

Also, one needs to use different contexts and different words which require the numbers to be totalled. Children should also become familiar with the word *sum*, that it denotes the answer to the numbers which have been summed.

It is good to raise the level of challenge for students by giving 'missing number' additions. One can build up problems of this kind in a graded manner as

below, where the blanks (or empty squares) need to be filled by digits appropriately.

- $1\_ + 403 = 529$
- $267 + \_3\_ = 400$
- $4\_ + 1257 = 6032$

A wide variety of such problems can be devised.

## GAME

### Game 3: ADDITION MATRIX BOARD

Make a 5 x 5 matrix board with squares of size 2 x 2 cm. Enter the numbers 6 to 10 in random order along both axes as shown. Also make 25 square cards (size 2 x 2 cm) and write the sums on these cards.

Before the game can begin, all the small cards are laid face downward and the time noted. Each player in turn turns the small cards face up one at a time and places them in the correct square as quickly as possible. The time taken to fill the board is noted. The other players can challenge any error and each wrongly placed card earns a five second penalty. The player completing the matrix in the shortest time is the winner.

	8	7	10	9	6
7					
6					
9					
10					
8					



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# NUMBER OPERATIONS: ADDITION

PADMAPRIYA SHIRALI

## A PRACTICAL APPROACH

In the various workshops that I have held with primary school teachers I have often found that teachers do not spend sufficient time on scaffolding exercises and tend to plunge straight into formal operations. Often the pace at which they proceed and the text materials they use are not built up gradually enough to allow time for internalisation. Also the prerequisite knowledge and skills are not looked into adequately. I hope the suggestions made here help teachers to fill these gaps and lay a stronger foundation.

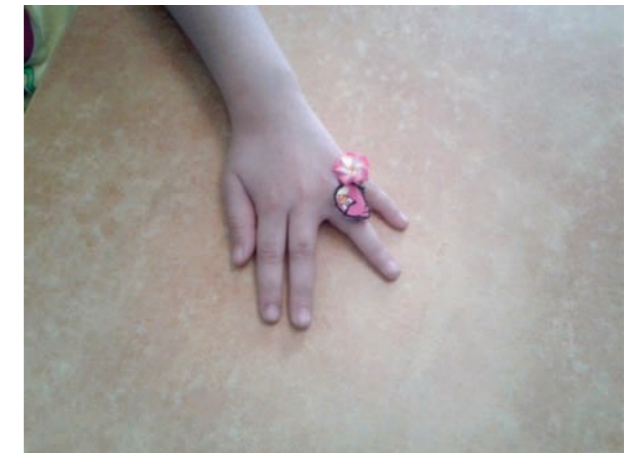
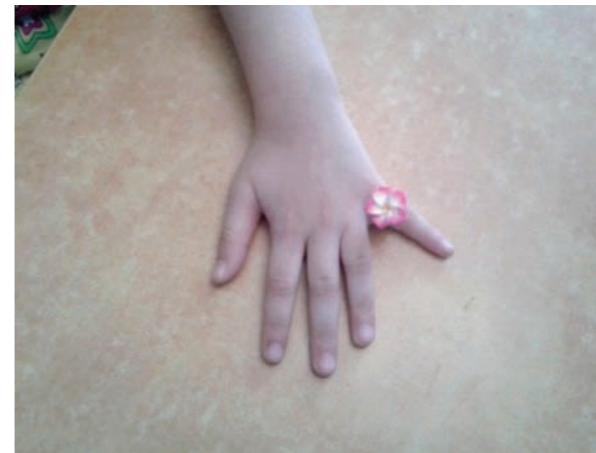
Teaching of number operations is intrinsically linked with teaching of numbers. The number sequence 1, 2, 3, 4, ... is produced by addition by 1:  $2 + 1$  makes 3,  $3 + 1$  makes 4. So a child who has learnt to count implicitly understands the notion of addition as coming together of a given number with 1 or increasing in quantity by 1. Before one attempts to teach children formal addition (that is, usage of the symbol +, methods of addition and vertically aligning numbers using place values) one needs to spend a fair amount of time in strengthening their number decomposition skills.

### PRE-REQUISITE

Ability to recognise the number in a small set of objects (1 to 6) instantaneously, without resorting to counting; knowledge of the fact that a hand has 5 fingers and both hands together have 10 fingers.

