



Master Lesson Plan

For

Symmetry

Board	Standard	Subject	Chapter	Language	Reference Link	Creation date
CBSE	STD VII	Mathematics	Symmetry	English	Symmetry	2020-01-27 19:10:48

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Symmetry

1. MS_Objectives_Symmetry

Notes to the teacher:

This asset lays down the proposed plan for transacting this chapter

It states the asset objectives of the MLP. This asset is for teacher's reference and need not be taught to the students.

Students will be able to

- Correlate symmetry in and around us
- Identify symmetrical objects and their lines of symmetry
- Demonstrate that a regular polygon has as many lines of symmetry as it has sides by taking examples of equilateral triangles, squares, regular pentagons and regular hexagons
- Identify shapes with rotational symmetry and their transformations after every fraction of a turn
- Solve problems on Rotational symmetry and angle of rotation
- Appreciate the beauty of Fractals
- Evaluate problems based on different types of symmetry
- Practice mental and emotional balance.

Time to teach	Asset Type	Theme	SubTheme
3 Minutes	Main Script	Symmetry	

2. 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.

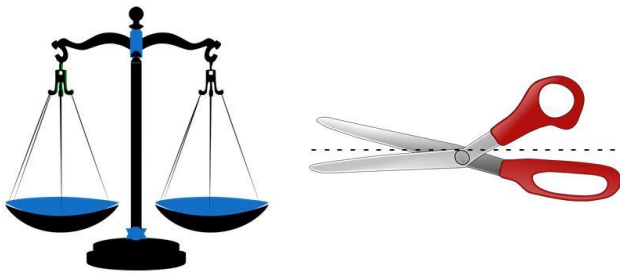
Observe the T-shirt and some casual dresses that you wear. Most of them would contain symmetrical designs in it. Asymmetrical design creates a sort of incomplete feeling in our brain even though it might aid our fashion needs.

Vegetables and flowers follow symmetry as well.

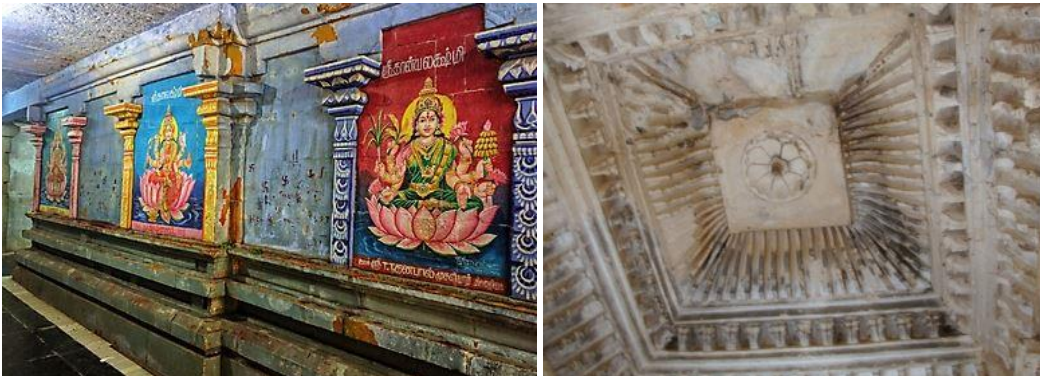


The simple gadgets that we use for our day to activities are symmetrical.

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.

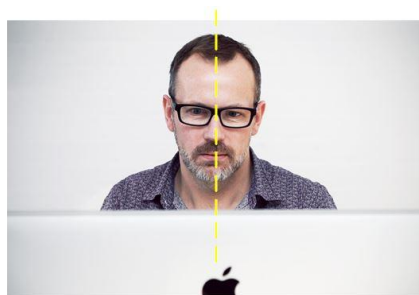


Asymmetrical designs create a sort of visual disturbance. Designers prefer symmetrical design as it gives a pleasing effect to human brain.



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.

Image Source:

<https://pixabay.com/en/polo-shirt-t-shirt-shirt-clothing-48105/>

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

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

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

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

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

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

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-Keyword-temple wall

Ceiling: SSSVV Gallery-Keyword-roof

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

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

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

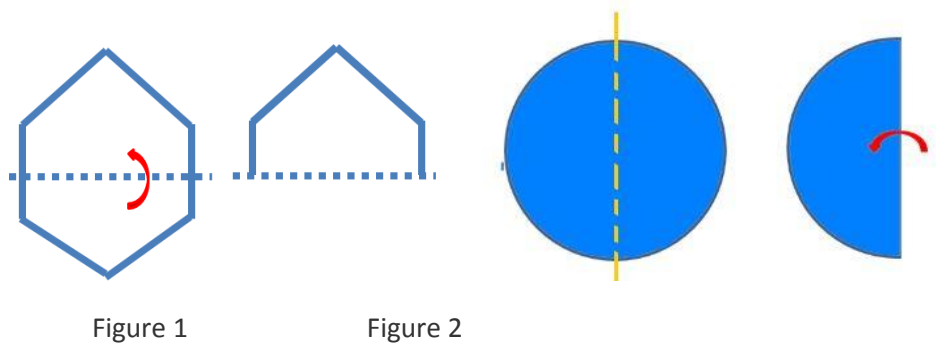
Facial Symmetry:CC: <https://pixabay.com/en/man-male-adult-person-caucasian-1209494/>

Time to teach	Asset Type	Theme	SubTheme
5 Minutes	Day-to-day Relevance	Symmetry	Application of reflectional symmetry

3. 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.



