

CHAPTER 3--ECOSYSTEMS: WHAT ARE THEY AND HOW DO THEY WORK?

Student: _____

1. Although tropical rain forests are only 2% of the earth's land surface, they contain what percentage of the earth's land plants and animal species?
 - A. 50
 - B. 40
 - C. 30
 - D. 20
 - E. 10
2. Which of the following is *not* a reason we should care about the disappearance of the tropical rain forests?
 - A. their loss will reduce earth's biodiversity
 - B. their loss will accelerate atmospheric warming
 - C. their loss will change regional weather patterns
 - D. their loss will mean more places to build cities
 - E. their loss may push us beyond an ecological tipping point
3. Ozone gas in the lower part of the stratosphere filters out how much of the sun's harmful ultraviolet (UV) radiation?
 - A. 33%
 - B. 20%
 - C. 95%
 - D. 67%
 - E. 10%
4. Which of the following is *not* a major component of the earth's life-support system?
 - A. unisphere
 - B. atmosphere
 - C. hydrosphere
 - D. geosphere
 - E. biosphere

5. Fossil fuels and minerals are found in the
- A. unisphere
 - B. atmosphere
 - C. hydrosphere
 - D. geosphere
 - E. biosphere
6. The oceans of the earth cover approximately what percentage of the earth's surface?
- A. 3%
 - B. 29%
 - C. 51%
 - D. 71%
 - E. 97%
7. All physical forms of water (solid, liquid, and gas) make up the
- A. atmosphere
 - B. lithosphere
 - C. biosphere
 - D. hydrosphere
 - E. troposphere
8. The parts of the earth's air, water, and soil where life is found is called the
- A. organism
 - B. population
 - C. community
 - D. ecosystem
 - E. biosphere
9. High quality energy is constantly
- A. being made
 - B. being recycled
 - C. being destroyed
 - D. becoming matter
 - E. becoming low quality energy
10. Life on earth depends on interaction of gravity, the cycling of matter, and
- A. cycling of energy
 - B. one-way flow of high-quality energy
 - C. one-way flow of matter
 - D. the destruction of energy
 - E. the consumption of matter

11. Ecology is the study of
- A. human impact on the environment
 - B. the abiotic elements of the environment
 - C. the biotic elements of the environment
 - D. how organisms interact with each other and the nonliving environment
 - E. how evolution formed populations
12. Which of the following is not an abiotic component of an ecosystem?
- A. nutrients
 - B. microbes
 - C. water
 - D. solar energy
 - E. air
13. Groups of different species living together in a particular place with a potential for interacting with one another is called a(n)
- A. organism
 - B. population
 - C. community
 - D. ecosystem
 - E. biosphere
14. The most fundamental structural and functional units of life are
- A. atoms
 - B. molecules
 - C. compounds
 - D. cells
 - E. mitochondrion
15. Which of the following is not a type of consumer?
- A. decomposer
 - B. producer
 - C. omnivore
 - D. carnivore
 - E. detritivore
16. Organisms that feed only on plants are called
- A. detritivores
 - B. omnivores
 - C. carnivores
 - D. herbivores
 - E. decomposers

17. The very necessary process of breaking down the dead bodies of organisms is a function of
- A. detritivores
 - B. omnivores
 - C. carnivores
 - D. herbivores
 - E. producers
18. Organisms that complete the final breakdown and recycling of organic materials from the remains of all organisms are the
- A. detritivores
 - B. omnivores
 - C. carnivores
 - D. herbivores
 - E. decomposers
19. Specialized bacteria can produce their own food from inorganic compounds in the environment without the use of sunlight. This process is called
- A. photosynthesis
 - B. cellular metabolism
 - C. fermentation
 - D. chemosynthesis
 - E. nitrogen fixation
20. Which of the following is *not* an end product of anaerobic respiration?
- A. acetic acid
 - B. methane
 - C. oxygen
 - D. ethyl alcohol
 - E. hydrogen sulfide
21. Which of the following about microorganisms is *false*?
- A. Bacteria and other microbes help purify the water we drink.
 - B. Bacteria and fungi help produce the foods we eat.
 - C. Bacteria help break down food in our intestines.
 - D. Microbes help speed up global warming.
 - E. Microbes help control diseases of plants.
22. Aerobic respiration requires
- A. glucose and carbon dioxide
 - B. glucose and oxygen
 - C. oxygen and water
 - D. carbon dioxide and water
 - E. carbon dioxide and oxygen

23. Complex networks of interconnected food chains are
- A. food webs
 - B. food chains
 - C. trophic levels
 - D. pyramids of energy
 - E. trophic chains
24. Each trophic level in a food chain or food web contains a certain amount of organic matter, called
- A. food
 - B. energy
 - C. biomass
 - D. organisms
 - E. decomposition
25. The typical percentage of high quality energy loss in transfers from one trophic level to the next is about
- A. 1%
 - B. 5%
 - C. 35%
 - D. 60%
 - E. 90%
26. If grass stores 1,000 energy units received from the sun, the ecological efficiency of the ecosystem is 10%, and the trophic levels are grass ® cow ® human, how many units of energy does the human receive of the original 1,000 units?
- A. 900
 - B. 200
 - C. 100
 - D. 10
 - E. 1
27. Despite a low net primary productivity (NPP), which ecosystem or life zone produces the most biomass each year?
- A. swamps and marshes
 - B. tropical rain forest
 - C. temperate forests
 - D. open ocean
 - E. estuaries

