BIOL1007 From Molecules to Ecosystems

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES · THE UNIVERSITY OF SYDNEY · SEMESTER 2, 2026

Full guide + ask Sia about BIOL1007

SIDE 1 · RECALL + DECIDE | EXAM REVISION SHEET · lecture + practical integration | **DEFINITIONS → MECHANISM → EVIDENCE LIMIT**

01 Exam map

COURSE DATA

40 | 15 | 10 | 20

TASK	WT	FORMAT / FUNCTION
Final exam	40%	2 h MCQ + short answer; attempt + 40% minimum
Proficiency Assessment	15%	30 min practical-skills SAQ/MCQ
Interactive Conversation	5%	5 min lecture + practical oral
Pre-practical Quizzes	4%	Short MCQ preparation
Writing Preparation and Reflection	5%	Writing-support quizzes
Practical Results	10%	Results + interpretation
Early-feedback Quiz	1%	Module 1 MCQ
Scientific Writing Assessment	20%	3 h in person

Permitted materials: not confirmed for this offering in the course materials we hold — check the exam instructions on the LMS.

02 The answer engine

COURSE OVERVIEW

OBJECT → LINK → TEST → LIMIT

structure → mechanism → observation

comparison + uncertainty → conclusion

Every strong response separates what was observed from what is inferred.

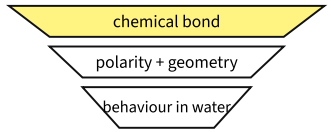
1. **Locate:** name molecule, structure, condition, scale or group.
2. **Define:** use the course term precisely; do not let a label stand in for an explanation.
3. **Trace:** state the process joining starting condition to outcome.
4. **Discriminate:** name the observation, control or competing explanation that tests the link.
5. **Bound:** answer only at the scale and measurement actually supported.

COURSE PRESSURE POINT	REPAIR
Molecular structure → cell process	Name the intermediate mechanism; do not jump scales.
Practical observation → inference	Separate recorded result, calculation and interpretation.
Regulation → wider consequence	Trace the causal link at each scale.
Confident wording beyond evidence	Add a control, competing explanation or measurement boundary.

FINAL CUE *Integrate molecular structure → cellular process, practical observation → inference, and one scale → the next while making uncertainty visible.*

03 Chemistry in water

C1



Source figure redrawn: bond → polarity → aqueous consequence.

TERM	RECITABLE DEFINITION
Bond	Attractive interaction holding atoms through shared or transferred electrons.
Polarity	Unequal electrical-charge distribution in a bond or molecule.
Aqueous environment	Water-based setting whose solvent properties affect structure, reaction and transport.

CHARGE SEPARATION

δ^+–δ^- ∝ Δχ

Greater electronegativity difference can increase **bond** polarity; molecular geometry controls net dipole.

DECISION RULE

First identify which bonds can be polar. Then determine whether bond dipoles cancel in the molecular geometry. Only then predict behaviour in water. A structural formula supports a chemical prediction but does not alone establish behaviour inside a complex cell.

04 Biopolymers

C2

monomer → bond → 3-D form → role

structure is the causal bridge

Source figure redrawn: subunit and bond matter through structure.

CONDENSATION SCHEMATIC

n monomers → polymer + (n-1)H_2O

CLAIM	CHECK
"Same monomer, same function"	**False.** Shared monomers do not guarantee identical 3-D structure, regulation or function.
Linear chain count	Formation from n monomers releases n−1 water molecules in this schematic.
What the count omits	It does not identify the enzyme or monomer class.

Exam chain: identify subunit → name linkage/assembly → describe structure → connect that structure to one cellular role → state the untested boundary.

DEFINITION CHECK

Monomer: small molecular subunit able to join others into a polymer. *Biopolymer*: biological macromolecule assembled from repeating or related subunits. Function depends on organisation.

05 Information flow

C3

transcription: DNA → RNA; translation: RNA → protein

processing · stability · degradation

Source figure redrawn: distinct processes; abundance need not track 1:1.

PROCESS	INPUT → OUTPUT	CORE RULE
Replication	DNA → DNA	Templated copying transmits information to daughter cells.
Transcription	DNA → RNA	RNA synthesis uses a DNA template and complementary base pairing.
Translation	mRNA → polypeptide	Ribosome reads codons to synthesise a polypeptide.

