

Section A: General Ecology

- (1 point) What is the process where carbon dioxide and water are used to create sugar known as?
A. Photosynthesis B. Respiration C. Evaporation D. Acidification
- (1 point) Which of the following groups are not autotrophs?
A. Plants B. Cyanobacteria C. Fungi D. Algae
- (2 points) Fish produce many offspring each breeding cycle. Most eggs die almost immediately, so very few make it to maturity. This is an example of a(n):
A. K-selected species B. r-selected species C. Producer D. Endotherm
- (2 points) Freshwater fishes constantly drink water to maintain a constant water potential. This process makes these fish an example of a(n):
A. K-selected species B. r-selected species C. Osmoconformer D. Osmoregulator
- (1 point) A frugivore would likely have a diet mostly composed of:
A. Fruit B. Seeds C. Grasses D. Leaves
- (1 point) A saprotroph would likely have a diet mostly composed of:
A. Small animals B. Leaves C. Aquatic plants D. Decaying organic matter
- (1 point) What type of survivorship curve would be best represented by an elephant?
A. Type I B. Type II C. Type III D. Type IV
- (6 points) Describe the difference between r-selected and K-selected species. Provide an example of each.

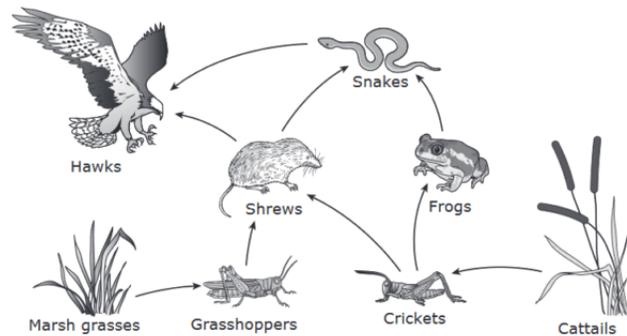
- (1 point) How much energy (in percent) is lost, if any, between trophic levels?
A. 0% B. 10% C. 20% D. 50% E. 90% F. None of the above
- (3 points) Which law states that two species cannot coexist if they are in the same ecological niche? (Hint: there are two names for this law)

- (3 points) What is the division of resources by species with similar niches is known as?

- (2 points) Giant Pandas are used by a variety of organizations to raise support for conservation. Which of the following best describes Giant Pandas?
A. Keystone species B. Indicator species C. Flagship species D. Foundation species
- (2 points) Common loons are only found in clear lakes of low turbidity. They are an example of a(n):
A. Keystone species B. Indicator species C. Flagship species D. Foundation species
- (2 points) Invasive species generally have _____ diets.
- (2 points) In the Amazon Rainforest, special groves of trees known as devil's gardens can be found. In these, ants and trees live together. The trees provide shelter for the ants, and the ants kill other trees nearby. What type of interaction is occurring between the ants and the trees?
A. Comensalism B. Mutualism C. Parasitism D. Competition

16. (2 points) Is the above example an example of symbiosis?
A. Yes B. No
17. (2 points) In coral reefs, some species of shrimp can be found eating parasites off of larger fish. What type of interaction is occurring between the shrimp and the fish?
A. Predation B. Parasitism C. Mutualism D. Comensalism
18. (2 points) Is the above example an example of obligate symbiosis?
A. Yes B. No
- Use the figure below for the next five (5) questions.

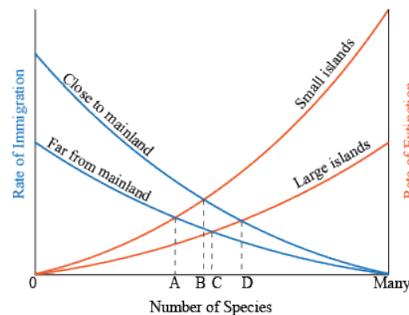
A partial wetland food web is shown.



A typical marsh food web. Credit: A&M University

19. (1 point) Which of the following organisms is a quaternary consumer?
A. Shrews B. Snakes C. Frogs D. Hawks
20. (1 point) Which of the following organisms is a primary consumer?
A. Cattails B. Crickets C. Frogs D. Snakes
21. (2 points) If 100,000 kilojoules of the sun's energy enter the ecosystem, then how much energy do the frogs receive (in joules)? Assume that the producers are 1% efficient.
A. 10 B. 100 C. 1,000 D. 10,000 E. 100,000
22. (3 points) Imagine that most of the marsh grass was cut down, leaving only a small patch of brown grass. Grasshoppers use this grass to camouflage, and range in color from green to brown. As a result of the clearing of grass, most of the grasshoppers become more brown as generations pass. This is an example of:
A. Stabilizing selection B. Disruptive selection C. Directional selection
23. (2 points) If all of the hawks were removed from the community, which of the following populations would most likely decrease?
A. Shrews B. Snakes C. Cattails D. Grasshoppers
24. (1 point) Which nutrient cycle does not have a major atmospheric component?
A. Phosphorus B. Nitrogen C. Hydrological D. Carbon
25. (1 point) About how much of the Earth's freshwater is stored in glaciers and ice caps?
A. 2% B. 40% C. 60% D. 70% E. 80%
26. (1 point) A water molecule above the ocean turns into a gas and then moves through the air to be above land. What is the name of the first of the two processes described?
A. Transpiration B. Evaporation C. Precipitation D. Infiltration

