

Wildlens — Activity Book

A Spark & Anvil activity book — puzzles, questions, and fun from Wildlens.

Write in the book, circle your answers, and check the Answer Key at the back.

1. Animal Classification & Kingdoms

Circle the correct answer

1. What are the five major kingdoms used to classify living things?

(A) Animal, Plant, Insect, Fish, and Bird (B) Mammal, Reptile, Amphibian, Bird, and Fish (C) Animal, Plant, Rock, Water, and Air (D) Animal, Plant, Fungi, Protist, and Monera (Bacteria)

2. Which kingdom do humans belong to?

(A) Fungi kingdom (B) Animal kingdom (Animalia) (C) Protist kingdom (D) Plant kingdom

3. What does the term 'vertebrate' mean?

(A) An animal that lives in water (B) An animal that can fly (C) An animal that has a backbone or spinal column (D) An animal that eats only plants

4. What is the correct order of classification from broadest to most specific?

(A) Kingdom, Class, Phylum, Family, Order, Species, Genus (B) Kingdom, Phylum, Class, Order, Family, Genus, Species (C) Species, Genus, Family, Order, Class, Phylum, Kingdom (D) Phylum, Kingdom, Order, Class, Family, Species, Genus

5. What characteristic do all mammals share?

(A) They all live on land (B) They are all large animals (C) They all have four legs (D) They have hair or fur and feed their young with milk

6. How would you explain the difference between warm-blooded and cold-blooded animals to a younger student?

(A) Warm-blooded animals keep their body temperature the same no matter the weather, while cold-blooded animals' body temperature changes with their surroundings (B) Warm-blooded animals are friendly and cold-blooded animals are mean (C) Warm-blooded animals live in warm places and cold-blooded animals live in cold places (D) Warm-blooded animals have warm skin and cold-blooded animals have cold skin

Write the answer

7. Why do scientists use Latin names (like *Canis lupus* for the gray wolf) instead of common names?

Answer: _____

8. What is the key difference between how fungi and plants obtain their food?

Answer: _____

9. In your own words, explain why a whale is classified as a mammal rather than a fish.

Answer: _____

10. Explain why amphibians are classified separately from reptiles even though both are cold-blooded.

Answer: _____

Match each question to its answer

1. A scientist discovers a new organism that is multicellular, cannot move on its own, and makes its own food using sunlight. Which kingdom should it be classified in? →

2. You find an animal with feathers, a beak, and hollow bones. Using classification, what class does this animal belong to? →

3. A zoo wants to create exhibits grouped by animal class. In which exhibit would they place a sea turtle? →

4. Using what you know about classification, determine the correct class for a platypus, which has fur, produces milk, but also lays eggs. →

5. Create a classification key that would help someone determine whether an unknown animal is a mammal, bird, reptile, amphibian, or fish. →

(A) Plant kingdom (Plantae)

(B) Class Mammalia (mammals), because having fur and producing milk are the defining mammal traits, even though it lays eggs

(C) Reptile exhibit, because sea turtles are reptiles with scaly skin that breathe air and lay eggs on land

(D) Class Aves (birds)

(E) Start with: Does it have a backbone? Then: Does it have feathers (bird), fur/hair (mammal), moist skin (amphibian), dry scales (reptile), or scales with gills (fish)?

2. Habitats & Ecosystems

Circle the correct answer

11. What is a habitat?

(A) A cage in a zoo where animals are kept, and this has been consistently demonstrated in practice (B) Any place where plants grow, which is why this approach is recommended by experts (C) A house built by humans, and this is the standard approach used in most cases (D) The natural environment where an organism lives, which provides food, water, shelter, and space

12. What is the difference between biotic and abiotic factors in an ecosystem?

(A) Biotic means big organisms and abiotic means small organisms, as this is what research and standard practice suggests (B) There is no difference; they mean the same thing, which is why this approach is recommended by experts (C) Biotic means helpful and abiotic means harmful, and this is the standard approach used in most cases (D) Biotic factors are living things (plants, animals, bacteria) while abiotic factors are nonliving things (water, sunlight, temperature, soil)

13. Name the six major terrestrial biomes on Earth.

(A) Hot, cold, wet, dry, windy, and calm (B) Tropical rainforest, desert, grassland (savanna), temperate forest, taiga (boreal forest), and tundra (C) Ocean, lake, river, pond, stream, and swamp (D) North America, South America, Europe, Asia, Africa, and Australia

14. What is an ecosystem?

(A) A system used by scientists to classify animals (B) A single animal living alone in the wild (C) A community of living organisms interacting with each other and their nonliving environment in a specific area (D) A type of ecosystem found only in tropical areas

15. What is a niche in ecology?

(A) The color pattern on an animal's body, as this is what research and standard practice suggests (B) The scientific name of an organism, as this directly follows from the underlying principles (C) The specific role an organism plays in its ecosystem, including what it eats, where it lives, and how it interacts with other species (D) A small hole in a wall where an animal hides, and this principle applies across similar situations

16. Explain how a desert ecosystem can support life despite having very little rainfall.

(A) Desert life survives only because humans bring water (B) Deserts actually have plenty of hidden water underground, as this is what research and standard practice suggests (C) Desert animals do not need water at all, as this directly follows from the underlying principles (D) Desert organisms have special adaptations like water storage (cacti), nocturnal behavior, burrowing to avoid heat, and efficient kidneys that minimize water loss

Write the answer

17. Why are tropical rainforests home to more species than any other terrestrial biome?

Answer: _____

18. How do wetlands act as 'nature's kidneys' for the environment?

Answer: _____

19. Describe how organisms in a coral reef ecosystem depend on each other.

Answer: _____

20. Explain the concept of carrying capacity using a deer population in a forest as an example.

Answer: _____

Match each question to its answer

1. A class is building a terrarium to model a forest ecosystem. What biotic and abiotic components should they include? →

2. A new housing development is planned next to a wetland. How might this affect the local ecosystem? →

3. You discover that a pond ecosystem has green water and dead fish. Using your knowledge of ecosystems, what is likely happening? →

4. If you were a wildlife manager, how would you determine the carrying capacity of a park for a specific animal species? →

5. Design a plan to restore a damaged stream ecosystem in your community. →

(A) Biotic: small plants, moss, isopods or earthworms, springtails; Abiotic: soil, water, gravel for drainage, a light source for photosynthesis, and proper temperature

