A1.1 Number patterns

objectives

- Know addition and subtraction facts to 20.
- Count on and back in steps of constant size.
- Generate terms of a simple sequence.
- Express simple functions in words.
- Solve problems and investigate in number.

starter

Vocabulary
add
subtract
addition
subtraction
difference

Resources
interlocking cubes
mini-whiteboards
ITP *Number facts* (optional)

Hold up a stick of 10 cubes. Break it into 1 and 9, and ask how many are in each piece. Repeat with 2 and 8. Take the stick of 10 cubes again and this time hold it behind your back. Break it into two pieces and hold up one piece. Ask:

Q How many cubes can you see? (e.g. 7) **How many are hidden?** (e.g. 3)

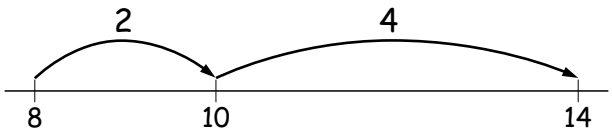
Repeat a couple more times. Remove one cube from the stick to make a stick of 9 cubes and show it to the class. Repeat the activity of holding it behind your back and breaking it into two pieces. Repeat for a stick of 8 cubes.

Ask a few questions to check pupils' understanding of the vocabulary, with an expectation that pupils answer quickly. For example:

Q What must I add to 7 to make 9?
Q Subtract 3 from 8.
Q What is the difference between 4 and 10?

Write 6 + 8 on the board. Say that you are going to show them some quick ways to add pairs of numbers between 5 and 10 in their heads.

Say that addition can be done in any order. It is usually easier to put the largest number first when adding. Write 8 + 6 on the board. Model on an empty number line how to start with 8, and then jump on 2 to reach 10. Say that you have used up 2 out of the 6, so there is still 4 to add on. Jump on 4 to reach 14.



Model what you have done with the cubes. Take a stick of 8 and a stick of 6 and hold them up. Take 2 from the 6 and attach them to the stick of 8 to make a stick of 10. Show the class that there are now sticks of 10 and 4, or 14.

Write on the board: 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14.

Start again with sticks of 8 and 6 cubes. Show a different way to add 8 and 6. Take 5 cubes from the 8 cubes to leave 3 cubes, and 5 cubes from the 6 cubes to leave 1 cube. Combine the two sticks of 5 to make 10, then the 3 and the 1 to make 4.

10 + 4 = 14

Write on the board: 8 + 6 = 5 + 3 + 5 + 1 = 10 + 4 = 14.

Repeat the two methods, including the modelling with cubes, for 7 + 9.

Ask a few more questions to emphasise the vocabulary, allowing a few seconds for pupils to make jottings on their whiteboards. Stress that they do not need to draw the diagrams but they may wish to jot down and rearrange the numbers.

Q Add 7 to 6. Find the sum of 8 and 9. What is the total of 5 and 8?

Now show how to add a pair of numbers when one is more than 10. Write on the board: 12 + 6. Show that this is the same as 10 + (2 + 6). Since the pupils know the answer to 2 + 6 is 8, the answer to 10 + 2 + 6 is 18.

You may wish to support the work above by using the ITP *Number facts*. Use it as an extra model to illustrate adding and subtracting small numbers.

Q What is the answer to 52 + 6? Explain how you worked it out.

Demonstrate how to use patterns to add a single digit to any two-digit number:

7 + 5 = 12
17 + 5 = 22
27 + 5 = 32
37 + 5 = 42, and so on.

Stress that all the basic number facts need to be remembered but that it is useful to know ways of working them out quickly if you don't know the answer straight away.

main activity

Vocabulary
pattern
rule

Resources
OHTs A1.1a (two copies), A1.1b, A1.1c

Ask the class to imagine a machine that will help them to find patterns. Show **OHT A1.1a**. Explain how the first machine will add 3 to any number, and work through the three inputs and outputs with the class.

Choose a rule for the second machine, such as '+ 5', and ask the pupils to suggest three numbers for the input boxes. Complete each output with the class.