## ACTIVITY ONE

### DECOMPOSITION OF THE NUMBER 5



A simple activity can be done to teach and strengthen decomposition of 5 through the usage of the five fingers on the hand. Hold one finger apart from the other four. Let the children say, '1 and 4 make 5'. Now hold 2 fingers together away from the rest. Let children say, '2 and 3 make 5'. Help them to discover that '5 and 0' is also a decomposition of 5. Let children realize on their own that '1 and 4' could also have been looked at as '4 and 1'. Encourage them to experiment and show different ways of 4 and 1 on one hand. It will help their motor coordination skills and help them to internalize the decomposition facts of 5 which are crucial in the skills needed for mental arithmetic.

## ACTIVITY TWO

### DECOMPOSITION OF THE NUMBER 10

Decomposition of 10 or number complements of 10 can now be introduced by using both the hands. Hold 1 finger up and keep the others down. Let the children say, '1 and 9 make 10'. Now hold 2 fingers up and keep the others down. Let children say '2 and 8 make 10'. Continue in sequence till all combinations are completed (including '10 and 0 make 10').

## ACTIVITY **THREE**

Place 10 clips of one colour in a line as shown. Place the straw between the first and second clip. Read off the addition facts:  $1 + 9 = 10$ . Also record it on the board. Now place the straw between the second and third clip. Read off the addition fact:  $2 + 8 = 10$ . Record it under the previously written fact. Continue in this manner till you reach  $9 + 1 = 10$ . It would be interesting to see if any of the children ask what would be recorded if the straw is placed after the last clip or before the first one. Tell them that it would be read as  $10 + 0 = 10$  or  $0 + 10 = 10$  as the case may be.



Now show the pattern as recorded on the board.

$0+10=10$	$3+7=10$	$6+4=10$	$9+1=10$
$1+9=10$	$4+6=10$	$7+3=10$	$10+0=10$
$2+8=10$	$5+5=10$	$8+2=10$	

Various questions can be posed to bring out properties.

1. What is happening to the numbers on the left side?
2. What is happening to the numbers on the right side?
3. Is  $4 + 6$  the same as  $6 + 4$ ? Are there any other pairs like that?

## GAME

**Game 1: MAKE 10**

**Objective:** Reinforce complements of 10.

**Materials required:**

- Two sets of Number Flashcards

Children play this game in pairs. Each child has a number set 1 to 9. One child shows a number (say 6) and the other child must quickly show its complement (4).

## GAME

**Game 2: SNAP 10**

**Objective:** Instant recognition of complements of 10.

**Materials required:**

- Three sets of Number Flashcards, 1 to 9 (three extra flash cards of 5 will be needed)

Children play this in fours. The flash cards are mixed up and placed in one pile upside down so that the numbers are not visible. By turns, each child takes the top card off the pile and places it open in front of everyone. If the next card is not a complement of the previous one, the new card is placed on the open card. If the next card removed from the closed pile is a complement of the card on top of the opened pile, whoever says 10 first gets the set of 2 cards. The game continues till all sets are removed. Whoever gets the maximum number of sets is the winner.

## ACTIVITY **FOUR**

### MASTERING ADDITION OF 5 TO NUMBERS FROM 1 TO 5

Fingers on the hand become an aid again to help children master adding  $5 + 1$ ,  $5 + 2$ ,  $5 + 3$ ,  $5 + 4$ ,  $5 + 5$ . The teacher again needs to help the child use his knowledge of the fact that a hand has 5 fingers (so he doesn't count them all over again) and do forward counting from 6 onwards. In fact the child should be in a position to quickly recognise combinations of the 5 fingers on one hand along with fingers on the other hand as 6, 7, 8, 9 and 10.

The usage of hands and fingers is an excellent aid in teaching number decomposition of 5, 10 and addition facts up to 10. But I often see children extending this one to one correspondence for

additions like  $9+8$  and going over fingers repeatedly and thus getting muddled. Sometimes teachers also encourage students in using the finger segments for adding bigger numbers. While it helps in solving the problem this does not lead to enhancement of further learning strategies. It is imperative that the teacher helps the child to use number decomposition skills and rounding numbers to 10 to arrive at the answer. Through repeated exercises, by discovering patterns in numbers addition rules can be discovered and internalised. Addition facts ( $1+1$  to  $9+9$ ) can be thus committed to memory.

