Date _____

Aim: What are the properties of the major subdivisions of the Earth?

1. Lithosphere

solid outer part of Earth
(Earth's crust and upper mantle)

thickness = 40-280 km

most abundant elements: silicon and oxygen

location of fossil fuels and mineral resources

2. Hydrosphere

water part of Earth (71% of Earth's surface)
(surface and groundwater, ice, and water vapor)

(97% salt, 3% freshwater)

2% ice 1% liquid

average ocean depth = 3.6km

3. Atmosphere

shell of gases surrounding Earth that extends up from Earth's surface approximately 480km

d. THERMOSPHERE -

contains the fewest molecules of all the layers (least dense air),
ultraviolet radiation causes breakdown of molecules, creating ions.

c. MESOSPHERE

b. STRATOSPHERE

OZONE LAYER ($O_{3(g)}$) (lower part of stratosphere) – absorbs harmful UV rays

a. TROPOSPHERE

78% nitrogen
21% oxygen
1% other (water vapor, carbon dioxide)

location of life, weather, pollutants

4. BIOSPHERE / ECOSPHERE

the portion of Earth where living organisms exist and interact with each other and with their nonliving environment

Levels of Organization:

SMALL

ORGANISM

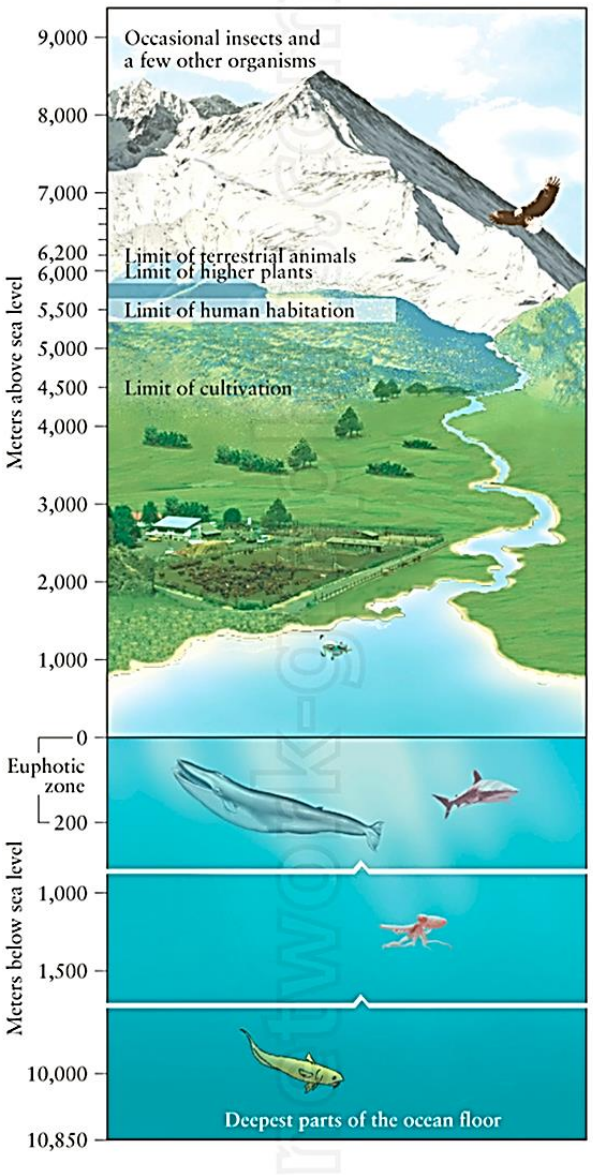
POPULATION
a group of the same species living together

COMMUNITY
populations of different species that live together

ECOSYSTEM
all living organisms (biotic factors) in an area as well as its physical environment (abiotic factors) functioning together

LARGE
(most inclusive)

BIOSPHERE / ECOSPHERE
the sum of all the ecosystems



Ecotone

the transitional zone in which one ecosystem merges with an adjacent one

TO SUSTAIN LIFE ON EARTH:

1. The Sun – **since energy can't be recycled** → it is just degraded and dispersed
2. Nutrient Cycling (a.k.a. biogeochemical cycles)
3. Gravity

Date _____

Aim: How do organisms acquire nutrition?

1. producers (autotrophs)

make their own food

a. photosynthesis

$CO_2 + H_2O + \text{energy} \rightarrow O_2 + C_6H_{12}O_6$

plants and some algae

b. chemosynthesis

bacteria

- use sulfur (ex. H_2S gas) and carbon to synthesize organic compounds such as sugar for nutrition
- base of food web in deep sea environments (ex. near hydrothermal vents)

2. consumers (heterotrophs) - acquire energy by feeding on other things

a. **herbivores** – eat plants (cows, deer, rabbits, elephants, horses)

b. **carnivores** – eat meat/animals (lions, tigers, sharks)

c. **omnivores** – eat plants and meat (humans, foxes, bears, rats, birds, raccoons)

d. **decomposers** – break down organic material

saprophytes – secrete enzymes and absorb nutrition (bacteria and fungi)

detritivores / detritus feeders – help begin the decomposition process by physically breaking down larger particles (earthworms, crabs, ants, termites)

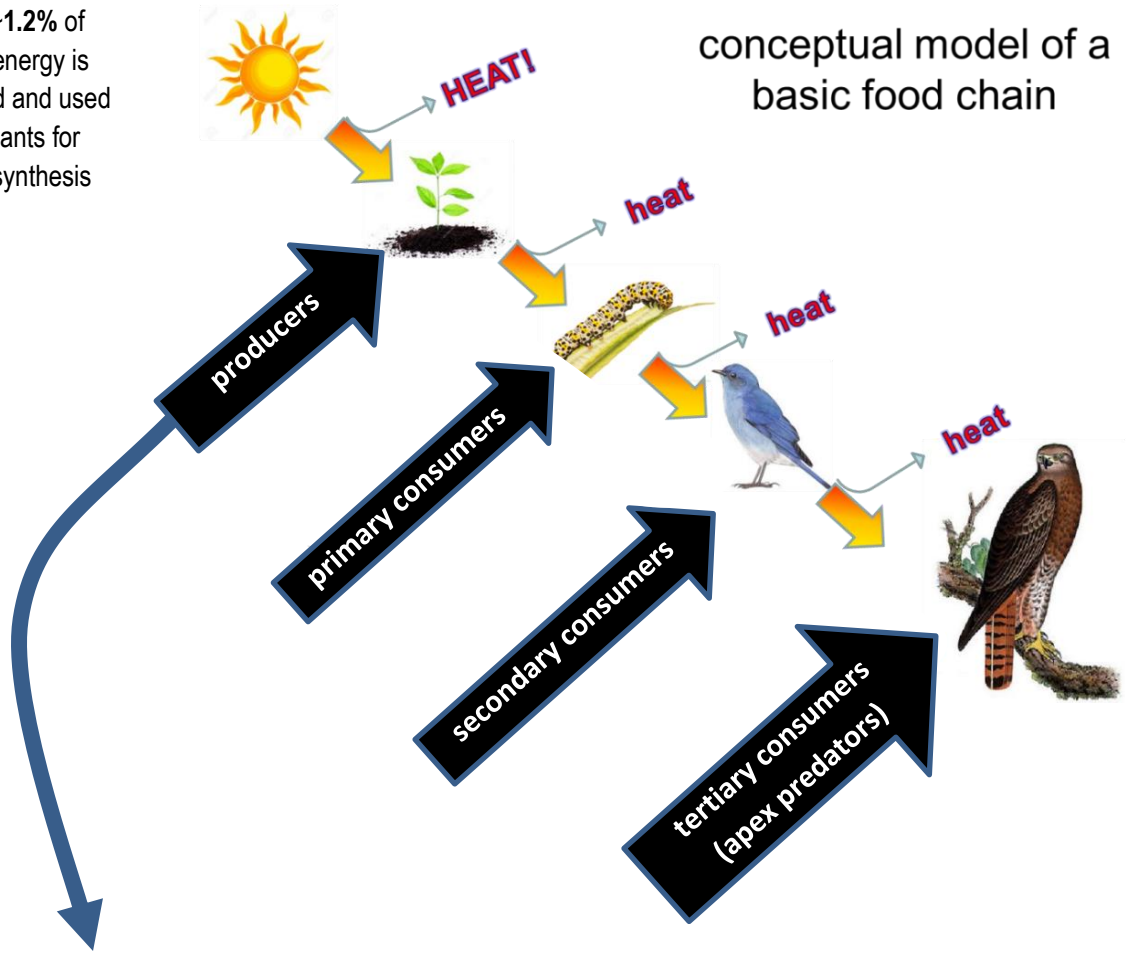
Date _____

Aim: How does energy flow through an ecosystem?

