

## Unit 8

### Properties of numbers and reasoning about numbers

Five daily lessons

National  
**Numeracy Strategy**

Year 4

Spring term

#### Unit Objectives

Year 4

- Recognise negative numbers in context (e.g. on a number line, on a temperature scale).
- Recognise and extend number sequences formed by counting from any number in steps of constant size, extending beyond zero when counting back.
- Make and investigate a general statement about familiar numbers by finding examples that satisfy it.
- Explain methods and reasoning about numbers orally and in writing.

Page 14

Page 16

Page 80

Page 76

This Unit Plan is designed to guide your teaching.

You will need to adapt it to meet the needs of your class.

#### Resources needed to teach this unit:

- Resource sheet 8.1
- Resource sheet 8.2
- Resource sheet 8.3
- Resource sheet 8.4
- Resource sheet 8.5
- Resource sheet 8.6
- Resource sheet 8.7
- Activity sheet 8.1
- OHT 8.1
- OHT 8.2
- Large number cards, -5 to 5
- Whiteboards
- Number fans
- Counting stick
- Thermometer animation downloadable from website ([www.numeracy.org.uk](http://www.numeracy.org.uk))
- OHP – calculator
- Class set of calculators
- Thermometers

#### Link Objectives

Year 3

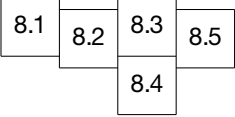
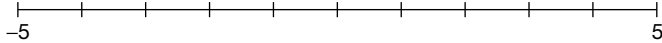
Year 5

- **Order whole numbers to at least 1000** and position them on a number line.
- Describe and extend number sequences: **count on or back in tens or hundreds starting from any two- or three-digit number.**
- Investigate a general statement about familiar numbers by finding examples that satisfy it.
- **Explain methods and reasoning** orally and, where appropriate, in writing.

- **Order a given set of positive and negative integers** (e.g. on a number line, on a temperature scale).
- Recognise and extend number sequences formed by counting from any number in steps of constant size, extending beyond zero when counting back. For example: count on in steps of 25 to 1000, and then back; count on or back in steps of 0.1, 0.2, 0.3...
- Make and investigate a general statement about familiar numbers by finding examples that satisfy it.
- Explain a generalised relationship (formula) in words.
- **Explain methods and reasoning.**

(Key objectives in bold)

