# CBC Grade 10 Mathematics Lesson Plan

## Distance and Displacement

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| **Strand** | **Measurement and Geometry** |
| **Sub-Strand** | Linear Motion |
| **Specific Learning Outcome** | Distinguish between distance and displacement in different situations and apply concepts to solve real-world problems |
| **Key Inquiry Questions** | What is the difference between distance and displacement? |
| **Learning Resources** | CBC Grade 10 textbooks, chalk or masking tape, measuring tape or ruler, notebooks |
| **Lesson Duration** | 40 minutes |

### Lesson Structure Overview

| Phase | Activity | Duration |
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| **Phase 1** | Problem-Solving and Discovery (Anchor Activity) | 15 minutes |
| **Phase 2** | Structured Instruction (Key Takeaways) | 10 minutes |
| **Phase 3** | Practice and Application (Worked Examples) | 15 minutes |
| **Phase 4** | Assessment (Exit Ticket) | 5 minutes |

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

#### Anchor Activity: Walking Two Different Paths

Work in Groups

What you need:

- • Chalk or masking tape to mark paths on the ground
- • A measuring tape or ruler to measure distances
- • A notebook and pen to record measurements and observations

What to do:

1. 1. Mark three points on the ground:

• Point A (Start)

- Point B (10 m east of A)
- Point C (10 m north of B)

2. 2. One student to walk:

- From A to B (10 m east)
- Then from B to C (10 m north)

3. 3. Another student to go directly from A to C (diagonal path).

Tasks:

4. (a) Record:

i. Total distance for the first student (A to B to C)

ii. Total distance for the second student (A to C)

iii. Displacement (straight line from A to C) for both students

5. (b) Compare the distance and displacement for both paths taken by the students.
6. (c) Can displacement ever be greater than distance? Why not?
7. (d) When will distance and displacement be equal?

### Teacher Guidance for Anchor Activity

This anchor activity introduces distance and displacement through hands-on exploration. Students physically walk different paths and measure the results, discovering that the straight-line path (displacement) is always shorter than or equal to the total path traveled (distance).

Facilitation Strategy:

- • Organize students into groups of 3-4
- • Take students outside or use a large indoor space (gymnasium, hallway)
- • Help groups mark points A, B, and C accurately using measuring tape
- • Ensure students understand the right-angle path (east then north)
- • Guide students to measure the diagonal distance from A to C
- • Ask probing questions: "Which path is shorter?" "Does the displacement change based on the path taken?"
- • Help students recognize that displacement is the same for both students despite different paths
- • Use student observations as bridge to formal definitions

## Phase 2: Structured Instruction (10 minutes)

### Key Takeaways

After students have explored through the anchor activity, formalize their discoveries with these key concepts:

#### *1. Distance Definition and Properties*

Distance is the total length of the path travelled by an object, regardless of direction.

**Key characteristics of distance:**

- • Distance tells us how much ground has been covered
- • Distance depends on the path taken
- • Distance is always a positive value (scalar quantity)
- • Distance has no direction associated with it

#### *2. Displacement Definition and Properties*

Displacement is the straight-line distance from the starting point to the ending point, along with the direction.

**Key characteristics of displacement:**

- • Displacement tells us how far and in what direction an object is from its starting point
- • Displacement depends only on the initial and final positions
- • Displacement is a vector quantity (has both magnitude and direction)
- • Displacement can be zero even if distance is not zero

#### *3. Relationship Between Distance and Displacement*

Distance is always greater than or equal to displacement.

When are they equal? Distance equals displacement only when the object moves in a straight line without changing direction.

When is displacement zero? Displacement is zero when the object returns to its starting point, even though distance traveled may be large.

#### *4. Real-Life Applications*

Real-life examples where displacement is more useful than distance:

Navigation systems like GPS: Displacement gives the straight-line distance and direction to the destination, which is more useful than the total distance traveled. GPS calculates "as the crow flies" distance to help you understand how far away your destination is.

Sports events: In events like long jump or javelin throw, displacement measures how far an athlete has moved from the starting point in a specific direction. The judges measure the straight-line distance from the takeoff point to the landing point.

Aviation and maritime navigation: Pilots and ship captains use displacement to determine the most direct route to their destination.

### Scaffolding Strategies

Address common misconceptions revealed during the anchor activity:

- • Clarify that distance depends on the actual path taken
- • Emphasize that displacement depends only on start and end positions
- • Show that displacement can never exceed distance
- • Use visual diagrams to illustrate the difference
- • Connect to everyday experiences (walking to school via different routes)

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

### Worked Examples

#### *Example 1: Right-Angle Path*

A person walks 3 m east, then 4 m north. What is the distance travelled and the displacement from the starting point?

Solution:

Distance travelled = 3 m + 4 m = 7 m

Displacement can be found using the Pythagorean theorem:

Displacement = $\sqrt{[(3\text{ m})^2 + (4\text{ m})^2]} = \sqrt{[9 + 16]} = \sqrt{25} = 5\text{ m}$

The displacement is 5 m in a north-east direction.

