

Fairfax Science Olympiad Tryouts 2018

Name: _____

Score: _____/104

ECOLOGY TEST

Part 1: Principles of Ecology

- 1) Seral Communities are _____. (1 point)
 - a. An intermediate stage found between ecological succession and the climate community
 - b. The first stage of ecological succession
 - c. Another name for climax community
 - d. A self-sustainable community before ecological succession

- 2) The bright colors of the granular poison frog to signal a warning to predators. This is an example of _____. (1 point)
 - a. Batesian Mimicry
 - b. Poyannian Mimicry
 - c. Aestivation
 - d. Aposematism

- 3) Which type of population distribution is the rarest? (1 point)
 - a. Random Distribution
 - b. Uniform Distribution
 - c. Clumped Distribution
 - d. Spiral Distribution

- 4) The carrying capacity is best described as _____. (1 point)
 - a. The maximum number of individuals of a given species that can be sustained indefinitely in a given space (K)
 - b. The maximum number of individuals of a given species that can be sustained indefinitely in a given space (R)
 - c. The maximum number of individuals that can reproduce in a year (K)
 - d. The maximum number of individuals that can reproduce in a lifetime (R)

- 5) Type I survivorship curve reproduction _____. (1 point)
 - a. Occurs late in life
 - b. Occurs early in life
 - c. Occurs in the middle of life
 - d. Does not occur

- 6) If a population of deer is growing at a rate of 10% per year. How long will it take for the population to double? (1 point)
 - a. 7 years
 - b. 10 years
 - c. 14 years
 - d. 20 years

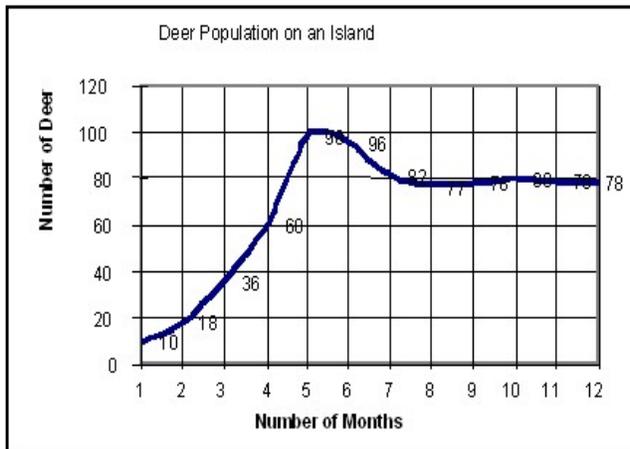
7) Nitrogen fixation is the process of _____. (1 point)

- a. Converting nitrate to nitrite
- b. Converting atmospheric nitrogen to a usable form
- c. Converting atmospheric nitrogen to sulfate
- d. Converting nitrite to nitrate

8) Which of these is a density-dependent factor? (1 point)

- a. Natural disasters
- b. Unusual weather patterns
- c. Parasitism
- d. Seasonal cycles

Use the following figure for questions 9-10.



9) What is the carrying capacity of the deer population? (1 point)

- a. 10
- b. 60
- c. 80
- d. 100

10) At what month best indicates an overshoot? (1 point)

- a. 4
- b. 5
- c. 6
- d. 7

11) Pacific Salmon die after a single process of reproduction. This type of reproductive pattern can best be described as _____. (1 point)

- a. Iteroparous
- b. Amensalism
- c. Allopatric
- d. Semelparous

12) Which of the following adaptations of autotrophs is beneficial in arid conditions? (1 point)

- a. C₃ pathway photosynthesis
- b. C₄ pathway photosynthesis
- c. CAM pathway photosynthesis
- d. Chemosynthesis

13) What percentage of energy is transferred to the next trophic level? (1 point)

- a. 1%
- b. 10%
- c. 50%
- d. 90%

14) No two species that occupy the same niche can coexist indefinitely. Eventually one species will reign dominant. This idea is known as _____. (1 point)

- a. Fundamental Niche
- b. Resource Partitioning
- c. Limiting Factor Principle
- d. Guase's Law
- e. Bottleneck Effect

15) A sea otter feeds on sea urchins. If the sea otter is removed, sea urchins would become a ravaging predator in the ecosystem. Sea urchins would consume the habitat's kelp. Ultimately, the population of the sea urchins would be left uncontrolled. The sea otter is an example of a(n) _____. (1 point)

- a. Indicator Species
- b. Foundation Species
- c. Flagship Species
- d. Keystone Species
- e. Pioneer Species

16) In a population of 100 jays, 35 individuals exhibit the recessive phenotype of brown feathers (bb) and 65 individuals exhibit the dominant phenotype of blue feathers (BB and Bb). What is the frequency of the allele for blue feathers? (1 point)

- a. 0.592
- b. 0.650
- c. 0.408
- d. 0.806
- e. 0.483

17) List the 5 conditions that must be satisfied for a population to not be evolving. (5 points)

- 1.
- 2.
- 3.
- 4.
- 5.