INFORMATION-FLOW RULE

DNA —transcription→ RNA —translation→ protein

Do not over-read the arrows: not every RNA is translated, and protein abundance need not follow mRNA abundance because processing, translation and degradation add control.

SEQUENCE TRACING

1. Name the strand or molecular product.
2. Apply the correct process and complementary pairing where relevant.
3. Carry information to the polypeptide.
4. Mark where regulation or error intervenes.
5. Separate sequence, abundance and function.

06 Variant logic

C4

sequence → product → function → phenotype

environment changes the path

test every arrow; never skip a level

Source figure redrawn: sequence change alone does not establish effect.

CONCEPTUAL RELATION

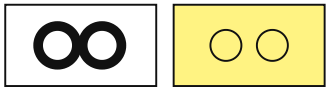
P = G + E + G×E

Read the relation as a conceptual partition of genetic, environmental and interaction influences—not fitted variance arithmetic here. The interaction means the genetic contribution can change with environment.

IF EVIDENCE SHOWS...	YOU MAY CONCLUDE...
Sequence change only	A variant exists; effect may be neutral, context-dependent or compensated.
Changed RNA amount	Expression differs; transcription or RNA stability is plausible.
Changed protein / phenotype	State the observed level; still test intervening mechanism.

07 Microscopy decisions

C5



larger blur | two points resolved

enlargement ≠ additional detail

Source figure redrawn: resolution, not size alone, adds image evidence.

TERM	MEANING / DECISION
Magnification	Apparent image size ÷ actual specimen size.
Resolution	Ability to distinguish nearby points separately.
Field of view	Specimen area visible at one optical setting.

SPECIMEN ESTIMATE

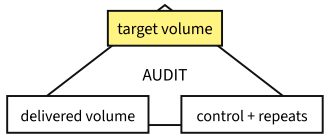
size ≈ field diameter ÷ objects across diameter

1. Use matching units.
2. Count objects spanning the calibrated diameter.
3. Divide field diameter by that count.
4. Report counting, orientation and optical uncertainty.

Classic trap: greater magnification without sufficient optical resolution produces a larger blur, not new evidence.

08 Pipette audit

C6



Source figure redrawn: display, delivery and precision are distinct claims.

RELATIVE ERROR

% error = |Vmeasured - Vtarget| ÷ Vtarget × 100

PATTERN	INTERPRETATION MOVE
Repeated scatter	Consider random technique error; quantify variation.
Repeated shift from target	Consider systematic technique or calibration error.
Treatment differs from control	Check that technique, range and handling do not explain it.

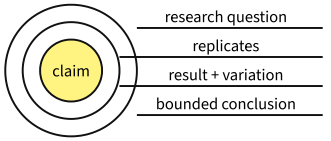
The denominator is the **target** volume. Repeat deliveries before classifying error. Displayed volume, operator precision and actual delivered volume require different evidence.

OPERATIONAL SEQUENCE

Select a micropipette whose specified range contains the target; execute the transfer; record what was produced; compare with target and controls; separate technique error from any proposed biological effect.

09 Inquiry → claim

C7



Source figure redrawn: the claim is constrained by design and evidence.

STAGE	WHAT MUST STAY VISIBLE
Question	System, variables and relationship being investigated.
Design	Comparison condition, independently repeated units and procedure.
Observation	What the instrument or procedure directly produced.
Calculation	Transformation and units; do not relabel as mechanism.
Interpretation	Answer within comparison, variation, controls and limitations.

REPLICATE SUMMARY

$\bar{x} = (1/n)\ \Sigma x_i$

The mean summarises replicate observations but must be paired with variation and the sampling design. One visible difference or successful trial cannot establish a general mechanism.

CONTROL TEST

- What alternative could produce the same pattern?
- Which control holds all but the investigated factor stable?
- Which additional measurement separates the proposed mechanism from that alternative?
- Are repeats independent units or repeated readings of one unit?

10 Scientific argument

C9

SENTENCE JOB	FRAME
Claim	"Under [condition], [measured outcome] differed from [comparison]."
Mechanism	"This is consistent with [process] because…"
Boundary	"It does not establish [downstream/unmeasured claim]."
Next test	"Measure [discriminator] with [control/replication]."

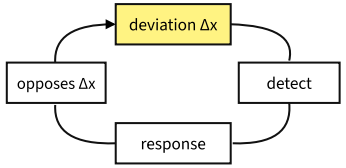
A scientific argument keeps question, method, result, interpretation and limitation distinguishable. Interactive explanation adds a direct response and a concise justification of the biological reasoning.

