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Master Lesson Plan

for

09 - Symmetry and Congruence (ପ୍ରତିସମତା ଓ ସମ୍ବନ୍ଧନତା)

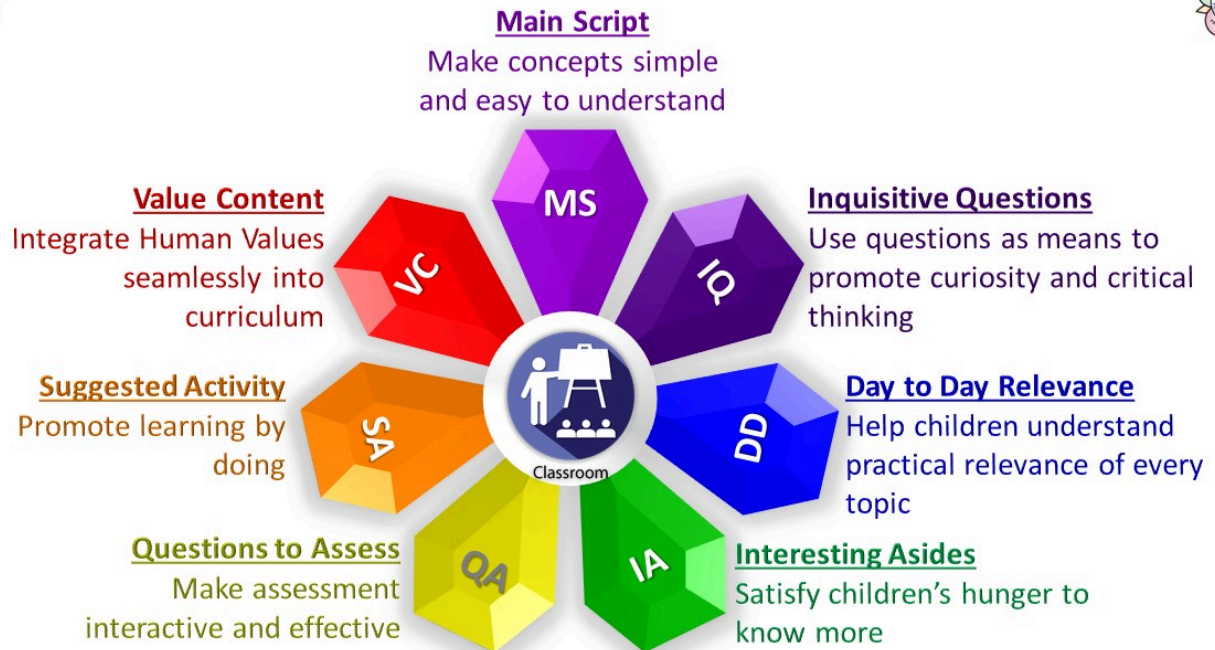
Board	Standard	Subject	Chapter	Language	Creation date
Odisha (English)	STD VII	Mathemat ics	09 - Symmetry and Congruence (ପ୍ରତିସମତା ଓ ସମ୍ବନ୍ଧନତା)	English	26-03-2024 22:29:58

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Master Lesson Plan (MLP) - Covers the entire chapter with the help of these 7 asset types

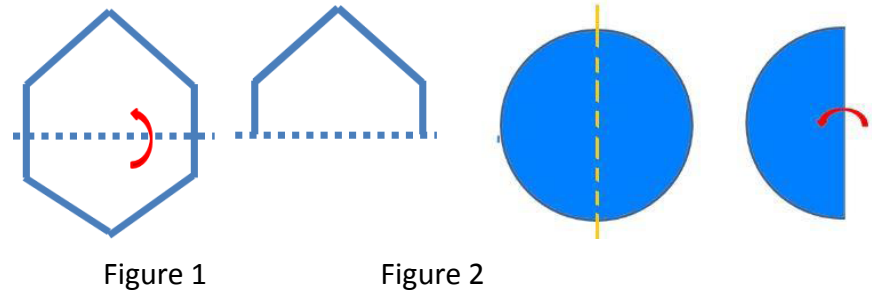


For more information on how to use the lesson plan effectively, please scroll to the guidelines at the end of this document.

MS_Identifying symmetry and lines of symmetry

Symmetric figures

A figure is said to be symmetrical if we can fold or divide it into half, such that the two halves match each other exactly.



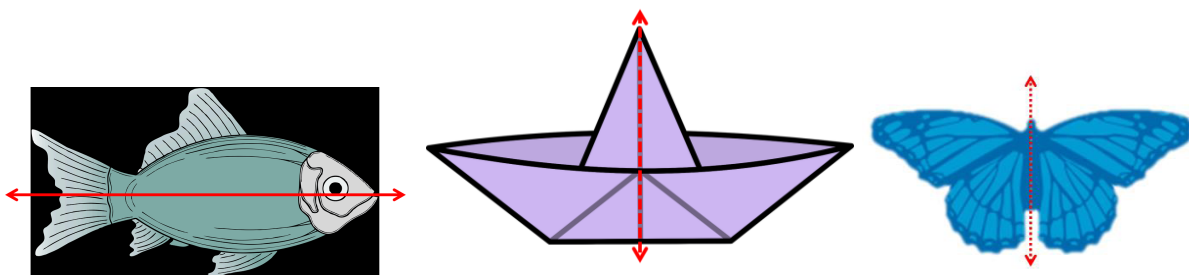
The dotted line in each of the symmetric figures which divides the figure into two equal halves is called the line of symmetry.

The above figures are said to have line symmetry.

Lines of symmetry

A line of symmetry divides a symmetrical shape into half. An object or figure may have one, two or more number of lines of symmetry.

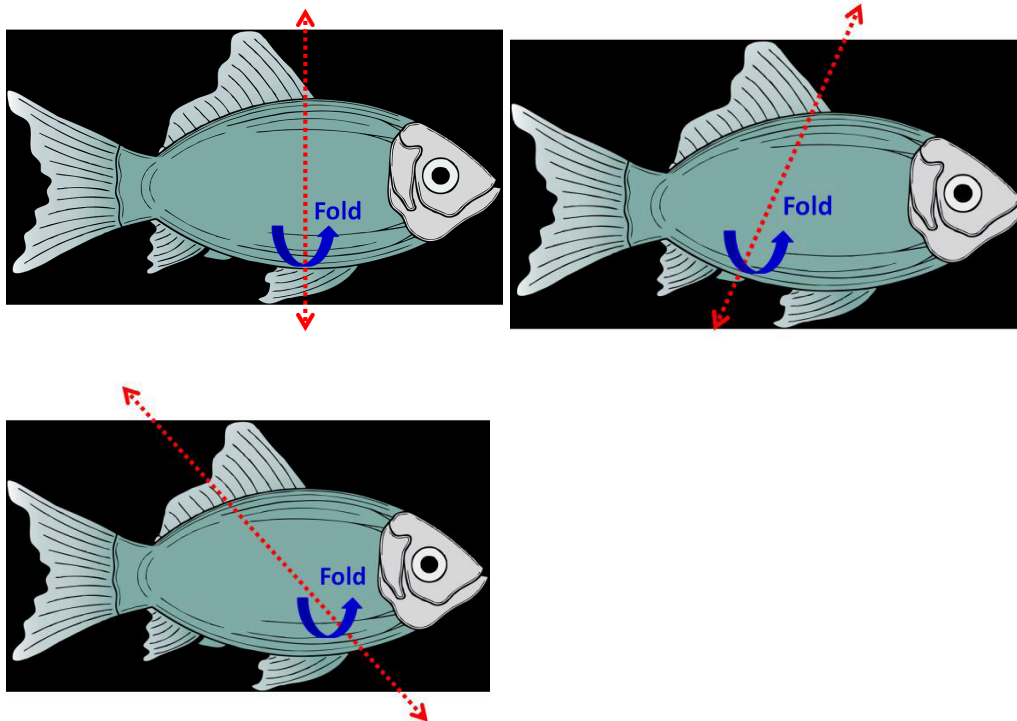
Shapes possessing one line of symmetry





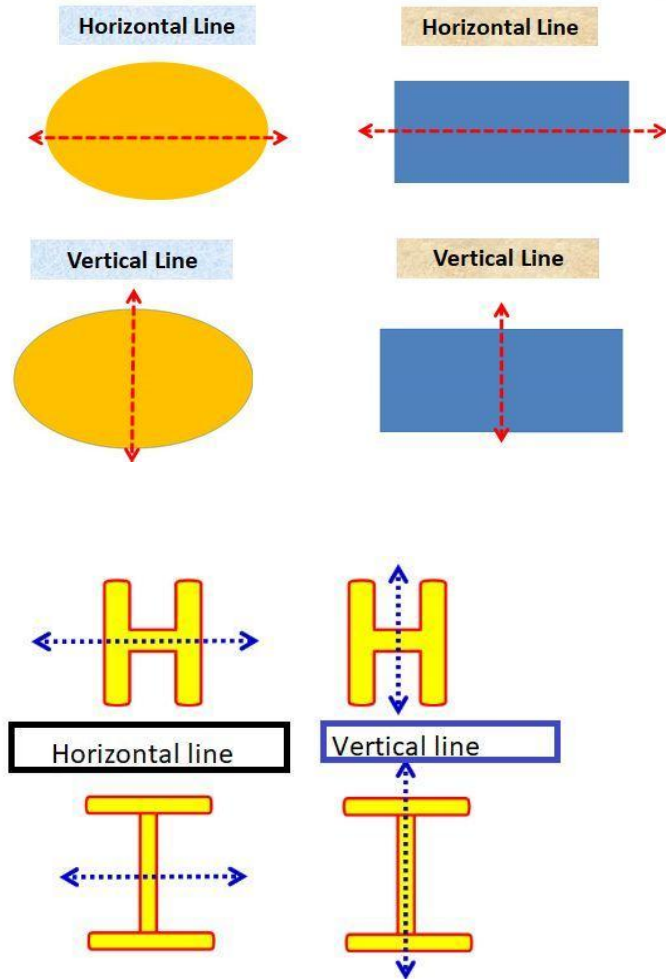
The above shapes can be folded along the dotted line such that the two halves are exactly the same.

If we try to fold the above shapes along any other dotted line we observe that the two halves on folding will not match each other.



Hence, all the above shapes possess only one line of symmetry.

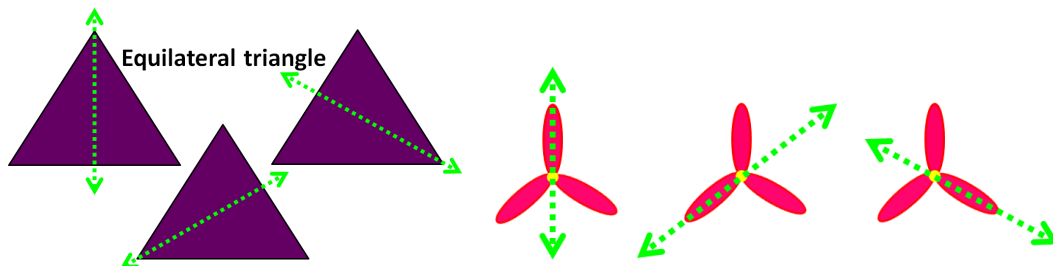
[Shapes possessing two lines of symmetry](#)



We observe that each of the above shapes can be folded along the vertical line and horizontal line such that the two halves are identical. Hence, the vertical and horizontal lines are lines of symmetry for each of the above figures.

Hence all the above shapes/figures have 2 lines of symmetry.

Shapes possessing three lines of symmetry

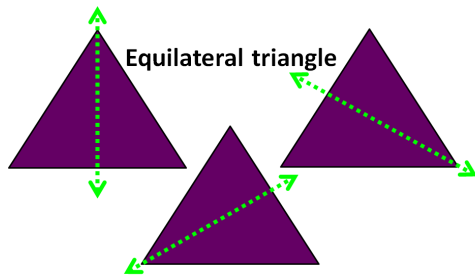


If we fold the above shapes along the lines in the three images , the resulting halves are exactly identical. Hence these lines are lines of symmetry.

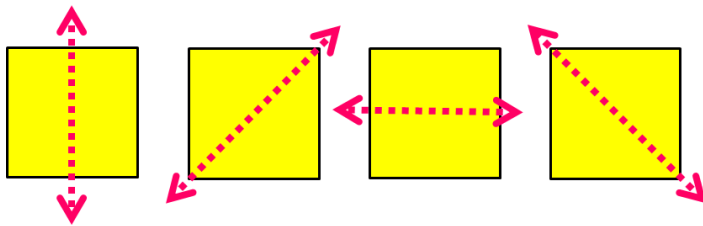
Symmetry in regular polygons

Equilateral Triangle

We have seen that an equilateral triangle has 3 lines of symmetry.

