5th Grade Mathematics Lesson Plan

For the Lesson on Thursday, October 25, 2007
Nueva School, Hillsborough, CA

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How Many Isosceles Triangles Can You Find?

1. Goal:

    a. To deepen students' understanding of the concept of isosceles triangles through open-ended problem solving
    b. To help students develop reasoning skills through developing and examining a variety of isosceles triangles by using their properties.
2. Instruction of the Lesson

Elementary-grade students are expected to explore a variety of geometric shapes and examine their characteristics by using manipulatives and dynamic geometry software in order to provide rich context for the development of mathematical reasoning including classifying and defining geometric objects.

Prior to the fifth grade, students learned isosceles triangle as a triangle with a pair of sides with equal length. Students are expected to develop the concept of basic shapes, including isosceles triangles, through hands-on activities in elementary grades. However, younger students sometimes have difficulty recognizing a shape like figure 1 as an isosceles triangle, because this does not look like their idea of an image of a isosceles triangle. Although the shape might not look like an isosceles triangle to them, upper elementary grade students are expected to examine such shapes by using its definition and explain this in their thinking.

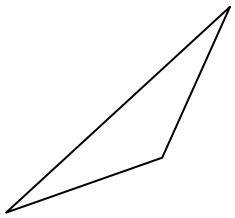


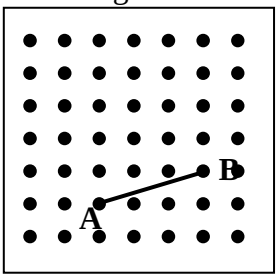
Figure 1

In order to build upon students' background knowledge, this lesson is designed as an introduction of a series of lessons designed to provide students with opportunities to classify and define basic geometric shapes by using their definitions. For example, students are expected to identify a shape like figure 1 by informally using its definition, for example, a triangle with two sides of equal length. In order to do so, students need to identify two sides with equal length by using their previous learned knowledge.

To provide an opportunity to extend this knowledge, this lesson employs the open-ended approach through a hands-on activity.

To maximize opportunity in order to enrich the students' concept of isosceles triangles and use

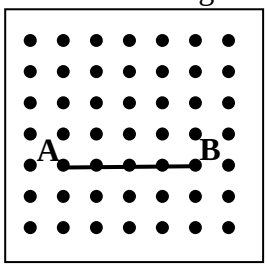
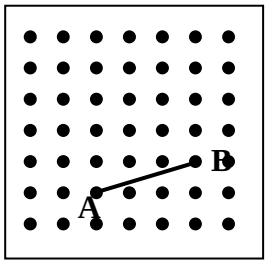
By using a line segment AB as one of the sides, make an isosceles triangle ABC on your geoboard. How many isosceles triangles can you make on your geoboard? Find as many as possible.



of their informal reasoing, the line segment AB has been decided. There are nine possible Cs, which can make ABC an isosceles triangle on the geoboards. Since the length of AB is not obvious, students are expected to not only identify possible isosceles triangles but also explain a reason why the triangle is a isoceles triangle. In other words, the students need to identify which two sides are equal in length and why these two sides are equal. It is expected that they will be able to enrich their concept of isosceles triangles and understand a way to explain their thoughts through this process. Since this is an important opportunity for students to develop their reasoning skills toward formal proofs, the lesson will focus on providing such opportunity as a major discussion in the lesson. Moreover, students are expected to find more possible Cs by extending the size of the geoboard. By using various isosceles triangles that the students themselves find, they will be given an opportunity to classify their triangles into three categories: triangles with AB=BC, with AB=AC, and with AC=BC in order to see if they have found all the possible solutions.

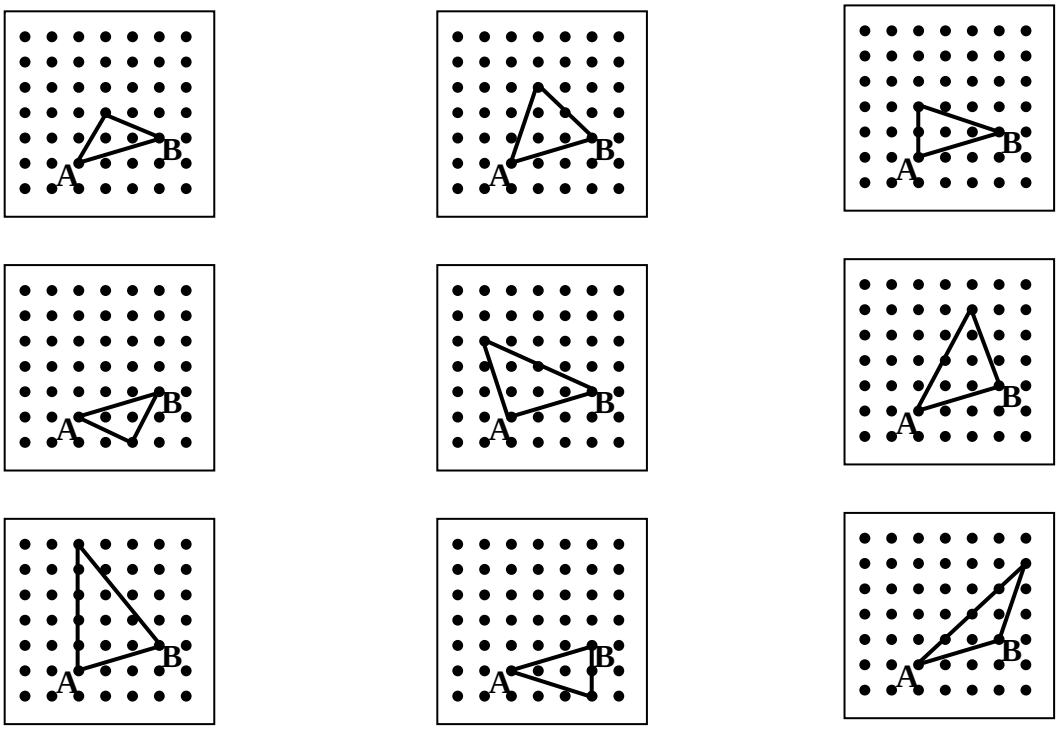
At the end of the lesson, dynamic geometry software will be used to see if all the possible Cs were able to found.

