Location teacher pack

Separate a position estimate, a map and a route prediction.

For learners around age 14 and curious adults. Three 40-minute sessions. Use with the current AHA Location manuscript. References use chapter titles so they work in both print and ebook.

Learning goals

Separate a position estimate, a map and a route prediction.

Use the terms coordinate; pseudorange; clock offset; satellite; map; route. Show the reasoning behind an answer and identify where the example stops applying.

Reading route

1. A listening device, not a conversation

2. Why four satellites are the usual starting point

3. The map can be wrong separately

Teaching plan

Session 1: Ask the opening question before reading (5 minutes). Read the first selected chapter together (15). Draw the mechanism or compare two possible explanations (15). End with a one-sentence explanation (5).

Session 2: Read the remaining selected material (10 minutes). Complete the worksheet individually, then compare reasoning in pairs (20). Discuss the common wrong turn (10).

Session 3: Revisit one uncertain answer (10 minutes). Try the extension (15). Give a two-minute explanation without the book (10). Use the exit question (5).

Materials and access

Paper, pencil, the book and an optional calculator. Read diagrams aloud, allow spoken or drawn responses, and give extra time for vocabulary. No real accounts or specialist equipment are needed.

Location learner worksheet

Opening question

If a navigation app shows the wrong entrance, does that prove its satellite position is wrong?

Investigation

On paper, draw a point and several possible distances from known landmarks. Discuss how timing helps estimate satellite distance. Use 300,000,000 meters per second as an approximation for signal speed. Keep this a simplified model.

1. What distance does light travel in one microsecond?

Show your reasoning, label units or evidence, and state any assumptions.

2. Why is receiver clock offset another unknown?

Show your reasoning, label units or evidence, and state any assumptions.

3. Name three separate possible causes of a wrong navigation instruction.

Show your reasoning, label units or evidence, and state any assumptions.

Transfer question

At the same approximation, 10 nanoseconds correspond to 3 meters. Explain why timing and correction matter.

Exit question

What would you now check before accepting a claim about this topic? Name one specific check and explain why.

Location answers and teaching notes

Answer 1

300,000,000 × 0.000001 = 300 meters.

Answer 2

An error in the receiver's clock changes the apparent travel time and therefore the apparent distance. Basic 3D positioning typically solves position and clock offset together.

Answer 3

The position estimate may be inaccurate, the map or entrance data may be wrong, or the routing and traffic assumptions may be wrong.

Common wrong turn

Four usable satellite measurements are a usual starting point for a basic solution, not a guarantee of accuracy in every environment.

Extension discussion

At the same approximation, 10 nanoseconds correspond to 3 meters. Explain why timing and correction matter.

Assess the explanation

Give one point each for a correct conclusion, visible reasoning, correct units or evidence, and a relevant limitation. A correct number with no explanation is not a complete answer. Accept equivalent wording and well-supported alternative interpretations where the question allows them.

If the learner gets stuck

Return to the diagram or the smallest example. Ask what is being counted, compared or transferred. Let the learner revise the answer after explaining the mistake; do not reward speed over understanding.

Family connection

Use an invented map to compare shortest distance with quickest travel time. Do not share a child's live location or home coordinates.