



Why scientists sample

Lesson plan: estimate a population with random and stratified sampling on a practice reef, the way survey divers do



Ages 13 to 18 (grades 8 to 12)

Time 60 minutes

Group Up to 35 students, in groups of three or four

Where Any classroom. No internet needed.

You need The slides, one practice reef map and one record sheet per group, calculators

What students learn

- Why scientists sample instead of counting everything, and how to scale a sample up to an estimate.
- The difference between random, stratified random and haphazard sampling, and what bias means.
- How sample size and replication affect how much we can trust an estimate.
- How MCP's survey divers apply the same ideas underwater.

Before the lesson

1. Print one **practice reef map** (A3 if possible) and one **urchin count record sheet** per group.
2. Have calculators ready.

The lesson

- 1 **How many sea urchins? 5 minutes, slides 1 and 2.** Show the map and ask every group for a quick guess. Write the guesses on the board.
- 2 **Why sample? 5 minutes, slide 3.** Explain the practical limits of time, air and area.
- 3 **Three methods 25 minutes, slides 4 to 6.** Groups run all three methods on their map and fill in the record sheet. For method 3, don't give any guidance: let them choose freely.
- 4 **Compare 12 minutes, slide 7.** Collect each group's estimates in a table on the board, then reveal the true total: **274 urchins**. Discuss which method was closest and why estimates varied between groups.
- 5 **Real surveys 8 minutes, slides 8 to 10.** Link to how MCP surveys, the key vocabulary and, for exam classes, the GCSE formula.
- 6 **Wrap up 5 minutes, slide 11.** Discuss one or two questions.

Answers and what to listen for

Answer key: the true total is 274 urchins. Reef flat (columns A to D, 40 squares): 189. Reef crest (E to G, 30 squares): 70. Reef slope (H to J, 30 squares): 15.

What to listen for: stratified estimates are usually closer and vary less between groups, because the zones differ so much. Haphazard choices often overestimate, because people are drawn to busy squares. More squares usually means less variation between groups.

Making it easier or harder

- **Younger or less confident groups:** run methods 1 and 3 only, and work out the means together.
- **Older groups:** pool the class's random-quadrat results, calculate the standard deviation, and discuss confidence in the estimate. Ask how you would design a survey to detect a 10% change.
- **Outdoors:** repeat method 1 in the schoolyard with a real 1 m quadrat and a common plant or leaf litter.

Curriculum links

- **Science:** sampling, estimating population size, fair testing (GCSE and IGCSE ecology practicals).
- **Maths:** means, scaling, proportion.
- **Philippine senior high school:** General Science and research skills.
- **Ocean Literacy Principle 5:** the ocean supports a great diversity of life and ecosystems.

The teacher reading has the science behind every slide, with links to the sources.

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