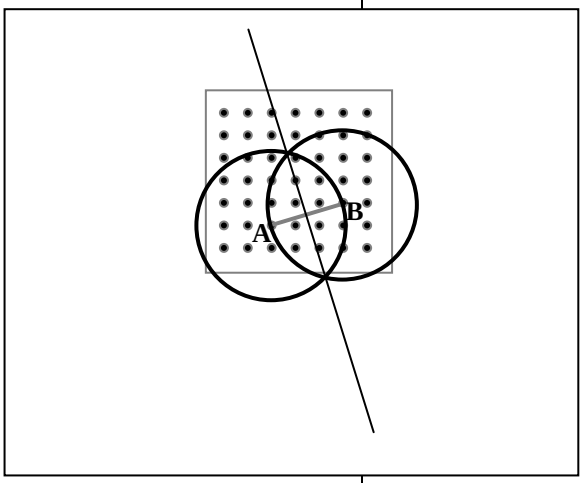
5. Lesson Procedure

Learning Activities Teacher's Questions and Expected Students' Reactions	Teacher's Support	Points of Evaluation
1. Introduction 1) Help students recall their previous knowledge about triangles, such as isosceles triangles and equilateral triangles. 2) Help students recall the use of geoboard. • Ask students to place line segment AB on the geoboard by using a rubber band. • Ask students make an isosceles triangle on the geoboard by using line segment AB as one of the sides and explain why the triangle is an isosceles triangle.  **2. Posing the Problem** 1) By showing the students a geoboard, ask students to place line segment AB on the geoboard by using a rubber band. 2) Pose the following problem to the students: By using line segment AB as one of the sides, make an isosceles triangle ABC on your geoboard. How many isosceles triangles can you make? Find as many isosceles triangles as possible.  **Students' anticipated solutions:** Nine isosceles triangles can be made on a geoboard by using the line segment AB as a side.	Write an informal definition of an isosceles triangle on the blackboard using the students' words such as, "a triangle with a pair of sides with equal length". Give a geoboard to each pair of students. By using an actual geoboard, show where the line segment AB should be. Provide worksheets to keep students' work to use for the class discussion. Pose the problem in written format on the blackboard. Give students enough worksheets so that they can draw each isosceles triangle that they find using a geoboard. Encourage students to talk freely about their ideas when finding isosceles triangles with their partners.	Do the students recall what an isosceles triangle is? Does each pair of students place the line segment AB on their geoboards? Do students understand the problem? Does each pair of students place the line segment AB on their geoboard? Do students understand the problem?

Learning Activities Teacher's Questions and Expected Students' Reactions	Teacher's Support	Points of Evaluation
3. Discussion (1) Ask students to explain their solutions. Students are expected to explain why two sides of the triangle are equal by using their previous knowledge. This knowledge might include congruence of right triangles and the Pythagorean theorem. (2) Help students categorize all the isosceles triangles they find into three groups in order to see if there are no other isosceles triangles on the geoboard. • Use the blackboard to help students organize all of the isosceles triangles by hanging up all of the students' worksheets	Give students a piece of tape to informally compare the length of sides of a triangle if students request it. Encourage students to explain the reasons why they think their triangle is an isosceles triangle without using other materials such as a piece of tape or a pencil to directly measure the length of sides.	

AC=BC **AB=AC** **AB=BC**



Learning Activities Teacher's Questions and Expected Students' Reactions	Teacher's Support	Points of Evaluation
4. Extending the problem If we have a larger geoboard with more pegs, can we find more isosceles triangles by using line segment AB as one of the sides? 1) Let students draw all the isosceles triangles that they have found on their new worksheets. 2) Encourage students to find more triangles by using the categories that they used to organize their solutions. 3) Let students show the class any new triangles that they have found. 3) Help students recognize that all the Cs, which make triangle ABC as isosceles triangles, are in the following geometric figures: • All the Cs that make triangle ABC with AC=BC are on the perpendicular bisector of AB • All the Cs that makes triangle ABC with AB=AC are on the circumference of a circle with the radius of the length equal to AB and A as its center. • All the Cs that makes triangle ABC with AB=BC are on the circumference of a circle with the radius of the length equal to AB and B as its center.	Give students another worksheet with more pegs.  Show above figure to the students by using dynamic geometry software	
4. Summing up (1) Using the writing on the blackboard, review what students learned through the lesson. (2) Ask students to write a journal entry about what they learned through the lesson.		

3. Evaluation
   a. Were students able to deepen their understanding of the concept of isosceles triangles through open-ended problem solving?
      Did they find several isosceles triangles by using geoboards?
      Did they identify two sides with equal length to examine various isosceles triangles during their problem solving as well as in the class discussion?
   b. Were they able to explain their thought formally and informally during the class?