Enter three inputs and corresponding outputs for the third machine (e.g. 4, 8, 10 and 10, 14, 16). Ask pupils to identify the rule. Prompt with questions like:

Q What do you need to do to 4 to make 10?

Use the second copy of **OHT A1.1a** for more examples. For example, identify the rule for these sets of numbers: 2, 4, 6 and 6, 12, 18 (the rule is ' ×3'), and for 35, 55, 95 and 26, 46, 86 (the rule is '– 9').

Show **OHT A1.1b**, with two linked machines. Fill in the first input boxes with 3, 5, 7, and rules of '+ 1' and '÷ 2'. Work with the class to identify the outputs (2, 3, 4). For the second example, you could use inputs of 1, 5, 7, a first rule of '– 1', and outputs of 0, 12, 18. Ask pupils to identify the second rule (' ×3').

Take the opportunity to stress that multiplication of 0 results in 0.

Work through the problem on **OHT A1.1c** with the class.

other tasks

Springboard 7
Unit 1

Unit 1 section 2: Simple sequences

1 Counting on and back in 6s page 50
2 Counting on and back in 9s page 50

You may wish to provide some further examples of function machines.

plenary

Vocabulary
sequence

Resources
OHT A1.1d

Display **OHT A1.1d**. Write 'add 2' in the first box in the rule column and 21 in the starting number box. Say that 21 is the start of a pattern or *sequence.*

Q **What will be the next number in the sequence?** (23)
Q **What will be the next number after 23?** (25)

Establish that there is a difference of 2 between each number, so the numbers go up in twos. Complete the other three terms with the class.

Q **How would you describe the numbers in this sequence?** (they are a sequence of odd numbers)

On OHT A1.1d write the rule '+ 11' and the starting number of 0.

Q **What will be the next five numbers?**

Establish that they will be 11, 22, 33, 44 and 55.

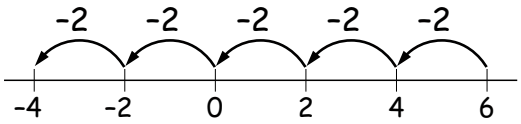
Q **What do you notice about the terms of this sequence?** (the first digit and the last digit are the same) **Will 99 be in this sequence?** (yes)

On OHT A1.1d write the rule '– 1' and the starting number of 13. Complete the next five numbers with the class.

Q **How would you describe the numbers in this sequence?** (they are counting numbers)

Q **What is the difference between this sequence and the previous two?** (the first two were going up; this one is going down)

On OHT A1.1d write the rule '– 2' and the starting number of 6. Complete 4, 2, 0 with the class. Establish that the next two terms term would be –2 and –4 (negative two and negative four). Confirm by using an empty number line.



Complete the last sequence, with a rule of ' $\times 2$' and a starting number of 3.

Q **What do you notice about the terms of this sequence?** (they are all even)

Remember

- Try to remember addition and subtraction facts to 20 so that you know them 'by heart'. If you forget one, there are strategies for working them out quickly.
- Addition can be done in any order. It often helps to put the larger number first.
- Decide whether a sequence is going up or going down.
- Look for patterns in the numbers of a sequence.
- Check whether the difference between each term in a sequence is always the same. If so, the rule is to add or subtract the number that is the difference.

A1.2 Generating sequences

objectives

- Count on and back in steps of constant size.
- Generate and describe terms of a simple sequence.
- Make general statements about odd and even numbers.
- Recognise and use multiples.

starter

Vocabulary
odd
even
multiple
two-digit number
three-digit number

Resources
OHT A1.2a
mini-whiteboards

Show **OHT A1.2a**, a grid of numbers 1 to 60. Say together the even numbers: two, four, six, eight, …, twenty. Point to each number on the grid as pupils say it. Then say the odd numbers from one to nineteen. Ask:

Q Is 9 odd or even? (odd) **Is 24 odd or even?** (even)
Q How can you tell if a number is odd or even?

Establish that the units digit of an odd number is 1, 3, 5, 7 or 9, and that of an even number is 0, 2, 4, 6 or 8. Write a two-digit odd number on the board, e.g. 87. Ask:

Q Is this number odd or even? What is the next odd number after 87? What is the odd number before 87?

Repeat with 236, 5731.