28. Which of the following terrestrial ecosystems or life zones produces the highest net primary productivity per year?
- A. temperate forest
 - B. Savanna
 - C. tundra
 - D. swamps and marshes
 - E. extreme desert
29. Which of the following terrestrial ecosystems or life zones produces the lowest net primary productivity per year?
- A. taiga
 - B. extreme desert
 - C. desert scrub
 - D. temperate grassland
 - E. agricultural land
30. Vitousek, Rojstaczer, and others estimate humans now use, waste, or destroy what percentage of the earth's total potential NPP?
- A. 1 - 8%
 - B. 9 - 18%
 - C. 10 - 55%
 - D. 20 - 65%
 - E. 90%
31. The hydrologic cycle is the movement of
- A. carbon
 - B. hydrogen
 - C. hydrocarbons
 - D. carbohydrates
 - E. water
32. How much of the earth's water supply is available as accessible liquid freshwater?
- A. 10%
 - B. 1%
 - C. 0.024%
 - D. 21%
 - E. 97%

33. The hydrologic cycle is driven primarily by
- A. solar energy
 - B. lunar tides
 - C. solar tides
 - D. mechanical energy
 - E. chemical energy
34. Which of the following is *not* one of the major processes of the water cycle?
- A. lunar tides
 - B. evaporation
 - C. transpiration
 - D. precipitation
 - E. all of these are major processes
35. Precipitation can take several paths when it reaches the earth's surface. Which of the following is *not* one of those paths?
- A. surface runoff into lakes, streams, and the ocean
 - B. storage as ice in glaciers
 - C. storage as groundwater in aquifers
 - D. permanent storage as part of rocks
 - E. storage in living components of ecosystems
36. Which of the following is a way that humans harmfully impact the water cycle?
- A. overpumping of aquifers
 - B. increasing runoff by clearing vegetation from the land
 - C. increased runoff due to crops, buildings, and pavement
 - D. change natural flood control by disturbing wetlands
 - E. all of these
37. Which of the following statements is *false*?
- A. Water exists as a liquid over a wide temperature range.
 - B. Water compresses when it freezes.
 - C. Water filters out wavelengths of UV radiation.
 - D. It takes a large amount of energy to evaporate water.
 - E. Liquid water is a good solvent.
38. Which of the following is a primary link between photosynthesis and aerobic respiration?
- A. phosphorus
 - B. sulfur
 - C. hydrogen
 - D. carbon
 - E. nitrogen

39. Carbon is a major component of
- A. water
 - B. the oceans
 - C. organic compounds
 - D. the atmosphere
 - E. hydrologic cycle
40. Humans intervene in the nitrogen cycle in several ways. Which of the following is *not* one of those ways?
- A. Burning fossil fuels adds nitric oxide.
 - B. Agriculture releases nitrous oxides.
 - C. Destruction of forests releases nitrogen.
 - D. We store nitrogen in the topsoil when we harvest nitrogen rich crops.
 - E. Agriculture using fertilizers adds nitrogen to aquatic systems.
41. Nitrogen is a major component of all of the following *except*
- A. proteins
 - B. nucleic acids
 - C. groundwater
 - D. ammonia
 - E. DNA
42. The form of nitrogen most usable to plants is
- A. ammonium ions
 - B. nitrogen gas
 - C. proteins
 - D. nitrites
 - E. nitrates
43. Which of the following is *not* a part of the phosphorus cycle?
- A. soil
 - B. atmosphere
 - C. organisms
 - D. rocks
 - E. marine sediments
44. All of the following are ways humans interfere in the phosphorus cycle *except*
- A. erosion from fertilized crop fields, lawns, increases phosphate ions in streams
 - B. increasing phosphate levels in tropical forests by clearing forests
 - C. removing large quantities of phosphate from the earth for fertilizer
 - D. stimulating aquatic systems to overproduce through runoff of phosphate ions
 - E. all of these interfere in the phosphorus cycle

45. Much of the earth's sulfur is stored in
- A. plants and animals
 - B. the oceans
 - C. the atmosphere
 - D. underground rocks and minerals
 - E. soil
46. Sulfur is added to the atmosphere in all the following ways *except*
- A. from volcanoes
 - B. anaerobic decomposition in swamps
 - C. eating meat
 - D. sea spray
 - E. acid rain deposition
47. Humans add sulfur to the atmosphere through which of the following?
- A. making electricity
 - B. making gasoline
 - C. converting metallic mined ores to free metals
 - D. burning coal
 - E. all of these
48. Ecologists would make use of which of the following in their study of nature?
- A. field research
 - B. geographic information system software
 - C. controlled experiments
 - D. remote sensing devices
 - E. all of these
49. Scientists have less than _____ percent of the ecological data they need to evaluate the ecosystems in the United States.
- A. 5
 - B. 8
 - C. 12
 - D. 25
 - E. 50
50. Sophisticated satellite imaging programs from _____ now allow scientists and non-scientists to be connected to even the most remote ecosystems.
- A. National Oceanic and Atmospheric Agency
 - B. National Aeronautic and Space Administration
 - C. U.S. Military
 - D. Google Earth
 - E. European Space Agency

51. Although tropical rain forests are only about 2% of the earth's land surface, they contain at least 50% of the world's land plant and animal species.
- True False
52. Only about 14% of the tropical rain forests have been destroyed or disturbed at this point.
- True False
53. Destruction of the tropical rain forest will likely change regional weather patterns in ways that will prevent their return.
- True False
54. Greenhouse gases, including methane, CO₂, and water vapor, make up about 30% of the earth's troposphere.
- True False
55. While the troposphere is 11 miles thick above sea level at the tropics, it is only four miles thick above the North and South poles.
- True False
56. If the earth were an apple, all life would be contained in the thickness of the skin.
- True False
57. Part of the solar energy striking the earth generates winds.
- True False
58. All life is based on the power of the sun.
- True False
59. The "greenhouse effect" is a strictly artificial (human-made) phenomenon.
- True False
60. A "trophic level" refers to the ability of an organism to survive outside the optimum range in a range of tolerance.
- True False
61. An ecosystem is defined as a community of different populations of species interacting with one another and their nonliving environment.
- True False