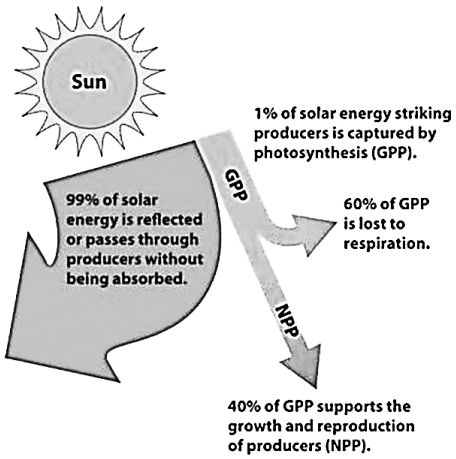
1. **Food Chain -** a linked feeding series (linear – not a true representation of all feeding habits)

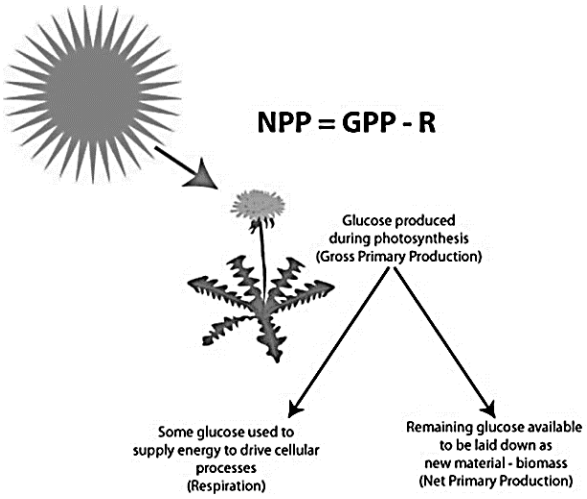
   the arrows in a food chain or web show flow of chemical energy (and/or matter)

only ~**1.2%** of solar energy is captured and used by plants for photosynthesis



Primary Productivity - the rate at which autotrophic organisms (primarily plants and algae) convert solar energy into organic substances through photosynthesis

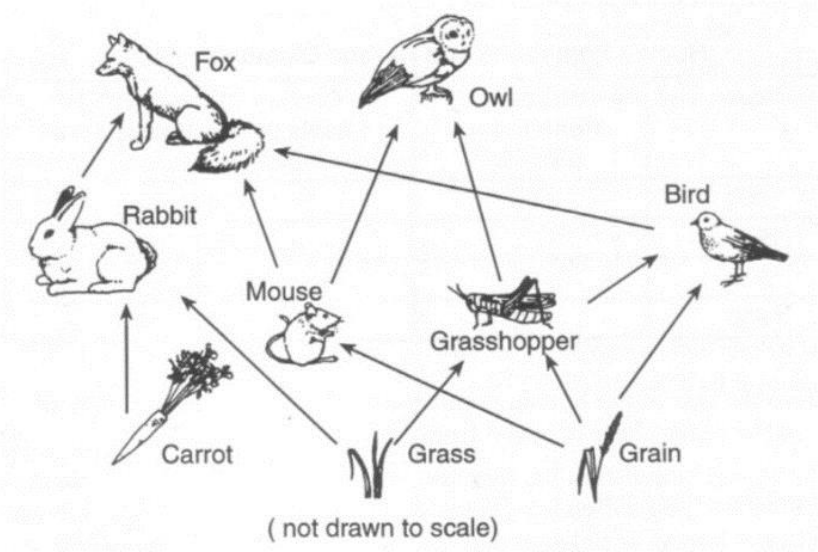




2. Food Web – interconnected food chains (a better representation of energy flow within an ecosystem)

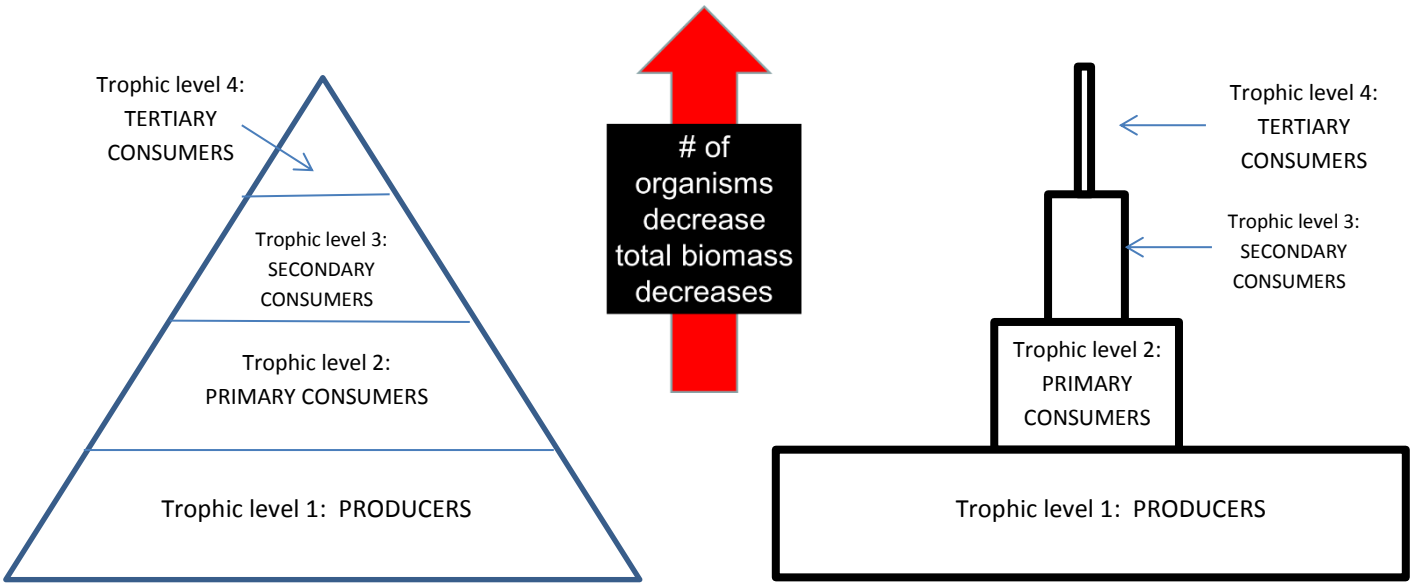
Remember:
following different paths through the food can alter an organism's consumer level

ex. birds can be considered both primary and secondary consumers



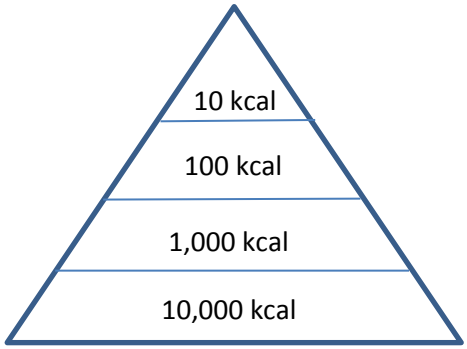
3. Biomass / Energy Pyramid

Biomass - the combined dry weight of all organic matter per trophic (energy/feeding) level



Ecological Efficiency

1. **<u>10%</u> rule - approx. 10% of energy is passed up each trophic level (90% is used up or lost at each level)**



2. Energy is used/lost because:
   a. not all parts are eaten
   b. some energy is used by organisms for life processes
   c. energy is used to maintain body temperature

3. Most energy is degraded and given off as heat as dictated by the **<u>Second Law of Thermodynamics.</u>**
   When energy is changed from one form to another, some of the useful energy is degraded to lower-quality, more dispersed, higher entropy, less useful energy *(usually dispersed heat).*

4. Since little energy can be transferred to higher levels, it is necessary that the 1st level contains greatest biomass to support higher trophic levels.

