

Azim Premji University

# At Right Angles

A RESOURCE FOR SCHOOL MATHEMATICS



# INTRODUCTION TO COUNTING

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# INTRODUCTION TO COUNTING

Children’s understanding of numbers begins naturally as they explore the world around them—even in infancy. Through repeated interactions with objects and the language used in their environment, they gradually build early number concepts.

In everyday situations, children encounter sets of objects and numbers like two and four, through interactions with familiar household items such as toys, plates, clothes, chairs, or food containers. Conversations around daily routines, for example, “*Did you eat two rotis?*”, “*She has three dolls,*” or “*I bought six bananas and four apples*”—provide meaningful opportunities to experience numbers in context. These real-life experiences form the foundation of early numerical thinking.

Toddlers begin to associate number words with actual quantities, such as understanding that “two” refers to two apples or two toys. They also grasp comparative ideas, such as “more” and “less,” for example, asking for more biscuits or fewer carrot slices. Initially, children view numbers as indicators of quantity. Gradually, they come to understand that numbers can also express position (second, third), serve as labels (House No. 104), or represent abstract measures (three years old).

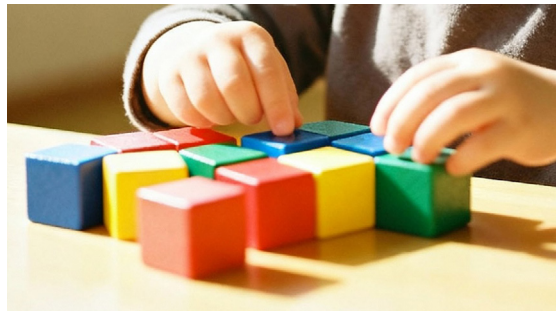


Figure 1

Children possess an innate ability to visually perceive and compare small groups of objects—usually up to five—without counting, a skill known as **perceptual subitising**. Teachers can build upon this natural ability in order to support the development of effective counting skills. Additionally, it is worth noting that addition is inherent in counting, and subtraction is inherent in backward counting. Hence, these three concepts go together.

This pullout begins by highlighting the natural ability of both children and adults to instantly recognize small quantities (up to 6) without counting. It emphasizes strengthening this skill through various activities, alongside teaching effective counting methods for students in the three years of pre-primary and in Classes 1–2. Subitising plays a key role in early mathematics education, as it helps children to build mental images for numbers and visualize number facts. It develops an intuitive understanding of numbers, enhancing mental arithmetic skills, goes beyond rote counting towards flexible thinking about numbers, and helps to recognize patterns in numbers that support more advanced concepts in mathematics.

*Keywords: number, pre-number skills, subitising, counting, numeracy, counting principles.*

### Not as simple as 1-2-3

Teachers at the foundational stage may observe that as children progress in their counting and number understanding, they often display certain common misconceptions and errors, such as:

- Misjudging amounts based on how objects are spaced or arranged.
- Not understanding that the last number counted represents the total quantity (the **cardinality principle**).
- Struggling to recall the correct counting sequence.
- Confusing the order of the number-names when counting forward or backward (the **stable order principle**).
- Making errors in one-to-one correspondence, such as skipping or double-counting items.
- Failing to grasp the **conservation principle** that quantity remains the same despite changes in arrangement.
- Underutilizing visual perception when comparing small sets of objects. Children may rely less on visual perception when comparing small groups of objects. After learning to count, they often believe they must count every time, even when recognizing the quantity visually—such as identifying a group of four objects.

Our teaching approaches must be designed to prevent these errors and actively support children in overcoming them as they learn to count and understand numbers.

Table 1

## ACTIVITY 1: DEVELOPING PERCEPTUAL SUBITISING SKILLS

**Objective:** To support and assess children’s ability to perceptually subitise—recognising small quantities (typically up to 5 or 6) instantly, without counting.

**Materials:** Dot flash cards, standard dice

### Procedure

Perceptual subitising is the immediate recognition of a few items. For instance, when a child sees four dots on a die, they can say “four” without counting each dot.

Use dice as a natural tool for reinforcing these patterns, especially for quantities 1 to 6.



Figure 2

Prepare flash cards displaying various spatial arrangements of 3, 4, 5, and 6 dots.