department for  
**education and skills**

Planning sheet	Day One	Unit 8 <i>Properties of numbers and reasoning about numbers</i>	Term: <i>Spring</i>	Year Group: 4
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
<p>Read and write whole numbers up to 10 000 presented in words and digits.</p> <p>RESOURCES Resource sheet 8.1 Resource sheet 8.2 Resource sheet 8.3 Resource sheet 8.4 Resource sheet 8.5 Whiteboards</p>	<ul style="list-style-type: none"> <li>Display Resource sheets 8.1 to 8.5 in the following way:</li> </ul>  <p>Say a number and point to the words on the display: e.g. 'Three hundred and fifty-six'; 'Six thousand, nine hundred and one'.</p> <p>Ask children to write the numbers in digits on their whiteboards.</p> <p>Write a number in digits on the board, ask children to say the number and a volunteer to point to the words on the display. Write a number in digits and ask children to write the number in words on their whiteboards.</p>	<p>Recognise negative numbers in context, e.g.:</p> <p>on a number line on a temperature scale</p> <p>VOCABULARY negative positive above and below zero minus</p> <p>RESOURCES Thermometers Activity sheet 8.1 Large number cards –5 to 5 Thermometer animation</p>	<p><b>Q</b> Where would you see/use negative numbers?</p> <ul style="list-style-type: none"> <li>Introduce negative numbers through the context of temperature. Compare temperatures of different resources, central heating, a fridge, a freezer. Compare climates and discuss times of year when temperature was below zero. Look at a room and other thermometers together, pointing out the negative values.</li> <li>Draw a vertical number line on the board with zero marked in the middle and 5 divisions above, 5 divisions below. Ask children to count on from zero as you point to the appropriate divisions above it on the line, then back to zero. Point to the –1 position.</li> </ul> <p><b>Q</b> What does this mark represent?</p> <p>Establish it is a negative one and repeat for the other negative values. Explain that numbers above zero are positive numbers, numbers below zero are negative numbers. Give examples of above and below freezing. Write all the numbers (–5 to 5) alongside the line. Ask the class to count back from 5 to –5, then up to 5. <li>Draw a horizontal number line:</li>  <p><b>Q</b> Which whole numbers lie between –5 and 5?</p> <p>In response to each suggestion, point along the line, asking children to tell you when to stop.</p> <ul style="list-style-type: none"> <li>Extend the line to –6 and 6. Ask the class to count back from 6 to the other end of the line. Hand out cards –5 to 0 inclusive. Ask the children to come out and position themselves in order. Repeat with cards, from –5 to 5 using different children to order themselves.</li> <li>Give out Activity sheet 8.1. Ask children to complete the number lines. Collect answers.</li> </ul> <p>Discuss the four thermometers. Explain that each thermometer tells the temperature in degrees Celsius and 0°C is freezing point.</p> <p>Ask children to fill in the missing temperatures.</p> </p>	<ul style="list-style-type: none"> <li>Discuss the activity and check the answers.</li> <li>Using the interactive thermometer, ask children to look at the third thermometer on Activity sheet 8.1. Ask questions such as the following for them to answer orally, demonstrate their responses with the interactive thermometer.</li> </ul> <p><b>Q</b> What will the temperature be if it rises by 3°C?</p> <p><b>Q</b> What will it be if it drops by 2°C?</p> <p><b>Q</b> What temperature is 3 degrees below zero or freezing point?</p> <p><b>Q</b> What temperature is 2 degrees above negative 6 degrees?</p> <p><b>By the end of the lesson the children should be able to:</b></p> <ul style="list-style-type: none"> <li><b>Order a set of positive and negative numbers;</b></li> <li><b>Locate positive and negative numbers on a number line;</b></li> <li><b>Use negative numbers in the context of temperature.</b></li> </ul> <p>(Refer to supplement of examples, section 6, pages 14.)</p>

