Science Olympiad
Ecology Free Response Packet
Seven Lakes Invitational

Team Name: _____

Team Number: _____

Directions:

- This packet contains all free response questions. You may write in this packet.
- There is no penalty for wrong answers. If you do not know a question, write a reasonable answer and you may earn partial credit.
- For free response questions, you are not required to show work, but you may earn partial credit from work if your final answer is wrong.
- Split your time between this packet and the multiple choice questions. You have 50 minutes to complete both the free response questions and the multiple choice questions.

For grading use only

Page:	2	3	4	5	6	7	8	Total
Points:	21	19	8	9	6	9	19	91
Score:								

Open Ended Questions

1. (3 points) Birds have a type _____ Survivorship curve, trees have a type _____ Survivorship curve, and elephants have a type _____ Survivorship curve.

2. (3 points) During immobilization of the phosphorus cycle, _____ compounds are converted to _____ compounds by _____.

3. (2 points) A hypothetical ecosystem has 5 species, each of which has 10 individuals. What is the Shannon Diversity Index of this ecosystem? _____

4. (1 point) What is the value of the species evenness for the ecosystem in the previous question? There are multiple ways to calculate species evenness, but use the equation with the Shannon Index for this question. _____

5. (2 points) The bioremediation process that is performed at the original site of contamination is known as _____ remediation. The bioremediation process that is performed on contaminants after they are removed from the original site is known as _____ remediation.

6. (2 points) What is the theory that describes how individuals have a tendency to deplete a natural resource out of self-interest? _____

7. (4 points) A highway will be built in a region, splitting the habitat in half. What is this process known as? What are some ways it might affect a population living in that area? Answer with at least 3 different effects on the population.

8. (4 points) The spread of taiga into tundra biomes would have what effect on carbon dioxide concentrations and temperature? Why?

9. (6 points) Define both fundamental and realized niche. Is it possible that the realized niche is larger than the realized niche. Why?

10. (6 points) Provide 2 characteristics and 1 example of r-selected organisms and K-selected organisms each.

11. (3 points) In one sentence, define the invasion paradox.

12. (4 points) Explain briefly (1 sentence each) the difference between alpha diversity, beta diversity, and gamma diversity.

Use the following diagram to answer the next three questions.

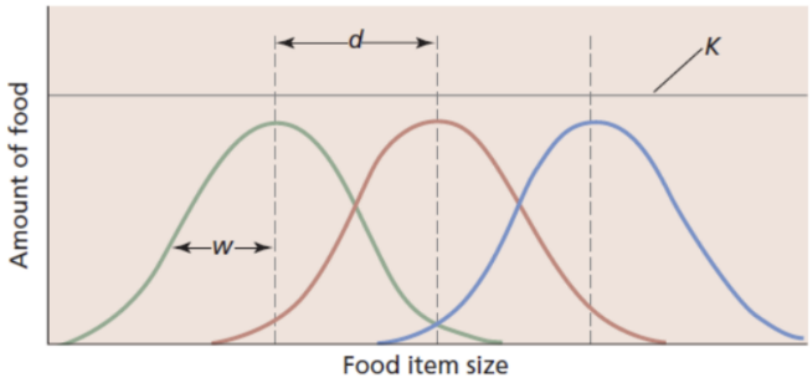


Figure 1: Food item size vs. amount of food of three different competing species

13. (2 points) Which region of the graph above represents the food sizes that all three species eats?

14. (3 points) Explain how increasing the variable "d" affects the chances of coexistence between three competing species.

15. (3 points) Explain how increasing the variable "w" affects the chances of coexistence between three competing species.

The latitudinal diversity gradient states that lower latitudes (the equator and tropics) are more biologically diverse than higher latitudes (polar regions). This has proven to be the case for all types of biodiversity, including functional diversity, genetic diversity, and species diversity. Answer the following three questions based on this knowledge of the latitudinal diversity gradient.

16. (2 points) Some ecologists have proposed the mid-domain effect as the reason behind the latitudinal diversity gradient. To explain the mid-domain effect, imagine a box of pencils being shaken up (each pencil representing a species range). Most of the pencils will overlap at the center of this box. What is the most obvious flaw in this hypothesis? (Hint: Think about the cardinal directions).

17. (3 points) Another hypothesis for the latitudinal diversity gradient is called the time-integrated hypothesis. Explain BRIEFLY how repeated ice ages and glaciations in the poles could help explain the latitudinal diversity hypothesis. (Hint: "Time" is evolutionary).

18. (4 points) Analyze the contour plot of the number of marine brachiopod genera over time in different latitudes. Does this contour plot prove, disprove, or not indicate anything about the hypothesis suggested in the previous question?

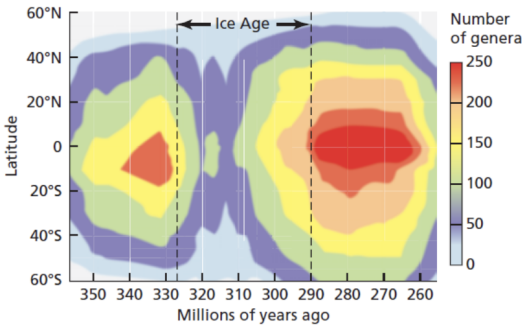


Figure 2: Brachiopod genera diversity

Hutchinson made another key insight in regards to the ecological niche when studying different species of desert mice that use similar resources. Desert mice species that were similar, except in the sizes of the food they eat, differed by a constant size ratio: a factor of 1.3 in length and 2.0 for body mass. This was true across different deserts, as shown by the data recorded below. Use this information to solve the next two questions.