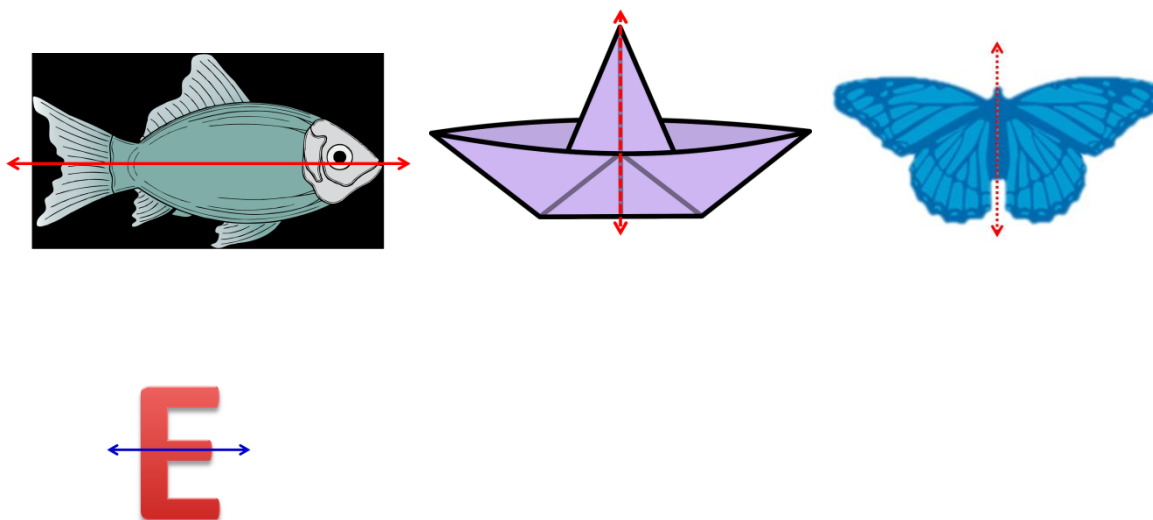
The dotted line in each of the symmetric figures which divides the figure into two equal halves is called the line of symmetry.

The above figures are said to have line symmetry.

Lines of symmetry

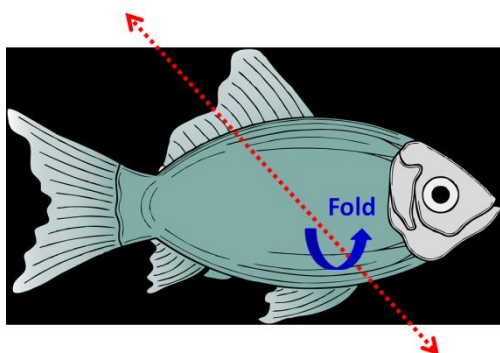
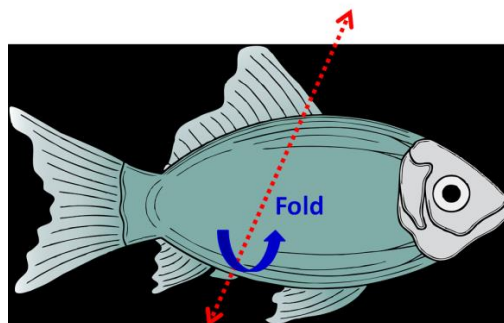
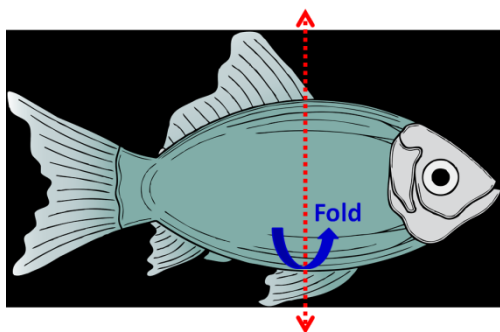
A line of symmetry divides a symmetrical shape into half. An object or figure may have one, two or more number of lines of symmetry.

Shapes possessing one line of symmetry



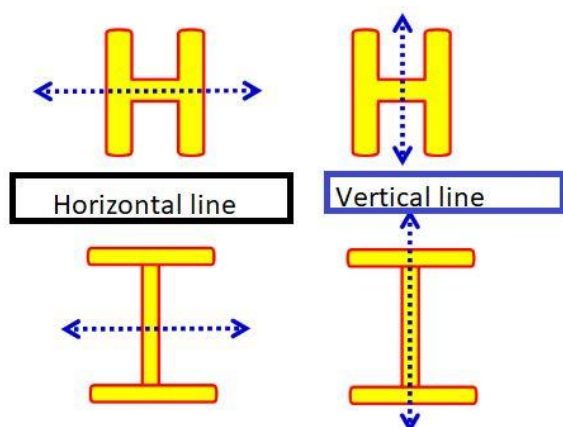
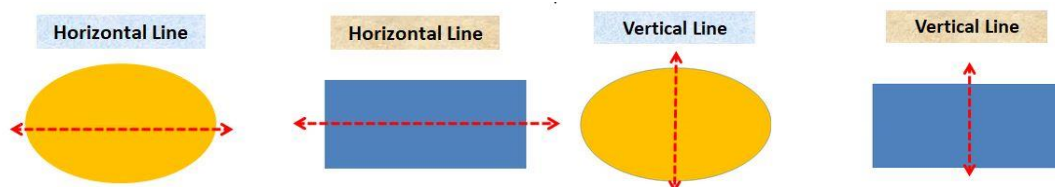
The above shapes can be folded along the dotted line such that the two halves are exactly the same.

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.

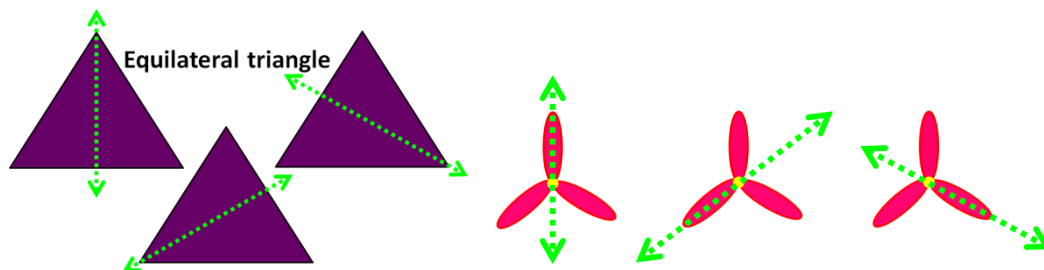
Shapes possessing two lines of symmetry



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

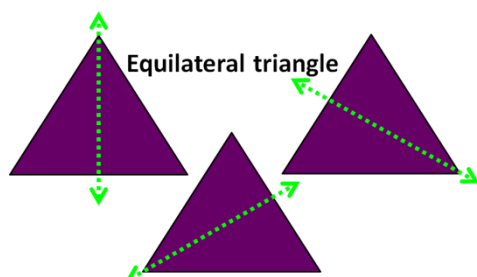


If we fold the above shapes along the lines in the three images, the resulting halves are exactly identical. Hence these lines are lines of symmetry.

