**Vision Empower & XRCVC**

Teacher Instruction KIT

# The Triangle and Its Properties

Syllabus: Karnataka State Board
Subject: Math
Grade: 7
Textbook Name: MATHEMATICS – Text cum Workbook (Revised) – Seventh standard
Chapter Number & Name: 6. Triangle and Its Properties

## 1. OVERVIEW

1.1 OBJECTIVE & PREREQUISITES

### Objective

By the end of the lesson, the student will be able to:

- Define, describe and construct medians, altitudes and angle bisectors
- List and describe the properties of medians, altitudes and angle bisectors (including naming the points of intersections of multiple medians, altitudes and angle bisectors)
- Define and describe the properties of general triangles, namely the angle sum property, side length sum property, and exterior angle property.
- Solve problems

### Prerequisite Concept

- Angles and triangles

*TIK_MATH_G6_CH4_Basic Geometrical Ideas*

- Triangles and their properties
- Angles- measuring and drawing

*TIK_MATH_G6_CH5_Understanding Elementary Shapes*

- Pairs of angles- complementary, supplementary and vertically opposite angles, corresponding angles, alternate interior angles, alternate exterior angles

*TIK_MATH_G7_CH5_Lines and Angles*

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name : The triangle and its properties

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## 2. LEARN

2.1 KEY POINTS

- Triangle
- Medians
- Altitudes
- Angle bisectors
- Interior angle
- Exterior angle

2.2 LEARN MORE

## 3. ENGAGE

3.1 INTEREST GENERATION ACTIVITY

### Sorting shapes

**Activity 1: Sorting shapes**

*Materials Required: Tactile diagrams of acute angled triangle, right angled triangle, obtuse angled triangle, equilateral triangle, isosceles triangle, and scalene triangle, quadrilaterals, polygons (square, rectangles, generic quadrilaterals, pentagons, hexagons, octagons*
*Prerequisites: Identifying shapes*

*Activity Flow*

*Ask the student to list (verbally) a few objects that have 3 corners.*
*Give the student tactile diagrams of triangles as well as other polygons. Have about 6 tactile diagrams of triangles (one of each type, namely acute angled, right angled, obtuse angled, equilateral, isosceles, and scalene triangles) and 6 other polygons (square, rectangles, generic quadrilaterals, pentagons, hexagons, octagons, including multiple types of each, and these need not be regular).*

*Make the student pick out one polygon at a time, count the number of corners, and ask them to keep all polygons on the right side and triangles of different types on the left side. After the first few polygons, ask them to describe each triangle that they pick.*

3.2 CONCEPT INTRODUCTION ACTIVITIES

## Introduction

**Activity 2: Introduction**

*Materials required: Geometry kit, parchment paper*
*Prerequisites: Construction of triangles*

*Activity Flow*

*Ask the students to draw different types of triangles based on length of sides such as scalene, isosceles and equilateral triangles and based on angles such as acute angled, obtuse angled and right angled triangles. Then let them write the length of sides and measure angles, then vertices of each triangle.*

## Medians of a triangle

**Activity 3: Medians of a triangle**

*Materials required: Tactile diagram of medians of triangle, geometry kit, parchment paper*
*Prerequisites: Construction of triangle*

*Activity Flow*

*First show them the tactile diagram of the median drawn for a triangle then let students draw a triangle ABC and then the median from point (vertex) A to the midpoint of segment BC, first mark out the midpoint of segment BC.*
*This can also be done by aligning the point BC, and making sure that the edge BC is being folded so that the edge stays together, and pinch the midpoint, calling this midpoint point D.*

*Take a triangular sheet of paper and fold the median, make a crease passing through points A and D.*
*Now the line from vertex A to the midpoint D is the median for the triangle ABC.*

*Answer the following questions,*

1. *How many medians can a triangle have?*
   *Answer: 3*
2. *Does a median lie wholly in the interior of the triangle? (If you think that this is not true, draw a figure to show such a case).*
   *Answer: Yes*

