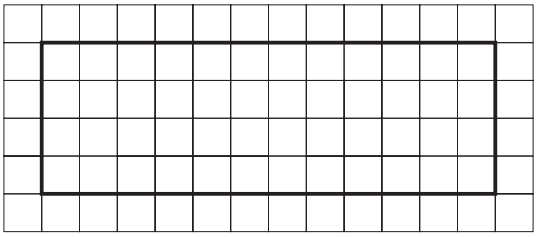
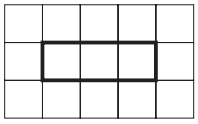
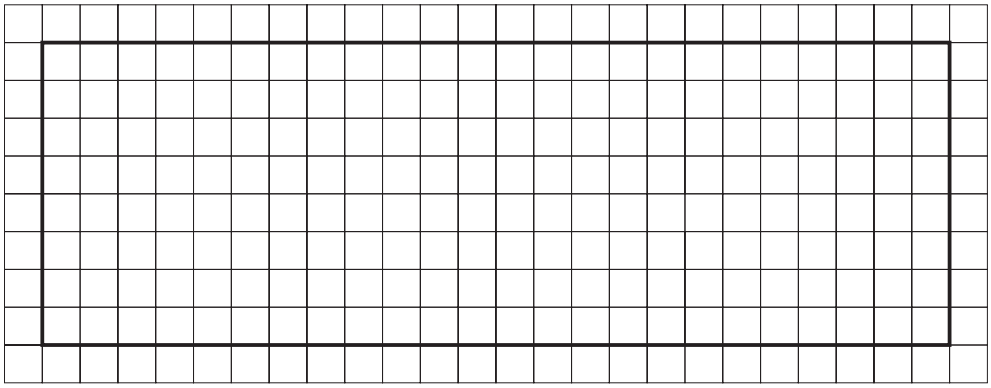
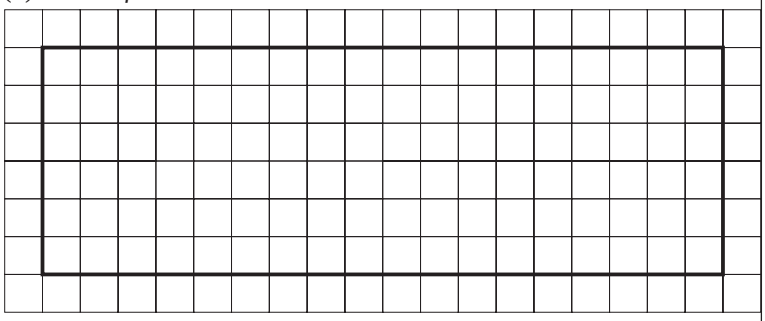
# Y8 UNIT 19 *Similarity* Lesson Plan 1 — *Enlargements*

