

Science Olympiad
Ecology Key
Seven Lakes Invitational



Team Name: _____ **KEY** _____

Team Number: _____

Directions:

- This test is a class set. **DO NOT WRITE ON THIS TEST**
- This test uses a scantron to grade multiple choice questions. Multiple choice questions have one correct answer unless otherwise specified. Allocate your time so that you have enough time to complete the scantron. You will not have additional time to complete the scantron.
- There is no penalty for wrong answers. If you do not know a question, choose a random answer.

General Principles of Ecology

1. (1 point) Which of the following factors contribute to population growth (select all that apply)?
A. Birth B. Death C. Emigration **D. Immigration**

Use the following food chain to answer the next six questions.



2. (1 point) Which of the following is a primary producer?
A. Sedges B. Snowshow hares C. Foxes D. Wolves
3. (1 point) Assume that the 10% rule is followed exactly in this question. The sedges receive 5670 kJ of energy from the sun and use 1% of it. How much energy is lost between the sun and the foxes (to the nearest whole number)?
A. .567 J B. 567 J C. 5670 J **D. 5669433 J** E. 5669944 J
4. (1 point) Which of the species in the population would likely have the smallest population?
A. Sedges B. Snowshow hares C. Foxes **D. Wolves**
5. (1 point) If the population of the snowshoe hares is reduced due to a new disease, which of the following populations would decrease? (select all that apply)
A. Sedges B. Snowshow hares **C. Foxes** **D. Wolves**
6. (1 point) The foxes compete with other individuals in their species for food. This is best characterized as:
A. Interspecific competition
B. Intraspecific competition
C. Bispecies competition
D. Specific competition
7. (1 point) What is the species richness of this ecosystem?
A. 2 B. 3 **C. 4** D. 5 E. 6
8. (2 points) In this same ecosystem, there are rare bright blue sedges with two copies of a mutant allele. If only one mutant allele is present, the sedges turn light blue. The population is 1853 individuals, and 14 individuals are bright blue. What is the allele frequency of the dominant allele? Assume that the population is in Hardy-Weinberg Equilibrium and that the trait of color is controlled by a single gene.
A. 8.7% B. 15.9% C. 37.4% D. 62.6% **E. 91.3%**
9. (2 points) Approximately how many light blue sedges are in the ecosystem from the previous question?
A. 158 **B. 294** C. 693 D. 1544 E. 1853
10. (1 point) On a farm, a certain species of insect feeds on a grass field with a total energy of 3300 calories. Given that 490.05 calories were used by the insects for production, and that they have a gross production efficiency of 33%, then what is the exploitation efficiency of these insects? Round to the nearest integer.
A. 15% B. 85% **C. 45%** D. 67% E. Impossible to determine
11. (1 point) On the same farm, there is also a species of chicken that feeds on the insects. Given that the exploitation efficiency of these chickens is 75%, and their net secondary production efficiency is 35% then how many calories are found in the biomass of these chickens? Round to the nearest integer.
A. 49 B. 127 C. 386 D. 33 **E. Impossible to determine**
12. (1 point) What does the y-axis usually describe in an Invasion Curve?
A. Percentage of Biomass B. Total Biomass **C. Area Occupied**
D. Population E. Number of Species