## ACTIVITY FIVE

### CREATION OF 1 TO 10 ADDITION TABLE TO HELP LEARN ADDITION FACTS

This is an important chart which every child should be encouraged to make and a larger one should be displayed in the class while children are learning additions.

Let the children write all the numbers 1 to 10 in the top row of the chart and all the numbers 1 to 10 in the first vertical column. Write + sign in the left most top corner. Tell the children to fill the addition table row wise with the corresponding sum.

+	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
2	3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12	13
4	5	6	7	8	9	10	11	12	13	14
5	6	7	8	9	10	11	12	13	14	15
6	7	8	9	10	11	12	13	14	15	16
7	8	9	10	11	12	13	14	15	16	17
8	9	10	11	12	13	14	15	16	17	18
9	10	11	12	13	14	15	16	17	18	19
10	11	12	13	14	15	16	17	18	19	20

What are the ways in which we can break down these facts into manageable sub-goals?

1. Addition by 1 is simple (the succeeding number), so is addition by 2 (skip one number)
2. Addition of numbers 1 to 5 to 5 (i.e.,  $5+1$ ,  $5+2$ , ...,  $5+5$ )
3. Addition of numbers 1 to 10 to 10 (i.e.,  $10+1$ ,  $10+2$ , ...,  $10+10$ )
4. Addition of doubles (i.e.,  $1+1$ ,  $2+2$ ,  $3+3$ , .....,  $9+9$ )
5. Addition of numbers differing by 1 (i.e.,  $7+6$  can be done as  $6+6+1$  or  $7+7-1$ )
6. Number pairs which add up to 10 (complements of 10)
7. Adding numbers to 9 by regrouping (using the fact that 9 is 1 less than 10, so  $9+7$  to be viewed as  $9+1+6$ , i.e.,  $10+6$ )
8. Adding numbers to 8 by regrouping (using the fact that 8 is 2 less than 10, so  $8+6$  to be viewed as  $8+2+4$ , i.e.,  $10+4$ ).

## ACTIVITY SIX

### REGROUPING

Give the child two number cards, say 8 and 7. Let the child pick up 8 straws and 7 straws and place them separately as two piles, lined up. Ask the child to count the number of straws in the left pile and move a few from the right pile to have 10 in the left pile. Now let the child say '8 and 7 is now 10 and 5', so '8 and 7 is 15'. Repeat this activity with various other number pairs to gain mastery over regrouping to 10 and adding 10 and some other number.

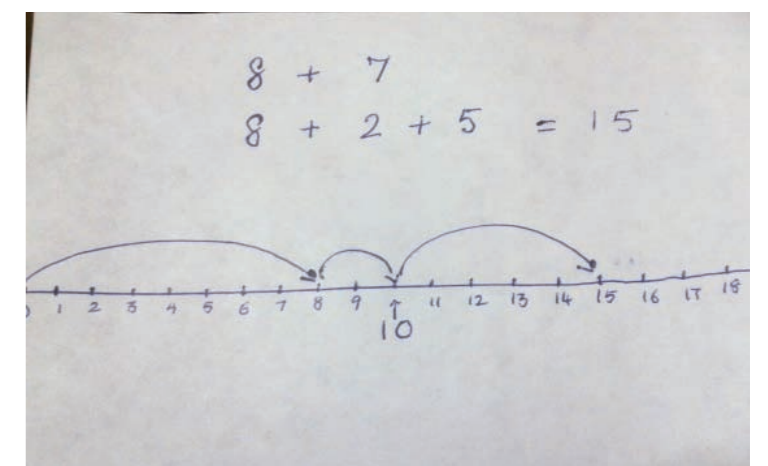
While the child is doing this activity the teacher needs to keep a watch on the following aspects.

1. Does the child recognise instantly the number of straws he has to move from the right side? (That is, check for mastery of decomposition facts of 10.)
2. Once he moves the straws does he recount the pile of 10? (That is, check for mastery of conservation principle.)
3. Is he able to quickly combine 10 and a number and give the right answer?

## ACTIVITY SEVEN

### REGROUPING ON A NUMBER LINE

Additions by regrouping should also be shown using a number line to help the child in building visualisation skills (10 and multiples of 10 are to be prominently displayed on the number line).





