



1. Triangles have three sides-but how long can those sides be, in relation to each other? If you have a set of sticks that are all 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 cm long, what combinations of sticks can be put together to form a triangle?
 - a. Use the Geometer's Sketchpad applet "Finding Sides" available on your facilitator's *Fostering Geometric Thinking Toolkit* DVD¹ to explore this question. In the chart below, list at least five sets of sticks (3 sticks in each set) that form a triangle and at least five sets of sticks that do not form a triangle.

Lengths of three sticks that can form a triangle:	Lengths of three sticks that cannot form a triangle:

¹If you do not have access to Geometer's Sketchpad software, you can find a Web-based applet for this problem at www.geometric-thinking.org/finding_sides.htm.



- b. Now consider a particular set of triangles—triangles with perimeter 12. What sets of three sticks combine to create a triangle with perimeter 12? Use the Geometer's Sketchpad file to explore this question. In the chart below, list at least five sets of sticks (3 sticks in each set) that form a triangle of perimeter 12 and at least five sets of sticks that do not form a triangle of perimeter 12.

Lengths of three sticks that can form a triangle with perimeter 12:	Lengths of three sticks that cannot form a triangle with perimeter 12:

- c. Are there other sets of three side lengths not shown on the applet that would create a triangle with perimeter 12? If so, what are they? If not, why not?
2. Sandy's teacher gave her 7 sticks and asked her to try to make triangles using only those 7 sticks. Sandy tried every possible combination of 3 sticks, but none of the combinations formed a triangle. All 7 sticks in Sandy's pile had integer lengths (i.e., the lengths did not include any fractions of units). It is possible that Sandy had more than one stick of the same length. Given what you learned about the side lengths that will form a triangle in question 1:
- a. Could the longest of Sandy's 7 sticks be 12 cm? Support your answer with a convincing mathematical argument.



- b. Could the longest of Sandy's 7 sticks be 13 cm? Support your answer with a convincing mathematical argument.
- c. Could the longest of Sandy's 7 sticks be 14 cm? Support your answer with a convincing mathematical argument.
3. If Sandy had 10 sticks that were all integer lengths and still couldn't form any triangles using those sticks. what is the shortest that the longest of those sticks could be? Explain why you think the length that you list is the shortest possible length for the longest of the 10 sticks.

Warm-up for Finding Sides

You can use a ruler, string, or any tools you choose for this Warm---up.

1. Draw a triangle that has sides with lengths 3 cm, 3 cm, and 3 cm.

2. Draw a triangle that has sides with lengths 5 cm, 6 cm, and 7 cm.



3. Compare the triangle you drew for question #2 with the triangle your partner drew.
- What do you notice about the two triangles?

b. What is the perimeter of each triangle?

4. List side lengths for four different triangles that have perimeter 18 cm:

	Length Side 1	Length Side 2	Length Side 3	Perimeter
Triangle A				18 cm
Triangle B				18 cm
Triangle C				18 cm
Triangle D				18 cm

5. Can you draw a triangle with sides of length 3 cm, 4 cm, and 11 cm? If so, draw it here. If not, explain why not.

Potential Sentence Starters and Frames

Some ideas for sentence frames/starters that could be incorporated into your lesson are listed below. If you think a sentence frame/starter will be helpful, consider how will it support students' mathematical learning and/or development of academic language, and decide which sentence frame/starter (from the list below or that you create) would best support students' learning. You may find that the starters and frames vary in level of difficulty, and plan to provide them to students accordingly.

Starters

Three sticks will not form a triangle if _____

All of the sets of three sticks that form a triangle of perimeter 12 _____

Frames

These three sticks _____ did not form a triangle because _____
(insert lengths of sticks)

Academic Language

Students should have opportunities to see, hear, and write key mathematical ideas during this activity. There are some specific terms that students need to understand in order to engage in this task, and there are some additional terms and phrases that may surface as the students engage with the task. You may think of additional words or phrases that are key to this activity. As the task is introduced, solved by the students, and discussed, ensure that students have opportunities to experience (i.e., through discussion, pictures, and the use of gestures) and to build understanding for key words and phrases. Examples of words and phrases that may be involved in work on this problem include:

- Triangle
- Form a triangle
- Side length
- Perimeter
- Every possible combination
- Integer lengths
- Fractions of units
- Convincing mathematical argument