13. (1 point) Which of the following does NOT support the Neutral Theory of Molecular Evolution?
- A. The rate of nucleotide substitution is the highest at the third position of a codon.
 - B. Nonfunctional proteins experience faster rates of evolution than functional proteins.
 - C. There is a positive correlation between the molecular weight of a protein and the polymorphism of the DNA sequence that encodes it.
 - D. Allele frequency changes due to linkage to a nearby allele under selection**
 - E. Conservative changes of protein sequence experience a faster rate of substitution than radical changes.
14. (1 point) Which of the following phenomena best describes Lewontin's Paradox?
- A. Increasing the food supply of an ecosystem can lead to ecological instability.
 - B. The level of genetic variability is not directly proportional to population size.**
 - C. A tolerant species can be driven to extinction by an intolerant species.
 - D. Predators can increase the overall health and diversity of prey populations.
 - E. There exists a positive correlation between population density and per capita growth rate.
15. (1 point) Which of the following organisms contradicts the principle of competitive exclusion?
- A. Paramecium **B. Plankton** C. Squirrels D. Mussels E. Cheatgrass
16. (1 point) What does the Red Queen Hypothesis propose?
- A. Species evolve through cooperation with other species
 - B. Species must constantly adapt and evolve to survive while competing with other species.**
 - C. Evolutionary changes in one species are not influenced by changes in other species.
 - D. The most significant evolutionary changes occur in isolated environments.
 - E. Species evolve through a dynamic equilibrium in order to maintain their relative fitness.
17. (1 point) What is the selection process in which two extreme traits of an organism are favored over the intermediate trait?
- A. Divergent Selection B. Extreme Selection C. Extraneous Selection
D. Disruptive Selection E. Distinctive Selection
18. (1 point) Which of the following describes the amount of chemical energy synthesized by autotrophs in a particular length of time?
- A. Net Primary Production B. Net Secondary Production **C. Gross Primary Production**
D. Gross Secondary Production E. None of the above
19. (1 point) There are 930 seagulls living in an area with a carrying capacity of 1200 seagulls. The population of seagulls is currently increasing at a rate of 82 seagulls per year. Assuming the population of seagulls in this area grows logistically, calculate the intrinsic rate of increase.
- A. 0.19 **B. 0.39** C. 0.60 D. 0.82 E. 1.05
20. (1 point) The 930 seagulls all relocate to a new area with a carrying capacity of 2500 seagulls. The population of seagulls is currently increasing at a rate of 228 seagulls per year. Assuming the population of seagulls in this area grows logistically, at what population of seagulls will the rate of population growth be the highest?
- A. 1250** B. 1350 C. 1450 D. 1550 E. 1650

21. (1 point) Which of the following scenarios best characterizes stabilizing selection?
- A. An ecological event causes species to become smaller over many generations
 - B. Invasive species are removed from the ecosystem
 - C. After an ecological event, the community has developed a flourishing steady state
 - D. A species of fish has a relatively fixed population size after generations of adaptation
 - E. An environment selects against phenotypic extremes**
22. (1 point) A hypercarnivore's diet consists of at least this much meat:
- A. 50 percent
 - B. 60 percent
 - C. 70 percent**
 - D. 80 percent
 - E. 90 percent

Use the figure below for the next three questions.

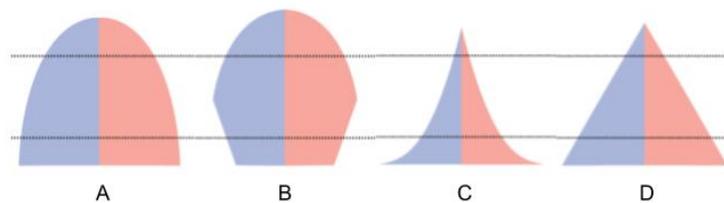


Figure 1: The graph above the left of each letter is blue, the graph above the right of each letter is red.

23. (1 point) Which of the following correctly matches the pyramid with its description?
- A. A: Negative Growth, B: No Growth, C: Slow Growth, D: Fast Growth
 - B. A: No Growth, B: Negative Growth, C: Fast Growth, D: Slow Growth**
 - C. A: Slow Growth, B: Fast Growth, C: Negative Growth, D: No Growth
 - D. A: Fast Growth, B: Slow Growth, C: Negative Growth, D: No Growth
24. (1 point) Using the figure from the question above, the colors of the pyramid represent:
- A. Sex**
 - B. Species
 - C. Country
 - D. Income
 - E. Food production
 - F. Age
25. (1 point) Using the figure above, the y-axis represents:
- A. Sex
 - B. Species
 - C. Country
 - D. Income
 - E. Age**
 - F. Food production
26. (1 point) Which of the following is an example of a r-selected species?
- A. Elephant
 - B. Chicken
 - C. Salamander**
 - D. Bison
27. (1 point) Which of the following are potential causes of secondary succession? (choose all that apply)
- A. Forest Fire**
 - B. Landslide**
 - C. Logging**
 - D. Flood**
28. (1 point) Which of the following is NOT a characteristic of primary succession?
- A. Involves pioneer species
 - B. First species to grow are lichens
 - C. Soil already present**
 - D. No previous life
29. (1 point) Which of the following are potential causes of primary succession?
- A. Forest fire
 - B. Glacier retreats**
 - C. Pest attack
 - D. Epidemic
30. (1 point) Which of the following would be the most beneficial biome to a K-selected species?
- A. Ocean**
 - B. Desert
 - C. Tundra
 - D. Chaparral