5. more trophic levels = greater amount of energy lost

6. *More individuals can be supported in an ecosystem if they eat at lower trophic levels.*

Date _____

Aim: What are the main non-living components of an ecosystem?

ABIOTIC FACTORS

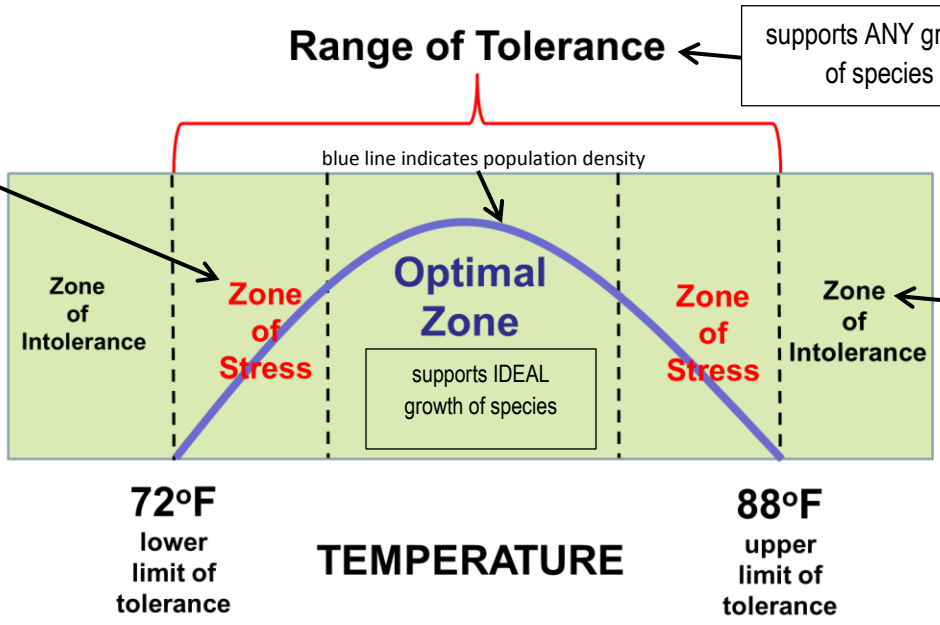
a. RESOURCES –
consumed or used by organism

sunlight, water, nutrients (N, P),
atmospheric gases, DO (dissolved oxygen)

b. CONDITIONS -
not consumed by organism
(physical part of environment)

temperature, rocks, wind, salinity, physical space,
transparency (clarity of air/water), pH of water,
turbidity (amount of suspended sediments in water)

Zone of Physiological Stress
species survive,
but do not thrive
- may not reproduce,
- lethargic
(can't hunt for food)
- weakened immunity



LIMITING FACTORS: any factor that prevents or inhibits the growth, distribution, and development of a population

Examples:

1. climate (temperature and precipitation)
2. amount of competition
3. availability of sunlight
4. specific nutrients in soil (N and P) / DO in water
5. too many predators
6. disease

limiting factors can change with time (example: seasonal changes)

 Date _____

Aim: How do organisms interact in an ecosystem?

SYMBIOSIS

a close physical relationship between two organisms

1. MUTUALISM

a relationship between two organisms in which both species benefit

clownfish and sea anemone
The anemone provides a home/protection as the clownfish is immune to its sting. The clownfish drops food particles that the anemones can use as nutrition.

crocodile and plover
The plover eats the leeches that get caught in the crocodile's teeth. The crocodile is then relieved of those parasites.

2. COMMENSALISM

a relationship between two organisms in which one species benefits and the other is unaffected

shark and remora
The remora attaches itself to a shark for a ride and to catch scraps of food from the shark's meals, but the shark remains unaffected.

cattle and egret
The egret will eat insects that have been disturbed when the cattle are moving through the grass searching for food.

3. PARASITISM

a relationship between two organisms in which one species benefits and the other is harmed

human and tapeworm
The tapeworm derives food (and shelter) from the human host and the human is denied the nutrition that is consumed by the tapeworm.

4. PREDATION

A predator is an organism that eats another organism. The prey is the organism which the predator eats.

Some examples of predator and prey are lion and zebra, bear and fish, and fox and rabbit. The words "predator" and "prey" are almost always used to mean only animals that eat animals, but the same concept (although untraditional) can also applies to plants: bear and berry, rabbit and lettuce, grasshopper and leaf.

5. COMPETITION

the fight for a resource (food, territory, mating rights)

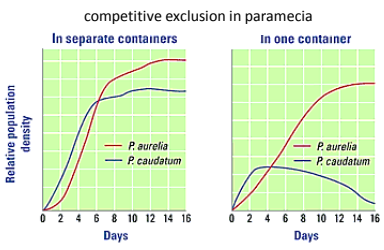
intraspecific competition – between members of the same species

interspecific competition – between members of different species

interference competition – an organism prevents/blocks use of a resource by another organism

exploitation competition – an organism uses up a resource more quickly than others can

competitive exclusion principle -
2 species competing for the same resource cannot coexist at constant population values



resource partitioning –
sharing of resources that avoids competition

different species of warblers (birds) – use different parts of the same tree
lions and leopards – lions eat bigger prey, leopards eat smaller
hawks and owls – hawks hunt during day, owls hunt at night

SYMBIOTIC RELATIONSHIPS

Organisms	Relationship	Explanation of Relationship
1. DEER / TICK	parasitism	ticks feed on deer blood to the deer's detriment – nutrient loss, disease transfer
2. CUCKOO / WARBLER	parasitism	a cuckoo may lay its eggs in a warbler's nest - the cuckoo's young will displace the warbler's young and will be raised by the warbler
3. OSTRICH / GAZELLE	mutualism	ostriches and gazelles feed next to each other and both watch for predators and alert each other to danger; since the visual abilities of the two species are different, they each can identify threats the other animal would not as readily see and both species benefit
4. HERMIT CRAB / SNAIL SHELL	commensalism	hermit crabs live in shells made and then abandoned by snails which neither harms nor benefits the snails
5. HUMANS / BACTERIA	mutualism	intestinal bacteria (such as some strains of e. coli) that feed on everything that the human body is not able to process and digests it partially, facilitating the work of the human intestine – both species benefit
6. MISTLETOE / SPRUCE TREE	parasitism	mistletoe extracts water and nutrients from the spruce tree to the tree's detriment
7. HONEY GUIDE BIRD / BADGER	mutualism	honey guide birds alert and direct badgers to beehives and then badgers expose the hives and feed on the honey - then the honey guide birds eat - both species benefit
8. COWBIRD / BUFFALO	commensalism	as buffalos walk through grass, insects become active and are seen and eaten by cowbirds which neither harms nor benefits the buffalo
9. BARNACLE / WHALE	commensalism	barnacles create home sites by attaching themselves to whales which neither harms nor benefits the whales
10. OXPECKER / RHINOCEROS	mutualism	oxpeckers feed on the ticks found on a rhinoceros - both species benefit

Date _____

Aim: How do species help shape biological communities?

HABITAT – the physical location where a species lives

NICHE - the functional role of a species in an ecosystem (the "job" of a species)

Example: scavengers (hyenas, crows, vultures) rid the environment of dead carcasses (carrion) and aid in the decomposition process

Species Significance within a Niche

SPECIALIST	versus	GENERALIST
- narrow niche		- broad niche
- adapted to very specific conditions		- wider range of tolerance
- prone to endangerment when conditions change		- can adapt to changing conditions well
Examples: koalas pandas hummingbirds		Examples: cockroaches raccoons horseshoe crabs

INDICATOR SPECIES

an organism whose presence, absence or abundance reflects a specific environmental condition because they are ESPECIALLY vulnerable to change

- "nature's early warning system" that can reflect the changing health of an ecosystem

EXAMPLES:

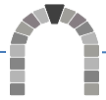
1. frogs (and other amphibians, like salamanders) - permeable skin absorbs toxins quickly
   → limb mutations and other dysfunction?
   Minnesota 1995 case study – frogs with extra legs still not "solved" – chemicals? parasites? UV radiation? – combo?

