Step by Step Guide: Enlargement — Positive Scale Factor

Pre-Class Preparation Checklist

- Ensure each pair has graph paper, rulers, pencils, and protractors.
- Prepare a large coordinate grid on the board or projector for demonstration.
- Have the digital textbook section open: innodems.github.io/CBC-Grade-10-Maths/subsec-enlargement.html
- Prepare printed handouts with the anchor activity instructions for each pair.
- Have pre-drawn coordinate grids available for struggling learners.
- Write the key formula on a card: (x', y') = (kx, ky) for origin-centred enlargement.

Phase 1: Problem-Solving and Discovery (15 minutes)

Opening (2 minutes)

[SAY] "Good morning, class. Have you ever used a photocopier to make a document bigger? Or zoomed into a photo on your phone? Today we are going to explore the mathematics behind making shapes bigger — a transformation called enlargement."

[DO] Show two versions of the same shape on the board — one small, one large — both centred at the same point.

[ASK] "What stays the same when you zoom in? What changes?"

[WAIT] Allow 30 seconds for responses.

[SAY] "Great observations! The shape stays the same, but the size changes. Let's investigate this precisely using coordinates."

Anchor Activity Launch (3 minutes)

[SAY] "You will work in pairs for this activity. Each pair needs graph paper and a ruler."

[DO] Distribute materials and display the instructions.

[SAY] "First, draw your x-axis and y-axis on the graph paper. Mark the origin at (0, 0) and label it O."

[SAY] "Now plot three points: A at (2, 3), B at (1, 1), and C at (4, 1). Connect them to form triangle ABC."

[SAY] "Next, draw straight lines from the origin O to each vertex — O to A, O to B, and O to C."

[SAY] "Here is the key step: extend each line to TWICE its original length from O. Mark the new endpoints as A-prime, B-prime, and C-prime. Then connect them to form a new triangle."

[SAY] "Finally, calculate the ratios OA-prime divided by OA, OB-prime divided by OB, and OC-prime divided by OC. Write down what you notice."

Student Work Time (8 minutes)

[DO] Circulate among pairs. Check that points are plotted accurately on the grid.

[ASK] To pairs plotting points: "What are the coordinates of A-prime? How did you find them?"

[DO] For struggling pairs: "Remember, if OA goes from (0,0) to (2,3), then twice the length means going to (4,6). Each coordinate doubles."

[ASK] To pairs who finish the ratios: "What value did you get for each ratio? Are they the same?"

[ASK] "Compare the two triangles. What is the same? What is different?"

[ASK] To advanced pairs: "What would happen if you extended to THREE times the length instead of twice?"

[DO] Note which pairs have clear explanations for the sharing phase.

Class Sharing (2 minutes)

[SAY] "Let's hear from a few pairs. What coordinates did you get for A-prime, B-prime, and C-prime?"

[WAIT] Call on 2 pairs to share.

[SAY] "Excellent! A-prime is at (4, 6), B-prime is at (2, 2), and C-prime is at (8, 2). Notice that each coordinate is exactly double the original."

[ASK] "And what about the ratios?"

[SAY] "Yes! OA-prime over OA equals OB-prime over OB equals OC-prime over OC, and they all equal 2. This number 2 is very important — it tells us how much bigger the new triangle is."

[ASK] "Are the two triangles the same shape?"

[SAY] "Exactly — same shape, different size. This is what we call ENLARGEMENT."

Phase 2: Structured Instruction (10 minutes)

Formalising Definitions (4 minutes)

[SAY] "What you just did has a formal mathematical name. The process of obtaining triangle A-prime-B-prime-C-prime from triangle ABC is called ENLARGEMENT."

[WRITE] On the board: "Enlargement: A transformation that changes the size of a shape by a scale factor while preserving its shape."

[SAY] "Triangle ABC is called the OBJECT. Triangle A-prime-B-prime-C-prime is called the IMAGE. The point O — the origin — is called the CENTRE OF ENLARGEMENT."

[WRITE] "Object → Image | Centre of Enlargement: O | Scale Factor: k"

[SAY] "The SCALE FACTOR tells us how many times bigger the image is. We calculate it by dividing the image distance by the object distance."

[WRITE] "Scale Factor = OA'/OA = OB'/OB = OC'/OC = A'B'/AB = 2"

[SAY] "For enlargement centred at the origin, there is a simple rule: if the original point is (x, y) and the scale factor is k, then the image point is (kx, ky)."

[WRITE] "Image of (x, y) = (kx, ky) when centre is the origin"

Positive Scale Factor Properties (3 minutes)

[SAY] "Today we focus on POSITIVE scale factors. There are two cases."

[WRITE] "Case 1: Scale factor > 1 → Image is LARGER (enlargement)"

[SAY] "In our activity, the scale factor was 2 — greater than 1 — so the image was bigger. This is what we typically call an enlargement."

[WRITE] "Case 2: 0 < Scale factor < 1 → Image is SMALLER (reduction)"

[SAY] "If the scale factor were one-half, every coordinate would be halved. The image would be smaller than the object. We still call this an enlargement in mathematics, even though the shape gets smaller."

[ASK] "If A is at (2, 3) and the scale factor is one-half, what would A-prime be?"

[WAIT] Allow students to respond.

[SAY] "Correct! A-prime would be at (1, 1.5). Each coordinate is multiplied by one-half."

