SAMPLE EXAM QUESTIONS FOR BIO 59

These are sample questions chosen to illustrate the range of questions that you are likely to see on the exam. It is not a sample exam. For example, questions are not drawn evenly from the material that has been represented; the length is not necessarily representative of a midterm exam; and we have not left you any space to write answers. These questions are intended as a tool to help guide the way you study. Working through these questions should not be taken as a substitute for studying your notes and doing the readings. You are encouraged to discuss the questions with your colleagues.

STRUCTURE OF EXAMS. Unless we indicate otherwise, exams will be primarily short answers. The structure of the questions will vary but most exams will include some questions drawn from most of the following categories. Sample questions from each category follow.

1. Terminology, natural history, and methodology
2. Recall of examples
3. Recall of data interpretation
4. Recall of theoretical concepts
5. Providing new examples to illustrate concepts or patterns
6. Interpreting new data
7. Using theoretical concepts to explain patterns or processes that we have not discussed
8. Using theoretical concepts to derive predictions about biological systems that we have not discussed
9. Designing ecological research

1. TERMINOLOGY, NATURAL HISTORY, AND THE METHODOLOGY

Define or identify the following terms:

- stomata
- Sphingidae
- science
- epistasis

Distinguish between the following pairs of terms by providing a clear and unambiguous example of each.

- Ancestral trait vs Derived trait

To what order do caribou belong?

What is a typical value for rainwater pH in NH? How would you measure it?

2. RECALL OF EXAMPLES

Carp are frequently able to survive in lakes where other fish cannot. Why?

What are the products of foregut fermentation that benefit ruminants? What are the substrates that yield the products?

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Product</th>
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3. **RECALL OF DATA INTERPRETATION**

Refer to the figure from your notes comparing enzyme kinetics as a function of temperature for geometrids and sphingids. What was the conclusion with respect to low temperature flight capabilities in geometrids?

4. **RECALL OF THEORETICAL CONCEPTS**

Draw and fully label a figure showing how metabolic rate varies with body size in mammals. Explain how this relationship influences the relative food requirements of small vs. large mammals.

State one important ecological advantage and one important ecological disadvantage of being a homeotherm.

On a global scale, where are the terrestrial ecosystems with the highest primary productivity? Why?

Consider a caterpillar with an average daily metabolic rate (ADMR) of 0.40 mg\(\text{g}^{-1}\text{d}^{-1}\). On birch leaves, it has a relative consumption rate (RCR) of 2.5 mg\(\text{g}^{-1}\text{d}^{-1}\) and an apparent digestibility of 0.30 mg / mg. What is its relative growth rate (RGR) in mg\(\text{g}^{-1}\text{d}^{-1}\)?

What fraction of the food consumed by this caterpillar is converted into caterpillar biomass?

After 2 days, what is the expected mass of a caterpillar that begins at 100 mg?

Assume that:

- A white-tailed deer weighs 75 kg.
- Basal metabolic rate falls on the interspecies curve for mammals \(V_0 = 0.676M^{0.25}\), where \(V_0 = \text{liters}\text{O}_2 \text{kg}^{-1}\text{hour}^{-1}\) and \(M = \text{mass in kg}\).
- Oxidative metabolism releases 20.083 kj / liter O\(_2\).
- In the Second College Grant, deer only eat hobblebush shoots during the winter.
- Available winter browse in the Second College Grant = 25,000 hobblebush shoots / km\(^2\)
- An average hobblebush shoot has a dry mass of 80 g and contains 650 kj / shoot.
- Deer are able to locate and consume all of the available hobblebush shoots.
- Winter lasts 6 months. During the remainder of the year, deer food is unlimited.

If winter food availability limits population size, how many deer per km\(^2\) could survive in this habitat?

Show your work. State any important additional assumptions that may be required.

5. **PROVIDING NEW EXAMPLES TO ILLUSTRATE CONCEPTS OR PATTERNS**

Provide an example other than the ones presented in class that unambiguously illustrates the distinction between acclimatization and adaptation.

Give a biological example other than the ones presented in class to illustrate the second law of thermodynamics and explain it briefly.
6. **INTERPRETING NEW DATA**

Brine flies (Diptera: Ephidridae) and midges (Diptera: Chironomidae) are aquatic insects. One species of each group occurs in the salty lakes of Utah and Nevada. Laboratory experiments have been used to test the tolerance of these two species to water of different salinity. Larvae were acclimatized for 1 week to a specified salinity, then challenged with 30 min exposures to water of increasingly lower or higher salinity, and monitored for survival. The following data describe the results. (ppm = parts per million salts). Answer the questions that follow the data.

<table>
<thead>
<tr>
<th>Acclimatization salinity (ppm)</th>
<th>Lower lethal salinity (ppm)</th>
<th>Upper lethal salinity (ppm)</th>
<th>Lower lethal salinity (ppm)</th>
<th>Upper lethal salinity(ppm)</th>
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</table>

Which species is most likely to be limited in its distribution by salinity? (Midge, brine fly, or neither)

Which species has the greatest capacity for acclimatization of its tolerance to salinity? (Midge, brine fly, or neither) Explain.

Identify environmental conditions that: (1) Allow existence of both species; (2) Allow existence of midges but not brine flies; and (3) Allow existence of brine flies but not midges.

7. **USING THEORETICAL CONCEPTS TO EXPLAIN PATTERNS OR PROCESSES THAT WE HAVE NOT DISCUSSED**

Spruce budworm, an early season folivore of fir and spruce, tends to be more abundant and have more frequent population outbreaks in the northern part of its distribution than in the southern part of its distribution. Suggest an explanation for this pattern based on the phenological race hypothesis.

8. **USING THEORETICAL CONCEPTS TO DERIVE PREDICTIONS ABOUT BIOLOGICAL SYSTEMS THAT WE HAVE NOT DISCUSSED**

Why do small herbivores tend to feed on higher quality foods than larger herbivores?

Earthworm populations A and B are identical in their physiology, and live in soil environments with the same average temperature, but population A experiences greater diurnal variability in soil temperatures. How will the maintenance energy requirements compare for worms of equal mass in the two populations? Explain.

Erosion from logging in one stream tributary within the College Grant results in an increase in water conductivity. How would you expect this increase in conductivity to influence the maintenance metabolism of aquatic insects within that tributary? Explain.

9. **DESIGNING ECOLOGICAL RESEARCH**

Conceive an experiment that would simultaneously test for acclimatization and adaptation in the same physiological process in the same species. Graph and briefly explain one set of results that would (1) provide evidence for acclimatization and (2) refute the existence of adaptation.