| *Activity* | | *Notes* |
|---|---|---|
| **1A** | **Introducing 'enlargement'**<br>**PB 19.1, Worked Example 1 (changed)**<br>T: I am planning to build a cupboard in a corner of my kitchen. I've drawn a plan of the corner. The plan shows a right-angled triangle with perpendicular sides of 1 m and 1.5 m. I have used a scale of 1 : 100.<br>Which of the triangles A to F is my plan? What do we mean by 1 : 100 ?<br>$P_1$: 1 cm on the plan represents 100 cm (= 1 m) in real life.<br>T: So what are the actual side lengths of the corner on my plan?<br>$P_2$: 1 cm and 1.5 cm.<br>T: Is there anything else we know about the plan?<br>$P_3$: The triangle is right-angled.<br>T: Why is this?<br>$P_4$: Because a plan is a reduction of the original, so the angles are the same size. Triangle A is the plan of the corner.<br>T: Good. We say that triangle A is the enlargement of the corner of my kitchen.<br>Ps: Enlargement? ...<br>T: Yes; when this word is used in mathematics it can mean increasing or decreasing the size of a shape. My plan is an enlargement with scale factor $\frac{1}{100}$. | *Ps will each need a ruler, a protractor, scissors and a pair of compasses for Activity 2*<br>Whole class activity.<br>The figure in Worked Example 1 on p130 of PB Y8B appears on OHP and each P is given a copy.<br>Ps will be familiar with the first questions as they have dealt with scales and maps, but T introduces the new topics of enlargement and similarity. |
| **1B** | **Enlargements**<br>T: Which of the other triangles could also be plans of my kitchen corner? Which ones are enlargements of triangle A ?<br>T: Shapes which are enlargements of each other are called similar shapes.<br>*10 mins* | Whole class activity continues, looking at Solution on p130 of PB.<br>*Notes*<br>1. When deciding that C and E are not enlargements of A, T must stress that, for an enlargement, the angles will not be changed.<br>2. T may ask (stronger) Ps to find e.g. the scale of plan B if we know that plan A has a scale of 1 : 100, and that B is an enlargement of A with scale factor 2. |
| **2**<br>*(continued)* | **Similar shapes**<br>T: We have to decide whether any two shapes which have equal angles are similar shapes.<br>**Set A** 1. Construct a triangle with base of length 3 cm and angles of 30° and 70° on the base.<br>2. Draw a rectangle with sides of lengths 4 cm and 5 cm.<br>**Set B** 1. Construct a triangle with base of length 6 cm and angles of 30° and 70° on the base.<br>2. Draw a rectangle with sides of lengths 6 cm and 2 cm. | Ps work in pairs.<br>T arranges Ps in pairs by seating. One P from each pair is given Set A, the other, Set B, to construct. T monitors work, helping slower Ps.<br>When all have finished, T asks the pairs to compare the triangles and then the rectangles. |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 1 | *Enlargements* |
|---|---|---|
| ***Activity*** **2** *(continued)* | | ***Notes*** Obviously the two rectangles are completely different, despite their angles being the same, while the triangles are similar (Ps can measure the sides and compare them). Discussion leading to conclusion that triangles will be similar if their angles are of the same size and that this is not the case for rectangles. Praising. |
| | *18 mins* | |
| **3** | **Practical activity** T: We've just stated that two triangles are similar if their angles are equal, pair by pair. Let's see what we can do if we are not allowed to use a protractor or a ruler to measure the angles and sides. **Activity 19.1 (without protractor or ruler)** | Whole class activity. Each P is given a copy of Activity 19.1. Ps cut out the triangles. Discussion: Ps will suggest fitting the angles, pair by pair, but then Ps suggest that it's sufficient to fit the angles that appear to be equal, then, if the third sides are parallel, the triangles are similar (using the equality of corresponding angles). Praising. |
| | *27 mins* | |
| **4** | **Practice with enlargements** **PB 19.1, Q3** *(*B *Scale factor* 2; C *Scale factor* 3 D *Scale factor* $\frac{1}{2}$ or 0.5; E *Scale factor* $1\frac{1}{2}$ *or* 1.5*)* **PB 19.1, Q6** *(*C, E*)* | Individual work, monitored, helped. Verbal checking. Q6 might lead to a debate but Ps can convince each other by measuring and comparing the sides of the flags. Self-correction, feedback. Praising. |
| | *38 mins* | |
| **5** | **Practical work with enlargements** **OS 19.2** | Whole class activity. Task appears on OHP and each P is given a copy. Volunteer Ps draw at BB and explain that we must not change the sizes of the angles when we enlarge a shape. Other Ps do the same on their sheet, T monitors and corrects while walking around the classroom. |
| | *45 mins* | |
| | **Set homework** **PB 19.1, Q2** **PB 19.1, Q7** | |

