

To take full advantage of the practice midterm you should:

1. Review course material and make your summary notes and concept maps.
2. Print the exam. Pick a quiet place and give yourself 45 minutes to do the exam. Answer all the questions in the space provided.
3. Check your answers with the marking key provided.
4. Continue with your reviewing as necessary.
5. If you are unclear about material, go to the Learning Centre, post questions on the bulletin board, ask your group members, come to the review session.
6. Email me with questions or to set up an appointment if you are still unsure of something. Note: The last opportunity to meet with me before the midterm will be 4:30-5:30 Fri. Jan. 25. I will check my email at 11 p.m. Sun. Jan. 27 and will respond to any emails received before that time. I will not respond to emails again before the midterm.

Keep in mind that this is a practice midterm and the questions on your midterm will be similar in format and style, not necessarily in content.

UNIVERSITY OF BRITISH COLUMBIA

Biology 121

Section 225

Practice Midterm 1, Jan., 2013

Instructor: Dr. Carol Pollock

Name: _____ Student number: _____

Instructions:

1. Answer all questions in the space provided.
2. All writing must be in **INK**.
3. Answers may be in sentences or point form. Illustrations are acceptable but must be annotated.
4. Students suspected of any of dishonest practices will be immediately dismissed from the examination and will be subject to disciplinary action.
5. Other than **one side of one page** for summary notes and **one side of the same page for concept maps**, no other memory devices are permitted.
6. Students may not speak or in any other way communicate with other students while in the examination room.
7. Students may not expose their written paper to other students. The excuse of accidental exposure, forgetfulness, or ignorance will not be accepted.
8. Make sure you have **5** pages including this cover page.

I have read and fully understand these instructions.

Student signature _____

Mark allocation:

Question	Marks possible	Your mark
1.	10	
2.	8	
3.	8	
4.	4	
5.	8	
6.	9	
Total	47	
On exam bonus for notes	1	
On exam bonus for concept map	1	
Total	47	

1. (10 marks) Two species of shore crab, *Hemigrapsus nudus* (the purple shore crab) and *Hemigrapsus oregonensis* (the hairy shore crab) live in the intertidal region of the marine ecosystem. Both crab species are scavengers, consuming dead organic material, and both play a similar ecological role in the intertidal area of the marine ecosystem. In 1975 first-year Biology students did a survey of shore crab abundance as a function of substratum size (mean size of substratum particles as measured at their largest dimension). Their data are presented in the following figure, frame A. In 2005 another group of first-year students repeated the survey; their data are presented in frame B.

Hemigrapsus nudus ———— *Hemigrapsus oregonensis* ————
 Frame A: Frame B:

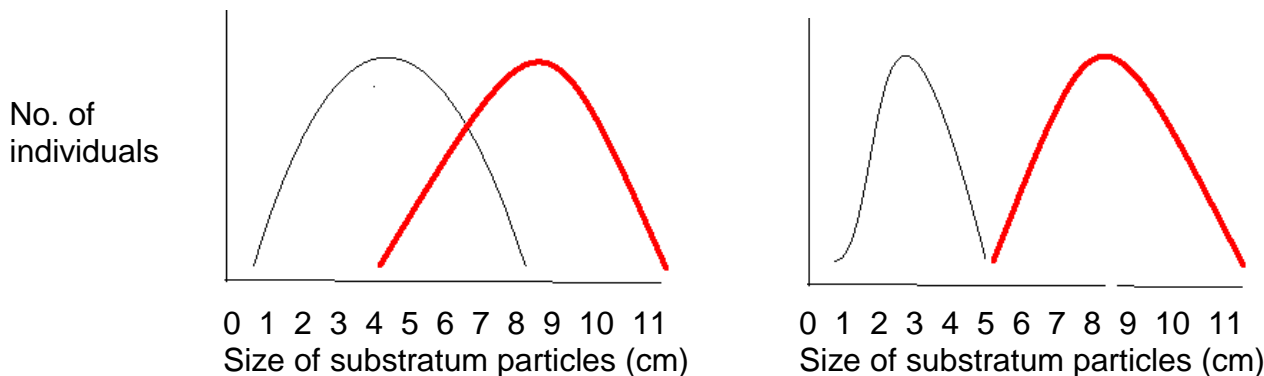


Fig. 1 the relative abundance of *H. nudus* and *H. oregonensis* as a function of substratum particle size at Tower Beach in 1975 (Frame A) and 2005 (Frame B).