EVIDENCE LEDGER

COLUMN	QUESTION
System	Which specimen, participant, molecule or condition?
Feature	What was directly observed or recorded?
Comparison	Against which control or reference?
Inference	Which mechanism is consistent with the pattern?

11 Homeostasis

C8



Source figure redrawn: negative feedback reduces departure from a range.

NEGATIVE FEEDBACK

Δx → response opposing Δx

TERM	USE
Homeostasis	Regulated maintenance within ranges compatible with function and survival.
Feedback regulation	System output influences the activity producing that output.
Ecosystem interaction	Organism–environment relation changing resources, abundance or processes.

Dynamic, not static: oscillation within a regulated range is compatible with homeostasis. Perfect constancy is not required.

CROSS-SCALE RULE

Name the regulated variable and scale; trace the feedback process; then state the consequence at the next biological scale. Do not copy organismal feedback directly onto every ecosystem pattern—show the actual interaction and evidence.

12 Marks + hurdle

COURSE / C9

WEIGHTED AGGREGATE

M = .40E + .15P + .05O + .04Qp + .05Qw + .10R + .01Qe + .20W

Test separately: exam attempted and E ≥ .40Emax

CHECK	TRUTH
Weights	Eight BIOL1007 tasks total 100%.
Final hurdle	Only hurdle row in the assessment table: attempt + at least 40% of available exam marks.
Attendance	Separate condition expects at least 80% of timetabled activities; inadequate attendance may cause failure.
Shared teaching	BIOL1907 materials may support concepts; its weights do not transfer.

The final covers lecture and practical content. In revision, practise the same logic across MCQ and short answers: identify the scale, connect structure to mechanism, and test the claim with practical evidence, a control or competing explanation.

FORMAT-TO-ACTION

QUESTION TYPE	FAST ACTION
MCQ contrast	Find the option that preserves the process, scale and evidence boundary together.
Short answer	State the decision first; show the mechanism; finish with limitation or next test.

BIOL1007

Self-test drills · answer paths · classic traps

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SIDE 2 · TEST + REPAIR

EXAM REVISION SHEET · cover the answers, speak the path, then check

MCQ CONTRAST + SHORT-ANSWER FRAME

13 Worked: 2× mRNA COURSE WORKED

Prompt [5 marks]. Treated cells have twice as much target mRNA as controls; protein abundance was not measured. Build a bounded conclusion.

control mRNA = 1× | treated mRNA = 2× | protein not measured

supported: mRNA differs | stop

transcription/RNA stability plausible

Measured 2× mRNA does not licence a 2× protein or phenotype claim.

MARK	ANSWER PATH
1	Outcome = target-mRNA abundance; comparison = treated vs control.
1	State the observed two-fold difference under the stated normalisation.
1	Transcription or RNA stability are plausible mechanisms.
1	Protein and phenotype were not measured; do not say they doubled.
1	Follow up with protein measurement plus replication/control check.

MODEL CONCLUSION

```
Treatment is associated with higher measured target-mRNA abundance under the experiment's normalisation. This supports a change in transcription or RNA stability; protein and phenotype conclusions need separate evidence.
```

SELF-MARK BEFORE REVEALING

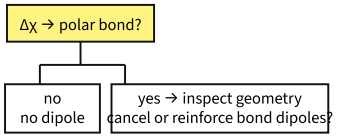
- Did the first sentence name the measured outcome and comparison?
- Did "two-fold" remain attached to target mRNA under the stated normalisation?
- Were transcription and RNA stability framed as plausible mechanisms, not proven causes?
- Were protein abundance and phenotype explicitly held outside the conclusion?
- Did the follow-up include both a protein measurement and replication or a control?

14 Which is true? C3–C4

TEMPTING STATEMENT	CORRECT CONTRAST
Every RNA becomes protein.	Only translation links an mRNA to a polypeptide; not every RNA is translated.
A mutation must alter phenotype.	It may be neutral, context-dependent or compensated.
More mRNA proves more protein.	Processing, translation and degradation intervene.
P = G + E + G×E is fitted arithmetic here.	It is a conceptual partition; interaction means genetic contribution may change with environment.

15 Chemistry drill C1 WORKED

Prompt. A bond has charge separation. Decide whether the whole molecule has a net dipole and predict its behaviour in water.