62. Most producers capture sunlight to produce energy-rich carbohydrates through photosynthesis.
- True False
63. Autotroph is another word for a consumer in a trophic system.
- True False
64. Deep sea habitats are an exception to the first principle of sustainability, in that they use a non-solar source of energy.
- True False
65. All microbes are pathogenic (disease causing) or otherwise dangerous.
- True False
66. Transfer of energy through food chains or webs is very efficient, making a lot of energy available to organisms.
- True False
67. The larger the number of trophic levels in a food chain or web, the greater the accumulated loss of energy.
- True False
68. The reason we observe a "pyramid" of energy flow instead of an energy flow "cube" is because the low ecological efficiency of biological systems limits the numbers of organism in the higher trophic levels.
- True False
69. A larger number of humans could be supported on the earth if more of them consumed grains, vegetables, and fruits rather than eating meat.
- True False
70. Gross primary productivity (GPP) is the biomass produced by photosynthesis minus the rate at which biomass is used for aerobic respiration.
- True False
71. Nutrient cycles connect past, present, and future forms of life.
- True False
72. The hydrologic cycle is a way nature renews water quality.
- True False

73. In hundreds of years we have released large quantities of fossil fuels that took millions of years to form.

True False

74. Nitrogen gas, the major component of the atmosphere, cannot directly be used by plants and animals.

True False

75. Because the soil contains a sufficient amount of phosphates, phosphorus is not usually a limiting plant nutrient.

True False

76. Agricultural runoffs containing phosphates cause huge blooms of algae in streams and lakes.

True False

77. Over land, most water that reaches the atmosphere comes from transpiration.

True False

78. Because carbon makes up such a small amount of the earth's atmosphere, even a small change, caused by nature or by humans, affects the earth's climate.

True False

79. Since 1950 human activities have more than doubled the annual release of nitrogen into the environment.

True False

80. Ecologists do not make use of most new technologies, preferring to continue the "muddy-boots biology" style of research.

True False

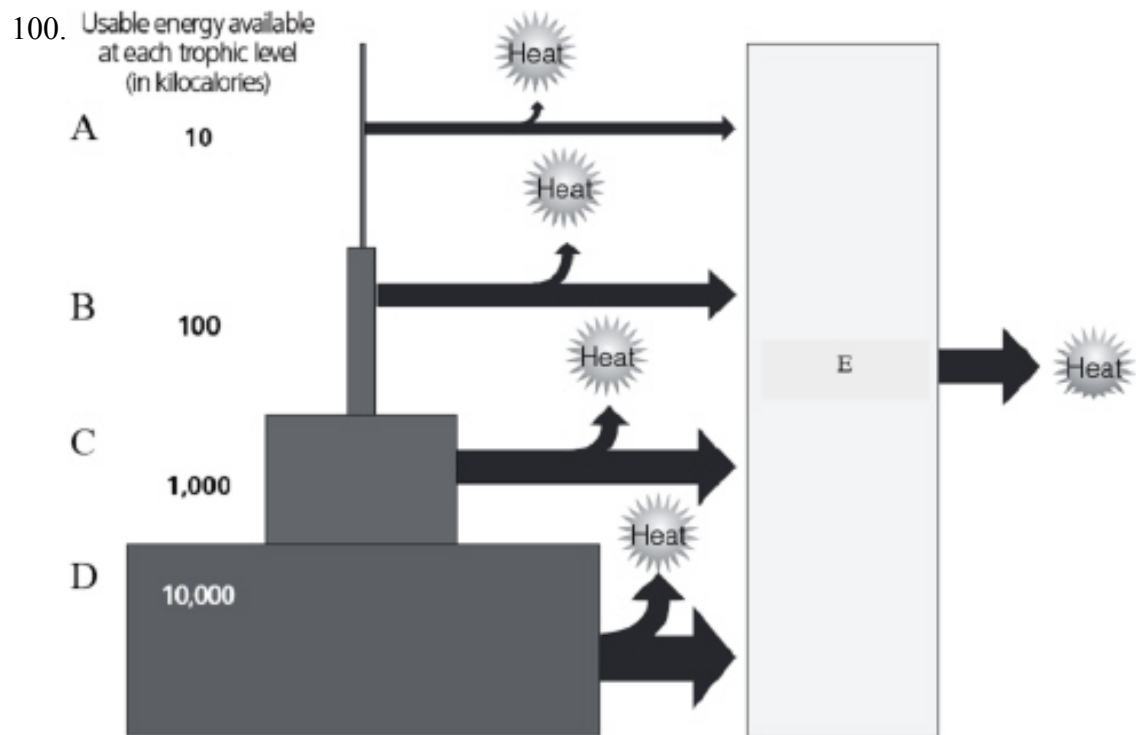
81. Destruction of tropical rain forests will help accelerate _____.

82. Tropical rain forests may be prevented from returning to cleared areas if an irreversible _____ is reached.

83. The study of connections in nature is _____.

84. A group of individuals of the same species living in the same place at the same time is a(n) _____.
- _____
85. Ecologists assign every type of organism in an ecosystem to a feeding level or _____.
- _____
86. Organisms that convert simple inorganic compounds into nutrients, without sunlight, are called _____ organisms.
- _____
87. Organisms that cannot produce their own food and, therefore, must eat other organisms, are called _____.
- _____
88. Decomposers are mainly bacteria and _____.
- _____
89. A sequence of organisms, each of which serves as a source of food or energy for the next, is called a(n) _____.
- _____
90. _____ from the sun is captured, converted into chemical energy, and stored as biomass in the tissues of the producer.
- _____
91. The rate at which an ecosystem's producers convert solar energy into chemical energy as biomass is called _____.
- _____
92. _____ are by far the most productive aquatic ecosystem when measured as average net primary productivity per square meter per year.
- _____
93. Some precipitation sinks through soil and permeable rock formations and into _____ where it is stored as _____.
- _____