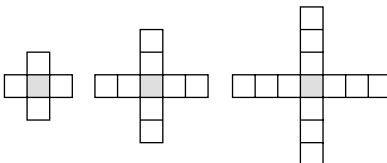

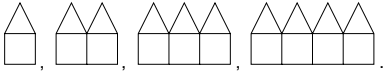


Planning sheet	Day Two	Unit8 <i>Properties of numbers and reasoning about numbers</i>	Term: <i>Spring</i>	Year Group: 4									
Oral and Mental		Main Teaching		Plenary									
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions									
<p>Recognise negative numbers in context.</p> <p>VOCABULARY positive negative above/below zero minus</p> <p>RESOURCES OHT 8.1 Thermometer animation Counting stick</p>	<ul style="list-style-type: none"><li>Use a counting stick held vertically to revise counting between positive and negative numbers.</li><li>Use program ‘Thermometer’ or display OHT 8.1. Discuss the scale on the thermometer, identify zero and the value of the intervals on the scale. Point to a value and ask children to write it on their whiteboards to show. Repeat for different values.</li></ul> <div><b>Q</b> What will this temperature be after a rise of 3 degrees, a fall of 4 degrees?</div> <p>Demonstrate using the thermometer to confirm the children’s answers.</p>	<p>Make and investigate a general statement about familiar numbers by finding examples that satisfy it.</p> <p>VOCABULARY total next, consecutive general statement</p> <p>RESOURCES Resource sheet 8.6</p>	<ul style="list-style-type: none"><li>Draw a 3 × 3 grid on the board and write in the numbers 1 to 9 as shown:<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table><p>Point out that 1–9 are consecutive numbers and show how they are arranged in the grid in order.</p><p>Ask children to total the middle row and the middle column, then each diagonal.</p><div><b>Q</b> What do you notice?</div><p>Discuss and agree a statement and record it on the board, e.g.:</p><p>In this grid the middle row, the middle column, and each diagonal have a total of 15.</p><div><b>Q</b> What other statements could you make?</div><p>E.g. All the corner numbers are odd etc...</p><ul style="list-style-type: none"><li>Tell the children you are going to give them a general statement to investigate.</li><li>Write on the board: ‘When nine consecutive numbers are arranged in order in a 3 x 3 grid, the middle row and column have the same total as each diagonal’.</li></ul></li></ul> <p>Model how to start the process of investigation using a different set of numbers, e.g. 6–14.</p> <p>Ask children to investigate this statement using Resource sheet 8.6.</p> <ul style="list-style-type: none"><li>When children have investigated the statement and satisfied themselves that this is a general statement, ask ‘Using the numbers 1, 1, 1, 2, 2, 2, 3, 3, 3 can you fill in a grid where all the rows, columns and diagonals total the same?’</li></ul> <p>Ask the children to investigate this statement using Resource sheet 8.6.</p> <p>After the children have had a few tries ask the following questions.</p> <div><b>Q</b> Will it work with 2 in the middle? 3 in the middle?</div> <div><b>Q</b> Where do the even numbers need to be?</div> <p>When the majority of the class are convinced it can’t be done, ask:</p> <div><b>Q</b> Can you explain why?</div>	1	2	3	4	5	6	7	8	9	<ul style="list-style-type: none"><li>Look again at the first grid. Ask the children in pairs to discuss the following:<div><b>Q</b> Are any of the statements made true for all sets of numbers?</div></li><li>Remind the children of the initial general statement.</li><li>After a few minutes, choose pairs of children to share their ideas with the class.</li></ul> <div><b>By the end of the lesson the children should be able to:</b><ul style="list-style-type: none"><li><b>Investigate a given statement by finding and testing examples;</b></li><li><b>Understand the term ‘general statement’.</b></li></ul><p>(Refer to supplement of examples, section 6, page 80.)</p></div>
1	2	3											
4	5	6											
7	8	9											

