Nasco Education

LESSON PLAN

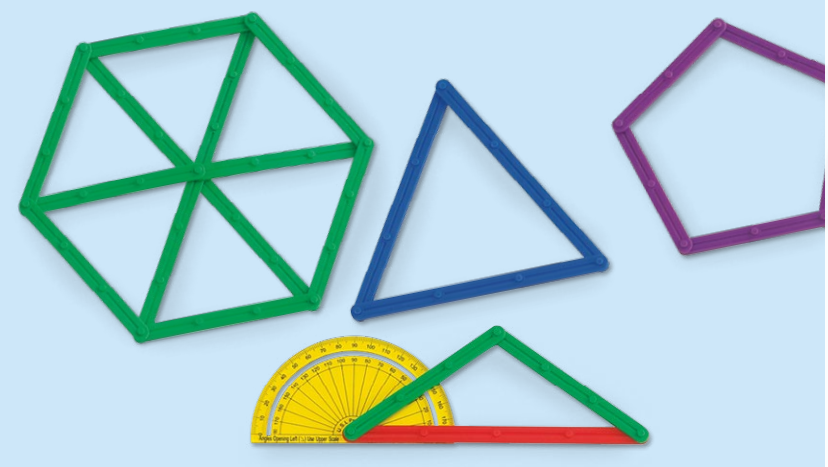
Math

Developed with Kristin Ulrich

Geo Stix: Determine angle measure of triangles

Volume 5 | Gr. 3-6

Time: 60 mins.



CCSS.Math.Content.4.MD.C.6
Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

CCSS.Math.Content.5.G.B.3
Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.

Objectives

Students will be able to...

- Prove that the three angles in all triangles add up to 180 degrees
- Examine a variety of triangles and measure each of their angle measures
- Categorize triangles according to angle measures

Materials list

- Geo Stix Individual Set **(TB25457)** or Geo Stix Class Set **(TB26482)**
- Worksheets (attached with lesson plan download)

Content

Use a protractor to measure the angles of and name a given triangle.

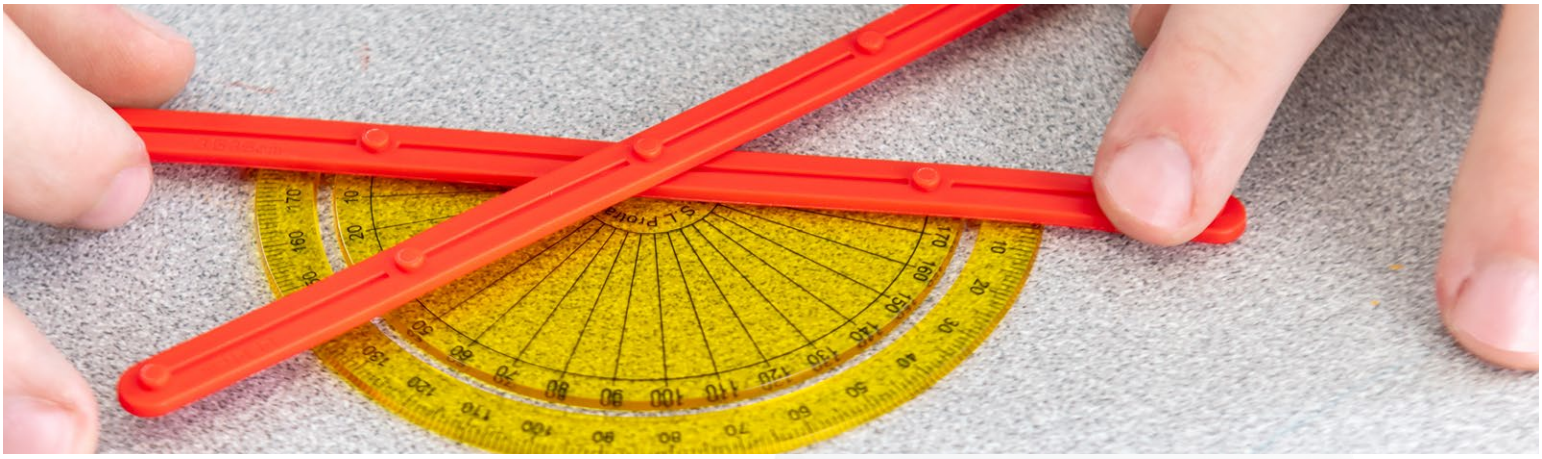
Introduction

NOTE: It is very important to teach students to always use the lines on the back of the Geo Stix when measuring. If they do not use the lines, they will measure the angles incorrectly.

