



MODULE 02 | TEACHER GUIDE

The Silent Spill

Who polluted Bluehaven Bay? | English C1 | Ages 15–18 | 60 minutes

A coastal community wants someone to blame after rain, litter and dead fish appear in its bay. Teams investigate several possible sources, challenge an unsupported accusation and present a proportionate response. The mystery ends with an evidence-based judgement, not a single proven culprit.

Learning outcomes

Students can distinguish pollution pathways, interpret a limited dataset, evaluate source reliability and qualify causal claims. They can prioritise action under a budget constraint and defend a recommendation while acknowledging uncertainty.

Lesson sequence

Time	Activity	Outcome
0–6 min	Read the case on p. 2. Record an initial explanation and one alternative.	Two hypotheses
6–15 min	Read the science brief. Trace routes on the map and compare samples on p. 3.	Annotated map
15–30 min	Sort the eight cards on pp. 4–5. Complete the case board on p. 6.	Evidence-based judgement
30–42 min	Choose exactly three actions costing at most six tokens. Prepare the public statement.	Prioritised response
42–56 min	Run paired team press conferences using p. 7. Swap roles halfway through.	Statement and questions
56–60 min	Revise one claim. Discuss what evidence could change the judgement.	Qualified conclusion

Preparation and organisation

Print pp. 2–7 for teams of four; retain p. 8. Print pp. 4–5 single-sided, cut and shuffle the cards. Supply pens and one A3 sheet per team. Students build the case board on A3 using the structure on p. 6. No online research or practical water sampling is required.

Allocate evidence reader, data analyst, sceptic and spokesperson. All contribute to the reasoning. Pair two teams for the press conference; questioning roles on p. 7 are perspectives, not extra evidence.

Optional extension to 90 minutes

Add 15 minutes to design a sampling plan: locations, timing, variables, comparison sites and limitations. Add 15 minutes to write a 180–220-word briefing distinguishing immediate response from long-term prevention. Review it against the assessment criteria on p. 8.

All locations, organisations, quotations and numerical records are fictional. Scientific principles are sourced on p. 8. Illustrations show possible pathways and must not be treated as evidence of guilt.

Ocean Literacy principles 1 and 6: rivers connect inland activity to the ocean; human choices affect marine environments.



STUDENT SHEET 1 | CASE BRIEFING

A bay under suspicion

Wednesday, 08:00. Bluehaven's waterfront is covered with scattered litter. The water looks cloudy, and a fisher has reported dead fish near the quay. Heavy rain fell the previous evening. A widely shared local post blames the factory upstream. The council wants a public statement before noon.

You are an independent investigation team. Decide which explanations are supported, which remain plausible and which claims go beyond the evidence. Recommend action without pretending to know more than the case file allows. Everything in the Bluehaven case is fictional.

Your first response

Write an initial explanation and one alternative. What would you need to know before naming a responsible source?

Science brief

Pollution can enter coastal waters through rivers, drains and direct discharges. Rain moving across streets and fields can carry pollutants downstream. A visible outlet indicates a pathway, but its appearance alone does not identify what it carried, when it flowed or how much it contributed. Agriculture, urban runoff and wastewater can all supply excess nutrients. [1]

Nitrogen and phosphorus are essential nutrients. In excess, they can encourage algal growth. When algae and other organic material decompose, microorganisms consume dissolved oxygen. Low oxygen can stress or kill aquatic animals. Wastewater may also add organic material whose breakdown consumes oxygen. A low reading identifies a condition worth investigating; it does not reveal a unique source or prove the cause of a particular fish death. [2, 3]

Visible litter is a different kind of evidence. Packaging and fishing gear may reach the shore from land or sea, and currents can move them away from their source. Counting items helps describe a litter problem, but says little about dissolved chemicals or oxygen levels. A shoreline count cannot measure microplastic pollution. [4]

Timing matters. A bloom may develop before a storm; rain can then bring additional nutrients, sediment or organic material. Fish deaths, cloudy water and litter need not share a single cause. A snapshot taken afterwards cannot reconstruct the whole event. Build explanations that fit the timeline and identify the measurements that could test them.

Language for careful reasoning

"This is consistent with ..., but does not establish ..."

"The source is relevant because ...; however, its account is limited by ..."

"An alternative explanation would be ..."

"We would revise our judgement if ..."

catchment: land draining to a shared water body • runoff: water flowing over land • outfall: a discharge outlet • dissolved oxygen: oxygen present in water • turbidity: cloudiness measured by light scattering • causal claim: a statement that one event produced another

STUDENT SHEET 2 | CATCHMENT AND SAMPLES

Follow the pathways



Gold circles = sampling sites U, M and B. Navy circles = locations A–D. Arrows show known flow routes, not proven causes. Schematic only; not to scale.