Answer path: electronegativity difference first; molecular geometry second.

CARRY THE RULE THROUGH

```
δ⁺-δ⁻ ∝ Δχ → bond polarity; geometry → net dipole; net polarity + solvent properties → aqueous prediction.
```

1. Define Δχ and identify charge separation.
2. Map every relevant bond dipole.
3. Use geometry to decide cancellation or reinforcement.
4. Predict aqueous behaviour.
5. Limit: a structural formula alone does not establish behaviour in a complex cell.

TRAP *"Polar bonds" and "polar molecule" are not interchangeable claims.*

16 Polymer drill C2 WORKED

WORKED SYMBOLIC COUNT

```
Input: n monomers. Linear chain has n-1 joining events. Each condensation releases H₂O. Therefore output = polymer + (n-1)H₂O.
```

CHECK	ANSWER
What earns the mechanism mark?	Join subunit, bond/assembly, 3-D structure and cellular role.
What cannot be inferred?	Same monomers do not guarantee identical structure, regulation or function.

WHICH STATEMENT SURVIVES?

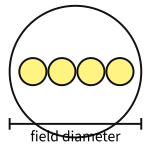
STATEMENT	VERDICT
n monomers release n waters.	Reject: a linear chain uses n−1 joining events.
The water count identifies the enzyme.	Reject: the schematic does not specify enzyme or monomer class.
Structure links assembly to function.	Keep: this is the required causal bridge.

FIVE-MARK AUDIT

Define	State n and the linear-chain condensation schematic.
Transform	n monomers require n−1 joining events; each releases H_2O.
Check	Test the result against the relationship's stated constraint.
Bound	The count specifies neither enzyme nor monomer class; shared monomers do not guarantee the same structure or function.

17 Microscopy drill C5 WORKED

Prompt. Objects span a calibrated field diameter. Estimate object size and judge whether a higher setting reveals more detail.



count objects across diameter

divide using matching units

Calibrated field ÷ objects across gives an estimate, not exact size.

ANSWER PATH

```
size ≈ field diameter ÷ objects across diameter → report unit → add counting, orientation and optical uncertainty.
```

IF YOU SEE…	DO…
Only a larger image	Do not claim added detail; ask whether two nearby points became resolvable.
Changed objective / setting	Re-establish calibration and field of view.
Partial objects at edges	State the counting rule and uncertainty.

18 Pipette drill C6 WORKED

CARRY THE DENOMINATOR

```
% error = |Vmeasured - Vtarget| ÷ Vtarget × 100
```

1. Define measured and target volumes in matching units.
2. Subtract, take absolute magnitude, divide by target and convert to per cent.
3. Repeat deliveries.
4. Use scatter vs persistent shift to distinguish random from systematic technique error.
5. Do not confuse a displayed setting with actual delivery.

CLAIM	EVIDENCE NEEDED
Displayed volume	The instrument setting and correct range selection.
Operator precision	Repeat deliveries and their spread.
Actual delivered volume	Calibration or an appropriate measurement of delivery.
Biological effect	A suitable control showing technique does not explain the difference.

DEFINITIONS THAT SEPARATE CLAIMS

Micropipette	Adjustable instrument for measuring and transferring small liquid volumes within a specified range.
Measurement uncertainty	Quantified or acknowledged range of doubt attached to a measured value.
Experimental control	Comparison condition designed to isolate the effect of the factor being investigated.

19 Practical mini-case C7 WORKED

Prompt. Replicate observations appear different between a treatment and control. Construct the result and the strongest defensible claim.

OBSERVE recorded values | CALCULATE mean + variation | INFER bounded claim

never move data straight to mechanism

Three lanes prevent calculation or inference being reported as observation.

WORKED SYMBOLIC SUMMARY

```
Replicates x₁…xₙ → x̄ = (Σxᵢ)/n. Report x̄ with variation and sampling design; compare like with like.
```

STEP	WRITE
1 Question	System, variables and relationship.
2 Evidence	Observed treatment–control pattern and replicate variation.
3 Mechanism	"Consistent with…" plus the process linking condition to outcome.
4 Alternative	Technique error or another biological explanation.
5 Discriminator	Control or additional measurement that separates them.

TRAP *A mean does not create independent replication. One successful trial cannot establish a general mechanism.*

REWRITE AN OVERCLAIM

Too far: "The treatment caused the biological mechanism because the mean was higher." **Bounded:** "The treatment group had the higher measured mean in these replicates. The result is consistent with the proposed mechanism, but variation, sampling design, controls and a discriminating measurement determine how far that interpretation can go."

