# Vision Empower & XRCVC Teacher Instruction KIT Congruence of Triangles

Syllabus: Karnataka State Board Subject: Math Grade: 7 Textbook Name: Text cum Workbook (Revised) – Seventh standard Chapter Number & Name: 7.Congruence of Triangles

# **1. OVERVIEW**

**1.1 OBJECTIVE & PREREQUISITES** 

# Objective

• Students will be able to understand congruence of lines, Angles, Triangles and criteria to find the congruent triangles

# **Prerequisite Concept**

- Lines, Angles and shapes TIK\_MATH\_G6\_CH4\_Basic Geometrical Ideas
- The triangle and its properties TIK\_MATH\_G6\_CH5\_Understanding Elementary Shapes
- The triangle and its properties *TIK\_MATH\_G7\_CH6\_The Triangle And Its Properties*

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Kindly Note: Activities marked with \* are mandatory

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- Plane figures
- Triangle
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#### **2. LEARN**

#### 2.1 KEY POINTS

- Line segments
- Plane figures
- Triangle
- Angle

# 2.2 LEARN MORE

# **3. ENGAGE**

# **3.1 INTEREST GENERATION ACTIVITY**

# **Copies of same object**

# Activity 1: Copies of same object

Materials required: 1, 2, 5 rupees coins, slate, taylor frame, books, different sizes of sheets, shapes/tactile diagram of square, rectangle, circle, two isosceles triangle and semicircles. Prerequisites: None

# Activity Flow

- Ask the students to take two coins of the same denominations. Place one coin over the other. Let them observe the coins and then ask them whether the top coin covers the coin below completely and exactly?
- If yes, then such objects are said to be congruent. The two coins are congruent to one another. Congruent objects are exact copies of one another.
- Hence we observed that if two objects are identical, it can be overlapped without missing/jutting out.
- If we take the five of spades from each of two identical decks of cards, they look exactly the same. We can move one card and place it on top of the other one so that the pictures on the two cards coincide exactly.

Note: Place one object on another is also called overlap or superimpose.

Then ask them to try the following and tell which are congruent and which are not.

- 1. Overlap of slate and Taylor frame
- 2. Overlap of two slates
- *3. Overlap of Taylor frame and A4 sheet*
- 4. Overlap of two A4 sheets
- 5. Superimpose of two isosceles triangles
- 6. Superimpose of square and rectangle
- 7. Superimpose of circle and two semicircles

# **3.2 CONCEPT INTRODUCTION ACTIVITIES**

# **Congruence of plane figures**

# Activity 2: Congruence of plane figures

Materials required: Geometry kit, parchment paper and scissor Prerequisites: Construct planar figures (square, rectangle, triangle)

#### Activity Flow

Ask the students to draw two same figures square, rectangle or triangle. Then cut the figures and superimpose them. If the figures cover each other completely, they are congruent. Ensure that they do not bend, twist or stretch the figure that it is cut in order to superimpose them. Also, ask them to give examples for non congruent figures in this activity.

#### **Congruence among line segments**

#### **Activity 3: Congruence among line segments**

Materials required: Straws/matchsticks/ice cream sticks, tactile diagram of lines of same length and varied length Prerequisites: Compare length, draw line segments

#### Activity Flow

Take multiple pieces of strawsand cut them to varying lengths. Make sure some of these pieces are of equal length. Show them to the students, allowthem to explore the material and ask them to organize the material according to size, and identify all the straws of matching length.

Define and describe line segments of equal length and demonstrate the concept by drawing sets of congruent line segments and incongruent line segments to compare. Show them the tactile diagram lines of same length and varied length and have discussion on which are congruent and which are not. Then ask them to draw line segments and determine congruent and non congruent lines by measuring the length. Then ask the student to make congruent lines of a certain length.

Hence, if two line segments have the same (equal) length, they are congruent. Also, if two line segments are congruent, they have the same length.

In view of the above fact, when two line segments are congruent, we sometimes just say that the line segments are equal; and we also write AB = CD. (What we actually mean is  $AB \cong CD$ )

#### **Activity 4: Congruence of angles**

Materials required: Tactile diagrams of two angles 50 and 90 degrees with varied length of arms, geometry kit and parchment paper Prerequisites: Constructing and measuring angles

Activity Flow Start with a window. In the corner of the room there are 2 angles. In a window just 1 in each corner. Take the student to the corners of the room, recognize the angles, and ask the student to estimate whether they are equal or not.

Show them the tactile diagram of angles for the student to feel and explore.

Ask them to measure the angles of the given tactile diagrams and later ask them which of the angles are congruent. Then explain to them the criteria to be observed in angles if they have the same measureto say whether they are congruent or not.

Talk about how right angles will be congruent to only right angles and that an angle cannot be both acute and obtuse simultaneously. Remember to teach students that the length of the arms of the angles does not affect the congruency of the angle itself also show them the tactile diagram of angle measures the same but have varied lengths of arm. Make the student draw angles that are congruent, but whose arms are not of equal length. Explain to the student how arms of an angle are in fact lines and not line segments, which is why the lengths of the arms do not matter.

