

Master Lesson Plan
for
Quadrilaterals

Board	Standard	Subject	Chapter	Language
NCERT	STD IX	Mathematics	Quadrilaterals	English

Sri Sathya Sai Central Trust

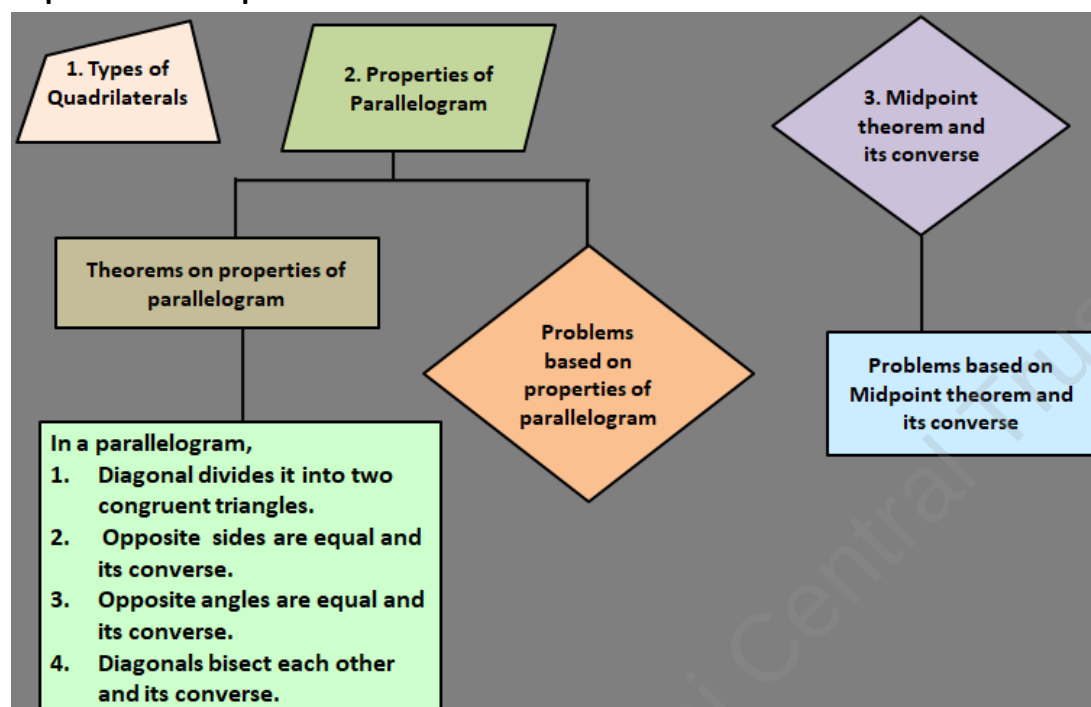
CURRICULAR GOALS	CG-4: Analyses the characteristics and properties of two-dimensional geometric shapes and develops mathematical arguments to explain geometric relationships
COMPETENCIES AS PER NCF/NIPUN BHARAT	C-4.2: Proves theorems using Euclid's axioms and postulates for triangles and quadrilaterals, and applies them to solve geometric problems
SDG(Sustainable Development Goals)	SDG4 – Quality Education
Technology aids	PPTs
Learning Teaching Materials (LTM)	
Learning Aids	Worksheets, Project Report Template
NEP recommended Strategies	Art Integration: SA_project Congruent triangles , Case Study: VC_Equality leads to harmony
Cross-Cutting Themes	Values and Dispositions – Integrated the value of Equality Inclusion – Gender sensitisation through Value content Technology in education – PowerPoint presentations

[Notes to teacher : Dear Teachers, through this MLP, we bring to you suggestions, pedagogical approaches, ideas, teacher reference documents(TRD), teaching aids(TA) and Learning Aids(LA) for the topic 'Quadrilaterals' for grade IX.]