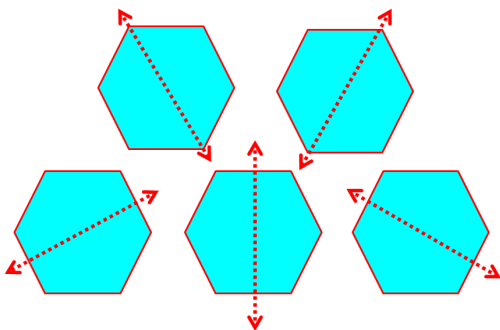


Square



We see that a square has four lines of symmetry.

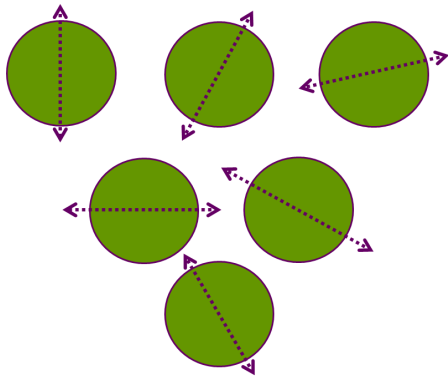
Regular Pentagon



We see that the pentagon(five sided regular polygon) has five lines of symmetry.

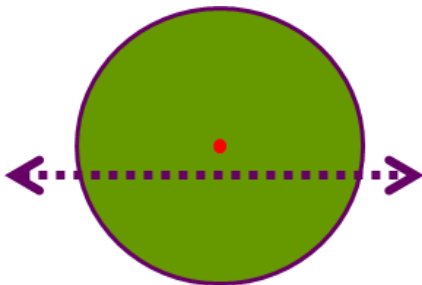
We find that a regular polygon of 'n' sides will possess 'n' lines of symmetry.

Lines of symmetry in a circle

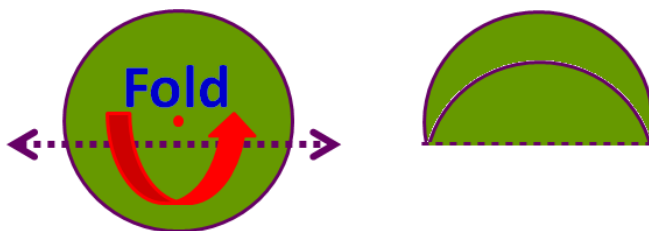


We observe that any line drawn through the center of the circle is a line of symmetry. We can draw any number of lines passing through the center of the circle. Hence, a circle is said to possess infinite (countless) number of lines of symmetry.

Consider the circle given below:



We observe that the line in above image is not a line of symmetry of the circle because folding the circle once along the dotted line does not result in identical overlapping halves as shown below:



Hence we say that the circle is not symmetrical about the given line or the line is not a line of symmetry of the circle.

Asymmetric figures

If a figure cannot be folded into two identical halves, then such a figure is called asymmetrical figure. Such figures have no lines of symmetry.

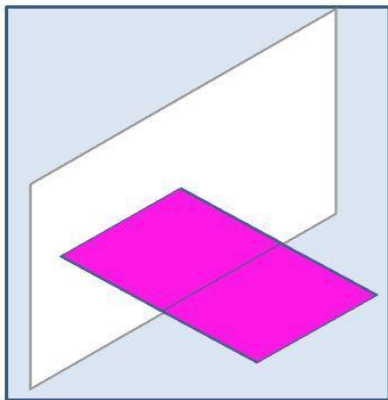
Consider the figures given below:



In whichever direction we try to fold these images, we will not get identical halves. Hence these do not possess any line of symmetry. They are called asymmetrical figures.

MIRROR SYMMETRY

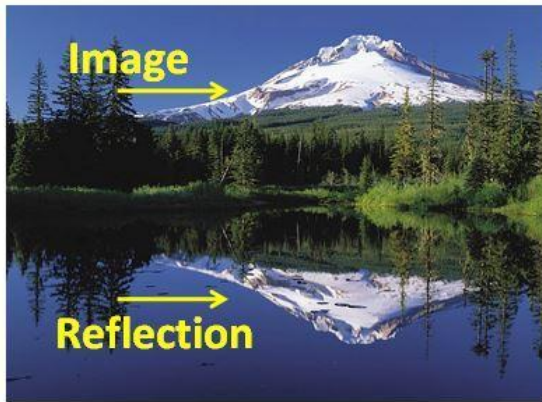
Observe the image given below:



From the image we find that, if a mirror is placed along the line, then we obtain an identical half on the other side of the line.

Hence, line symmetry is also called as mirror symmetry.

The two halves right and left to the mirror line (obtained by reflection) are identical to each other. Hence line symmetry is also called reflection symmetry.



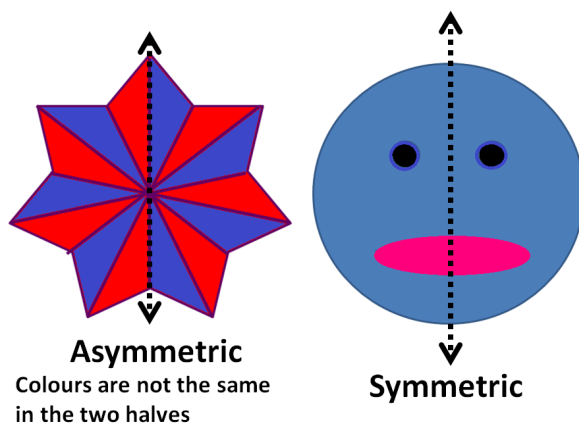
In the picture, the image of the mountain is reflected on the surface of water. We consider the waterline as line of symmetry as the two halves above and below the waterline (obtained by reflection) are identical to each other. The same applies to the image of the swan. Hence, line symmetry is also called reflection symmetry.

So, line symmetry / mirror symmetry / reflection symmetry all mean the same.

In all the above images , if a mirror is placed along the dotted line , we will have two identical halves one is the half of the figure and another is the image in the mirror .

Thus, we observe that:

A symmetrical shape has two halves which look like mirror images of each other.
An asymmetrical shape has two halves which do not make a mirror image.



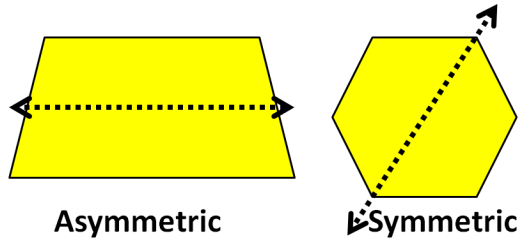


Image Source:

Fish: <http://www.freestockphotos.biz/stockphoto/10702>

Boat - <https://pixabay.com/vectors/paper-boat-toy-folded-crafts-34131/>

Butter Fly -

https://en.wikipedia.org/wiki/Symmetry_%28geometry%29#/media/File:Simetria-bilateria.svg

Alphabets – Original contribution by saimiteshrinki@gmail.com

Triangle- https://en.wikipedia.org/wiki/File:Green_equilateral_triangle_point_up.svg

Shape – Original Contribution by saimiteshrinki@gmail.com

House : <http://www.freestockphotos.biz/stockphoto/14938>

Tree : <https://pixabay.com/en/tree-forest-trunk-nature-leaves-576847/>

Mountain mirror image -

https://commons.wikimedia.org/wiki/File:Mount_Hood_reflected_in_Mirror_Lake,_Oregon.jpg

Bird mirror image - <https://pixabay.com/photos/swan-bird-nature-water-bird-293157/>

All others are Original contribution by saimiteshrinki@gmail.com

Time to teach	Asset type	Theme	Sub Theme
10 minutes	Main Script	Symmetry	Lines of symmetry for regular polygon

DD_Practical uses of Symmetry in our daily life

The uniforms that you wear are symmetrical. Would you like to wear a shirt with one sleeve half and the other to be sleeveless?



No, isn't it?

Now try designing your own dress with symmetry.

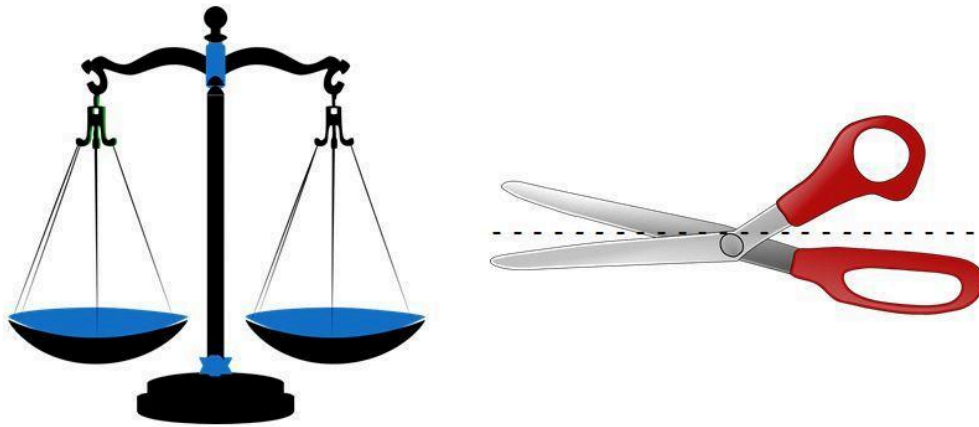
Observe the T-shirt and some casual dresses that you wear. Most of them would contain symmetrical designs in it. Asymmetrical design creates a sort of incomplete feeling in our brain even though it might aid our fashion needs.

Vegetables and flowers follow symmetry as well.



The simple gadgets that we use for our day to activities are symmetrical.

The tools that are symmetrical are handier to use. Any vendor will give the things that we want to buy, only when the pans of the balance is the same! Check out next time when you go for a shopping in the market!



Ceilings and walls of temples have symmetrical designs to create harmony and balance.



The bedsheets, pillow covers and carpets that we use all have symmetrical designs in it.

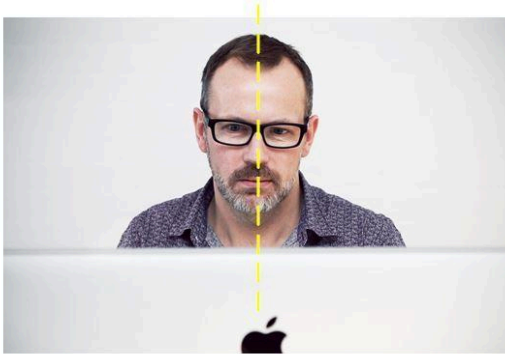


Asymmetrical designs create a sort of visual disturbance. Designers prefer symmetrical design as it gives a pleasing effect to human brain.



Symmetry creates a sense of completeness in the things that we see. Moreover symmetrical design in jewellery-making reduces the cost and amount of time taken to complete it.

Photographers try to bring more of symmetry in the picture that they capture because, symmetry makes the photograph visually more appealing. Asymmetrical photographs give a sort of weird look.



The human face and body is considered to be symmetrical in nature. The more the symmetry is there in the human body the more the person looks beautiful and attractive. That's why sometimes when we try taking selfies, our face looks weird because it is not symmetrical.

boy's shirt - <https://pixabay.com/en/polo-shirt-t-shirt-shirt-clothing-48105/>

girl's shirt - <https://pixabay.com/en/blouse-pink-clothing-female-shirt-154159/>

girl's pants - <https://pixabay.com/en/pants-maroon-cloth-2414348/>

boy's pants - <https://pixabay.com/en/pants-blue-cloth-2414349/>

Pumpkin - <https://pixabay.com/en/pumpkin-white-back-ground-squash-963043/>

Flower - <https://pixabay.com/en/floral-daisy-blossom-plant-natural-50157/>

Onion - <https://pixabay.com/photos/spices-onion-purple-food-cut-3005240/>

Weighing Scale: <https://pixabay.com/en/scales-balance-measure-weigh-blue-309810/>

Scissors: <https://pixabay.com/en/scissors-office-open-scissor-tool-28697/>

Wall: SSSVV Gallery-Keywrd-temple wall

Ceiling: SSSVV Gallery-Keyword-roof

pillow - <https://pixabay.com/en/pillow-sofa-cozy-furniture-2092155/>

bedding - <https://pixabay.com/en/bed-bedroom-pillows-design-modern-1834916/>

necklace - <https://pixabay.com/en/necklace-pearl-jewelry-luxury-gift-2125146/>

Facial Symmetry:CC: <https://pixabay.com/en/man-male-adult-person-caucasian-1209494/>

Time to teach	Asset type	Theme	Sub Theme
5 minutes	Day-to-day Relevance	Symmetry	Application of reflectional symmetry

SA_Activity To Learn Lines Of Symmetry

Aim: To find lines of symmetry of the given shapes

Materials required: Paper, pencil, scale, scissors

Setting of Activity: Indoor

Type of activity: Individual activity

Instructions to teacher

Teacher should inform the students prior to the day of the experiment regarding materials to be brought on the day of the activity..Teacher should ask each student to bring their own material. Teacher asks questions to recall line of symmetry before the start of the activity.