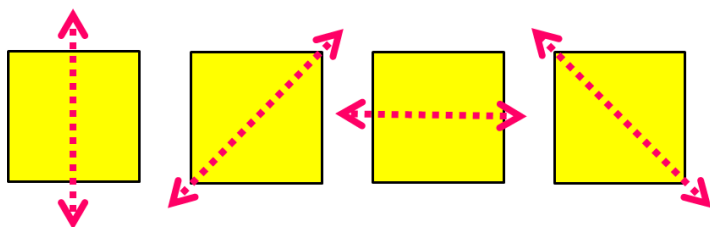
Symmetry in regular polygons

Equilateral Triangle

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

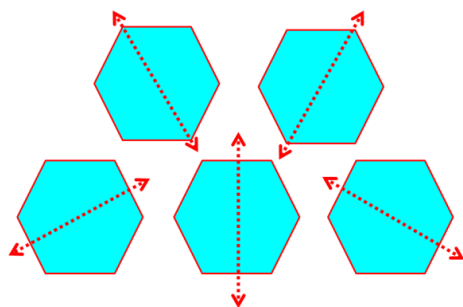


Square



We see that a square has four lines of symmetry.

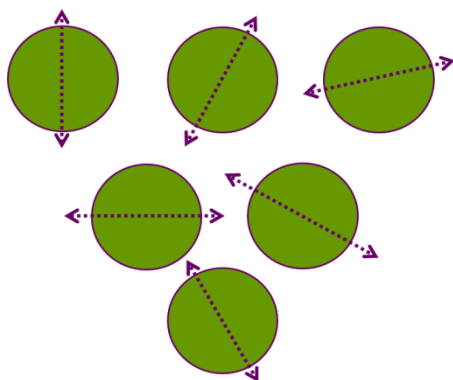
Regular Pentagon



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

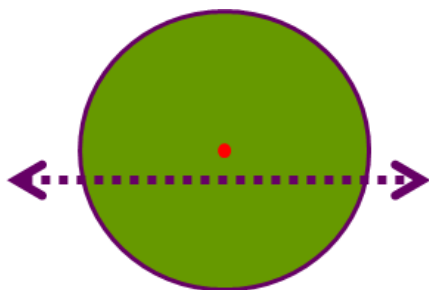
We find that a regular polygon of 'n' sides will possess 'n' lines of symmetry.

Lines of symmetry in a circle

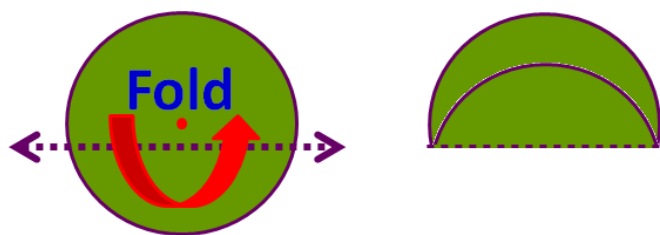


We observe that any line drawn through the centre of the circle is a line of symmetry. We can draw any number of lines passing through the centre of the circle. Hence, a circle is said to possess infinite (countless) number of lines of symmetry.

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:

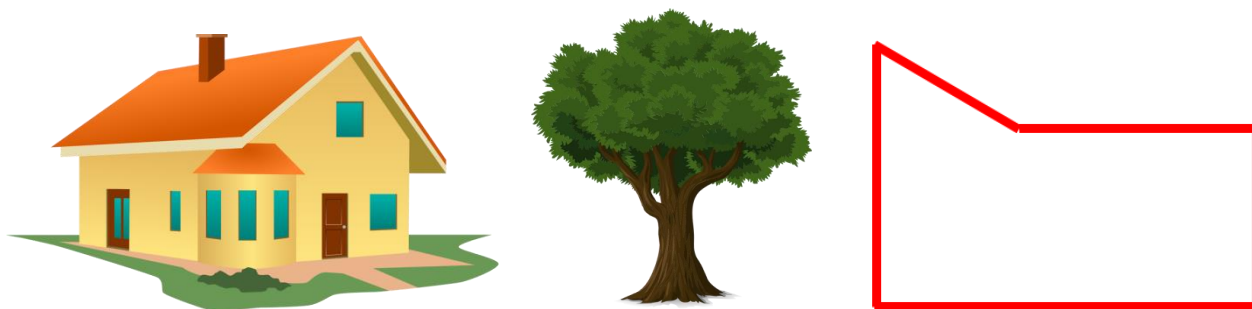


Hence we say that the circle is not symmetrical about the given line or the line is not a line of symmetry of the circle.

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.

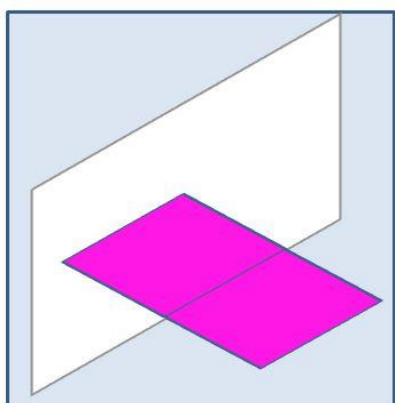
Consider the figures given below:



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

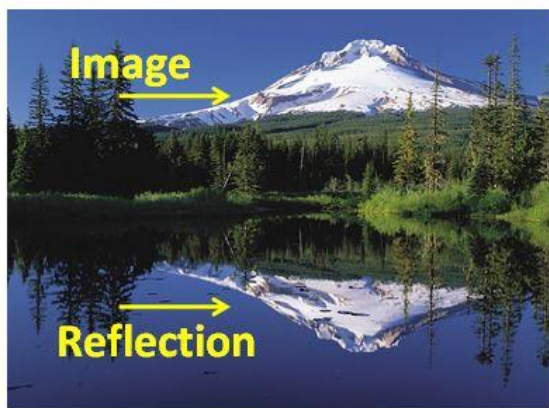
Observe the image given below:



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.