31. (1 point) Which of the following would be the most beneficial biome to an r-selected species?
 A. Rainforest B. Coniferous Forest C. Taiga **D. Desert**

Use the table below for the next four questions.

A (x)	B (nx)	C (Ix)	D (mx)
0	100	1	0
1	25	0.25	0
2	12	0.12	2
3	9	0.09	5
4	6	0.06	5
5	4	0.04	5
6	3	0.03	2
7	2	0.02	2
8	0	0	0

32. (1 point) Which of the following could best replace letter A?
 A. Number Alive B. Survivorship C. Age-Specific Fertility **D. Age**
33. (1 point) Which of the following could best replace letter B?
A. Number Alive B. Survivorship C. Age-Specific Fertility D. Age
34. (1 point) Which of the following could best replace letter C?
 A. Number Alive **B. Survivorship** C. Age-Specific Fertility D. Age
35. (1 point) Which of the following could best replace letter D?
 A. Number Alive B. Survivorship **C. Age-Specific Fertility** D. Age
36. (1 point) A poisonous frog has a bright orange color scheme. This vibrant coloring is an example of
 A. Sexual dimorphism B. Cryptic coloring **C. Aposematic coloring** D. Structural coloration
37. (1 point) Another poisonous frog has a very similar color, so that both poisonous frogs have a similar color. This form of mimicry is most similar to:
 A. Batesian mimicry **B. Müllerian mimicry** C. Mertensian mimicry D. Vavilovian mimicry
38. (1 point) In the same forest, a venomous snake is pure black. Yet another snake is also pure black, but this one is harmless. The coloration of the venomous snake most closely represents which type of mimicry:
 A. Batesian mimicry B. Müllerian mimicry **C. Mertensian mimicry** D. Vavilovian mimicry
39. (1 point) In which of the following biomes would Lotka-Volterra predation relationships be most common?
A. Tundra B. Tropical rainforest C. Chaparral D. Taiga
40. (1 point) In which of the following ocean zones would you find an inverted biomass pyramid?
A. Epipelagic B. Mesopelagic C. Bathypelagic D. Abyssopelagic
41. (1 point) A mouse and a rabbit are both preyed on by the ugly eagle of the ecosystem (hope that you will never have to come across an image of this occurring). What type of competition is exhibited by the mouse and rabbit?
 A. Interference **B. Apparent** C. Exploitative D. Scramble
42. (1 point) Which of the following is the largest reservoir of carbon on Earth?
 A. Terrestrial biosphere B. Atmosphere C. Fossil fuels **D. Deep ocean sediment**

43. (1 point) Select all of the following that are examples of ecosystem engineers. (Hint: A correct answer choice is also MIT's mascot).
A. Parrotfish B. Beavers C. Prairie dogs **D. Kelp**
44. (1 point) Select all of the following that are examples of dominant species.
A. Parrotfish B. Beavers C. Prairie dogs **D. Kelp**
45. (1 point) Select all of the following that are examples of keystone species.
A. Parrotfish B. Beavers **C. Prairie dogs** D. Kelp
46. (1 point) Which of the following environments would be considered optimal for a semelparous organism?
A. Desert B. Tropical rainforest C. Taiga D. Photic zone
47. (1 point) Which of the following is a density-dependent limiting factor?
A. Natural disasters B. Specialization **C. Disease** D. Resource partitioning