Independence check: distinguish independently repeated observational or experimental units from repeated readings of the same unit; only the former address biological or experimental replication as defined in the guide.

20 Control judgement cards C6–C7

IF YOU SEE X…	→ DO Y
No comparison condition	Do not isolate the investigated factor.
Same shift across repeats	Check calibration or systematic technique.
Wide replicate spread	Report variation; inspect biological and measurement sources.
Mechanism beyond measured outcome	Stop at the observed level; propose the missing measure.
Representative image only	Do not generalise as if every specimen were identical.

21 Feedback drill C8 WORKED

Prompt. A regulated variable departs from its compatible range. Explain negative feedback and then trace one consequence at another biological scale.

ANSWER PATH

```
deviation Δx → detector/control process → response opposing Δx → reduced departure from range → cross-scale consequence.
```

1. Name the variable, range and biological scale.
2. Describe how output influences the activity producing that output.
3. Show that the response opposes, rather than amplifies, Δx.
4. State the downstream consequence at cell, organism or ecosystem scale.
5. Qualify: organismal feedback is not automatically an ecosystem mechanism.

22 Mutation judgement C4

WHICH IS TRUE?	WHY
Mutation = heritable nucleotide-sequence change.	Definition does not guarantee altered product or phenotype.
Phenotype reflects G, E and G×E.	Environment and interaction can alter consequence.
Molecular evidence precedes organismal claim.	Product quantity, sequence and function are distinct checkpoints.

CROSS-SCALE JUDGEMENT CARDS

IF THE PROMPT MOVES…	INSERT THIS CHECKPOINT
Sequence → phenotype	RNA/protein product and molecular function.
Cell process → organism	Which regulated function changes and by what evidence?
Organism → ecosystem	Which interaction changes resources, abundance or system process?
Diagram → mechanism	What observation distinguishes the mechanism from an alternative?

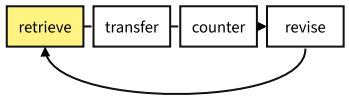
VARIANT ANSWER PATH

1. **Define:** gene expression is the regulated use of genetic information to produce functional RNA or protein.
2. **Trace:** for a sequence or regulatory change, test molecular product quantity or sequence, then function, then phenotype; each arrow needs evidence.
3. **Partition:** read P = G + E + G×E conceptually here; G×E means the genetic contribution may change with environment.
4. **Bound:** a mutation may be neutral, context-dependent or compensated; sequence change alone does not establish organismal effect.

23 Fast-recall matrix C1–C9

SEE THIS	WRITE / DECIDE
Δχ	Bond polarity first; geometry decides net dipole.
n monomers	Linear condensation: n−1 waters; structure bridges to function.
DNA → RNA	Transcription; do not call it translation.
RNA → protein	Translation; abundance is not forced 1:1.
Sequence variant	Trace product → function → phenotype; test each arrow.
Bigger image	Ask whether resolution increased; larger blur is possible.
Objects across field	Field diameter ÷ count; matching units + uncertainty.
Pipette error	|measured−target| ÷ target ×100; repeat.
Replicates	Mean plus variation and design; one trial is not general evidence.
Deviation from range	Negative feedback response opposes Δx.
Short answer	Object → mechanism → evidence → limit → next test.
Final aggregate	Calculate weights, then test attempt + 40% exam minimum separately.

24 Exam-morning plan STUDY STRATEGY



repair the first failed reasoning move

Source practice figure redrawn: retrieval is followed by transfer and repair.

1. **Retrieve:** recite the definitions and nine formula/rule boxes without notes.
2. **Transfer:** apply each to a changed scenario; do not merely recognise the diagram.
3. **Counter-case:** name a plausible alternative or condition that would change the conclusion.
4. **Repair:** record the first failed reasoning move and redo that link.
5. **Check operations:** confirm the exact sitting and instructions in the institutional systems.

LAST SCAN

- Correct biological scale named?
- Observation separated from inference?
- Units, denominator and reference condition visible?
- Mechanism actually supported?
- Control, replication or discriminator named?
- Conclusion stops at the measurement boundary?

TWO-HOUR FINAL *MCQ rewards clean contrasts; short answer rewards a visible chain. When uncertain, state what the evidence does support before naming what remains unmeasured.*