'Poly'thagoras and Transformations

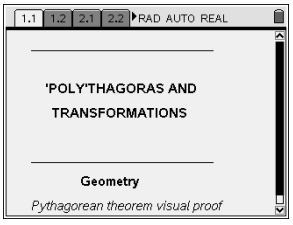
Student Worksheet

Name _____

Class_____

In this activity, you will explore:

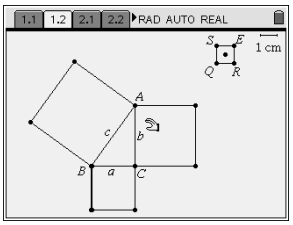
- Relationships among non-square regular polygons constructed on the sides of a right triangle
- Visual and numerical proofs of the Pythagorean Theorem using rotations and non-square polygons



Open the file Polythag.tns on your TI-Nspire™ handheld device and follow along with your teacher to work through the activity.
Use this document as a guide to the activity and to record your answers.

Problem 1 – Reviewing what you know

Advance to Page 1.2 by pressing (ctrl) and the right side of the NavPad.



Consider right triangle ABC.

1. Explain what a^2, b^2, and c^2 represent.

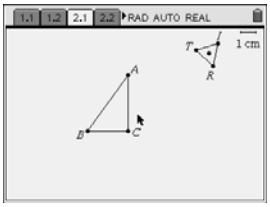
2. Explore several different right triangles by dragging a vertex and use the measurement tool to find corresponding values for a^2, b^2, and c^2. Record the values below.

a^2	b^2	c^2

3. What is the relationship between $a^2 + b^2$ and c^2?

Problem 2 – Investigating equilateral triangles constructed on the sides of a right triangle

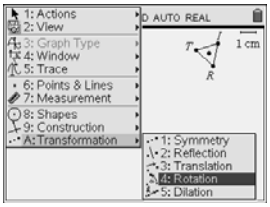
Advance to Page 2.1 by pressing (ctrl) and the right side of the NavPad.



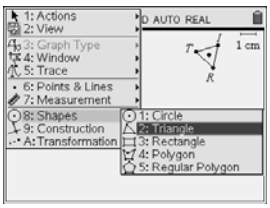
4. What is the measure of each angle in an equilateral triangle such as ΔTRI?

Step 1: Construct an equilateral triangle on side ***a*** by first rotating side ***a***.

- Select (menu) and chose A: Transformation, 4: Rotation.
- Select side ***a***, then select the center point of the rotation (point **B**), and then select three points that determine an angle in equilateral triangle TRI (point **T**, point **R**, and point **I**) for the rotation angle.
- Draw a triangle on side ***a*** using (menu), 8: Shapes, 2: Triangle.

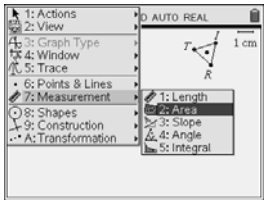


Step 2: Repeat the process in Step 1 for side ***b***, point **C**, and ∠TRI.
Step 3: Repeat the process in Step 1 for side ***c***, point **A**, and ∠TRI.



5. Predict how the areas of equilateral triangles drawn on the sides of a right triangle relate.

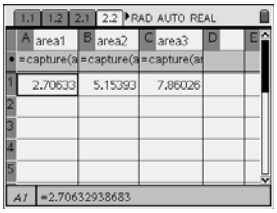
Step 4: Find the area of each of the equilateral triangles constructed on the sides of ΔABC.



- Select (menu) and chose 7: Measurement, 2: Area.
- When the triangle blinks, press (·).

Step 5: Store the area on side ***a*** as a variable by selecting (sto→var), 1:Store Var, and type ***ar1***. Repeat this process twice more to store the area on side ***b*** as ***ar2***, and the area on side ***c*** as ***ar3***.