Terrestrial ecosystems

48. (1 point) What is the most common terrestrial biome on Earth?
A. Taiga B. Tundra C. Tropical Rainforest D. Desert E. Deciduous Forest
49. (1 point) Which of the following are types of tundras (select all that apply)?
A. Alpine Tundra B. Flatland Tundra **C. Arctic Tundra** **D. Antarctic Tundra**
50. (1 point) Which of the following plants would you expect to see in a tundra (select all that apply)?
A. Willows B. Firs **C. Arctic moss** D. Pines
51. (1 point) Which of the following Koppen climate classification describes the tundra?
A. Af **B. ET** C. Dwd D. Csb E. EF
52. (1 point) Which of the following gases is released when permafrost thaws?
A. Sulfur Hexafluoride **B. Methane** C. CFC-12 D. Nitrous Oxide
53. (1 point) A forest burns down. The process by which species return to it is called:
A. Primary succession **B. Secondary succession** C. Tertiary succession D. None of the above
54. (1 point) Which of the following trees would you expect to be least common in a taiga?
A. Pine B. Spruce C. Fir **D. Maple**
55. (1 point) The line at which trees stop being able to grow is known as the:
A. Tree boundary **B. Tree line** C. Goldilocks zone D. Tree border
56. (1 point) Closed canopy forests are generally found in taigas that are geographically to the:
A. north **B. south** C. east D. west
57. (2 points) Many trees in taigas release their seeds in response to heat and/or fire. This property of these cones is known as:
A. Ripening B. Pyrotropism **C. Pyriscence** D. Igneodissemination
58. (1 point) Ravens call out to wolves when they discover a dying animal, allowing the wolves to kill and eat the animal. After the wolves are done, the raven is also able to eat from the remains, but they have other ways of getting food. This is an example of:
A. obligate parasitism B. facultative parasitism C. obligate mutualism **D. facultative mutualism**
59. (2 points) Salmon are born in freshwater and live in the ocean. When breeding, they return to their freshwater breeding grounds and reproduce once before dying. Salmon are: (select all that apply)
A. anadromous B. catadromous C. iteroparous D. K-selected **E. r-selected** **F. semelparous**

60. (1 point) An ecosystem with infinite diversity would have a Simpson's index (note that this is λ , not $1 - \lambda$) value of:
A. $-\infty$ B. -1 **C. 0** D. 1 E. ∞
61. (1 point) What is the average length of the growing season in the Tundra biome?
A. 1-2 weeks B. 3-4 weeks C. 5-6 weeks **D. 7-8 weeks** E. 9-10 weeks
62. (1 point) Sue is a tree enthusiast. To the front of her, she identifies a maple tree. To the right of her, she identifies a chestnut tree. There is also a sycamore behind her, but she does not see it. Which terrestrial biome is Sue most likely in?
A. Boreal Forest B. Grassland C. Tropical Rainforest D. Tundra **E. Deciduous Forest**
63. (1 point) Pioneer species in deciduous forests tend to be (select all that apply):
A. Shade-tolerant **B. Shade-intolerant** **C. Fast growing** D. Slow growing
64. (1 point) Which of the following is the name for stunted and windblown trees found near the tree line?
A. Schulte B. Wegener **C. Krummholz** D. Wilmar
65. (1 point) Which of the following compounds released by decomposing needles is responsible for taiga soil's acidity?
A. Water B. Methane **C. Carbon dioxide** D. Phosphate
66. (1 point) Select all of the following that are characteristics of oxisols.
A. Rich in aluminum oxide
B. Little cation-exchange capacity
C. High leaching of calcium ion
D. Rich in silica
67. (1 point) Which of the following processes is responsible for returning nitrogen to the atmosphere?
A. Nitrification B. Ammonification C. Assimilation **D. Denitrification**
68. (1 point) Which of the following is the Koppen climate classification of a tropical rainforest?
A. Aw **B. Af** C. Bfh D. Cfa
69. (1 point) Which of the following types of silviculture is most damaging to the environment?
A. Clear cutting B. Selective cutting C. Shelterwood cutting D. Snever cutting
70. (1 point) Which of the following types of silviculture cuts down trees such that the forest has an uneven age distribution?
A. Clear cutting **B. Selective cutting** C. Shelterwood cutting D. Snever cutting
71. (1 point) What is the name given to the first species that arrive in an ecosystem undergoing primary succession?
A. Originator species B. Pilgrim species C. Colonizer species **D. Pioneer species**
72. (1 point) Scientists observe a small plot of land in the Canadian taiga. They find that there are 15 North American beavers, 11 caribou, 4 gray wolves, 12 great gray owls, and 2 lynxes. What is the total species richness of this plot of land?
A. 15 B. 8.8 **C. 5** D. 2