## Altitudes of a triangle

**Activity 4: Altitudes of a triangle**

*Materials required: Tactile diagram of altitudes of triangle, geometry kit, parchment paper*

*Prerequisites: Construction of triangle*

*Activity Flow*

*Show them the tactile diagram of altitude of a triangle then ask them to draw a triangle PQR. How 'tall' is the triangle? The height is the distance from vertex P to the base QR. From P to QR, you can think of many line segments. Which among them will represent its height? The height is given by the line segment that starts from P, comes straight down to QR, and is perpendicular to QR. This line segment PL is an altitude of the triangle. An altitude has one endpoint at a vertex of the triangle and the other end point is on the line on the opposite side of the vertex. Through each vertex, an altitude can be drawn.*

*Take a triangular sheet of paper and fold an altitude from point P to segment QR, fold a crease from point P, and at the same time make sure that the segment QR stays overlapped when you fold.*

*Ask the following questions to the students*

1. *How many altitudes can a triangle have?*
   *Answer: 3*
2. *Will an altitude always lie in the interior of a triangle? If you think that this need not be true, draw a rough sketch to show such a case.*
   *Answer: Yes*
3. *Can you think of a triangle in which two altitudes of the triangle are two of its sides?*
   *Answer: right angled triangle*
4. *Can the altitude and median be the same for a triangle?*
   *Answer: In case of an equilateral triangle, all the altitudes drawn are median as well and vice versa. In case of an isosceles triangle, the altitude drawn from the vertex (where the equal sides meet) to the unequal side is the median.*

## The exterior angle of a triangle and its property

**Activity 5: Exterior angle of a triangle and its property**

*Materials required: Tactile diagram of an exterior angle of a triangle, geometry kit, parchment paper*

*Prerequisites: Construction of triangles,* measuring angles

*Activity Flow*

*Start by revising the concept of supplementary angles and defining the exterior angle. Give the student tactile triangles examples with the exterior angles drawn out. Then you can ask the*

*student to measure all interior and exterior angles and have a discussion on what they have observed. State and describe the property, and verify the property by making the student draw triangles, draw exterior angles to a given triangle (drawings to be made on parchment paper) and measure all the relevant angles.*

*Hence, observe that an exterior angle of a triangle is equal to the sum of its interior opposite angles.*

*Ask the following questions,*

1. *Are the exterior angles formed at each vertex of a triangle equal?*
   *Answer: Yes*
2. *What can you say about the sum of an exterior angle of a triangle and its adjacent interior angle?*
   *Answer: Adjacent interior and exterior angles are supplementary angles. In other words, the sum of each interior angle and its adjacent exterior angle is equal to 180 degrees (straight line).*
3. *If one of the interior angles is 40 degrees and the exterior angle is 120 degrees. Find another interior angle x.*
   *Answer: 80 degrees*

## Angle sum property of a triangle

**Activity 6: Angle sum property of a triangle**

*Materials required: Geometry kit, parchment paper, foam sheet/cardboard cutout of a triangle*

*Prerequisites:* Construction of triangle, measuring angles

*Activity Flow*

*Ask them to draw a triangle and measure all three angles then add them up and see. Similarly, let them draw 3 to 4 types of triangles and ask them to measure all three angles for all the triangles and find the sum of angles for each triangle. Ask them what they observed and what conclusion they can draw from this activity.*
*Hence, observe that the total measure of the three angles of any triangle will be 180 degrees.*

*Follow this exercise up by making the students measure all three angles of several (tactile) triangles. (The triangles whose angles have to be measured should be big and drawn on parchment paper to make the measuring easy).*

*Ask the following questions:*

1. *Two angles of a triangle are* $30^\circ$ *and* $70^\circ$ *Find the third angle.*
   *Answer:* $2.5$