# Y8 UNIT 19 *Similarity* Lesson Plan 2 — *Similar Shapes 1*

| *Activity* | | *Notes* |
|---|---|---|
| **1** | **Checking homework**<br>**PB 19.1, Q2** B, E<br>**PB 19.1, Q7**<br>(a) *Scale factor* 2<br>  <br>(c) *Scale factor* $\frac{1}{2}$<br>  <br>(b) *Scale factor* 4<br>  | Verbal checking of Q2 with detailed discussion of the possible methods:<br>1. measuring the sides and checking if they are in the same ratio;<br>2. measuring the angles (or looking at the gradients).<br>Checking Q7: T walks among Ps and look at their work, suggesting corrections if necessary and praising. |
| | (d) *Scale factor* 3<br>  | While checking homework, T makes Ps review, repeat and summarise the points learnt in the previous lesson:<br>- an enlargement is an increasing or decreasing of all the sizes of a shape in the same ratio<br>- an enlargement does not change the sizes of the angles in a shape<br>- two triangles are similar if all their angles are the same. |
| | *8 mins* | |
| **2** | **Practice with similar triangles/enlargements**<br>**OS 19.3**<br>T: What can you see on the sheet?<br>Ps: Three similar triangles.<br>T: How do you know they are similar?<br>$P_1$: From the markings on the angles ...<br>$P_2$: All the triangles contain a right angle and have an angle marked with two arcs ...<br>T: Fine. So what can you say about the first and second triangles?<br>Ps: They are enlargements of each other.<br>T: What is the scale factor? | Whole class activity.<br>T puts OS on OHP, covering the text at the top of the page, and asks questions to lead Ps to the main point. |
| *(continued)* | | |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 2 | *Similar Shapes 1* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **2** *(continued)* | $P_3$: 3 cm $\rightarrow$ 9 cm, so the scale factor is 3.<br>T: I think 3 cm $\rightarrow$ 12 cm, so the scale factor is 4.<br>Ps: No!<br>T: Why? FD is a perpendicular side in the triangle DEF as BC is in triangle ABC.<br>Ps: ?<br>T: How do you identify the sides with each other.<br>Ps: ?<br>T: Why are the triangles similar?<br>Ps: Because the angles in each of the triangles are the same.<br>$P_4$: DF is opposite the angle marked by two arcs, so it must be the match of the side with the same property in triangle ABC, and that side is AC.<br>T: You've convinced me ... So the scale is 3. What does that mean?<br>$P_5$: All the lengths in triangle DEF will be three times the lengths in triangle ABC.<br>T: Give me the length of DE.<br>$P_6$: It will be $3 \times 5\text{ cm} = 15\text{ cm}$.<br>T: Why?<br>$P_6$: Because DE is the match of AB since each is a hypotenuse.<br>T: What about AC?<br>$P_7$ (Writes on BB): $DF = 3 \times AC$ $\quad \frac{BC}{3} = 8$<br>$12 = 3 \times AC$<br>$AC = 4\text{ cm}$<br>*22 mins* | T needs to make Ps think carefully to enable them so that they fully understand and are able to explain their reasons.<br>T can/should help Ps understand this.<br>T agrees, praises.<br>Then lesson continues with triangle HIG. |
| **3** | **Further practice**<br>**PB 19.2, Q3**<br>...<br>T: So the sides of the two triangles are of the ratio $\frac{AB}{DE}$, which gives the scale factor of the enlargement. We can write, for example,<br>$\frac{BC}{EF} = \frac{AB}{DE}$<br>$\frac{BC}{3} = \frac{32}{4}$<br>$\frac{BC}{3} = 8 \quad (\times 3)$<br>$BC = 24\text{ cm}$<br>*29 mins* | Whole class activity.<br>Now T encourages slower Ps to match the sides of the two triangles, find the scale factor and the missing sides mentally. Praises.<br>Then T summarises what Ps have said and suggests an alternative way of writing this. Ps all write this in Ex.Bs. |
| **4** | **Individual work**<br>**PB 19.2, Q4** *(*Scale factor $= 7$; GE $= 42$ cm; FG $= 35$ cm*)*<br>**PB 19.2, Q1** *(*Scale factor $= \frac{30}{6} = 5$; CD $= 5 \times 16 = 80$ cm*)*<br>*38 mins* | Individual work, monitored, helped.<br>Checking at BB in detail (giving reasons for the pairing of sides in the triangles).<br>Agreement, feedback, self-correction. Praising. |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 2 | *Similar Shapes 1* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **5** | **Calculating length of sides of similar triangles**<br>**PB 19.2, Q6** (changed in order to make the task easier: examining only the triangles ABC and DEF, and so giving extra data: AC = 5 cm) | Individual work, monitored, helped.<br>T lets Ps think and work, monitoring their work but not helping, noting which Ps rotate the triangles to identify the pairs of sides.<br>Then, after 4 minutes, T stops the work, sketches the two triangles on BB (in the same position as shown in PB), and asks a volunteer P to write solution on BB and give reasons.<br>Agreement, stressing and summarising the main points of the lesson. Feedback, self-correction. Praising. |
| | *45 mins* | |
| | **Set homework**<br>**PB 19.2, Q2**<br>**PB 19.2, Q5**<br>**PB 19.2, Q6 (completing: finding the missing side of triangle HIG)** | |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 3 | *Similar Shapes 2* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **1** | **Checking homework**<br>**PB 19.2, Q2** *Scale factor* $= \frac{12}{6} = 2$<br>(a) AB $= 2 \times 2.5 = 5$ cm (b) EF $= \frac{13}{2} = 6.5$ cm<br>**PB 19.2, Q5** *Scale factor* $= 2,\ 6$<br>(a) EG $= 10$ cm (b) HJ $= 30$ cm<br>(c) EF $= 12$ cm (d) AB $= 6$ cm<br>**PB 19.2, Q6 (completing)**<br>*Scale factors* $= 1\frac{1}{2},\ 2\frac{1}{2}$<br>(a) HI $= 7.5$ cm (b) BC $= 3$ cm<br>(c) AC $= 5$ cm (e) DF $= 7.5$ cm<br>*7 mins* | Verbal checking , with solutions written on BB where necessary.<br>T emphasises the main points from the previous lesson:<br>- when triangles are similar, all the lengths follow the same ratio (scale factor);<br>- it's important to match the correct pairs of sides;<br>- the scale factor can be found if two known sides from the two shapes can be matched. |