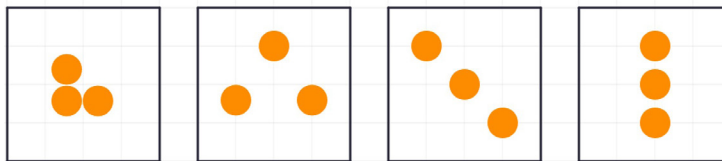


Figure 3: Example of flashcards for 3 dots

Use consistent dot sizes and spacing to ensure clarity. Briefly show each card (for 1–2 seconds) and ask children to say the number they see. This encourages visual pattern recognition rather than counting.

### Extension

Once children confidently identify quantities from 1 to 6 across different configurations, introduce flash cards with 7 to 10 dots. An example for 9 is given (Figure 4).

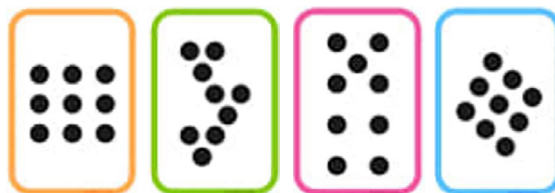


Figure 4

These cards may require more complex mental grouping and lay the foundation for conceptual subitising.

**Conceptual subitising** involves recognizing larger numbers by mentally grouping smaller sets within them. For example, seeing nine dots as three groups of three. This type helps children understand part-whole relationships important for addition and subtraction.

## ACTIVITY 2

**Objective:** To support and evaluate children’s development of perceptual and conceptual subitisation.

**Materials:** Hands and fingers, ten-frames, ten-frames with dots

Let them start with numbers below 5 initially. For example: Show 3 in different ways. (Figure 5)

Children naturally use their hands and fingers to show numbers up to ten. They begin to recognise number patterns formed by finger arrangements, such as seeing eight as five plus three or four plus four.

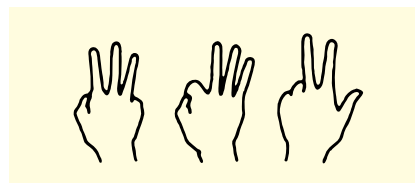


Figure 5



Figure 6

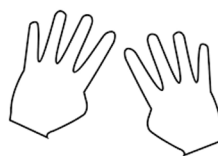


Figure 7

A ten-frame (Figure 8) is a rectangular grid made up of two rows and five columns, totalling ten sections or boxes. Children use it to place counters or markers to represent numbers up to ten, helping them develop number sense, understand one-to-one correspondence, subitising, and visual representations of numbers.

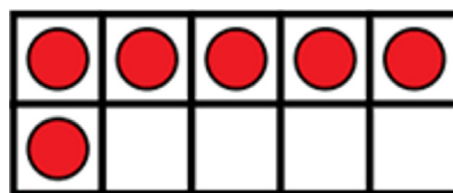


Figure 8

Let children place counters on these frames in various patterns and call out the number of counters. Its layout helps children identify numbers larger than five more easily.

This can be followed by using charts or flashcards with various number patterns displayed on ten-frames to enhance their ability to subitise both perceptually and conceptually.

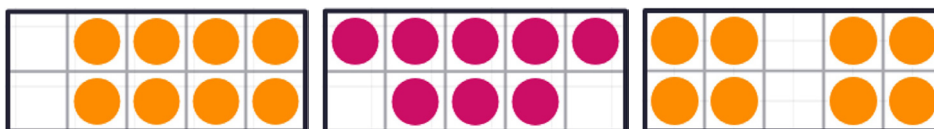


Figure 9: Flashcards showing the number 8 using a ten-frame arrangement

As children become more comfortable with the ten-frame, they may begin to view the cards in different ways. For instance, some might instantly recognize a pattern such as 4 and 4, while others may notice that two counters are missing from a full frame and conclude that the number is 8. It is essential to allow students the space and freedom to develop their own strategies for interpreting the frame. The teacher can encourage deeper thinking by asking questions like, “What makes you think it’s 8?” or “What would happen if the bottom row were empty?”