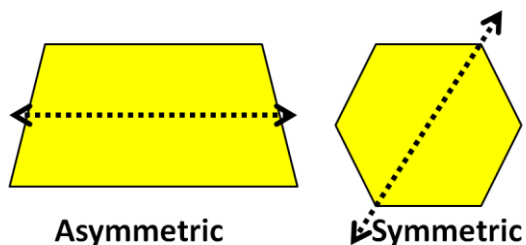
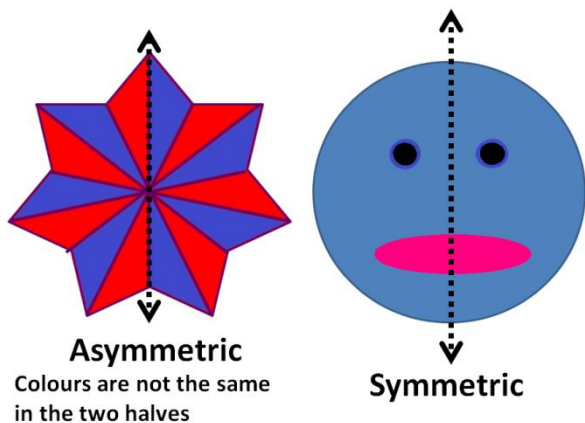


Image Source:

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	SubTheme
10 Minutes	Main Script	Symmetry	Line symmetry, Lines of symmetry for regular polygon, Reflection

4. SA_Activity to Learn Lines of Symmetry

Aim: To find lines of symmetry of the given shapes

Materials required: Paper, pencil, scale and 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 the shape creating two perfectly identical halves.

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

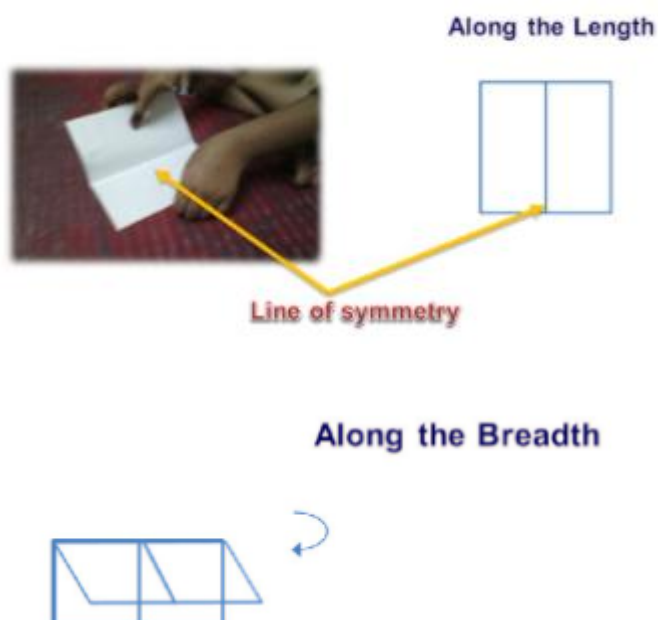
Expected answer: A regular polygon has as many lines of symmetry as it has sides. They may have several lines of symmetry.

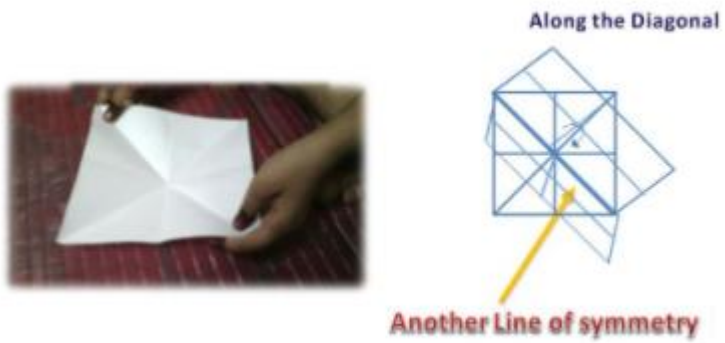
Procedure:

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



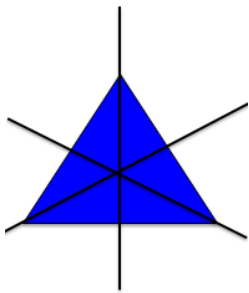


Step 3: Draw a dotted line over lines of fold

Step 4: These dotted lines indicate lines of symmetry

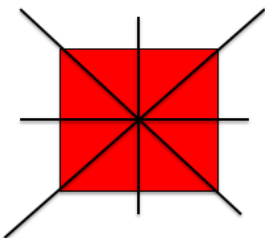
Observation:

- An equilateral triangle has 3 lines of symmetry



Equilateral Triangle
3 lines of symmetry

- A square has 4 lines of symmetry



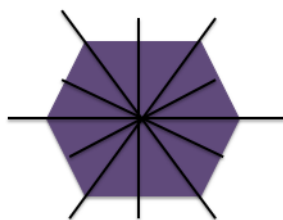
Square - 4 lines of symmetry

- A regular pentagon has 5 lines of symmetry



Pentagon – 5 lines of symmetry

- 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

Time to teach	Asset Type	Theme	SubTheme
20 Minutes	Suggested Activity	Symmetry	Line symmetry

5. MS_ Rotational Symmetry

Introduction:

We recall that letter “S” does not possess Line Symmetry.