27. (2 points) What is the name of the second of the two processes described in the previous question?
A. Percolation B. Guttation C. Interception D. Advection
28. (2 points) What is the largest carbon sink on Earth?
A. Soil B. Organic Matter C. The Atmosphere D. Oceans
29. (1 point) A tree captures carbon dioxide molecules and stores them in its trunk. This is best described as an example of:
A. Evaporation B. Respiration C. Carbon Sequestration D. Decomposition
30. (2 points) The process of gaseous nitrogen being converted to ammonia or other nitrogenous compounds by organisms is known as:
A. Denitrification B. Nitrification C. Nitrogen fixation D. Decomposition
31. (2 points) Ammonification is carried out mostly by:
A. Fungi B. Algae C. Trees D. Mosses
32. (2 points) Which group of plants have special structures which house nitrogen fixing bacteria?
A. Orchids B. Roses C. Cacti D. Legumes
33. (2 points) Which of the following modes of photosynthesis would an agave, a desert dwelling plant, most likely use?
A. C_3 B. C_4 C. CAM D. None of the above
34. (2 points) Beech trees produce special chemicals that inhibit the growth of other nearby plants. This would likely result in which distribution pattern?
A. Clumped B. Uniform C. Random
35. (3 points) Which of the following is not a density dependant factor?
A. Disease B. Competition C. Food D. Waste
- Use the below graph for the next two (2) questions.**



The Island Equilibrium Model

36. (1 point) The intersections of the lines corresponds when the community is:
A. In equilibrium B. Disrupted C. Unsustainable D. None of the above
37. (1 point) Which of the intersections represents when a small island far from the shore is in the above state?
A. A B. B C. C D. D
38. (2 points) Which of the following types of estuary is Chesapeake Bay?
A. Fjord B. Bar Built C. Coastal plain D. Tectonic
39. (2 points) Estuaries are also known as _____ of the sea.

40. (2 points) The phrase “Lake Superior never gives up her dead” is a common saying in regards to Lake Superior. Why don’t dead bodies float to the surface specifically in Lake Superior?
A. The cold prevents growth of bacteria that produce gases. B. The cold freezes the water
C. The low salt content reduces buoyancy D. The cold makes the bodies more dense
41. (2 points) A trophic state index of 43 best describe which type of lake?
A. Oligotrophic B. Mesotrophic C. Eutrophic D. Hypereutrophic
42. (3 points) A hypereutrophic lake would likely contain:
A. High trout populations B. High nutrient levels C. Low turbidity D. None of the above
43. (2 points) Approximately how much of the world’s surface freshwater is found in the Great Lakes? (Provide a percentage, guesses within 5% will be given half credit) _____
44. (6 points) List and give an example of the 4 types of ecosystem services

45. (4 points) List 4 services estuaries provide.

46. (2 points) Briefly explain the difference between interspecific competition and intraspecific competition.

47. (3 points) What is the most common distribution pattern, and why?

48. (3 points) A volcano erupts and smothers the surrounding ecosystem. The soil is all covered in igneous rock, so no life has colonized it yet. What is the name of the process that follows, and what are the likely first species to colonize the land? What are these species called?

Use the following information for the next 3 questions.

Lycanrocs have 3 different forms: midday, dusk, and midnight. Many people pretend that this is due to the time that they evolve, but it is actually due to their genes! The t^d allele, when homozygous, creates midday Lycanrocs, while the t^n allele, when homozygous, creates midnight Lycanrocs. When heterozygous, the alleles create dusk Lycanrocs. The population of Lycanrocs is in Hardy-Weinberg equilibrium.

49. (5 points) What are the 5 requirements for a population to be in Hardy-Weinberg equilibrium.

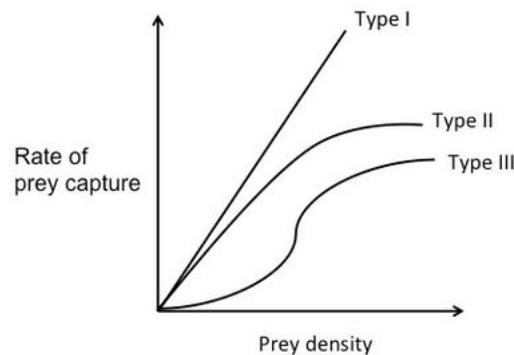
50. (5 points) If the number of midday Lycanrocs is 345 and the total number of Lycanrocs is 1786, what is the frequency of the 2 alleles in this population? Write your answers rounded to the nearest 3 decimal places.