Wednesday sampling record

Site	Dissolved oxygen mg/L	Nitrate nitrogen mg N/L	Turbidity NTU
U Upstream	8.1	0.5	5
M Mixed downstream	5.8	3.2	42
B Bay near quay	1.7	2.8	28

Fictional measurements taken between 07:00 and 07:20 at 0.3 m depth. Instruments were checked. These are single samples, not averages or pollution limits. NTU is a turbidity unit. For this activity, use oxygen below 2 mg/L as a low-oxygen warning, not a universal species-safety boundary. [3]

- Trace three possible routes from inland sources to the bay.
- Compare U and B: calculate the oxygen difference in mg/L. What does it suggest, and what can it not establish?
- Which site has the highest nitrate result? Explain why that alone cannot identify the responsible source.



STUDENT SHEET 3 | EVIDENCE DECK ONE

Records and possible sources

01



RAINFALL RECORD

A weather station recorded 28 mm of rain on Tuesday, 18:00–22:00. Street-drain flow increased during the storm. No samples were taken from the rain or the drains that evening.

BLUEHAVEN / EVIDENCE FILE

02



FARM LOG

A farmer applied nitrogen fertiliser on Monday. A field drain connects the land to the river. The farmer reports following the planned application rate. No drain-water sample or runoff volume is available.

BLUEHAVEN / EVIDENCE FILE

03



OVERFLOW LOG

At D, a combined-sewer overflow operated on Tuesday, 21:10–21:55. It released mixed rainwater and untreated wastewater to the river. The event is confirmed; its volume and chemical composition were not measured.

BLUEHAVEN / EVIDENCE FILE

04



FACTORY STATEMENT

Factory B reports no accidental release. Its routine outfall sample, taken Tuesday at 09:00, showed zinc within its permit limit. No sample was taken during the storm, and no results for other substances are supplied.

BLUEHAVEN / EVIDENCE FILE

Cut along the dashed lines. Record the source, time, claim and limitation of each card. Keep “a known pathway” separate from “a proven contribution”.



STUDENT SHEET 4 | EVIDENCE DECK TWO

Observations and disputed claims

05



FISHER'S OBSERVATION

A fisher noticed greenish water in the bay on Sunday, before the storm. On Wednesday at 06:30 she saw dead fish near the quay. She did not see a discharge. Her observations were not independently verified.

BLUEHAVEN / EVIDENCE FILE

06



SHORELINE SURVEY

On Wednesday, volunteers counted 96 visible litter items along 100 metres of shoreline: 72 packaging items, 18 pieces of fishing gear and 6 other items. They did not measure mass or microplastics. The items' origins are unknown.

BLUEHAVEN / EVIDENCE FILE

07



VIRAL ACCUSATION

A fictional local post claims: "Factory poison killed the fish." It shows a pipe photograph from last year without a date. No sampling results are linked. Many residents have shared it; the number of shares is not evidence of accuracy.

BLUEHAVEN / EVIDENCE FILE

08



LABORATORY NOTE

The measurements on p. 3 are single surface samples taken after the event. No toxins, pathogens or microplastics were tested. No fish examination was carried out. Low oxygen is a plausible stressor, but these results cannot identify the complete cause.

BLUEHAVEN / EVIDENCE FILE

Calculate the percentage of litter items that were packaging. Then explain why that percentage cannot show who caused the fish deaths.



STUDENT SHEET 5 | TEAM INVESTIGATION

Build your pollution case board

Arrange the cards beside an A3 sheet. Sketch the map in the centre of the sheet and connect sources, pathways and possible effects. Use solid lines for recorded links and dashed lines for hypotheses. Label each link with the relevant card number.

Board section	What to include
Established observations	Three findings supported by the case file. Separate direct measurements from reported observations.
Competing explanations	At least two explanations for the low oxygen or fish deaths. Explain the mechanism and cite a clue.
Limits and counter-evidence	One limitation or conflicting clue for each explanation. Include the timing of the green water.
Next investigation	Two checks that could distinguish between explanations. Specify where, when and what to measure.

Choose a response

You have six planning tokens. Choose exactly three actions. Costs are fictional planning values, not money. Justify the package using evidence, likely benefits and one trade-off. Include a way to review progress.

Action	Cost	Purpose and limitation
A Targeted sampling	2	Repeat oxygen readings; test likely contaminants at sources and downstream. Improves evidence, not immediate removal.
B Overflow investigation	3	Audit the confirmed event and plan overflow reduction. Requires engineering time; does not identify every source.
C Farm runoff prevention	3	Review fertiliser timing and buffer strips. May reduce nutrient loss over time; this farm's contribution is unmeasured.
D Supervised litter removal	1	Remove visible debris with trained staff. Does not remove dissolved nutrients or establish the fish-death cause.
E Street-drain litter capture	2	Intercept larger litter with maintained equipment. Does not capture all pollutants or address every pathway.
F Public update and reporting	1	Explain findings, uncertainty and how to report new evidence. Does not itself reduce pollution.

Our actions: _____ + _____ + _____ = _____ tokens.