| **2** | **Finding similar shapes**<br>**PB 19.2, Q9**<br>T: How many shapes can you see in this figure?<br>Ps: Three.<br>T: What are they?<br>Ps: Triangle ABE, trapezium BCDE ...<br>T: And the third ... ?<br>$P_1$: Triangle ACD.<br>T: This unit is called 'Similarity': what do you think I'm going to ask you?<br>$P_2$: Are there any similar shapes in the figure?<br>T: Yes. So? ...<br>$P_3$: The two triangles might be similar.<br>T: Let's use the information we have - that lines BE and CD are parallel ... What do we need to know to be able to say that the two triangles are similar?<br>Ps: All three angles must be the same.<br>T: So?<br>$P_4$: $\angle$EAB $= \angle$DAC, since they cover each other.<br>Ps: $\angle$AEB $= \angle$ADC and $\angle$ABE $= \angle$ACD, since they are corresponding angles.<br>T: Clever! Match the sides ... Which pair do we know? ... Look at p141 in your PB and answer Q9 (b).<br>P (at BB): $\frac{AC}{AB} = \frac{CD}{BE}$<br>$\frac{AC}{4.4} = \frac{9}{6}$<br>$\frac{AC}{4.4} = 1.5 \quad (\times 4.4)$<br>$AC = 1.5 \times 4.4$ | Whole class activity.<br>T puts the figure from the question on OHP; discussion follows with questions/answers interactively.<br>T gives Ps 2 minutes to think and write, then asks a volunteer P to come out and show and explain the solution. |
| *(continued)* | | |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 3 | *Similar Shapes 2* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **2** *(continued)* | AC = 6.6 cm<br>and BC = AC − AB = 2.2 cm<br>... and similar for Q9, part (c). | Agreement, self-correction, feedback. Praising.<br>After another 2 minutes a slower P is encouraged to come to BB and give solution to part (c) (may need help).<br>Agreement, self-correction, feedback. Praising. |
| | *18 mins* | |
| **3** | **Similar triangles**<br>**OS 19.4**<br>T: What can you see on the figure?<br>Ps: Two triangles.<br>T: What is my question?<br>Ps: Are the triangles similar?<br>T: That's right. Can you find the equal angles? Use your protractors to measure the angles.<br>T (after Ps have measured pairs of angles):<br>Why does ∠EBA = ∠DBC ?<br>$P_1$: They are vertically opposite angles.<br>T: Good. Mark each of them with an identical arc.<br>Why does ∠EAB = ∠BDC ?<br>$P_2$: They are alternate angles.<br>T: Mark them with two arcs. Why won't I ask you about the third pair of angles?<br>Ps: ?<br>T: Explain how the third pair of angles might not be equal.<br>$P_3$: They must be equal. If two of the angles are the same, the third ones must be as well, since the angles in a triangle add up to 180°.<br>T: So?<br>$P_3$: We've proved that two of the pairs of angles are equal, so the triangles must be similar.<br>T: That's right. But I'd like you to tell me anyway why this third pair of angles is equal.<br>$P_4$: They are alternate angles.<br>T: Mark them with three arcs ... Why have I asked you to mark the equal angles? What are we going to do next?<br>Ps: Match the sides.<br>T: Right. Let's do that now.<br>P (in front of class): We can find the pairs of sides by looking at the equal angles ... We can match EA and DC since they are both opposite the angle marked with one arc in their own triangle ... The pair of sides will be AB and BD, the sides opposite the angles with three arcs ... so we can write:<br>$\frac{EA}{DC} = \frac{AB}{BD}$ | Whole class activity.<br>Task appears on OHP and each pair of Ps is given a copy.<br>Ps might find out which angles are equal, but Unit 11 was studied some time ago, so T should first make Ps measure the angles and then let them find the reason for this.<br>Volunteer P comes out, shows on OHP, explains and then writes on BB (T may help). |
| *(continued)* | | |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 3 | *Smilar Shapes 2* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **3** *(continued)* | $\frac{EA}{22} = \frac{5}{20}$ $(\times 22)$<br>$EA = \frac{1}{4} \times 22$<br>$EA = 5.5$ cm<br>... and so on to find BC. *(24 cm)* | Agreement, praising, Ps write in Ex.Bs.<br>T chooses a slower P to calculate BC.<br>Agreement. Praising. |
| | *32 mins* | |
| **4** | **Further practice with similar triangles**<br>**Extra Exercises 19.2, Q3 (without the equal angles marked)**<br>*(*AB $= 4\frac{1}{2}$ cm , CD $= 5$ cm*)* | Individual work. Task appears in OHP.<br>T monitors and helps Ps.<br>Checking at BB with explanations.<br>Agreement, self-correction, feedback. Praising. |
| | *39 mins* | |
| **5** | **Individual work followed by discussion**<br>(a) Construct an isosceles triangle with base of length 5 cm and equal angles of $72°$ on the base.<br>(b) Divide the triangle into two by halving one of the two equal angles.<br>(c) Now you have 3 triangles. Determine the sizes of their angles. What do you observe?<br>(d) Determine the scale factor by measuring. | Individual work.<br>Task appears on OHP or each P is given a copy.<br>T monitors Ps' work and helps or corrects where necessary. After 5 minutes, T stops the work and discussion follows, with T sketching on BB what Ps have done.<br>Agreement. Praising. |
| | *45 mins* | |
