
Is It A Triangle?

ID: 13581

Time required
45 minutes

Activity Overview

In this activity, students will investigate properties of triangles, classify the various types of triangles, and determine if specific side lengths will make a triangle or not.

Topic: Geometry

- *Triangles, Pythagorean Theorem*
 - *Angles*
-

Teacher Preparation and Notes

- *Students should be familiar with the vocabulary scalene, equilateral, isosceles, obtuse, acute, and right.*
- *TI-Navigator is not required for this activity, but an extension is given for those teachers that would like to use it.*
- ***To download the student worksheet and TI-Navigator file, go to education.ti.com/exchange and enter "13581" in the quick search box.***

Associated Materials

- *MGAct16_IsATriangle_worksheet_TI73.doc*
- *MGAct16_IsATriangle_LrnChk.edc*
- *A.73I, B.73I, C.73I (lists)*

Suggested Related Activities

To download the activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Classifying Angles (TI-73 Explorer & TI-Navigator) — 6074*
- *TryAngle? (TI-73 Explorer) — 4472*
- *Triangle Sides & Angles (TI-73 Explorer) — 8795*

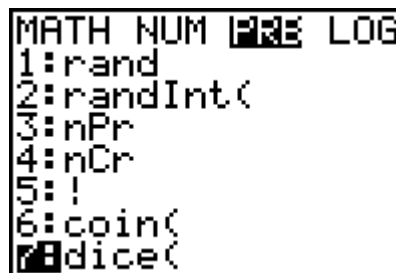
Problem 1 – Is it a triangle?

Students will investigate properties of triangles by randomly generating possible side lengths for triangles. They will experimentally try to make triangles with the randomly generated numbers and then make conjectures about triangle inequalities.

Students will work with a partner in the first activity. Demonstrate to students how to make a triangle with the given materials. Emphasize to the students to measure accurately and use a marker to mark the cut line. Insert the twist ties inside the straws so the straws meet to form vertices. You may need to settle any disagreements students may have on if it is a triangle or not.

Questions 1–2

To find the **dice** command, press **[MATH]** **[>]** **[>]** and select option 7. Then, enter 3 to indicate finding three random numbers by simulating the role of 3 dice. Press **[ENTER]** to execute the command. This will return three numbers such as {6, 2, 4}.



Use the ruler and cut straws of the given lengths. Insert the twist ties in the ends of the cut pieces and try to connect to form a triangle. If Player 1 is able to make a triangle with the given lengths, then Player 2 will inspect it and make sure the sides are measured accurately.

Player 1 will record his/her results in Table 1. Player 2 will now take a turn. For example, if a player rolls the dice 1, 1, 2 and it is determined that it is not possible to make a triangle, then the result is recorded as 1, 1, 2 in the appropriate player column for “not a triangle.” Likewise, if a player rolls the numbers 3, 4, 5 and it is determined possible to make a triangle then these results are recorded in the appropriate player column for “is a triangle.”

Questions 3–4

Students should start to see a pattern and be able to identify sides that will and will not make a triangle. Straws can be used by students to verify if the triangles can be made, if needed.

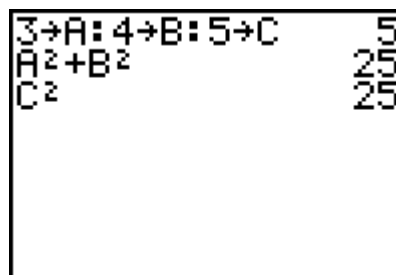
Questions 5–8

After creating triangles and discussing the possible sides that create triangles, students will then classify triangles based on their characteristics (side lengths and angles).

Questions 9–13

In a right triangle, the square of the hypotenuse (longest side) is equal to the sum of the squares of the other two sides. This important theorem is called the Pythagorean Theorem. A set of numbers that satisfy this equation $a^2 + b^2 = c^2$ is called a Pythagorean triple.

To test each triangle, store the values to A, B, and C.



To store A, B, and C as in the example shown, press the following.

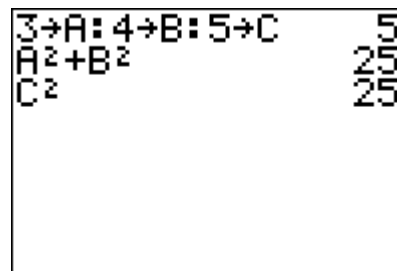
3) **STO▶** **2nd** **MATH** **ENTER** (to select A) **▲** **ENTER** **2nd** **PRGM** **▲** **▲** **▲** **ENTER**.

4) **STO▶** **2nd** **MATH** **▶** (to select B) **ENTER** **▲** **ENTER** **2nd** **PRGM** **▲** **▲** **▲** **ENTER**.

5) **STO▶** **2nd** **MATH** **▶** **▶** (to select C) **ENTER** **▲** **ENTER** **ENTER**.