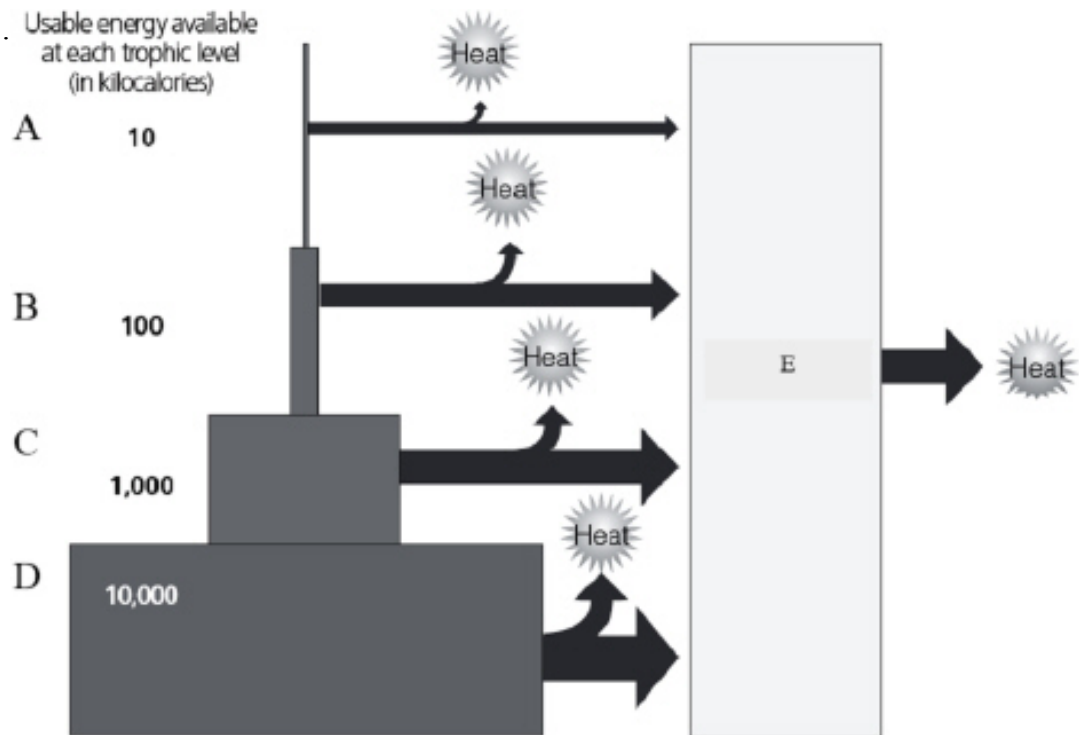
94. The major reservoir for nitrogen is the _____.
- _____
95. Carbon cycles through the biosphere and depends on the process of _____ and _____.
- _____
96. Nitrogen fixation is accomplished by specialized _____ in the soil and _____ in aquatic environments.
- _____
97. The rotten-egg smell coming from volcanoes and anaerobic decomposition in bogs and swamps comes from the gas _____.
- _____
98. _____ can help scientists understand large and very complex systems by allowing them to change variables and project possible changes.
- _____
99. Human activities are altering both the _____ of energy flow and the _____ of nutrients within the carbon cycle.
- _____



Use the Figure above to answer the following question(s).

Letter D, at the base of the pyramid given above, represents what group of organisms?

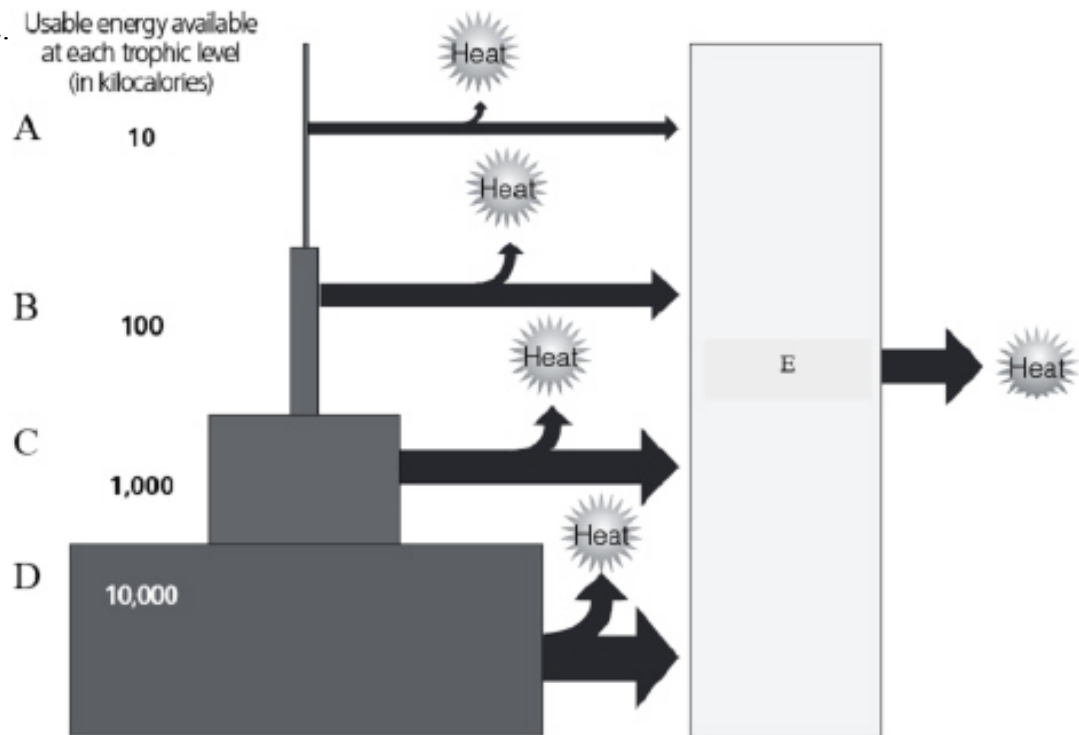
101. Usable energy available
at each trophic level
(in kilocalories)



Use the Figure above to answer the following question(s).