Planning sheet	Day Three	Unit 8 <i>Properties of numbers and reasoning about numbers</i>	Term: <i>Spring</i>	Year Group: 4
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
<p>Read and write numbers up to 10 000.</p> <p>Round three-digit numbers to the nearest 10 or 100.</p>	<ul style="list-style-type: none"> <li>Return to the display of Resource sheets 8.1 to 8.5. Point to a number and ask children to read the number aloud as you point. Ask children to write the number in digit form on the board.</li> </ul> <div>Q What is 1000 more/ 100 less than this number?</div> <div>Q What do you get when you add 200/ subtract 1000/ take away 50 from this number?</div> <p>Ask children to say the answers aloud and to point to the numbers on the display as they do so.</p> <ul style="list-style-type: none"> <li>Remind children about the rules for rounding to the nearest 10, then the nearest 100.</li> <li>Write on the board a three-digit multiple of 10, e.g. 370. Ask children to suggest numbers that when rounded to the nearest 10 would give that number. Record them on the board.</li> </ul> <p>Repeat for a three-digit multiple of 100, asking children to give numbers that would make that number when rounded to the nearest 100.</p> <ul style="list-style-type: none"> <li>Provide other numbers for children to use number fans to show numbers that would round to them.</li> </ul> <div>Q How many possible numbers are there that would round to 460?</div> <div>Q What about 300?</div> <p>Collect answers and discuss strategies.</p>	<p>Make and investigate a general statement about familiar numbers by finding examples that satisfy it.</p>	<ul style="list-style-type: none"> <li>Write <math>1 + 2 + 3</math> on the board.</li> </ul> <div>Q What sort of numbers are these?</div> <p>Ask children to find the total. Record it then write</p> $\begin{array}{l} 2 + 3 + 4 = \\ 3 + 4 + 5 = \\ 4 + 5 + 6 = \\ 5 + 6 + 7 = \end{array}$ <p>Ask children to describe the list, copy the list and, record each total. Ask children to continue the pattern of calculations by three lines or more.</p> <ul style="list-style-type: none"> <li>Ask them to look at the totals.</li> </ul> <div>Q Is there a pattern in the totals? Can you describe it?</div> <div>Q How might you explain it to someone?</div> <p>Establish that the totals are consecutive multiples of 3, starting at 6.</p> <ul style="list-style-type: none"> <li>Agree the general statement: 'The sum of any three consecutive numbers is a multiple of 3' and write it on the board.</li> </ul> <p>Ask the children to find further examples to satisfy the statement. Encourage them to try larger numbers.</p> <ul style="list-style-type: none"> <li>Discuss results, ask for some examples and establish that the general statement appears to be true.</li> </ul> <div>Q Is it true for every set of three consecutive numbers? Can we see any relationships?</div> <div>Q Is there a relationship between the totals and the numbers in each set?</div> <ul style="list-style-type: none"> <li>Encourage children to offer reasons and explanations. Look at the adding of 1 to each number to get the next three consecutive numbers and the property that the sum of three consecutive numbers is <math>3 \times</math> the middle number.</li> </ul> <div>Q Can you use the rule to work out the sum of <math>29 + 30 + 31</math> without adding them together?</div> <p>Ask children to add groups of five consecutive numbers <math>1 + 2 + 3 + 4 + 5</math>, <math>2 + 3 + 4 + 5 + 6</math> etc. and look for any patterns. Encourage them to make a general statement and test it by using other examples, e.g. <math>101 + 102 + 103 + 104 + 105</math>.</p>	<ul style="list-style-type: none"> <li>Discuss children's findings and agree statements for each case.</li> </ul> <div>Q Can you think of a statement for the sum of any odd number of consecutive numbers?</div> <p>Discuss, allowing time for children to collectively formulate the wording for the statement, with your help if necessary.</p> <div>Q What numbers could we use to test the statement?</div> <p>Collect answers and check the children's calculations.</p> <div> <p><b>By the end of the lesson the children should be able to:</b></p> <ul style="list-style-type: none"> <li><b>Find examples that match a general statement;</b></li> <li><b>Make and explain a general statement.</b></li> </ul> <p>(Refer to supplement of examples, section 6, page 80.)</p> </div>