- a. Are the curves illustrated in the graph in **frame A** examples of the fundamental or realized niches of these organisms? Explain your answer. (2 marks)
fundamental (1) because they illustrate the range where each species can be found (1)
- b. What interaction (be specific) would you expect between the two species where their distribution overlaps in **frame A**? Why would you expect this interaction to occur? (3 marks)
*competition (1) for one of: space (under rocks), food (on or under rocks) accept any reasonable answer (1)
 Can't have two species in same niche (1)*
- c. Describe the effect of this interaction on the distribution of the two species in this area over 30 years between 1975 and 2005 (**frame B**). What is the name of this ecological process (be specific). (3 marks)
*In the area of niche overlap H. nudus decreases until it is no longer present (1)
 Its range is decreased to smaller particles (1)
 Called competitive exclusion (½) – resource partitioning or niche partitioning (1)*
- d. List one possible characteristic of *H. oregonensis* and *H. nudus* that could have led to the results observed and indicate how this characteristic could have led to the results observed. (2 marks)
*Anything reasonable that explains why H. oregonensis could be a better competitor; 1 mark for characteristic and one for reason e.g., larger – better competitor for food, space
 Better camouflaged – more protection from predators
 etc.*

2. Point Grey, where UBC is situated, has many paths down to the beach. One of these paths, Beach trail #3, leads to Tower Beach. The cliffs surrounding the beach are made of sand and are quite unstable. In Jan. 1935, 37 cm of rain and snow fell in the Lower Mainland over four days. The subsequent flooding washed 100,000 tonnes of material down one bank above Tower Beach, forming a gully. All soil and vegetation were swept away down the gully. In 1965 a survey of the vegetation in the disturbed area and the adjacent undisturbed area next to the gully was completed. The following plant species were found at the two sites:

Species	Number at undisturbed site	Number at disturbed site
Sword fern	5	0
alder	3	50
Mature Douglas fir	15	0
Douglas fir seedling	5	5
salmonberry	8	2
<i>Mnium</i> (moss)	5	2
Maple	3	0
hemlock	5	5

- a. Which site has the greatest species richness? (1 mark)
Undisturbed site (1))
- b. Which species is the most likely to be a pioneer species at the disturbed site? (1 mark)
Alder (1)
- c. List two features that are characteristic of a good pioneer species. (2 marks)
Any two for 1 mark each e.g., good dispersers, can survive extreme abiotic conditions, produce lots of offspring, grow and mature quickly. Other answers may be acceptable.
- d. Compare the importance of abiotic and biotic factors in communities that are in earlier and later successional stages. Explain using examples from the data presented above. (4 marks)
*Abiotic are more important than biotic in earlier succession (1) because pioneer species can moderate a hostile environment e.g., alder can increase the amount of nitrogen in the soil [nitrifying bacteria in nodules bonus ½] so species such as Douglas fir can obtain enough nutrients (1)
Biotic are more important in later communities because species prominent here are usually better competitors e.g., Douglas fir shade alder so they die back (1)*
3. (8 marks) Arnold and Danny are going out for sushi. Danny orders a cucumber roll (rice, seaweed and cucumber) and Arnold orders a tuna roll (rice, seaweed and tuna).
- a. How many trophic levels are represented in each of the different sushi types? Explain. (5 marks)
*cucumber - 1 trophic level (1) because rice, seaweed and cucumber are all producers (1)
tuna – 2 trophic levels (1) because rice and seaweed are producers (1) and tuna is a consumer (1)*
- b. Arnold and Danny each believe that their sushi is the healthier to eat. Who do you support – Danny (cucumber roll) or Arnold (tuna roll)? Use bioaccumulation and biomagnification to explain your answer. (3 marks)

Danny (1) because tuna is a higher level consumer (can say 2° or higher) (1). Toxins are bioaccumulated in all trophic levels (1) but toxins are biomagnified at each trophic level (1); therefore since tuna is at a higher trophic level it is likely to have more toxins (1)

4. (4 marks) You completed an online questionnaire to determine your Ecological Footprint (EF).

a. Based on your answers to this questionnaire what is one reasonable way you can reduce your EF? (1 mark)

One reasonable way

b. Explain why, based on the calculation of the EF, this action will be effective in reducing your EF (3 marks).