51. (3 points) Using information from the previous question, what is the proportion of the population that is dusk Lycanrocs?

52. (5 points) DumpsterVil has a population of 10,000 individuals. Each year, it grows by 6.3%. How many years will it be until the population exceeds 100,000? Round to the nearest year. Assume that the population grows geometrically, and that there is no immigration or emigration.

53. (3 points) Briefly explain the difference between species richness and species diversity.

54. (5 points) Explain why seasonal turnover occurs in freshwater lakes. List 2 benefits of seasonal turnover.



Credit: Staddon, J.E.R. "Foraging and Behavioral Ecology."

Using the graph above, write the functional response best described by each predator's behavior.

55. (2 points) _____ Predator A eats prey randomly and takes 10 minutes to eat each prey animal. At low densities, it increases its rate of capture very quickly. At high densities, it is limited by its slow handling time.
56. (2 points) _____ Predator B eats only prey Z, and spends much of its time searching for food at low prey densities. At high densities, it is not limited by anything and still eats the same proportion of the prey population as at low densities.
57. (2 points) _____ Predator C is a generalist that constantly changes prey. At low prey densities, it increases its rate of capture, slowly at first. At higher densities, it slows down its rate of prey capture and frequently switches prey.
58. (4 points) Which of the functional responses is the most common, and why?

Use the below table for the next question

Species	Forest	Desert	Grassland
A	✓		
B	✓	✓	✓
C	✓		✓
D	✓	✓	✓
E	✓	✓	✓
F	✓		✓
G		✓	
H	✓	✓	✓
I	✓		✓
J	✓		
K	✓		✓
L	✓	✓	✓
M		✓	
N		✓	
O		✓	✓
P	✓		✓
Q			✓
R			✓
S			
T	✓		✓

59. (18 points) Solve for the α , β , and γ diversity of the above ecosystems. You do not have to show work, but you may be given partial credit if your process is shown. A ✓ indicates that the species is found in the ecosystem. You may assume that all 3 ecosystems are in the same region.

60. (25 points) Calculate the abundance, species richness, species evenness (also known as Pielou index), Shannon Index, Menhinick Index, Margalef Index, and Simpson Diversity (Also known as Inverse Simpson Index) for the below hypothetical community. Write your answers rounded to 3 decimal places. You do not need to show work, but you may be awarded partial credit for work.

Species	Number
A	16
B	33
C	3
D	48

Where S is the species richness and N is the abundance:

Margalef Index

$$D = \frac{S-1}{\ln N}$$

Meninick Index

$$D = \frac{S}{\sqrt{N}}$$

61. (2 points) If all species were equally likely, what would the Shannon Index be?

62. (3 points) Based only off of the Shannon Index, is the above community diverse? Why?

Section B: Human Impacts on the Environment

63. (1 point) Which of the following is most likely not a limiting nutrient in aquatic environments?
A. Iron B. Nitrogen C. Phosphorus D. Aluminum
64. (1 point) Which of the following has a slight cooling effect on the atmosphere?
A. Ozone B. Sulfur Dioxide C. Carbon Dioxide D. CFCs
65. (1 point) Which of the following is known to deplete the ozone layer?
A. Methane B. Carbon Dioxide C. CFCs D. Water Vapor
66. (2 points) Which nutrient, when in excess amounts in water supplies, can cause methemoglobinemia, or blue baby syndrome?
A. Nitrites B. Nitrates C. Ammonia D. Ammonium
67. (1 point) A factory dumps toxic waster into a river. This is an example of which type of pollution?
A. Point source B. Nonpoint source C. Thermal D. Light
68. (1 point) Water from rain runs over a farm and picks up excess fertilizer, which enters a nearby river. This is an example of which type of pollution?
A. Point source B. Nonpoint source C. Thermal D. Light
69. (2 points) A stream next to a reactor has warm water from the reactor constantly being added. This warm water increases the productivity of the plant species in the water. This scenario is best described as an example of:
A. Thermal pollution B. Thermal enrichment C. Thermal enhancement D. Light pollution
70. (2 points) Ocean garbage patches are composed of mostly what material?
A. Wood B. Rubber C. Large plastics D. Microplastics
71. (2 points) At or below what dissolved oxygen value is water considered hypoxic?
A. <1 mL/L B. 1 mL/L C. 2 mL/L D. 3mL/L
72. (3 points) Fish A is a fish species which is being hunted by humans for food. Humans have caught almost all of the adults of breeding age, so the species is having trouble maintaining its population. This is best an example of:
A. Growth overfishing B. Recruitment overfishing C. Ecosystem overfishing
73. (2 points) Which of the following is not a benefit of mangroves?
A. Coastal protection B. Water filtration C. Reduced transpiration D. Tourism
74. (1 point) Which of the following areas has had a net increase in mangrove area over the last 20 years?
A. Northwest Mexico B. Southeast Asia C. Northeast Brazil D. Sri Lanka
75. (7 points) A rain droplet you sampled has an OH^- concentration of 5.34×10^{-12} . What is the pH of this rain droplet? Would this be considered acid rain, and why?