CURRICULAR GOALS	CG-4: Analyses characteristics and properties of two-dimensional geometric shapes and develops mathematical arguments to explain geometric relationships
COMPETENCIES AS PER NCF/NIPUN BHARAT	C-4.2 Proves theorems using Euclid's axioms and postulates for triangles and quadrilaterals, and applies them to solve geometric problems
SDG(Sustainable Development Goals)	SDG4 – Quality Education
Technology aids	PPTs
Learning Teaching Materials (LTM)	Cutouts of parallelograms
Learning Aids	Worksheets, Project Report Template
NEP recommended Strategies	Art Integration: IA_Parallelograms in art, Case Study: VC_You are special!! Project-based: QA_LA_Solve using Midpoint theorem.pdf
Cross-Cutting Themes	Values and Dispositions – Integrated the value of self-respect Inclusion – Gender sensitisation through Value content Technology in education – Powerpoint presentations

Total Time: 245 minutes, 7 periods

Topics in this Chapter:



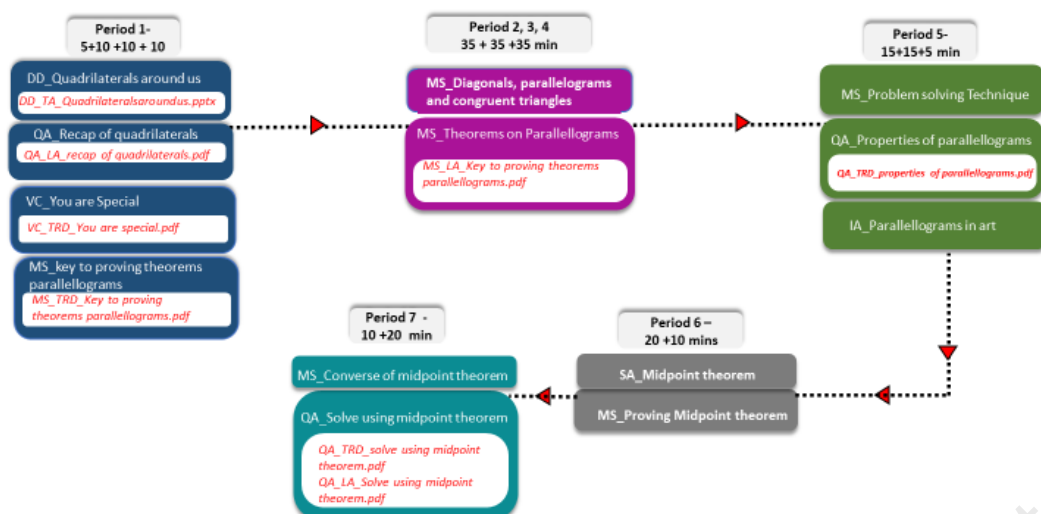
[Notes to teacher: The chapter on Quadrilaterals has been broken down into these subtopics. Ideas and strategies on how each topic can be dealt with has been suggested. As you view this lesson plan, you will find that all the seven assets are integrated seamlessly to make learning 'Insightful', 'Inspiring', 'Enjoyable', and 'Participative'. You will also notice that the activities and Value content are designed towards attainment of curricular expectations.

This lesson plan is designed for **7** periods, considering **each period to be of 35 minutes**. Additional one or two periods may be used, if required.]

Lesson Plan Flow

[Notes to the teacher: Here is the MLP at a glance for a quick reference.]

MLP Design flow - Overview



PERIOD 1

Topic : Quadrilateral types, Introduction to theorems on parallelogram

Time : 3 + 8 + 10 + 9 = 30 mins

Asset Types: DD, QA, VC, MS

Objective: Students will be able to

- 1) Relate quadrilaterals to real situations
- 2) Recap the properties of quadrilaterals
- 3) Recognize that each one of us is unique
- 4) Use the guidelines to prove any theorem related to parallelograms

1)DD_Quadrilaterals around us

Facilitate the students to understand the relevance of quadrilaterals in real life. A few examples are given in the ppt **DD_TA_Quadrilaterals around us.pptx** around us which is provided as a teaching aid.

2)QA_Recap of Quadrilateral Types

1. Revise the properties and types of quadrilaterals as learnt in previous classes.

Table given below could be used .