Ask pupils to write on their whiteboards a two-digit odd number greater than 60, then a three-digit even number.

Explain that the even numbers are *multiples* of 2 and are numbers that divide exactly by 2. They include the numbers in the two times table. We also count 0 as even.

Count together in fives to 60, pointing to the numbers on the grid. Explain that pupils have been counting in multiples of 5. Multiples of 5 divide exactly by 5.

Q What do you notice about the units digits of multiples of 5? (0 or 5)
Q Is 87 a multiple of 5? (no) **Is 95 a multiple of 5?** (yes) **How do you know?**
Q What is the next multiple of 5 after 95? How did you work it out? (add 5)
Q How can you tell if a number is a multiple of 10? (its units digit is 0)
Q What is the next multiple of 10 after 150? (160) **Before 150?** (140)

main activity

Vocabulary
pattern
sequence
term
rule

Resources
OHTs A1.2a, A1.2b
OHP pens (red, blue)
ITP *Number grid* (optional)

You may wish to support the main activity of this lesson by using the ITP *Number grid*, downloaded from www.standards.dfes.gov.uk/numeracy. Use it instead of or in addition to the OHTs. Select options and ask questions to consolidate pupils' understanding.

Leave **OHT A1.2a** on the projector. Say together the three times table: one three is three, two threes are six, … Ring the multiples 3, 6, 9, … up to 30 on the grid with a red pen as you say them.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

Remind pupils that multiples of 3 are numbers that divide exactly by 3 and include the numbers in the three times table.

Q Are the multiples of 3 odd or even? (they alternate)

Q Can you describe the pattern the ringed numbers make? (sloping lines) **How will it continue?** (the sloping lines will extend across the grid)

Q Will 36 be in the extended three times table? How do you know?

Encourage pupils to look down the sloping lines of ringed numbers to judge whether 36 would be included. Repeat for 57 and 41.

Repeat this process for the four times table, marking them with a blue square. Draw out that all the multiples of 4 are even.

Q Which numbers have both a red circle and blue square round them?

Write the sequence of numbers on the board: 12, 24, 36, 48, 60.

Q What do you notice about these numbers? Describe the sequence.

Establish that the numbers: go up in twelves; are the 12 times table numbers; are in both the three times and four times tables.

Q What would be the next number in the sequence? (72) **And the next?** (84) **How did you work it out?**

Explain that 'add 12' is the *rule* for the sequence.

Show **OHT A1.2b**. Write 2 and 5 in the first two boxes of the first row. Say that these numbers are the start of a sequence. They are called the first two *terms*.

Q What might be the next number in the sequence? How would you describe the rule for the sequence?

Take responses, asking pupils to explain their reasoning. Say that there are many possibilities but that you were thinking of a sequence in which the third term is 8.

Q What might be the next term after 8? (11)
Q How would you describe the rule for this sequence?

Establish that there is a difference of 3 between each term, so the numbers go up in threes. The rule is 'add 3'. Write this on the OHT.

On **OHT A1.2b** write the sequence 17, 13, 9, 5, 1.

Q How is this sequence different from the last sequence?

Establish that the numbers are going down and the rule is 'subtract 4'.

Q What will be the next term in the sequence?

Establish that the next term would be –3. Confirm if necessary by using an empty number line.

Complete and extend some more sequences:

3, 8, ☐, 18, 23, ☐, 33

Q What do you notice about the terms of this sequence? Will 95 be in this sequence? (no, its last digit is not 3 or 8)

105, ☐, 101, ☐, 97

Q Will 49 be in this sequence? (yes, it is an odd number)

1, 2, 4, ☐, 16, 32

Q Will 999 be in this sequence? (no, it is not an even number)

other tasks

Springboard 7
Unit 1

Unit 1 section 2: Simple sequences

plenary

Resources
OHT A1.2c
ITP *20 cards* (optional)

Work through the examples on **OHT A1.2c** with the class. Ask questions such as:

Q Will … be in the sequence?

Ask pupils to justify their answers by explaining their reasoning.