### *Example 2: Opposite Directions*

A learner walks 5 m east and then 3 m west. What is the distance travelled? What is the displacement from the starting point?

Solution:

Distance travelled = 5 m + 3 m = 8 m

Displacement = Final Position - Initial Position = 5 m - 3 m = 2 m east

The learner ends up 2 meters east of the starting point.

### *Example 3: Returning to Start*

A student jogs 100 meters east and then 100 meters west. What are the total distance and displacement?

Solution:

Distance = 100 m + 100 m = 200 m

Displacement = Final Position - Initial Position = 100 m - 100 m = 0 m

The student returns to the starting point, so displacement is zero even though 200 meters were traveled.

### *Example 4: Different Directions*

A person walks 3 m west, then 4 m south. Find the total distance traveled and the displacement.

Solution:

Distance = 3 m + 4 m = 7 m

Displacement = $\sqrt{[(3\text{ m})^2 + (4\text{ m})^2]} = \sqrt{[9 + 16]} = 5\text{ m}$

The displacement is 5 m in a south-west direction.

### Individual Practice (Students work independently)

Provide students with similar problems to solve:

8. 1. A car travels 60 km north and then 80 km east. What is the total distance travelled and the displacement from the starting point?
9. 2. A person walks 6 meters north, then 8 meters east. Calculate the distance and displacement.
10. 3. A student runs around a rectangular park of length 60 m and width 40 m and returns to the starting point. Find the distance and displacement.

## Phase 4: Assessment - Exit Ticket (5 minutes)

Students complete individually to demonstrate understanding:

Question 1: A delivery driver travels 12 km north from the warehouse, then 5 km east to make a delivery.

11. a) Calculate the total distance traveled.
12. b) Calculate the displacement from the warehouse.
13. c) Explain why the displacement is less than the distance.

Question 2: A student walks 8 m forward along a straight corridor, then turns around and walks 3 m back.

14. a) What is the total distance walked?
15. b) What is the displacement from the starting position?
16. c) In what direction is the student displaced?

Question 3: Can the displacement of an object be greater than its distance? Explain why or why not with an example.

### Exit Ticket Answer Key

Question 1:

a) Distance = 12 km + 5 km = 17 km

b) Displacement = $\sqrt{(12^2 + 5^2)} = \sqrt{(144 + 25)} = \sqrt{169} = 13$ km

c) Displacement is less than distance because displacement is the straight-line distance from start to finish, while distance includes the actual path taken (north then east).

Question 2:

a) Distance = 8 m + 3 m = 11 m

b) Displacement = 8 m - 3 m = 5 m

c) The student is displaced 5 m forward from the starting position.

Question 3:

No, the displacement of an object cannot be greater than its distance. This is because distance is the total length of the path traveled, while displacement is the straight-line distance from the starting point to the ending point. The straight-line distance (displacement) can never exceed the total path length (distance). For example, if you walk in a circle and return to your starting point, your distance might be 100 m, but your displacement is 0 m.

## Differentiation Strategies

### For Struggling Learners:

- • Use grid paper to draw paths and visualize distance vs. displacement
- • Provide pre-drawn diagrams with labeled paths
- • Start with simple one-dimensional motion (east-west only)
- • Use physical demonstrations with students walking paths
- • Provide Pythagorean theorem reference for right-angle calculations
- • Allow calculators for all calculations

### For Advanced Learners:

- • Introduce three-dimensional displacement problems
- • Explore vector notation for displacement
- • Challenge with complex multi-leg journeys
- • Investigate displacement in circular motion
- • Connect to coordinate geometry and vector addition
- • Analyze real GPS data showing distance vs. displacement

## Extension Activity

### School Navigation Project

Objective: Apply distance and displacement concepts to analyze routes around the school.

Activity Description:

17. 1. Choose two locations in or around the school (e.g., classroom to library).
18. 2. Identify at least three different walking routes between these locations.
19. 3. Measure and record the distance for each route.
20. 4. Calculate the displacement (straight-line distance) between the two locations.
21. 5. Create a map showing all routes with distances labeled.

22. 6. Compare the efficiency of each route (distance vs. displacement).
23. 7. Present findings to the class explaining which route is most efficient and why.

### GPS Comparison Activity

Students can:

- • Use a GPS app to track a walk with multiple turns
- • Record the total distance traveled from the app
- • Measure the straight-line displacement on a map
- • Calculate the ratio of distance to displacement
- • Discuss why GPS gives both "distance traveled" and "distance remaining"

## Post-Lesson Reflection for Teachers

- • Did students successfully distinguish between distance and displacement?
- • Were students able to apply the Pythagorean theorem for displacement calculations?
- • What misconceptions emerged about scalar vs. vector quantities?
- • How engaged were students with the hands-on anchor activity?
- • Did students understand when distance equals displacement?
- • What adjustments are needed for future lessons on this topic?