Questions to recall

1. What is a line of symmetry?

Expected Answer: The axis or **line of symmetry** is an imaginary line that runs through the center of a shape creating two perfectly identical halves.

2. How many lines of symmetry are there in a regular polygon?

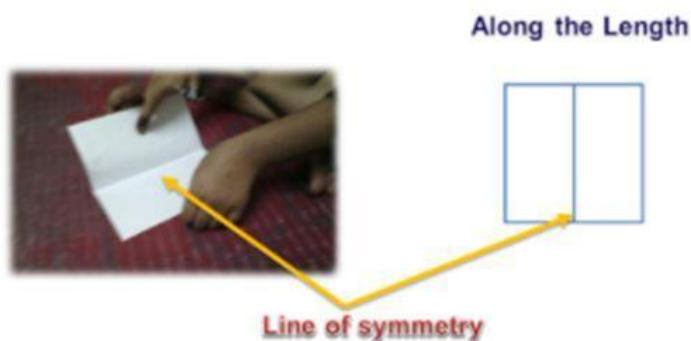
Expected answer: A regular polygon has as many lines of symmetry as it has sides. They may have several lines of symmetry.

Procedure:

Step 1: Cut the sheets by drawing the shapes of equilateral triangle, square, regular pentagon, and regular hexagon.

Step 2: Starting with a triangle. By folding the paper find out the number of lines of symmetry in each figure.

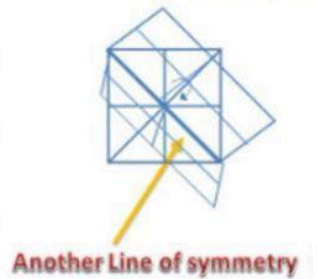
The lines of symmetry for a square are obtained as follows:



Along the Breadth



Along the Diagonal

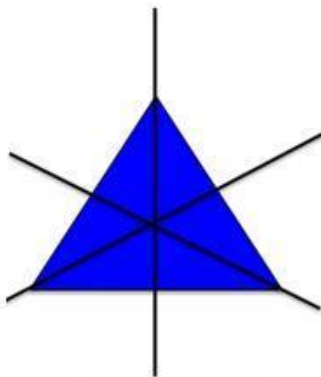


Step 3: Draw a dotted line over lines of fold

Step 4: These dotted lines indicate lines of symmetry

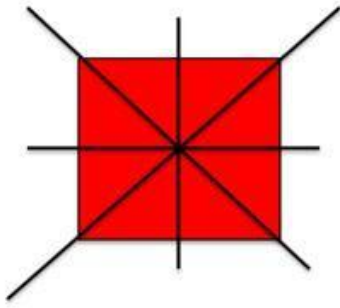
Observation:

1. An equilateral triangle has 3 lines of symmetry



Equilateral Triangle
3 lines of symmetry

2. A square has 4 lines of symmetry



Square - 4 lines of symmetry

3. A regular pentagon has 5 lines of symmetry



Pentagon – 5 lines of symmetry

4. A regular hexagon has 6 lines of symmetry.



Hexagon - 6 lines of symmetry

Conclusion: A regular polygon has as many lines of symmetry as it has sides.

Image Source: All others are original contribution using autosshapes in MS Powerpoint.

rajeswariraju.tr@gmail.com

Folding image : Original Contribution by vishmom@gmail.com

Time to teach	Asset type	Theme	Sub Theme
20 minutes	Suggested Activity	Symmetry	Line symmetry

IA_Fractals

1. A fractal is a pattern, based on a mathematical function that is repeatable, self-similar, and that cannot be scaled. Different functions have different patterns.
2. The structure can be split into parts, each one is a miniature of the whole, having self-similarity.

Image of Koch flake

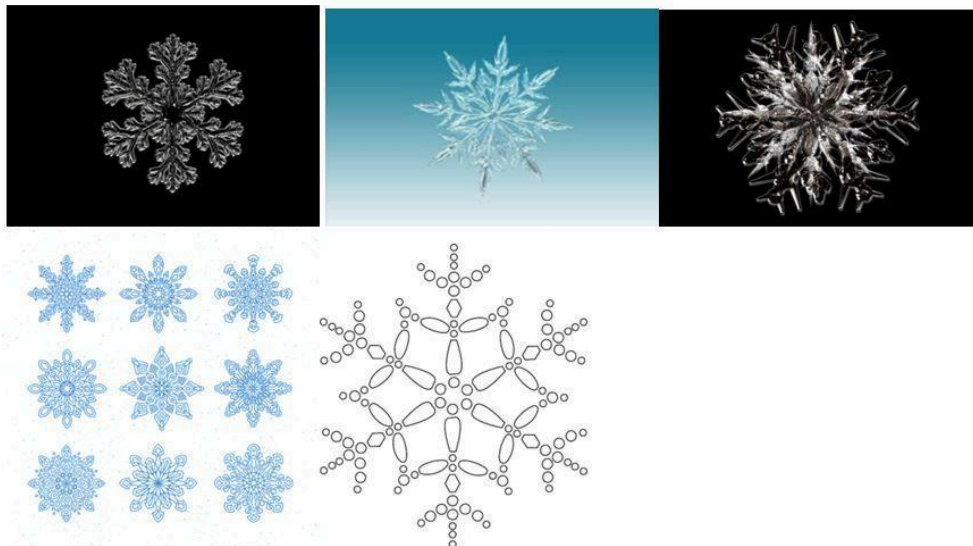


Every Koch snowflake is a fractal curve also known as Koch curve, Koch star. It can be built up in a sequence of stages as an equilateral triangle and each stage makes outward bends to form smaller triangles. It has an infinite perimeter.



Here, each Koch curve starts as a triangle, which gets built up into triangles of equal sizes outward, thus forming a beautiful pattern of Snowflake

Here are some images of snowflakes.



Here is a video on fractal zoom which gives a clear idea of fractals.

http://youtu.be/G_GBwuYuOOs

Image Source:

<https://pixabay.com/illustrations/snowflakes-vector-new-year-s-eve-1523381/>

<https://pixabay.com/vectors/star-snow-snowflake-season-winter-145393/>

<https://pixabay.com/illustrations/ice-crystal-ice-form-frost-fabric-528534/>

<https://pixabay.com/illustrations/snowflake-ice-crystal-snow-ice-5544636/>

<https://pixabay.com/illustrations/snowflake-ice-crystal-winter-snow-1065155/>

<https://pixabay.com/vectors/koch-snowflake-maths-design-3271115/>

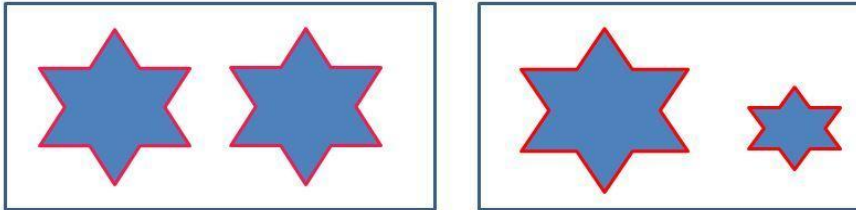
GIF image: https://en.wikipedia.org/wiki/Fractal#/media/File:Von_Koch_curve.gif

Attribution : [António Miguel de Campos](#)

Time to teach	Asset type	Theme	Sub Theme
5 minutes	Interesting Asides	Symmetry	Symmetry in nature

MS_Introduction to Congruence

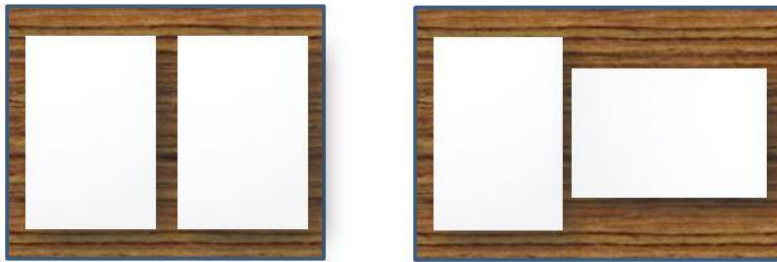
Consider the two pictures shown below.



Observe the difference between the two pictures. In first picture both stars are same shape and size. In the second picture both stars are of same shape but different size.

DEFINITION

Any two shapes are said to be congruent if they have exactly the same shape and size.



Any two A4 sized plain paper are congruent. Even when they are rotated (any orientation), they are congruent to each other.

Identifying congruent shapes-Method of Superposition

When two shapes are superimposed (laid over) on each other and they fit perfectly into each other, then the shapes are said to be congruent. This method is called method of superposition and is used to check if any two figures are congruent.



The two A4 size sheets when placed over each other are a perfect fit. Hence the two sheets are congruent.

Congruence of objects

Any two objects having exactly same size and shape are said to be congruent.



Two jars are congruent.

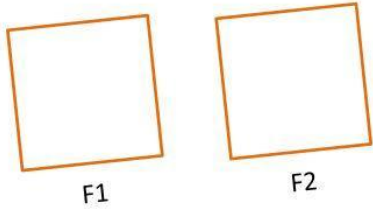
Any two objects having same shape but different size are said to be similar.



Two jars are similar.

Symbol for congruence

Consider the figures F_1 and F_2 shown below



The two figures are congruent. The symbol for congruence is



Here, F_1  F_2

Image Source:

Background board for A4 paper :

<https://pixabay.com/photos/business-branding-blank-paper-792113>

Jars: <https://pixabay.com/illustrations/jar-candles-candle-mason-jar-4004158/>

All other images are Original Contribution by sailakshmi1973@gmail.com

Time to teach	Asset type	Theme	Sub Theme
5 minutes	Main Script	Triangle	Congruent triangles

SA_Activity on Congruent Shapes

Aim - To identify congruent shapes.

Material required - pen, pencil, eraser, ruler(one per team)

Setting of activity - Indoor

Type of activity - Group Activity

Questions to recall - Teacher starts the activity by recalling congruent shapes.

Q1) What are congruent shapes?

Expected answer - Any two shapes are said to be congruent if they have the same shape and same size.

Q2) Are the ear rings worn by your classmate congruent?

Expected Answer - Yes, any pair of ear rings will be congruent.

Q3) Are the two shoes/slippers worn by each of you congruent?

Expected answer - No, each of the shoes/slippers is of same size having a different shape.

Procedure-

1. Teacher divides the class into 4 groups.

2. Each group is allotted 5 mins to list any number of congruent shapes /objects inside the classroom.(Examples- two blades of a fan,two desks,two tubelights,two rulers...etc)

3. Each group writes the answers on a paper.

4. Teacher reads out the answers (also corrects it if necessary).

5. The group that lists the maximum number of congruent objects inside the classroom is declared as winner.

Observation

The following congruent shapes were observed:

1) Two full chalks(same colour)

2).....

3).....

4).....

Conclusion

Congruent shapes were identified.

Possible congruent shapes listed could be

Two bangles worn by one girl in the class.



Two coins of same denomination.



Two tiffin boxes of same size and shape.



Two pens of same make.



Two chairs in the class.



Two tiles on the floor(if the floor is tiled)

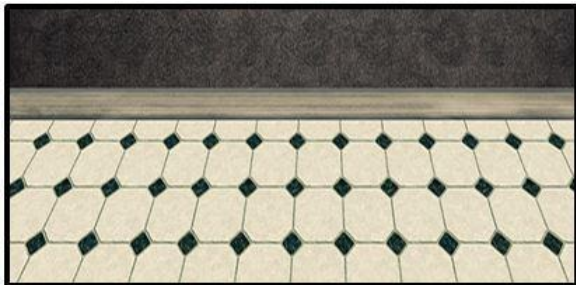


Image Source:

Bangles- <https://pixabay.com/photos/background-blackboard-blue-board-1869471/>

Indian coins- <https://pixabay.com/photos/rupee-indian-india-money-bank-note-4395557/>

Chairs - <https://pixabay.com/photos/wall-wooden-wall-red-boards-chairs-4467345/>

Tiffin Boxes - <https://pixabay.com/photos/pinto-put-the-food-container-3628571>

Pens - <https://pixabay.com/photos/pens-stationery-office-set-blue-1736044/>

Tiles - <https://pixabay.com/illustrations/room-empty-interior-ground-tiles-2103285/>

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Suggested Activity	Triangle	Congruent triangles

QA_Investigate congruent figures

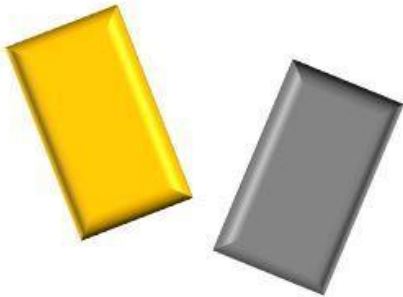
Investigate congruent figures

1) State true or false

- 1.All right angles are congruent.
- 2.If two figures are congruent they have the same area.
- 3.Triangles with the same perimeter are congruent.
- 4.Any two quadrilaterals are congruent.
- 5.A 10-rupee note and a 100 rupee note are congruent.