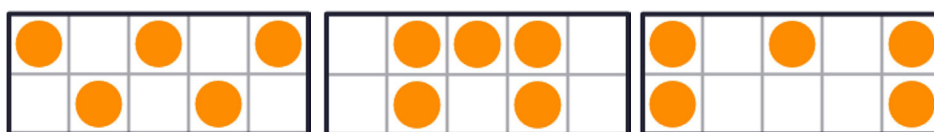


Figure 10: Flashcards showing the number 5 using a ten-frame arrangement

## Extension: Showing Numbers in Different Ways

Hold up five fingers, display a giant dice, or show a large numeral, and then ask children to represent that number in as many ways as possible. Provide countable items and resources so they can experiment with different representations.

Possible materials:

- Seeds, counters, small toys, large blocks, multilink cubes (cubes that can be connected)
- Dot patterns such as on dice and dominoes
- Structured materials such as ganitmalas, 10-bead strips, Montessori number rods
- Everyday packing items such as egg boxes or crayon boxes, which have slots
- Number symbols, such as number lines or 100 square grids

## Encouraging Mathematical Thinking

There are three 5s shown in Figure 11.

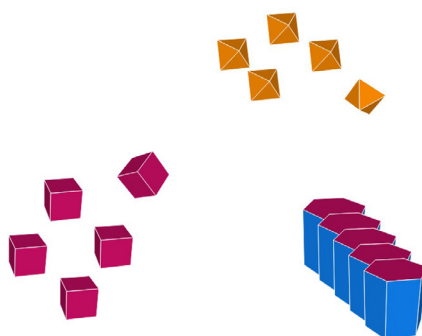


Figure 11

### Describing

- How does this five look different from that five (point to another group)?
- What does this pattern of five (point to one group) look like?
- What can you see?

### Reasoning

- How do you know these are all the same number?
- How does each five in Figure 11 look different from the others? What is the same, and what is different about these fives?

### Opening Out

- How can you make five with two hands?
- Can you show me five using your fingers in another way?



Figure 12

## Game 1: Hide-and-Reveal Counter Game

Children are naturally drawn to games of hiding and discovery.

Place one, two, and three counters beneath three separate but identical bowls. Briefly reveal the contents of one bowl, then cover it again, and ask the children to identify how many counters they saw. This encourages instant recognition.

### ACTIVITY 3

**Objective:** To support and evaluate children's development of the conservation of number.

**Materials:** Counters of 2 different sizes or seeds of two different sizes, such as rajma and channa

In comparing two groups of objects, students may focus on the relative size of the objects or the way they are arranged rather than the number of items. They may see a collection of 4 objects arranged at a distance from each other as being more than a collection of the same 4 objects packed closely together.



Figure 13: Conservation Principle

The teacher can use different arrangements of counters (such as shown in Figure 14) and ask students to compare the two rows or two groups and identify pairs which show the same number, to ensure that the students have developed conservation of number.

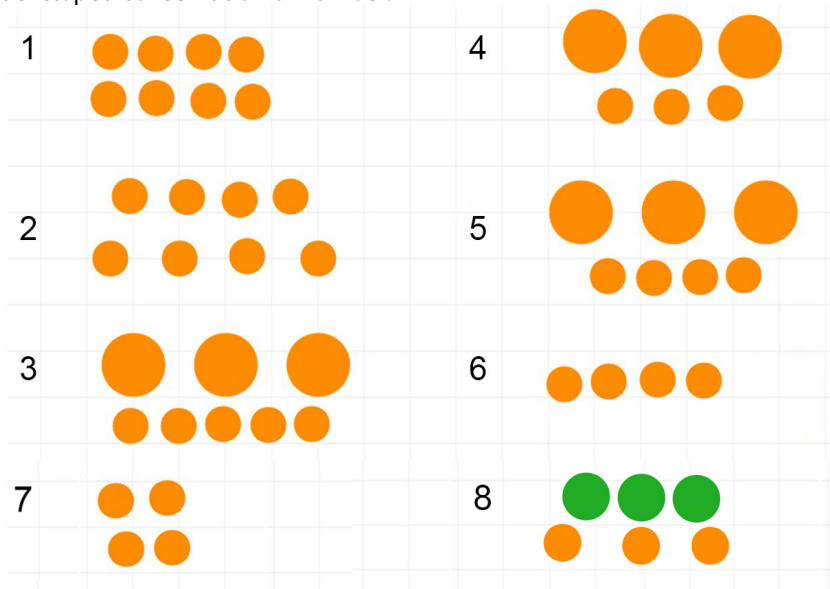


Figure 14: Exposure to such an activity will help students grasp the conservation principle that the quantity remains the same despite changes in arrangement.