2. lichens - sensitive to heavy metals or acids
   - good indicators of air pollution (esp. SO_2) if lichen population decreases or is absent

3. birds (especially birds of prey such as eagles and falcons) -
   - decline in bird populations helped indicate the negative effects of the chemical pesticides such as DDT (eggshell and beak abnormalities)

4. macroinvertebrates (ex: dragonfly and stonefly larvae, snails, worms, beetles) -
   - commonly used as indicators of pollution of aquatic ecosystems because they spend all or most of their lives in water, are easy to collect and differ in their tolerance to pollution.

KEYSTONE SPECIES



species whose role is vital for the survival of other species and the ecosystem itself

EXAMPLES:

1. starfish of the Tatoosh Islands (Washington State) – the study that coined the term "keystone species"
   When starfish were removed from tidal flats, mussels took over and crowded out other species – biodiversity of the ecosystem decreased by 50% within one year

2. sea otter of the Pacific Northwest – Sea otters keep sea urchin populations in check; an overpopulation of sea urchins would destroy the kelp forests that serve as the base of the food chain as well as a habitat for many organisms.

3. prairie dogs of the Great Plains – Prairie dog colonies aerate and help fertilize and retain water the soil allowing a greater diversity of plants to thrive

4. gray wolf of North America (Yellowstone) – Grey wolves were hunted to local extinction in early 1900's.
   A "trophic cascade" occurred: Elk populations increased → overgrazed territory affecting many other species.
   After being reintroduced to the park in 1995 – the ecosystem's struggling populations of fish, beaver, willow, and songbirds recovered.

Date _____

AIM: How can invasive species change established ecosystems?

Invasive Species: not originally from the location they are found AND causes harm

Synonyms: invading introduced alien exotic non-indigenous

How do invasive species disrupt the natural, balanced relationships in an ecosystem?

a. direct predation of native species

b. no natural predators → unchecked, sometimes exponential, population growth

c. **outcompete native species** and cause their populations to decline

Examples of Invasive Species:

1. Rabbits in Australia

Rabbits were introduced when Europeans first settled in Australia in 1859. They were brought there for two main reasons – the domesticated rabbit was a ready source of meat, and the wild rabbit introduced later for hunting. The rabbit populations exploded because they reproduced much quicker than they were hunted. To control the problem from spreading, an 1833km fence was built to try to prevent the rabbits from spreading, but it was a complete failure. Kangaroos and emus were negatively affected as they would get caught in the fence just like dolphins are affected by drifting nets in the ocean. The rabbits are partially blamed for the extinction of almost an eighth of the mammal species in Australia and have caused millions of dollars of agricultural and soil damage a year. To control the problem, a virus was injected into the rabbit population that usually killed the infected rabbit within 14 days, but could be spread to others by mosquitoes or fleas.

2. Water Hyacinths in Louisiana

The water hyacinth was first brought from South America to the U.S. as part of a fair held in New Orleans. They proved to be popular gifts and were transported to garden ponds around the city. The hyacinths reproduced and quickly spread to neighboring waterways. With no natural controls, such as disease or predators, it soon covered immense areas of Louisiana, clogging canals used for boating and fishing. Water hyacinths have been considerably reduced by the introduction of insects that would feed on the plants, heavy doses of herbicides, and physical removal.

3. Asian Long-horned Beetles in New York

Native to Eastern Asia, the long-horned beetle accidentally made its way to New York in wood packing material. Spread of the Asian long-horned beetle is accomplished through infested tree-based materials, including live trees, fallen timbers and firewood. This can be difficult to address, due to the larvae being deep within the wood. Larvae develop out of the eggs and chew "galleries" into the inner parts of the tree, on which they will feed during the overwinter process. Adults emerge during the spring through these holes that can be found on various spots on the tree, mainly around the branches and trunk of the tree. There can be thousands of the holes that the adults appear from in an infested tree. By making so many holes, adults cause the tree to lose nutrients to maintain its life needs, such as water and sap. To prevent the spread, tree removal and then quarantines are established which prohibit the movement of infected wood.

4. Brown Tree Snakes in Guam

Indigenous to Australia, Indonesia, and the Solomon Islands, the brown tree snake was accidentally transported from its native range in the South Pacific to Guam either as a stowaway in ship cargo or by crawling into the landing gear of Guam-bound aircraft shortly after World War II. Because of the absence of natural predators, brown tree snake populations reached unprecedented numbers. Snakes caused the local extinction of most of the native forest vertebrate species, especially birds (the Guam rail) and lizards. This, in turn, caused a spike in the spider population. To control the problem, mouse bait injected with Tylenol (which was poisonous to the snakes), was released in the environment.

5. Cane Toads in Australia

Cane toads were intentionally introduced in Australia in 1935 to help combat cane beetles that were destroying sugar cane crops. They completely failed at regulating the cane beetles, and instead turned their attention to other native insects. Cane toads will eat just about any insect and they reduced prey for native insectivores which created imbalance in the native food webs. Since the initial release of 3,000 toads, cane toad populations in Australia number in the millions and their range continues to expand. In addition to Australia, they're found in south Florida, throughout the Caribbean, and in other tropical and subtropical locales. Cane toads are also poisonous throughout their lifecycle. Whether they're eggs, tadpoles, or full-grown adults, cane toads can poison and potentially kill anything that ingests them. Cane toad poisoning in household pets, such as dogs, has become quite common in Australia and Hawaii. Manual removal is the main management strategy for cane toads. Although toads can be removed as adults, it's easiest to collect the jelly-like strings of cane toad eggs from local creeks or ponds. Also, mesh fencing is used to stop the spread of the toad, but native fauna can also get caught up in the nets. In Australia especially, there is a widespread education campaign to warn people about the dangers of cane toads and invasive species.

6. Asian Carp in the Mississippi River

Asian carp were brought to the United States in the 1970s to help control algae in catfish farms of the Deep South. The carp escaped into the Mississippi River system during flooding episodes in the early 1990s, established self-sustaining populations in the lower Mississippi River, and then began moving northward. Thus far, the fish have been restricted to the Mississippi River watershed; however, it is feared that they will be able to enter the Great Lakes. They are fierce competitors, capable of pushing aside native fishes to obtain food, and their populations grow rapidly, accounting for 90% of the biomass in some stretches of the Mississippi and Illinois rivers. Once in the Great Lakes ecosystem, they could wreak havoc on the foundations of the food chains of the major lakes and adjoining rivers. To deal with this potential menace, two electric fish barriers have been placed within a 1,500-foot stretch of the canal. Electrical pulses emanating from the barriers keep the fish at bay while also allowing barge traffic to move up and down the waterway. This measure, however, may not be 100% effective. In addition, rotenone, a biodegradable piscicide (fish poison) is added to the water whenever repairs to the electric barriers are required.

SUMMER ASSIGNMENT PART 1:
ECOLOGY TERMINOLOGY AND MULTIPLE-CHOICE QUESTIONS

To be submitted on a Google Form by midnight on Friday, September 15th
30-point assignment based on accuracy.
Breakdown is as follows: 95-100 questions correct = 30 points, 85-94 questions correct = 27 points, 65-84 questions correct = 25 points, < 65 = 15 points

Terminology Check: After reading through the notes provided by your teacher, you will have reviewed many of the terms and concepts that you have already learned in previous coursework. Keep in mind that the hybrid structure of school during your 8th and 9th grade years may have created some gaps in learning. You may not remember some of this material, while some of your previous teachers may also have adjusted/truncated curricula because of changes in course requirements during those years. Use the information in the notes provided to fill in the Google form with the correct term from the "word box" provided. To be very clear: **Make sure that you spell each term correctly and do not use any capital letters or your answer will be marked incorrect**. For the multiple-choice questions, make sure that you do not omit any of the questions and only choose one answer to each question.