*I.e., if two angles have the same measure, they are congruent. Also, if two angles are congruent, their measures are the same.* 

As in the case of line segments, congruence of angles entirely depends on the equality of their measures. So, to say that two angles are congruent, we sometimes just say that the angles are equal; and we write  $\angle ABC = \angle PQR$  (to mean  $\angle ABC \cong \angle PQR$ )

# Ask the following question to the students

1. Whether any obtuse and acute angles are congruent to each other?

# **Congruence of triangles**

#### **Activity 4: Congruence of triangles**

Materials Required: Tactile diagram of two sets of scalene, equilateral and isosceles triangles, tactile diagram of congruent triangles ABC and PQR. Geometry kit, parchment paper Prerequisites: Construction of triangles, measuring angles and sides

#### Activity Flow

Keep samples of triangles ready, and ask the student to identify what they think are identical triangles, i.e. can be overlapped without anything missing/jutting out.

Two line segments are congruent when they are of the same length and 2 angles are congruent when they are equal. Similarly, two triangles are congruent when they are the copy of the other. We extend this idea to triangles. Two triangles are congruent if they are copies of each other and when superposed, they cover each other exactly. Show the students the tactile diagram of congruent triangles and naming them the first triangle is ABC and the second one is PQR; explain that they have the same shape and size. Thus, in these two congruent triangles, we have: Corresponding vertices: A and P, B and Q, C and R. Corresponding sides: AB and PQ, BC and QR, AC and PR. Corresponding angles:  $\angle A$  and  $\angle P$ ,  $\angle B$  and  $\angle Q$ ,  $\angle C$  and  $\angle R$ .

This shows that while talking about congruence of triangles, not only the measures of angles and lengths of sides matter, but also the matching of vertices. In the above case, the correspondence is  $A \leftrightarrow P$ ,  $B \leftrightarrow Q$ ,  $C \leftrightarrow R$  We may write this as  $ABC \leftrightarrow PQR$ and geometry two figures or objects are congruent if they have the same shape and size.

#### Criteria for congruence of triangles

#### Activity 5: Criteria for congruence of triangles

Materials required: Geometry kit, tactile diagram of SSS, SAS, ASA congruent triangles Prerequisites: Measure sides and angles

Activity Flow

Explain how congruent triangles have all sides of equal length and all angles equal. Remind the student of the angle sum property of triangles (i.e. sum of measures of all three triangles is 180 degrees).

We make use of triangular structures and patterns frequently in day-to-day life. So, it is good to find out when two triangular shapes will be congruent. If we have two triangles drawn on parchment paper and want to verify if they are congruent, we cannot cut out one of them every time and use the method of superposition. Instead, if we can judge congruence in terms of measures, it would be quite useful.

The useful tests are as follows:

• SSS Congruence criterion: If under a given correspondence, the three sides of one triangle are equal to the three corresponding sides of another triangle, then the triangles are congruent.

*Example:* In triangles ABC and PQR, AB = 3.5 cm, BC = 7.1 cm, AC = 5 cm, PQ = 7.1 cm, QR = 5 cm and PR = 3.5 cm. Examine whether the two triangles are congruent or not. If yes, write the congruence relation in symbolic form.

Solution: Here, AB = PR (= 3.5 cm),

BC = PQ (= 7.1 cm)

And

 $B \leftrightarrow P$ 

This shows that the three sides of one triangle are equal to the three sides of the other triangle. So, by SSS congruence rule, the two triangles are congruent. From the above three equality relations, it can be easily seen that  $A \leftrightarrow R$ ,  $B \leftrightarrow P$  and  $C \leftrightarrow Q$ .

Therefore  $\triangle ABC \cong \triangle RPQ$ 

Show them the tactile diagram for the above example. Let them verify the SSS criterion by measuring corresponding sides of both the triangles.

• SAS Congruence criterion: If under a correspondence, two sides and the angle between them of a triangle are equal to two corresponding sides and the angle between them of another triangle, then the triangles are congruent.

Example: Given the measurements of some parts of two triangles. Examine whether the two triangles are congruent or not, by using SAS congruence rule. If the triangles are congruent, write them in symbolic form. AB = 7 cm,

BC = 5 cm,

 $\angle B = 50^{\circ}$ 

Solution: Here, AB = EF (= 7 cm), BC = DE (= 5 cm) and included

 $\angle B =$ included  $\angle E (= 50^{\circ}) \dots Also, A \leftrightarrow F$ 

 $B \leftrightarrow E$ 

and  $C \leftrightarrow D$ . Therefore,  $\triangle ABC \cong \triangle FED$  (By SAS congruence rule)

Show them the tactile diagram for the above example. Let them verify the SAS criterion by measuring the corresponding sides and angle of both the triangles.