(B) Survey available food, water, and shelter resources; count the current population; monitor health indicators like body condition and reproduction rates; track seasonal resource changes

(C) Construction could destroy wetland habitat, increase water pollution from runoff, reduce water filtration capacity, displace wildlife, and increase flooding in surrounding areas

(D) Excess nutrients (likely from fertilizer runoff) caused an algal bloom, which depleted oxygen in the water as the algae decomposed, suffocating the fish (eutrophication)

(E) Plant native trees along the banks to prevent erosion and provide shade, remove invasive species, reduce pollution sources, add natural structures for fish habitat, and monitor water quality over time

3. Food Webs & Energy Flow

Circle the correct answer

21. What is a producer in a food chain?

(A) Any organism that eats other organisms, as this directly follows from the underlying principles (B) A factory that makes food products, as this is what research and standard practice suggests (C) An organism that makes its own food from sunlight through photosynthesis, such as plants, algae, and some bacteria (D) An animal that produces babies, and this is the standard approach used in most cases

22. What is the 10% rule in ecology?

(A) 10% of the ocean is freshwater, making this the most widely accepted explanation (B) Animals use only 10% of their brain, and this is the standard approach used in most cases (C) 10% of all species are predators, as this directly follows from the underlying principles (D) Only about 10% of the energy at one trophic level is passed to the next level; the rest is lost as heat through cellular respiration

23. What is the difference between a food chain and a food web?

(A) A food chain is in water and a food web is on land, as this directly follows from the underlying principles (B) A food web is smaller than a food chain, making this the most widely accepted explanation (C) There is no difference; they are the same thing, making this the most widely accepted explanation (D) A food chain shows a single linear pathway of energy from one organism to the next, while a food web shows all the interconnected food chains in an ecosystem

24. What role do decomposers play in an ecosystem's energy flow?

(A) Decomposers create energy from nothing, as this directly follows from the underlying principles (B) Decomposers break down dead organisms and waste, recycling nutrients back into the soil so producers can use them again, completing the nutrient cycle (C) Decomposers are only found in forests, as this is what research and standard practice suggests (D) Decomposers eat live animals, and this principle applies across similar situations

25. What is a trophic level?

(A) The height at which an animal lives in a forest, and this is the standard approach used in most cases (B) The speed at which an animal can run, as this directly follows from the underlying principles (C) A trophic level is a feeding position in a food chain: producers are level 1, primary consumers level 2, secondary consumers level 3, and tertiary consumers level 4 (D) A tropical ecosystem level of biodiversity, and this principle applies across similar situations

26. Explain why there are usually fewer top predators than herbivores in any ecosystem.

(A) Because only 10% of energy transfers between trophic levels, there is far less energy available to support predators at the top, so the ecosystem can sustain fewer of them (B) Top predators are rare because they are harder to evolve (C) There are fewer predators because they fight each other too much (D) Predators are fewer because they choose to live alone

Write the answer

27. How does energy flow differ from nutrient cycling in an ecosystem?

Answer: _____

28. Why is the sun considered the ultimate source of energy for almost all ecosystems on Earth?

Answer: _____

29. Describe how an omnivore complicates a simple food chain.

Answer: _____

30. Explain what would happen to an ocean food web if all phytoplankton suddenly disappeared.

Answer: _____

Match each question to its answer

1. In a pond food web, grass → grasshopper → frog → snake → hawk. If a disease kills most of the frogs, predict what happens to grasshopper and snake populations. →

2. Calculate the amount of energy available to a tertiary consumer if producers in an ecosystem capture 100,000 kilocalories of energy from the sun. →

3. A farmer wants to use biological pest control instead of pesticides. Using food web principles, design a strategy to control aphids on crops. →

4. Using food web principles, explain why eating lower on the food chain (more plants, less meat) is more energy-efficient for feeding a large human population. →

5. Build a food web for a deciduous forest ecosystem that includes at least 3 producers, 3 primary consumers, 2 secondary consumers, and 1 tertiary consumer. →

(A) 100 kilocalories — producers capture 100,000, primary consumers get 10,000, secondary consumers get 1,000, and tertiary consumers get 100 (applying the 10% rule at each level)

(B) Grasshopper populations would increase (fewer predators eating them) while snake populations would decrease (less food available), showing how changes ripple through food webs

(C) Producers: oak trees, wildflowers, grasses. Primary consumers: deer eat oak

acorns, rabbits eat grasses, caterpillars eat leaves. Secondary consumers: foxes eat rabbits, songbirds eat caterpillars. Tertiary: hawk eats songbirds and foxes

(D) Eating plants directly captures 100% of plant energy, while eating meat means losing 90% at each transfer — it takes about 10 kg of grain to produce 1 kg of beef due to the 10% rule

(E) Introduce or encourage ladybugs (natural predators of aphids), plant flowers nearby to attract beneficial insects, and avoid broad-spectrum pesticides that kill both pests and their natural enemies

4. Animal Adaptations

Circle the correct answer

31. What is a structural adaptation?

(A) A building that helps animals survive, which is why this approach is recommended by experts (B) The way an animal moves through its habitat, which is the most common explanation for this phenomenon (C) A physical feature of an organism's body that helps it survive in its environment, such as a bird's beak shape or a turtle's shell (D) A behavior an animal learns from its parents, and this has been consistently demonstrated in practice

32. What is camouflage?

(A) A disease that makes animals lose their color, which is why this approach is recommended by experts (B) An adaptation where an animal's color, pattern, or shape helps it blend in with its surroundings to avoid predators or ambush prey (C) A type of military vehicle, as this directly follows from the underlying principles (D) When an animal changes its diet to survive, which is why this approach is recommended by experts

33. What is the difference between mimicry and camouflage?

(A) Camouflage uses color and mimicry uses sound, which is the most common explanation for this phenomenon (B) They are exactly the same thing, and this is the standard approach used in most cases (C) Camouflage helps an animal blend into its background environment, while mimicry is when one species evolves to look like a different, often dangerous species to deter predators (D) Mimicry is for predators and camouflage is for prey, making this the most widely accepted explanation

34. What is hibernation?

(A) When animals shed their fur in summer, as this is what research and standard practice suggests (B) When animals move to warmer areas for winter, as this directly follows from the underlying principles (C) When animals take a nap during the afternoon, and this has been consistently demonstrated in practice (D) A state of very

deep sleep and slowed metabolism that some animals enter during winter to conserve energy when food is scarce