6.If rectangles are congruent then their area & perimeter are equal.



7.Two acute angles are always congruent.



8.All coins are congruent.



Solve

1. Two rectangles ABCD and PQRS are congruent. If the length of the rectangle ABCD is 12 m and its perimeter is 40m, find the length and breadth of rectangle PQRS.
2. Circle C1 is congruent to circle C2. If the radius of C1 is 5 cm, find the diameter of C2.

Answers

- 1.True
- 2.True
- 3.False
- 4.False
- 5.False
- 6.True
- 7.False
- 8.False

Solve

1. For rectangle ABCD,
perimeter=2(l+b)
 $40=2(12+b)$
 $b= 8 \text{ m}$

As rectangle ABCD is congruent to rectangle PQRS so breadth of PQRS is 8m and length is 12m.

2. As circle C1 is congruent to C2 so radius is same for both circles. So
diameter of C2= 2(radius of C1)=2(5)=10cm

Image Source:

- 1.Rs. 10 note:

https://commons.wikimedia.org/wiki/File:India_new_10_INR,_MG_series,_2018,_obverse.jpg

- 2.Rs. 100 note: https://commons.wikimedia.org/wiki/File:Rs_100_note_front_view.jpg

- 3.Coins - <https://pixabay.com/photos/rupees-money-coins-currency-390472/>

Time to teach	Asset type	Theme	Sub Theme
10 minutes	Questions to Assess	Triangle	Congruent triangles

DD_Congruency in the world around us

Congruent shapes are often seen in the world around us. It is indeed fascinating to find the reason behind this. Here are few examples.

1) Grill Gate at the entrance of the house

Observe that the grill gates are made up of congruent iron bars. The congruency enhances the beauty of the entrance gate.

2) Steps of a ladder



The steps of a ladder are made congruent to each other. This ensures that we do not slip while climbing.

3) Wheels of a bicycle



Both wheels of the bicycle are congruent to each other. This ensures that the bicycle is perfectly horizontal to the road and the bicycle moves with ease.

4) Overhead Bridges



Often bridges are made of triangular structures. These triangular structures are congruent to each other. This enhances the structural strength of the bridge.

5)Blades of a fan



Observe that the blades of a fan are congruent in shape. This enhances the beauty and also the congruent blades ensure better air circulation.

Thus, we observe that congruent shapes add great value to our daily life.

Image Source:

Ladder : <https://pixabay.com/vectors/aluminium-ladder-metal-tool-work-1295387/>

Bicycle : <https://pixabay.com/illustrations/black-shape-transport-bicycle-bike-163595/>

Bridge : <https://pixabay.com/photos/golden-gate-bridge-san-francisco-388917/>

Fan : <https://pixabay.com/photos/ceiling-fan-fan-whirling-ceiling-1016677/>

Time to teach	Asset type	Theme	Sub Theme
4 minutes	Day-to-day Relevance	Triangle	Congruent triangles

IA_Congruency in Egyptian Pyramids



Look at the figure of the three famous ancient Pyramids of Giza in Egypt. These Pyramids housing the ancient royal tombs are perfect examples of congruent triangles. Each of the faces of these Pyramids are equilateral triangles of same size and are congruent to each other. The largest Pyramid is known as Pyramid of Khufu or Pyramid of Cheops. The biggest among the three is the oldest of the seven wonders of ancient world and the only one still remaining intact to a great extent. It is about 147 m in height and has a square base with each side of the base being about 230 m length. The base is so perfect that the error is within 58 mm in length between side to side.

Why Pyramids were built?

It was believed by ancient Egyptians that when their king(also called pharaoh) died,a part of his spirit still remained in the body.In order to take care of the spirit ,the dead body was mummified(preserved by embalming and wrapping in cloth).Everything the king would need in the afterlife was kept in the tomb along with his mummified body.They kept gold vessels,furniture,food etc inside the pyramid.

Thus the story about the Pyramids as well as its unique structure continue to fascinate all.

Image Source:

<https://pixabay.com/photos/pyramids-egypt-egyptian-ancient-2371501/>

Time to teach	Asset type	Theme	Sub Theme
4 minutes	Interesting Asides	Triangle	Congruent triangles

IQ_Congruence of Triangles - Think and Answer

Consider the above figure and answer the following questions:

- Can we say ADE and AFE are congruent triangle? If yes, did you conclude by superimposing the triangles?
- Which sides of AED match with AF, EF and AE of AEF? Which angles correspond to each other in these triangles?
- By applying the logic used in above questions, can we list the other pairs of congruent triangles?
- Should we always superimpose to recognise congruent figures?
- Is it possible to define congruency by identifying corresponding parts of two figures?

Answers:

- ADE and AFE are congruent. We can place one triangle on the other such that they super impose each other.
By just folding along AE we can see that the two triangles are of same shape and size, hence they are congruent.
- Sides $AF = AD$, $EF = ED$ and $AE = AE$. Corresponding angles $\angle AEF = \angle AED$, $\angle AFE = \angle ADE$, $\angle FAE = \angle DAE$.
- AHG and AHI, AKJ and AKL, AMB and AMC
- We can also ascertain congruence by identifying corresponding parts.
- Yes.

Image Source: Vallisairam9@gmail.com

Time to teach	Asset type	Theme	Sub Theme
6 minutes	Inquisitive Questions	Triangle	Congruent triangles

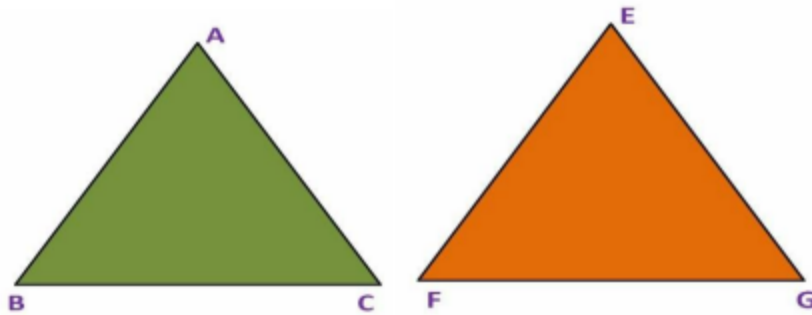
MS_Congruence of Triangles

Congruence Of Triangles

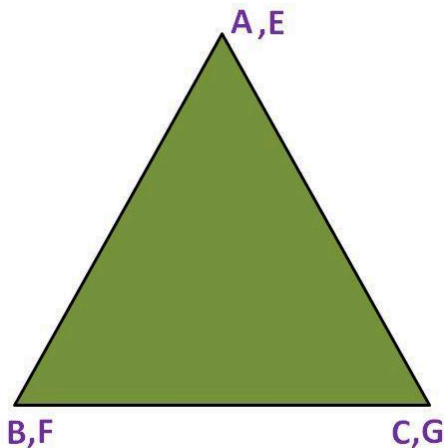
Introduction

Two objects are said to be congruent, if they are exactly of the same shape and size. The word congruence is represented by the symbol " $\cong$ " and read as 'is congruent to'

Consider two triangles $\triangle ABC$ and $\triangle EFG$



Superimpose the triangles



Observe that

- Triangles are exact copies of each other
- Triangles exactly superimpose on each other.

Thus the two triangles $\triangle ABC$ and $\triangle EFG$ are congruent.

we can write it mathematically as

$$\triangle ABC \cong \triangle EFG$$

Corresponding parts of congruent triangles

When any two triangles are congruent the corresponding parts of the triangles are equal.

In the above triangles $\triangle ABC$ and $\triangle EFG$ the corresponding parts are

Corresponding angles

The corresponding angles of both triangles are equal.

$$\angle BAC = \angle FEG \quad \angle ACB = \angle EGF \quad \angle CBA = \angle GFE$$

Corresponding vertices

The corresponding vertices of both the triangles are equal.

$$A=E \ C=G \ B=F$$

Corresponding sides

The corresponding sides of both the triangles are equal.

$$AB=EF \ BC=FG \ AC=EG$$

Corresponding parts of congruent triangles is also written in abbreviation as 'CPCT'

Note that the order of letters representing two congruent triangles must be the same as their corresponding relationship.

The above triangles cannot be written as

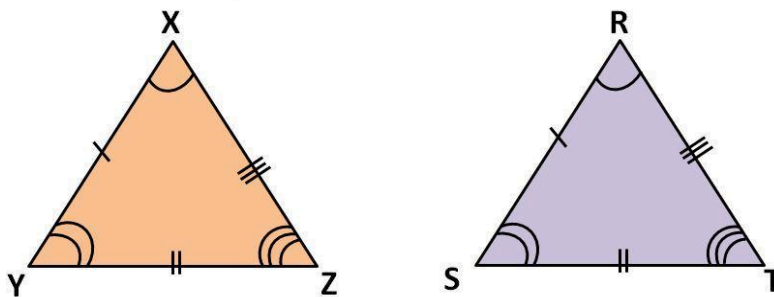
$$\triangle ABC \cong \triangle GFE$$

$$\text{Or } \triangle BAC \cong \triangle FGE$$

$$\text{Or } \triangle CBA \cong \triangle EFG$$

Illustration

Consider two triangles $\triangle XYZ$ and $\triangle RST$



Here, X falls on R, Y falls on S, Z falls on T.

XY falls on RS, YZ falls on ST and ZX falls on TR.

This relationship between the parts of two triangles is known as correspondence and is denoted by the symbol $\longleftrightarrow$

Corresponding triangles are $\triangle XYZ \triangle RST$,

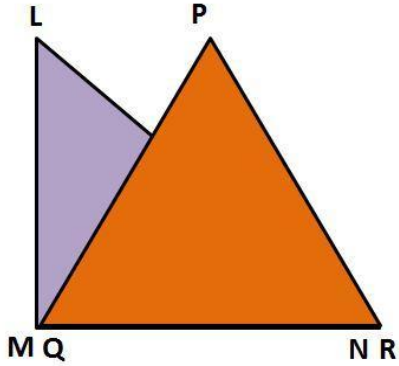
$$\triangle YXZ \triangle SRT,$$

$$\triangle XZY \triangle RTS$$

Hence $\triangle XYZ \cong \triangle RST$

Non -Example

Consider the two triangles shown below



We can see that both the $\triangle LMN$ and $\triangle PQR$ do not superimpose on each other. How much ever we try, we will not be able to establish one to one correspondence between vertices, angles and sides of these two triangles. Hence, they are not congruent.

Hence, the triangles $\triangle LMN$ and $\triangle PQR$ are not congruent .

We can write it mathematically as

$$\triangle LMN \neq \triangle PQR$$

Image Source: OC by chinni.wgl@gmail.com

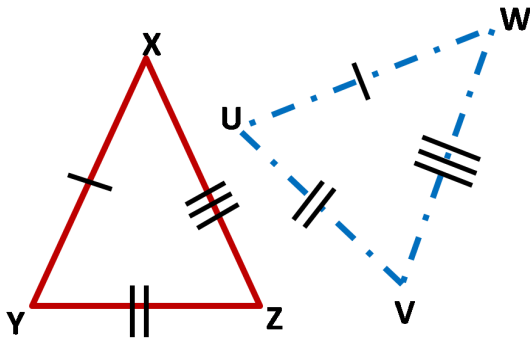
Time to teach	Asset type	Theme	Sub Theme
15 minutes	Main Script	Triangle	Congruent triangles

MS_SSS Congruency Criteria

SSS congruency criteria

Introduction

Consider two triangles $\triangle XYZ$ and $\triangle WUV$ shown below.



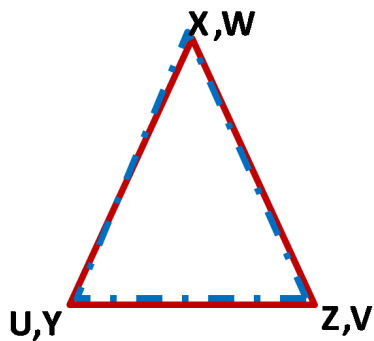
Observe that

$$XY = WU$$

$$YZ = UV$$

$$XZ = VW$$

The two triangles can be superimposed.

