Chapter 2: TRIANGLES

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Various properties of a triangle will be examined. GSP allows students to construct visual representations of triangles; this helps the students solve the problems in each lesson. Each lesson provides opportunity to use the various commands in GSP used in the previous chapter and also introduces new commands specific to this chapter.

The chapter, Triangles, is divided into various lessons ensuring each expectation stipulated in the Ontario Curriculum is properly met. Students will gain a better understanding of the mathematical concepts of perpendicular bisectors, angle bisectors, medians, altitudes, types of triangles (scalene, isosceles and equilateral), congruence and Pythagorean Theorem through exploration in GSP. This chapter involves a high concentration of problem solving and critical thinking by the student. As a result of the complexity of this chapter, it is recommended that students have basic mathematical knowledge of concepts prior to exploration in GSP with each lesson.

The new GSP commands that will be used within this chapter include: perpendicular line, angle bisector, point at midpoint, polygon interior and rotate.

LESSON ONE - Investigation of Angle Bisectors
ONTARIO CURRICULUM Covered:
- Grade 7: 7m52, 7m62
- Grade 8: 8m57, 8m60, 8m63, 8m69

The first lesson Investigation of Angle Bisectors acts as an introduction to triangles. It uses the basic GSP functions explored in the chapter one, which will therefore be familiar to the students. The only new function explored in this lesson is angle bisector.

As a result of the new function introduced, it is recommended that the instructor aid the students through the first lesson. The students will then discover different properties of angles and triangles in GSP such as bisectors, incentre and incircle. It is suggested that students work in pairs or small groups. To ensure that the expectations are met by each of individual, students will then formulate conclusions about angle bisectors on their own. Students may share responses with the class.
Angle Bisector: Bisects an angle into two equal angles.

LESSON TWO - Investigation of Medians
ONTARIO CURRICULUM Covered:
- Grade 7: 7m47, 7m52
- Grade 8: 8m57, 8m58, 8m60, 8m64, 8m67, 8m72

This lesson introduces the concept of a median while calling upon prior knowledge of a triangle and its properties. Students will then be able to formulate their own conclusions about medians of a triangle.

The recommended mode of instruction for this lesson is a student-directed approach as there will not be any new GSP commands implemented.
NOTE: It is important for the students to have mathematical knowledge of the concepts investigated prior to
implementation of this lesson, in order for them to fully comprehend the concepts and terminology
examined. It will give them a better understanding of the visual representations that they will be creating
in GSP.

LESSON THREE – Investigation of Altitudes

ONTARIO CURRICULUM Covered:
- Grade 7: 7m47, 7m52, 7m57
- Grade 8: 8m55, 8m60, 8m63, 8m64, 8m67, 8m68

The lesson Investigation of Altitudes will examine the altitude of various triangles. Similar to the previous lesson in this chapter, a prior knowledge of the mathematical concepts explored is fundamental for student success.

It is suggested that the instructor work alongside the students as they investigate the properties of the altitude of the first triangle constructed. The students will then independently problem solve the altitudes of two more triangles they have created in GSP. They will make informed observations using the visual images presented in GSP. This independent work will incorporate concepts used at the beginning of the lesson.

Altitude: A line segment joining the vertex of a triangle to the opposite side of the same triangle.

LESSON FOUR - Area of a Triangle
ONTARIO CURRICULUM Covered:
- Grade 7: 7m63, 7m41, 7m47
- Grade 8: 8m42, 8m43

This lesson covers two strands of the Ontario Mathematics Curriculum: Geometry and Spatial Sense and Measurement. Area of both a rectangle and triangle will be studied. Many of the commands used in GSP have already be implemented, however, new commands such as hide lines and polygon interior will also be utilized.

Students will hypothesize the formulas used by the GSP program to calculate the area of a rectangle and triangle. They will then proceed to record observations from their images. This lesson is highly concentrated in problem solving and requires critical thinking on behalf of the students. Thus, it is recommended that the instructor initiate the activity while making allowances for the students to investigate the new commands and hypothesize on their own.

Area: Area is the amount of space within a specified object. The formula for area of geometric shapes differs

depending on the shape being examined.

LESSON FIVE - Angles of a Triangle
ONTARIO CURRICULUM Covered:
- Grade 7: 7m51, 7m62, 7m65
- Grade 8: 8m57, 8m64, 8m67, 8m72

The lesson Angles of a Triangle allows the students to investigate angles in a triangle while discovering their special property. Students will notice that despite the size of the triangle or the measurement of each angle, the sum of the three angles of a triangle will always equal 180 degrees (this is the special property a triangle possesses).

This lesson is designed for students to guide themselves through the various steps involved along the road of discovery in GSP.

LESSON SIX - Investigation of Types of Triangles
ONTARIO CURRICULUM Covered:
- Grade 7: 7m47, 7m52, 7m57, 7m61
- Grade 8: 8m55, 8m60, 8m64, 8m67

This lesson deals with the construction of three different triangles: a scalene triangle, an isosceles triangle and an equilateral triangle. Students will investigate the properties of each type of triangle by creating 3 triangles and solving the properties of the specific angles necessary to form a particular triangle.

This lesson can be taught by the mathematics instructor, however, given the previous experience with the GSP functions being used, students may work on this activity in small groups or in

pairs. Students will make observations regarding the angles needed for each triangle without assistance from the instructor.

LESSON SEVEN - Investigation of Congruent Triangles
ONTARIO CURRICULUM Covered:
- Grade 7: 7m47, 7m49, 7m52, 7m58, 7m59, 7m60
- Grade 8: 8m55, 8m58, 8m60, 8m67

The lesson Investigation of Congruent Triangles will examine the congruence of triangles as well as the three conditions of congruence: SSS, SAS and AAS. A prior knowledge of the mathematical concepts explored is fundamental for student success.

This lesson includes a number of GSP commands that have not been used previous in this chapter. Therefore, the best method of instruction will be a teacher-centred focus throughout the lesson. Functions such as distant unit and precision will be put to use in the lesson and it is imperative that students have a strong understanding of the commands in order to comprehend the different properties of congruence.

This lesson will also require independent problem solving on behalf of the students. They will compare triangles to derive the properties of congruence. GSP will provide an ideal visual for the students to properly make the comparison.

SSS: side, side, side
SAS: side, angle, side
AAS: angle, angle, side

LESSON EIGHT - Pythagorean Theorem
ONTARIO CURRICULUM Covered:
- Grade 7: 7m52
- Grade 8: 8m55, 8m58, 8m59, 8m60, 8m65, 8m70, 8m73

This lesson deals strictly with the mathematical concept of the Pythagorean Theorem. The Pythagorean Theorem is $a^2 + b^2 = c^2$. Students will be given the opportunity to discover this theorem using GSP to construct the triangles and squares necessary. As stipulated in other lessons, it is strongly suggested that students have a basic knowledge of the concepts prior to using GSP in this lesson.

Since this lesson is complex, it is recommended that the instructor guide students through it.

By the end of the lesson, students will be able to derive the equation for the Pythagorean Theorem/solve for the hypotenuse. This lesson is a good culminating activity for the end of the chapter on Triangles as it deals with prior knowledge of GSP commands used throughout the chapter.