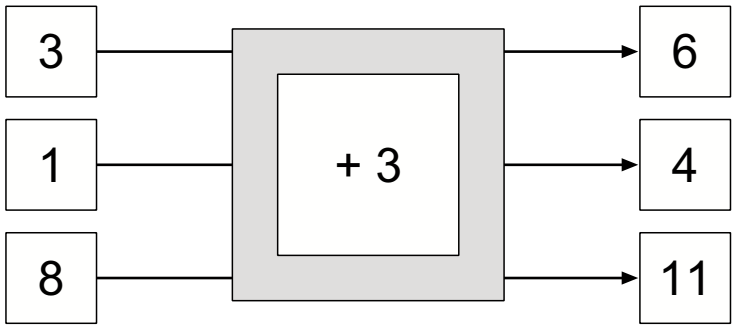
You could, if you wish, extend the plenary by using the ITP *20 cards*, asking pupils to predict the next number in the sequence from the stack of cards.

Remember

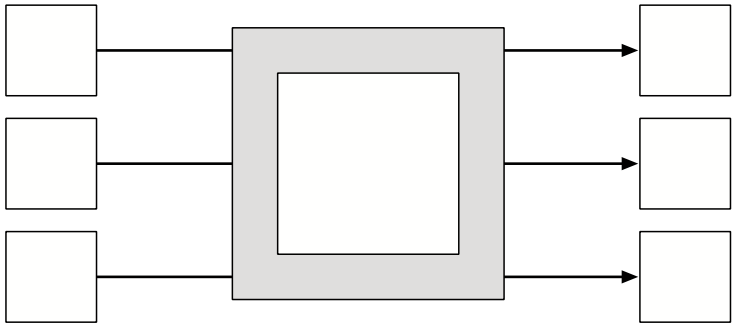
- Even numbers always end in 0, 2, 4, 6, 8. They are multiples of 2 so they divide exactly by 2. They include the numbers in the two times table.
- Odd numbers always end in 1, 3, 5, 7, 9. They leave a remainder of 1 when they are divided by 2.
- Multiples of 10 end in 0. They include numbers in the ten times table.
- Multiples of 5 end in 0 or 5. They include numbers in the five times table. Every other multiple of 5 is a multiple of 10.
- Check whether the difference between each term in a sequence is always the same. If so, the rule is to add or subtract the number that is the difference.

OHT A1.1a

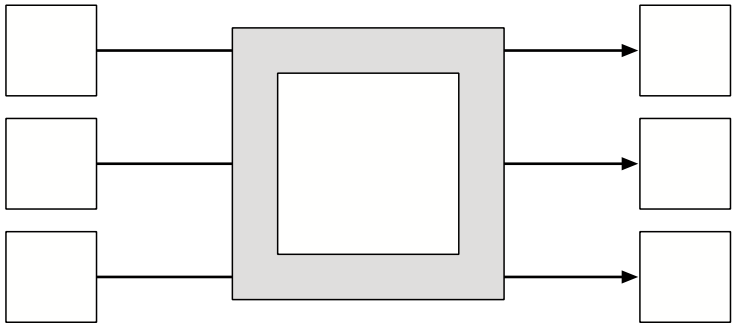
This machine adds 3 to any number.