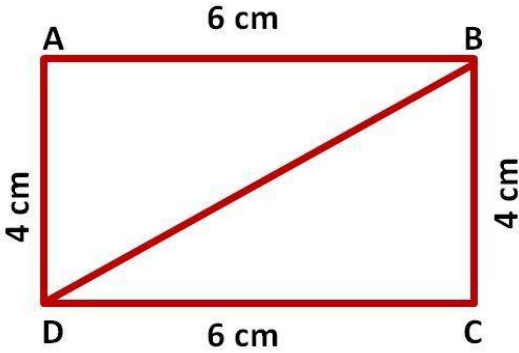


Hence $\triangle XYZ \cong \triangle WUV$

Thus we find that if 3 sides of a triangle are equal to the 3 corresponding sides of another triangle then both the triangles are said to be congruent. This is called SSS rule of congruency. SSS stands for Side-Side-Side.

Example

Consider the following rectangle ABCD.



Prove that $\triangle ABD \cong \triangle CDB$

Solution

Given: $AB=CD=6\text{cm}$ (SIDE)

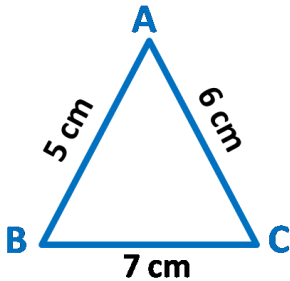
$DA=BC=4\text{cm}$ (SIDE)

$BD=BD$ (common SIDE to both triangles)

Hence by SSS congruency rule, $\triangle ABD \cong \triangle CDB$

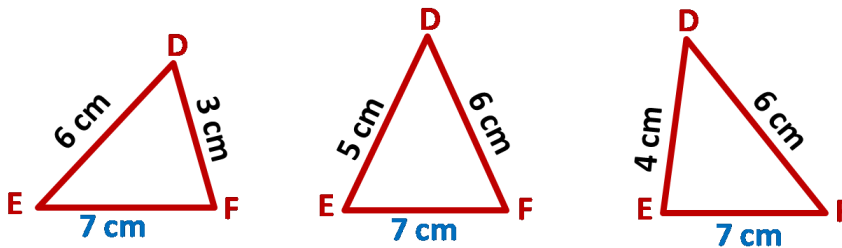
Justification of SSS rule of congruence

Consider $\triangle ABC$ as shown below.



CASE-1

In order to construct a triangle $\triangle DEF$ congruent to $\triangle ABC$, suppose only one side $EF=7\text{cm}$ is known. Many triangles are possible as shown below

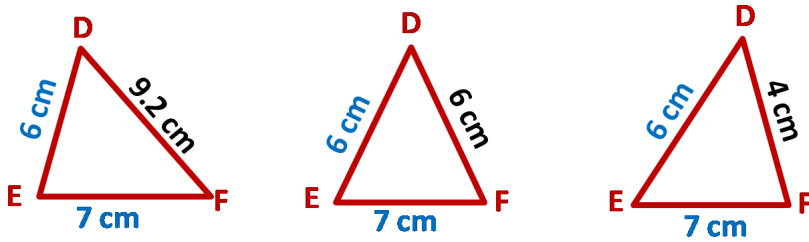


None of the triangles are congruent to $\triangle ABC$. Hence **two triangles will not be congruent if only one side of triangle is equal to the corresponding side of the other triangle.**

CASE-2

Suppose two sides of triangle are known say $EF=7\text{cm}$ and $DE=6\text{cm}$. The following triangles are

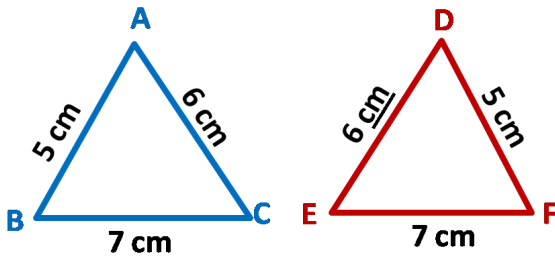
possible



None of the triangles are congruent to $\triangle ABC$. Hence **two triangles will not be congruent if two sides of a triangle are equal to the corresponding two sides of the other triangle.**

CASE-3

Suppose three sides of triangle are known say $EF=7\text{ cm}$, $DE=6\text{ cm}$ and $DF=5\text{ cm}$. The triangle is as shown below



This triangle is congruent to $\triangle ABC$.

Conclusion

When three sides are given, we can construct a unique triangle.

In the triangles,

$$AB=DF$$

$$BC=FE$$

$$AC=DE$$

This justifies SSS rule of congruence.

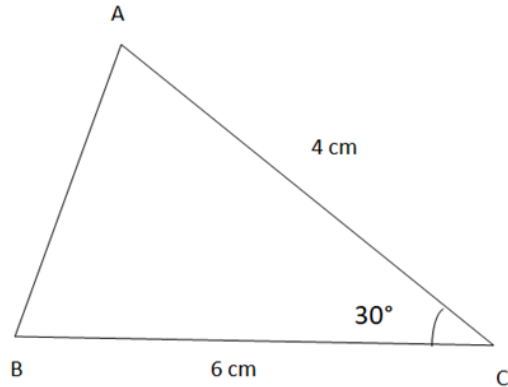
If three sides of a triangle are equal to the three corresponding sides of other triangle, then the two triangles are congruent by SSS congruency rule.

Image Source: All images created by sailakshmi1973@gmail.com

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Main Script	Triangle	Congruent triangles

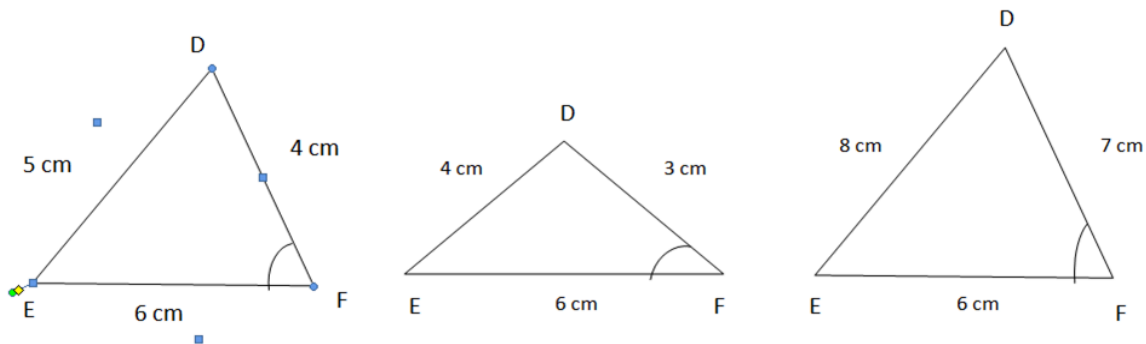
MS_SAS Congruency Criteria

Consider a triangle $\triangle ABC$ as shown below.



CASE - 1

In order to construct a triangle $\triangle DEF$ congruent to $\triangle ABC$, suppose only one side $EF=6\text{ cm}$ is known. Many triangles are possible as shown below:

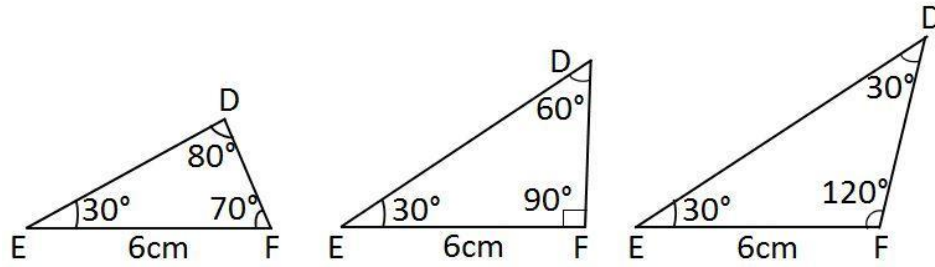


None of the triangles is congruent to $\triangle ABC$.

Hence, it ascertains that **two triangles cannot be congruent if one side of a triangle is equal to the corresponding side of another triangle.**

CASE - 2

Suppose two parameters of triangle $\triangle DEF$ are known say $EF=6\text{ cm}$ and $\angle E=30^\circ$. The following triangles are possible:

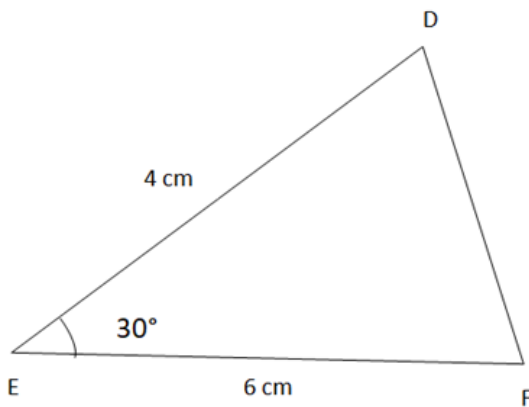


None of the triangles is congruent to $\triangle ABC$.

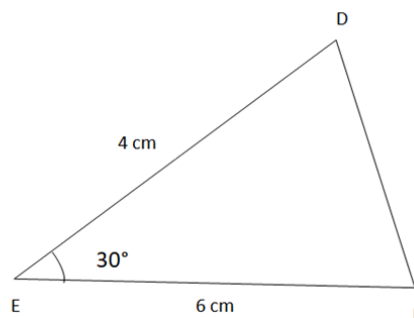
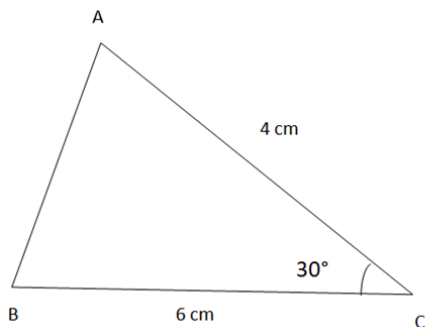
Hence, it ascertains that **two triangles cannot be congruent if one side and one angle of a triangle are equal to the one corresponding side and one corresponding angle of another triangle.**

CASE - 3

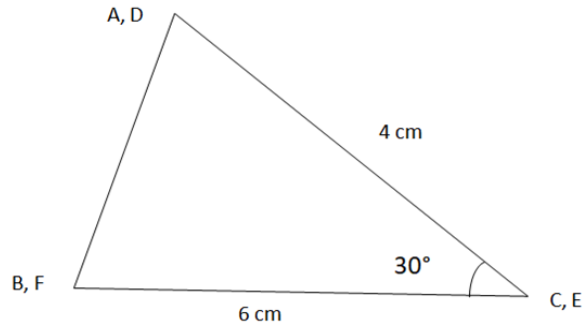
Suppose three parameters of triangle $\triangle DEF$ are known say $EF=6$ cm, $DE=4$ cm and $\angle E=30^\circ$. The triangle is as shown below:



Compare the triangles



The two triangles superimpose



In the triangles, $\triangle ABC$ and $\triangle DEF$

$AC=DE$, $BC=EF$ and $AB = DF$

$\angle C=\angle E$, $\angle A=\angle D$ and $\angle B =\angle F$

All six parts of one triangle match with all six parts of other triangle.

We are able to establish a one to one correspondence between the vertices of $\triangle ABC$ and $\triangle DEF$. Thus we observe that, when two sides and the included angle are given, we can draw a unique triangle.

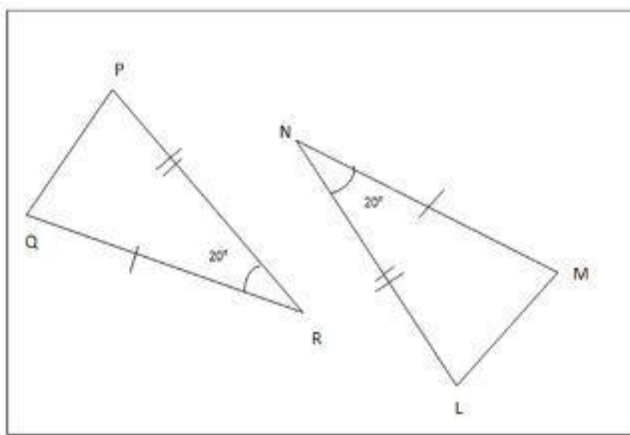
Based on this observation we define SAS congruence criteria.

Statement:

If two sides and one common angles of a triangle are equal to two corresponding sides and one corresponding common angle of another triangle then the two triangles are said to be congruent by SAS congruency criteria.

SAS stands for Side-Angle-Side.

Example 1 :



In the figure,

$QR=MN$ (given) (S)

$\angle R=\angle N=20^\circ$ (A)

$RP=NL$ (given) (S)

Observe that,

- Two sides QR and RP of $\triangle PQR$ are equal to corresponding sides MN and NL of $\triangle LMN$.
- $\angle R$ (common angle between sides QR and RP) of $\triangle PQR$ is equal to corresponding $\angle N$ (common angle between sides MN and NL) of $\triangle LMN$.

