Mastering the Slopes: The Secret Code of SOH CAH TOA

Lesson Overview

Subject: Year 9 Mathematics / Trigonometry

Target Learner: Michael (14 years old)

Time: 60–75 minutes

Learning Objectives:

- Identify the Hypotenuse, Opposite, and Adjacent sides of a right-angled triangle relative to a given angle.
- Recall and apply the **SOH CAH TOA** mnemonic to select the correct trigonometric ratio.
- Calculate missing side lengths and angles in right-angled triangles using a scientific calculator.

Materials Needed

- Scientific calculator (must have *sin*, *cos*, and *tan* buttons)
- Ruler and Protractor
- Graph paper or plain paper
- Pen/Pencil and a Highlighter
- A smartphone or tablet (optional, for "Real-World Measurement" extension)

---

1. Introduction: The "Mountain-Mover" Hook (10 mins)

The Scenario: Imagine you are a structural engineer tasked with building a ramp for a world-record skate park jump. You know how long the ramp needs to be and what angle it should be at for safety, but how do you know exactly how tall to build the support beams without actually building it first?

The Secret: For thousands of years, humans have used the "Code of the Triangle" to measure things they couldn't reach—like the height of Mount Everest or the distance to the moon. Today, Michael, you're going to learn that code: **Trigonometry**.

The Big Idea: In a right-angled triangle, if you know just one angle and one side, you can find out *everything else* about that triangle. It's like having a mathematical superpower.

2. The Foundation: Labeling the Triangle (I Do)

Before we use the formulas, we have to know where we are. Everything depends on the **Reference Angle** (usually called θ or Theta).

- **Hypotenuse (H):** The longest side. Always opposite the 90° angle.

- **Opposite (O):** The side directly across from your reference angle.
- **Adjacent (A):** The side next to your reference angle (that isn't the hypotenuse).

Check for understanding: Draw three triangles in different orientations and have Michael highlight the 'Opposite' side for a specific angle.

3. The Code: SOH CAH TOA (I Do / We Do)

This is the "cheat code" for trigonometry. We use it to pick our formula:

SOH: Sin(θ) = **O**pposite / **H**ypotenuse

CAH: Cos(θ) = **A**djacent / **H**ypotenuse

TOA: Tan(θ) = **O**pposite / **A**djacent

Example 1: Finding a Side (We Do)

Scenario: A ladder is leaning against a wall at a 60° angle. The ladder is 5 meters long. How high up the wall does it reach?

1. **Identify:** We have the Hypotenuse (5m) and we want the Opposite (height).
2. **Choose:** Which one uses O and H? **SOH**!
3. **Set up:** Sin(60°) = x / 5
4. **Solve:** 5 × Sin(60°) = x. (Using calculator: 5 × 0.866 = 4.33m)

4. Interactive Practice (We Do / You Do)

Work through these examples together, then let Michael take the lead on the calculations.

Scenario	Given Info	Which Ratio?	Target
The Shadow	Angle = 30°, Adj = 10m	TOA (Tan)	Height (Opp)
The Zip Line	Opp = 15m, Adj = 20m	TOA (Tan)	Angle of descent
The Anchor	Angle = 45°, Hyp = 8m	CAH (Cos)	Distance (Adj)

Michael's Solo Challenge: A drone is flying 50 meters directly above a target. If you are standing 30 meters away from the target, what is the angle of elevation from you to the drone? (Hint: Use *Inverse Tan* or $\tan^{-1}$ on your calculator!)

5. Real-World Mini-Project: "The Room Surveyor" (You Do)

Instead of a worksheet, let's apply this to Michael's actual environment:

1. **The Mission:** Calculate the height of a tall object in the room (or outside) that you can't reach (e.g., the top of a door frame, a tree, or a basketball hoop).
2. **Measure:** Measure a distance of 2 meters away from the object (this is your *Adjacent* side).
3. **Estimate:** Use a phone "Level" app or a protractor to estimate the angle from your eye level to the top of the object.
4. **Calculate:** Use **TOA** (Tan) to find the "Opposite" height. Remember to add your own height (eye level) to the final answer!

6. Conclusion & Recap (Closure)

- **Summary:** Today we learned that right-angled triangles follow strict rules. SOH CAH TOA is the key to unlocking those rules.
- **Key Takeaway:**
  - **S**in = **O**/**H**
  - **C**os = **A**/**H**
  - **T**an = **O**/**A**
- **Reflective Question:** "Michael, if you were building a bridge and the angle was slightly off by 2 degrees, why would trigonometry be more useful than just 'guessing and checking' with real steel beams?"

Assessment & Success Criteria

Success Criteria: Michael can successfully...

- Label all three sides of a triangle based on a theta symbol.
- Correct identify which ratio (S, C, or T) to use for a word problem.
- Use the calculator to get a decimal answer and round it to 2 decimal places.

Formative Assessment: Observe Michael's choice of ratio during the "Zip Line" and "Anchor" examples. If he chooses the wrong ratio, ask: "Which sides do we actually know, and which side are we looking for?"

Differentiation Tips

- **For Support:** Provide a "SOH CAH TOA" triangle cheat sheet where the formulas are already rearranged (e.g., $O = H \times Sin\theta$).
- **For Extension:** Introduce "Angles of Depression" vs. "Angles of Elevation" and have Michael solve a two-step problem involving two connected triangles.