ECOLOGY TERMINOLOGY

Fill in the blank with the most appropriate term. Not all terms will be used, and each term may only be used once.

specialist species	keystone species	invasive species
generalist species	indicator species	habitat
community	intraspecific competition	interspecific competition
ecotone	ecosystem	population
mutualism	parasitism	commensalism
optimal zone	range of tolerance	limiting factors
niche	abiotic conditions	abiotic resources
zone of stress	zone of intolerance	saprophyte
chemosynthesis	photosynthesis	detritivores
scavenger	predator	autotrophs
heterotrophs	lithosphere	hydrosphere
atmosphere	troposphere	stratosphere
biomass		

1. leeches attach to and feed off the blood of animals to gain nutrition to the detriment of the other organism _____

2. layer of the atmosphere containing the ozone layer _____

3. an overlapping zone between ecosystems _____

4. turbidity, temperature, transparency _____

5. hunts for its food _____

6. range of conditions with the highest population density _____

7. range of conditions in which organisms survive, but do not thrive _____

8. anything that inhibits the growth, and development of a population; examples: climate, too many predators _____

9. process by which producers convert sunlight to glucose _____

10. fungi and bacteria _____

11. layer of the atmosphere where people and animals live _____

12. have a broad niche; adapt well to changing conditions _____

13. groups of different interacting species _____

14. Asian long-horned beetle in NY _____

15. when two different species fight for a food source or territory _____

16. the combined dry weight of all organic matter per trophic level _____

17. frogs, lichens, birds of prey _____

18. grey wolves, sea otters, sea stars _____

19. the role of an organism in an ecosystem _____

20. process by which deep sea bacteria convert hydrogen sulfide gas into nutrition _____

21. carpenter ants, termites, worms _____

22. contribute to the ecosystem by consuming "leftovers" which aids in the decomposition process _____

23. consists of the Earth's crust and upper mantle _____

24. prone to endangerment when environmental conditions change _____

25. all living organisms and their physical abiotic environment _____

26. bees get the nectar they need to make honey by traveling between flowers and bring pollen from one plant to another, resulting in pollination _____

27. the entire range of conditions that supports any growth of a species _____

28. the base of a biomass pyramid _____

29. shark and remora relationship _____

30. a group of the same species _____

ECOLOGY MULTIPLE CHOICE QUESTIONS

Questions 1-6: Answer as either True or False

____ 31. 99% of the biosphere exists in the thermosphere

____ 32. The biosphere and ecosphere are synonymous terms.

____ 33. The highest concentration of beneficial ozone is located in the upper stratosphere.

____ 34. Primary consumers are heterotrophs.

____ 35. Energy can be recycled in the environment.

____ 36. Energy degradation in a food chain is best explained by the First Law of Thermodynamics

Questions 37-40: Choose the region that best fits the description provided.

(A) lithosphere
(B) hydrosphere
(C) atmosphere
(D) troposphere
(E) stratosphere

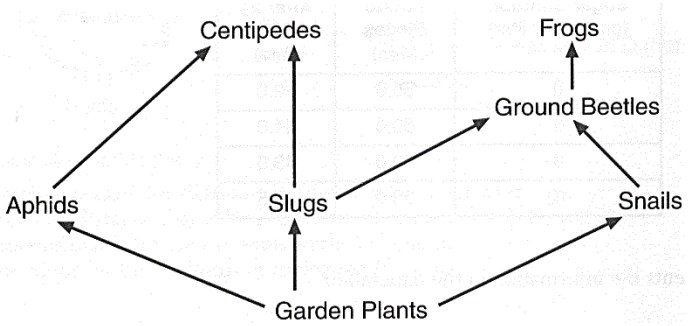
37. silicon and oxygen are most abundant elements in this region

38. lowest layer of the atmosphere

39. the region that is 480km in depth, but the bottom 12km consists of the highest concentration of oxygen

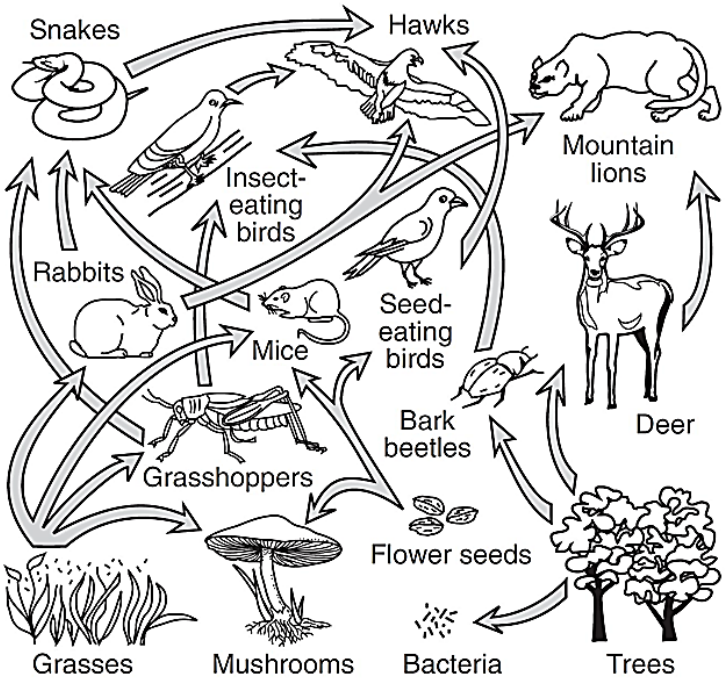
40. makes up 71% of Earth's surface

41. Which of the following is true of the food web shown to the right?
    (A) aphids eat centipedes
    (B) slugs are omnivores
    (C) snails prey on ground beetles
    (D) frogs are tertiary consumers
    (E) garden plants are herbivorous



42. Most of the energy put into the food chain
    (A) is in the form of heat
    (B) is converted to biomass by the end of the chain
    (C) is recycled by the end of the chain
    (D) exits in the form of low-quality waste heat
    (E) is used efficiently by the end of the chain

43. In the diagram below, which organisms are correctly paired with their nutritional roles?
    (A) hawk - decomposer; insect-eating bird - parasite
    (B) mouse - autotroph; flower seed - heterotroph
    (C) mountain lion - predator; bark beetle - herbivore
    (D) grasshopper - carnivore; grass - autotroph
    (E) snake – omnivore; mushroom – detritivore



44. A fundamental concept of ecology is that living organisms
    (A) are independent and do not interact with each other or with the physical environment.
    (B) do not interact with other living organisms, but do interact with the physical environment
    (C) interact with each other, but do not interact with the physical environment
    (D) interact with other living organisms and interact with the physical environment

45. Which of the following statements is true of tertiary consumers in an ecosystem?
(A) There are more secondary consumers than tertiary consumers.
(B) They are eaten by secondary consumers.
(C) They contain the most biomass out of all of the trophic levels.
(D) They are the largest trophic level.
(E) This level of the food chain has the highest amount of diversity.

46. Which trophic level does a lion belong to
(A) level 1 - producers
(B) level 2 - primary consumers
(C) level 2 – secondary consumers
(D) level 3 - secondary consumers
(E) level 3 – tertiary consumers

47. What percentage of energy is generally said to be passed upwards each successive level in the biomass-energy pyramid?
(A) 10% (B) 30% (C) 50% (D) 70% (E) 90%

48. Approximately what percentage of the solar energy that strikes the Earth is used for photosynthesis by plants?
(A) 1% (B) 10% (C) 21% (D) 71% (E) 78%

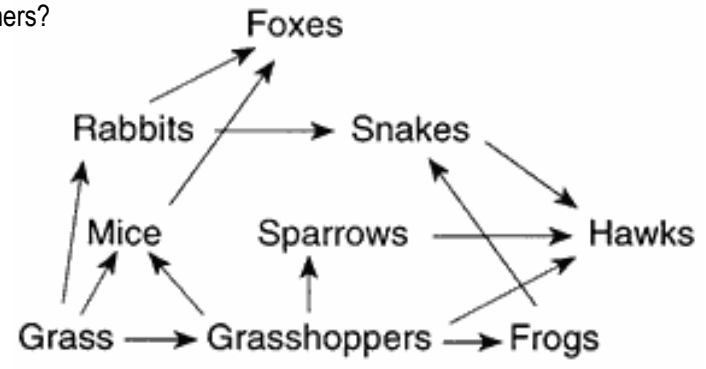
49. The second trophic level of a typical biomass pyramid consists of
(A) producers
(B) primary consumers
(C) secondary consumers
(D) carnivores
(E) detritivores

