Please Attempt ALL of the Questions in This Section.

Matching**: Write the letter corresponding to the correct objective from the list at right for each space below:**

#1. Objectives of All of Unit 3 - Ecological Systems of Life

(1) _____

(2) _____

2 pts

#2. Objectives of Individual Ecology (Physiological + Behavioral Ecology)

(1) _____

(2) _____

2 pts

#3. Objectives of Population Ecology

(1) _____

(2) _____

2 pts

#4. Objectives of Community Ecology

(1) _____

(2) _____

2 pts

#5. Objectives of Ecosystems Ecology

(1) _____

(2) _____

2 pts

A You will improve your cognitive skills at critical thinking and reflective judgement

B To understand how organisms respond adaptively to their total environment (biophysical, resource, social/ reproductive, predation/ parasitism, mutualists) in ecological time

C To understand how all of the populations interact with each other and with their physical environments (air, soil, water) to create ecosystem structure/ function

D To understand the vast interdependencies between our global society and natural world

E To understand how all of the population interactions with their biological * physical environments (air, soil, water) cause evolutionary change by natural selection

F To improve your understanding of the process of biological inquiry which is the scientific method

G To understand the evolution of the design of the organism (behavior, physiology, morphology) as “adapted” over evolutionary time to selection from its total environment

H To understand how physical, biological, and evolutionary processes affect individual organisms and their populations and communities that in turn affect ecosystem structure and function

I To improve your biological literacy

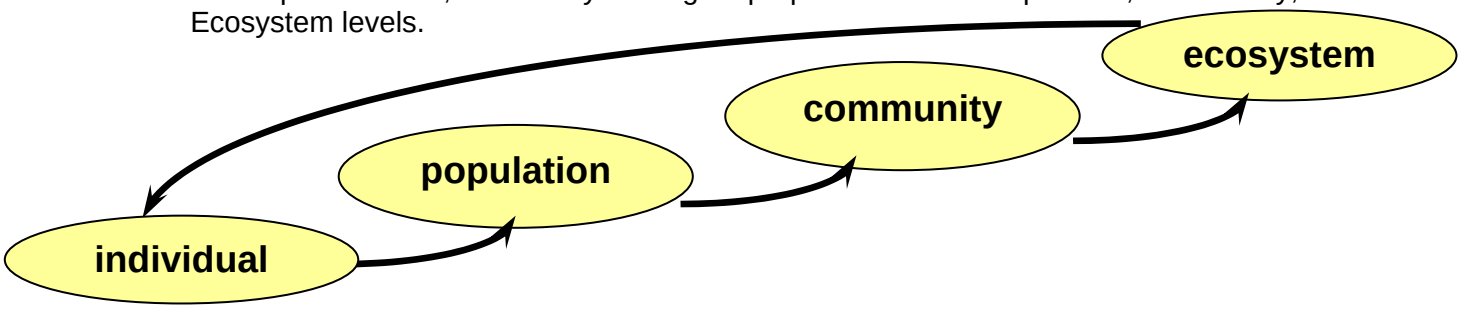
J To understand the dynamics of evolutionary change among all interacting populations due to the forces of natural selection they impose

K To understand the dynamics of population size of all of the interacting populations

L To understand the dynamics of population size

M To understand the dynamics of evolutionary change due to all processes that cause evolution

#6. This question will assess your understanding of the key "emergent properties" at the higher levels of ecological organization that cannot be predicted by knowledge of lower levels alone. In the three spaces below, list the key "emergent properties" for the Population, Community, and Ecosystem levels.