2. *One of the angles of a triangle is* $80^\circ$ *and the other two angles are equal. Find the measure of each of the equal angles.*
   *Answer:* $50^\circ$
3. *The three angles of a triangle are in the ratio* $1:2:1$*. Find all the angles of the triangle.*
   *Answer:* $45^\circ, 90^\circ, 45^\circ$

## Two special triangles- Equilateral and Isosceles

**Activity 7: Two special triangles- Equilateral and Isosceles**

*Materials required: Geometry kit, parchment paper, glue*
*Prerequisites: Constructing triangles and measuring angles, sides*

*Activity Flow*

- *A triangle in which all the three sides are of equal lengths is called an equilateral triangle.*

*Ask the students to construct two equilateral triangles and cut them out.*
*Keep one of them fixed. Place the second triangle on it. It fits exactly into the first. Turn it round in any way and still they fit with one another exactly. tell them that when the three sides of a triangle have equal lengths then the three angles are also of the same size.*
*Conclusion- in an equilateral triangle:*

*(i) All sides have the same length.*
*(ii) Each angle measures 60 degrees.*

- *A triangle in which two sides are of equal lengths is called an isosceles triangle.*

*Similarly, ask the students to draw two isosceles triangles. Ask the students what they observe and conclude. Observe that in an isosceles triangle:*

*(i) Two sides have the same length.*
*(ii) Base angles opposite to the equal sides are equal.*

*Give the students tactile diagrams of equilateral, isosceles triangles and ask them to describe the difference between the given triangles by measuring the sides of triangles and also their angles. Also, ask them to calculate the 3rd angle if two angles are given in an equilateral and isosceles triangle.*

## Sum of the lengths of two sides of a triangle

**Activity 8: Sum of the lengths of two sides of a triangle**

*Materials required: Geometry kit, parchment paper, ice cream sticks/craft wires*
*Prerequisites: Construction of triangles, measuring sides*

*Activity Flow*

*To explain this property, make a triangle using ice cream sticks or craft wires or even pencils. If required use temporary adhesives like BluTack (available at any stationery or craft store). State the side length sum property, that the sum of length of two sides is always greater than the length of the third side. Ask the student to pick out any two sides, measure their lengths, place the sides back correctly, and then measure the length of the third side and verify the property by comparing the sum of lengths of the initially measured two sides with the length of the third side. Follow this exercise up by making the students measure the length of all three sides of several (tactile) triangles and verify the property.*

*Ask the following questions*

1. *Is it possible to have a triangle with the following sides?*
   *(i) 2 cm, 3 cm, 5 cm*
   *(ii) 3 cm, 6 cm, 7 cm*
   *(iii) 6 cm, 3 cm, 2 cm*

*Answer: Yes*

2. *The lengths of two sides of a triangle are 6 cm and 8 cm. Between which two numbers can the length of the third side fall?*
   *Answer: In a triangle sum of 2 sides must be greater than the 3rd side.*

   *So, the third* $> 8-6=2$ *and also the third* $< 8+6=14$.

   *So, the answer is* $2 < \text{third side} < 14$

   *The third side lies between* $(2,14)$

## Right angled triangles and Pythagoras property

### Activity 9: Right angled triangles and Pythagoras property

*Materials Required: Geometry kit, parchment paper*

*Prerequisites: Construction of right angled triangle, square, measuring sides, area*

*Activity Flow*

- *When discussing the Pythagorean Theorem discuss other specific properties of the right angle which is that in a right-angled triangle the sides have some special names. The side opposite to the right angle is called the hypotenuse; the other two sides are known as the legs of the right-angled triangle. Give them a model/tactile right angled triangle to refer to as required. The theory of this special triangle is to be explained to a student with visual impairment the same way you would explain it to a sighted student. The theorem states that, for any right-angled triangle, the area of the square on the hypotenuse is equal to the sum of the areas of the squares on the legs.*

