

Experiential Learning Plan (ELP) - Maths

TOPIC	Patterns in Mathematics
SUB-TOPIC	Patterns in Numbers
DURATION	75 minutes

CURRICULAR GOALS	CG 1: Looks for patterns and appreciates relationships between numbers. CG-9: Knows and appreciates the development of mathematical ideas over a period of time and the contributions of past and modern mathematicians from India and across the world.
COMPETENCIES AS PER NCF/NIPUN BHARAT	C1.2 - Discovers, identifies and explores patterns in numbers and describes rules for their formation (e.g., multiples of 7, powers of 3, prime numbers) and explains the relationship between different patterns C9.2 - Knows and appreciates the contributions of ancient Indian Mathematicians
SDG (Sustainable Development Goals)	SDG4: Quality Education

Strategies As Per NEP	Experiential Learning - Story based
Collaborative Learning approaches	Think-Pair-Share

Technology aids	PPT: ELP_Patterns in Numbers.pptx Video: ELP_IA_Patterns and Chhanda Shastra.mp4 [IA- Interesting aside]
Learning Aids	Worksheet: ELP_QA_Number Patterns_Worksheet.pdf
Assessment (As, For, Of)	1. Assessment For Learning(AFL) - Questions for reflection and conceptualisation 2. Assessment As Learning(AAL) - Case Study 3. Assessment Of Learning(AOL) - Worksheet
Interdisciplinary Connections	Connect with Languages - Patterns in Poetry Metres
Cross-Cutting Themes	Values and dispositions - Value based question(Value: Empathy) Indian Knowledge System - <i>Chhanda Shastra</i> and patterns Technology aids - PPT and Video

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Previous Knowledge Required	Basic mathematical operations
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Brief Description:

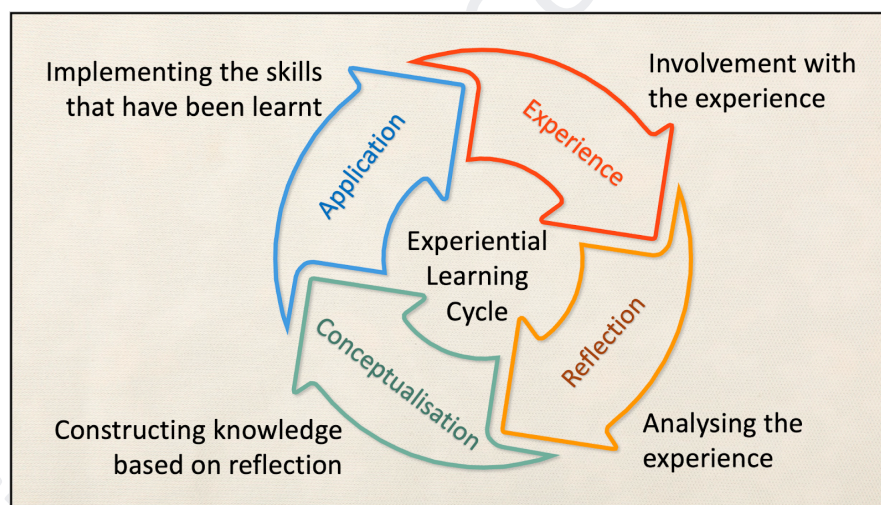
This **Experiential learning plan** on the topic '**Patterns in Numbers**' uses a **story-based** pedagogy. The module integrates inquisitive questions(IQ), Value Content(VC), a Main script(MS), a Day-to-day relevant case study-based activity(DD, SA), an Interesting aside(IA) and Questions to Assess(QA).

Cross-cutting themes of value integration, Indian Knowledge system and technology aids are provided as per NCF recommendation.

Specific Learning Outcomes

Students will be able to

1. **connect** to real-world examples like patterns of numbers in train berths [Fulfills C1.2]
2. **identify** the rule that governs a pattern [Fulfills C1.2]
3. **predict** the next term in a sequence [Fulfills C1.2]
4. **create** their patterns using numbers. [Fulfills C1.2]



Note to teacher: The table below highlights the tasks for each stage of the experiential learning cycle. The details and explanation of the content, wherever required, will be available as 'Note ___' after this section. The same can also be accessed by clicking on 'Refer Note ___' wherever mentioned in the table below.