Indicate the letter at which humans would be found?

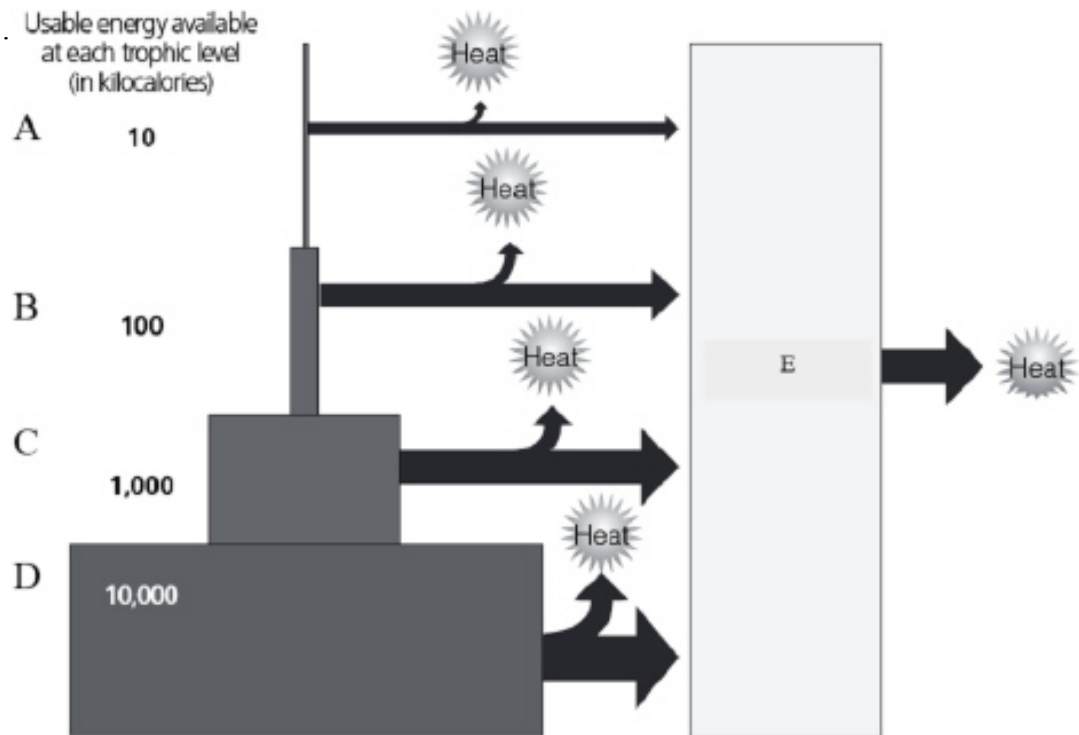
102. Usable energy available
at each trophic level
(in kilocalories)



Use the Figure above to answer the following question(s).

How many kilocalories have been lost between level A and level D?

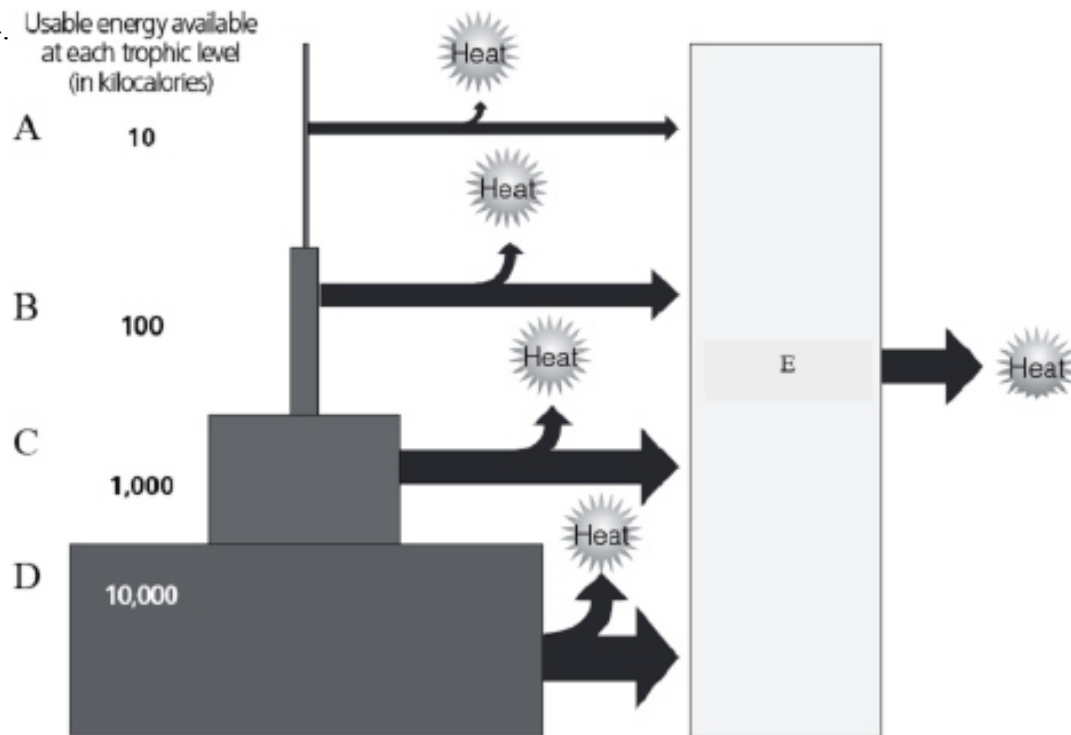
103. Usable energy available
at each trophic level
(in kilocalories)



Use the Figure above to answer the following question(s).

Why is heat shown as being lost to the environment?