- *Show them the tactile diagram of squares drawn on the sides of the right angled triangle. Later ask them to construct a right angled triangle and draw a square on all three sides whose length willbe the same as the sides of the triangle. And verify that the square on the hypotenuse = sum of the squares on the legs. That is, the area of a square drawn on a hypotenuse is equal to the sum of the areas drawn on the legs of the right angled triangle.*

- *Draw squares with sides 3 cm, 4 cm, 5 cm long. Have cut-outs and arrange to get a triangular shape by placing the corners of the squares suitably, trace out the triangle formed. Measure each angle of the triangle.*

*Ask the following questions,*

1. *Determine whether the triangle whose following lengths of sides:*
   - i. *4cm, 5 cm, 6 cm is a right angled triangle. Answer: No*
   - ii. *6cm, 8cm, 10cm is a right angled triangle. Answer: Yes*

3.3 LET'S DISCUSS: RELATE TO DAILY LIFE*

- Some everyday objects like plates, trays, cups, bowls, etc.
- Some floor tiles
- Triangles are often used in art motifs and designs, company logos, etc.
- Triangles are effective tools for architecture and are used in the design of buildings and other structures as they provide strength and stability.
- The concept of right triangles is used because carpenters need to be sure that walls are straight and corners are square.
- This application is frequently used in architecture, woodworking, or other physical construction projects. For instance, say you are building a sloped roof. If you know the height of the roof and the length for it to cover, you can use the Pythagorean Theorem to find the diagonal length of the roof's slope. It is used to calculate the steepness of slopes of hills or mountains.

## 4. EXERCISES & REINFORCEMENT

4.1 EXERCISES & REINFORCEMENT

### Practice and Recall

**Activity 10: Exercise problems**

*Materials Required: None*

*Prerequisites: Triangle and its properties*

*Activity Flow*

*Note: Teachers should provide the required materials to solve the problems.*

1. *Take several cut-outs of (i) an equilateral triangle (ii) an isosceles triangle and (iii) a scalene triangle. Find their altitudes and medians. Do you find anything special about them?*
2. *Verify by drawing a diagram if the median and altitude of an isosceles triangle can be same*
3. *An exterior angle of a triangle is of measure* $70^o$ *and one of its interior opposite angles is of measure* $25^o$*. Find the measure of the other interior opposite angle.*
4. *The two interior opposite angles of an exterior angle of a triangle are* $60^o$ *and* $80^o$*. Find the measure of the exterior angle.*
5. *Can you have a triangle with two right angles?*
6. *Can you have a triangle with two obtuse angles?*
7. *Can you have a triangle with two acute angles?*
8. *Can you have a triangle with all the three angles greater than* $60^o$ *?*
9. *Can you have a triangle with all the three angles equal to* $60^o$ *?*
10. *Can you have a triangle with the entire three angles less than* $60^o$ *?*
11. *Is the sum of any two angles of a triangle always greater than the third angle?*
12. *Which of the following can be the sides of a right triangle?*

*a)* 2.5 cm, 6.5 cm, 6 cm

*b) 2 cm, 2 cm, 5 cm.*

*c)* 1.5 cm, *2cm,* 2.5 cm

13. *A 15 m long ladder reached a window 12 m high from the ground on placing it against a wall at a distance a. Find the distance of the foot of the ladder from the wall*

## 4.2 IMPORTANT GUIDELINES*

**Exercise Reading**

It is very important that the children practice their learnings as well as their reading. Hence have the children read out the newly learned concepts from their textbooks or other available resources.

**Perform Textbook Activity**

It is good practice to have the children perform the textbook activities. Your textbook activities might not be accessible hence go through this resource to learn how to make textbook content accessible

**Provide Homework**

To evaluate their understanding and to help the student revise and implement the new learnt concept ensure to provide them with homework. Students should perform one or two of the questions mentioned above or from the textbook exercises with the teacher in Class and the remaining may be given for homework. Also, ensure that the student knows their special skills linked to independently using their accessible books as it will be critical to doing homework independently

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