18) Inverted ecological pyramids of numbers are typical of _____. (1 point)

- a. Grassland ecosystems
- b. Pond ecosystems
- c. Forest ecosystems
- d. Parasitic food chains

19) Inverted ecological pyramids of biomass are typical of _____. (1 point)

- a. Grassland ecosystems
- b. Pond ecosystems
- c. Forest ecosystems
- d. Parasitic food chains

20) Of the three types of ecological pyramids, which gives the best representation of the overall nature of an ecosystem? (1 point)

- a. Numbers pyramid
- b. Biomass pyramid
- c. Energy pyramid

21) In an act of altruism, individual A sacrificed its life (and thus, its genes) to save the life of individual B. Individual A and individual B are cousins. If individual A had the potential to produce 2 offspring, and individual B has the potential to produce 10 offspring, was the altruistic act favored by natural selection according to Hamilton's Rule? Show your calculations. (4 points)

22-27) Provide a brief description of each of the following forms of natural selection. (2 points each)

22) Stabilizing selection

23) Disruptive selection

24) Directional selection

25) Artificial selection

26) Sexual selection

27) Kin selection

28) Differentiate between *inclusive fitness* and *direct fitness*. (4 points)

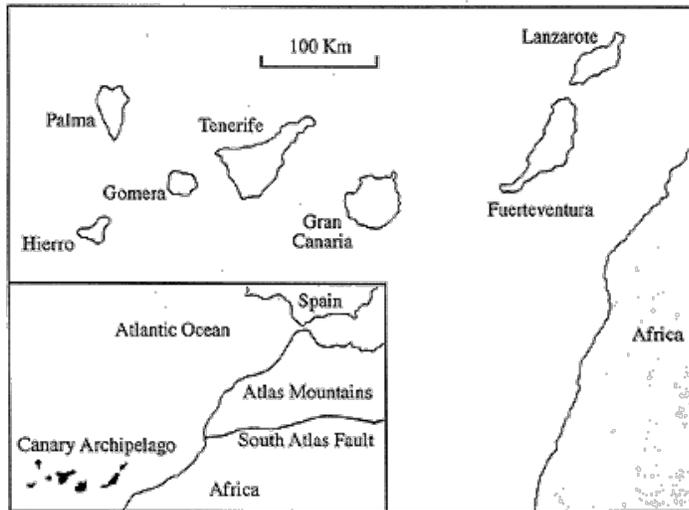
29) R-strategists are typically associated with which population fluctuation model? (1 point)

- a. Stable
- b. Irruptive
- c. Cyclic
- d. Irregular

30) Contrast the *Energetic Hypothesis* and the *Dynamic Stability Hypothesis*. (4 points)

Use the following figure for questions 31-32.

Map 1. The Canary Islands Archipelago. (redrawn from Anguita et al., 1986)



31) According to the Theory of Island Biogeography, which of the pictured islands would exhibit the most impoverished species diversity? (1 point)

- a. Hierro
- b. Lanzarote
- c. Gran Canaria
- d. Fuerteventura

32) Which of the pictured islands would likely have the lowest extinction rate? (1 point)

- a. Hierro
- b. Lanzarote
- c. Gran Canaria
- d. Fuerteventura

33) Approximately what percent of all species on Earth are parasites? (1 point)

- a. 0.1%
- b. 1%
- c. 5%
- d. 25%
- e. 40%

34) Approximately how many kilograms of carnivore biomass can be supported by a field plot containing 1,000 kg of plant material? (1 point)

- a. 1
- b. 10
- c. 100
- d. 1,000
- e. 10,000

35) Community A has 50 different species, and Community B has 25 different species. Communities A and B share 12 species in common. Community C has 16 different species, and Community D has 10 different species. Communities C and D share 4 species in common. Which pair of communities has greater community similarity? Show your calculations. (4 points)

Part 2: Terrestrial Biomes

36) What USDA soil taxonomy class of soil dominates deserts and xeric shrublands and is characterized by low concentration of organic matter and one or more subsurface soil horizons rich in silicate clays, sodium, and calcium carbonate? (2 points)

37) What latitude(s) are occupied by deserts? (1 point)