This letter exhibits a different kind of symmetry called the ROTATIONAL SYMMETRY.

What is meant by ROTATION?

"Rotation" means turning around a centre.

The distance from the centre to any point on the shape stays the same. Every point makes a circle around the centre.

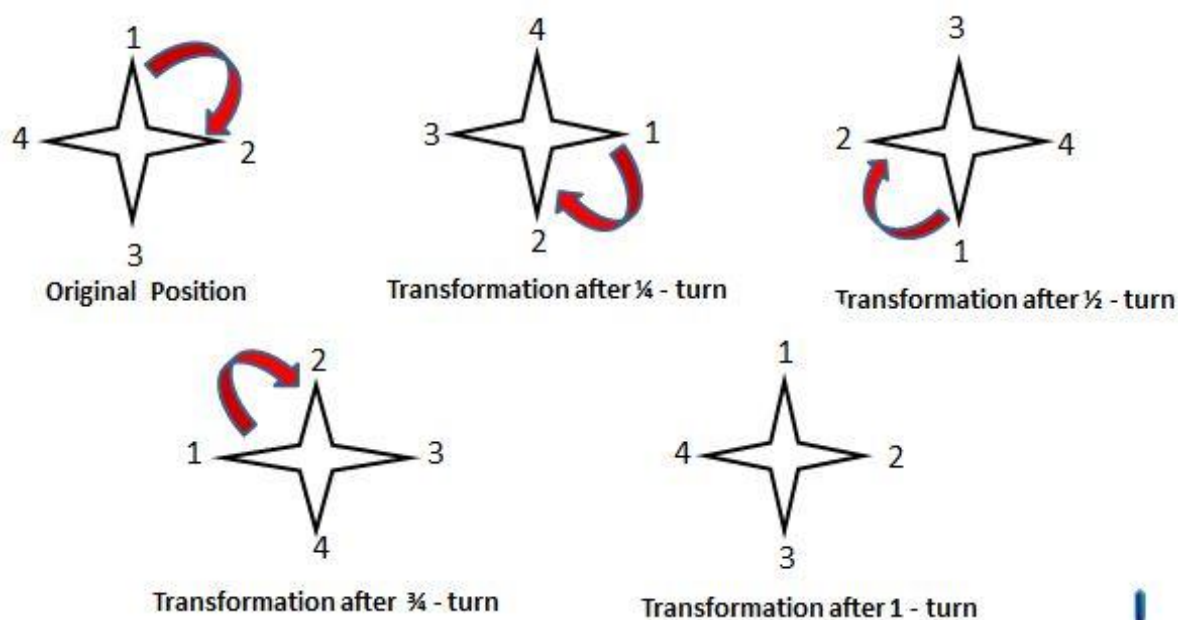
Rotational symmetry:

A shape has Rotational symmetry when it still looks the same after a rotation (of less than one full turn)

Rotational Symmetry is also as "Turn Symmetry"

After a rotation (of less than one full turn) means turning through some angle (in degrees) depending on the object.

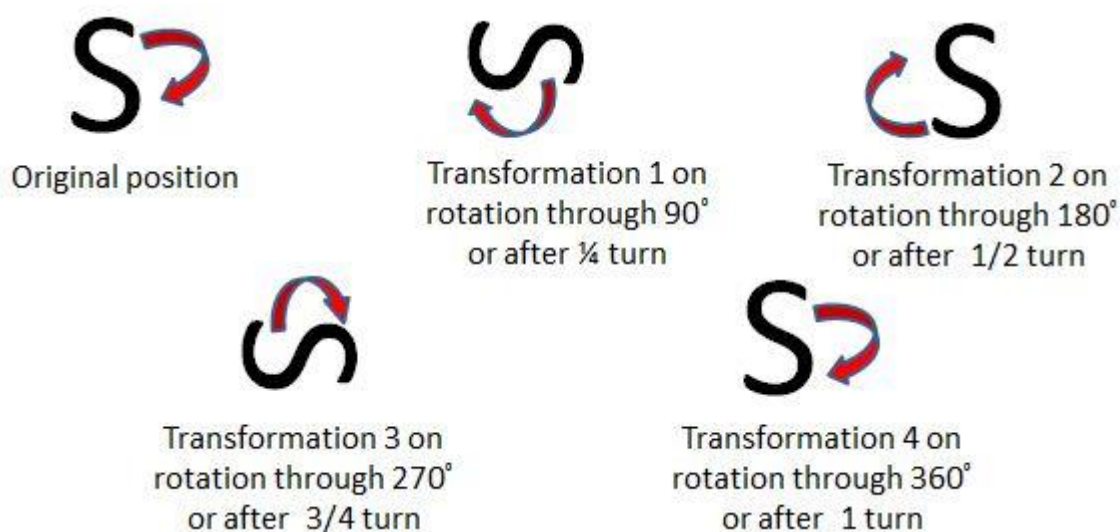
Example 1:



Order of Rotational Symmetry:

Example 2:

Consider the alphabet "S". Let us rotate it around a point and observe the transformation



The alphabet “S” appears twice as its original shape on one complete rotation of 360° , in Transformation -2 and Transformation-4.

The number of times we get the same shape on rotating an object (until it completes a circle) is called ORDER OF ROTATION.

Hence, the “Order of Rotation” of alphabet “S” is 2.

When the alphabet “S” undergoes $\frac{1}{2}$ turn as in Transformation-2 it regains its original shape.

Example 1 will have an “Order of Rotation” 4 as it regains its original position in all 4 turns

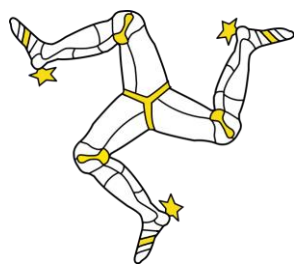
Fraction of turn:

The fraction of turn after which the given shape regains its original position on rotating about a fixed point is called "Fraction of turn symmetry".