VOCABULARY  
nearest ten  
nearest hundred  
round up  
round down

RESOURCES  
number fans

VOCABULARY  
consecutive  
multiple  
example  
pattern

Planning sheet	Day Four	Unit8 Properties of numbers and reasoning about numbers	Term: Spring	Year Group: 4																														
Oral and Mental		Main Teaching		Plenary																														
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions																														
<p>Recall multiplication facts in the 3 and 4 times table.</p> <p>Begin to recall multiplication facts in the 6 times table.</p> <p>VOCABULARY multiply product</p>	<ul style="list-style-type: none"><li>Play ‘Ping Pong’ for ×4 facts. The teacher sets a rhythm with the children as shown below, then gives a number for children to give the ×4 product within the rhythm set. Repeat the start number twice to consolidate the product.</li></ul> <table><tr><td>Teacher</td><td>Children</td></tr><tr><td>ping</td><td>pong</td></tr><tr><td>ping</td><td>pong</td></tr><tr><td>ping</td><td>pong</td></tr><tr><td>3</td><td>12</td></tr><tr><td>3</td><td>12</td></tr><tr><td>7</td><td>28</td></tr><tr><td>7</td><td>28</td></tr><tr><td>5</td><td>20</td></tr><tr><td>5</td><td>20</td></tr></table> <ul style="list-style-type: none"><li>Repeat for 3× facts. Introduce the 6 times table. Start in order 1 to 10, then randomly.</li></ul>	Teacher	Children	ping	pong	ping	pong	ping	pong	3	12	3	12	7	28	7	28	5	20	5	20	<p>Make and investigate a general statement about familiar numbers by finding examples that satisfy it.</p> <p>Recognise and extend number sequences.</p> <p>VOCABULARY sequence multiple rule predict</p>	<ul style="list-style-type: none"><li>Write a starting number on the board, e.g. 4.</li><li>Write ‘the rule is +3’.</li><li>Discuss the rule and how to generate the sequence using the rule.</li><li>Get children to recite the sequence formed, i.e. 4, 7, 10, 13, 16, 19, 22.</li></ul> <div>Q Is 34 in our sequence?</div> <p>Continue counting to establish 34 is in the sequence.</p> <p>Write <math>34 = 4 + (\square \times 3)</math>.</p> <p>Discuss this with the children and establish 10 goes in the box. Emphasise that you are adding on a multiple of 3.</p> <p>Repeat for other sequences.</p> <ul style="list-style-type: none"><li>Present this problem to the class:</li></ul> <div>Q How many squares will there be in the 10th cross?</div> <div></div> <p>Give children time to read the question and with the class work through the stages shown below.</p> <p>Recording</p> <table><tr><th>Cross</th><th>Squares</th></tr><tr><td>1</td><td>5</td></tr><tr><td>2</td><td>9</td></tr><tr><td>3</td><td>13</td></tr><tr><td>4</td><td>17</td></tr></table> <p>Identify the rule for the sequence ×4.</p> <p>Statement</p> <p>1st cross → <math>1 + (1 \times 4)</math> 2nd cross → <math>1 + (2 \times 4)</math> 3rd cross → <math>1 + (3 \times 4)</math></p> <p>Test</p> <p>10th cross → <math>1 + (10 \times 4)</math></p> <ul style="list-style-type: none"><li>In pairs get children to investigate and record in the same way, the number of posts needed to make a fence.</li></ul> <div></div> <div>Q Where have you seen a sequence like this before?</div> <div>Q Can we write each statement as <math>1 + (\square \times 4)</math>?</div> <ul style="list-style-type: none"><li>Ask children to investigate the number of posts used to build these huts:</li></ul> <div></div> <div>Q What is the rule for the huts? What statement can we make? How do we test it?</div> <p>Collect responses and identify the rules and carry out tests with the children.</p>	Cross	Squares	1	5	2	9	3	13	4	17	<ul style="list-style-type: none"><li>Draw on the board:</li></ul> <div></div> <div>Q Which table will generate this sequence?</div> <p>Write on the board:</p> <p><math>1 + (\square \times ?)</math></p> <p>Test suggestions.</p> <div>Q What shape or symbol could we use to generate a sequence using the 6 times table?</div> <p>Give children two minutes to work in pairs with whiteboards.</p> <p>Collect ideas from the class and discuss, e.g.</p> <div></div> <p>HOMEWORK – Practise six times table.</p> <div>By the end of the lesson the children should be able to:</div> <ul style="list-style-type: none"><li>Investigate a problem by using the following skills:<ul style="list-style-type: none"><li>– recording</li><li>– identifying a sequence</li><li>– making a general statement</li><li>– testing the statement.</li></ul></li></ul> <p>(Refer to supplement of examples, section 6, pages 76 and 80.)</p>
Teacher	Children																																	
ping	pong																																	
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3	12																																	
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Cross	Squares																																	
1	5																																	
2	9																																	
3	13																																	
4	17																																	

Planning sheet	Day Five	Unit8 <i>Properties of numbers and reasoning about numbers</i>	Term: <i>Spring</i>	Year Group: 4
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
Recall multiplication facts in 2, 3, 4 and 6 times tables.	<ul style="list-style-type: none"><li>Get the class to chant the 2 times table, saying each number statement twice.  Repeat the chant this time saying the 2 times table followed by the 4 times table, i.e.  <math>1 \times 2 = 2;</math>      <math>1 \times 4 = 4</math> <math>2 \times 2 = 4;</math>      <math>2 \times 4 = 8</math> <math>3 \times 2 = 6;</math>      <math>3 \times 4 = 12 \dots</math>  Highlight the doubling process.  <div>Q What table could help us learn our six times table?</div></li><li>Get the class to chant the 3 times table, saying each number statement twice.  Repeat the chant but saying the 3 times table followed by the 6 times table, i.e.  <math>1 \times 3 = 3;</math>      <math>1 \times 6 = 6</math> <math>2 \times 3 = 6;</math>      <math>2 \times 6 = 12</math> <math>3 \times 3 = 9;</math>      <math>3 \times 6 = 18 \dots</math>  Remind the children that the numbers in the 6 times table are double the numbers in the 3 times table.</li><li>Play ‘Ping Pong’ to practise 2, 3, 4 and 6 times tables. Set a rhythm then give numbers for children to respond with products as shown below:  (<math>\times 3</math>)    <i>Teacher</i>    <i>Children</i> ping      pong ping      pong ping      pong 5      15 9      27</li></ul>	Make and investigate a general statement about familiar numbers by finding examples that satisfy it.  Explain methods and reasoning.  <		