Explanation 3 marks, based on questionnaire categories, e.g., transportation, housing, food, etc. 1 mark for simple answer e.g., transportation contribution will decrease. Add additional marks for more detail in answer.

5. (8 marks) You have a cell in G₁ of interphase with 6 chromosomes and 20 pg (picograms, 1 picogram = 1 x 10⁻¹² g) of DNA.

a. Complete the following table for this cell: (6 marks)

Stage	No. of chromosomes	Amount of DNA/cell (pg)
G ₁	6	20
Beginning of S	6	20
End of S	6	40
G ₂	6	40
Prophase	6	40
Beginning of metaphase	6	40
Anaphase	12	40

½ mark for each answer. Note: sister chromatids don't become chromosomes until each has its own centromere; dividing cell doesn't become two until cell plate is completed (plants) or fission furrow separates two cells (telophase).

b. Cells such as neurons that are not going to ever divide are in a modified G₁ stage called G₀. Which cell cycle checkpoint, G₁/S, G₂/M or M, do you think is most important in converting a cell is to G₀? Explain. (2 marks)

G₁/S (1) because if cells get through this checkpoint they will replicate DNA and could go on and divide (1). [It would be energetically wasteful to have S and not divide.]

6. (9 marks) When CO₂ is absorbed by the ocean it combines with water to produce carbonic acid. The increased acidity reduces the amount of dissolved calcium carbonate in ocean waters. Calcium carbonate is an important component of the shell of many marine species; a decrease in calcium carbonate can result in decreased survival of intertidal animals such as mussels. At the same time, eelgrass, which is tolerant of low pH conditions, has been increasing in intertidal areas. Dr. Chris Harley of the Zoology department at UBC is concerned because mussels in the intertidal region of Tower Beach are decreasing in numbers; however it is not clear what is causing the decrease in number: 1) decreased pH (from 5.5 in 2005 to 5.0 in 2011) impacting survival or 2) competition from eelgrass. You are

hired as a summer student to work on this project. You are going to design an experiment to distinguish between the two possibilities listed above.

- a. What are two hypotheses for this experiment? (2 marks)

Hypothesis 1: *Decrease in number of mussels is a result of decrease in pH (1)*

Hypothesis 2: *Decrease in number of mussels is a result of competition with eelgrass (1)*

- b. Briefly describe an experiment you could do to investigate which of these hypotheses is supported. Assume you have access to tanks with a suitable substratum (rocks) and sufficient mussels, eelgrass, and two batches of ocean water, one with pH = 5.5 and other with pH = 5.0. Draw a diagram if it helps with your explanation. (3 marks)

Look for:

Does the design distinguish between the two hypotheses? (1)

Are there controls and replicates? (1)

Is it feasible? (1)

Several types of experiments are possible; this is just one example

Half the tanks with mussels only, half with mussels and eelgrass (don't need eelgrass alone, don't take off marks if they have this)

Total number of organisms have to be the same in each tank

Half the tanks with ocean water at pH = 5.5; half with ocean water at pH = 5.0

Replicates

e.g., Tanks 1 - 6

2 mussels alone

Tanks 7 - 12

1 mussels with 1 eelgrass

Tanks 1-3 and 7-9 – pH = 5.5

Tanks 4-6 and 10-12 pH = 5.0

- c. What predictions would you make if each of these hypotheses were supported? (2 marks)

Prediction if hypothesis 1 is supported:

Number of mussels will decrease most at pH 5.0 whether eelgrass is present or not i.e., there will be relatively more mussels in tanks 1-3 and 7-9 than tanks 4-6 and 10-12. (1)

Prediction if hypothesis 2 is supported:

Number of mussels will decrease where mussels and eelgrass are both in the same tank (regardless of pH (1) i.e., tanks 7-12. (1)

- d. If a combination of decrease in pH and competition are causing the decrease in numbers of mussels, how would that influence your results? (2 marks)

The least impact would be where mussels alone are at pH = 5.5 (1); the greatest impact would be in the tanks with eelgrass and mussels at pH = 5.0 (1). The results of the other two would be in between.