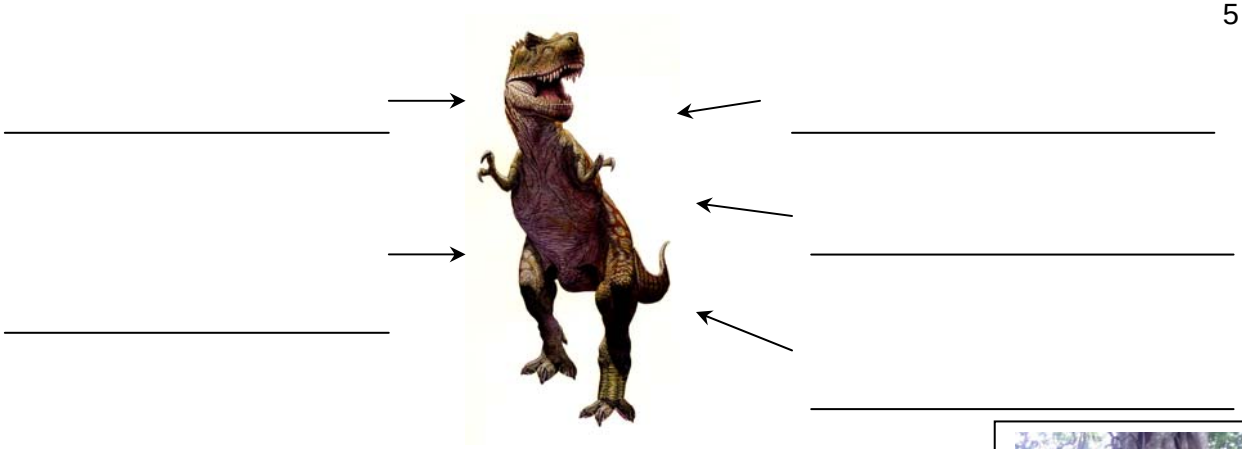


Emergent Properties at the **Individual Level**:	Emergent Properties at the **Population Level**:	Emergent Properties at the **Community Level**:	Emergent Properties at the **Ecosystem Level**:

8 pts

#7. Please write on the lines below what are the five environmental types that directly affect the day to day lives of individual organisms?

5 pts



#8. It is estimated that there are 20-50 times more species of trees per area in a tropical rainforest than in a comparably sized area in Pennsylvania. However, the number of species is only one measure of the ways in which the tropics have higher diversity. Please state two important measures of biodiversity:

1 –

2 –

(4 pts)

#9. Of what economic value is biodiversity to humans? Please list <u>and explain in 1 sentence</u> three different ways in which biodiversity is of economic value. {Hint: this question is NOT about aesthetics, it's about economics.}

1 –

2 –

3 –

(6 pts)

#10. Please offer a brief but concise explanation of how Evolution can occur by natural selection (hint: there three specific conditions).

1 –
2 –
3 –

(6 pts)

#11. By the year 2006, it is predicted that Zebra mussels will have invaded every waterway in the lower 48 states of the USA. List two of the MOST important life individual history characteristics of Zebra mussels that make them such good ecological invaders.

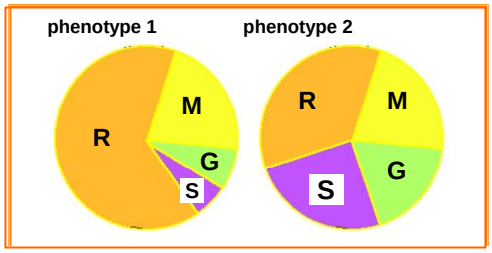
1 –
2 –

(4 pts)

#12. Which of the two phenotypes at right more accurately depicts the energy budget of a good ecological invader, such as the zebra mussels?

"Phenotype 1" or "Phenotype 2" (circle)

Energy Budget Allocation Δ's:



(3 pts)

#13. This question will assess you understanding of the contribution of Konrad Lorentz to our understanding of the evolution of behavior.

Why are these geese following Konrad Lorentz's yellow boots?

(4 pts)

#14. According to the CIA Word Fact Book (http://www.cia.gov), the US population birth rate is 14.13 births/1,000 people, the death rate is 8.34 deaths/1,000 people, and the net migration rate is 3.41 net immigrants/1000 people (as of July 2004). If the US population is about 293 million now (2004), what will be the size of the US population next year?

Please set up the equation to calculate the US population for next year (2004), but you do not need to do any math – just set up the problem and plug in the numbers where they belong.

(6 pts)

#15. Consider the simple logistic model of single species population growth.

$$\frac{1}{N} * \frac{\Delta N}{\Delta t} = r * \left[1 - \frac{N}{K} \right]$$

(a) Please briefly explain IN WORDS what do we mean by "density-dependent" population regulation - how does the equation above include "density-dependence"?

(2 pts)

(b). Draw a little graph below showing the per capita population growth rate (Y) vs. the population size (X) for this model. LABEL the AXES and indicate ALL relevant constants!

(2 pts)

(c). **Without using any math symbols or notation**, explain in words what is the main prediction of this model?