Addressing Misconceptions (3 minutes)

[SAY] "Let me address a common mistake. When we say 'extend each line to twice its length,' we mean the TOTAL distance from O to the new point is twice the distance from O to the original point."

[DO] Draw on the board: O to A is 3.6 cm. O to A' is 7.2 cm (not A to A' is 3.6 cm).

[SAY] "Another important point: with a positive scale factor, the image is always on the SAME SIDE of the centre as the object. The object and image do not flip."

[ASK] "What property do the object and image always share?"

[WAIT] Students respond.

[SAY] "They are always SIMILAR — same shape, same angles, proportional sides. Enlargement preserves similarity."

Phase 3: Practice and Application (10 minutes)

Worked Example (4 minutes)

[SAY] "Let's work through a problem together. Triangle P-prime-Q-prime-R-prime is the enlarged image of triangle PQR, with centre O."

[WRITE] "Given: OP = 6 cm, PP' = 9 cm. Find the scale factor."

[ASK] "First, what is OP-prime? Remember, P is between O and P-prime."

[WAIT] Students respond: "OP + PP' = 6 + 9 = 15 cm."

[SAY] "Correct! OP-prime = 15 cm."

[WRITE] "Scale factor = OP'/OP = 15/6 = 5/2"

[SAY] "Now, if QR = 4 cm, find Q-prime-R-prime."

[WRITE] "Q'R'/QR = 5/2 → Q'R'/4 = 5/2 → Q'R' = (4 × 5)/2 = 10 cm"

[SAY] "The image side Q-prime-R-prime is 10 cm — two and a half times the original."

Coordinate Practice (4 minutes)

[SAY] "Now let's practise with coordinates. A pentagon has vertices A(6,8), B(8,8), C(12,8), D(14,2), and E(10,0). The centre of enlargement is the origin."

[SAY] "Find the image with scale factor 2. Remember our rule: multiply each coordinate by k."

[DO] Give students 2 minutes to calculate. Circulate and assist.

[WRITE] Show the results in a table on the board:

[SAY] "A-prime is (12, 16), B-prime is (16, 16), C-prime is (24, 16), D-prime is (28, 4), E-prime is (20, 0)."

[SAY] "Now try scale factor one-half on your own."

[DO] Give 1 minute, then reveal: A'(3,4), B'(4,4), C'(6,4), D'(7,1), E'(5,0).

[ASK] "What do you notice about the image with scale factor one-half compared to the original?"

[SAY] "The image is smaller — every coordinate is halved. But it is still the same shape!"

Digital Checkpoint (2 minutes)

[SAY] "If you have access to the digital textbook, open the Enlargement section and try Checkpoint 2.1.19 and Checkpoint 2.1.21. These give you randomized enlargement problems to practise."

[DO] Display the digital textbook checkpoint on the projector if available.

Phase 4: Assessment — Exit Ticket (5 minutes)

[SAY] "For our exit ticket, answer these four questions on a separate piece of paper. You have 5 minutes."

[SAY] "Question 1: A triangle has vertices P(1,2), Q(3,2), and R(2,5). Find the image after enlargement with the origin as centre and scale factor 3."

[SAY] "Question 2: Triangle XYZ is enlarged from centre O. If OX = 4 cm and OX-prime = 12 cm, what is the scale factor? If YZ = 5 cm, find Y-prime-Z-prime."

[SAY] "Question 3: A rectangle ABCD has vertices A(2,1), B(6,1), C(6,3), D(2,3). Find the image with origin as centre and scale factor one-half. What are the new dimensions?"

[SAY] "Question 4: Describe the steps to construct the enlarged image of a triangle with centre O and scale factor 4."

[DO] Collect exit tickets as students finish.

Answer Key:

- 1. P'(3, 6), Q'(9, 6), R'(6, 15).
- 2. Scale factor = 12/4 = 3. Y'Z' = 3 × 5 = 15 cm.
- 3. A'(1, 0.5), B'(3, 0.5), C'(3, 1.5), D'(1, 1.5). Original: 4×2. Image: 2×1.
- 4. (i) Measure OX, OY, OZ. (ii) Multiply each by 4. (iii) Extend lines from O. (iv) Mark and connect image points.

Differentiation Notes

Struggling Learners:

Provide pre-drawn coordinate grids with triangle ABC already plotted. Use a step-by-step checklist: (1) Write coordinates, (2) Multiply by k, (3) Plot new points, (4) Connect. Use whole-number scale factors only (2, 3).

On-Level Learners:

Complete all problems independently. Encourage peer teaching. Use digital textbook checkpoints for additional randomized practice.

Advanced Learners:

Explore enlargement with a centre NOT at the origin using the formula: Image = Centre + k × (Point − Centre). Investigate the area relationship: if the scale factor is k, the area of the image is k^2 times the area of the object.

Post-Lesson Reflection

1. Did students accurately plot points and construct both triangles on the coordinate plane?

2. Were students able to discover that the ratios are all equal to the scale factor?

3. How effectively did pair work support collaborative discovery?

4. Did the structured instruction successfully connect the activity to formal definitions?

5. Were students able to apply the coordinate method (kx, ky) independently?

6. How well did the differentiation strategies meet the needs of all learner levels?

7. What adjustments would improve the lesson for future delivery?