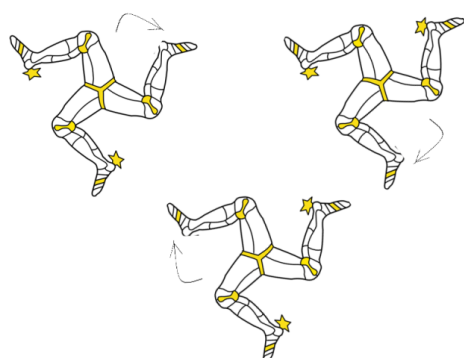
Hence, the “Fraction of Turn Symmetry of alphabet “S” is $\frac{1}{2}$.

Fraction of turn symmetry for the first set of images is $\frac{1}{4}$

Example 3:



The triskelion appearing on the Isle of Man flag.



The Triskelion shown above can be rotated to three different positions in one complete rotation or turn and each look the same.

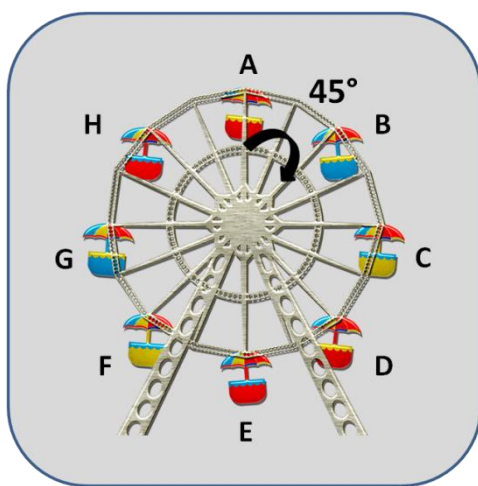
We say the Triskelion has Rotational Symmetry of Order 3.

As the Triskelion regains its original shape in $\frac{1}{3}$ turn, we say that the Triskelion has $\frac{1}{3}$ turn symmetry.

Angle of rotation:

The angle of rotation is the measure of the angle by which a figure is rotated in the clockwise direction about a fixed point.

In rotational symmetry, after the object is rotated through a specific angle of rotation, the object appears as the original object.



In moving from point A to point B (clockwise), the angle of rotation of the Ferris wheel is 45°

After rotating 45° , the Ferris wheel looks the same except for change of position of the passenger carrying components.

Relation between Fraction of Turn and Order of Rotation:

Fraction of turn	Angle of rotation in degree	Examples of Shapes	Order of Rotation	Shapes
Half	180°	Oval	2	
$1/3$	120°	Equilateral Triangle	3	
$1/4$	90°	Hospital first aid symbol (in plus form)	4	
$1/6$	60°	6 Pointed Star (made of equilateral triangles)	6	
$1/8$	45°	8 Spoked Wheel	8	
$1/8$	45°	Regular Octagon	8	
$1/4$	90°	Square	4	

Note:

- 1) If angle of rotation is x° and $x < 360$ then Order of rotation = $\frac{360}{x}$
- 2) A shape which has $\frac{1}{n}$ turn symmetry is said to have order of rotation "n".

Image source:

Triskelion: http://commons.wikimedia.org/wiki/File:Manx_Triskelion.png

Ferris Wheel: <https://pixabay.com/illustrations/circus-clown-strongman-face-4880938/>

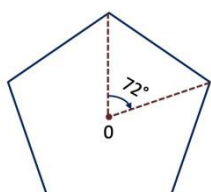
Stop Sign : <https://pixabay.com/vectors/traffic-sign-stop-road-sign-157617/>

All others are original contribution using autosshapes in MS Powerpoint.

Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Main Script	Symmetry	Angle of rotation

6. QA_ Questions on Rotational symmetry

- 1) What is the order of rotational symmetry of a regular pentagon?



- A) 2 B) 5 C) 10 D) 15

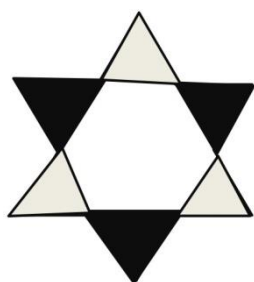
Ans: B

Explanation:

If a regular pentagon is rotated by 72° (one fifth of 360°), then it exactly fits its own outline. Therefore a regular pentagon has rotational symmetry of order

$$\frac{360}{72} = 5$$

- 2) This star is made up of equilateral triangles:



What is the order of rotational symmetry of the star? A) 3 B) 4 C) 6 D) 12

Ans: A

Explanation:

There are 6 triangles; alternate grey and black triangles.

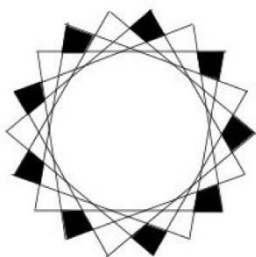
Now if you rotate by $\frac{360}{6}=60^\circ$, grey triangle is replaced by black and vice versa

The star will only fit its own outline if it is rotated about the center point by

$60^\circ + 60^\circ = 120^\circ$ (one third of 360°).

So, its order of rotational symmetry is $\frac{360}{120} = 3$

3)



What is the order of rotational symmetry of the above pattern?

A) 6 B) 9 C) 12 D) 18

Ans: B

Explanation:

There are 18 quadrilaterals; alternate white and black quadrilaterals.

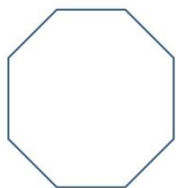
Now if you rotate by $\frac{360}{18}=20^\circ$, white quadrilateral is replaced by black and vice versa

We get exact shape if it is rotated about the center point by

$20^\circ + 20^\circ = 40^\circ$

So, its order of rotational symmetry is $\frac{360}{40} = 9$

4) What is the order of rotational symmetry of this octagon?