(2 pts)

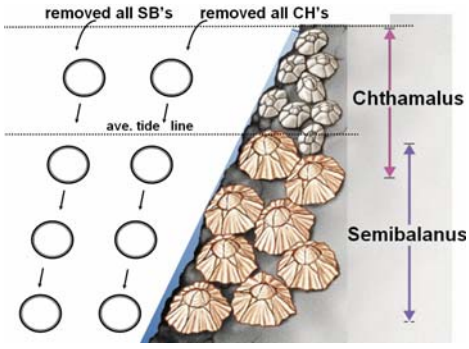
(d). Draw a little graph below showing the population size vs. time beginning with an initially large (N >> K) and with an initially small (N << K) population size for this model. **LABEL THE AXES AND ALL CONSTANTS!**

(4 pts)

#16. This question will assess your understanding of Joe Connell's (1961) studies of competition among two species of barnacles in Scotland. Recall that in nature *Chthalamus* occurs above and *Semibalanus* occurs below the average tide line. Recall also that Connell placed ceramic plates at various heights in the inter-tidal to explore colonization by each species alone (following manual removal of larvae as they settled).

(a) What did Connell observe about the distribution of two barnacle species from his reciprocal removal experiments? Please label the figure at right AND state clearly where did each species grow?

(3 pts.)



(b) What was Connell's interpretation about why these two species of barnacles coexist?

(3 pts.)

(c) What generalities can we draw from this study about the mechanisms of coexistence among competing species in nature? (Please refer to the figure at right in your response.)

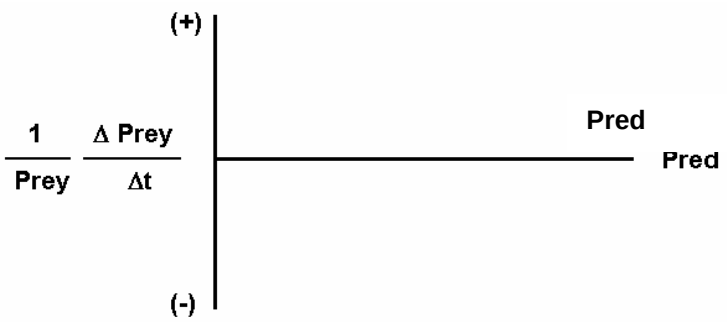
(3 pts.)

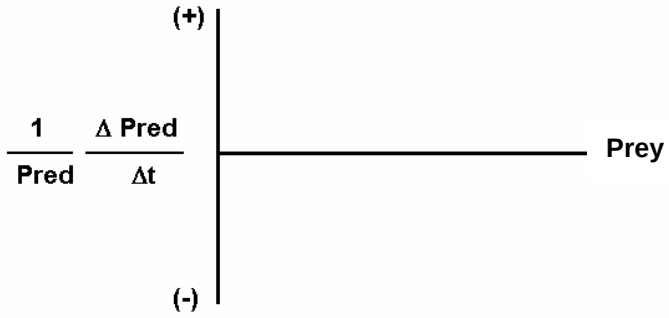
#17. Consider the simple model of the predator-prey interaction:

$$\frac{1}{Prey}\frac{\Delta Prey}{\Delta t} = r_1 - alpha * Pred$$

$$\frac{1}{Pred}\frac{\Delta Pred}{\Delta t} = -r_2 + beta * Prey$$

For each of these equations, sketch the corresponding relationships between growth and density on the axes below – please label ALL constants.

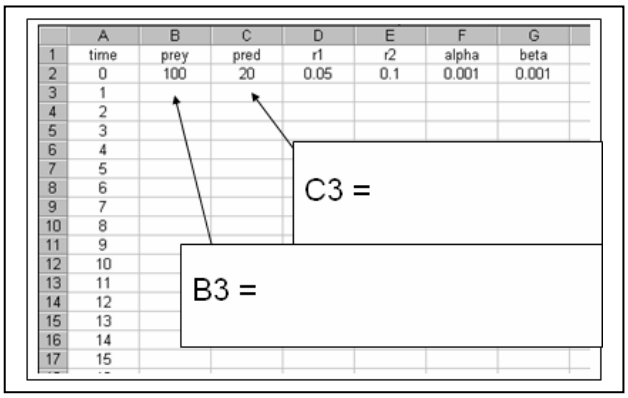




(4 pts)

#18. This question will assess your understanding of how to code the above model in EXCEL. In the box at right below, please enter the exact code that would successfully simulate the above model:

(4 pts)



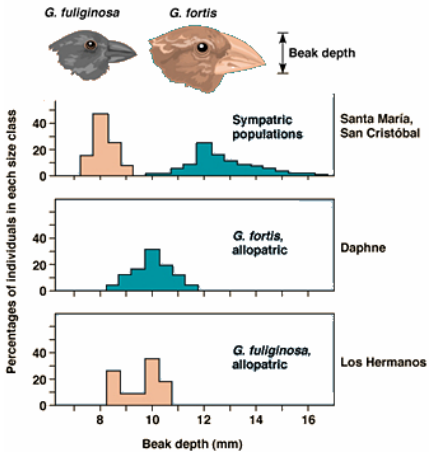
#19. Please briefly explain what is coevolution? Specifically address how coevolution differs from ordinary evolution?