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Stages	Description of task	Teacher tasks	Student tasks	Time (Mins)
Experience	The Story is about a family travelling in a train and kids trying to figure out the seat and berth numbers. For the full story - Refer Note E1.1	Narrate the story with the help of a PPT(Visual aid)	Listen intently and become an experienter of the characters of children in the story.	5
Reflection	List made by the children: Lower berths: 1, 4, 7, 9, 12, 15, 17, 20, 23,.. Middle berths: 2, 5, 10, 13, 18, 21, ... Upper berths: 3, 6, 8, 11, 14, 16, 19, 22, 24 1)What would be the number of the next middle berth? 2)Look at the diagram of the coach and identify which particular kind of berths the numbers 8, 16, 24, etc. represent. What is the common property of all the numbers in this category? 3)If you are allotted number 57, which berth will it be? Were you able to identify the berth type by using any shortcut method? 4)Value Based question Refer Note R1.1	Show the questions on a slide or write it on the blackboard and ask students to write the answer in their notebooks. [Note: Some children may like to do a diagrammatic or pictorial representation by drawing. Please encourage them to do it.] Do not reveal the answers on the slide, till you finish the discussion.	Every Student writes the answer for each question. Some children may draw diagrams or picture to think and express their answers.	20
Conceptualisation	[Some clues for your probing questions while discussing the reflections.] a)What pattern did you notice in the seat numbers of middle berths? b)Did you see a rule in the pattern of the side upper berths? How will you express that rule?	Interactively elicit the answers along with the reasoning and how they went about doing it. Answers may vary - each may have a different method of finding out. Try to get all the methods and	Participate actively in the discussion.	15

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	c)How did you decide which berth is 57? For clues to the answers - Refer Note C1.1	help them see if a formula will work. To further strengthen the concept, give another simple problem for finding the next number in the sequence. You may use their inputs to summarise a few ways of identifying the rule - Refer Note C1.2		
Application	Case study - 'Road Traffic congestion in Delhi' Refer Note A1.1 Some possible solutions for teacher's reference - Refer Note A1.2 Use of pattern in daily life - Refer to PPT	Present the case study given. Option: You may choose to use the case study based question given in the worksheet, depending on the level of your students. Use the TPS (Think-Pair- Share) technique - Refer Note A1.3 Allow presentations by students and enable discussion. Elicit examples of patterns in daily life.	Think and prepare their solutions. Collaborate with their partner and arrive at a plan. Present their solutions to the class. Participate in discussions with presentations of other students.	30

1)Interesting Aside(IA)_Patterns and Chhanda Shastra by Ancient Indian Mathematician Pingala

Duration: 5 minutes

Specific Learning Outcome: Students will be able to

- connect number patterns to patterns in poetry metres in language
- appreciate the contribution of ancient Indian Mathematician Pingala. [Fulfills C9.2]

[Note: This brings an **interdisciplinary** connect with the Languages and Literature]

Show the Video **ELP_IA_Patterns and Chhanda Shastra.mp4** to the students.

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This video explains about poetry metres of the Sanskrit language in our ancient Vedic texts - the *Chhanda Shastra* and was developed by one of our ancient mathematicians, Pingala.

After watching the video, you may ask the students to find out the poetic metres of their own regional language or mother tongue.

2) Questions to assess (QA)_Number Patterns

Specific Learning Outcome: Students will be able to

- solve questions based on number patterns. [Fulfills C 4.2]

A worksheet, **ELP_QA_Number Patterns_Worksheet.pdf**, has been provided as a learning aid. Use the worksheet to reinforce the application of the concepts learnt. The students may solve the worksheets in groups in a subsequent period or may complete them individually as a home assignment.

Note E1.1

Story :

Sirish and Shriya, along with their parents, boarded a train from Hyderabad to New Delhi for a holiday trip. They were both very excited as they were travelling for the first time by train. They were very curious about everything around them. They were in the coach numbered S9. They wanted to know how the middle berth would hang up. "Will it be able to hold our weight?" they wondered. Just then two passengers arrived, claiming that those seats were theirs. The children were worried. The mother asked the new passengers to show their tickets and she saw that the numbers of the berths were indeed the same. But the passengers had come to the wrong coach. They had to go to the next coach, S8. So the passengers' confusion was cleared, and they moved on. The children continued to ask questions about all that aroused their curiosity.