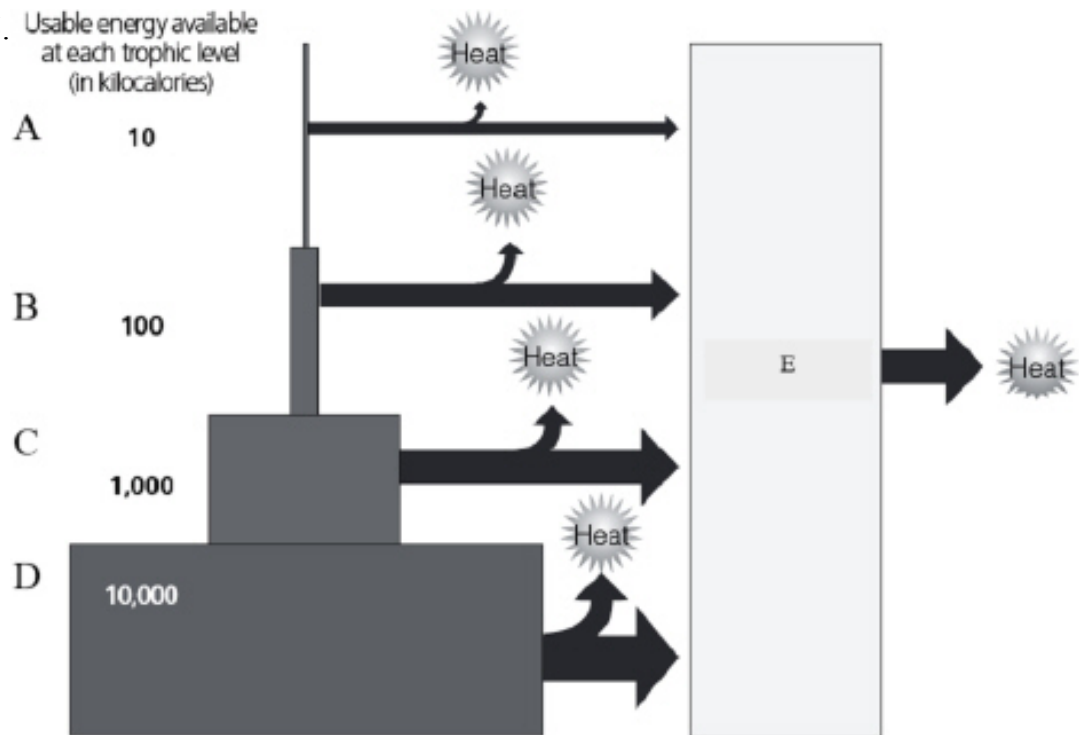
104. Usable energy available
at each trophic level
(in kilocalories)



Use the Figure above to answer the following question(s).

What group is indicated by letter E, to which all organisms in the pyramid eventually succumb?

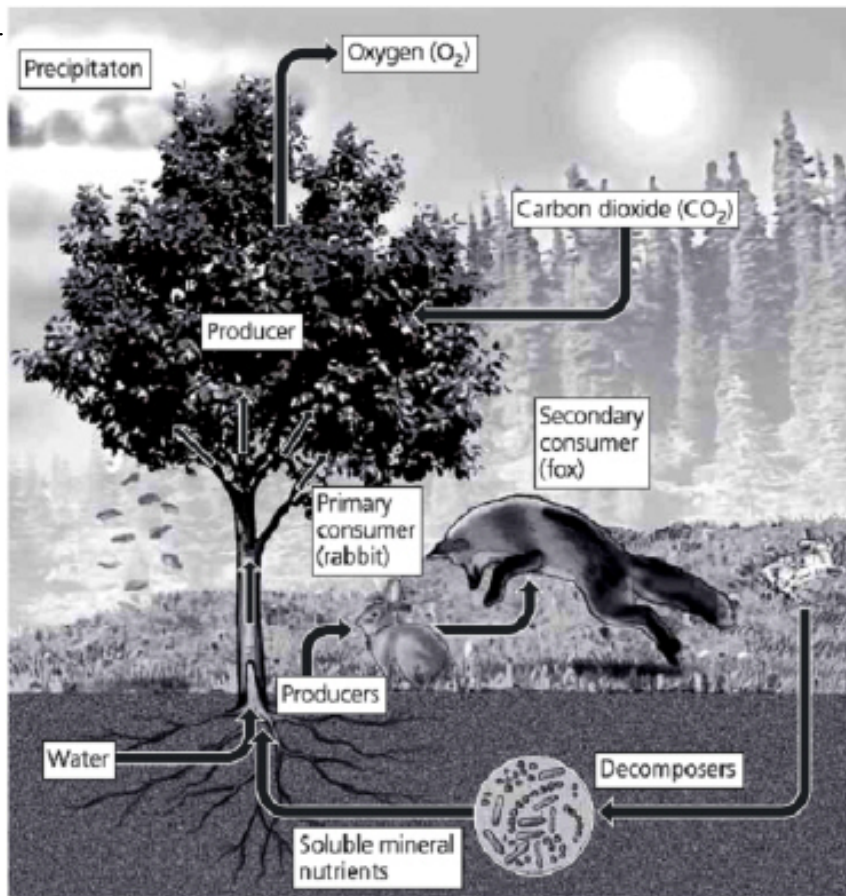
105. Usable energy available
at each trophic level
(in kilocalories)



Use the Figure above to answer the following question(s).