1. Remind students that all triangles have three sides. Go over the three types of triangles.
   - **Equilateral triangle** — All three sides have the exact same length.
   - **Isosceles triangle** — Two sides have the same length and the third has a different length.
   - **Scalene triangle** — All three sides have different lengths.
2. Have students take three purple Geo Stix and clip them together to make a triangle as you model how to do so for them. Students should hold up their purple triangles when they are done.
3. Have students use their protractors to measure the bottom left angle of the purple triangle. They should do this by putting the bottom left vertex of the triangle on the hole on the bottom of the protractor. Make sure the bottom edge of the triangle lines up with the bottom of the protractor (as shown above). Model how to do this while explaining what they should be doing. Use the inner set of numbers on the protractor to obtain the exact measure of the bottom left angle. Everyone should come up with an exact measure of 60 degrees.
4. Follow the same procedure to obtain the exact measures of the bottom right angle and the top angle of the triangle. Be sure to model every step. Students should conclude that all three angles measure 60 degrees.
5. Now it's time to figure out how many degrees are in this triangle all together. Show students how to add all three angles together to get the answer: *(60 + 60 + 60 = 180)*.
6. Repeat the following steps above with a triangle made from three brown legs, another made from three blue legs, and a third from three yellow legs. Students should be able to determine in every instance that the angles all measure 60 degrees and the total degrees in the triangle is 180 degrees.
7. Ask students why they think all the angles were always exactly the same. *(The legs for each triangle were all exactly the same.)*
8. Point out to students that they have only been working so far with equilateral triangles, and that since the sides were all the same lengths, the angles are all the same lengths as well. Get students to wonder what would happen if they started making some triangles where the sides were different lengths.

Activity

1. Have students make a triangle that has two red legs and one dark green leg. The dark green leg should be the bottom of the triangle. Ask them to hold their triangle up when it is constructed so you know they are done.
2. Measure the bottom left vertex of this triangle by snapping the protractor in behind the triangle. Make sure the line on the back of the green piece is lined up with the line on the bottom of the protractor. Be sure to model how to do this for students. Tell students to use the inside set of numbers on the protractor to obtain their measurement. Help them read their protractor correctly by saying something like this, "I see that my angle is somewhere between 70 and 80 degrees. It looks like it is closer to 70 degrees, so I am going to say it is 72 degrees. I said 72 degrees because if you look at the top of the protractor, it is about two lines (which measure degrees) further than 70 degrees." Ask students to give you a thumbs up if they have something similar on their protractors. If theirs is not similar, either individually model it for them or have students who had their thumbs up help those struggling.
3. Measure the bottom right vertex the same way they did the bottom left vertex. Make sure students are snapping the protractor behind the triangle and the line on the back of the green piece is lined up with the line on the bottom of the protractor. Model this for them. Since they are on the opposite side of the triangle, tell students they will need to use the outside set of numbers this time. Students should get 72 degrees as an answer. Point out that this measurement is the same as the previous one, and ask them to give you a thumbs up if they think the third angle will be the same and to give a thumbs down if they think the third angle will be a different measure.
4. Have students measure the third angle. They should snap the protractor behind the vertex where both the red legs meet. Line up the bottom line with the line on the back of the red leg that makes the right side of the triangle. They should use the outside set of numbers because the angle opens to the left. Ask them these questions:
   - What does the angle measure? *(36 degrees)*
   - Why is it different than the other two angle measures? *(The length of the third side is different than the other two, so the angle would have a different measure also.)*
   - Why did we not get 72 degrees for the measure of this angle also? *(The length of that side was different than the length of the other two sides.)*
5. Remind students that when they measured the equilateral triangle earlier, they added 60, 60, and 60 to get 180 degrees. Have them add the three angle measures of the current triangle together *(72 + 72 + 36 = 180 degrees)*
6. Have students try another triangle to see if those angles also measure up to 180 degrees. This triangle will have two blue sides and one yellow side. The yellow side should be the bottom of the triangle. Have students hold up their triangle when completed so you know when they are done.
7. Measure the bottom left vertex first by snapping the protractor behind the bottom left vertex and making sure the line across the bottom lines up perfectly with the line on the back of the yellow leg. Remind students that since the angle opens to the right, they need to use the inside numbers to obtain their measurement. They should come up with 65 degrees.
8. Have students predict what will happen when they measure the bottom right vertex. They should predict it will measure the same as the bottom left vertex. Have them measure the bottom right vertex to see if they are correct. Ensure they are snapping the protractor behind the bottom right vertex, that the line across the bottom is lined up perfectly with the line on the back of the yellow leg, and that they use the outside set of numbers to obtain the measurement because the angle opens to the left. They should come up with 65 degrees.
9. Ask students why this triangle's bottom two vertices have the same measure. *(Both triangles have the same length and a different length for the bottom.)* Tell students that they have been working with isosceles triangles because the triangles have two sides with the same measure and the third side has a different measure.
10. Remind students that all of the triangles they have measured so far have had a total degree measurement of 180 degrees. Keeping that in mind, ask them to hypothesize what the measure of the third angle will be, knowing that two angles measure 65 degrees each. Have them add the two angles together to account for 130 degrees of the 180 degree total. Ask students how they can figure out the measure of the missing angle. They should say that they can subtract 130 from 180. When they do that, they should get 50 degrees.
11. Have students test their hypothesis by measuring the third angle. Make sure they snap their protractor into the top vertex where the two blue legs meet, then move it until it is positioned so the angle is opened to the left. They should measure using the inside set of numbers to get 50 degrees. Get them wondering if all triangles add up to a measure of 180 degrees.
12. Have students create a triangle with one dark green leg, one purple leg, and one yellow leg. The yellow leg will be the bottom or base of the triangle. The green leg will be the left leg of the triangle, and the purple leg will be the right leg. Model how this triangle should look for students.
13. Students will now measure the bottom left vertex angle where the green and yellow legs meet. Snap the protractor to the back and make sure the line along the bottom is matched up with the line along the bottom of the yellow leg. Have students tell you which set of numbers they should use *(the inside set)*. They should come up with 44 degrees.
14. Ask students what they should measure next. *(The measure of the angle at the yellow and purple vertex.)* Have them give you a thumbs up if they think it will also measure 44 degrees and a thumbs down if they think it will measure something different. Have students measure that angle to see who is correct. *(It should measure 59 degrees.)* Ask why they think it has a different measure from the first angle they measured. *(The legs are different lengths.)*
15. Knowing the measure of two of the angles, ask how they can find the measure of the third angle. *(Add up the two known measures and subtract that number from 180.)* Have them do so to get 77 degrees. They should then measure the third angle to see if they are correct, which they should be.
16. Remind students that triangles with three different leg lengths are scalene triangles. Scalene triangles also have three angle measures that are different. The three different angle measures for this triangle are 44, 59, and 77.
17. Let students know that they will be doing some practice on their own by making a bunch of triangles, figuring out the measure of each angle, and saying if the triangle is equilateral, isosceles, or scalene.