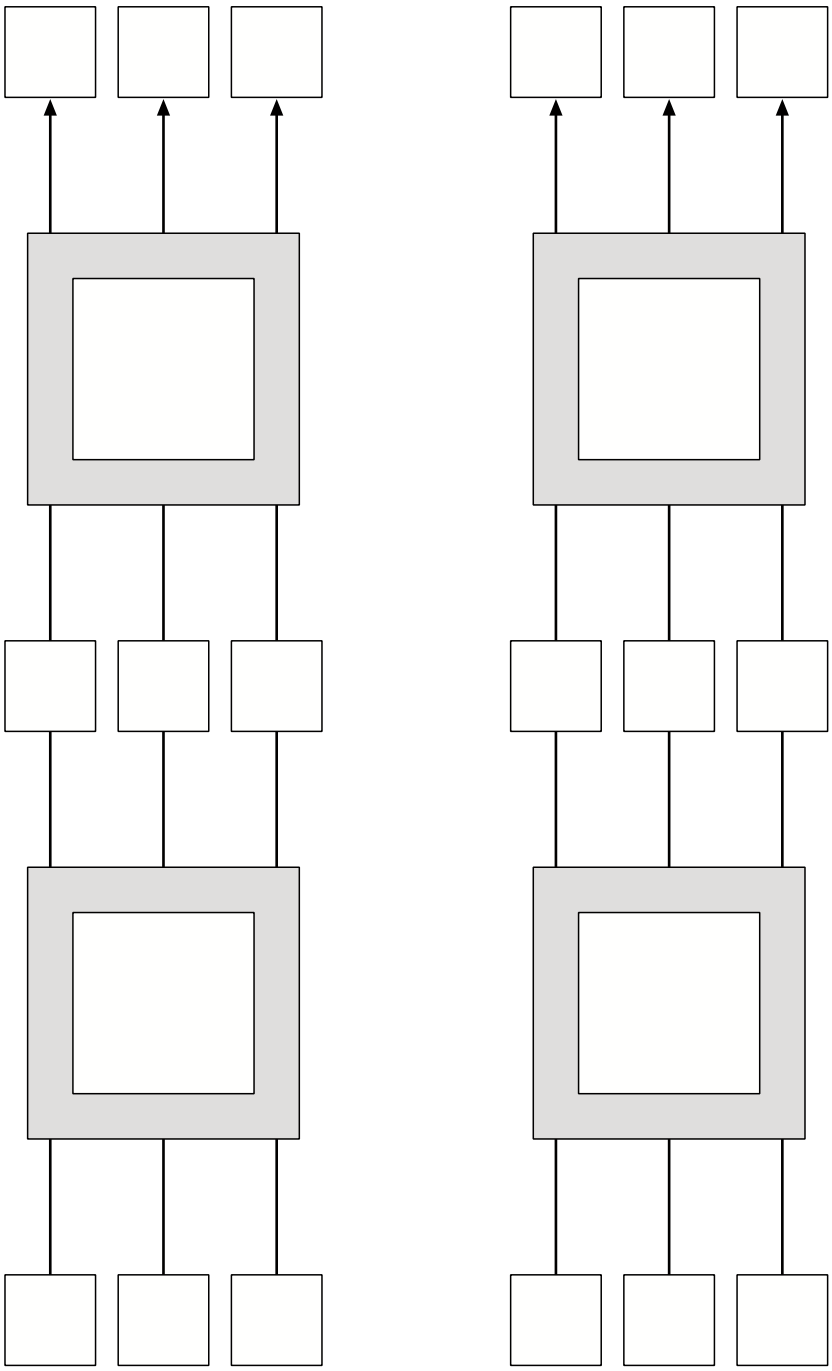


What answers will this machine give?

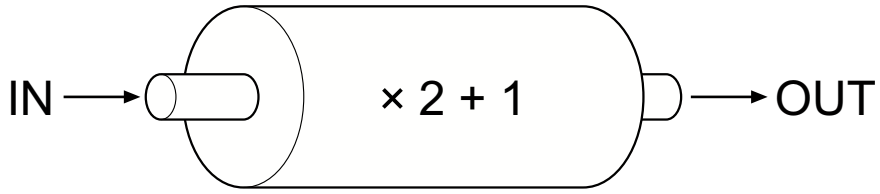


What is the rule for this machine?





This number machine multiplies all numbers by 2, and then adds 1.



Write the missing numbers in the table.

IN	OUT
5	11
13	
	117

OHT A1.1d

Rule	Starting number	Next five numbers				

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

OHT A1.2b

Rule					
Sequence of numbers					

OHT A1.2c

The rule for these number sequences is
'double then subtract 1'.

Write in the missing numbers.

2 → 3 → 5 → 9 → .....

..... → 13 → 25 → 49

Some number chains start like this: 1 → 5 →

Show three different ways to continue this chain.
For each chain write down the next three numbers.
Then write down the rule you are using.

First chain

1 → 5 → ..... → ..... → ..... Rule .....

Second chain

1 → 5 → ..... → ..... → ..... Rule .....

Third chain

1 → 5 → ..... → ..... → ..... Rule .....