. If the original points were used for the right hand translation:*

$$xprh2 = xp - 20 \text{ (approximate)} \quad (\text{Mapping: } x' = x - 20 \text{ \& } y' = y)$$

$$yprh3 = yp$$

*Answers will vary if different starting points were used and also by degree of the translation.*

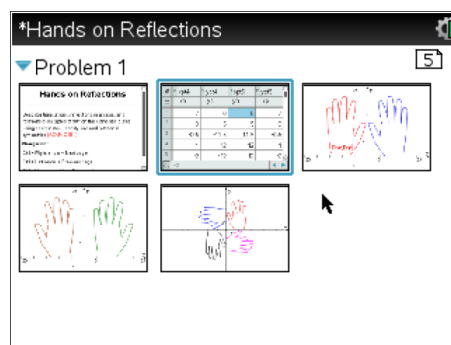
*The Left Hand translation could also be done from the original points:*

$$xplh1 = xp - 20 \text{ (approximate)}$$

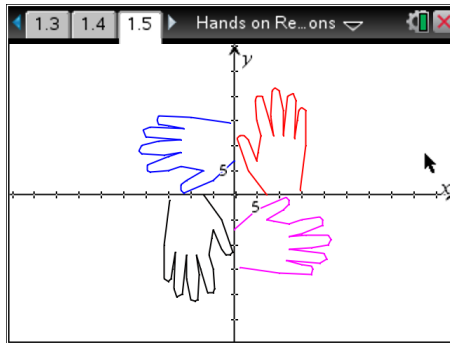
$$yplh1 = yp$$



A quick way to navigate between pages in a large document is to use Ctrl + Up (arrow), navigate to the required page in the document and press **Enter**.



Another Graph application has been included on page 1.5. Add new lists to page 1.2 with appropriate names and formulas to produce the images shown below.



**Question: 5.**

Explain how you achieved each of the images above.

*These images are all rotations of the right hand with coordinates  $x_p$  and  $y_p$ . A counter-clockwise rotation of  $90^\circ$  can be achieved by:*

$$x_{pr90} = -1 \times y_p \quad (\text{Mapping: } x' = -y \text{ \& } y' = x)$$

$$y_{pr90} = x_p$$

*The second rotation is  $180^\circ$  either clockwise or counter-clockwise:*

$$x_{pr180} = -1 \times x_p \quad (\text{Mapping: } x' = -x \text{ \& } y' = -y)$$

$$y_{pr180} = -1 \times y_p$$

*The third rotation is  $270^\circ$  counter-clockwise or  $90^\circ$  clockwise*

$$x_{pr270} = y_p \quad (\text{Mapping: } x' = y \text{ \& } y' = -x)$$

$$y_{pr270} = -1 \times x_p$$