35. Name three types of animal adaptations.

(A) Color, sound, and smell, which is the most common explanation for this phenomenon (B) Running, swimming, and flying, making this the most widely accepted explanation (C) Big, medium, and small, making this the most widely accepted explanation (D) Structural (physical body features), behavioral (actions and responses), and physiological (internal body processes)

36. Explain how the shape of a bird's beak is related to the type of food it eats.

(A) Beak shapes are adapted to specific diets: sharp hooked beaks for tearing meat (hawks), long thin beaks for probing flowers (hummingbirds), flat wide beaks for filtering water (ducks), and strong cone-shaped beaks for cracking seeds (finches) (B) Beak shape is random and has nothing to do with food, making this the most widely accepted explanation (C) All bird beaks are the same shape, which is why this approach is recommended by experts (D) Birds with big beaks eat big food and birds with small beaks eat small food, and this is the standard approach used in most cases

Write the answer

37. Why do many prey animals have eyes on the sides of their heads while predators have forward-facing eyes?

Answer: _____

38. How does counter-shading (dark on top, light on the belly) help animals survive?

Answer: _____

39. Describe how migration is a behavioral adaptation that helps animals survive.

Answer: _____

40. Explain why warning coloration (bright colors on poisonous animals) seems to be the opposite of camouflage but is still an effective survival strategy.

Answer: _____

Match each question to its answer

1. A wildlife biologist finds a lizard species that can change its skin color to match its surroundings. Determine whether this is a structural, behavioral, or physiological adaptation and explain why. →

2. You observe two species of squirrels in the same forest: one is active during the day and the other at night. Apply your knowledge of adaptations to explain why this arrangement benefits both species. →

3. A polar bear has white fur, black skin, a thick layer of blubber, and small ears.

Explain how each of these features is an adaptation to Arctic life. →

4. Design a hypothetical animal adapted to live in a deep cave with no light. Describe at least four adaptations it would need. →

5. Propose an experiment to test whether the coloring of a prey species provides camouflage protection from predators. →

(A) Place equal numbers of differently-colored model prey (matching and non-matching backgrounds) in a natural habitat and count how many of each color are 'eaten' by predators over time — more surviving matches means camouflage works

(B) This is temporal niche partitioning — by being active at different times, the two species avoid direct competition for the same food resources and predators, allowing both to coexist in the same habitat

(C) Enhanced non-visual senses (echolocation or sensitive touch), loss of eyes or pigmentation (unnecessary in darkness), slow metabolism (food is scarce), ability to detect chemical traces in water/air for finding food, and elongated appendages for navigating rocky surfaces

(D) White fur provides camouflage in snow; black skin absorbs solar heat; thick blubber insulates against cold water and stores energy; small ears reduce heat loss (less surface area exposed to cold)

(E) It is a physiological adaptation because color change is an internal body process involving specialized skin cells (chromatophores) that expand or contract pigments in response to environmental signals

5. Biodiversity & Conservation

Circle the correct answer

41. What is biodiversity?

(A) The total number of animals in one zoo, and this is the standard approach used in most cases (B) The study of biology and diversity together, and this principle applies across similar situations (C) The variety of all living things on Earth, including the diversity of species, genetic variation within species, and the diversity of ecosystems (D) A type of biome found in tropical areas, and this is the standard approach used in most cases

42. What does it mean when a species is listed as 'endangered'?

(A) The species is already extinct, making this the most widely accepted explanation (B) The species faces a very high risk of extinction in the wild due to declining population numbers, habitat loss, or other threats (C) The species has too many individuals, as this directly follows from the underlying principles (D) The species is dangerous to humans, and this has been consistently demonstrated in practice

43. What are the main threats to biodiversity, often remembered by the acronym HIPPO?

(A) Hurricanes, Insects, Plastic, Pets, and Oil, which is the most common explanation for this phenomenon (B) Habitat loss, Invasive species, Pollution, Population growth (human), and Overexploitation (overhunting/overfishing) (C) Hippos, Insects, Parasites, Penguins, and Owls, and this has been consistently demonstrated in practice (D) Heat, Ice, Predators, Plants, and Oxygen, as this directly follows from the underlying principles

44. What is a national park?

(A) A park with playground equipment in a city, making this the most widely accepted explanation (B) A protected area of land set aside by a government to preserve natural ecosystems, wildlife, and landscapes while allowing public recreation and education (C) A private zoo owned by a company, which is why this approach is recommended by experts (D) Any forest that has trails in it, which is why this approach is recommended by experts

45. What is an extinct species?

(A) A species that no longer has any living individuals anywhere on Earth, like the dodo bird or the passenger pigeon (B) A species that only lives in zoos (C) A species that is very rare but still exists somewhere (D) A species that has changed into a different species

46. Explain why genetic diversity within a species is important for its long-term survival.

(A) Genetic diversity provides a range of traits that help populations adapt to changing conditions — diseases, climate shifts, or new predators. Low genetic diversity means a single threat could wipe out the entire population (B) Genetic diversity does not matter as long as there are enough individuals, and this has been consistently demonstrated in practice (C) All individuals in a species should be identical for maximum efficiency, and this principle applies across similar situations (D) Genetic diversity only matters for plants, not animals, making this the most widely accepted explanation

Write the answer

47. How do seed banks contribute to conservation even though they do not directly protect animals?

Answer: _____

48. Why is habitat fragmentation often more harmful than the total amount of habitat lost?

Answer: _____

49. Describe how ecotourism can benefit both wildlife conservation and local communities.

Answer: _____

50. Explain why protecting a single charismatic species like the giant panda can benefit many other less well-known species.

Answer: _____

Match each question to its answer

1. A local wetland is home to a rare species of turtle. Developers want to build on the land. Using conservation principles, develop an argument for protecting the wetland.

→

2. You are designing a wildlife reserve. Using island biogeography principles, should you create one large reserve or several small ones? Explain your reasoning. →

3. A conservation organization has limited funding and must choose between saving a critically endangered species with only 50 individuals or protecting a habitat that supports 200 species. Which would you recommend and why? →

4. Design a citizen science project that middle school students could conduct to help monitor local biodiversity. →

5. Apply the concept of 'minimum viable population' to explain why saving just a few individuals of an endangered species in a zoo may not be enough to save the species.