So by applying SAS congruency rule we get

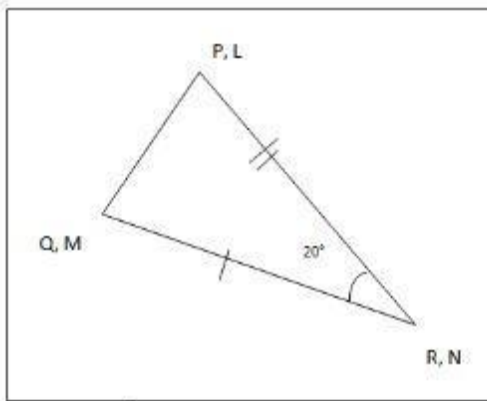
$$\triangle PQR \cong \triangle LMN.$$

Corresponding relationships are

1. L $\longleftrightarrow$ P
2. M $\longleftrightarrow$ Q
3. N $\longleftrightarrow$ R

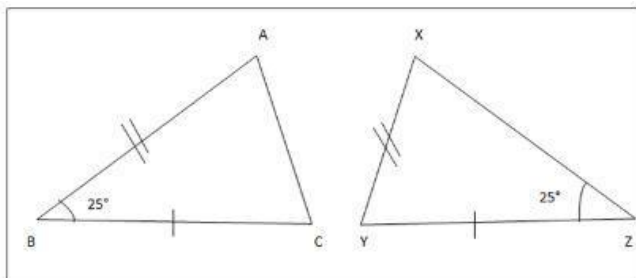
VALIDATION

On superimposing the two triangles their congruence is confirmed



Example 2:

Consider the two triangles



In the figure,

$$AB=XY$$

$$BC=YZ$$

$$\angle B=\angle Z=25^\circ$$

Observe that,

1. The corresponding sides AB and BC of $\triangle ABC$ are equal to the corresponding sides XY and YZ of $\triangle XYZ$.
2. However the common angle between sides AB and BC is $\angle B = 25^\circ$ but the corresponding common angle between sides XY and YZ i.e. $\angle Y$ is unknown.

Hence SAS congruency cannot be applied. $\triangle ABC \not\cong \triangle XYZ$ since we cannot establish a one to one correspondence between the vertices.

Image Source: All images created by vallisairam9@gmail.com

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Main Script	Triangle	Congruent triangles

MS_ASA Congruency Criteria

ASA Congruency Criteria

We know that two triangles become congruent if three sides of one triangle match with three sides of other triangle (SSS rule) or two sides and the common angle of one triangle match with two sides and the corresponding included angle of other triangle (SAS rule). With similar reasoning as in SSS and SAS, we have the ASA congruence criteria.

Statement

If two angles and its included side of a triangle are equal to two corresponding angles and one corresponding included side of another triangle then the two triangles are said to be congruent by ASA congruency criteria.

ASA stands for Angle-Side-Angle

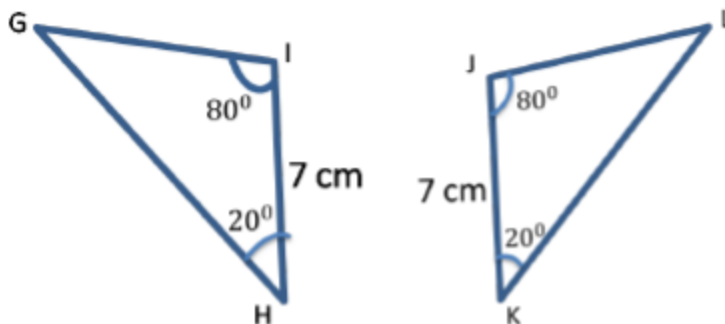
Example

In the figure,

$$\angle H = \angle K = 20^\circ \text{ (A)}$$

$$HI = KJ = 7\text{cm} \text{ (S)}$$

$$\angle I = \angle J = 80^\circ \text{ (A)}$$



Observe that,

- Two angles ($\angle H$ and $\angle I$) of ΔGHI are equal to corresponding two angles ($\angle K$ and $\angle J$) of ΔLKJ .
- Side HI (included side between $\angle H$ and $\angle I$) of ΔGHI is equal to corresponding side KJ (included side between $\angle J$ and $\angle K$) of ΔLKJ .

So by applying ASA congruency rule we get

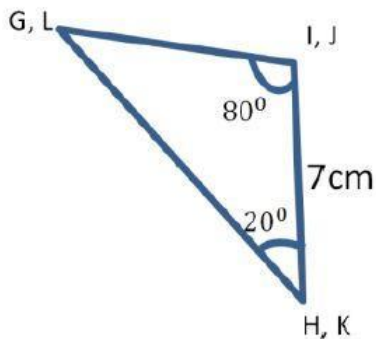
$$\Delta GHI \cong \Delta LKJ.$$

Corresponding relationships are

G $\longleftrightarrow$ L
H $\longleftrightarrow$ K
I $\longleftrightarrow$ J

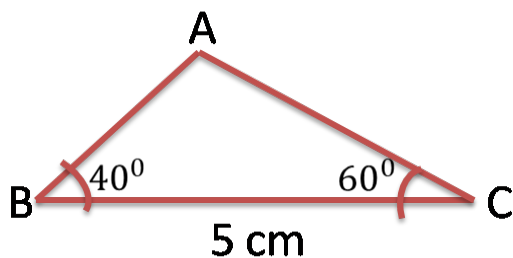
VALIDATION

On superimposing the two triangles their congruence is confirmed.



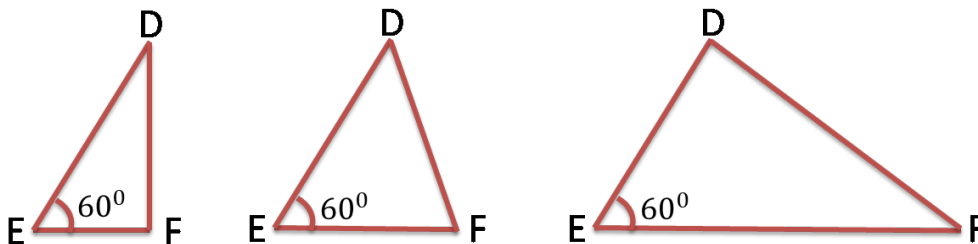
Justification of ASA Congruency rule

Consider a triangle Consider $\triangle ABC$ as shown below.



CASE-1

In order to construct a triangle $\triangle DEF$ congruent to $\triangle ABC$, suppose only one angle say $\angle E = 60^\circ$ is known. Many triangles are possible as shown below:



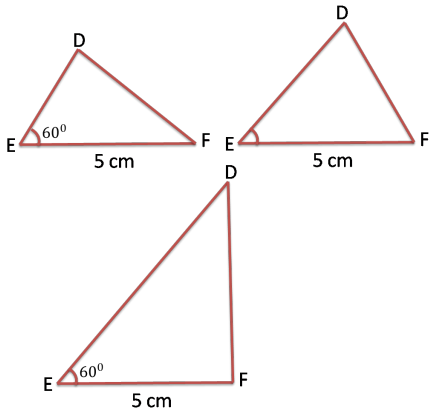
None of the triangles are congruent to $\triangle ABC$.

Hence, it ascertains that **two triangles cannot be congruent if one angle of a triangle is equal**

to the corresponding one angle of another triangle.

CASE-2

Suppose two parameters of triangle $\triangle DEF$ are known say $EF=5$ cm and $\angle E=60^\circ$. The following triangles are possible:



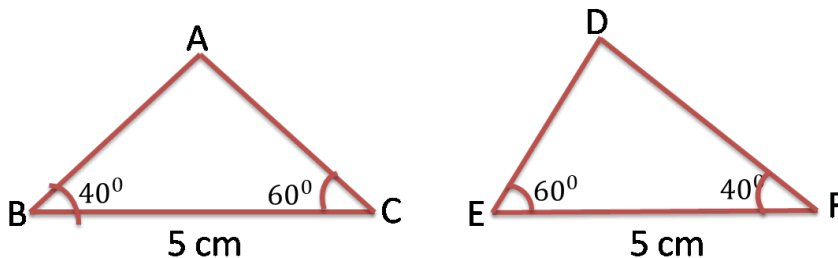
None of the triangles are congruent to $\triangle ABC$.

Hence, it ascertains that **two triangles cannot be congruent if one side and one angle of a triangle are equal to the one corresponding side and one corresponding angle of another triangle.**

CASE-3

Suppose three parameters of triangle $\triangle DEF$ are known say $EF=5$ cm, $\angle F=40^\circ$. and $\angle E=60^\circ$.

Compare the triangles



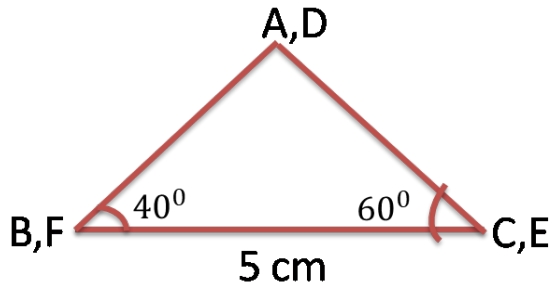
In the triangles, $\triangle ABC$ and $\triangle DEF$

$$\angle B = \angle F = 40^\circ (A)$$

$$BC = EF = 5 \text{ cm} (S)$$

$$\angle C = \angle E = 60^\circ (A)$$

On superimposing the triangles we observe their congruence



Thus we get a unique triangle which matches with given triangle.

$$\triangle ABC \cong \triangle DEF$$

This justifies ASA Congruency criteria.

Image Source: All images by vallisairam9@gmail.com

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Main Script	Triangle	Congruent triangles

MS_RHS Congruency rule

RHS Congruency Criteria

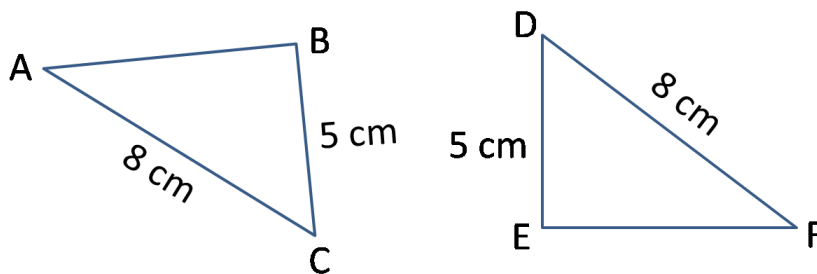
Statement

If the hypotenuse and one side of right angled triangle are equal to the corresponding hypotenuse and one side of another right angled triangle then both the right angled triangles are said to be congruent by RHS congruency criteria.

RHS stands for Right angle-Hypotenuse-Side

Example

Consider two right angled triangles $\triangle ABC$ and $\triangle FED$.



In the figure,

$\angle B = \angle E = 90^\circ$ (R)

$AC = DF = 8$ cm (H)

$BC = DE = 5$ cm (S)

Observe that,

- The hypotenuse AC of $\triangle ABC$ IS equal to corresponding hypotenuse DF of $\triangle FED$.
- Side BC of $\triangle ABC$ is equal to corresponding side DE of $\triangle FED$.

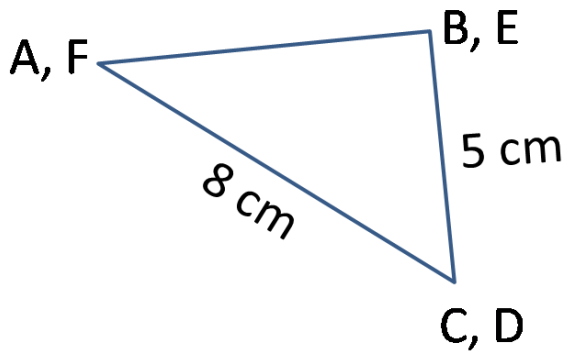
So by applying RHS congruency rule we get

$\triangle ABC \cong \triangle FED$.

Corresponding relationships are

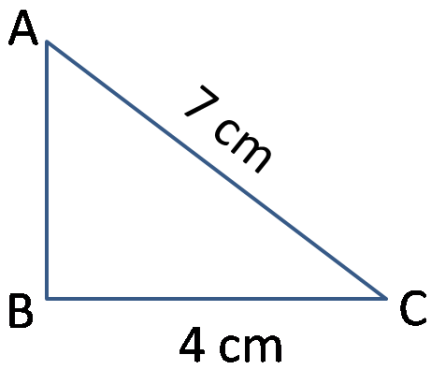
A $\longleftrightarrow$ F
 B $\longleftrightarrow$ E
 C $\longleftrightarrow$ D

On superimposing the two triangles their congruence is confirmed.