In the next activity, we approach understanding the cardinal value of a set, which involves understanding that the value doesn't change unless something is added or taken away, an element of conservation of number.

## ACTIVITY 4

**Objective:** To build a sound conceptual understanding of numbers through the notion of 'one more'.  
To understand the **cardinality** principle.

**Materials:** Set of objects (colourful beads/cubes), string of 10 beads, 10 interlocking cubes

The issues referred to in Table 1, (common errors while learning to count) can largely be resolved by explicitly introducing the concept of 'one more' at first and emphasizing it till the number relationships are fully grasped. This is followed by the concept of 'one less'. For example, 5 is 1 more than 4 or 9 is 1 less than 10. This approach slows the counting process, allowing time to point to each object (one-to-one correspondence) and highlight the counted group (cardinality principle).

The following conversation centred around Figure 16 will illustrate this approach.



Figure 15: A string of 10 large beads is a good aid to teaching counting in order.

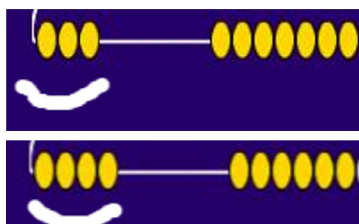


Figure 16

*'Let's start. This is 1.'* (Point to the first bead.)

*Now move one more bead across. 'How many beads are on this side now? That's right, 2!'* (Point to the two beads.)

*Slide another bead over. 'How many beads are here now? Yes, 3!'* (Point to the three beads together.)

*Then slide another bead and point to the four beads together.*

Repeat this activity by counting in different directions—right to left, left to right.

Later, the string can be held vertically and the counting can be from top to bottom, or bottom to top.

While working with cubes, a typical conversation between the teacher and the student would look like this:

Holding up one blue cube



Look, I have one cube.

Places it on the table.



Now, I'm adding one more.  
(Adds a blue cube beside it.)  
Let's count: one, two.  
(Points to the set of two cubes.)  
How many cubes now?

Two



Yes! Two cubes. One (points to one of the two cubes) and one more make two.



Now I'm adding one more. (Adds another blue cube.) Let's count together: one, two, three. Now we have ...

Three cubes



Right! One, two, three — (points to three) three cubes.



One more cube. (Adds a blue cube.) Let's count: one, two, three, four. How many have they become? (points to all four)

**Note:** When teaching counting and number names, it is often more effective to divide the learning process into two stages. In the first stage, children are introduced to the numbers up to 5. This helps them grasp small quantities, understand basic counting, and become familiar with the corresponding number names. Once they are comfortable with this foundation, the second stage can focus on numbers from 1 to 10. Gradually extending the range allows children to build confidence, recognize number patterns, and strengthen both their counting and number recognition skills.

## Game 2: Treasure Box

**Materials:** A cardboard box for holding small objects (such as shells, pebbles, or counters).

### Instructions:

Display a few objects (for example, three shells) and count them aloud with the children: “1, 2, 3.”

Place the counted shells into the opaque box while children watch.

Ask the children: ‘How many shells are in the box?’

Then continue the activity by adding more shells to the box and prompt further thinking:

How many shells will there be if I add one more?

How many will there be if I add two more?

How many will be there if I remove one?

Encourage children to respond based on their counting and mental addition skills before checking by opening the box.

## ACTIVITY 5

**Objective:** To build a sound conceptual understanding of zero through the notion of ‘one less’. Counting backward, using language such as one less, zero, none.

**Materials:** Numeral cards (10 to 1)

**Scenario:** Engaging Children through Song, Story, and Number Play

This activity can be enacted by students while reciting any rhyme that counts from 10 to 0. Here is one possible rhyme.

“Zoom zoom zoom,  
We're going to the moon!  
Zoom zoom zoom  
  
We'll be there very soon!  
10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0. Blast off!”

This rhyme uses repetition and storytelling to make counting backwards accessible and enjoyable for young learners. Let children stand in a line behind one another, holding numeral cards 10 to 1, in decreasing order. Teach them the rhyme about going to the moon. Let them join in singing and acting out the story. Begin to sing the rhyme slowly. At the end of each verse, the child who is leading will leap and leave the column. Ask children to share aloud how many remain each time. ‘We were 10. One less. Now 9’, ‘We were 9, one less. Now 8.’ Children will find the answer easy to predict, as each time it is one less.