## Thousands

ONE THOUSAND

TWO THOUSAND

THREE THOUSAND

FOUR THOUSAND

FIVE THOUSAND

SIX THOUSAND

SEVEN THOUSAND

EIGHT THOUSAND

NINE THOUSAND

TEN THOUSAND

## Hundreds

ONE HUNDRED

TWO HUNDRED

THREE HUNDRED

FOUR HUNDRED

FIVE HUNDRED

SIX HUNDRED

SEVEN HUNDRED

EIGHT HUNDRED

NINE HUNDRED

AND



## Tens

NINETY

EIGHTY

SEVENTY

SIXTY

FIFTY

FORTY

THIRTY

TWENTY

## Teens

NINETEEN

EIGHTEEN

SEVENTEEN

SIXTEEN

FIFTEEN

FOURTEEN

THIRTEEN

TWELVE

ELEVEN

TEN

## Units

NINE

EIGHT

SEVEN

SIX

FIVE

FOUR

THREE

TWO

ONE

Grids









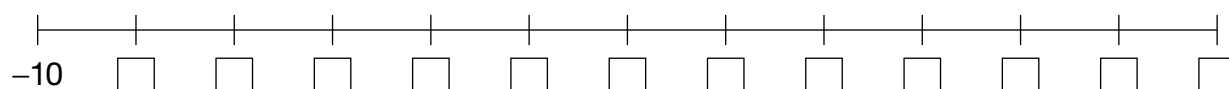
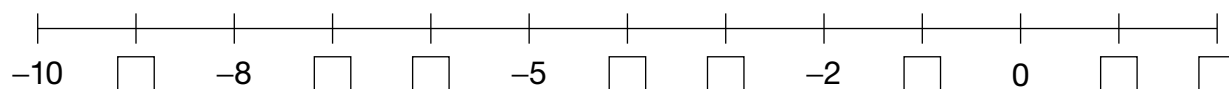
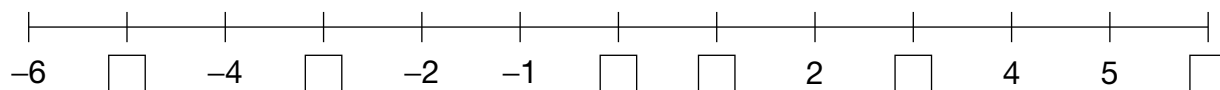