Next, enter $A^2 + B^2$. Press **2nd** **MATH** **ENTER** (to select A), **x²** **▲** **ENTER**, **+** **2nd** **MATH** **▶** **ENTER** (to select B), **x²** **▲** **ENTER**. Press **ENTER** to execute the command.

Then, enter C^2 . Press **2nd** **MATH** **ENTER** **▶** **▶** (to select C), **x²** **▲** **ENTER** **ENTER**.



Problem 2 – How Many Triangles?

In Problem 2 you will lead the class to summarize the data, and the Class Data Table will be completed.

Questions 14–15

The class will now combine all their data and include any possible missing sets to make an organized list with all possible triangles to be included in the mobile. Remind students that 3, 4, 5 is the same as a 5, 3, 4, so they should not list it twice in the table.

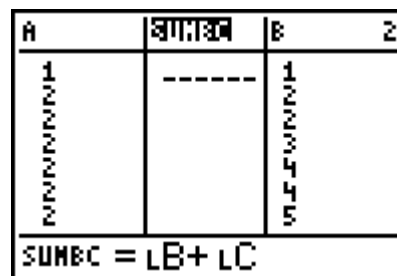
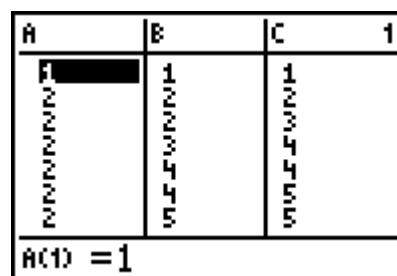
After completing the table, students should find all the triangles that are possible with sides from 1 inch to 6 inches. There are 28 in total. If students find more or less, have them check the triangles carefully and make sure they have captured all triangles that may have been missing from the original list and that they have not repeated any triangles between rows.

In the final part of this activity, use the calculator list to enter all 28 triangles and test to make sure they are triangles using the triangle inequality rule discovered. Name the lists A, B, and C (if desired) to represent the sides.

Then, after students have entered the lists, they can test the triangle inequality theorem discovered through this activity by adding lists together.

Insert a list called **SUMBC** after the A list. Go to the top of column B and press **2nd** **DEL** to insert a new list. Then type **SUMBC** (using **2nd** **MATH**) and press **ENTER**. Go back to the top of the list and press **2nd** **LIST** and select B, press **+** **2nd** **LIST** and select C, then press **ENTER** to execute the addition.

Repeat this process creating lists **SUMAC** and **SUMAB** to see if the inequality theorem holds for all sides.



Extension – TI-Navigator™

1. Send the LearningCheck™ file **MGAct16_TryAngle_LrnChk_TI73.edc** to students to assess knowledge of the prerequisite vocabulary.
2. For Questions 3 and 4, use **Quick Poll** to gather sides that students think will or will not create a triangle. This is a faster way to determine if students are on the correct path before moving on in the activity.
3. For Questions 5 and 6, call out one of the triangles, ask students to classify as **E, S, I** or **R, O, A** and use **Quick Poll** to gather input.
4. Instead of having students enter data for Question 14 and 15, use TI-Navigator to send lists **A, B,** and **C** to students. They can then enter the additional lists (**SUMAC, SUMAB,** and **SUMBC**) to add **A** and **B, A** and **C,** and **B** and **C.**
5. Use **Screen Capture** throughout to monitor student progress.

Solutions – student worksheet
Problem 1

1. Tables will vary. Check students' work.
2. Students should conclude that the sum of two sides has to be greater than the third side.
3. Answers will vary with lots of possibilities. Examples include {3, 4, 5} or {6, 6, 5}.
4. Answers will vary with lots of possibilities. Examples include {1, 2, 4} or {3, 2, 6}.
5. Answers will depend on the table in Question 2. Check students' work.
6. Answers will depend on the table in Question 2. Check students' work.
7. The sum of the two 90° angles would be 180° and the other angle would be 0° .
8. 60°
9. yes
10. $>$ Examples used will vary but the symbol should be $>$.
11. $<$ Examples used will vary but the symbol should be $<$.
12. If the triangles are right triangles, then the equation should be $=$.
13. If $a^2 + b^2 = c^2$, then the triangle is right. If $a^2 + b^2 > c^2$, then the triangle is acute.
If $a^2 + b^2 < c^2$, then the triangle is obtuse.

Problem 2

14.

All triangles with side(s)	List Triangles	Total
of 1 inch	111 E-A	1
of 2 inch	222 223 234 244 245 255 256 266 E-A I-O S-O I-A S-O I-A S-O I-A	8
of 3 inch	333 334 335 344 345 346 355 356 366 E-A I-A I-O I-A S-R S-O I-A S-O I-A	9
of 4 inch	444 445 446 455 456 466 E-A I-A I-O I-A S-A I-A	6
of 5 inch	555 556 566 E-A I-A I-A	3
of 6 inch	666 E-A	1

15. 28 triangles



Problem 1 – Is it a triangle?