50. Which term (or terms) can be used to describe a city rat?
(A) omnivore
(B) saprophyte
(C) heterotroph
(D) A and C, only
(E) A, B, and C

51. Which of the following reasons account for the decrease in energy passed on to each successive trophic level?
(A) metabolic heat loss
(B) not all biomass is consumed at each level
(C) the increased number of organisms at high levels use up the excess energy
(D) A and B, only
(E) A, B, and C

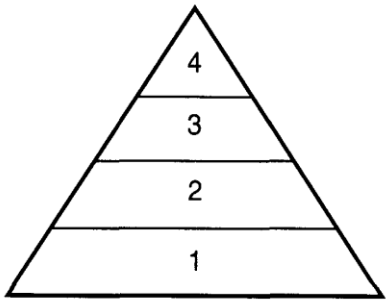
52. Which of the following organisms occupies the trophic level of greatest biomass?
(A) herbivores
(B) producers
(C) primary consumers
(D) secondary consumers
(E) tertiary consumers

53. In the food web above, which animals are tertiary consumers?
    (A) rabbits and sparrows
    (B) sparrows and hawks
    (C) snakes and hawks
    (D) frogs and foxes
    (E) mice and grasshoppers



54. Organisms that have the exact same source of nutrition within a food web can best be described as
    (A) providing links in the food chain
    (B) occupying the same trophic level
    (C) being omnivores
    (D) being herbivores
    (E) being tertiary consumers

Base your answers to **questions 55-56** on the drawing below of the pyramid of energy and numbers.



55. In which level would a monarch caterpillar that feeds on the milkweed plant belong to?
    (A) 1
    (B) 2
    (C) 3
    (D) 4

56. If the first trophic level represents an ecosystem with 100,000 kcal available to its producers, how much energy is available for the tertiary consumers in the ecosystem?
    (A) 100,000 kcal
    (B) 10,000 kcal
    (C) 1,000 kcal
    (D) 100 kcal

57. In a forest food chain, the least amount of energy would flow to which of the following organisms?
    (A) herbivores
    (B) producers
    (C) primary consumers
    (D) secondary consumers
    (E) tertiary consumers

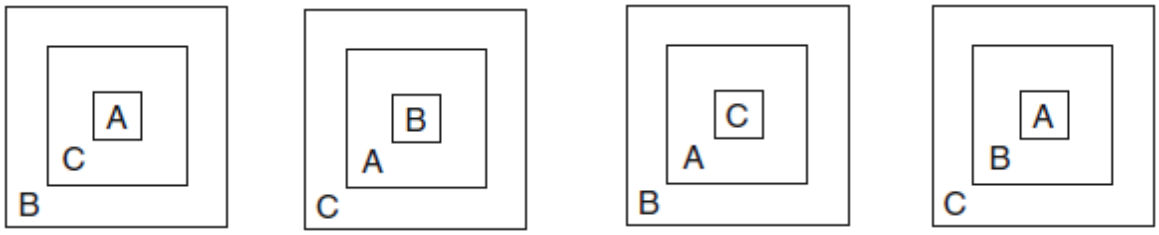
58. Which of the following organisms occupies the lowest trophic level?
    (A) lion
    (B) hawk
    (C) shark
    (D) cow
    (E) spider

59. A food chain represents
    (A) a list of what one organism eats
    (B) the flow of energy from one organism to another
    (C) links of what animals live together
    (D) the way that food is produced in an ecosystem

The chart below shows three ecological terms used to describe levels of organization on Earth.

A	ecosystem
B	population
C	biosphere

60. Which diagram best represents the relationship of these ecological terms?



(A) (B) (C) (D)

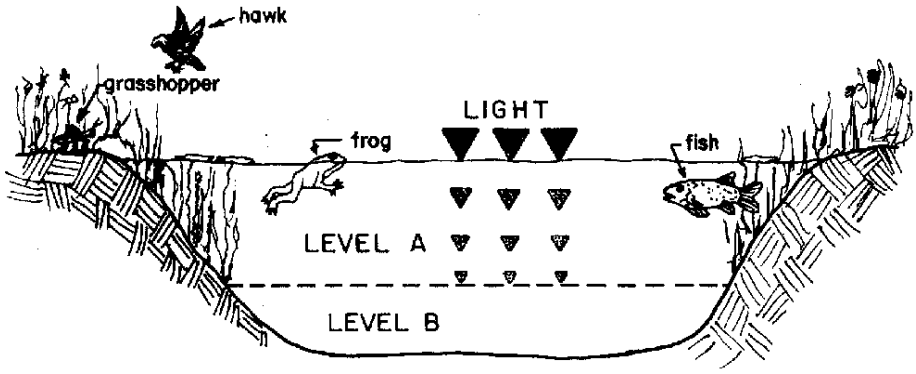
61. Which statement best describes an ecosystem maintaining a state of approximate equilibrium?
    (A) Nutrients from decayed organisms are recycled in a forest ecosystem by decomposers.
    (B) All the frog species in a South American rain forest become extinct.
    (C) A mutation spreads through a species of bacterium, making them unable to decompose wastes.
    (D) Mice are released into a field ecosystem as food for a declining predator population.

62. What is the term used to describe the transitional zone in which one ecosystem merges with an adjacent one?
    (A) ecoboundary
    (B) ecotone
    (C) biotransition zone
    (D) biosphere
    (E) ecotranzonation

63. "True" decomposers that secrete enzymes to absorb nutrition are known as
    (A) scavengers
    (B) detritus feeders
    (C) detritovores
    (D) saprophytes
    (E) specialists

64. In deep sea environments, by what process do bacteria convert sulfur compounds to organic sugars?
    (A) aphotosynthesis
    (B) modified photosynthesis
    (C) chemosynthesis
    (D) saprophytic nutrition
    (E) succession

Base your answers to **questions 65-67** on the diagram of a lake ecosystem below and on your knowledge of biology. The diagram shows a cross section of a deep lake. the dashed line which separates level A from level B indicates the depth beyond which light cannot penetrate.



65. Which type of organism that ordinarily inhabits a lake ecosystem would not be found in level B because of the lack of light penetration?
    (A) decomposers
    (B) scavengers
    (C) carnivores
    (D) producers
    (E) omnivores

66. A possible food chain represented by the diagram could be
    (A) plant → grasshopper →frog → fish
    (B) hawk → plant → grasshopper → frog
    (C) grasshopper → fish → frog → plant
    (D) plant → hawk → frog → fish

67. The amount of light received by the pond would be considered a(n)
    (A) biotic limiting factor
    (B) abiotic limiting factor
    (C) trophic level
    (D) ecotone

68. Which of the following are necessary to sustain life on Earth?
    I. gravity
    II. biogeochemical cycles
    III. the Sun

    (A) I, only
    (B) II, only
    (C) III, only
    (D) I and III, only
    (E) I, II, and III

69. Almost all of the Earth's weather occurs in the:
    (A) exosphere
    (B) stratosphere
    (C) mesosphere
    (D) thermosphere
    (E) troposphere

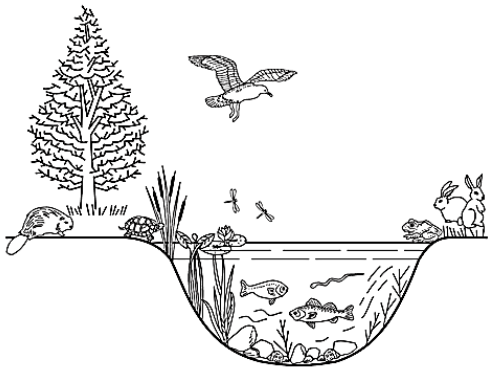
70. The ozone layer helps life on Earth because ozone
(A) modifies the normal El Niño weather pattern
(B) reflects insolation from the Sun
(C) absorbs damaging ultraviolet radiation from the Sun
(D) deflects winds from a straight line to a curved path

71. Which formula correctly illustrates the process of photosynthesis?
(A) $C_6H_{12}O_6 + H_2O \rightarrow CO_2 + O_2 + \text{energy}$
(B) $O_2 + H_2O \rightarrow \text{energy} + CO_2 + C_6H_{12}O_6$
(C) $CO_2 + H_2O + \text{energy} \rightarrow O_2 + C_6H_{12}O_6$
(D) $CO_2 + C_6H_{12}O_6 + \text{energy} \rightarrow H_2O + O_2$