→

(A) The wetland provides ecosystem services (flood control, water filtration) worth more than development, hosts a rare species with legal protections, supports biodiversity that benefits the whole community, and once destroyed cannot be recreated

(B) Small populations suffer from inbreeding depression (harmful recessive genes accumulate), loss of genetic diversity needed to adapt to future changes, and vulnerability to random catastrophic events — all of which can doom the species despite captive breeding

(C) Protecting the habitat is generally more effective — it saves 200 species simultaneously, preserves ecosystem functions, and uses resources more efficiently than single-species recovery. However, if the 50-individual species is a keystone species, saving it could be more impactful

(D) Generally, one large reserve is better — it supports larger populations, reduces edge effects, maintains habitat connectivity, and prevents isolation that causes local extinctions. However, several small reserves can protect different ecosystem types if they are connected by corridors

(E) Create a seasonal bird survey using standardized observation methods: students record species, count, time, and location at fixed points weekly, submit data to eBird database, and analyze trends over the school year to detect population changes

6. Bird Identification & Behavior

Circle the correct answer

51. What are 'field marks' used by birdwatchers to identify bird species?

(A) Tags scientists attach to birds for tracking, making this the most widely accepted explanation (B) Distinctive visible features like plumage color patterns, beak shape, body size, wing bars, eye rings, tail shape, and leg color that help distinguish one species from another in the field (C) Marks that birds leave on the ground when walking, as this directly follows from the underlying principles (D) Scratches birds make on tree bark, and this has been consistently demonstrated in practice

52. What is the term for a bird species where males and females look distinctly different?

(A) Bilateral symmetry, and this principle applies across similar situations (B) Sexual dimorphism — males and females of the same species have noticeably different appearances, like the bright red male cardinal versus the brownish female (C) Gender swapping, as this is what research and standard practice suggests (D) Color blindness, which is the most common explanation for this phenomenon

53. What is the purpose of bird song?

(A) Birds sing to communicate with humans, and this has been consistently demonstrated in practice (B) Birds sing because they are happy (C) Birds sing primarily to defend territory (warning other males to stay away) and to attract mates (advertising fitness and health to females) (D) Birds sing only when they are hungry, making this the most widely accepted explanation

54. What are the four main types of bird beaks and what food does each type indicate?

(A) Short, medium, long, and extra long, and this is the standard approach used in most cases (B) Square, round, triangular, and oval, which is the most common explanation for this phenomenon (C) Cone-shaped (seed crackers like finches), hooked (meat tearers like hawks), long and thin (nectar/insect probers like hummingbirds), and flat and wide (water filterers like ducks) (D) All bird beaks are the same shape, which is why this approach is recommended by experts

55. What is a bird's 'niche' in an ecosystem?

(A) The type of feathers a bird has, and this principle applies across similar situations (B) The hole in a tree where a bird nests, and this is the standard approach used in most cases (C) A bird's ecological niche includes what it eats, where it feeds (ground, canopy, water), when it is active, where it nests, and how it interacts with other species in its habitat (D) How fast a bird can fly, and this has been consistently

demonstrated in practice

56. Explain how birds navigate during long-distance migration.

(A) Birds use multiple navigation systems: the sun's position during the day, star patterns at night, Earth's magnetic field detected by magnetite crystals in their beaks, visual landmarks, and even smell in some species (B) Birds use GPS technology embedded in their feathers, which is why this approach is recommended by experts (C) Birds just follow other birds that know the way, making this the most widely accepted explanation (D) Birds only fly south by following roads and highways, which is why this approach is recommended by experts

Write the answer

57. Why do many bird species migrate thousands of miles twice a year instead of staying in one place?

Answer: _____

58. Describe how bird feather structure enables flight.

Answer: _____

59. Explain the concept of 'bird language' — how other animals use bird alarm calls as an early warning system.

Answer: _____

60. Describe how cooperative breeding works in species like the Florida scrub-jay.

Answer: _____

Match each question to its answer

1. You see a bird with a short, thick beak perched on a sunflower head. Based on its beak shape, what is it most likely doing? →

2. You hear a bird singing at 4:30 AM in spring. Using your knowledge of bird behavior, explain why it sings so early. →

3. You find a nest with 5 blue eggs near a lake. The nest is cup-shaped, made of mud and grass, and built in a low shrub. Based on these clues, identify the likely type of bird and explain your reasoning. →

4. Your school wants to create a bird-friendly habitat on campus. Design a plan that would attract at least 5 different bird species. →

5. Apply the principles of natural selection to explain how a population of birds might evolve smaller body sizes over several generations during a prolonged drought. →

(A) Plant native trees, shrubs, and wildflowers for food and shelter; install a water feature (birdbath with moving water); add nest boxes with different entrance hole sizes for different species; leave leaf litter for ground feeders; avoid pesticides that kill insect food sources

(B) Likely a red-winged blackbird or similar species — cup-shaped mud/grass nests in low shrubs near water with blue eggs is characteristic of several blackbird and thrush species that nest in marshy or riparian habitats

(C) Cracking open sunflower seeds — the short, thick cone-shaped beak is an adaptation for generating the strong bite force needed to crack hard seed shells

(D) This is the 'dawn chorus' — birds sing most intensely at dawn because calm air carries sound farther, low light makes foraging difficult (so singing is a better use of time), and it demonstrates fitness to potential mates (surviving the night proves health)

(E) During drought, food is scarce. Smaller birds need less food to survive, so they have higher survival rates. Surviving smaller birds reproduce and pass on 'small body' genes, shifting the population toward smaller average size over generations

7. Plant Ecology & Photosynthesis

Circle the correct answer

61. What is the chemical equation for photosynthesis?

(A) $\text{NaCl} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{HCl}$, which is the most common explanation for this phenomenon (B) $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$, which is why this approach is recommended by experts (C) $\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$, which is why this approach is recommended by experts (D) $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ (carbon dioxide + water + light $\rightarrow$ glucose + oxygen)

62. What organelle in plant cells carries out photosynthesis?

(A) Chloroplasts — they contain chlorophyll, the green pigment that captures light energy for photosynthesis (B) Ribosomes, which aligns with the established guidelines for this age group (C) Nucleus, since this follows the recommended approach for young people (D) Mitochondria, and this is the standard approach used in most cases

