

# Step by Step Guide: Identifying Lines of Symmetry Given an Object

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## Lesson Information

<b>Topic</b>	Properties of symmetry and reflection
<b>Grade Level</b>	10
<b>Duration</b>	40 minutes (15 + 10 + 15 + Exit Ticket)
<b>Materials</b>	CBC Grade 10 Mathematics Textbooks, A4 paper, scissors, rulers, pencils

## Pre-Class Preparation Checklist

- Prepare enough A4 paper sheets for each group (at least 2 per group)
- Ensure each group has scissors, rulers, and pencils
- Write definitions of symmetry and line of symmetry on the board (covered until Phase 2)
- Prepare the shapes reference table on the board or chart paper
- Print or write the alphabet letters in large font for the practice activity
- Have extension activity problems ready for advanced learners

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

### Opening Hook (2 minutes)

**[SAY]** "Good morning, class! Look around this classroom. Can you spot anything that looks the same on both sides? Think about doors, windows, desks, even your own face."

**[WAIT]** 10 seconds for students to observe

**[ASK]** "Who can name something in this room that looks the same on both sides?"

**[WAIT]** for 2–3 responses (Expected: door, window, clock, whiteboard)

**[SAY]** "Great observations! That quality of looking the same on both sides is called SYMMETRY. Today we're going to discover exactly how symmetry works by folding paper. Let's get started!"

### Anchor Activity: Paper Folding (10 minutes)

**[DO]** Distribute A4 paper, scissors, rulers, and pencils to each group.

**[SAY]** "Each group needs to cut out a square from your paper. Label the four corners A, B, C, and D – A at the top left, B at the top right, C at the bottom right, and D at the bottom left."

**[DO]** Draw the labelled square on the board for reference.

**[WAIT]** 1 minute for groups to prepare their squares

**[SAY]** "Step 1: Fold your square in half from LEFT to RIGHT, so that corner A lines up exactly with corner B, and corner D lines up with corner C. You should have a rectangle."

**[DO]** Demonstrate the fold with your own paper.

**[SAY]** "Now unfold it. You'll see a crease line running down the middle. Draw a dotted line along that crease and label it XY."

**[ASK]** "What do you notice about the left side and the right side of line XY?"

**[WAIT]** for response (Expected: "They are exactly the same" or "identical")

**[SAY]** "Step 2: Now fold your square from TOP to BOTTOM, so corner D lines up with corner A and corner C lines up with corner B. Another rectangle."

**[DO]** Demonstrate the fold.

**[SAY]** "Unfold and draw a dotted line along this crease. Label it RS."

**[ASK]** "Is the pattern the same? Are both halves identical?"

**[WAIT]** for confirmation

**[SAY]** "Step 3: Now fold from corner A to corner C – that's a diagonal fold. You'll get a triangle."

**[DO]** Demonstrate the diagonal fold.

**[SAY]** "Unfold and trace the crease line. This goes along BD."

**[SAY]** "Step 4: Finally, fold from corner D to corner B – the other diagonal. Unfold and trace the crease along AC."

**[ASK]** "How many dotted lines do you have on your square now?"

**[WAIT]** for response (Expected: "Four")

### **Group Sharing (3 minutes)**

**[ASK]** "What is special about each of these four lines? What do they all have in common?"

**[WAIT]** for responses (Expected: "Each line divides the square into two identical halves")

**[ASK]** "If I drew a random line through the square – say from one corner to the middle of a non-opposite side – would that also divide it into identical halves?"

**[WAIT]** for response (Expected: "No, the halves wouldn't be identical")

**[SAY]** "Excellent thinking! Not every line through a shape creates identical halves. Only special lines do. Let's now give these special lines a proper name."

## Phase 2: Structured Instruction (10 minutes)

### Defining Symmetry (3 minutes)

**[SAY]** "Based on what you discovered, let me give you the formal definition."

**[WRITE]** On the board:

"Symmetry is when an object or shape looks exactly similar or identical on one side and the other side when the object is folded, flipped, rotated, or reflected."

**[SAY]** "And those four dotted lines you drew? They have a special name."

**[WRITE]** On the board:

"A line of symmetry divides an object or shape into similar/identical parts – one half is the mirror image of the other half."

**[SAY]** "So your square has 4 lines of symmetry: XY, RS, BD, and AC. Two are straight (vertical and horizontal) and two are diagonal."

### Lines of Symmetry in Common Shapes (4 minutes)

**[SAY]** "Let's look at how many lines of symmetry other shapes have."

**[WRITE]** Draw the reference table on the board:

- Equilateral Triangle: 3 lines (vertex to midpoint of opposite side)
- Square: 4 lines (2 straight + 2 diagonal)
- Rectangle: 2 lines (1 vertical + 1 horizontal, NOT diagonals)
- Regular Pentagon: 5 lines
- Regular Hexagon: 6 lines
- Circle: Infinite lines

- Isosceles Triangle: 1 line

[ASK] "Can anyone spot the pattern for regular polygons?"

[WAIT] for response (Expected: "The number of lines equals the number of sides")

[SAY] "Exactly! A regular polygon with  $n$  sides has exactly  $n$  lines of symmetry. This is a powerful rule to remember."

### Addressing Misconceptions (3 minutes)

[SAY] "Now, here's a very common mistake. Many people think a rectangle has 4 lines of symmetry, just like a square. But it doesn't! Let me show you why."