| | **Set homework**<br>**(1) PB 19.2, Q7 with the addition of**<br>**(f): Calculate the perimeter of both shapes. What do you notice?**<br>**(2) PB 19.2, Q8**<br>**(3) T gives out the two problems described in Activity 19.2 to two volunteer Ps to study at home so that they can describe this to other Ps at the start of the next lesson.** | |
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| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 4 | *Area Ratios* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **1** | **Checking homework**<br>**(2) PB 19.2, Q8** *((a)* (i) *Angle* ABE = *angle* DBC<br>(ii) *Angle* BAE = *angle* BDC<br>(iii) *Angle* AEB = *angle* BCD<br>*(b)* AB = 16.4 cm; BE = 20 cm*)*<br><br>**(3) Activity 19.2** ***(See notes on Activity 19.2 in Teacher Support)*** | T sketches the figure from Q8 on BB and a volunteer P shows and explains solution. Agreement, self-correction, feedback. Praising.<br><br>Then T asks the two Ps who volunteered to look at the problems in Activity 19.2 how they would estimate the width of a river or the height of a tower. Praising. |
| | **(1) PB 19.2, Q7 (extended with calculation of perimeters)**<br>*((a)* IP = 8 cm; *(b)* JK = 2 cm;<br>*(c)* LM = 2 cm<br>*(d)* FG = 6 cm NO = 4 cm<br>*(e)* EF = 4.5 cm<br>*Perimeters are 45 cm and 30 cm; same ratio as side lengths.)* | Verbal checking. When asked for the perimeters, Ps also discuss what they have noticed - that the perimeters are in the same ratio as the sides. Agreement, self-correction, feedback. Praising. |
| | *14 mins* | |
| **2** | **Perimeter ratio**<br>A rectangle has sides of lengths 4 cm and 6 cm.<br>Find the side lengths of a rectangle which is similar to this one and has a perimeter of 50 cm.<br><br>P (at BB): $a_1 = 4$ cm<br>$b_1 = 6$ cm<br>$P_1 = (a_1 + b_1) \times 2$<br>$= 20$ cm<br><br>$P_2 = 50$ cm<br>$a_2,\ b_2 = ?$<br>Since the perimeters are in the same ratio as the sides, $P_2 : P_1$ will give the scale factor.<br>$a_2 : a_1 = b_2 : b_1 = P_2 : P_1 = \frac{5}{2} = 2.5$<br>$a_2 = 2.5 \times a_1 = 10$ cm<br>$b_2 = 2.5 \times b_1 = 15$ cm<br>T: Clever! How do we check the solution?<br>$P_2$ (at BB):<br>Check: $(10 + 15) \times 2 = 50$ (cm) | Task appears on BB or OHP. T gives Ps 2-3 minutes to think then asks a volunteer P how to find the solution. P suggests, T and other Ps agree. T chooses another P to work it out at BB. All Ps write in Ex.Bs.<br><br>Praising. |
| | *21 mins* | |
| **3A**<br><br>*(continued)* | **Area ratio**<br>T: Do areas follow the same ratio as sides and perimeters?<br>Ps: ?<br>T: Let's calculate the area of the rectangles we have just been dealing with. | Whole class activity.<br><br>T encourages a slower P to come and calculate areas at BB and give their ratio. |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 4 | *Area Ratios* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **3A** *(continued)* | P (at BB): $A_2 = (10 \times 15)\ \text{cm}^2 = 150\ \text{cm}^2$<br>$A_1 = (4 \times 6)\ \text{cm}^2 = 24\ \text{cm}^2$<br>$A_2 : A_1 = \frac{150}{24} = \frac{75}{12} = \frac{25}{4}$<br>T: So?<br>Ps: The areas are not in the same ratio as the sides.<br>T: Is there a connection between the areas? Look at another pair of rectangles and work out the ratios, then think! | |
| **3B** | **Individual work**<br>**PB 19.3, Q1**<br>T (writes on BB):<br>scale factor 4<br>ratio of areas 16<br>***(Solutions:*** (a) 12 $\text{cm}^2$, 192 $\text{cm}^2$ (b) 4 (c) $4^2 = 16$*)* | Individual work, monitored, helped.<br>Verbal checking of the areas, scale factor and ratio of the areas.<br>Agreement, self-correction, feedback. Praising.<br>Then T writes the answers for parts (b) and (c) on BB; discussion follows. |
| **3C** | **Introducing the area factor**<br>T: Is there any connection between the two ratios? ... Look at the previous ratios (writes on BB):<br>$\frac{5}{2}$<br>$\frac{25}{4}$<br>$P_1$: The ratio of areas is the square of the ratio of the sides.<br>T: That's right. But why? ... Since the perimeters give the same ratio as the sides, ...<br>$P_2$: When we calculate perimeters we add up the side lengths, when we calculate areas we multiply the side lengths. If we give a factor to the sides, the sum will be given once, while the product uses the factor twice.<br>T: Good! So the areas of similar shapes also follow a rule, the factor the area is enlarged by is called the area factor.<br>Summarising what we have said,<br>when enlarging (writes on BB):<br>scale factor $= k$<br>area factor $= k^2$ | Whole class activity.<br>Perhaps a stronger P will give the reason. If not, T will explain it.<br>Praising.<br>Ps write in Ex.Bs. |
| | *35 mins* | |
| **4** *(continued)* | **Practice with area factors**<br>**PB 19.3, Q2**<br>T: What will be the area factor if the scale factor is 2 ?<br>Ps: 4<br>T: What is the area of the rectangle?<br>Ps: 12 $\text{cm}^2$. | Whole class activity.<br>Part (a) is answered with encouragement from T. |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 4 | *Area Ratios* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **4** *(continued)* | T: What will be the area of the enlarged rectangle?<br>Ps: 48 $cm^2$.<br>T: How could you check this?<br>P: 3 cm $\rightarrow$ 6 cm and 4 cm $\rightarrow$ 8 cm after the enlargement, and $6 \times 8 = 48$. | T has prepared a table in advance on BB. Ps copy table.<br>T fills in first row as Ps answer, then a volunteer P completes the second row. Then T points to slower Ps for answers for the third and fourth rows.<br>Ps agree, write correct answer in Ex.Bs. T praises. |