Human Impacts on the Environment

73. (1 point) Which of the following is a renewable resource?
A. Coal B. Oil C. Uranium **D. Wind**

74. (1 point) Rain dust is characterized by a pH that is:
A. Acidic B. Neutral **C. Basic** D. None of the above
75. (1 point) Which of the following is not an effect of acid rain?
A. Leaching
B. Ocean acidification
C. Dissolution of magnesium
D. Higher aluminum concentrations
76. (1 point) Which of the following does not contribute significantly to anthropogenic soil erosion?
A. Monocultures **B. Terrace farming** C. Overgrazing D. Tilling
77. (1 point) Which of the following is not a type of environmental steward:
A. Advocate B. Doer C. Donor D. Practitioner
78. (1 point) Which of the following is not a disadvantage of hydroelectric dams?
A. Risk of flooding
B. High initial cost
C. Habitat degradation
D. Unstable energy production
E. Industrial waste buildup
79. (1 point) Which of the following best characterizes rhizofiltration?
A. Fungi are used to process toxins and remove them from an area
B. Air is blown into the dirt, allowing for oxygen to seep in
C. A multitude of microbes are introduced into an area to filter out toxins and wastes
D. Contaminated water flows through a mass of roots and toxic substances are removed
E. A stream flows through an area that is abundant with flora which filters out industrial wastes
80. (1 point) Which acids are the main types of compounds can fall with precipitation and form acid rain? (select all that apply)?
A. Nitric Acid B. Carbonic Acid **C. Sulfuric Acid** D. Hydrochloric Acid
81. (1 point) Which of the following best characterizes biopiling?
A. It utilizes microorganisms in piles of compost in order to reduce contamination by industrial waste.
B. It is commonly used for minimizing petroleum components by excavating and aerating soil.
C. It is a technology that uses layers of mycelium to filter groundwater.
D. It injects oxygen into the unsaturated zone of soils in order to increase soil quality.
82. (1 point) Bioremediation that does not use human-engineered systems is known as what?
A. Natural Bioremediation
B. Unengineered Bioremediation
C. Unmediated Bioremediation
D. Intrinsic Bioremediation