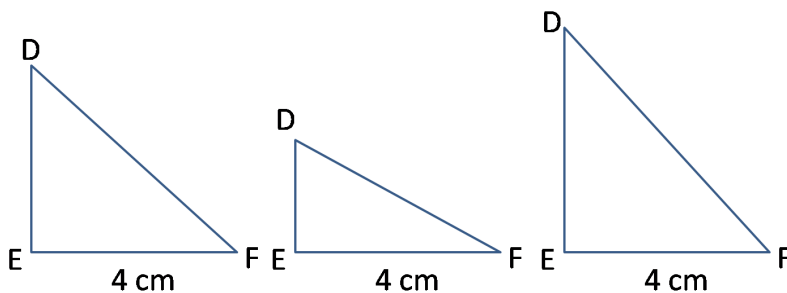
Justification of RHS Congruency rule

Consider a right angled triangle $\triangle ABC$ as shown below.



CASE-1

In order to construct a triangle $\triangle DEF$ congruent to $\triangle ABC$, suppose only one side $EF = 4$ cm is known. Many triangles are possible as shown below:

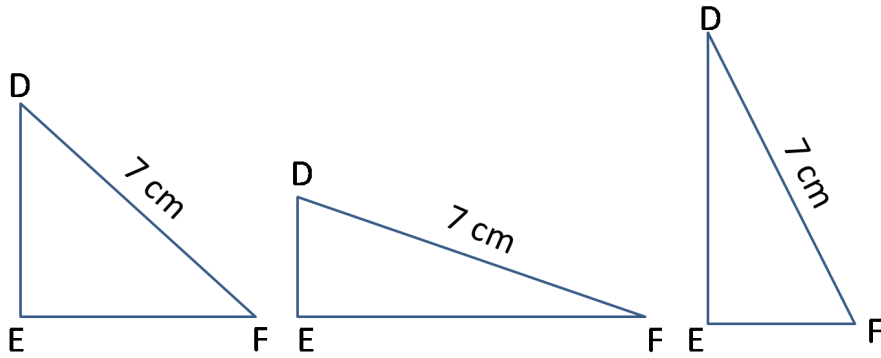


None of the triangles is congruent to $\triangle ABC$.

Hence, it ascertains that **two right angled triangles cannot be congruent if one side of a right angled triangle is equal to the corresponding side of another right angled triangle.**

CASE-2

Suppose only the hypotenuse of the right angled triangle $\triangle DEF$ is known i.e. $DF = 7$ cm. The following triangles could be possibly drawn:

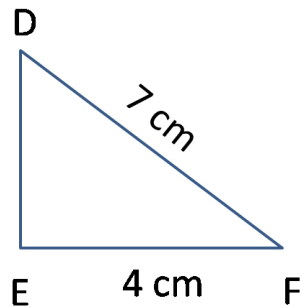


None of the triangles is congruent to $\triangle ABC$.

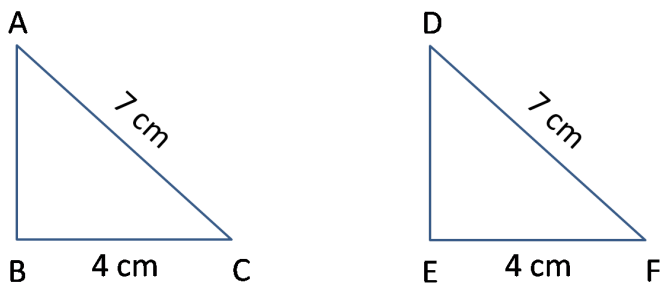
Hence, it ascertains that **two right angled triangles cannot be congruent if the hypotenuse of one right angled triangle is equal to the corresponding hypotenuse of another right angled triangle.**

CASE-3

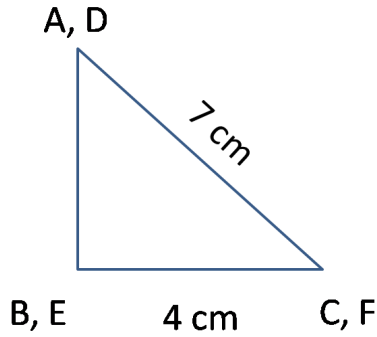
Suppose two parameters of the right angled triangle $\triangle DEF$ are known say hypotenuse $DF=7$ cm and side $EF=4$ cm. The possible triangle could be as shown below:



Compare the triangles



On superimposing the triangles we observe their congruence



In the triangles, $\triangle ABC$ and $\triangle DEF$

$\angle B = \angle E = 90^\circ (R)$

$AC = DF = 7 \text{ cm} (H)$

$BC = EF = 4 \text{ cm} (S)$

Thus, we get a unique triangle which matches with given triangle.

This justifies RHS Congruency criteria.

Image Source: Original Contribution by Sailakshmi Narayanan - sailakshmi1973@gmail.com

Time to teach	Asset type	Theme	Sub Theme
12 minutes	Main Script	Triangle	Congruent triangles

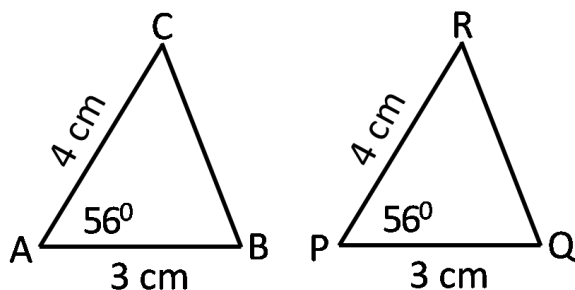
QA_Assessment based on Congruency criteria

Assessment based on Congruency Criteria

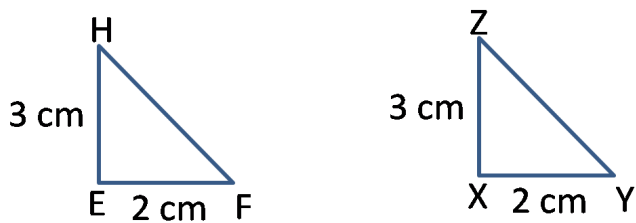
Identify the relationship

Write the congruence relation between the triangles given below and also write the congruence criteria.

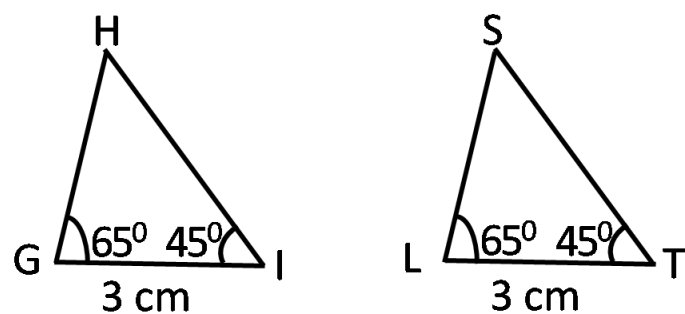
1)



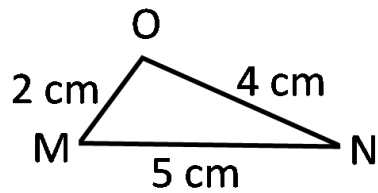
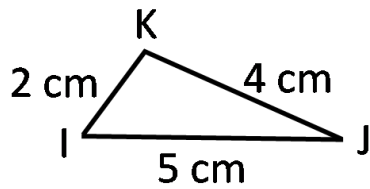
2)



3)

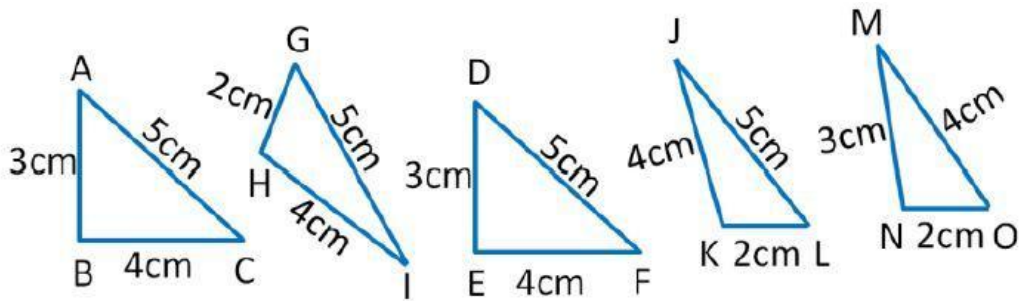


4)

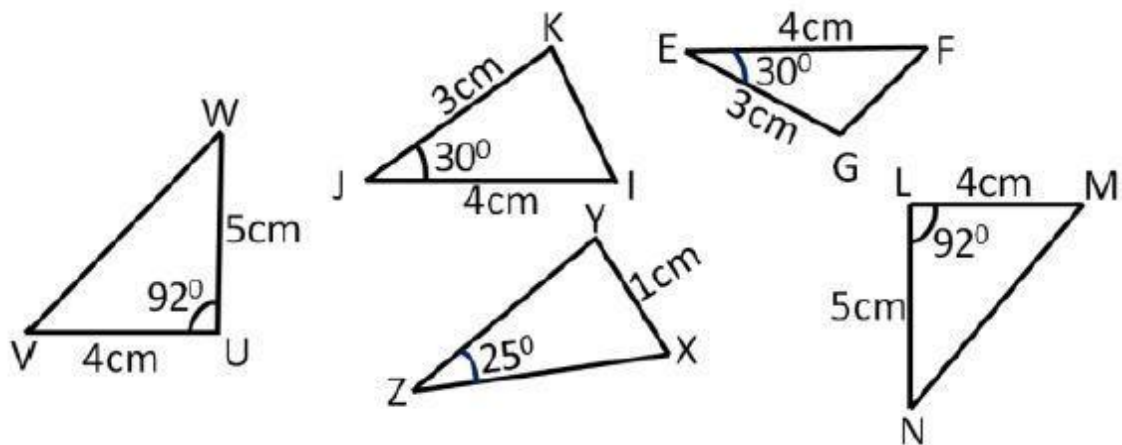


Find the right pair

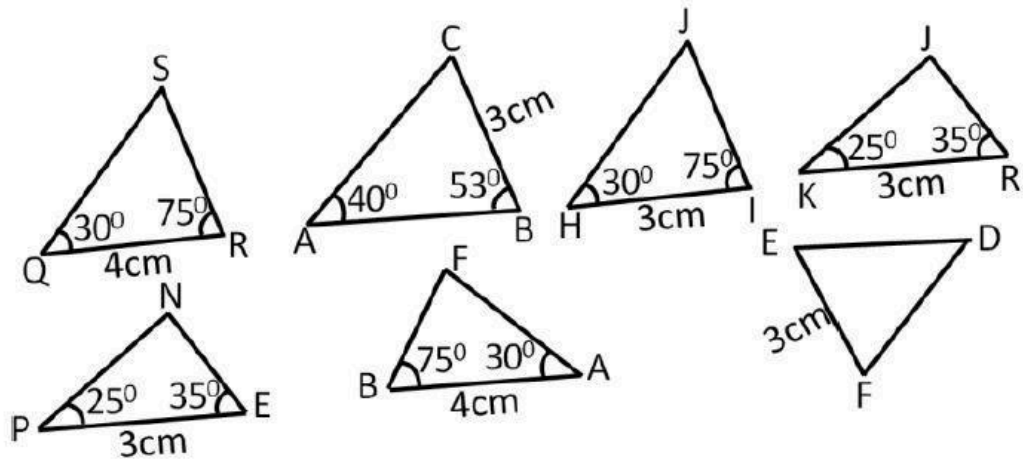
1) Identify the congruent triangles based on SSS criterion.



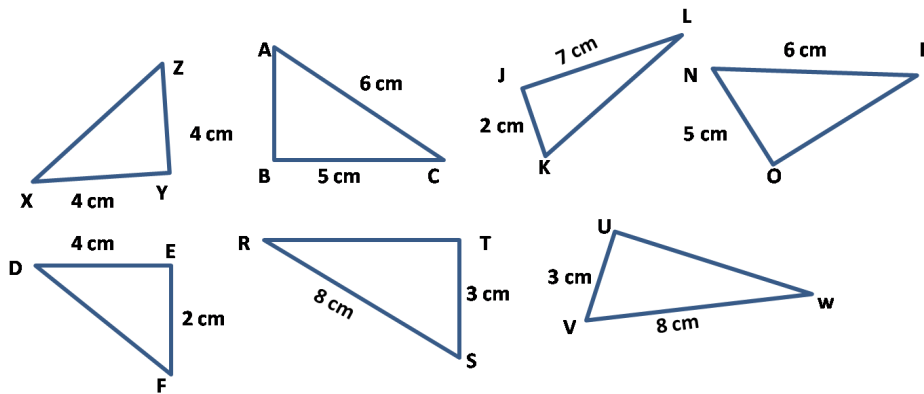
2) Identify the congruent triangles based on SAS criterion.



3) Identify the congruent triangles based on ASA criterion.

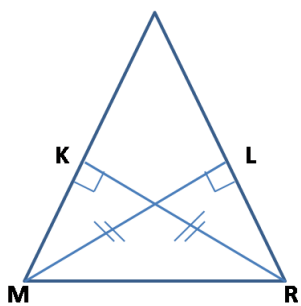


4) Identify the congruent triangles based on RHS criterion.