| | $k$ | 2 | 3 | 6 | 10 |
|---|---|---|---|---|---|
| | $k^2$ | *(4)* | *(9)* | *(36)* | *(100)* |
| | Area ($cm^2$) | *(48)* | *(108)* | *(432)* | *(1200)* |
| *Checking* | $a$ (cm) | *(6)* | (9) | *(18)* | *(30)* |
| | $b$ (cm) | *(8)* | *(12)* | *(24)* | *(40)* |
| | $a \times b$ ($cm^2$) | *(48)* | *(108)* | *(432)* | *(1200)* |

*40 mins*

| | | |
|---|---|---|
| **5** | **Practice with enlargement**<br>**PB 19.3, Q3 (starting to complete the table)** | Individual work, monitored, helped.<br>After 3-4 minutes, T stops the work and checks the rows all Ps have completed (about 3 rows).<br>Agreement, feedback, self-correction. Praising. Short summarising of the topic of the lesson. |

*45 mins*

| | | |
|---|---|---|
| | **Set homework**<br>**PB 19.3, Q3 (completing the table)**<br>**PB 19.3, Q4**<br>**PB 19.3, Q5** | |
| | | |

# Y8 UNIT 19 *Similarity* Lesson Plan 5 — *Volume Ratios*

| *Activity* | | *Notes* |
|---|---|---|
| **1** | **Checking homework and further discussion**<br>**PB 19.3, Q3 (completing table)** | T has prepared the completed table for Q3 in advance and now shows it on OHP so that Ps can self-correct.<br>Feedback. Praising. |

| *Length of Sides* | | *Scale Factor* | *Area* | *Area Factor* |
|---|---|---|---|---|
| *Base* | *Height* | | | |
| 3 cm | 4 cm | 1 | 6 $cm^2$ | 1 |
| 6 cm | 8 cm | 2 | 24 $cm^2$ | 4 |
| 9 cm | 12 cm | 3 | 54 $cm^2$ | 9 |
| 12 cm | 16 cm | 4 | 96 $cm^2$ | 16 |
| 15 cm | 20 cm | 5 | 150 $cm^2$ | 25 |
| 18 cm | 24 cm | 6 | 216 $cm^2$ | 36 |
| 30 cm | 40 cm | 10 | 600 $cm^2$ | 100 |
| 4.5 cm | 6 cm | 1.5 | 13.5 $cm^2$ | 2.25 |

**PB 19.3, Q4** *(Area* $= 25 \times 42 = 1050\ cm^2$*)*

**PB 19.3, Q5** *(Area* $= 9 \times 50 = 450\ cm^2$*)*

Then verbal checking of Q4 and Q5.
Agreement, self-correction, feedback. Praising

*6 mins*

| | | |
|---|---|---|
| **2** | **Whole class activity**<br>T: I'm not sure that the wording of Q5 is correct. In Q4 we are told that the second parallelogram is found by enlarging the first one, so we can use the area factor. But for Q5 we are not told that the second circle is similar to the first one ... what do you think? ... | Whole class activity, thinking together about similarity.<br>Discussion, finally agreeing that all circles are similar. (If anyone is not convinced, T can ask them to draw on BB a circle that is not similar to others.) |

T: Let's look at some other problems. Decide whether each of the following statements is true or false.

(a) All squares are similar. *(True)*

(b) Since all 4 angles of each rectangle are the same, all rectangles are similar. *(False)*

(c) Two quadrilaterals are similar if all their 4 angles are the same. *(False)*

(d) Two triangles are similar if all their 3 angles are the same. *(True)*

(e) Two triangles are similar if 2 of their angles are the same. *(True)*

(f) Two isosceles triangles are similar if one of their angles are the same. *(False)*

(g) Two right-angled triangles are similar if one of their acute angles are the same. *(True)*

(h) All rhombuses are similar. *(False)*

(i) All spheres are similar. *(True)*

(j) All cubes are similar. *(True)*

T reads out questions, Ps think, T makes them vote.

Then discussion, agreement.

*Note*: for each '*False*' statement, T asks for an example to prove that the statement is false, and also asks if Ps can change the statement slightly to make it true.
(e.g. Two rhombuses are similar if one of their angles are the same.)