Quadrilateral	Opposite sides are parallel	Opposite sides are equal	All sides are equal	Opposite angles are equal	Diagonals are equal	Diagonals bisect each other	Diagonals bisect vertex angle
Parallelogram 	Both pairs	Yes	No	Yes	No	Yes	No
Rhombus 	Both pairs	Yes	Yes	Yes	No	Yes, at right angle	Yes
Square 	Both pairs	Yes	Yes	Yes, all 90°	Yes	Yes, at right angle	Yes
Rectangle 	Both pairs	Yes	No	Yes, all 90°	Yes	Yes	No
Trapezium 	One pair	No	No	No	No	No	No
Kite 	No	Adjacent sides are equal	No	One pair only	No	Yes, at right angle. One diagonal is bisected.	Yes, in one case

2. Use the question given in the worksheet **QA_LA_Recap of Quadrilateral types.pdf** which is provided as a learning aid.

[Note to the teacher: If required, the teacher can prove the 'Angle Sum property of a quadrilateral'.]

Angle Sum property of a quadrilateral: The sum of angles in a quadrilateral is 360°

3) VC_You are special!

Square, Rectangle and Rhombus are all parallelograms. However, each is unique! Each has its beauty, elegance and harmony. Likewise, we are all human beings but each one of us is unique. One should not compare oneself with others and feel inferior. Instead, one could work on one's weaknesses and get better.

You may use the case-study given in the Value asset **VC_TRD_You are special.pdf** which is provided as a Teacher Reference Document, to bring out the value of Self-respect.

4) MS_Key to proving theorems on parallelograms

Use the guidelines as provided in the document **MS_TRD_Key to proving theorems_Parallelograms.pdf**, which is provided as a Teacher Reference Document to explain how to read, understand, apply and prove any theorem on parallelograms.

PERIOD 2, 3, 4

Topic : Parallelogram theorems and their converse

Time : 35 + 35 + 35

Asset Types: MS

Objective:

Students will be able to

- 1) Use the guidelines to prove that a diagonal of a parallelogram divides it into two congruent triangles.
- 2) Prove and verify the theorems on properties of parallelograms

1) MS_Diagonals, parallelograms and congruent triangles

1. Prove the theorem “**Diagonal of a parallelogram divides it into two congruent triangles**” using the guidelines given in the ‘Key to proving theorems’
2. Use the TLM as given below to further demonstrate this property of the parallelogram.

The students can cut a parallelogram shape on paper. They can draw a diagonal and cut along the diagonal to form two triangles. When the two triangles are superimposed, it can be observed that the triangles are congruent.

MS_Parallelogram Theorems and their converse

Theorems on properties of Parallelograms:

1. Write all the theorems on the board and familiarise the students with the theorems and its converse.

	Theorem		Converse
1	In a parallelogram, opposite sides are equal	1a	If each pair of opposite sides of a quadrilateral is equal, then it is a parallelogram
2	In a parallelogram, opposite angles are equal	2a	If, each pair of opposite angles of a quadrilateral is equal, then it is a parallelogram
3	The diagonals of a parallelogram bisect each other	3a	If the diagonals of a quadrilateral bisect each other, then it is a parallelogram

2. Use the flipped classroom technique - divide the class into 6 groups. Assign one theorem for every group. Theorem 1 has already been shown by you. Theorem 2 to 1 group, Theorem 2a to next and so on..
3. Every group can be given 20 mins time to prepare themselves.
4. They go through the theorem, find a way to verify the theorem using any materials.
5. They use the guidelines **MS_LA_Key to Proving theorems on Parallelograms.pdf** which is provided as a Learning Aid and previous knowledge to develop the proof.
6. Each group is then given 10 minutes to present their theorem in front of the whole class.
7. After the presentation, encourage the class to ask questions for the next 2 mins.

Note: The allocation of the timeline for the 3 periods can be decided by the teacher. Typically period 2 may be used for instructions and verification. Periods 3 and 4 may be

used by the students to verify the properties, derive the theorems, prepare the presentation, and demonstrate.

[Note to the teacher: The teacher can prove one more condition for a quadrilateral to be a parallelogram if required and given in their board syllabus. The condition and its proof are given below.]

Another condition for a quadrilateral to be a parallelogram

[Note to the teacher: The teacher can explain...