• ASA Congruence criterion: If under a correspondence, two angles and the included side of a triangle are equal to two corresponding angles and the included side of another triangle, then the triangles are congruent.

Example 1: By applying ASA congruence rule, it is to be established that  $\triangle ABC \cong \triangle QRP$  and it is given that BC = RP. What additional information is needed to establish the congruence?

Solution: For ASA congruence rule, we need the two angles between which the two sides BC and RP are included. So, the additional information is as follows

 $\angle B = \angle R$ 

and  $\angle C = \angle P$ 

*Example 2: Use ASA congruence rule and conclude that*  $\triangle AOC \cong \triangle BOD$ ?

Show them the tactile diagram of  $\triangle AOC \cong \triangle BOD$ ? for ASA congruence and explain the solution.

Solution: In the two triangles AOC and BOD,  $\angle C = \angle D(\text{each } 70^\circ)$ . Also,  $\angle AOC = \angle BOD = 30^\circ$ (vertically opposite angles) So,  $\angle A$  of  $\triangle AOC = 180^\circ - (70^\circ + 30^\circ) = 80^\circ$  (using angle sum property of a triangle) Similarly,  $\angle B$  of  $\triangle BOD = 180^\circ - (70^\circ + 30^\circ) = 80^\circ$  Thus, we have  $\angle A = \angle B$ ,

AC = BD

And

 $\angle C = \angle D$ . Now, side AC is between  $\angle A$  and  $\angle C$  and side BD is between  $\angle B$  and  $\angle D$ . So, by ASA congruence rule  $\triangle AOC \cong \triangle BOD$ ,

Ask students to draw congruent triangles for all the three congruence criteria (SSS, SAS and ASA).

#### **Congruence among right angled triangle**

#### Activity 6: Congruence among right angled triangle

Materials required: Tactile diagram of right angled triangle Prerequisites: Construction and measuring sides and angles

Activity Flow

RHS Congruence criterion: If under a correspondence, the hypotenuse and one side of a rightangled triangle are respectively equal to the hypotenuse and one side of another right-angled triangle, then the triangles are congruent.

Show them the tactile diagram of congruent right angled triangle and explain the RHS congruence criterion.

Ask the students to try the following example and check if they can verify the RHS congruence.

Given below are measurements of some parts of two triangles. Examine whether the two triangles are congruent or not, using RHS congruence rule. In case of congruent triangles, write the result in symbolic form.

- 1.  $\triangle ABC : \angle B = 90^{\circ}$ , AC = 8 cm, AB = 3 cm and  $\triangle PQR : \angle P = 90^{\circ}$ , PR = 3 cm, QR = 8 cm
- 2.  $\triangle ABC : \angle A = 90^{\circ}$ , AC = 5 cm, BC = 9 cm and  $\triangle PQR : \angle Q = 90^{\circ}$ , PR = 8 cm, PQ = 5 cm

3.3 LET'S DISCUSS: RELATE TO DAILY LIFE\*

• Traffic signs form the most commonly found examples of the triangle in our everyday life. The signs are in equilateral triangular shape.

• Mostly congruent triangles are used for construction of things like bridges and buildings because they are considered more stable and strong to use.

### **4. EXERCISES & REINFORCEMENT**

4.1 EXERCISES & REINFORCEMENT

#### **Practice and Recall**

Activity 7: Measure lengths of real objects Materials required: Tactile ruler

Prerequisites: Measuring length

Activity Flow

Make the student measure the lengths of sheets of paper/ parchment paper, clipboards, tables, and pick out congruent lines

# **Activity 8: Homework problems**

Materials required: Geometry kit, parchment paper Prerequisites: congruence of triangles

#### Activity Flow

- 1. Complete the following statements:
- (a) Two line segments are congruent if \_\_\_\_.
- (b) Among two congruent angles, one has a measure of 70°; the measure of the other angle is \_\_\_.

(c) When we write  $\angle A = \angle B$ , we actually mean \_\_\_\_.

Give any two real-life examples for congruent shapes.

- 2. If  $\triangle ABC \cong \triangle FED$  under the correspondence  $ABC \leftrightarrow FED$ , write all the corresponding congruent parts of the triangles.
- 3. If  $\triangle DEF \cong \triangle BCA$ , write the part(s) of  $\triangle BCA$  that correspond to
  - a) ∠*E*
  - b) *EF*
  - **c)** ∠*F*
  - d) *DF*
- 4. You want to establish  $\triangle DEF \cong \triangle MNP$ , using the ASA congruence rule. You are given that  $\angle D = \angle M$  and  $\angle F = \angle P$ . What information is needed to establish the congruence? (Draw a rough figure and then try!)
- 5. By applying SAS congruence rule, you want to establish that  $\triangle PQR \cong \triangle FED$ . It is given that PQ = FE and RP = DF. What additional information is needed to establish the congruence?

#### **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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