Pose questions:

‘What happens to the number of children each time one zooms away?’

‘If two zoom away, how many are left? How do you know?’

‘What if all zoom away at once? What if more children join?’

The teacher can evaluate the students by asking the children to model the activity with their fingers.



Figure 17

## Evaluation

Pose riddles based on classroom context: You can see only one of me in the classroom! Who am I? You can see only two of me! Who am I? Let students give examples such as a blackboard or a door for the number one.

Home context: Pose questions that help them reflect on some objects at home. Discuss the number of members in the family. Ask if the number of cots is the same or more than the number of family members. Can they think of any objects that are more or less than the number of family members? Some objects in the house are usually only one, some may be two, and so on. Ask children to find objects in the house for which there is only one such object, only two, and so on.

## Notes: Motivation

Children usually enjoy counting and often do it naturally in everyday situations. However, within the classroom, the teacher may sometimes need to create meaningful reasons to count. Encourage curiosity by asking questions such as, “How can we find out how many are here?”

Provide varied opportunities for counting:

- Count objects arranged in a line or scattered randomly.
- Count drumbeats, claps, or the number of jumps it takes to cross the room.
- Compare the number of letters in each child’s name.
- Encourage estimation of small groups of objects and verify by counting.

Act out number-based stories like *Panch Pandavas* or *Snow-White and the Seven Dwarves*.

Missing magic number: Show a group of objects, secretly remove a few, and challenge children to find the “missing magic number.”

### ACTIVITY 6

**Objective:** To compare quantities using terms such as ‘more’ and ‘less’.

**Materials:** Set of objects (colourful beads/cubes)

**Collections:** Children love to collect objects from nature. It could be stones, seeds, flowers from nature, or beads, cubes, and toys in the classroom. The teacher can give a container to each child or one container to be shared by 2 or 3 children. They can collect a few (between 5 and 10) objects of the same kind in their container.

Initiate a conversation: ‘Tell me about what you have in this basket. How many? What happens when you put in another? What happens if you give me some of them?’

‘Let’s look at what is in these two containers. Do they have the same number of things? What makes that one different?’

In a daily situation, talk about ‘as many as’, for example, ‘The number of stools is as many as the number of students.’

**Objects in hand:** Ask children to hold more objects in one hand and less in the other hand.



Figure 18: A ganitimala helps in counting forward and back and in comparing numbers

Switching sides: Draw 2 circles and ask two children to stand in one circle and five in the other circle. Pose the question ‘How can we have more in this circle (pointing to the one with 2) and fewer in the other?’ Do the students find more than one way of solving this?

Pose **open-ended** questions: ‘Can you show more than that number? In how many ways can you show more?’

‘Can you show less than that number? In how many ways can you show less?’

What should we do to make these two containers hold the same number of objects? Children have an implicit idea of balance and will come up with various suggestions.



Figure 19a



Figure 19b

**Note:** Related relationships should be emphasised while comparing groups. ‘There are more pencils than crayons. So, there are fewer crayons than pencils.’

Usage of **one-to-one correspondence**: Children may be able to identify more or less for small sets through visual perception. However, as the numbers grow, the usage of one-to-one correspondence is the approach to be used.

Note: Before entering school, children usually learn to count a small number of objects (usually, up to 10). In school, this understanding of counting is further strengthened through structured teaching methods. Activities 4, 5, and 6 may be introduced before the subitisation activities 1, 2, and 3. The activities need not follow a fixed order, as some can progress in parallel.

## ACTIVITY 7

**Objective:** To build effective counting techniques.

**Materials:** Set of objects (colourful beads/ cubes)

Children come to understand from their diverse experiences that the order in which they count objects does not affect the total count. This concept is known as the stable order principle. To grasp this, children need multiple opportunities to count the same set arranged in different ways, helping them realize that changing the counting order does not alter the total. Teachers can provide the experience of counting rows of objects such as the number of tiles on the floor, or shoes on the rack or books on shelves from multiple directions.

Although counting usually begins anew—from 1 up to the end of the set—effective counting often involves using prior knowledge or strategies such as partitioning, counting forward or backward, and grouping.