83. (1 point) As Arctic ice continues to melt due to rising temperatures, it exposes a greater surface area of dark ocean water that absorbs more heat and causes more ice to melt. What is this phenomenon known as?
- A. Ocean Warming Loop
 - B. Liquid Absorption Effect
 - C. Ice-Albedo Feedback**
 - D. Sea-ice Melting Cycle
84. (1 point) Which of the following processes of bioremediation involves injecting oxygen into the groundwater to increase microbial activity?
- A. Biosparging**
 - B. Biostimulation
 - C. Bioattenuation
 - D. Bioaugmentation
85. (1 point) Which of the following processes of bioremediation involve adding microbial cultures to enhance chemical breakdown?
- A. Biosparging
 - B. Biostimulation
 - C. Bioattenuation
 - D. Bioaugmentation**
86. (1 point) The invasion curve describes the stages of managing invasive species over time. What are the four stages of the invasion curve?
- A. Detection, Evaluation, Containment, Removal
 - B. Prevention, Eradication, Containment, Long-Term Control**
 - C. Prevention, Evaluation, Eradication, Legislation
 - D. Detection, Awareness, Short-Term Control, Long-Term Control
87. (1 point) Which of the following is not an example of a positive feedback loop?
- A. Permafrost melt
 - B. Ocean warming
 - C. Carbon dioxide fertilization**
 - D. Deforestation
88. (1 point) What is acid deposition?
- A. A form of mining done by depositing acidic material into the ground
 - B. Any form of precipitation comprised of acidic components**
 - C. The dumping of acidic substances into rivers, lakes, and other bodies of water
 - D. Acidic waste created as a byproduct of the decomposition of organic matter getting deposited in soil
89. (1 point) What is currently the most used clean energy source in the world?
- A. Hydropower**
 - B. Nuclear power
 - C. Wind power
 - D. Geothermal energy
90. (1 point) This renewable energy source uses photovoltaic technology to turn energy into electricity and comprises about 4% of total energy production in the world. What type of energy is it?
- A. Solar power**
 - B. Tidal power
 - C. Voltaic power
 - D. Hydrogen cells
91. (1 point) Select all of the following that are considered types of ecosystem services.
- A. Regulating**
 - B. Provisioning**
 - C. Cultural**
 - D. Supporting**
92. (1 point) Which of the following is the name of the phenomenon in which persistent organic pollutants make their way from the lower latitudes to higher latitudes?
- A. Butterfly effect
 - B. Chameleon effect
 - C. Grasshopper effect**
 - D. Octopus effect
93. (1 point) Which of the following types of wildfires is responsible for the destruction of suspended materials such as vines and mosses?
- A. Ground
 - B. Surface
 - C. Ladder
 - D. Crown**

94. (1 point) A rich exotic animal collector in Florida adopts a pair of rare Indian Gharials, a species of crocodile native to the Indian subcontinent. He decides that it's too much work to take care of the animals and wants to get rid of them. Why should he not release them into the wild?
- A. Gharials are an endangered species, so releasing them is wasteful
 - B. Gharials are not native to the Floridian ecosystems and could pose a threat to native species there**
 - C. The Gharials wouldn't be able to survive in the wild, since they're being released from captivity
 - D. None of the above, releasing them into the wild is the best way to get rid of them
95. (1 point) What is a tipping point?
- A. A point in sea level rise where dams and levees stop being effective measures in preventing flooding
 - B. A threshold of environmental damage that, when crossed, results in irreversible changes to the ecosystem**
 - C. A ratio of invasive species to native species that will result in invasive species dominating an ecosystem
 - D. An approximate number of humans that can live in an environment without damaging it
96. (1 point) By approximately how many degrees has the Earth warmed in the past 150 years?
- A. Less than 1°C
 - B. 1-1.5°C**
 - C. 1.6-2°C
 - D. Over 2°C
97. (1 point) What mineral does acid rain leach from soil?
- A. Mercury
 - B. Aluminum**
 - C. Calcium
 - D. Lead
98. (1 point) Select all of the following that are differences between horizontal-axis and vertical-axis wind turbines.
- A. Vertical-axis turbines are most effective on the coast, while horizontal-axis turbines are most effective farther inland
 - B. The vast majority of wind turbines in use are horizontal-axis turbines**
 - C. Horizontal-axis turbines are a "dirtier" source of energy
 - D. Vertical-axis turbines are cheaper to construct than horizontal-axis turbines**
 - E. Darrieus turbines are an example of a vertical-axis turbine**
99. (1 point) Which renewable energy source has the lowest death rate per unit of energy produced?
- A. Solar power**
 - B. Hydropower
 - C. Wind power
 - D. Nuclear power
100. (1 point) Which of the following is not a way wind power damages ecosystems?
- A. Contaminate soil**
 - B. Create noise pollution
 - C. Occupy habitats
 - D. Kill birds