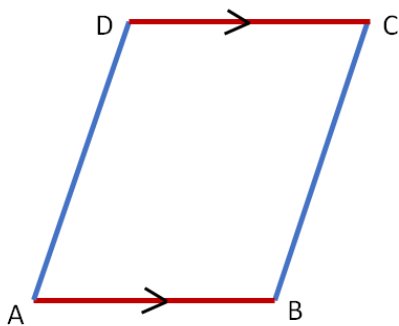
- 1) If each pair of opposite sides in a quadrilateral is parallel, then it is a parallelogram.
- 2) Also if each pair of opposite sides in a quadrilateral is equal, then it is a parallelogram.

Can you combine the two results?

If results (1) and (2) both are true for one pair of opposite sides in a quadrilateral then it is a parallelogram. We state and prove the result as follows]

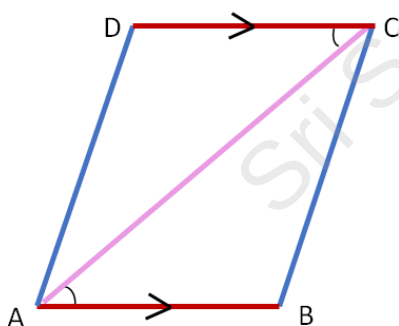
Theorem: A quadrilateral is a parallelogram if a pair of opposite sides is equal and parallel.

Given: In quadrilateral ABCD, $AB = CD$ and AB is parallel to CD



To prove: ABCD is a parallelogram

Construction: Join diagonal AC (or BD)



Proof: In $\triangle ABC$ and $\triangle CDA$,

$AB = CD$ (given)

$AC = AC$

$\angle DCA = \angle BAC$ (alternate angles when parallel lines AB and CD are cut by a transversal)

Thus, $\triangle ABC \equiv \triangle CDA$ (using SAS rule of congruence)

$\therefore DA = BC$ (CPCT)

Each pair of opposite sides in ABCD is equal, ABCD is a parallelogram

[Note to the teacher: The teacher can also give the proof as follows

$\triangle ABC \equiv \triangle CDA$

$\therefore \angle DAC = \angle BCA$. (CPCT)

Alternate angles when lines AD and BC are cut by a transversal are equal.

Thus, AD is parallel to BC. Each pair of opposite sides in ABCD is parallel. ABCD is a parallelogram]