Adrienne is making a mobile of triangles for a geometry project. She will use straws from 1 inch to 6 inches (whole number lengths only) for the sides and twist ties to connect them. She wants to make sure she uses all the possible sizes of triangles in her mobile.

To help Adrienne, you are going to play a game to determine if three numbers can be the sides of a triangle. Play with your partner and complete the following table. The player with the greatest difference between the “Is A Triangle” column and the “Not A Triangle” column wins.

1. Use the **dice(** command to randomly find three digits between 1 and 6. Take a straw and cut lengths to match the numbers rolled. Then, try to make a triangle with the given sides.

If you can make a triangle, record the sides in the appropriate column. If you cannot make a triangle, record the side lengths in that column. After 10 times, find the difference between the number of triangles made and not made to determine the winner.

```

dice(3)
      (5 4 5)

```

	Player 1:		Player 2:	
Trial	Not A triangle	Is A Triangle	Not A Triangle	Is A Triangle
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Totals				
	Player 1 Total		Player 2 Total	

2. What conclusions can you draw about the lengths of sides of triangle and when they form a triangle? _____



Is It A Triangle?

- Give an example of a set of 3 numbers (different from those in the table above) that could be the sides of a triangle. _____
 - Give an example of a set of 3 numbers (different from those in the table above) that could not be the sides of a triangle. _____
 - Go back to Question 1 and classify the triangle as **equilateral**, **scalene**, and **isosceles**, by writing an **E**, **S**, or **I** next to each row.
 - Go back to Question 1, look at the angles in the triangles you created. Classify the triangles as **right**, **acute**, or **obtuse**. Write an **R**, **O**, or **A** next to each row.
 - Why can't a right triangle have two right angles? _____
-
- An equilateral triangle is said to also be equiangular. What is the measure of each angle in an equilateral triangle? _____

In a right triangle, the square of the hypotenuse (longest side) is equal to the sum of the squares of the other two sides. This important theorem is called the **Pythagorean Theorem**. A set of numbers that satisfy this equation $a^2 + b^2 = c^2$ is called a **Pythagorean triple**.

Test 3, 4, and 5 in this equation to see if it is a Pythagorean triple. Press $\boxed{3}$ $\boxed{\text{STO}\blacktriangleright}$ $\boxed{2\text{nd}}$ $\boxed{\text{MATH}}$, select **A**, and then **Done** using $\boxed{\text{ENTER}}$. Then press $\boxed{2\text{nd}}$ $\boxed{\text{PRGM}}$ $\boxed{\blacktriangle}$ $\boxed{\blacktriangle}$ $\boxed{\blacktriangle}$ $\boxed{\text{ENTER}}$ to select **:**. Repeat to store 4 to B and 5 to C.

Next enter both sides of the equation as shown. Press $\boxed{2\text{nd}}$ $\boxed{\text{MATH}}$ $\boxed{\text{ENTER}}$ $\boxed{x^2}$ then $\boxed{\blacktriangle}$ $\boxed{\text{ENTER}}$ to select **Done**. Then, press $\boxed{+}$ and enter B² following the same procedure and press $\boxed{\text{ENTER}}$. Then enter C².

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3→A:4→B:5→C      5
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```
3→A:4→B:5→C      5
A2+B2           25
C2              25
```

- Does the 3, 4, 5 triangle appear to have one right angle and two acute angle? _____
- Using an acute triangle, evaluate the equation. It is okay if $a = b$.

a (shortest side) = _____ b (middle side) = _____ c (longest side) = _____

Fill in the box \square with $<$, $>$, or $=$. $a^2 + b^2 \square c^2$

- Repeat using a right triangle.

a (shortest side) = _____ b (middle side) = _____ c (longest side) = _____

Fill in the box \square with $<$, $>$, or $=$. $a^2 + b^2 \square c^2$



Is It A Triangle?

12. Repeat using an obtuse triangle.

a (shortest side) = _____ **b** (middle side) = _____ **c** (longest side) = _____

Fill in the box \square with $<$, $>$, or $=$. $a^2 + b^2$ \square c^2

13. Compare your results from Questions 10 – 12 and make a conjecture from your experiment. _____

Problem 2 – How Many Triangles?

Now, use the information from the first part of this activity to make sure you find all the possible triangles.

14. Combine all the data generated by the class into one table. List all triangles with the side length given in the first column. If there are triangle sizes that were not found during the game, include it now.

A triangle with sides 332 would NOT be included in the 3 inch side row because it was already included in the 2" row (233). Do not repeat triangles.

All Triangles with side(s)	List Triangles	Total
of 1 inch		
of 2 inch		
of 3 inch		
of 4 inch		
of 5 inch		
of 6 inch		

15. How many triangles would Adrienne need to make for her mobile? _____