Word Chart for Finding Sides

Spanish, French, Portuguese

* = Cognate

Words and Phrases	Academic Language Meaning	Everyday Language Version	Other Forms of the Word or Phrase	Related Words or Phrases	Translation	Examples of word use with students
Convincing	Persuading or assuring by argument or evidence	Causing one to believe the truth of something; plausible	Convince Convinced Convincer Convincible Convincingly	Persuasive Believable Credible Plausible	*Convincente *Convaincant(e) *Convincente	
Perimeter	For a polygon: the sum of the lengths of its sides; for a circle: the limiting value of a sequence of perimeters of regular polygons (inscribed in a circle) with increasing numbers of sides; the total length of any closed curve.	The distance around a figure; the border or outer boundary of a two--dimensional figure.	Perimetric Perimetrically	Boundary Outer limit Periphery	*Perímetro *Périmètre *Perímetro	



Words and Phrases	Academic Language Meaning	Everyday Language Version	Other Forms of the Word or Phrase	Related Words or Phrases	Translation	Examples of word use with students
Sides	The line segments that form a polygon.	The space next to something.	Side Siding Sided	Boundary Edge	Lados Côtés Lados	
Length	Measurement between two fixed points on a line segment or a curve.	-----	Lengths	Long Extent Breadth Measure	Longitud Longueur Comprimento	
Form	-----	To construct; to make or produce.	Forms Forming Formed	Construct Make Produce Assemble Build	*Formar *Former *Formar	
Combination	A collection of objects, in which the order does not matter.	Bringing together different items.	Combinations Combined Combining Combine	Composition Mix To come together	*Combinación *Combinaison *Combinação	



I. Sticks

You may find it helpful to clarify the difference between “sticks” ----- thin pieces of wood – and the verb “to stick” – to attach; hold firmly in place. Similarly, something can be described using the adjective “sticky.” Though, the meaning of “stick,” in the context of the problem, may seem straightforward, the word is essential to the task and it is imperative that students are clear on its meaning.



Longitudes de tres palitos que forman un triángulo:	Longitudes de tres palitos que no forman un triángulo:

ción del uno con el largo, ¿qué

ar en el *Fostering* mbra como mínimo no mínimo cinco

Longitudes de tres palitos que forman un triángulo:	Longitudes de tres palitos que no forman un triángulo:

¹ Si no tienes acceso al Geometer's Sketchpad software, lo puedes encontrar en una Web-based applet para este problema, a www.geometric-thinking.org/finding.sides.htm.

- b. Ahora considera un juego particular de triángulos—triángulos con perímetro 12. Combina un juego de tres palitos para crear un triángulo de perímetro 12. Usa el Geometer’s Sketchpad y explora la pregunta. En la tabla de abajo, nomra como mínimo cinco juegos de palitos (3 palitos en cada juego) que forman un triángulo de perímetro 12, y como mínimo cinco juegos de palitos que no forman un triángulo de perímetro 12.

Longitudes de tres palitos que forman un triángulo de perímetro 12:	Longitudes de tres palitos que no forman un triángulo de perímetro 12

- c. ¿Hay otros juegos de tres lados que no aparecen en el applet y que crearían un triángulo de perímetro 12? Si es así, ¿dónde están? Y si no es así, ¿porque no?

2. La profesora de Sandy le dió 7 palitos y le preguntó que hiciera triángulos usando solamente esos 7 palitos. Sandy trató todas las combinaciones posibles con los tres palitos, pero con ninguna de las combinaciones pudo formar un triángulo. Los palitos de Sandy tenían longitudes enteras (en las longitudes, no se incluye ninguna fracción). ¿Es posible que Sandy tuviera más de un palito de la misma longitud? Dado lo que aprendistes sobre las longitudes de los lados que forman un triángulo en la pregunta #1:
 - a. ¿Podría ser que el más largo de los 7 palitos de Sandy fuera de 12 cm.? Escribe una respuesta matemática convincente.

 - b. ¿Podría ser que el más largo de los 7 palitos fuera de 13 cm.? Escribe una respuesta matemática convincente.

 - c. ¿Podría ser que el más largo de los 7 palitos fuera de 14 cm.? Escribe una respuesta matemática convincente.

3. Si Sandy tenía 10 palitos que todos eran de longitudes enteras (sin fracciones) y no pudo formar ningún triángulo usando los palitos, ¿cuál es el palito más corto y cuál es el palito más largo? Describe porque crees que la longitud que has dado es la longitud más corta posible para el más largo de los 10 palitos.