They asked about the numbers written above their seats. Their mother replied that the seats are numbered, so that the passengers can easily locate their assigned seats. Then she gave them a task. She asked them to look at the seat numbers carefully and list them to find a pattern in how the lower berths, middle berths and upper berths are numbered. They both took out their notebooks and started writing down the seat numbers for each type of berth in the first 24 seats of their coach. They noticed a very interesting pattern in the seat numbers.

Note R1.1

Value Based Question

Now imagine that you are inside a train. Imagine that you have been allotted a number 57 (lower berth). A middle-aged lady or man with a knee problem has been allotted the middle berth. How will you act when you find him disappointed with the berth allotted to him?

Options:

- If he/she asks me for an exchange of seats, I will give the person my berth.
- I am afraid of falling from the middle berth. It is not very comfortable for me. So I will not exchange my berth even if they ask me.

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c) If I observe any elderly person having difficulty with their allotted berth, I will offer to exchange my lower berth with him/her.

Note C1.1

Clues to answers

1) The middle berths are **2, 5, 10, 13, 18, 21, ...**

What rule can you observe in this list?

$$2 + 3 = 5$$

$$5 + 5 = 10$$

$$10 + 3 = 13$$

$$13 + 5 = 18$$

$$18 + 3 = 21$$

So, now what should be added to 21 to get the next middle berth? (Expected Answer: **5**. Why?)

So, the next middle berth is $21 + 5 = 26$.

2) 8, 16, and 24 are all side upper berths. All these numbers are multiples of 8.

3) Given any seat number greater than 8, we can find the type of berth using this technique.

Divide the seat number by 8 and find the remainder. The remainder will give you the berth position.

When 57 is divided by 8, the remainder is 1. Seat number 1 is a lower berth, and hence, 57 is a lower berth.

Note C1.2

Rules that govern a pattern

Given a number pattern with 4 or 5 terms, how can you find the next terms in the pattern?

Expected answer: A sequence follows a specific rule that helps us to determine the next term.

What is the rule followed by the terms in the first pattern, second pattern?

Finally, summarise the ideas with inputs from the students as follows

How can you identify the specific rule that governs the pattern?

To identify the pattern,

- Check the difference between consecutive terms to find any added number.
- Sometimes, the differences between subsequent consecutive numbers may not be the same. They may follow another pattern themselves. (E.g. berth number patterns)
- Check the quotient of consecutive terms to find any multiplied number.
E.g. 1, 2, 6, 24, 120, ...
Rule: $1 \times 2, 2 \times 3, 6 \times 4, 24 \times 5, \dots$
- Sometimes, the consecutive number may be obtained by multiplying by a constant and then adding or subtracting another constant.
E.g. 2, 10, 34, ...
Rule: $2 \times 3 + 4, 10 \times 3 + 4, 34 \times 3 + \dots$

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Note A1.1

Case Study

In New Delhi, the air quality becomes very bad in October and November. To reduce the air pollution, the government introduced the following plan to reduce the number of vehicles on the road. On all odd-numbered dates only vehicles with odd registration numbers like 4053, 7121, ... would be allowed on the roads. On all even-numbered dates only the vehicles with even registration numbers like 5244, 6890, ... would be allowed on the roads. But despite this, the air quality did not improve much. So, the authorities began to look for other measures to further reduce the number of vehicles on the roads. Now, we want you to come up with your ideas in the form of number patterns. Take a small sample of vehicle numbers, say, from 1201 to 1220. The same can then be implemented for all numbers.

Develop patterns so that all vehicles may get a chance to be on the roads for at least 1 day of the week.

A sample is shown below. Fill it up to get an idea. Then, you may have a single day in the first column and different rules in the last column.

Day/Days of the week	Vehicle numbers	Rule of the pattern
Monday, Thursday	1201, 1204, 1207, 1210, 1213, 1216, 1219	(Multiple of 3) + 1

[Note to teacher: Divide the students into groups of 5 or 6.]

Give 15 minutes for the students to come up with their ideas. After that, ask each group to present their solutions in front of the whole class. After the presentation, ask them the following questions.

1. On how many days in a week will a car with number 1205 be allowed on the roads?
2. Do taxis and autos also have to follow the same rule? What do you think?
3. Suppose someone needs to be taken to the hospital and his vehicle number is not allowed that day. What is to be done?