PERIOD 5

Topic : Solving problems using the properties of parallelogram

Time : 15 + 15 + 5 = 35 mins

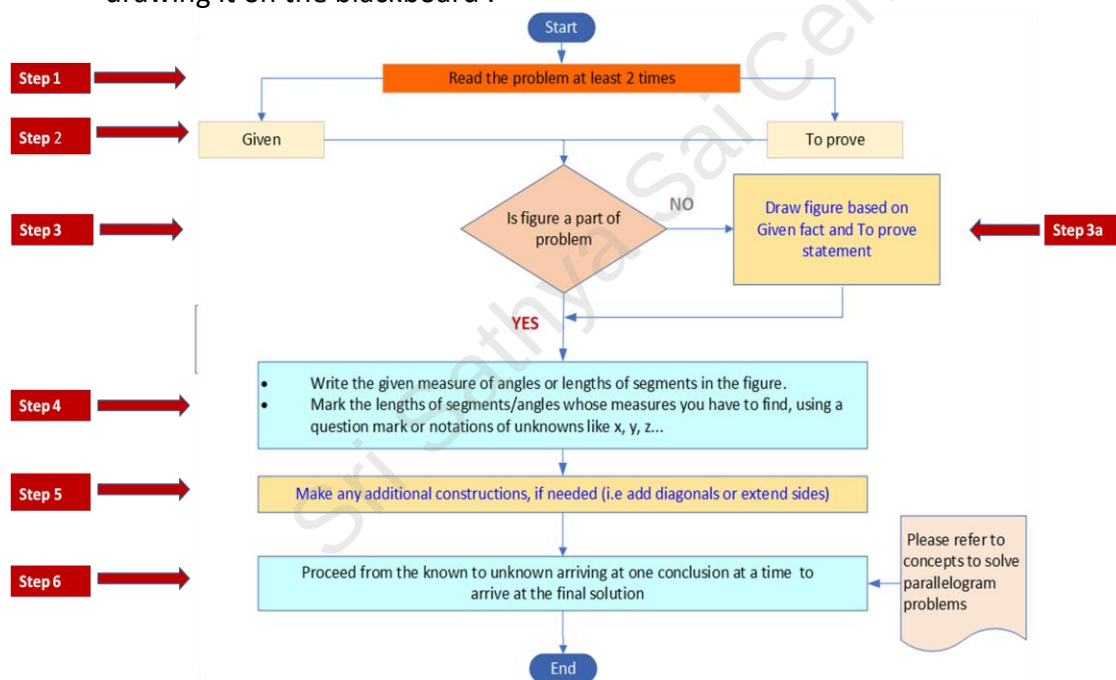
Asset Types: MS, QA, IA

Objective: Students will be able to

- 1) Solve problems related to properties of parallelograms and mid - point theorem systematically
- 2) Apply properties of parallelogram to solve problems
- 3) Appreciate the applications of properties of parallelograms in other disciplines

1) MS_Problem solving technique

1. A few stepwise guidelines are given below in the form of a flow-chart diagram. These steps will help a child to read, understand and apply the most suitable properties to solve any problem. You may explain these steps given below by drawing it on the blackboard .



2. After explaining the steps you can put up these following concepts that will be useful to solve any problem.

a. If the question states that certain lines are parallel, then identify the transversal if any. E.g. When a parallelogram is given, opposite sides are parallel. Side adjacent to the parallel sides, or any diagonal is a transversal.

b. From the given angles and the angles you need to find,

- group the linear pairs, vertically opposite angles
- when parallel lines are cut by a transversal, group the corresponding angles, alternate interior angles, angles on the same side of the

transversal etc.

c. When you have to find angles/sides

- o identify the triangles containing those sides/angles
- o if possible, try to prove that they are congruent using any one rules of congruence of triangles like SSS, SAS, ASA or RHS

d. Check if you can find the unknown or prove the given result using the properties of a parallelogram and the midpoint theorem.

3. You may pick up 2 questions from the QA asset and use the above guidelines as examples.

2) QA_Properties of parallelogram

Solve MCQs and two questions from the document **QA_TRD_Properties of parallelogram.pdf** which is provided as a Teacher Reference document. Give the rest of the questions in the document for additional practice.

3) IA_Parallelograms in Art - Corridor Domain

1. Encourage the students to research and make an art design, with parallelogram standing out as the main feature of the design.
2. It could be a collage, or embroidery or a rangoli. Materials could include paper, mirrors, fabric.
3. This team activity could be displayed as a poster on the notice board.
4. The students can do this activity in their own time.

PERIOD 6

Topic: Mid- point theorem and its proof

Time: 20 + 10

Asset Types: SA with IQ, MS

Objective: Students will be able to

- 1) Discover that the line segment joining the mid-points of two sides of a triangle is parallel to the third side and equal to half of it
- 2) Prove the mid-point theorem

1) SA_Mid-point theorem

Note : The Inquisitive questions are integrated with the Suggested activity as given below.

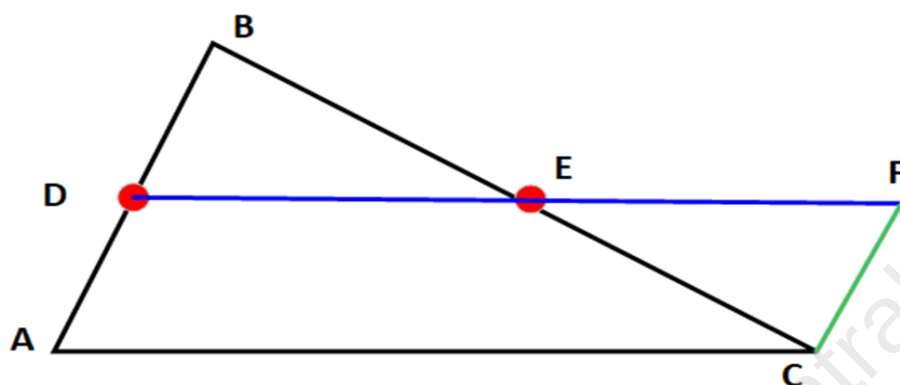
1. Conduct the activity as explained below
2. **Make the activity interactive by asking the Inquisitive questions. Sample questions are given.**
3. Through the interactions facilitate the students to discover the statement of the midpoint theorem.