## ACTIVITY **EIGHT**

### ADDITIONS OF MULTIPLES OF TENS

Use straw bundles, tens strips and a number line to show additions of different multiples of tens (20+30, 50+20, etc). Ask one child to pick up 2 tens or 20, and another to pick up 4 tens or 40, and ask for the sum. Use the words 2 tens and 20 interchangeably so that children recognise their equivalence. It must be clearly established that only like ones can be grouped together. While doing additions of multiples of ten, intersperse with questions which require summing of tens and ones. Ex. Take 2 tens and 3 ones. How much is that? Children must learn to pay close attention to the words 'tens' and 'ones'. Place value needs to be emphasised while teaching all the operations.

Complements of 100 in terms of tens: At this point it is also useful to focus on the combinations of multiples of 10 which sum up to 100. Questions can be framed in terms of "I have 3 tens, how many more tens to make 100?" Child must have a clear understanding at this point that 100 is the same as 10 tens. Their knowledge of complements of 10 is applied here as well and will be applied later in finding complements of 1000 in terms of multiples of 100. (Ex. 1000 = 8 hundreds and 2 hundreds.)

## ACTIVITY **NINE**

### ADDITION OF 3 SINGLE DIGIT NUMBERS

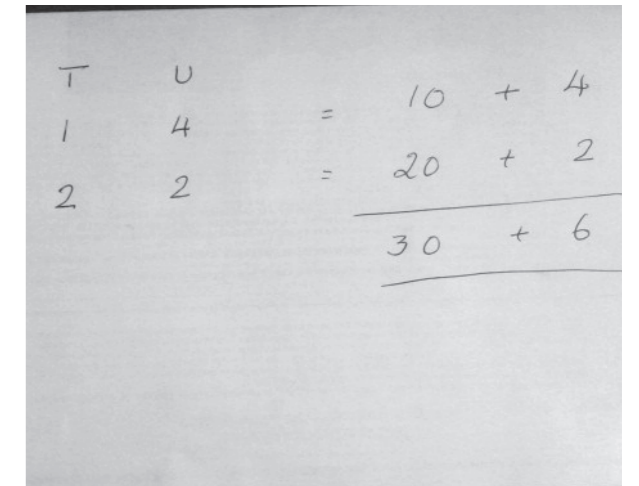
While adding three single digit numbers (7+5+3), the usual method to follow is the left to right sequential approach. Add the first two numbers and then add the third number to the sum. It will be good to also encourage children to look for a pair which sums easily (complements of 10 or doubles etc, and then add the third). This helps children to look at numbers in a flexible manner and use their understanding of arithmetic laws and properties.

## ACTIVITY **TEN**

### ADDITIONS OF TENS AND ONES WITH TENS AND ONES WITHOUT REGROUPING



This can be easily demonstrated using tens and ones materials placing them under one another as shown and recording it with place value. As mentioned, the teacher needs to constantly bring it to the child's attention that ones are being added to ones and tens are being added to tens. It is important that in a problem like this, the child does not read it as  $4 + 2 = 6$  and  $1 + 2 = 3$ :



It should be read as 4 ones and 2 ones make 6 ones; 1 ten and 2 tens make 3 tens.

To reinforce this it is also good to write a few problems initially in expanded form.

$$\begin{array}{r} T \quad U \\ 2 \quad 4 = 20 + 4 \\ 3 \quad 5 = 30 + 5 \end{array}$$

Problem exercises should initially contain visuals. Also, let children use materials (tens and ones) till they gain confidence and drop usage of aids on their own.

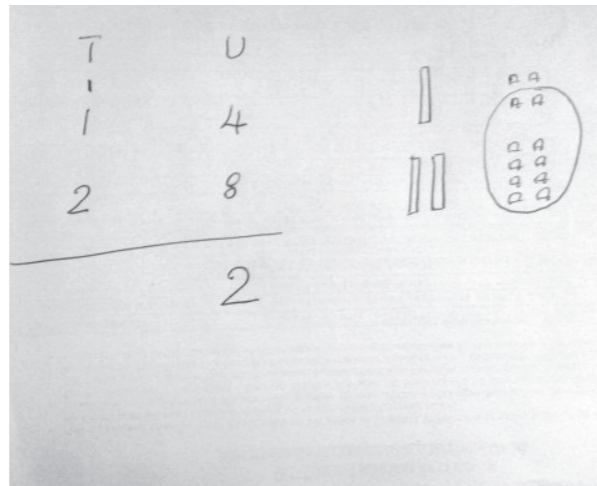
Oral arithmetic: While doing additions mentally we often work out left to right, that is add tens and then ones. It is important that we allow children to use their own methods and not restrict them in any way as long as the methods being used are logical.