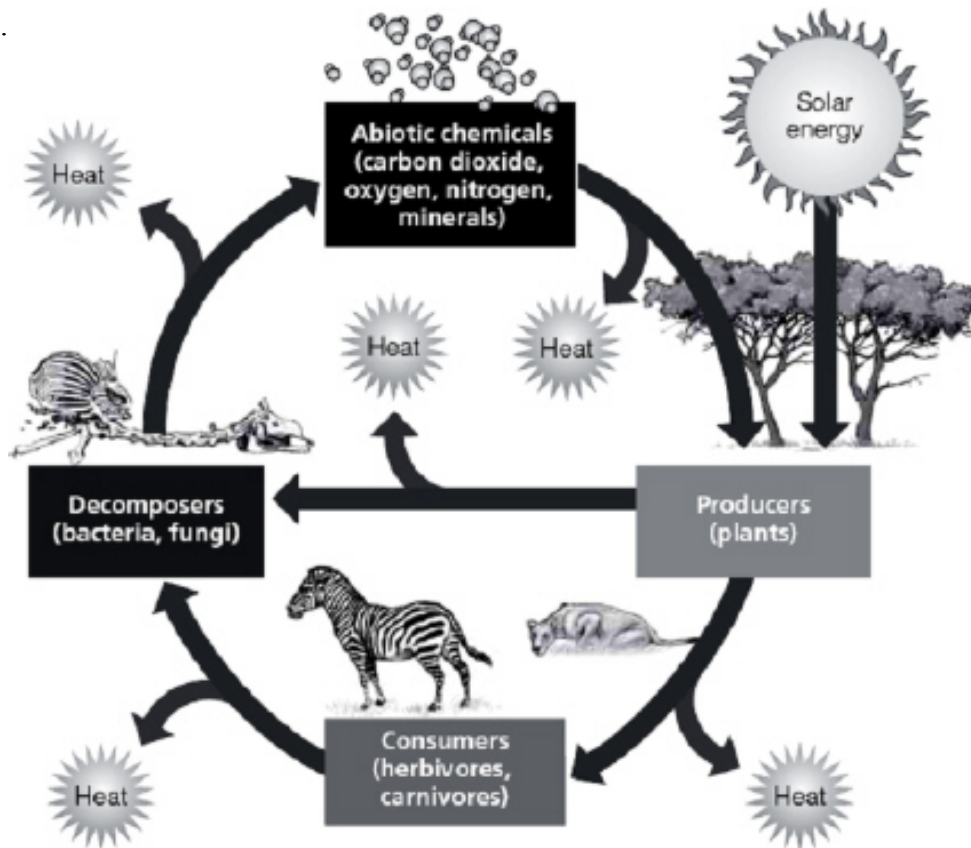
Why would there be fewer organisms at level A than at any level below it?

106.



In the figure above, notice that the fox (secondary consumer) is in the process of pouncing on the rabbit. If humans were to remove that predator (fox), what would be the effects on the rest of the ecosystem? Be as specific as possible.

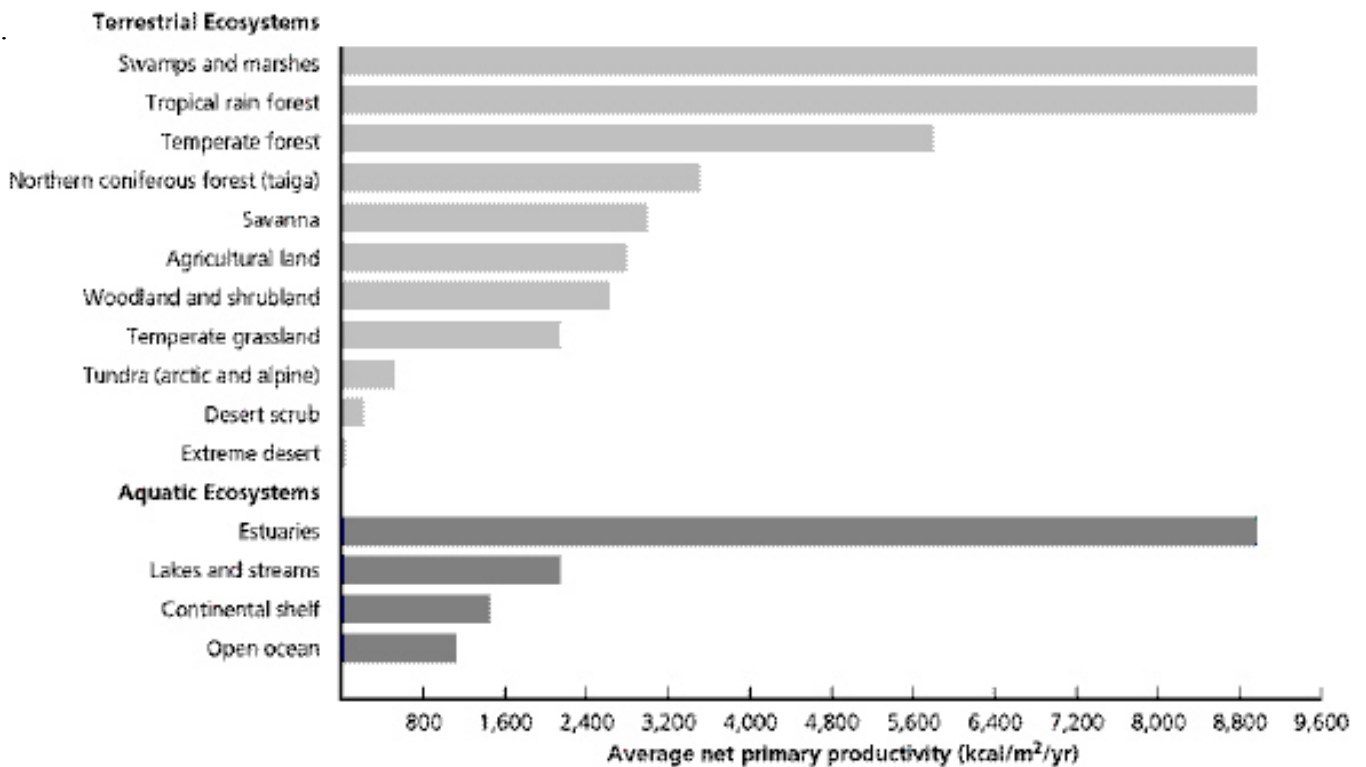
107.