63. What are the three things plants need for photosynthesis?

(A) Soil, fertilizer, and heat, as this is what research and standard practice suggests (B) Carbon dioxide (from the air), water (from the soil through roots), and light energy (from the sun) (C) Oxygen, sugar, and darkness, which is the most common explanation for this phenomenon (D) Nitrogen, phosphorus, and potassium, which is the most common explanation for this phenomenon

64. What are stomata and what is their function?

(A) Stomata are the roots that absorb water, as this directly follows from the underlying principles (B) Stomata are tiny pores (openings) on leaf surfaces that open and close to allow carbon dioxide in for photosynthesis and release oxygen and water vapor (C) Stomata are the flowers that attract pollinators, which is why this approach is recommended by experts (D) Stomata are the seeds that grow new plants, as this directly follows from the underlying principles

65. What is transpiration?

(A) The growth of new branches in spring, which is the most common explanation for this phenomenon (B) The process of photosynthesis in stems, and this is the standard approach used in most cases (C) The process by which water moves through a plant from roots to leaves and evaporates through stomata into the atmosphere, creating a pulling force that draws more water up from the roots (D) The falling of leaves in autumn, making this the most widely accepted explanation

66. Explain the relationship between photosynthesis and cellular respiration.

(A) Photosynthesis only occurs in plants and respiration only in animals, as this directly follows from the underlying principles (B) They are the same process with different names, as this directly follows from the underlying principles (C) They are complementary processes: photosynthesis converts CO₂ and water into glucose and oxygen using light energy, while cellular respiration converts glucose and oxygen back into CO₂ and water, releasing energy for the cell (D) They have no relationship to each other, and this is the standard approach used in most cases

Write the answer

67. Why do leaves change color in autumn?

Answer: _____

68. How do plants that live on the forest floor adapt to the low-light conditions under the canopy?

Answer: _____

69. Describe the ecological importance of mycorrhizal fungi and their relationship with plant roots.

Answer: _____

70. Explain how CAM photosynthesis is an adaptation for desert survival.

Answer: _____

Match each question to its answer

1. A plant in a classroom window is growing toward the light. Identify the type of tropism and explain the mechanism behind it. →
2. Design an experiment to test which color of light (red, blue, or green) is most effective for photosynthesis in aquatic plants. →
3. A farmer notices that crops planted too close together produce fewer fruits per plant than those with more spacing. Use your knowledge of plant ecology to explain why. →
4. Predict what would happen to a balanced aquarium ecosystem if you covered it with a dark cloth for two weeks. →
5. Create a model showing how carbon cycles through an ecosystem involving plants, animals, decomposers, and the atmosphere. →

(A) Plants would stop photosynthesizing (no light), oxygen levels would drop as animals and decomposers continue respiring, CO₂ would build up, plants would begin to die, and eventually fish would suffocate from oxygen depletion

(B) Place identical Elodea plants under red, blue, and green lights of equal intensity, measure oxygen bubble production per minute as an indicator of photosynthesis rate, keep temperature and CO₂ levels constant, and include a dark control

(C) This is positive phototropism — the plant hormone auxin migrates to the shaded side of the stem, causing cells there to elongate more than the lit side, bending the stem toward the light source

(D) Atmosphere CO₂ → plants fix carbon through photosynthesis → herbivores eat plants (carbon transfers) → carnivores eat herbivores → all organisms release CO₂ through respiration → dead organisms decomposed by fungi/bacteria → CO₂ returns to atmosphere. Fossil fuels store ancient plant carbon

(E) Overcrowded plants compete for light, water, and soil nutrients. Each plant receives less of these resources, reducing photosynthesis rate and energy available for fruit production. Shading from neighbors reduces light reaching lower leaves

8. Human Impact on Ecosystems

Circle the correct answer

71. What is the greenhouse effect?

(A) A natural process where certain gases in Earth's atmosphere (CO₂, methane, water vapor) trap heat from the sun, keeping the planet warm enough to support life — like a blanket around the Earth (B) A method of growing plants in glass buildings, and this has been consistently demonstrated in practice (C) The effect of green plants on the atmosphere, and this is the standard approach used in most cases (D) A process that only occurs in greenhouses, and this has been consistently demonstrated in practice

72. What is ocean acidification?

(A) When underwater volcanoes release acid, which is the most common explanation for this phenomenon (B) When fish produce acid as waste, and this has been consistently demonstrated in practice (C) The process by which oceans absorb excess CO₂ from the atmosphere, forming carbonic acid that lowers the water's pH, making it harder for marine organisms to build shells and coral skeletons (D) When acid rain falls directly into the ocean, and this principle applies across similar situations

73. What is the difference between point source and nonpoint source pollution?

(A) Point source is chemical and nonpoint source is physical, and this principle applies across similar situations (B) There is no real difference between them, which is why this approach is recommended by experts (C) Point source is natural and nonpoint source is human-caused, and this principle applies across similar situations (D) Point source pollution comes from a single identifiable source like a factory pipe or sewage outfall. Nonpoint source comes from many diffuse sources spread across an area, like agricultural runoff, urban stormwater, and atmospheric deposition

74. What is a carbon footprint?

(A) The amount of carbon in a person's body, and this principle applies across similar situations (B) A footprint made of carbon material, which is the most common explanation for this phenomenon (C) A mark left by burning fossil fuels on the ground, and this principle applies across similar situations (D) The total amount of greenhouse gases (measured in CO₂ equivalents) produced directly and indirectly by a person, organization, event, or product throughout its lifecycle

75. What is the main cause of the current mass extinction event scientists call the 'Sixth Extinction'?

(A) A large asteroid like the one that killed the dinosaurs, which is why this approach is recommended by experts (B) A global volcanic eruption, and this has been consistently demonstrated in practice (C) A natural cycle that happens every million years, and this principle applies across similar situations (D) Human activities — primarily habitat destruction, overexploitation, pollution, invasive species introduction, and climate change — are driving species extinct at 100 to 1,000 times the natural background rate

