I. Short Answer Questions (4-9 points each) DO ALL QUESTIONS

SAQ #1. Please state and briefly explain the three major objectives of this course (listed on page two of the syllabus).

- state and explain objective 1 -
- state and explain objective 2 -
- state and explain objective 3 -
- SAQ #2. Smoking tobacco (and the ammonia compounds added to cigarettes by tobacco companies) has been a widely popular activity in this country for several decades.

In the figure at right appears a typical relationship between the number of cigarettes smoked per day and the risk of lung cancer by the smoker. What is your response to the newspaper reporter who said that "this graph shows that smoking caused these cancers"?

- Please BRIEFLY explain (in 2-3 sentences) -How **valid** is this conclusion?
- SAQ #3. Please briefly explain (2 sentences) why the problem of "multiple causality" makes it so difficult to apply the standard hypothetico-deductive process discussed in class to research questions in evolutionary ecology.

5 pts.

SAQ #4. Please **list** the principal strengths and weaknesses of **controlled laboratory experiments** to understand ecological phenomena. strengths weaknesses:

5 pts.

- SAQ #5. This question will assess your understanding of ecological energy flow (please refer to the figure on the previous page). For each question, please write down the correct number or numbers from the figure. Where appropriate, express the answer as a sum, product, quotient, etc., but you do not need to use a calculator to solve any equations.
 - (a). Net primary productivity (which is defined as gross productivity minus metabolic expenditure) for this ecosystem is numerically equal to what?
 - (2 pts)
 - (b). Gross primary productivity for this ecosystem is numerically equal to what?
 - (c). The ecological efficiency of net primary productivity for this ecosystem is numerically equal to what?
 - (d). The ecological efficiency of "insects" for this ecosystem is numerically equal to what?

(2 pts)

4 pts.

(2 pts)

SAQ #6. Take a close look at the box for "bacteria" which is the primary category of decomposers in this ecosystem. What's missing?



(3 pts)

(3 pts)

(3 pts)

- SAQ #7. How might the problem of temporal or time scale pose a challenge to the accuracy of THIS ecosystem model? Please briefly speculate.
 - 5 pts.
- SAQ #8. Please use a little diagram AND briefly explain why the coastal areas of the Pacific northwest (e.g., around Seattle, WA) are so rainy and therefore have such vast forests?

6 pts.

SAQ #9. This question will test your understanding of the coriolis effect. If the Earth were a perfect cylinder rotating exactly on its cylindrical axis (see sketch), would there be a deflection of a northbound air mass starting at the equator, and if so, would it deflect to its left or its right?

Please briefly explain WHY.

6 pts.



SAQ #10. Data from a census of tree species include 40 trees of species A, 30 of species B, and 10 each of species 3, 4 and 5 (note that the total number of species is 5 and the total of individuals is 100). The equation for the Shannon Diversity Index, H',

$$H' = -\sum_{i}^{S} p_i^* \ln(p_i)$$

(for which p_i is the proportion of data from the ith species, and S is the total number of species)

...what is the diversity of species present? Please set up the problem, i.e. write out the equation for diversity, but you need not solve it numerically.

(5 pts)

- SAQ #11. PLEASE SELECT ONE of the two questions below to answer for this question:
 - a. According to analyses in Costanza et al (1997), the "ecosystem services" of the natural world are greatly undervalued. What are some of the major services, and what is the total approximate annual value of all of these services combined?

OR

b. According to analyses in Costanza et al (1997), the "ecosystem services" of the natural world are greatly undervalued. Stiling notes that "the majority of these services are currently outside of the market system" (these are called market externalities). What does this mean and what would happen to the prices of commodities if these services were included in the market?

SAQ #12. PLEASE SELECT ONE of the two questions below to answer for this question:

- a. What is an inverted biomass pyramid? Why doesn't this violate the laws of thermodynamics
- OR b. Charles Elton almost 70 years ago noted that rarely did ecological communities contain more than 5 or 6 trophic levels. Why might food webs be capped at 5 or 6 levels?

I. Longer Answer Questions (10 points each)

- LAQ #1. This question will assess your understanding of "ecological ethics" as presented in the preface and introduction of Stilling's text and in class.
- (a). According to anthropologists studying Easter Island, Polynesians colonized the island by about 400 AD, but by 1500 AD, they had thoroughly deforested and degraded the landscape. Further writes Stiling, "once the population exceeded the carrying capacity of the island, warfare was rampant, as were chronic cannibalism and slavery" (p. 2).

Q - What does this text imply about whether scientific disciplines should or should not include morality and moral positions?

(5 pts)

(b). Stiling lists some of the effects of humans upon our world today including acid rain, global atmospheric imbalances in CO₂ and N, pesticide residues, extinctions, etc. and notes that "Now, more than ever, there is strong impetus to understand how natural systems work, how humans change those systems, and how in the future we can reverse these changes" (p. 3).

Q - What does this text imply about whether scientific disciplines should or should not include morality and moral positions?

(5 pts)

- LAQ #2. Please briefly explain the key differences between Inductive and Deductive reasoning in the scientific method. In addition, **please use a figure** to illustrate your explanation.
- LAQ #3. Please diagram and label the two basic "functional characteristics", i.e. energy flow and biogeochemical cycling, of an ecosystem. In addition to your diagram, please also write somewhere on the page what are the basic differences between the paths of energy and biogeochemicals in an ecosystem, i.e. highlight the unique differences between them. (Please OMIT OMNIVORES for simplicity) functional characteristic 1: energy flow -

(5 pts) functional characteristic 2: biogeochemical cycling -(5 pts)

LAQ #4. Please state what are the two principal objectives of individual ecology.

state objective 1 - (3 pts) state objective 2 - (3 pts) How can the study of individual ecology contribute to understanding concepts in ecosystems ecology such as the limitations on food chain length. What exactly can individual ecology contribute to understanding why food chains are generally so short? (4 pts) LAQ #5. This question will further assess your understanding of individual ecology.

a. Please state why the concept of the "ecological energy budget" is critical to so many research questions in individual ecology. (3 pts)

- b. Please define the components of an individual energy budget. [hint: what do M, G, S, and R represent in the figure below.] (4 pts)
 M = G =
 - S =
 - R =
- c. For an ectothermic animal such as a lizard, how might environmental constraints and limitations affect the total **size** of its energy budget (EB) from the environmental types listed below?

how might the resource environment limit total EB size? -	(2 pts)
ow might the biophysical environment limit total EB size? -	(2 pts)
how might the social/demographic environment limit total EB size? -	(2 pts)
ow might the predation environment limit total EB size? -	(2 pts)

- LAQ #6. Data from a recent census of tree species from a woodlot include 45 individuals of species 1, 35 of species 2, and 10 each of species 3 and 4 (note that the total number of individuals is 100).
 - (a). What is the total number of species present? _____
 - (b). According to the equation for the Shannon Diversity Index, H',

 $H' = -\sum_{i}^{S} p_i^* \ln(p_i)$ (for which p_i is the proportion of data from the ith species, and S is the total number of species)

- ...what is the diversity of species present? Please set up the problem, i.e. write out the equation for diversity, but you need not solve it numerically.
 - (4 pts)

(2 pts)

(c). Please briefly explain what are the advantages of using a diversity index, such as H', to estimate biodiversity rather than simply using the number of species censused?

(6 pts)

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