

Below the Surface

C1 | AGES 16+ | 90 MINUTES | WHAT MAKES A COAST ALIVE?

S01

A waterfront redevelopment attracts competing claims about biodiversity. Commissioned by a local magazine, your team must assess a limited ecological dataset, challenge causal assumptions and propose a defensible next step.



A / Old jetty: shaded rocks; frequent visitors.

B / Rockpool cove: pools, crevices and varied rock surfaces; sheltered.

C / New sea wall: mostly smooth surfaces; greater wave exposure.

YOUR COMMISSION

Produce an evidence-led editorial brief: compare communities, evaluate competing explanations and justify a proportionate intervention with a testable monitoring plan.

Work in teams of 3–4. Share the roles of data analyst, ecological modeller, evidence critic and editor. Combine the last two in a team of three. All places, observations and headlines in this case are fictional.



The evidence desk

ONE VISIT / SIX TARGET SPECIES / SIMULATED DATA

S02

The dataset represents observations from five equal-area patches at each site, surveyed on the same day at a comparable tidal height, with equal search time. Counts are pooled. Only six target species were recorded. Habitat notes are on S01.

Recorded individuals	A	B	C
Common mussel	24	8	0
Common rock barnacle	20	10	38
Common periwinkle	4	12	8
Common limpet	2	4	0
Beadlet anemone	0	6	0
Shore crab	0	10	4

Teaching model: simplified individual counts, not a recommended field protocol. Real surveys may use percentage cover for dense attached species. A zero means “not recorded in these samples”. No earlier survey or water-quality results are available.

Calculate / compare	A	B	C
Total recorded individuals			
Observed richness (species with count > 0)			
Largest species count / total × 100			

Interpret richness, dominance and relative evenness. Explain why the three equal totals conceal distinct community structures. State two limits on generalising beyond these pooled samples.



Meet the community

CUT-OUT SPECIES CARDS | FEEDING LINKS, NOT IDENTIFICATION GUIDES

S03

Cut along the dashed borders. Use the feeding information to build a web on S04. These short profiles describe real species; the counts on S02 are invented.

01 FILTER FEEDER

Common mussel

Mytilus edulis

Filters phytoplankton (tiny drifting algae) and other particles from water. Can be eaten by shore crabs. [1]

02 SUSPENSION FEEDER

Common rock barnacle

Semibalanus balanoides

Catches zooplankton (small drifting animals) when underwater. Young shore crabs can eat barnacles. [2, 3]

03 GRAZER

Common periwinkle

Littorina littorea

Feeds on algae growing on surfaces. Shore crabs can eat periwinkles. [3, 4]

04 GRAZER

Common limpet

Patella vulgata

Scrapes algae from rock surfaces. Its feeding links algae to animal consumers in the shore community. [5]

05 PREDATOR

Beadlet anemone

Actinia equina

Uses tentacles to capture small animals, including crustaceans. Crevices and pools can provide habitat. [5]

06 OMNIVORE

Shore crab

Carcinus maenas

Eats animal and plant material, including mussels, periwinkles and algae. Diet changes with size and available food. [3]



Connect the living system

MODEL A FOOD WEB / TEST AN EXPLANATION

S04

Construct a food web with at least seven supported links. Define your arrow convention and annotate an ontogenetic limitation (a change with life stage). Distinguish this potential web from feeding actually observed at a site.

PHYTOPLANKTON

ZOOPLANKTON

SURFACE ALGAE

Draw / arrange your web here

Evaluate a hypothetical decline in surface algae. Trace a plausible indirect effect and discuss dietary flexibility or other factors that could weaken it. Do not infer effect size from the web alone.



Headlines under review

EVIDENCE CHALLENGE / DO NOT PUBLISH AN UNSUPPORTED CLAIM

S05

01 / "EQUALLY FULL OF LIFE"

"All three sites have the same total, so their biodiversity is equal."

Separate the observation from the inference. Identify the logical gap and specify evidence that would discriminate between explanations.

02 / "SEA WALL POLLUTION EXPOSED"

"Site C has fewer species. Pollution must be the cause."

Separate the observation from the inference. Identify the logical gap and specify evidence that would discriminate between explanations.

03 / "THE COVE IS RECOVERING"

"Site B has six target species. The coast is recovering."

Separate the observation from the inference. Identify the logical gap and specify evidence that would discriminate between explanations.

Editorial standard: qualify the inference, not the observation. Precise uncertainty is stronger than a dramatic but unsupported conclusion.



From evidence to action

PLAN A FOLLOW-UP / PREPARE YOUR EDITORIAL BRIEF

S06

Prioritise a testable explanation. Design a feasible follow-up that distinguishes habitat effects, a possible pressure or temporal change. Identify a result that would weaken your interpretation.