Examples of these strategies include:

- Partitioning and counting
- Matching and counting
- Grouping and counting
- Counting forward and backward

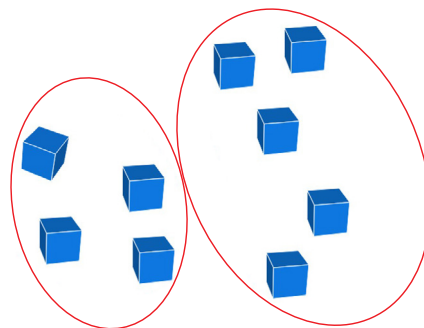


Figure 20

**Partitioning and counting:** A child may partition a group of objects into small manageable sets and use perceptual subitisation to arrive at the number.

Example: To count the collection of given cubes, child may mentally partition it into two sets and arrive at 9.

## Matching and counting

How many berries?

A child may recognize that there are 9 leaves and that there are 9 berries that are connected (matched) to each, and then count the remaining berries, arriving at 15 berries. (9 and 6 is 15.)

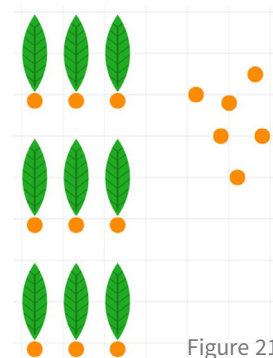


Figure 21

## Grouping and counting

How many shapes in Figure 22? The child may decide to treat them as 3 groups with 3, 4, and 5 shapes in each group and count them together, recognising 3 and 4 together as 7 and then adding on 5 or recognising 5 and 4 as 9 and adding on 3.

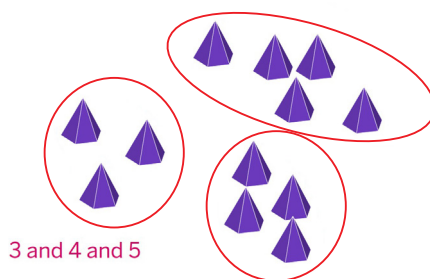


Figure 22

## Counting forward and backward

How many circles in Figure 23?



Figure 23

A child may recognise the configuration as 9 and 9 and count forwards from 9 onwards as 10, 11, 12, .... 18. Or may recognise the two frames as 10 and 10, and go 2 steps backwards as 20, 19, 18.

It is good to demonstrate these concepts through multiple materials. Ganitmala is to be used to reinforce the idea.

In forward counting, watch whether children are recognising the group and counting forward

**Note: Avoid the use of the word 'plus/minus' and the symbols '+/-' in the early phase.**

## ACTIVITY 8

**Objective:** Counting using Patterns.

Create simple patterns such as shown in Figure 24 and ask them to count the shapes. Children may use their pattern recognition and classification skills.

How many pink circles? How many orange circles?



Figure 25

Construct patterns from right to left, left to right, top to bottom, etc.

Explore a variety of patterns, linear borders, and growing patterns.

Figure 26 shows a more complex pattern! How many blues? How many reds? How many yellows?

Ask the children to explain how they obtained their answers.

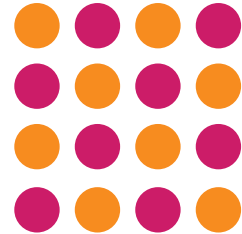


Figure 24

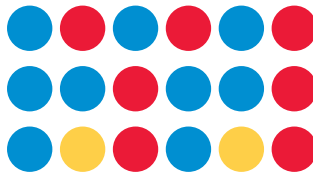


Figure 26

## ACTIVITY 9

**Objective:** Counting exposure through everyday experiences.

Classroom: Counting the number of students present, counting materials like shapes, beads, etc., while tidying up the classroom at the end of the day.

The teacher could make number labels for seats.

Counting days remaining for a particular event on the calendar, or counting hours on the clock are ways to count using visual materials such as the calendar and the clock which are present in most classrooms.

The following rote counting ideas help students learn the number names in the correct sequence.

- Have students count forward and backward, one to nine.
- Let them count on from a given number
- Let them count between two given numbers

Common games: Snakes and Ladders, counting in hide and seek, and local versions of hopscotch (Kunte Bille/ Kith-Kith) with numbers from 10 to 20.

