



A reef through a heatwave

Lesson plan: track water temperature, bleaching and coral cover through the 2024 heatwave, and compare recovery at protected and unprotected sites



Ages	14 to 18 (grades 9 to 12)
Time	60 to 75 minutes
Group	Pairs, one computer per pair
Where	Computer room or laptops
You need	The slides, the Reef data lab workbook (coral surveys sheet), one worksheet per pair

What students learn

- How to summarise data month by month and year by year.
- How to plot two variables on one chart and describe the relationship.
- What a marine heatwave looks like in real survey data, and how coral cover responds.
- How to write a careful conclusion that states its limits.

Before the lesson

1. Share the **workbook** or **coral-surveys.csv**.
2. Print one **worksheet** per pair.
3. The Changing ocean module's lesson on degree heating weeks is a good lead-in.

The lesson

- 1 **2024 5 minutes, slides 1 and 2.** Link to the global bleaching event.
- 2 **Part 1 20 minutes, slides 3 to 5.** Pairs build the monthly table and chart, then compare with the reveal.
- 3 **Part 2 20 minutes, slides 6 and 7.** Pairs compare coral cover by year and protection.
- 4 **Conclusions 10 minutes, slides 8 and 9.** Discuss the limits of the conclusion.

Answers and what to listen for

Expected results, 2024: mean temperature by month Jan 27.1, Feb 26.7, Mar 27.0, Apr 29.3, May 30.6, Jun 31.0, Jul 30.9, Aug 31.3, Sep 30.5, Oct 30.6, Nov 28.9, Dec 28.6. Bleaching by month Jan 3.9%, Feb 3.6%, Mar 3.6%, Apr 18.3%, May 30.0%, Jun 46.6%, Jul 43.6%, Aug 38.6%, Sep 31.0%, Oct 18.0%, Nov 4.0%, Dec 3.5%. Bleaching in other years averages about 3.8%. June to August bleaching by depth: shallow 59.6%, medium 40.7%, deep 24.5%.

Coral cover by year (protected / not): 2018 37.5 / 28.6, 2019 35.0 / 27.1, 2020 30.4 / 30.2, 2021 40.5 / 34.8, 2022 32.6 / 28.0, 2023 30.8 / 26.2, 2024 28.4 / 20.9, 2025 24.6 / 15.1, 2026 28.1 / 18.7. Reserves have more coral throughout. Both fell after 2024, but open reefs lost more and recovered less by 2026. By enforcement, mean hard coral is Strong 33.4%, Moderate 29.3%, Weak 25.1% and open reefs 23.1%, and algae is highest on open reefs (34.9%). Small samples in 2020 and 2021 make those years noisy.

Making it easier or harder

- **Less confident groups:** do Part 1 only.
- **Older groups:** calculate a correlation coefficient between monthly temperature and bleaching with =CORREL(), and discuss why correlation is not proof.
- **Link:** The changing ocean module, lesson 1.

Curriculum links

- **Maths and statistics:** time series, dual-axis charts, correlation.
- **Science:** climate change and ecosystems.
- **Philippine senior high school:** General Science, General Mathematics and research skills.
- **IB and GCSE:** data analysis and evaluation.

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

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