76. (3 points) Eutrophication of aquatic and marine environments results in what condition, and why?

77. (6 points) Explain the difference between natural eutrophication and cultural eutrophication.

78. (1 point) List one direct cause of ocean acidification.

79. (5 points) Write out the main 3 chemical reactions of ocean acidification. (hint: which molecule enters water from the atmosphere). What effect does this have on the shell formation of corals?

80. (4 points) Which 2 gases are the main causes of acid rain, and what are 2 sources of each of them?

81. (7 points) Explain how temperature affects dissolved oxygen concentration in freshwater. Name the principle that most directly influences the way dissolved oxygen changes with water temperature.

Section C: Solutions to Human Problems

82. (3 points) The addition of iron into the oceans to increase biological productivity is known as:

83. (4 points) Willow has the ability to absorb large amounts of cadmium from soil. Willow is a(n) _____ for cadmium and a plant used for the process of _____ (be specific).

84. (4 points) Describe the process of enhanced bioremediation.

85. (1 point) Which of the following is not an advantage of a bioswale?

- A. Increasing infiltration to groundwater B. Concentrating stormwater C. Stormwater storage
D. Removing debris and pollution

86. (1 point) Which of the following is not a type of green infrastructure?

- A. Artificial Lawns B. Permeable Pavement C. Rain Gardens D. Downspout Disconnection

87. (1 point) Which of the following are used industrially to desulfurize waste?

- A. Haber Bosch Process B. Wet Scrubbers C. Aeration basins D. Flocculation

88. (4 points) Briefly describe the Urban Heat Island effect, and 2 ways to mitigate its effects.

89. (1 point) Which city's fire in 1969 led to the passing of the Clean Water Act?

- A. Cleveland B. New York C. Austin D. Boston

90. (2 points) What is the difference between *in situ* and *ex situ* bioremediation

91. (2 points) Which of the following is not a type of phytoremediation?

- A. Rhizofiltration B. Phytoextraction C. Phytoabsorbance D. Phytodegradation

92. (2 points) Over the last 25 years, sun-blocking aerosol levels have _____ steadily.

93. (2 points) The use of fungi in bioremediation is:
A. Mycoremediation B. Phytoremediation C. Dendroremediation D. None of the above

Matching

Match each of the following environmental laws or agreements to its description. Use each of the following choices for the next fourteen (14) problems. You will only use each answer once.

- (a) Clean Air Act
 - (b) Clean Water Act
 - (c) Safe Drinking Water Act
 - (d) Comprehensive Environmental Response, Compensation, and Liability Act
 - (e) Pollution Prevention Act
 - (f) Oil Pollution Act
 - (g) Toxic Substances Control Act
 - (h) Federal Insecticide, Fungicide, and Rodenticide Act
 - (i) Endangered Species Act
 - (j) Marine Mammal Protection Act
 - (k) Kyoto Protocol
 - (l) Montreal Protocol
 - (m) Madrid Protocol
 - (n) Paris Agreement
94. (1 point) _____ Prohibits the killing, capture, and collecting of marine species in US waters.
95. (1 point) _____ The first piece of legislature controlling air pollution passed in the US.
96. (2 points) _____ A global agreement to protect the natural environment of Antarctica.
97. (2 points) _____ Established a "Superfund" to clean up sites contaminated with toxic substances.
98. (1 point) _____ Created a fund that could be used to clean up oil spills.
99. (1 point) _____ Regulates discharges of pollutants into surface waters.
100. (2 points) _____ 1997 global convention where countries agreed to lower greenhouse gas emissions.
101. (2 points) _____ Focused on reduction of pollution at the source through changes in US industry.
102. (1 point) _____ Addresses production, importation, use, and disposal of toxic substances in the US.
103. (1 point) _____ Created a program for conservation of threatened or endangered species
104. (2 points) _____ Global agreement to limit global warming to under 2 degrees Celsius.
105. (1 point) _____ Regulates the drinking water supply and protects drinking water sources.
106. (2 points) _____ International agreement that regulates release of ODPs (Ozone depleting substances).
107. (1 point) _____ Regulates the production, sale, and consumption of pesticides in the US.