Practice

Hand out the worksheet. Students should work on problems 1-3 independently, with a partner, or in a small group.

Check for Understanding

After students have completed problems 1-3, check for understanding by using the following line of questioning. You will focus on problems 2 and 3 because problem 1 is an equilateral triangle. Project an example of the worksheet on the board that you can fill in as students answer the following questions:

Problem 2

1. What is the measure of the bottom left vertex? *(68 degrees)*
2. What is the measure of the bottom right vertex? *(68 degrees)*
3. How do we fill in the missing addends?
   (68 + 68 = 136; 180 – 136 = 44 degrees)
4. Did the third angle measure 44 degrees? *(Yes)*
5. How do we fill in the three-part equation?
   (68 degrees + 68 degrees + 44 degrees = 180 degrees)
6. What type of triangle was that? *(Isosceles)*
7. How do we know? *(Two legs are the same length. Two angles are the same measure.)*

TB26482

Problem 3

1. What is the measure of the bottom left vertex? *(88 degrees)*
2. What is the measure of the bottom right vertex? *(62 degrees)*
3. How do we fill in the missing addends? *(88 + 62 = 150; 180 – 150 = 30 degrees)*
4. Did the third angle measure 30 degrees? *(Yes)*
5. How do we fill in the three-part equation? *(88 degrees + 62 degrees + 30 degrees = 180 degrees)*
6. What type of triangle was that? *(Scalene)*
7. How do we know? *(All three legs have a different measure. All three angles have a different measure.)*

Students should complete problems 4-6 independently.

Intervention

- Only work on problems that include equilateral and isosceles triangles.
- All problems could be done in a whole group setting.
- Strategically match students who understand the concept with struggling students and let them teach one another.
- Add which scale of the protractor (inside or outside) is used for each angle students will measure.
- An Intervention Worksheet has also been provided.