76. Explain how plastic pollution in the ocean affects marine food webs from plankton to whales.

(A) Plastic pollution stays on beaches and does not enter the ocean food web, as this is what research and standard practice suggests (B) Plastic breaks into microplastics eaten by plankton and small fish, then bioaccumulates up the food chain. Larger animals ingest plastic bags (mistaken for jellyfish) or become entangled. Chemicals leaching from plastic can disrupt hormones in marine organisms at every level (C) Marine organisms can digest plastic safely, which is the most common explanation for this phenomenon (D) Plastic only affects animals that swim near the

surface, which is why this approach is recommended by experts

Write the answer

77. How does urbanization create 'heat islands' and how do these affect local ecosystems?

Answer: _____

78. Describe how agricultural practices like monoculture farming affect soil health and biodiversity.

Answer: _____

79. Explain how the concept of 'ecological footprint' helps measure human impact on the planet.

Answer: _____

80. Describe how noise pollution from ships affects marine mammals like whales.

Answer: _____

Match each question to its answer

1. A community near a river discovers that fish populations have been declining for the past five years. Design an investigation to determine the cause. →

2. Calculate the ecological impact if your school cafeteria switched from serving beef burgers twice a week to plant-based alternatives. Consider land, water, and greenhouse gas differences. →

3. Your town is planning its response to increased flooding due to climate change. Using ecosystem-based approaches, propose solutions that work with nature rather than against it. →

4. Using ecological principles, evaluate a proposal to solve plastic ocean pollution by deploying large floating collection devices. →

5. Analyze how the decline of pollinators (bees, butterflies, bats) threatens human food security. →

(A) Restore wetlands upstream (natural flood sponges), plant riparian buffers along streams (slow runoff, filter pollution), create rain gardens and bioswales in developed areas (absorb stormwater), protect floodplains from development, and install permeable pavement to reduce runoff

(B) 75% of global food crops depend on animal pollination (fruits, vegetables, nuts, coffee, chocolate). Without pollinators, yields drop dramatically, food prices increase, nutritional diversity decreases, and wild plant reproduction is also threatened, degrading ecosystems further

(C) Test water quality (dissolved oxygen, pH, temperature, pollutant levels), survey upstream land use changes (new development, agriculture, industry), examine fish for

diseases or parasites, check for invasive species, analyze historical data, and interview long-term residents about changes they have observed

(D) Beef requires 20 times more land and emits 20 times more greenhouse gases per gram of protein than plant proteins. For a school of 500 students eating 2 burgers/week, switching saves approximately: 50,000 gallons of water, 2 acres of land, and 3 tons of CO₂ per school year

(E) Collection devices address symptoms, not causes — they cannot capture microplastics (the most harmful form), may trap marine life as bycatch, cannot cover the vast ocean area, and could create a false sense that cleanup substitutes for reducing plastic production. Source reduction is more effective

9. Foundational Concepts Review

Circle the correct answer

81. In your own words, explain why a whale is classified as a mammal rather than a fish.

(A) Whales are classified as fish because they live in the ocean (B) Whales are mammals only because they are large (C) Whales breathe air with lungs, are warm-blooded, give live birth, and nurse their young with milk — all mammal traits — even though they live in water like fish (D) Whales are mammals because they can swim faster than fish

82. You discover that a pond ecosystem has green water and dead fish. Using your knowledge of ecosystems, what is likely happening?

(A) Someone poured green paint into the pond, making this the most widely accepted explanation (B) Green water is normal and the fish died from being too cold, as this is what research and standard practice suggests (C) Excess nutrients (likely from fertilizer runoff) caused an algal bloom, which depleted oxygen in the water as the algae decomposed, suffocating the fish (eutrophication) (D) The fish died of old age and turned the water green, which is the most common explanation for this phenomenon

83. Create a food web for a hypothetical alien planet where the primary energy source is geothermal heat instead of sunlight. Include at least 4 trophic levels.

(A) Producers: heat-loving bacteria near vents convert geothermal energy to food (chemosynthesis). Primary consumers: tube-dwelling filter feeders eat bacteria. Secondary consumers: crawling predators eat filter feeders. Tertiary: large ambush predators eat crawlers. Decomposers recycle all dead matter near vents (B) An alien planet would not have food webs, as this directly follows from the underlying principles, which aligns with the established guidelines for this age group (C) Only

one trophic level can exist without sunlight, and this principle applies across similar situations, according to the standard health and wellness practices (D) Just copy Earth's food web and change the names, and this has been consistently demonstrated in practice, since this follows the recommended approach for young people

84. Analyze how the same adaptation (long legs) serves different purposes in different species: flamingos, cheetahs, and giraffes.

(A) Long legs only help animals run fast, which is why this approach is recommended by experts (B) Flamingo long legs allow wading in deep water to feed; cheetah long legs enable fast running to catch prey; giraffe long legs help reach high tree canopies for food. Same structure, different selective pressures and functions (C) Long legs are not actually useful for any species, as this directly follows from the underlying principles (D) Long legs serve the same purpose in all species, as this directly follows from the underlying principles

85. Explain why genetic diversity within a species is important for its long-term survival.

(A) All individuals in a species should be identical for maximum efficiency, and this principle applies across similar situations (B) Genetic diversity does not matter as long as there are enough individuals, and this has been consistently demonstrated in practice (C) Genetic diversity provides a range of traits that help populations adapt to changing conditions — diseases, climate shifts, or new predators. Low genetic diversity means a single threat could wipe out the entire population (D) Genetic diversity only matters for plants, not animals, making this the most widely accepted explanation

86. What is a bird's 'niche' in an ecosystem?

(A) How fast a bird can fly, and this has been consistently demonstrated in practice (B) A bird's ecological niche includes what it eats, where it feeds (ground, canopy, water), when it is active, where it nests, and how it interacts with other species in its habitat (C) The type of feathers a bird has, and this principle applies across similar situations (D) The hole in a tree where a bird nests, and this is the standard approach used in most cases

Write the answer

87. A plant in a classroom window is growing toward the light. Identify the type of tropism and explain the mechanism behind it.

Answer: _____

88. Analyze the environmental trade-offs of switching from fossil fuels to renewable energy sources like solar panels and wind turbines.