*18 mins*

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 5 | *Volume Ratios* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **3A** | **Surface areas**<br>T: Now we'll look at solids. We've already seen that when enlarging a shape using scale factor *k*, the area of the shape will change by the factor $k^2$. Can we find 'areas' on a solid? What area of solids have we looked at?<br>Ps: Surface area.<br>T: Do you think that surface area will follow the same rule as for enlarging a solid? ... Let's look at this.<br>**OS 19.5 (surface area)**<br>T: What can you see on the sheet?<br>Ps: Two similar cuboids ...<br>T: ... with scale factor ...?<br>Ps: 2<br>T: What do we mean by 'surface area'?<br>$P_1$: The total area of the faces which cover a solid.<br>T: How do you think the area will increase here?<br>Ps: By a factor of 4.<br>T: Let's see if you can still remember how to calculate surface areas ...<br>P (Cuboid A): $S$ = ... = 94 $\text{cm}^2$<br>P (Cuboid B): $S$ = ... = 376 $\text{cm}^2$<br>P (checking): 376 ÷ 94 = 4 | Whole class activity.<br>Before studying volume ratios, T makes Ps consider how the surface area changes when enlarging a solid.<br>Task appears on OHP, firstly with the sections on volumes and the last three rows covered.<br>For Cuboid A, T points to a volunteer P to give the surface area and explain the calculation used to obtain it. Then, for Cuboid B, T chooses a slower P to do the same.<br>Finally agreeing (checking) that (if) the prediction was right.<br>Praising. Ps write in Ex.Bs. |
| **3B** | **Introducing volume ratios**<br>T: We've also dealt with volumes of solids. Can you remember the formula which gives the volume of a solid?<br>P (writes on BB): $V = a \times b \times c$<br>T: In the last lesson, one of you gave us the reason why the perimeter changes with factor *k* while the area changes with factor $k^2$.<br>Who can predict the increase in volume when we enlarge our cuboid by a scale factor of 2 ?<br>P (stronger): Since the volume is given by the product of three edges and all of them are multiplied by 2, the result will be 8 times the volume of the original cuboid.<br>T: Clever! Let's check it.<br>P (A): $V = a \times b \times c = (3 \times 4 \times 5)\ \text{cm}^3 = 60\ \text{cm}^3$<br>P (B): $V = a \times b \times c = (6 \times 8 \times 10)\ \text{cm}^3 = 480\ \text{cm}^3$<br>Ps: And $480 = 60 \times 8$ | Then T introduces volume ratios – interactive discussion.<br>T asks slower Ps to calculate at BB, agrees, praises, writes correct results on OS.<br>Finally T uncovers the last 3 rows, discusses the results with Ps and introduces volume ratio. |
| | *30 mins* | |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 5 | *Volume Ratios* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **4** | **Individual work with volume ratio**<br>T: You are probably familiar with this type of table.<br>**PB 19.3, Q8**<br>T: Let's check if the previous result was by chance.<br><br>T (writes on BB):<br>If the scale factor $= k$<br>$\Rightarrow$ the volume factor $= k^3$.<br>*38 mins* | Individual work, monitored, helped.<br><br>Ps copy the table from PB, of T can give them a copy to save time.<br><br>*Checking*: T puts solution on OHP. Then self-correction, feedback, praising; Ps state and write down the rule. |
| **5** | **Similarity for cubes**<br>T: Just two more questions:<br>- Are all cubes similar? *(Yes)*<br>- Can you give the volume-formula of the cube? *($V = a^3$)*<br>T: Now give me the volume of the cube with sides of<br>**T:** / **Ps:**<br>1 cm / $1\ \text{cm}^3$<br>2 cm / $2^3\ \text{cm}^3$<br>3 cm / $3^3\ \text{cm}^3$<br>8 cm / $8^3\ \text{cm}^3$<br>100 m / $100^3\ \text{m}^3$<br>0.1 mm / $0.1^3\ \text{mm}^3$<br>T: Right. So all the cubes are similar ...<br>*42 mins* | A quick mental exercise.<br><br>Praising.<br>Agreeing that this is correct. |
| **6** | **Using the rule**<br>We have two similar bottles with heights 20 cm and 40 cm. The smaller one has a capacity of 100 ml. What is the capacity of the larger bottle?<br><br>P: Since the bottles are similar, we can get the scale factor by dividing, e.g. their heights, $k = 2$. The ratio of the volumes will be $k = 8$, so the other capacity is 800 ml.<br>*45 mins* | Individual work.<br>Task appears on OHP.<br>Time is short but the numbers used are easy to calculate.<br>T gives Ps 2 minutes, then a volunteer P explains (verbally) the solution.<br>Agreement, feedback. Praising. |
| | **Set homework**<br>**PB 19.3, Q9**<br>**PB 19.3, Q10** | |