Extension

- Have students work with a partner and create their own triangles using different legs.
- Students can begin to explore with quadrilaterals.
- An Extension Worksheet has also been provided.

Name: _____ Date: _____

Directions: Create the triangles described below. Make sure you assemble each triangle exactly as you are instructed to in the problem. Measure the first two angles, predict the measure of the third angle, then measure it. Finally, name the triangle as an equilateral, isosceles, or scalene triangle.

1. **Use three blue legs to create a triangle.**

   What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

   What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

   Use the formula to figure out the measure of the third angle at the top vertex.

   (Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

   What is the measure of the angle at the top vertex? _____ (Angle 3)

   (Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

   What type of triangle did you create? _____

2. **Use two brown legs and one yellow leg to create a triangle. The yellow leg should be the bottom leg.**

   What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

   What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

   Use the formula to figure out the measure of the third angle at the top vertex.

   (Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

   What is the measure of the angle at the top vertex? _____ (Angle 3)

   (Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

   What type of triangle did you create? _____

3. **Use a blue, purple, and red leg to create a triangle. The purple leg should be the bottom leg, the red leg should be the right leg, and the blue leg should be the left leg.**

   What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

   What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

   Use the formula to figure out the measure of the third angle at the top vertex.

   (Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

   What is the measure of the angle at the top vertex? _____ (Angle 3)

   (Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

   What type of triangle did you create? _____

4. Use a purple, dark green, and orange to create a triangle. The orange leg should be the bottom leg, the purple leg should be the right leg, and the dark green leg should be the left leg.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

5. Use two orange legs and one purple leg to create a triangle. The purple leg should be the bottom leg of the triangle.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

6. Use a blue, orange, and yellow leg to create a triangle. The orange leg should be the bottom leg, the yellow leg should be the right leg, and the blue leg should be the left leg.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

Geo Stix Intervention — **worksheet**

Volume 5

Name: _____ Date: _____

- For Angle 1, you'll always use the inside scale because the angle opens to the right.
- For Angle 2, you'll always use the outside scale because the angle opens to the left.
- For Angle 3, turn the triangle so the angle opens to the left. Use the outside scale.

1. Create a triangle using three purple legs.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

2. Create a triangle using two purple legs and one yellow leg. The yellow leg should be the bottom leg of your triangle.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

3. Create a triangle using two blue legs and one red leg. The red leg should be the bottom leg of your triangle.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

4. Create a triangle that has two dark green legs and one orange leg. The orange leg should be the bottom leg of your triangle.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

5. Create a triangle that has three red legs.

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

What type of triangle did you create? _____

Geo Stix Extension — **worksheet**

Volume 5

Name: _____ Date: _____

1. Create your own equilateral triangle.

What color did you choose? _____

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

2. Create your own isosceles triangle.

What two colors did you choose? _____

Which color is the bottom leg? _____

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

3. Create your own scalene triangle.

What three colors did you choose? _____

Bottom leg color _____ Right leg color _____ Left leg color _____

What is the measure of the angle at the bottom left vertex? _____ (Angle 1)

What is the measure of the angle at the bottom right vertex? _____ (Angle 2)

Use the formula to figure out the measure of the third angle at the top vertex.

(Angle 1) _____ + (Angle 2) _____ = _____ degrees 180 – (total of last problem) _____ = _____ degrees

What is the measure of the angle at the top vertex? _____ (Angle 3)

(Angle 1) _____ + (Angle 2) _____ + (Angle 3) _____ - _____ degrees

Geo Stix Worksheet Problems 4-6

4. Bottom left angle: 54 degrees Bottom right angle: 89 degrees Top angle: 37 degrees
   Scalene triangle

5. Bottom left angle: 44 degrees Bottom right angle: 44 degrees Top angle: 92 degrees
   Isosceles triangle

6. Bottom left angle: 53 degrees Bottom right angle: 104 degrees Top angle: 23 degrees
   Scalene triangle

Geo Stix Intervention Worksheet

1. All angles should measure 60 degrees.
   Equilateral triangle

2. Bottom left angle: 44 degrees Bottom right angle: 44 degrees Top angle: 92 degrees
   Isosceles triangle

3. Bottom left angle: 54 degrees Bottom right angle: 54 degrees Top angle: 72 degrees
   Isosceles triangle

4. Bottom left angle: 74 degrees Bottom right angle: 74 degrees Top angle: 32 degrees
   Isosceles triangle

5. All angles should measure 60 degrees.
   Equilateral triangle