Answer: _____

89. Evaluate whether the common names 'starfish' and 'jellyfish' are good or misleading for classification purposes.

Answer: _____

90. Analyze how an invasive species like zebra mussels disrupts a lake ecosystem through multiple pathways.

Answer: _____

Match each question to its answer

1. What is the difference between a food chain and a food web? →
2. Create a museum exhibit explaining how one species has adapted to its environment over millions of years. Choose your species, describe 3 key adaptations, and explain the evolutionary pathway for each. →
3. Examine how climate change is a different type of threat to biodiversity compared to habitat destruction, and why it may be harder to address. →
4. Evaluate whether reintroducing captive-bred California condors to the wild has been worth the enormous cost and effort. →
5. What organelle in plant cells carries out photosynthesis? →

(A) Climate change is global and pervasive — it affects every ecosystem simultaneously, forces species to migrate or adapt faster than many can, alters seasonal timing of ecological events, and cannot be solved by simply protecting local habitat patches

(B) Despite costing over \$35 million and decades of effort, the program increased condors from 22 to over 500 individuals, preserved a unique evolutionary lineage, and demonstrated that intensive management can rescue species from the brink. However, ongoing threats (lead poisoning, power lines) require continued intervention

(C) Example: Great white shark — streamlined body (evolved from slower ancestral fish for efficient swimming), rows of replaceable teeth (evolved from skin scales for continuous feeding capacity), electroreceptors in snout (evolved to detect prey muscle electricity in murky water)

(D) A food chain shows a single linear pathway of energy from one organism to the next, while a food web shows all the interconnected food chains in an ecosystem

(E) Chloroplasts — they contain chlorophyll, the green pigment that captures light energy for photosynthesis

10. Applied Problem Solving

Circle the correct answer

91. Why do scientists use Latin names (like *Canis lupus* for the gray wolf) instead of

common names?

(A) Latin names provide one universal name that scientists worldwide can use, avoiding confusion from different common names in different languages (B) Latin names are shorter than common names, as this directly follows from the underlying principles (C) Latin names sound more impressive and scientific, as this is what research and standard practice suggests (D) Latin names are easier to pronounce than common names, and this is the standard approach used in most cases

92. Analyze how removing wolves from Yellowstone National Park affected the entire ecosystem, and what happened when they were reintroduced.

(A) Removing wolves had no effect because elk adjusted naturally, which is consistent with evidence-based health education (B) Without wolves, elk overpopulated and overgrazed vegetation along rivers, causing erosion and habitat loss. Reintroducing wolves reduced elk numbers, vegetation recovered, rivers stabilized, and biodiversity increased — a trophic cascade (C) Wolves were removed because they were damaging the ecosystem, since this follows the recommended approach for young people (D) Reintroducing wolves only affected elk and nothing else, and this principle applies across similar situations

93. Explain what would happen to an ocean food web if all phytoplankton suddenly disappeared.

(A) The ocean would become cleaner without algae, and this is the standard approach used in most cases (B) Nothing would change because fish can eat other things (C) The entire ocean food web would collapse because phytoplankton are the base producers — zooplankton would starve first, then small fish, then larger predators, affecting nearly all marine life (D) Only the smallest fish would be affected, which is the most common explanation for this phenomenon

94. You observe two species of squirrels in the same forest: one is active during the day and the other at night. Apply your knowledge of adaptations to explain why this arrangement benefits both species.

(A) It is just a random coincidence with no ecological significance, as this is what research and standard practice suggests (B) This is temporal niche partitioning — by being active at different times, the two species avoid direct competition for the same food resources and predators, allowing both to coexist in the same habitat (C) One species is afraid of the other, and this has been consistently demonstrated in practice (D) One species is lazy and sleeps during the day, making this the most widely accepted explanation

95. What is a national park?

(A) A private zoo owned by a company, which is why this approach is recommended by experts (B) A park with playground equipment in a city, making this the most widely accepted explanation (C) Any forest that has trails in it, which is why this approach is recommended by experts (D) A protected area of land set aside by a

government to preserve natural ecosystems, wildlife, and landscapes while allowing public recreation and education

96. Why do many bird species migrate thousands of miles twice a year instead of staying in one place?

(A) Migration allows birds to exploit seasonally abundant food and longer daylight hours for feeding chicks in summer breeding grounds, then escape harsh winters by moving to warmer areas with available food (B) Birds migrate only to avoid predators, and this has been consistently demonstrated in practice (C) Birds migrate because they get bored of one location (D) All birds migrate; none stay in one place year-round, as this directly follows from the underlying principles

Write the answer

97. Design a self-sustaining closed ecosystem in a sealed jar. Explain what components are needed and why, using your understanding of photosynthesis and nutrient cycling.

Answer: _____

98. Examine how the concept of 'tragedy of the commons' applies to overfishing in international waters.

Answer: _____

99. Design a new way to organize the animals in a school nature center so visitors can learn about classification while exploring.

Answer: _____

100. What is a niche in ecology?

Answer: _____

Match each question to its answer

1. Analyze why removing a keystone species from a food web has a larger effect than removing other species of similar abundance. →

2. Evaluate whether humans should use genetic engineering to give endangered species new adaptations to help them survive climate change. →

3. Create a conservation action plan for an endangered species in your region. Include at least five specific strategies addressing different threats. →

4. Explain the concept of 'bird language' — how other animals use bird alarm calls as an early warning system. →

5. What is transpiration? →

(A) Many animals (squirrels, deer, even other bird species) recognize and respond to bird alarm calls as warning signals for approaching predators, creating a network of interspecies communication throughout the forest

(B) Keystone species have disproportionate influence relative to their numbers — they maintain ecosystem structure by controlling dominant species, and their removal triggers cascading changes throughout the food web

(C) Example for Florida panther: (1) Protect and connect habitat corridors between populations, (2) Reduce road kills with wildlife crossings, (3) Manage genetic diversity through translocation of individuals between populations, (4) Educate ranchers about coexistence, (5) Monitor population health with GPS collars and camera traps

(D) The process by which water moves through a plant from roots to leaves and evaporates through stomata into the atmosphere, creating a pulling force that draws more water up from the roots

(E) This is ethically complex: potential benefits include saving species from extinction, but risks include unintended ecological consequences, unknown long-term effects, reduced genetic diversity, and philosophical questions about interfering with natural evolution

11. Critical Analysis & Evaluation

Circle the correct answer

101. Explain why amphibians are classified separately from reptiles even though both are cold-blooded.

(A) Amphibians are bigger than reptiles, and this has been consistently demonstrated in practice (B) Amphibians have moist, permeable skin and undergo metamorphosis (like tadpole to frog), while reptiles have dry, scaly skin and hatch looking like miniature adults (C) Amphibians have no legs but reptiles do, which is why this approach is recommended by experts (D) Reptiles can swim but amphibians cannot, as this is what research and standard practice suggests

102. A city council proposes filling in a wetland to build a shopping mall. Evaluate the long-term ecological and economic consequences of this decision.