In the figure above, notice that heat is lost by each component of the ecosystem, and that the sun is shown entering at only one point in the system. Explain how this is representative of the two laws of energy (two laws of thermodynamics).

108. Thinking about the concept of trophic levels, explain why it may be necessary for humans to eat less meat. How much energy is lost from one level to the next? Use numbers to support your argument

109.



Examine the figure above. Notice the amount of average net primary productivity gets smaller and smaller as you move down the list of terrestrial ecosystems and, similarly, in the list of aquatic ecosystems. What is the common factor in the terrestrial system that causes the decline? What is the common factor in the aquatic system that causes the decline there?

110. In the plains states of the U.S. (Kansas, Nebraska, Texas, etc.) agricultural withdrawal of groundwater from aquifers has greatly exceeded the supply. Explain why removal of this resource will have long-term effects on the hydrologic cycle.

CHAPTER 3--ECOSYSTEMS: WHAT ARE THEY AND HOW DO THEY WORK? **Key**

1. A
2. D
3. C
4. A
5. D
6. D
7. D
8. E
9. E
10. B
11. D
12. B
13. C
14. D
15. B
16. D
17. A
18. E
19. D
20. C
21. D
22. B
23. A
24. C
25. E
26. D
27. D
28. D
29. B

- 30. C
- 31. E
- 32. C
- 33. A
- 34. A
- 35. D
- 36. E
- 37. B
- 38. D
- 39. C
- 40. D
- 41. C
- 42. E
- 43. B
- 44. B
- 45. D
- 46. C
- 47. E
- 48. E
- 49. E
- 50. D
- 51. TRUE
- 52. FALSE
- 53. TRUE
- 54. FALSE
- 55. TRUE
- 56. TRUE
- 57. TRUE
- 58. TRUE
- 59. FALSE
- 60. FALSE
- 61. TRUE
- 62. TRUE
- 63. FALSE

- 64. TRUE
- 65. FALSE
- 66. FALSE
- 67. TRUE
- 68. TRUE
- 69. TRUE
- 70. FALSE
- 71. TRUE
- 72. TRUE
- 73. TRUE
- 74. TRUE
- 75. FALSE
- 76. TRUE
- 77. TRUE
- 78. TRUE
- 79. TRUE
- 80. FALSE
- 81. global warming
- 82. ecological tipping point
- 83. ecology
- 84. population
- 85. trophic level
- 86. chemosynthetic
- 87. heterotrophs *or* consumers
- 88. fungi
- 89. food chain
- 90. Energy
- 91. gross primary productivity *or* GPP
- 92. Estuaries
- 93. aquifers; groundwater
- 94. atmosphere
- 95. photosynthesis; respiration *or* respiration; photosynthesis
- 96. bacteria; blue green algae *or* bacteria; cyanobacteria
- 97. hydrogen sulfide *or* H₂S

98. Computer modeling *or* Computer simulations

99. rate *or* cycling

100. Producers or plants

101. A

102. 9,990

103. In the process of living, energy is transformed in metabolic processes, with much of the energy being lost as heat.

104. Decomposers

105. The amount of energy lost between levels is so great there is not sufficient energy remaining at the upper level to sustain more.

106. The loss of a predator in an ecosystem results in an imbalance in the system. The primary consumer is freed from the environmental pressure of predation and increases its population. The increased population puts additional pressure on the producers, potentially reducing their viability. The rabbit's food source will eventually decline, possibly resulting in increased death in the rabbit population. Decomposers will have additional food sources and may increase in population. Other prey populations, held in check by the fox, may also experience the same changes.

107. The first law of energy or thermodynamics says that energy can only be transformed, not made or lost. The sun's energy entering only through plants is the means by which light energy is transformed and made available to living organisms. The loss of heat is representative of the first law in that it is a transformation. The loss of heat is also indicative of the second law, which states that high quality energy (sunlight) will constantly be lost as low quality energy (heat).

108. Biological systems are notoriously inefficient in the transfer of energy from trophic level to trophic level. Because 90% of the available energy is lost in each transfer, a human who eats meat is obtaining only about 1% of the energy available in the grains and vegetables of the producer level. Because the human population continues to grow at a rapid pace, there will be millions of new persons to feed each year. As countries become more affluent, they tend to want to eat more meat. The question becomes whether or not there will be enough energy available if we continue to pass it through animals on the way to humans.

109. Terrestrial ecosystems are significantly affected by the amount of water, and consequently, the amount of nutrients. The most productive terrestrial ecosystems are those that have the highest amounts of both water and nutrients. Swamps/marshes and tropical rain forests have significant amounts of water, and therefore have high levels of productivity. When the biomass is recycled, large amounts of nutrients are released and made available. This perpetuates the high net primary productivity. As water becomes less available productivity declines and nutrient availability declines. In aquatic systems the estuaries are the highest and open ocean the lowest. The common factor would appear to be depth. However, the limiting factors are nutrient availability and the number of available niches. Estuaries are close in to shore where they have available nutrients and fresh water from the land. Sunlight will also be available to all levels. The numbers of niches will also be affected by tidal activity. This provides high levels of variability and high net productivity. In the open ocean sunlight cannot reach the depths. Biomass in the upper levels will be lost to the depths, taking nutrients with it. In addition, the open ocean is more uniform and does not provide the amount of variation represented in the estuaries.

110. Aquifers, such as the Oglalla Aquifer in the plains states, provide long-term storage of water. Such aquifers are slow to recharge and may take thousands of years to fill up. The rapid removal of the resource causes the land above the aquifer to subside, and places the water in the rapid turn-over phases of the hydrologic cycle. Irrigation for future droughts will be severely hampered, possibly making them worse.