72. Which level of biological organization includes the greatest total number of species?
(A) community
(B) ecosystem
(C) population
(D) biosphere

73. What does the diagram best represent?

(A) community
(B) ecosystem
(C) population
(D) biosphere



74. The abiotic factors of a given area include the
(A) animals
(B) climatic conditions
(C) plants
(D) decomposers

75. Which term refers to the behavior of two species attempting to use the same living space, food source, and water source?
(A) saprophytic
(B) competitive
(C) predatory
(D) symbiotic

76. During its annual migration, the red knot, a medium-size shorebird, flies the entire length of North and South America. During one critical stop to feed on the eggs of horseshoe crabs, the birds nearly double their body mass. The relationship between the red knot and the horseshoe crab is that of
(A) parasite–host
(B) consumer–producer
(C) scavenger–producer
(D) predator–prey

77. Which relationship best describes the interactions between lettuce and a rabbit?
(A) predator — prey
(B) producer — consumer
(C) parasite — host
(D) decomposer — scavenger

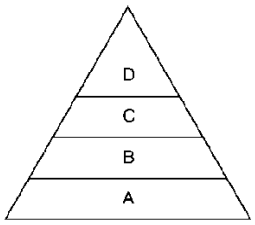
78. Which of the following would be considered a specialist species?
    (A) pandas
    (B) rats
    (C) cockroaches
    (D) raccoons

79. Two interactions between organisms are shown in the table below. X and Y do *not* represent the same organisms in the two interactions

	Organism X	Organism Y
Interaction 1	predator	prey
Interaction 2	parasite	host

Which statement best describes the relationship between organism X and organism Y in each interaction?
(A) Organism X is positively affected by the relationship and organism Y is negatively affected.
(B) Organism X is negatively affected by the relationship and organism Y is positively affected.
(C) Both organisms are positively affected by the relationship.
(D) Both organisms are negatively affected by the relationship

The diagram to the right represents an energy pyramid.



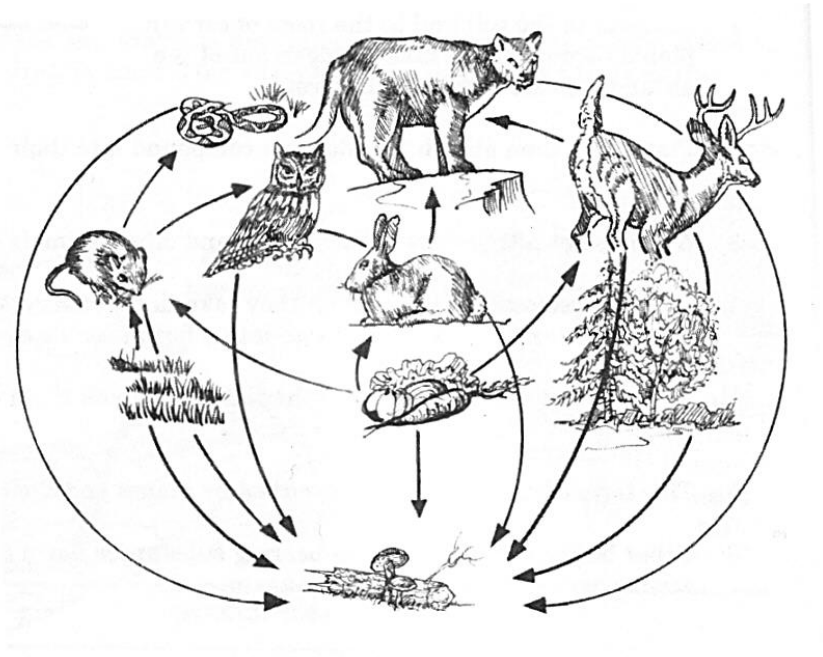
80. Which organisms would *most likely* be found at level A?
    (A) birds (C) algae
    (B) worms (D) mammals

81. Which represents the correct flow of energy through an ecosystem?
    (A) consumer, decomposer, producer, Sun
    (B) producer, consumer, decomposer, Sun
    (C) Sun, decomposer, consumer, producer
    (D) Sun, producer, consumer, decomposer

82. The reason that producers are at the base of almost all energy pyramids and food chains is
    (A) most organisms build their homes on or near producers
    (B) plants are the least abundant organisms on Earth
    (C) producers are strong and form a good base for the food chain or pyramid
    (D) most organisms use food, directly or indirectly, made by the producers

83. The net primary production of a pine forest on a lava flow on Mount Fuji is about 180,000kcal/m^2/yr, and the plant respiration is estimated to be 110,000kcal/m^2/yr . Using the primary productivity formula (NPP = GPP – R) formula, what is the total amount of energy transferred during photosynthesis for this ecosystem?
    (A) 70,000 kcal/m^2/yr (C) 190,000 kcal/m^2/yr
    (B) 100,000 kcal/m^2/yr (D) 290,000 kcal/m^2/yr

Use the diagram to the right to answer **questions 84-86.**

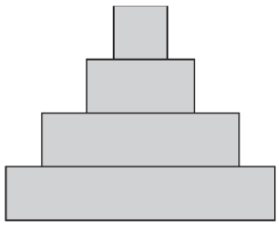


84. Which of the following combinations are all consumers?
    (A) deer, rabbit, owl
    (B) grass, snake, mouse
    (C) vegetables, rabbit, owl
    (D) tree, vegetables, grass

85. Which organisms are in competition for the vegetables?
    (A) snakes and mice
    (B) rabbits and owls
    (C) deer and rabbits
    (D) mountain lions and deer

86. If the number of owls was to increase, the number of mice would
    (A) increase
    (B) decrease
    (C) remain the same

87. A diagram frequently used in ecological studies is shown to the right. This diagram can be used to represent the



    (A) dependency of animal survival on physical conditions in an ecosystem
    (B) loss of energy from various groups of organisms in an ecosystem
    (C) competition among species in an ecosystem
    (D) mechanisms that maintain homeostasis in the plants in an ecosystem

88. According to the Second Law of Thermodynamics,
    (A) energy can neither be created nor destroyed, only changed in form
    (B) energy can be destroyed but not created
    (C) the entropy of the universe is continually fluctuating between zero and infinity
    (D) the entropy of the universe tends to increase

89. Burmese pythons are large snakes that have been introduced into the Florida Everglades ecosystem. Burmese pythons and alligators hunt the same prey. One likely effect of the introduction of the pythons is that
    (A) alligators will have more prey available
    (B) pythons will become native to the Everglades
    (C) alligator populations will decline
    (D) pythons will become an endangered species
    (E) alligators will outcompete the pythons because they are more accustomed to their native ecosystem

90. "Nature's early warning system" of the changing health of an ecosystem rests in observations of changing populations of environmentally sensitive organisms such as frogs and lichens. The aforementioned sentence makes reference to the importance of
    (A) invasive species
    (B) generalist species
    (C) indigenous species
    (D) keystone species
    (E) indicator species

91. Parasitism is best represented by the relationship between
    (A) crocodiles and plovers
    (B) fleas and dogs
    (C) monarch butterflies and milkweed
    (D) sea anemones and clownfish
    (E) bears and foxes

92. Which of the following is a characteristic of a keystone species?
    (A) their presence dictates the survival of the entire community
    (B) they evoke a strong emotional response in people
    (C) they have a very large population
    (D) they provide an early warning of environmental degradation
    (E) they are always generalist species

93. When environmental change occurs, which type of species is most prone to extinction because they do not adapt well to such change?
    (A) generalist species
    (B) r-selected species
    (C) specialist species
    (D) invasive species