## ACTIVITY 10

**Objective:** To encourage students to find ways of counting in new situations.

**Materials:** Pictures of objects numbering between 10 and 20.

Collect pictures of objects that may or may not be ordered in any manner. Pose the challenge of counting them. Observe the strategies that children are using.

Ask, 'How many are there? Show me how you counted them. How did you keep track of which ones had been counted?'

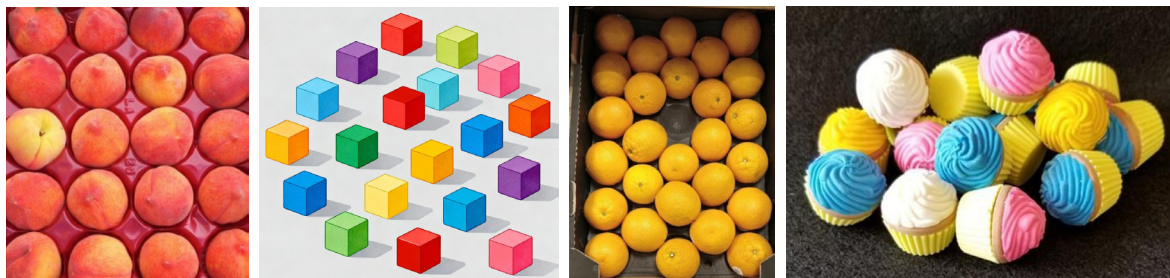


Figure 27

Figure 28 shows three groups of fruits. Which two groups together have 10 fruits?

Children enjoy counting, and teachers can create meaningful, fun activities and contexts in which children exercise their skill of counting.

Counting can take place in a variety of situations and with different kinds of objects. Some contexts involve static, movable objects—such as cubes or pencils—that children can physically handle during counting activities. Others might include moving objects, such as vehicles passing on a road. Counting can also refer to games, like the number of times a ball is bounced. Here are some examples:

- Children can be encouraged to count objects like the number of bicycles (cycles) passing by on the street.
- When counting objects that cannot be moved (for example, items shown in a worksheet), it becomes harder for children to keep track of which ones have been counted. It's important to use strategies such as marking or colouring.
- Counting actions (like jumps, claps, or bounces) is even more abstract, as these events do not leave a visible or tangible trace. Recording each occurrence—perhaps through tally marks—can help children keep track.



Figure 28

These activities will help the children to move from concrete object counting to abstract counting and later on to data handling.

The introduction to the concept of counting typically begins in early childhood education programs. In many Indian states, children become familiar with numbers up to 9 before they enter Class 1. During Class 1, they continue to develop their understanding of counting, numbers, and numerals—starting with numbers up to 20 and gradually progressing toward 99.

When teaching and learning numbers, teachers need not be strictly bound by the prescribed learning outcomes. If children show readiness, teachers can extend their learning beyond the stated outcomes.

This article addresses both the early childhood or foundational stages as well as Class 1. Teachers of Class 1 can use subitisation activities to revisit number concepts. Recognizing patterns in geometric arrangements of small numbers (such as 8 or 9) supports this process. Children develop this ability naturally through hands-on experiences—arranging pegs on pegboards, forming tile squares, or creating symmetric dot patterns. However, the emergence of this skill cannot be prescribed as a stage-specific learning outcome; it develops gradually and at different stages for different learners. Teachers may also choose to present these activities in the form of games to make learning more engaging.

### Reference:

[How Much or Till What: When and Why?](#)

Review of Ten-Frames <https://bit.ly/4r79Qkb>

**Note:** AI has been used to generate some of the images in this article

### Acknowledgement:

<https://nrich.maths.org/articles/subitising>

<https://nrich.maths.org/eyfs-activities/explanation-our-eyfs-format>



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PADMAPRIYA SHIRALI is part of the Community Math Centre based in Valley School (Bangalore) and Rishi Valley (AP), where she has worked since 1983, teaching a variety of subjects – mathematics, computer applications, geography, economics, environmental studies and Telugu. In the 1990s, she worked closely with the late Shri P K Srinivasan. She was part of the team that created the multigrade elementary learning programme of the Rishi Valley Rural Centre, known as ‘School in a Box.’ She is currently part of the NCERT textbook development group. Padmapriya may be contacted at [padmapriya.shirali@gmail.com](mailto:padmapriya.shirali@gmail.com)