Advance to Page 2.2. Observe how the Automated Data Capture tool dynamically collects measurement data for ΔABC. Observe that your values for a^2, b^2, and c^2 are already listed in cells A1, B1, and C1.



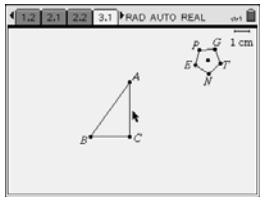
Step 6: To collect additional data, return to Page 2.1, drag point **A** around, and then drag point **B** around.
Step 7: Return to your spreadsheet on Page 2.2.

6. Record several of the collected triangular areas in the table below.

a^2	b^2	c^2

7. Make a conjecture about the relationship between $a^2 + b^2$ and c^2 for equilateral triangles constructed on the sides of a right triangle.

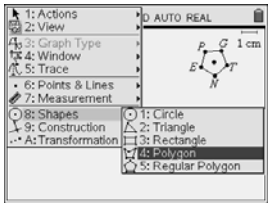
Problem 3 – Investigating regular pentagons constructed on the sides of a right triangle
Advance to Page 3.1.



8. What is the measure of each angle in a regular pentagon?

Step 8: Construct a regular pentagon on side ***a*** by first rotating side ***a***.

- Select (menu) and chose A: Transformation, 4: Rotation.
- Select side ***a***, then select the center of rotation (point **B**), and then select three points that determine an angle in pentagon PENTG (point **P**, point **E**, and point **N**) for the rotation angle.
- Select the rotated side, the endpoint of the segment not on the triangle, and then the three points **P**, **E**, and **N**, in order.
- Select the newly rotated side, the endpoint of the newly rotated side not connected to another segment, and then the three points **P**, **E**, and **N**, in order.
- Repeat the process one more time.
- Draw a pentagon on side ***a*** using (menu), 8: Shapes, 4: Polygon.



Step 9: Repeat the process in Step 8 for side ***b***, initial rotation center point **C**, and ∠PEN.
Step 10: Repeat the process in Step 8 for side ***c***, initial rotation center point **A**, and ∠PEN.

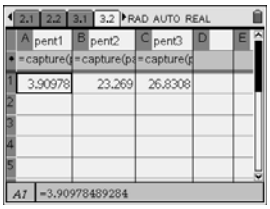
9. Predict how the areas of pentagons drawn on the sides of a right triangle relate.

Step 11: Find the area of each of the regular pentagons constructed on the sides of ΔABC.

- Select (menu) and chose 7: Measurement, 2: Area.
- When the pentagon blinks, press (⚙).

Step 12: Store the area on side ***a*** as a variable by selecting (stor var), 1:Store Var, and type ***par1***.
Repeat this process twice more to store the area on side ***b*** as ***par2***, and the area on side ***c*** as ***par3***.

Advance to Page 3.2. Observe how the Automated Data Capture tool dynamically collects measurement data for ΔABC. Observe that your values for a^2, b^2, and c^2 are again listed in cells A1, B1, and C1.



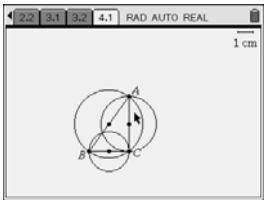
Step 13: To collect additional data, return to Page 3.1, drag point **A** around, and then drag point **B** around.
Step 14: Return to your spreadsheet on Page 3.2.

10. Record several of the collected pentagonal areas in the table below.

a^2	b^2	c^2

11. Make a conjecture about the relationship between $a^2 + b^2$ and c^2 for regular pentagons constructed on the sides of a right triangle.

Extension – What happens when a non-polygon such as a semi-circle is constructed on the sides of a right triangle?
Advance to Page 4.1.



12. Record several of the non-polygon areas in the table below.

a^2	b^2	c^2

13. Make a generalization about the relationship between $a^2 + b^2$ and c^2 for similar shapes constructed on the sides of a right triangle. Make certain to provide an explanation that supports your generalization.