OUR QUESTION / PREDICTION

What pattern would you expect if your explanation is right?

COMPARISON AND MEASUREMENTS

Which sites, dates and variables would you compare or measure?

A FAIR, REPEATABLE SURVEY

What would you keep comparable? How would you record variation?

ONE PROPORTIONATE ACTION

What should happen now, and what evidence would make you reconsider?

Address replication, temporal coverage, confounding variables and measurement relevance. A before-and-after comparison needs a reference site where possible; retaining patch-level data enables assessment of variation.



Teaching the investigation

C1 | TEACHER GUIDE | 90 MINUTES

T01

Learning outcomes: distinguish abundance, observed richness and relative evenness; model feeding relationships; separate observation from causal inference; justify a proportionate response and a testable follow-up.

Preparation: print S01–S07 per team, S02 and S07 per learner if desired. Cut S03 or let learners cut it. Provide pens and optional calculators. Entirely classroom-based; no internet or field visit is needed.

Time	Learning sequence
0–8	S01: launch the editorial commission and allocate roles.
8–23	S02: calculate metrics; compare interpretations in pairs.
23–38	S03–S04: build and explain the food web.
38–53	S05: audit the three headlines; require evidence.
53–66	S06: design a follow-up and proportionate action.
66–82	S07: draft an individual or joint editorial brief.
82–90	Exchange briefs, peer-review and revise. Discuss one disagreement.

Differentiation

C1: require seven links, a qualified interpretation of pooled data, a competing explanation and an explicit condition for revising advice. Challenge causal language and weak comparisons.

Access and participation: provide enlarged cards when needed; allow oral rehearsal, typing or a spoken brief assessed against the same criteria. Rotate intellectual roles so language confidence does not determine who reasons.

Evidence status: this is an original fictional case, not a field report. Do not present it as a validated survey or a tested teaching intervention.

Answers and assessment

TEACHER REFERENCE / MULTIPLE DEFENSIBLE RECOMMENDATIONS

T02

S02 / NUMERICAL KEY

Total individuals: **A 50 / B 50 / C 50.**

Observed richness: **A 4 / B 6 / C 3** target species.

Largest-species share: **A 48% / B 24% / C 76%.**

B is relatively more even; C is most dominated by one species. These indicators describe the sampled target community, not all biodiversity.

S04 / Supported arrows (food → consumer)

Phytoplankton → mussel; zooplankton → barnacle; surface algae → periwinkle, limpet and shore crab; mussel → crab; periwinkle → crab; barnacle → juvenile crab. Small crustaceans → anemone is also supported, but is not proof that it eats the sampled shore crabs.

Less surface algae could reduce food for grazers and indirectly affect predators. Alternative foods, movement and other conditions may alter the result. The cards show potential feeding links, not observed predation rates.

S05 / Claim audit

1: totals are equal, but richness and dominance differ.

2: C has the lowest observed richness; no pollution data exist. Surface type and wave exposure are alternative explanations.

3: B has six target species in these samples. Recovery requires evidence of change over time, with a meaningful baseline.

Non-detection is not proof of complete absence. The survey cannot establish which site is “healthiest”.

S06–S07 / Example direction

Protect existing rockpool microhabitats from avoidable disturbance while investigating. Compare matched habitats and repeat standardised sampling across dates; retain individual patch records. Measure habitat complexity and exposure. This would help evaluate a habitat explanation, although observational associations alone would still not establish causation.

Criterion	2 points	1 point	0 points
Data use	Accurate + scoped	Minor error / vague	Missing / misleading
Ecological reasoning	Links + qualification	Partly explained	Unsupported
Critical judgement	Gap + alternative	Gap only	Accepts claim
Action and follow-up	Specific + justified	Partly specified	Not testable



Sources and use

BACKGROUND REFERENCES / ORIGINAL CLASSROOM CASE

T03

Species information is paraphrased from the sources below. The scenario, dataset, map, cards and tasks were created for this material. No source photographs, published worksheets or external diagrams are reproduced.

1 / MarLIN: Common mussel

OPEN SOURCE

2 / MarLIN: Common rock barnacle

OPEN SOURCE

3 / MarLIN: Common shore crab

OPEN SOURCE

4 / MarLIN BIOTIC: Common periwinkle

OPEN SOURCE

5 / MarLIN: Rockpool community ecology

OPEN SOURCE

6 / Field Studies Council: Marine diversity methods

OPEN SOURCE

7 / NatureScot: Marine biodiversity monitoring handbook

OPEN SOURCE

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