(Hint: look at the side lengths carefully)

A) 2 B) 4 C) 6 D) 8

Ans: B

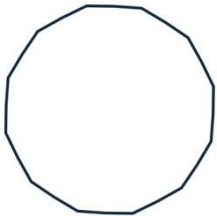
Explanation:

This is NOT a regular octagon, so it does not look the same after a rotation of $\frac{360}{8} = 45^\circ$:



After 45 degree rotation, it requires one more rotation of 45° to fit its own outline. Therefore it looks the same after rotations of 90° , 180° , 270° (and 360° takes it back to its original position). So the order of rotational symmetry is $\frac{360}{90} = 4$.

5)



The diagram shows the outline of a 50 cent coin from Fiji. What is its order of rotational symmetry?

A) 8 B) 9 C) 12 D) 15

Ans: C

Explanation:

It is a regular dodecagon (12 sided figure) and looks the same after rotations of $\frac{360}{12} = 30^\circ$, 60° , 90° , 120° , 150° , 180° , 210° , 240° , 270° , 300° and 330° (and 360° takes it back to its original position). So the order of rotational symmetry is 12.

6) What is the order of rotational symmetry of this shape?

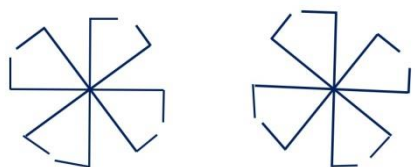


A) 2 B) 4 C) 8 D) 16

Ans: B

Explanation:

It does not look the same after a rotation of 45° :

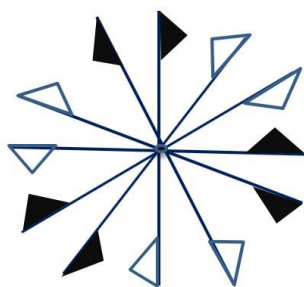


After a 45° rotation

It requires a rotation of 90° before it looks the same.

So it looks the same after rotations of 90°, 180°, 270° and 360° takes it back to its original position. So the order of rotational symmetry is $\frac{360}{90} = 4$.

7)



What is the order of rotational symmetry of the above pattern?

A) 3 B) 4 C) 6 D) 12

Ans: A

Explanation:



There are 3 sets of designs shown above

So, the shape will only fit its own outline if it is rotated about the center point by one third of a full rotation of 360° (= 120°).

It will look the same after one-third of a rotation (120°), two-thirds of a rotation (240°) and then it will be back to the start (one full rotation of 360°).

So its order of rotational symmetry is $\frac{360}{120} = 3$.

8) What is the order of rotational symmetry of the following?



Ans: 1, 1, 2

Explanation:

First two shapes are not symmetric. So after rotating 360° takes it back to the original position. Thus order of rotational symmetry is $\frac{360}{360} = 1$

Rotation through 180° , takes it back to the original position. Thus order of rotational symmetry is $\frac{360}{180} = 2$

Image Source:

Original Contribution of shapes using MM powerpoint by rajeswariraju.tr@gmail.com

1. <https://pixabay.com/photos/swan-mirror-image-water-bird-water-338712/>

2. <https://pixabay.com/vectors/horse-race-horse-animal-equine-1297225/>

Time to teach	Asset Type	Theme	SubTheme
10 Minutes	Assessments	Symmetry	Rotational symmetry, Rotational symmetry

7. IA_Fractals

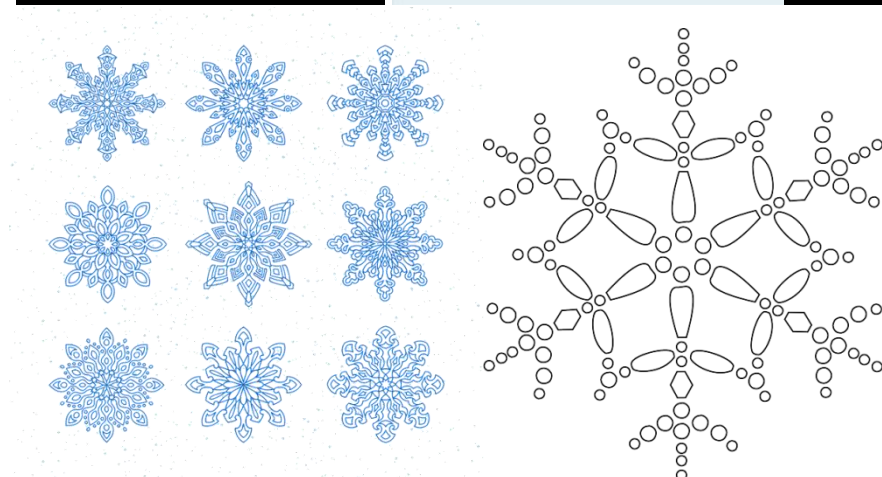
1. A fractal is a pattern, based on a mathematical function that is repeatable, self-similar, and that cannot be scaled. Different functions have different patterns.
2. The structure can be split into parts, each one is a miniature of the whole, having self-similarity.

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 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/vectors/koch-snowflake-maths-design-3271115/>

<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/>

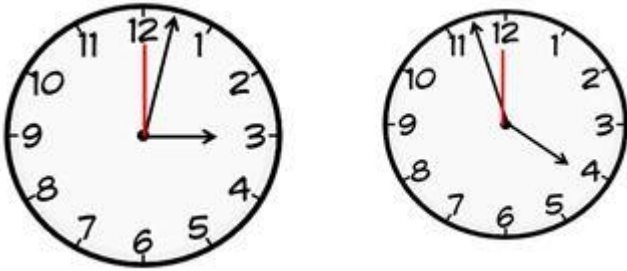
<https://pixabay.com/vectors/koch-snowflake-maths-design-3271115/>

Time to teach	Asset Type	Theme	SubTheme
5 Minutes	Interesting Asides	Symmetry	Symmetry in nature

8. IQ_Why and why not?

Answer the following:

1) Imagine the time to be 3:02 p.m. How many full rotations would it take for the seconds hand to reach 3:56 p.m. on the same day?



Options:

- (a) 60
- (b) 72
- (c) 54
- (d) 48

Ans: (c)

Explanation:

The seconds hand makes one full rotation to signify that 1 minute is over. Now, the second hand is at 3:02. It will take it 54 minutes to go to the time 3:56 [as $56-2=54$]. Therefore, it will take 54 rotations to reach the time 3:56.