## ACTIVITY *ELEVEN*

ADDITIONS OF TENS AND  
ONES WITH REGROUPING



Additions of the kind  $14+28$  require regrouping of ones into a ten and recording the result appropriately. Let the child pick up tens and ones corresponding to 14 and place it on the place value card. The number should also be recorded using tens and ones as headers. The child then picks up material corresponding to 28 and places it in the second row of the place value card. The second number is also recorded now. Now the child counts the ones and exchanges 10 ones for a ten and the teacher places it on the top in the place value card as shown. At this point the teacher needs to show the correspondence between the recording norms that are followed for addition. In the regrouped ones the ten is indicated by 1 on the top in tens place, and the ones are written underneath.



This whole sequence has been spelled out to make the reader see the importance of matching the activity to the writing process. Often I find that activities are performed independently and writing is taken up later. The child does not necessarily see the connection between actions performed in the activity and the process being followed while recording. Activities should be made explicit by verbalizing every action and matching it with writing, it is like a running commentary.

## ACTIVITY *TWELVE*

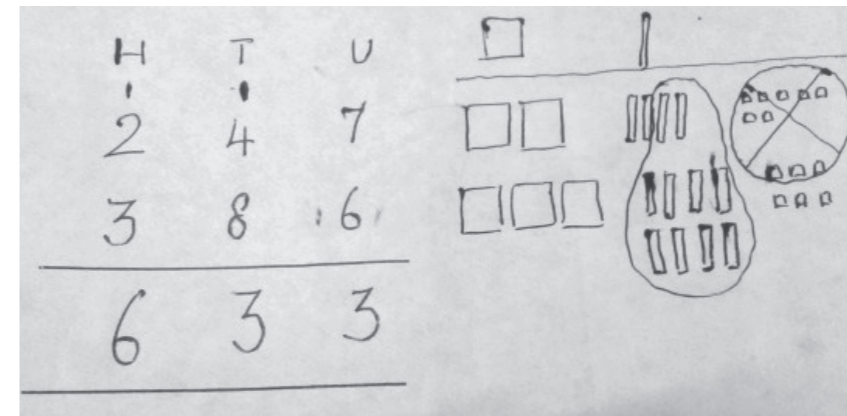
ADDITIONS OF 3 DIGIT NUMBERS  
WITH REGROUPING

A similar procedure needs to be followed while teaching additions of 3 digit numbers. The place value kit (hundreds, tens and units) needs to be used. However it is important to initially teach regrouping in one place only (say units to tens) e.g.,  $135+248$ , and the second stage will then be regrouping tens as hundreds, e.g.,  $246+172$ . At the third stage one must carefully introduce regrouping in both the places, e.g.,  $247+386$ .

Adding 7 and 6 units gives 13 units, which is regrouped as 1 ten and 3 units. 3 units is recorded under the units place and the regrouped 1 ten is recorded in the tens place, at the top.

Adding 1 ten, 4 tens and 8 tens gives 13 tens, which is regrouped as 1 hundred and 3 tens. 3 tens is recorded under the tens place and the regrouped 1 hundred is recorded in hundreds place, at the top.

In a similar manner additions with regrouping can be done for four-digit numbers. Here too it is advisable to first practice with problems which involve regrouping in just one place, followed by regrouping in two places, and then by regrouping in all the three places.



## WORD PROBLEMS AND CHALLENGES

A conscious effort must be made to discuss all the three addition situations:

- *Combining two groups.* Example: 20 children in class 1; 25 children in class 2; how many children in class 1 and 2 together?
- *Increasing a number by another quantity.* Example: 15 children in the bus; 4 more get in; how many children are there now?

- *Finding the required amount to raise a given number to a higher number.* Example: 12 children in the group; 8 pencils; how many more pencils are needed so that each child has one?