- a. Between 0° and 15° N and S latitude
- b. Between 15° and 35° N and S latitude
- c. Between 35° and 50° N and S latitude
- d. Between 50° and 65° N and S latitude
- e. Between 85° and 90° N and S latitude

38. List two differences between “hot” deserts and “cold” deserts. (One is hot and one is cold does not count). (2 points)

39. What are the four distinct deserts in the United States and Northern Mexico? (4 points)

- 1 _____
- 2 _____
- 3 _____
- 4 _____

40. What are the two desert climate classes according to the Köppen Climate Classification system? (2 points)

- 1 _____
- 2 _____

41. Approximately what percentage of Earth's land surface is covered by deserts? (1 point)

- a. 1-5%
- b. 10-15%
- c. 25-35%
- d. 35-45%
- e. 50-60%

42. Explain the effect of the extremely low humidity of hot and dry deserts on temperature changes during day and night. Provide temperature values to justify your answer. (4 points)

43. Which of the following net primary productivity values best characterizes temperate grassland ecosystems? (1 point)

- a. $8,800 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- b. $5,800 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- c. $3,200 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- d. $2,200 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- e. $600 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$

44. Which of the following net primary productivity values best characterizes tropical grassland ecosystems? (1 point)

- a. $8,800 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- b. $5,800 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- c. $3,200 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- d. $2,200 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$
- e. $600 \text{ kcal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$

45. Define *edaphic savannah*. (2 points)

46. Define *derived savannah*. (2 points)

47. Which of the following best characterizes the soil of savannahs? (1 point)
- a. Thin, moist, and nutrient poor.
 - b. Porous with rapid drainage of water and a thin layer of humus.
 - c. Alfisols are a typical soil type and an abundance of humus provides nutrients and helps topsoil hold water.
 - d. Acidic with podsolization and bleaching overlying eluvial horizons.
 - e. Of the soil order “entisols”.
48. Which of the following grasses would not be found in a temperate grassland? (1 point)
- a. river bushwillow
 - b. galleta
 - c. buffalo grass
 - d. purple needlegrass
 - e. blue grama
49. Savannahs develop in regions where the climax community should be a _____, but edaphic conditions or disturbances prevent the establishment of species of trees associated with the climax community. (2 points)
50. Describe two roles of fire in regulating grassland ecology. (4 points)

Part 3: Human Impact

- 51) What does the acronym **HIPPO** stand for? (2 points)
- 52) Define *ecosystem services* and estimate their total monetary value in USD. (4 points)
- 53) Define *desertification* and explain how human activities such as slash and burn agriculture and overgrazing by domesticated animals accelerate this process. (4 points)

54) As of December 2016, 194 states and the European Union had signed the UNFCCC's Paris Agreement, including the U.S., which is responsible for approximately 18% of the summative greenhouse emissions of all 194 states. Which of the following countries is currently not part of the UNFCCC's Paris Agreement? (1 point)

- a. North Korea
- b. Pakistan
- c. Russia
- d. China
- e. United States

55) Which of the following statements comparing the Kyoto Protocol and the Paris Agreement is false? (1 point)

- a. Unlike its predecessor, the Kyoto Protocol, which sets commitment targets that have legal force, the Paris Agreement, with its emphasis on consensus-building, allows for voluntary and nationally determined targets (thus goals are politically encouraged but not legally bound).
- b. While the Kyoto Protocol differentiated between Annex-1 and non-Annex-1 countries, this distinction is not clear in the Paris Agreement, as all parties will be required to submit emissions reductions plans
- c. The U.S. has ratified the Kyoto Protocol but is not currently a member of the Paris Accord.
- d. The Kyoto Protocol is an international treaty, while the Paris Accord is considered an executive agreement.
- e. Both were created by the United Nations Framework Convention on Climate Change in an effort to reduce global greenhouse gas emissions.

56) Match the renewable energy source with the correct description. (5 points)

- 1. Geothermal power
- 2. Hydroelectric power
- 3. Hydrogen power
- 4. Nuclear fusion
- 5. Wind power

i) Zero-emission energy source envisioned by Jules Verne as the fuel of the future in his 1874 book *The Mysterious Island*.

ii) According to the EPA, this type of energy exchange is the most energy-efficient, cost-effective, and environmentally clean way to heat or cool a building.

iii) Extremely high theoretical energy density (about four times the net yield of nuclear fission), but not yet controlled by humans in a way that is usable.

iv) Fastest growing renewable energy source; also the source of 90% of Denmark's electricity.

v) Significant disadvantages to this type of renewable energy include damage to lowland and riverine valley forest, marshland, and grassland ecosystems, and relocation of nearby human residents.