2) If a car's wheel makes 1.75 rotations, how many degrees has the wheel covered?



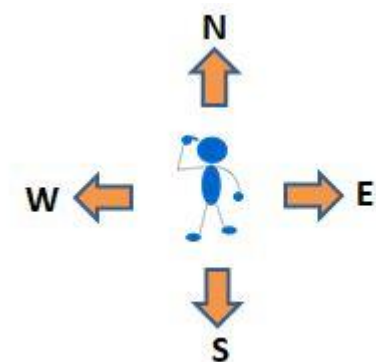
Explanation:

One rotation = 360°

Then,

$$1.75 \text{ rotation} = 1.75 \times 360^\circ = 630^\circ$$

3) If you start facing south, and then turn 450° clock wise, which direction will you be facing?



Answer: West

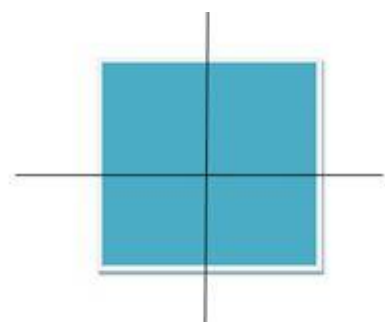
Explanation:

$$450^\circ = 360^\circ + 90^\circ$$

If we turn 360° we'll face the direction which we started in i.e. south. A turn of 90° will make us face the direction towards our right.

[Example- Quest: 90° from south clockwise? Answer: WEST]

4) How many minimum number of lines of symmetry will you need to make FOUR squares out of a square?



Answer: 2

You can see four squares being formed inside the square after we have drawn 2 lines of symmetry.

Clock , square, arrows , : original contribution by saimiteshrinki@gmail.com

Wheel : <https://pixabay.com/vectors/classic-car-wheel-sports-cars-295180/>

Blue man : <https://freessvg.org/blueman>

Time to teach	Asset Type	Theme	SubTheme
10 Minutes	Inquisitive Questions	Symmetry	Angle of rotation

9. VC_Symmetry-Tranquility

Respect and care for harmony, balance, and beauty in Nature.

A figure has line symmetry, if there is a line about which the figure may be folded so that the two parts of the figure will coincide.

Symmetry in nature is a sign of balance, evenness, beauty and physically defined order.

As students, you need line symmetry to maintain balance in our own lives.

Teacher initiates a discussion in the class:

What are the ways in which you can balance your life?

(Let children come out with their views)

Suggested answer:

Between

- work and play
- happiness and sadness
- courage and fear
- giving and receiving
- mental and emotional etc.

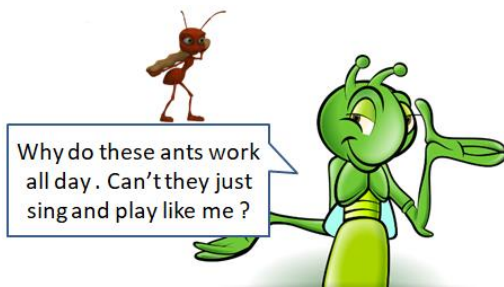
Children, let us recount the story of the grass hopper and the ants which you might have heard quite a few times from your early childhood.

During the summer, while the hard-working ants were collecting and dragging grains of wheat from some corner to store food for the winter; the grasshopper was wasting away his time hopping around, singing & playing in the sun.



During summer ants worked hard to collect grains





But when the winter came and the ants were enjoying the food they have collected & stored in the last summer grasshopper had nothing to eat because he was so busy playing around in that summer and the winter had come before he realized. As a result, he had to starve.



Ants enjoyed the food they saved



I am starving while the ants are enjoying the food they saved. Wished I had worked hard in summer too!!



The Moral of the story is prioritizing and balancing your tasks, just like the clever ants. Take care of your daily studies and other important works before you indulge in play. It will balance your time between the work & the play.



Children, remember; we need to inculcate & develop the qualities of mental & emotional balance, and right attitudes for a happy, healthy & peaceful coexistence with others in the society.

Image Source:

<https://pixabay.com/illustrations/sun-astro-vector-ray-lights-1789653/>

<https://pixabay.com/vectors/animal-grasshopper-insect-nature-1296187/>

<https://pixabay.com/vectors/ant-pismire-insect-emmet-149611/>

<https://pixabay.com/photos/wheat-grain-agriculture-seed-crop-381848/>

<https://pixabay.com/illustrations/emoticon-emoji-pray-smiley-smile-1626442/>

Grain small heap - <https://pixabay.com/photos/ground-ground-coffee-isolated-heap-315405/>

<https://pixabay.com/vectors/cricket-insect-grasshopper-pest-47470/>

<https://pixabay.com/vectors/stick-safety-danger-ant-rain-44577/>

<https://pixabay.com/illustrations/read-book-students-study-of-2841722/>

<https://pixabay.com/vectors/kite-boy-kid-children-play-flying-2521627/>

<https://pixabay.com/illustrations/snowman-snow-winter-christmas-1090261/>

Time to teach	Value Type	Value Sub Type	Value Attribute
5 Minutes	Non-Violence		Quotation

10. MS_Summary-Symmetry

- The concept of symmetry is introduced by giving different examples in our daily life
- The method of identifying symmetrical objects and their lines of symmetry is explained
- Students are made to identify lines of symmetry of regular polygons like equilateral triangle, square, regular pentagon and regular hexagon in a paper activity
- Rotational symmetry and angle of rotation are explained with examples. The transformation of shapes with rotational symmetry after every fraction of a turn is explained
- Different types of problems related to rotational symmetry and angles of rotation are solved
- Symmetry in fractals is explained with beautiful examples
- Problems related to different types of symmetry are solved
- The need to develop the mental and emotional balance is explained by means of a story

Time to teach	Asset Type	Theme	SubTheme
5 Minutes	Main Script	Symmetry	