Prove It

Prove $\triangle MKR \cong \triangle RLM$



Answers

Identify the relationship

1) $\triangle CAB \cong \triangle RPQ$

Criteria: SAS rule

2) $\triangle HEF \cong \triangle ZXY$

Criteria: SAS rule

3) $\triangle HGI \cong \triangle SLT$

Criteria: ASA rule

4) $\triangle KIJ \cong \triangle OMN$

Criteria: SSS rule

Find the right pair

1) $\triangle ABC \cong \triangle DEF$

$\triangle GHI \cong \triangle LKJ$

2) $\triangle TUW \cong \triangle MLN$

$\triangle KOI \cong \triangle GEF$

3) $\triangle QRS \cong \triangle ABF$

$\triangle KRJ \cong \triangle PEN$

4) $\triangle ABC \cong \triangle PON$

$\triangle RTS \cong \triangle WUV$

Prove It

In $\triangle MKR$ and $\triangle RLM$,

$\angle MKR = \angle RLM = 90^\circ (R)$

$MR = MR$ (common hypotenuse) (H)

$KR = LM$ (given) (S)

Hence by RHS rule,

$\triangle MKR \cong \triangle RLM$

Image Source : Original Contribution by sailakshmi1973@gmail.com

Time to teach	Asset type	Theme	Sub Theme
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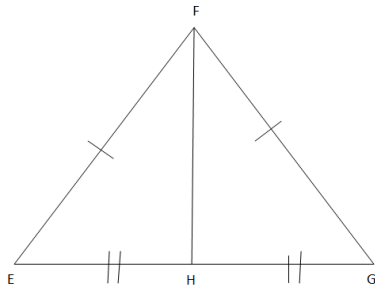
15 minutes	Questions to Assess	Triangle	Congruent triangles
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QA_Congruence of Triangles - Practice Questions

Answer the following questions

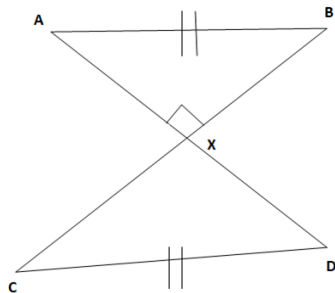
1) In the figure, $\triangle EFG$ is isosceles with $EF=GF$.

If H is the midpoint of EG , show that $\triangle EHF \cong \triangle GHF$.
Is HF the angle bisector of $\angle EFG$? Why?

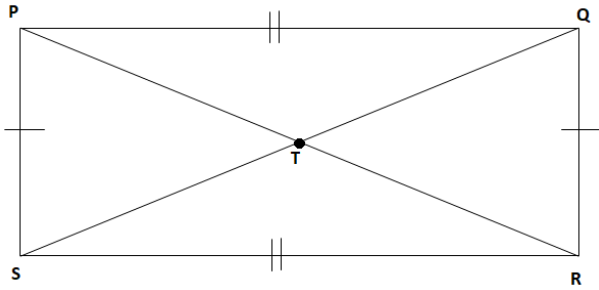


2) In the figure, $AX \perp XB$ and $AB=DC$.

If X is the midpoint of BC , show that $\triangle ABX \cong \triangle DCX$ by RHS rule.
Complete the following $\angle A = \dots$ and $\angle B = \dots$

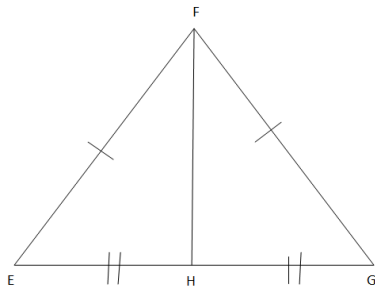


3) Study the given rectangle and name at least two pairs of congruent triangles. State the conditions of congruence chosen.



Solutions

1) In $\triangle EHF$ and $\triangle GHF$,



$EH = HG$ (as H is mid point)

$EF = GF$ (given)

$FH = FH$ (common)

By SSS congruence rule,

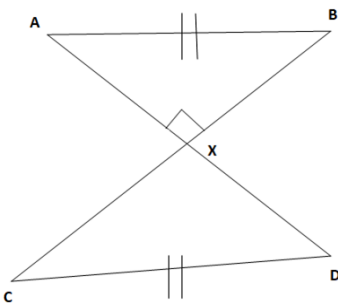
$$\triangle EHF \cong \triangle GHF$$

By CPCT,

$$\angle EFH = \angle GFH$$

Hence HF is angle bisector of $\angle EFG$.

2) In $\triangle AXB$,



$\angle AXB = 90^\circ$ (given)

$\angle AXB = \angle CXD$ (vertically opposite angles)

Hence $\angle CXD = 90^\circ$

Hence $\triangle AXB$ and $\triangle CXD$ are right angled triangles.

$\angle AXB = \angle DXC = 90^\circ$ (R)

$AB = CD$ (given) (H)

$XB = CX$ (X is midpoint of BC) (S)

So by RHS rule,

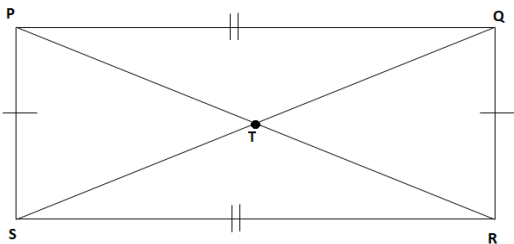
$$\triangle AXB \cong \triangle DXC$$

By CPCT,

$\angle A = \angle D$

$\angle B = \angle C$

3) Consider $\triangle PQR$ and $\triangle PSR$,



$PS = QR$ (S) (opposite sides of rectangle)

$\angle S = \angle Q = 90^\circ$ (A) (angle of a rectangle)

$SR = PQ$ (S) (opposite sides of rectangle)

By SAS rule,

$$\triangle PQR \cong \triangle RSP$$

$$\text{Similarly } \triangle SPQ \cong \triangle QRS$$

Other pairs of congruent triangles are PQR & QPS and PSR & QRS .

Note-The congruency can also be proved by SSS rule. In that case, the common side between two triangles should be considered.

Image Source : vallisairam9@gmail.com

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Questions to Assess	Triangle	Congruent triangles

VC_Team Spirit

We have just learnt that two objects are **congruent** if they have **identical** dimensions and shape. When two triangles are congruent they will have exactly the same three sides and exactly the same three angles.

In real life, for any team or group, congruence is very important. Unless all the team members share identical values and identical goals, they cannot put up a good performance as a team.

Congruence provides several advantages:

- a. Clear defining of team/group goals.
- b. Giving a direction to the team /group to look ahead.
- c. Better deployment of available resources.
- d. Helps to monitor the progress.

“Congruency helps us become convergent; Creating concord even if we are divergent.”

For e.g., In any sports, each team’s objective is to win the match with their opposite team. Here, their congruent desire is to win the match and bring laurels to their team. A congruent desire in all the teachers of a school as a group is to impart quality education to all the students in their school.

Now let me share a story with you all.

Once, a group of boys decided to play their favourite Cricket game. So each of them decided to bring one item that is **used in professional matches**. It was decided that one would bring the ball, another the cricket bats, another the wickets, others the wicket keeper gloves, batsmen gloves, protective padding, the boundary marker rope, etc.

But before the game started, they decided that the boy who had brought the most important object would get to pick the teams.

But it was difficult to **decide which is the most important object**, so they decided to just start playing, using all the objects, and gradually get rid of those items which they thought were unimportant.

Then first thing they got rid of was the set of keeper gloves; they managed to catch/stop the ball just as well without them.

Next they stopped using the boundary Marker.

Then they replaced the wickets with a couple of brick piles at either end.

And so they continued, until finally they replaced the bats with two plywood pieces, the cricket ball with a tennis ball and managed to keep playing....

At the same time a couple passed by the playground. The man **said to his wife**, "Look, they are playing cricket without even a proper ball or bat. I’m sure they're not enjoying the game."

When the boys heard this comment, they realized how foolish they were. And true to the man’s comment, they were not enjoying the game at all. It was their pride and ego that made them discard all the items that were required to play a proper cricket game.

It was then they all decided together to play a proper game with all the necessary items and to enjoy it thoroughly, which they did. They had great fun together.

Children! What changed here?

- In the first instance when they began their game, their egos came into play. They all lost sight of the main objective of enjoying the game.

- But the moment their objective got congruent (identical), they shed off their ego and focused on the common objective—to enjoy the game.

So remember, success always comes when all the members of a team or group are on the same page and their thoughts are congruent.

Time to teach	Asset type	Value	Sub Value
3 minutes	Value Content	Right Action	Goals

Master Lesson Plan

Seven Asset Methodology for MLP

What is the purpose of this Master lesson Plan?	This Master Lesson Plan (MLP) prepared by Sri Sathya Sai Vidya Vahini (SSSVV), covers the entire chapter for the given board. The MLP for the chapter given in the textbook is broken down into smaller modules known as assets. Any chapter can be taught using the 7 asset types in SSSVV methodology. Several different assets together complete the entire chapter. Depending on the requirement, each asset is supported by teaching aids such as animated presentation, audio, video, and learning aids such as worksheets. The MLP is for the teacher's preparation and the teaching aids are for use in the classroom.
How to use it?	You can prepare for your class with this MLP by following 3 simple steps: 1. Read your textbook; 2. Go through the information given in the assets (document & multimedia); 3. Prepare your teaching notes. Great! Now you are ready to transact the chapter.
Duration	Kindly note the duration given for each asset. Due care has been taken in planning the assets, to ensure the chapter is completed within the time specified by the Board. Note: Preparation time is not included in the asset duration. The teaching time depends on the duration of the teaching aids and is not impacted by the length of the MLP.
What is a 'Main Script' (MS) Asset?	The Main Script asset is there for explaining the main concepts of the chapter clearly. The information given in the textbook is simplified, organised and structured to give more clarity. Additionally, you may find a video or mnemonics or a graphic organiser to deepen the understanding of the concept.
How to teach using the MS asset?	Please use the blackboard, slides and interaction to develop the concept.
What is an 'Inquisitive Questions' (IQ) asset?	The Inquisitive Questions asset uses questions to promote higher order thinking like the n^{th} why, what-if, new perspectives, cause-effect, and others, creating curiosity.
How to teach using the IQ asset?	You may use the questions to connect with the students, encourage exploration to engage them in the learning process. You may allow multiple responses and instead of rejecting any of the responses, ask why, before revealing the suggested answer or hints.
What is a 'Day to day Relevance' (DD) Asset?	The Day to Day Relevance asset helps students understand the practical relevance of every topic, making them eager participants in the classroom. If students connect the concepts to their environment, they would learn meaningfully without dislike or simply memorizing for exams.

How to teach using the DD asset?	You may use the asset by asking questions about their experience and use it to establish why they are learning the topic. If necessary you may substitute with a recent or local example.
What is an 'Interesting Aside' (IA) asset?	The Interesting Aside asset uses attention grabbing titbits or anecdotes to bring joy and satisfy the child's hunger to know more. This is a quick/short asset intended to bring attention back to the main concept being taught.
How to teach using the IA asset?	You may use this asset to give a piece of interesting information relevant to the topic, without prolonged explanation/discussion. You may suggest appropriate books for further reading.
What is a 'Suggested Activity' (SA) Asset?	The Suggested Activity asset provides a detailed step by step procedure for the teacher to conduct a hands-on activity. This promotes Activity Based Learning.
How to teach using the SA asset?	You may use this asset to energise your students to learn by doing simple, fun-filled activities based on the topic. The asset includes - preparation, activity, and follow-up. You may engage the students in the preparation and follow-up stages to develop collaboration and responsibility. You could try it once, yourself, before the actual delivery to be more comfortable with it. Note: The duration mentioned in the asset is usually for the activity part only.
What is a 'Value Content' (VC) Asset?	The Value Content asset integrates Universal Human Values (such as empathy, inclusivity, respect for nature that translates into responsible behaviour) seamlessly into the curriculum, as the "End of education is character".
How to teach using the VC asset?	You may use this asset to engage with the students to bring out their innate values and connect with the intrinsic values in the topic/concept. The asset includes pointers on the specific pedagogical technique followed.
What is a 'Questions to Assess' (QA) asset?	The Questions to Assess asset uses an interactive approach to check learning of different types of learners, and provides feedback to the teacher for appropriate action. The questions cater to all the levels of Bloom's Taxonomy. Questions from 'Apply' level and above enable students to reflect on their learning.
How to teach using the QA asset?	You may go through the slides to understand its flow and know when to click for the answer (slides include suggested answers). While presenting in the class, you may display the question and encourage multiple responses, before revealing the answer. In some cases, this asset may include extra questions/worksheet that can be given as homework.