(4 pts)

#20. Please explain how the story of the tarantula and the tarantula hawk wasp might be an example of coevolution of predator and prey.

(4 pts)

#21. Please explain how the story of character displacement in beak size among Galapagos Finches might be an example of coevolution due to competition.

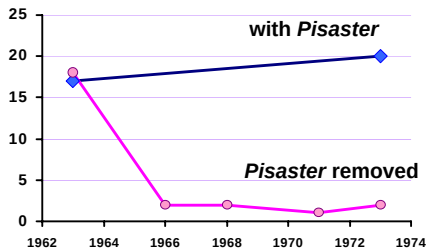


(4 pts)

#22. Please explain how the story of the acacia tree and the acacia ants might be an example of coevolution due to mutualism.

(4 pts)

#23. At right is a diagram of the research results by Robert Paine on causes of species diversity in the intertidal in the Pacific northwest.



***** Please, fill in the blanks with the SINGLE BEST WORD or PHRASE****

The figure at right shows that when the seastar *Pisaster* was removed, the diversity quickly _____.
This occurred because *Pisaster* was a voracious predator on a single species of mussel that was relatively rare when _____. However, without Pisaster, these mussels proliferated, and as a result other species, such as limpets, other bivalves, marine plants, and barnacles were absent because _____. (4 pts)

EXTRA CREDIT QUESTION:

According to Dr. Erick Guerra in his seminar at Widener on 6 December 2004, Radio-loud Galaxies and the Cosmic Microwave Background, and information available on his website, which of the following are likely to be true: (please write true or false in the spaces provided)

_____ massive black holes are at the center of many galaxies,

_____ there is more infra-red radiation coming from deep space than can be accounted for,

_____ the universe will continue to expand forever,

_____ red Doppler shifts of incoming radiation from distant galaxies tell us that these galaxies are receding from us.

(10 pts)

Remember: choose TWO questions out of the choices below. Put a huge "X" across the entire pages of the questions you do not want me to grade.

Question #1. Please use a diagram and briefly explain what is the greenhouse effect? (8 pts)
What are three of the principal greenhouse gasses?

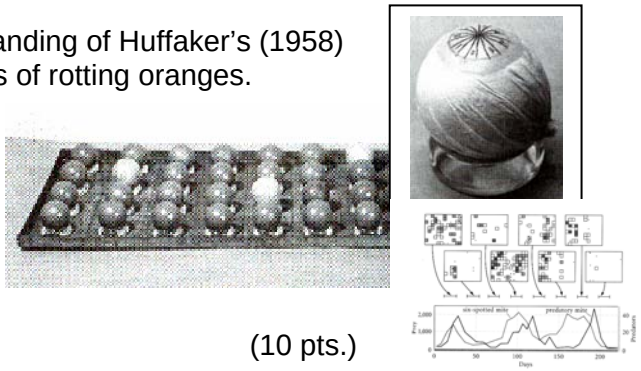
1 – (6 pts)
2 –
3 –

Current models predict that +2-5°C warming is likely by 2100 if nothing is done and atmospheric CO_2 concentration is allowed to double. Please list at least three of the principal predictions for what is likely if global warming on this magnitude were to occur.

1 - (6 pts)
2 -
3 -

Question #2. This question will assess your understanding of Huffaker's (1958) study of predator and prey mites living in trays of rotting oranges.

(a) Please refer specifically to the figures at right and explain what did Huffaker observe about population regulation of the prey and predator mites on individual oranges (within patches) and summed among all oranges (among patches). What is the evidence and likely mechanism(s) for their coexistence?



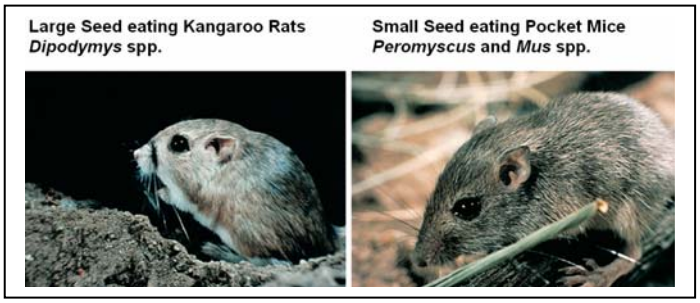
(10 pts.)