[DO] Draw a rectangle on the board. Show that folding along the diagonal does NOT create identical halves – the triangles overlap unevenly.

[SAY] "When you fold a rectangle along its diagonal, the two triangles are the same size but they are NOT mirror images along that fold line. So the diagonal is NOT a line of symmetry for a rectangle. A rectangle has only 2 lines of symmetry."

[ASK] "Can a shape have zero lines of symmetry?"

[WAIT] for response (Expected: "Yes – irregular shapes, parallelogram")

[SAY] "Correct! A parallelogram, for example, has no lines of symmetry even though it looks 'balanced.' Always test by folding or using a mirror."

## Phase 3: Practice and Application (15 minutes)

### Worked Example: Equilateral Triangle (3 minutes)

[SAY] "Let's work through an example together. How many lines of symmetry does an equilateral triangle have?"

[DO] Draw an equilateral triangle on the board.

[SAY] "An equilateral triangle has all sides equal and all angles equal. Each line of symmetry goes from one vertex straight down to the midpoint of the opposite side."

[WRITE] Draw all 3 lines of symmetry on the triangle, labelling each.

[SAY] "So an equilateral triangle has 3 lines of symmetry. This confirms our rule: 3 sides = 3 lines of symmetry."

### Alphabet Symmetry Challenge (7 minutes)

[SAY] "Now for a fun challenge! I want you to work with your partner. Look at every letter of the alphabet and decide: does it have a line of symmetry? If so, is it vertical, horizontal, or both?"

**[WRITE]** Display on the board:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

**[SAY]** "Sort each letter into one of four groups: vertical symmetry only, horizontal symmetry only, both vertical and horizontal, or no symmetry at all."

**[DO]** Circulate among pairs. Use these probing questions:

- "Try imagining folding the letter A in half vertically. Do both halves match?"
- "What about the letter B? Try folding it horizontally instead."
- "Does the letter S have any line of symmetry? Be careful – test it!"
- "How is the letter H different from the letter A in terms of symmetry?"

**[DO]** After 5 minutes, review answers together:

- Vertical only: A, M, T, U, V, W, Y
- Horizontal only: B, C, D, E, K
- Both: H, I, O, X
- None: F, G, J, L, N, P, Q, R, S, Z

### **Real-World Symmetry Hunt (5 minutes)**

**[SAY]** "For our final practice, look around this classroom. With your group, find at least 5 objects that have lines of symmetry. Write down the object and how many lines of symmetry it has."

**[DO]** Allow groups to explore the classroom. Circulate and guide.

**[SAY]** "Remember – also think about objects at home. Doors, windows, plates, butterflies, leaves... symmetry is everywhere!"

**[DO]** Have 2–3 groups share their findings.

### **Phase 4: Assessment – Exit Ticket**

**[SAY]** "For our exit ticket, complete these questions independently in your notebooks."

**[WRITE]** Display exit ticket questions:

1. Identify the lines of symmetry in each of the 26 alphabetical letters.
2. Identify and draw lines of symmetry on 5 different objects in your classroom or at home.
3. How many lines of symmetry does a regular hexagon have? Draw and label each one.
4. Explain why a rectangle has 2 lines of symmetry but NOT 4.

5. Design a logo with exactly 3 lines of symmetry. Sketch and explain.

### Closure (1 minute)

**[SAY]** "Today we discovered that symmetry is all about mirror images. A line of symmetry divides a shape into two identical halves. We learned that a square has 4, an equilateral triangle has 3, and a regular polygon with  $n$  sides has  $n$  lines of symmetry. Most importantly, we saw that symmetry is everywhere – in letters, in our classroom, and in nature. For homework, find 10 symmetric objects at home and draw their lines of symmetry. See you next class!"

### Complete Answer Key

1. Alphabet Symmetry:

Vertical only: A, M, T, U, V, W, Y

Horizontal only: B, C, D, E, K

Both: H, I, O, X

None: F, G, J, L, N, P, Q, R, S, Z

2. Answers will vary. Accept any correct identification with drawn lines.

3. Regular hexagon: 6 lines of symmetry (3 vertex-to-vertex + 3 midpoint-to-midpoint)

4. Rectangle: Only 2 lines (vertical and horizontal). Diagonals do NOT create mirror-image halves.

5. Accept any design based on equilateral triangle or 3-fold symmetric shape.

### Differentiation Notes

**Struggling Learners:** Provide pre-cut shapes for physical folding. Use mirrors to verify symmetry. Start with simple shapes before letters. Focus on questions 1 and 2 from the exit ticket.

**On-Level Learners:** Complete all practice activities and exit ticket questions. Verify answers by folding or using a ruler.

**Advanced Learners:** Extend to challenge problems: symmetry in flags, architecture, tile patterns, and rotational vs reflective symmetry. Create a symmetry portfolio.

## Post-Lesson Reflection Prompts

1. Did the paper folding activity effectively help students discover lines of symmetry?
2. Were students able to distinguish between lines of symmetry and other lines through a shape?
3. Which letters caused the most confusion?
4. How well did students connect symmetry to real-world objects?
5. Were differentiation strategies effective?
6. Was the 40-minute timeframe sufficient?
7. What modifications would improve this lesson?