Note A1.2

Possible Solutions to case-study

Some suggested answers are only for the Teacher's reference.

[Note to the teacher: Do not show these tables to the students before they present their ideas. If the students are not able to do this, the teacher may give aptly filled in solutions and ask the students to fill in the rule or the vehicle numbers]

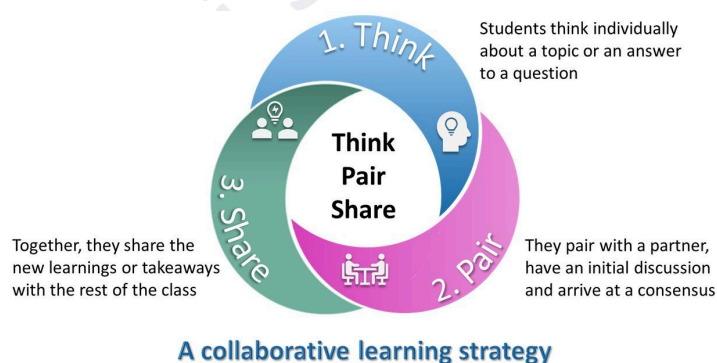
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Day/days of the week	Vehicle Numbers	Rule
Mon and Thurs	1201, 1204, 1207, 1210, 1213, 1216, 1219	(Multiple of 3) + 1
Tue and Fri	1202, 1205, 1208, 1211, 1214, 1217, 1200	(Multiple of 3) + 2
Wed and Sat	1203, 1206, 1209, 1212, 1215, 1218	Multiple of 3
Sunday	All vehicles	No rule

Day/days of the week	Vehicle Numbers	Rule
Monday	1201, 1206, 1211, 1216	(Multiple of 5) + 1
Tuesday	1202, 1207, 1212, 1217	(Multiple of 5) + 2
Wednesday	1203, 1208, 1213, 1218	(Multiple of 5) + 3
Thursday	1204, 1209, 1214, 1219	(Multiple of 5) + 4
Friday	1205, 1210, 1215, 1220,	Multiple of 5
Sat and Sun	All vehicles	No rule

Note A1.3

TPS Technique(Think-Pair-Share)



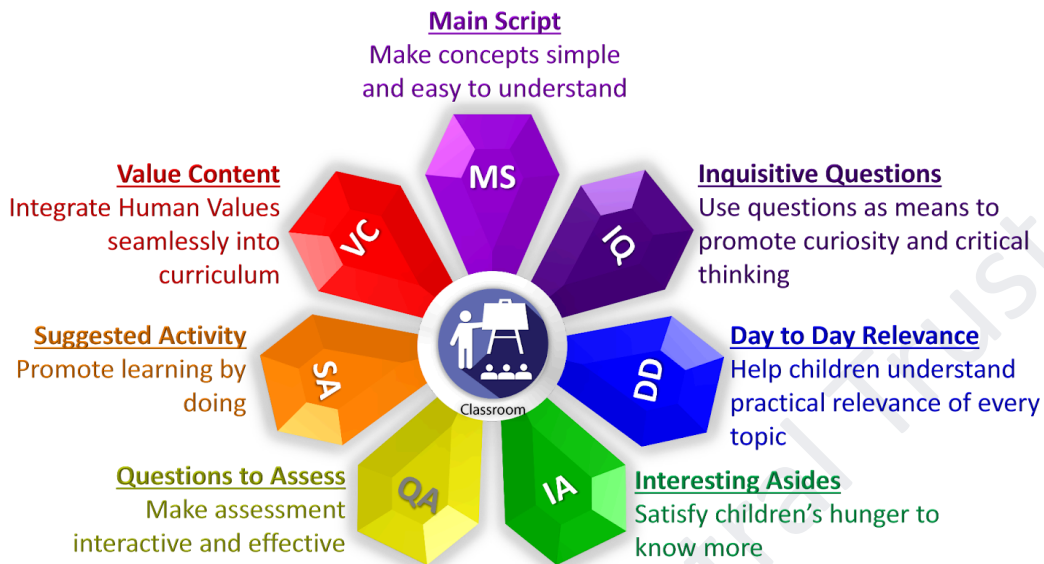


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7 Assets [Components] of SSSVV



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