Aim: To discover that the line segment joining the mid-points of two sides of a triangle is parallel to the third side and equal to half of it.

Materials required : Ribbon, crepe paper or masking tape and chalk

Setting for the Activity : Indoor**Role of the Teacher:** Facilitator**Procedure:**

1. Draw a triangle ABC on the floor.
2. Mark the mid points of any 2 sides. One way of doing this without measuring is as follows



Take a masking tape equal to AB. Fold it into two equal halves. Use this to mark the midpoint D of AB. Similarly find the midpoint E for BC.

3. Cut a masking tape equal to AC
 - a) Cut it into two equal halves. Place one half on DE.

What do you observe?

Hint DE = _____ AC ($DE = \frac{1}{2} AC$)

- b) Place the second half along EF such that DEF is a straight line.

What is the relation between DF and AC? ($DF=AC$)

- c) Cut a tape equal to DA. Use this tape to join points F and C

What is the relation between DA and FC? ($DA=FC$)

What type of quadrilateral is DACF? Why?

What are some other ways you can conclude that the quadrilateral DACF is a parallelogram?

Note: There can be many other ways of showing that DACF is a parallelogram.

Hint: Encourage the students to see if any line can be transversal and angle pair properties (when parallel lines cut by a transversal) can be checked.

Observation: Opposite sides of DACF are equal and so it is a parallelogram.

Based on the above observation, what can you conclude about line segments DE and AC?

Conclusion: Through this activity we can conclude that the line segment joining the

mid-points of two sides of a triangle is parallel to the third side and half of it.

2) MS_Proving Mid-point theorem

Facilitate the students to prove the theorem in their notebooks.

PERIOD 7

Topic: Converse of the midpoint theorem, Problems using the midpoint theorem

Time : 10 + 20

Asset Types: MS, QA

Objective: Students will be able to

- 1) Complete the proof of the converse of the midpoint theorem
- 2) Apply Midpoint theorem and its converse to solve problems

1) MS_Converse of Mid - point theorem

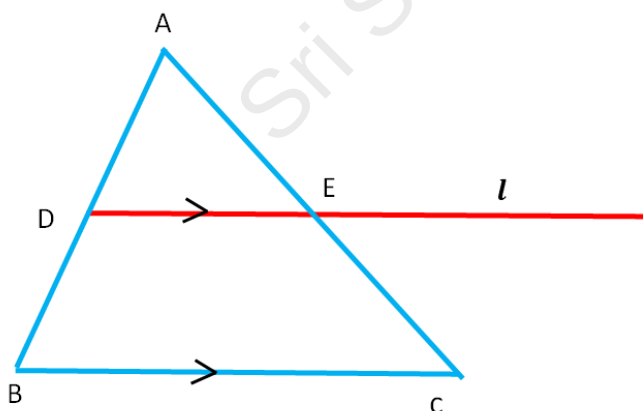
1. State the Converse of the Midpoint Theorem.
2. Give the skeleton proof on the blackboard. A sample skeleton is given below for your reference.
3. Elicit the answers from students enabling students participation in the proof
4. Make the students to write down the proof in their notebook

Converse of Mid-point theorem:

Statement: The line drawn through the mid-point of one side of a triangle, parallel to another side bisects the third side

[Note to the teacher: The teacher can start the class, as follows.

Let us draw a triangle and rewrite the statement using an 'if..then' clause with names for sides, points, etc. in the triangle.]



In a triangle $\triangle ABC$, if a line l is drawn through the midpoint D of side AB and l is parallel to the second side BC then it bisects the third side AC

Let E be the point of intersection of line l with AC

[Notes to the teacher: The teacher may give the following skeleton proof on the blackboard and elicit the answers from the students, thereby enabling student participation in proving the theorem]



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Annexure to Master Lesson Plan

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	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

asset?	recent or local example.
What is an 'Interesting Aside' (IA) asset?	The Interesting Aside asset uses attention grabbing tidbits 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.