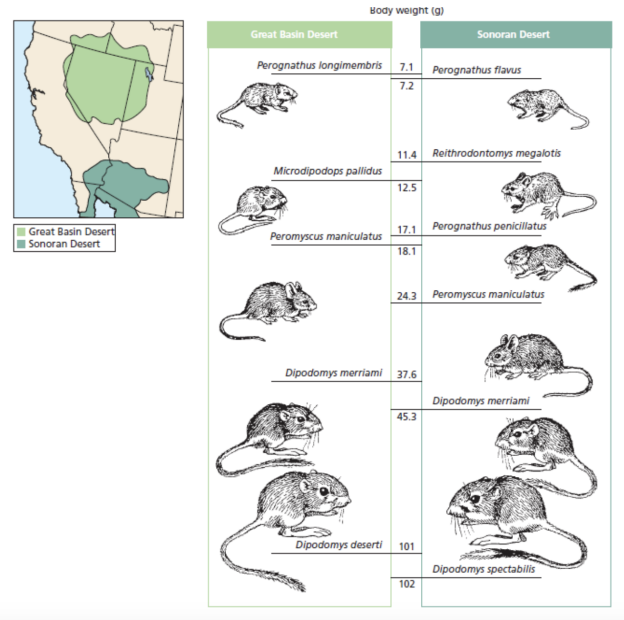
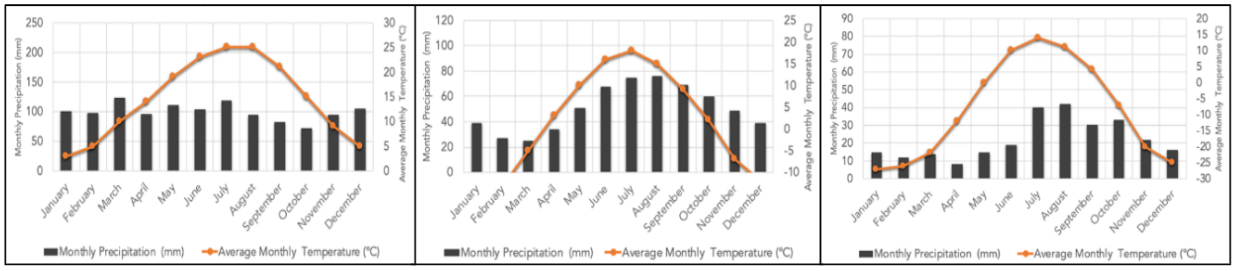


Figure 3: Mice of two different deserts

19. (3 points) Explain briefly (1 sentence or less) why the differences in body size are regular as opposed to irregular, even amongst mice of different desert ecosystems.

20. (3 points) Objects in nature that are not biological in origin also exhibit size ratios of 1.3. Does this strengthen or weaken the idea that the Hutchinsonian ratios in the Great Basin and Sonoran desert are a result of niche differentiation? Briefly justify.

A. B. C.



21. (3 points) Match the temperature and rainfall graphs above to tundra, taiga, and deciduous forest.

Use the following table for the next 11 questions:

Species	Number of Individuals
Jack Pine	15
White Spruce	267
Quaking Aspen	105
Black Spruce	31
Paper Birch	45

22. (1 point) What is the total abundance of this ecosystem?

23. (2 points) Berger Parker Dominance is calculated with the following formula. Calculate and interpret the value of the Berger Parker Dominance index for this ecosystem. Answer to three decimal places.

$$d = \frac{N_{max}}{N}$$

where N is the number of individuals and N_{max} is the number of individuals in the most abundant species.

24. (1 point) What is the species richness of this ecosystem?

25. (2 points) What is the value of the Shannon Diversity Index for this ecosystem.

26. (2 points) Calculate the value of evenness (E_H) using the Shannon Diversity from the previous question. If you did not answer the previous question, assume that the Shannon Diversity was 1, and solve using this number.

27. (5 points) MacArthur (1965) suggested that we measure Shannon Diversity as e^H, where H is the Shannon Diversity and e is Euler's number ($e \approx 2.718$). Calculate and interpret the value of e^H with units. You may assume $H = 1$ if you did not answer the previous questions.

28. (2 points) What is the biggest advantage of measuring transforming H in this way?

29. (2 points) Calculate e^H for this community if each species has exactly 50 individuals.

30. (3 points) Calculate the inverse Simpson Index with units. Use the formula below to calculate the index.

$$D = \frac{1}{\sum_{i=0}^{S} p_i^2}$$

where S is the number of species and p_i is the relative abundance of the species.

31. (2 points) Calculate the Simpson Evenness of this ecosystem. Use the formula below to calculate the index.

$$E_D = \frac{D}{S}$$

32. (3 points) Is E_D higher, lower, or the same as E_H. Explain why this is the case.