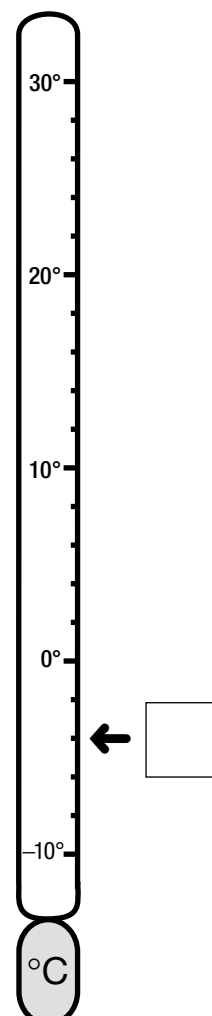
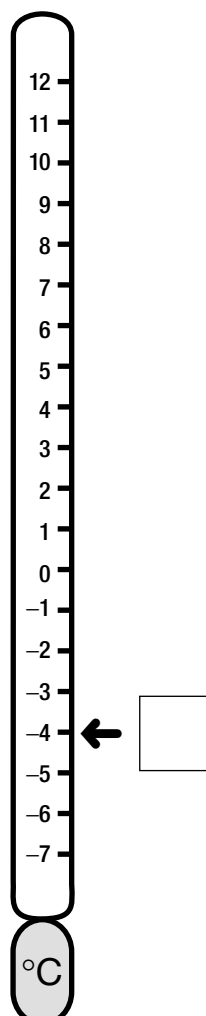
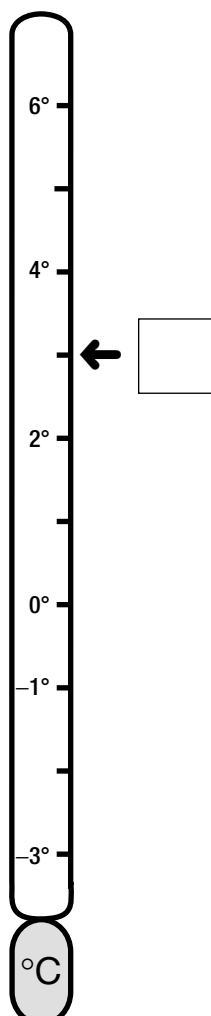
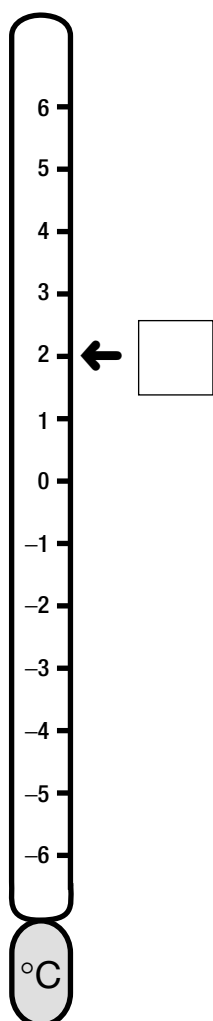
1	2	3	4	1	2	3	4	5	1	2	3	4	5	6
5	6	7	8	6	7	8	9	10	7	8	9	10	11	12
9	10	11	12	11	12	13	14	15	13	14	15	16	17	18
13	14	15	16	16	17	18	19	20	19	20	21	22	23	24
17	18	19	20	21	22	23	24	25	25	26	27	28	29	30
21	22	23	24	26	27	28	29	30	31	32	33	34	35	36
25	26	27	28	31	32	33	34	35	37	38	39	40	41	42
29	30	31	32	36	37	38	39	40	43	44	45	46	47	48
33	34	35	36	41	42	43	44	45	49	50	51	52	53	54
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57	58	59	60	71	72	73	74	75	85	86	87	88	89	90
61	62	63	64	76	77	78	79	80	91	92	93	94	95	96
65	66	67	68	81	82	83	84	85	97	98	99	100	101	102
69	70	71	72	86	87	88	89	90	103	104	105	106	107	108
73	74	75	76	91	92	93	94	95	109	110	111	112	113	114
77	78	79	80	96	97	98	99	100	115	116	117	118	119	120

# Negative numbers

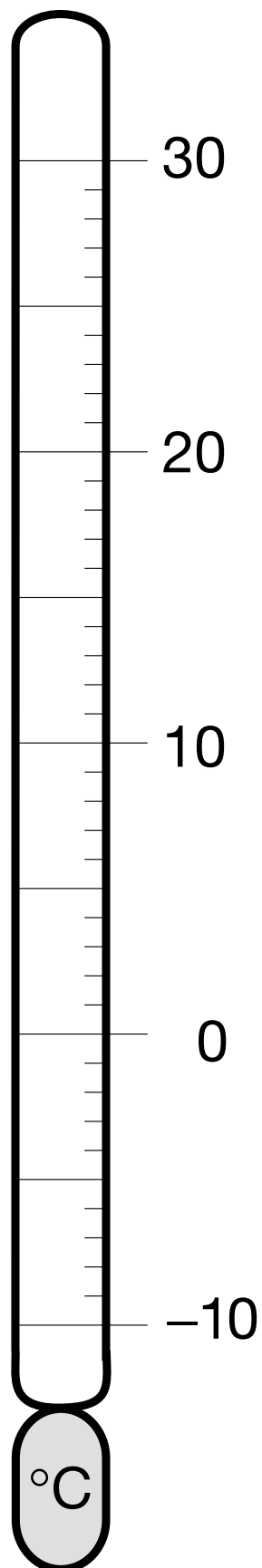
Write the missing numbers.



Write the temperature shown on each thermometer.



# Thermometer



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
61	62	63	64	65	66
67	68	69	70	71	72
73	74	75	76	77	78
79	80	81	82	83	84
85	86	87	88	89	90
91	92	93	94	95	96
97	98	99	100	101	102
103	104	105	106	107	108
109	110	111	112	113	114
115	116	117	118	119	120