Our strongest reason: _____

Our main trade-off: _____

Prepare one statement you are confident about, one claim you must qualify and one result that would make you change your mind.



STUDENT SHEET 6 | PRESS CONFERENCE

Explain without overstating

Your council briefing must help residents understand the evidence and the next steps. You are not a court deciding guilt. Give a 90-second statement, then answer questions for three minutes. The audience must challenge the reasoning fairly.

Statement structure

- 1 State two findings and refer to specific cards or sampling sites.
- 2 Explain the strongest hypothesis and one credible alternative.
- 3 Correct the unsupported accusation without declaring the factory innocent.
- 4 Present your three actions, their total cost and a realistic review plan.

Questioning roles

Perspective	Concern and question
Fisher	Your livelihood depends on a healthy bay. "What supports your explanation of the fish deaths, and what would you test next?"
Factory representative	You want fair treatment. "Our zinc result met the permit limit. Why does that not settle the case?"
Environmental advocate	You want prevention as well as investigation. "How does your package address invisible pollution as well as visible litter?"
Council budget officer	You must justify limited resources. "Which action did you reject, what is the trade-off, and how will you review the decision?"

These are discussion roles, not additional evidence. Do not invent test results, official orders or admissions of responsibility.

C1 communication tools

Concede a valid point: "That finding is relevant; nevertheless ..."
Qualify a conclusion: "The evidence supports ... only to the extent that ..."
Distinguish timing from cause: "The event preceded ..., but that alone ..."
Defend a priority: "Given the uncertainty and the confirmed pathway, we propose ..."

Peer review and revision

After the questions, identify one sentence that was too certain, vague or unsupported. Rewrite it and explain which piece of evidence prompted the change. Swap presenting and questioning roles.

Original claim: _____

Revised claim: _____

Reason for the change: _____



Reasoning and suggested responses

What the evidence supports

U–B oxygen difference: $8.1 - 1.7 = 6.4$ mg/L. B falls below the activity's low-oxygen warning. M has the highest nitrate result (3.2 mg N/L), but receives mixed inputs. Neither comparison identifies a single source. Packaging: $72 \div 96 \times 100 = 75\%$ of counted items, not mass or all pollutants.

Cards 01 and 03 document rain and a sewer-overflow event. Card 02 gives a plausible agricultural pathway, not a measured contribution. Card 04 is relevant but limited to one substance before the storm. Card 05 is a witness account: green water preceded the storm, so a new post-storm bloom cannot explain its onset. Green colour alone does not confirm algae. Card 06 concerns visible litter; 07 supplies no reliable causal evidence; 08 defines major testing gaps.

Plausible explanations and useful checks

Low oxygen could involve decomposition linked to earlier algal growth or organic inputs, including the confirmed overflow. Multiple inputs may contribute. Other untested causes of fish deaths remain possible. No fish examination or pre-event oxygen series is available. Do not infer that plastic caused the deaths, that rain created an immediate bloom, or that zinc compliance rules out all factory contributions.

Useful checks: repeated oxygen profiles at U, M and the bay across depth and time; nutrient and organic-load sampling at field drains, overflow and outfalls during and after rain; relevant contaminant screening and professional examination of fish. Pair locations and times so comparisons are meaningful. A measured source pulse would strengthen attribution; normal source results alone cannot rule out an earlier unobserved release.

Actions and model public statement

Example package: A + B + F = 6 tokens. It prioritises evidence, the confirmed overflow route and accurate communication, but leaves direct litter removal and farm prevention unfunded. A + C + D = 6 is also defensible if the unproven farm contribution and the omitted overflow work are acknowledged. Accept other three-action packages within budget when justified.

"The bay sample shows very low oxygen, while the shoreline survey confirms a separate litter problem. The confirmed overflow is a plausible contributor, but its volume is unknown. Earlier green water suggests the timeline began before the storm. The factory's pre-storm zinc test neither proves nor rules out a wider contribution. We propose repeated sampling, an overflow investigation and a public update. Review new results after 48 hours and publish the engineering follow-up timetable."

Assessment and extension

Award 0–2 each for scientific reasoning, use of evidence, treatment of uncertainty, feasible priorities and C1 communication (10 total). Strong responses synthesise conflicting clues, qualify claims precisely and address objections. For the 90-minute extension, look for matched sampling times, comparison sites, depth information and a clear distinction between prevention and proof.

Sources

[1] US EPA. Sources and Solutions. <https://www.epa.gov/nutrientpollution/sources-and-solutions>

[2] US EPA. Basic Information on Nutrient Pollution. <https://www.epa.gov/nutrientpollution/basic-information-nutrient-pollution>

[3] US EPA. Hypoxia 101. <https://www.epa.gov/ms-htf/hypoxia-101>

[4] NOAA Marine Debris Program. Where Does Marine Debris Come From? <https://marinedebris.noaa.gov/discover-marine-debris/where-does-marine-debris-come>

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