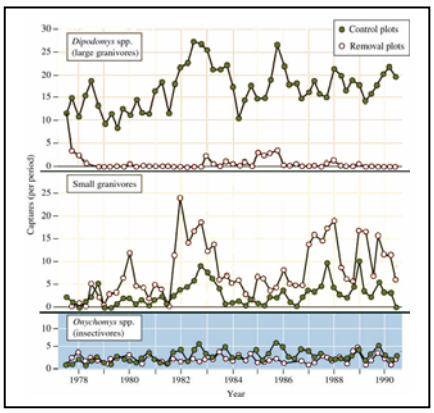
(b) What generalities can we draw from this study about the mechanisms of coexistence among predator and prey species in our ever fragmenting human-impacted landscapes?

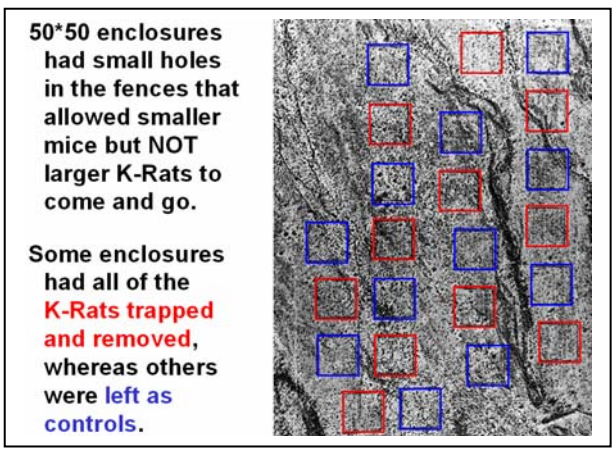
(10 pts.)

Question #3. This question will assess your understanding of Brown's (1999) study of competition among species of desert rodents.

Please examine the figures at right and explain the evidence that the large seed eating rodents (*Dipodymys*) are competing with the small seed-eating mice. Please refer specifically to the data.







(20 points)

Question #4. According to archeologist Gary Rollefson, the dramatic abandonment of the Neolithic settlements such as the 'Ain Ghazal at 6000 b.c. was due to anthropogenic degradation of the fragile Jordan Valley ecosystem.

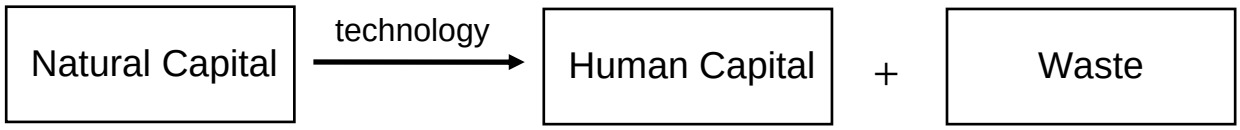
Imagine yourself as one of the members of this community at about 6100 b.c., just prior to its abandonment. What were the major environmental signposts that the 'Ain Ghazal culture and way of life were nearing a collapse?

(10 pts)

Please list 5 major global environmental signposts that <u>our</u> "modern" culture and way of life are not sustainable. (note: precision is not expected for any numbers you give)

(10 pts)

Question #5. This question will test your understanding of ecological economics. Below is a sketch of the relationships between "natural capital," "human capital," and "human-generated waste" that we used in class to describe the present unsustainable economic system (referred to as the "Neolithic" model).



(a). List and briefly explain the three basic assumptions under which this economic model operates:

1 – 2 – 3 - (6 pts)

(b). List and briefly explain the three basic assumptions under which a "sustainable" economic system (or the "post-Neolithic" model) would operate:

1 – 2 – 3 - (6 pts)

(c). Herman E. Daly, an internationally recognized economist, once wrote that "There is something fundamentally wrong in treating the earth as if it were a business in liquidation..." Please briefly explain what he meant by this comment. Exactly what is being liquidated?

(8 pts)

Tropical Rainforest Ecosystem

Urban Ecosystem

Question #4. For this question, choose one of the above two – either the tropical rainforest or the urban ecosystem and answer the question in the space provided.

Circle your choice ⟶ Tropical Rainforest Ecosystem or Urban Ecosystem

Why do we need to understand the structure and function of this ecosystem type? Of what value to humanity is an <u>ecological understanding</u> of this ecosystem type?

Explain and defend your answer using details discussed in class or from your readings. (Use the back of this page if necessary.)

(15 pts.)