# Y8 UNIT 19 *Similarity* Lesson Plan 6 *Maps and Scale Models*

| *Activity* | | *Notes* |
|---|---|---|
| **1** | **Checking homework**<br>**PB 19.3, Q9** Vol = $27 \times 32 = 864$ cm$^3$<br>**PB 19.3, Q10** Vol = $(2.5)^3 \times 42 = 656.25$ cm$^3$<br>*5 mins* | Detailed checking at BB, while reviewing the topic of the previous lesson.<br>Agreement, feedback, self-correction. Praising. |
| **2A** | **Revision - basic connections between units**<br>T: We started our unit with a 'map problem' and will finish it with some similar problems which are common in real life. With models, maps and plans the scales used will often be larger than those we used in the previous lessons; the difference between the area or volume of the similar things could be huge. You will need to change units - can you still remember the basic connections?<br>1 m = 100 cm<br>1 km = 1000 m<br>1 km = 100 000 cm<br>1 m$^2$ = 10 000 cm$^2$<br>1 km$^2$ = 1 000 000 m$^2$<br>1 m$^3$ = 1 000 000 cm$^3$ | Whole class activity.<br>T makes Ps list the possible length connections which can be used when talking about maps or models and their actual sizes. When asking for the connection between area - or volume - units, T makes Ps explain them at BB (e.g. in a square with sides of 1 m, there are $100 \times 100$ squares with sides of 1 cm, so 1 m$^2$ = 10 000 cm$^2$).<br>T agrees and write conversions as a list on BB. Ps copy them in Ex.Bs. |
| **2B** | **Conversions - mental work**<br>T: Let's do some conversions in our heads.<br>**T:** **Ps:**<br>2 km = ? m 2000<br>5 km = ? cm 500 000<br>3.5 m = ? cm 350<br>430 000 cm = ? km 4.3<br>8 m$^2$ = ? cm$^2$ 80 000<br>75 000 cm$^2$ = ? m$^2$ 7.5<br>2.5 m$^3$ = ? cm$^3$ 2 500 000<br>6 000 000 cm$^3$ = ? m$^3$ 6<br>7 km$^2$ = ? m$^2$ 7 000 000<br>20 000 000 m$^2$ = ? km$^2$ 20<br>1 km$^2$ = ? cm$^2$ 10 000 000 000 | Mental work.<br>T asks the questions aloud while writing them on BB. Ps are given time to think and can use the previous conversion table, which has been left on BB. Slower Ps can write in Ex.Bs. Agreement, praising at each question. |

*(continued)*

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 6 | *Maps and Scale Models* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **2B** *(continued)* | T: And if you get a huge number in $cm^2$, how will you convert it to $km^2$ ?<br>P (stronger): In two steps.<br>T: Try it (writes on BB):<br>$85\,000\,000\,000\ cm^2 = ...$<br>P: First we convert it into $m^2$ by dividing the number by 10 000 ...<br>... (counts the zeros at BB and writes):<br>... $8\,500\,000\ m^2$<br>then dividing by 1 000 000, moving the decimal point forward (to the left) ... (writes):<br>... $= 8.5\ km^2$<br>T: Well done. You'll need to know how to do this for the next question.<br>*18 mins* | Then a further question ...<br><br>Ps write in Ex.Bs. |
| **3** | **Map scales**<br>**OS 19.8**<br><br>T: $A = 6\,250\,000\,000\ cm^2$<br>$P_1$: $A = (6\,250\,000\,000 \div 10\,000)\ m^2$<br>$= 625\,000\ m^2$<br>$P_2$: $A = (625\,000 \div 1\,000\,000)\ km^2$<br>$= 0.625\ km^2$<br>*24 mins* | Whole class activity.<br>Task appears on OHP.<br>Discussion, reviewing that the area will change with the square of the scale.<br>Ps calculate the area in $cm^2$ using their calculator and dictate to T. Agreement, T writes correct result on OS, Ps in Ex.Bs.<br>Conversion, praising. |
| **4** | **Individual practice**<br>**PB 19.4, Q4** *( (a)* $16\,000\,000\,000\ cm^2$<br>*(b)* $1\,600\,000\ m^2$<br>*(c)* $1.6\ km^2$ *)*<br>*31 mins* | Individual work, monitored, helped.<br>Checking at BB, solution and explanation by a volunteer P.<br>Agreement, self-correction, feedback. Praising. |
| **5** | **Review of similarity**<br>**PB 19.4, Q1** *( (a)* $400\ cm = 4\ m$<br>*(b)* $50\,000\ cm^2 = 5\ m^2$<br>(c) $3.2\ m^3$ ($3\,200\,000\ cm^3$) *)*<br>*39 mins* | Firstly a discussion and review of the topic of the previous lesson; that linear, area and volume ratios can be seen from 1-D, 2-D or 3-D parts of similar solids.<br>Then individual work, monitored, helped.<br>Verbal checking, converting results into m, $m^2$ and $m^3$.<br>Agreement, self-correction, feedback. Praising. |

| **Y8** | **UNIT 19 *Similarity*** Lesson Plan 6 | *Maps and Scale Models* |
|---|---|---|
| ***Activity*** | | ***Notes*** |
| **6** | **Practical work with maps**<br>**Activity 19.3** | Whole class activity.<br>T should obtain a copy of a detailed local map of the area around the school. Each P is given a copy.<br>Ps and T together choose some objects on the map to estimate their area. Then working together (Ps dictate, T writes on BB, Ps in Ex.Bs), calculating the actual areas (using the scale), and converting them into $m^2$, $km^2$. Praising. |
| | *45 mins* | |
| | **Set homework**<br>**(1) Completing Activity 19.3**<br>**(2) PB 19.4, Q5** | |