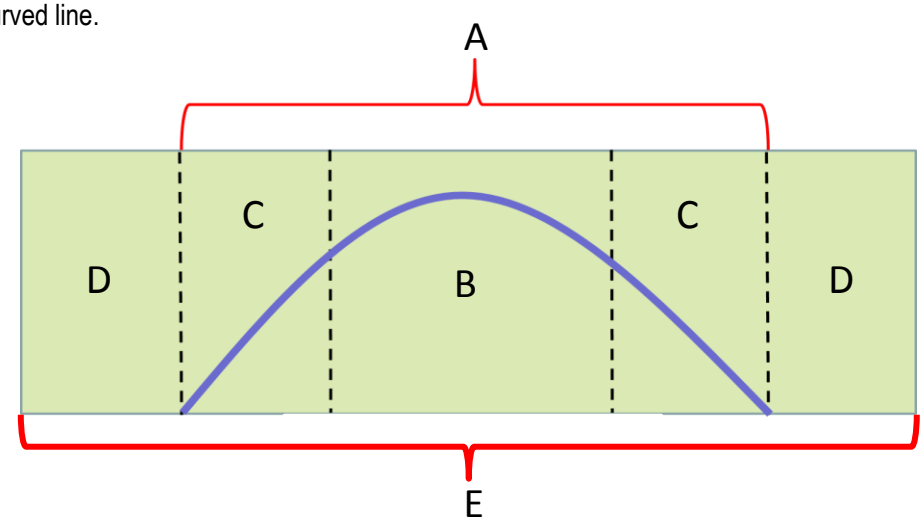
94. An earthworm lives and reproduces in the soil. It aerates the soil and adds organic material to it. The earthworm provides a source of food for other organisms. All of these statements together best describe
    (A) a habitat
    (B) autotrophic nutrition
    (C) an ecological niche
    (D) intraspecific competition
    (E) specialist species behavior

95. An ecological relationship in which one species benefits, but another remains unaffected is known as
    (A) mutualism
    (B) commensalism
    (C) competitive
    (D) parasitism
    (E) predator-prey

96. Resource partitioning helps organisms avoid
    (A) mutualism
    (B) commensalism
    (C) competition
    (D) parasitism

97. Which pair of organisms would most likely compete for the same ecological niche?
    (A) bacteria and fungi
    (B) deer and wolf
    (C) tree and fungi
    (D) deer and bacteria
    (E) grasses and birds

Use the diagram below to answer **questions 98-100**.
The diagram shows an unknown environmental factor and its effect on the population density of a species as illustrated by the curved line.



98. Which lettered zone indicates the range of conditions necessary for the ideal growth of this species?
    (A) A (B) B (C) C (D) D (E) E

99. Which lettered zone indicates the zone in which organisms survive, but do not thrive?
    (A) A (B) B (C) C (D) D (E) E

100. Which lettered zone indicates the zone in which conditions are outside the range of tolerance?
    (A) A (B) B (C) C (D) D (E) E

SUMMER ASSIGNMENT PART 2:
FREE RESPONSE AND REVIEW MATH

To be submitted as per teacher instructions provided upon return to school.
20-point assignment based on completion as per instructions.
Appropriate points will be deducted for any incomplete part of the assignment or for disregarding instructions.

1. Fill in the chart below with the information about each invasive species based on the case studies you read in the notes packet.

Name of Organism	Geographic Location Introduced To	Resulting Environmental Problems	Methods Attempted to Remediate Problem
a.			
b.			
c.			
d.			
e.			
f.			

2. When you read over the notes provided, you learned about a few examples of indicator species, keystone species, generalists and specialists.

Do some research to find one more example for each type of species and give a brief explanation as to why it is classified as such.

Indicator Species:

Keystone Species:

Specialist Species:

Generalist Species:

3. Some Basic Math Review!

Remember that any time you need to make a calculation, you need to show your work. This means that you write out the complete formula, substitute the data into the formula, and then show your answer with the correct units attached. (round to whatever you feel is appropriate – whole #, tenths or hundredths place).

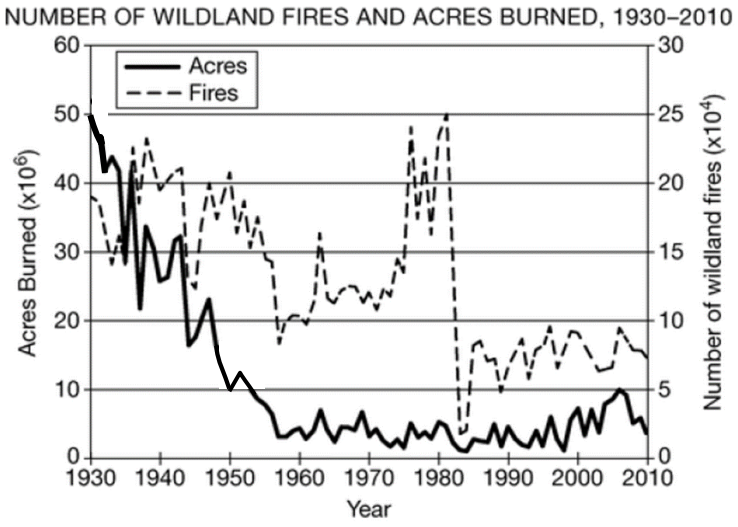
First up … Scientific Notation Practice

Convert the following numbers expressed in scientific notation to standard form:		Convert the following numbers to scientific notation:	
a. 4.6×10^{9}	_____	e. 12,000,000,000	_____
b. 9.4×10^{7}	_____	f. 11,000	_____
c. 1.0×10^{-4}	_____	g. .000001	_____
d. 3×10^{-6}	_____	h. 435,000	_____

Next… Rate of Change

Formula: rate = $\frac{\text{change in value}}{\text{time period}}$

i. What is the average rate of change in acres burned between the years 1930 and 1950?



And then there is … Percent Change (increase or decrease)

Formula: percent change = $\frac{\text{(new value – original value)}}{\text{original value}}$ x 100

j. Calculate the percent change in China's births per 1000 people between the years 1994 and 2019.

Population Growth Data, China 1994 - 2019

Year	Births per 1,000	Deaths per 1,000
1994	17.6	6.8
2004	11.8	6.3
2014	12.3	7.4
2019	11.9	8.1

4. Constructing a Graph

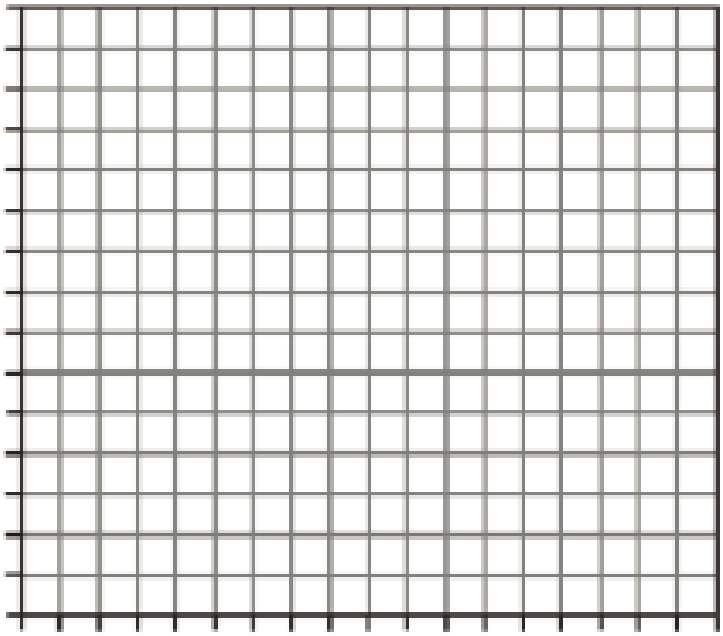
A study was done to see the how water temperature affects the concentration of dissolved oxygen in a body of water.

Use the information in the data table to construct a line graph on the grid provided.

a. Mark an appropriate scale on each axis.
b. Label each axis with correct units
c. Plot the points and connect with a smooth line.

Water temperature (°C)	Dissolved Oxygen (ppm)
1	14
7	12
10	11
15	10
17	9.5
20	9
25	8

Dissolved Oxygen Levels of the Surface Waters of Lake Erie
(January → August 2021)



d. Indicate the independent and dependent variables: independent: _____
dependent: _____

e. State the relationship between the water temperature and the concentration of dissolved oxygen.

_____

f. If the trend continues shown in the data, what would the dissolved oxygen level most likely be if the water temperature was 30°C? _____