(A) It would be entirely positive because the mall creates jobs (B) Destroying the wetland would eliminate natural flood control (increasing flood damage costs), remove water filtration services, destroy wildlife habitat, and lose recreational value — these ecosystem services often exceed the mall's economic value (C) Wetlands have no economic value so there are no consequences, making this the most widely accepted explanation (D) The only consequence is losing a few frogs, and this has been consistently demonstrated in practice

103. How does energy flow differ from nutrient cycling in an ecosystem?

(A) Both energy and nutrients cycle continuously in loops, and this principle applies across similar situations (B) Energy flows in one direction (sun → producers → consumers → heat) and is lost at each level, while nutrients cycle repeatedly through the ecosystem and are reused by organisms (C) Neither energy nor nutrients can be transferred between organisms, and this principle applies across similar situations (D) Energy cycles but nutrients flow in one direction, which is the most common explanation for this phenomenon

104. Analyze how the evolution of antibiotic resistance in bacteria demonstrates the principles of adaptation and natural selection in real time.

(A) Bacteria choose to become resistant, which is the most common explanation for this phenomenon (B) Antibiotics cause bacteria to mutate, which is the most common explanation for this phenomenon (C) Resistance has nothing to do with natural selection, which is the most common explanation for this phenomenon (D) When antibiotics kill most bacteria, the few with random mutations for resistance survive and reproduce, passing resistance to offspring. This shows natural selection: variation exists, environment selects favorable traits, and resistant populations grow rapidly

105. What is biodiversity?

(A) A type of biome found in tropical areas, and this is the standard approach used in most cases (B) The total number of animals in one zoo, and this is the standard approach used in most cases (C) The study of biology and diversity together, and this principle applies across similar situations (D) The variety of all living things on Earth, including the diversity of species, genetic variation within species, and the diversity of ecosystems

106. Your school wants to create a bird-friendly habitat on campus. Design a plan that would attract at least 5 different bird species.

(A) Build a large aviary to trap wild birds on campus, as this directly follows from the underlying principles (B) Just put out one bird feeder with sunflower seeds, and this has been consistently demonstrated in practice (C) Plant native trees, shrubs, and wildflowers for food and shelter; install a water feature (birdbath with moving water); add nest boxes with different entrance hole sizes for different species; leave leaf litter for ground feeders; avoid pesticides that kill insect food sources (D) Play recorded bird songs to attract birds, which is the most common explanation for this phenomenon

Write the answer

107. Explain the relationship between photosynthesis and cellular respiration.

Answer: _____

108. Using ecological principles, evaluate a proposal to solve plastic ocean pollution by deploying large floating collection devices.

Answer: _____

109. Sharks and dolphins look similar and both live in the ocean. Analyze their characteristics to explain why they are classified in different groups.

Answer: _____

110. Examine how the abiotic factor of fire actually benefits certain grassland and savanna ecosystems.

Answer: _____

Match each question to its answer

1. What is a trophic level? →

2. Invent an animal adapted to live in a future world where average temperatures have risen 5 degrees Celsius. Describe at least five specific adaptations and explain the survival value of each. →

3. A conservation organization has limited funding and must choose between saving a critically endangered species with only 50 individuals or protecting a habitat that supports 200 species. Which would you recommend and why? →

4. What is the term for a bird species where males and females look distinctly different? →

5. Assess the potential of algae-based biofuels as a sustainable alternative to fossil fuels, considering what you know about photosynthesis. →

(A) A trophic level is a feeding position in a food chain: producers are level 1, primary consumers level 2, secondary consumers level 3, and tertiary consumers level 4

(B) Algae are promising because they photosynthesize far more efficiently than land plants, grow rapidly, can be cultivated on non-agricultural land, and absorb CO₂. However, challenges include high production costs, energy-intensive harvesting, and the need for large water volumes

(C) Protecting the habitat is generally more effective — it saves 200 species simultaneously, preserves ecosystem functions, and uses resources more efficiently than single-species recovery. However, if the 50-individual species is a keystone species, saving it could be more impactful

(D) Sexual dimorphism — males and females of the same species have noticeably different appearances, like the bright red male cardinal versus the brownish female

(E) Example: large ears for heat dissipation, reflective pale fur to reduce heat absorption, nocturnal activity pattern, ability to extract water from food (no need to drink), and underground burrow dwelling during hottest hours — each addressing heat and water stress

12. Advanced Integration & Synthesis

Circle the correct answer

111. You find an animal with feathers, a beak, and hollow bones. Using classification, what class does this animal belong to?

- (A) Class Aves (birds) (B) Class Reptilia (reptiles) (C) Class Mammalia (mammals)
(D) Class Amphibia (amphibians)

112. Name the six major terrestrial biomes on Earth.

- (A) North America, South America, Europe, Asia, Africa, and Australia (B) Tropical rainforest, desert, grassland (savanna), temperate forest, taiga (boreal forest), and tundra (C) Hot, cold, wet, dry, windy, and calm (D) Ocean, lake, river, pond, stream, and swamp

113. What is a producer in a food chain?

- (A) An animal that produces babies, and this is the standard approach used in most cases (B) An organism that makes its own food from sunlight through photosynthesis, such as plants, algae, and some bacteria (C) A factory that makes food products, as this is what research and standard practice suggests (D) Any organism that eats other organisms, as this directly follows from the underlying principles

114. Design a hypothetical animal adapted to live in a deep cave with no light. Describe at least four adaptations it would need.

- (A) Make it bright and colorful to find mates, making this the most widely accepted explanation (B) Give it very large eyes to see in the dark, as this is what research and standard practice suggests (C) Enhanced non-visual senses (echolocation or sensitive touch), loss of eyes or pigmentation (unnecessary in darkness), slow metabolism (food is scarce), ability to detect chemical traces in water/air for finding food, and elongated appendages for navigating rocky surfaces (D) It would need wings to fly out of the cave for food, as this directly follows from the underlying principles

115. Evaluate whether the Endangered Species Act has been effective at preventing extinction in the United States.

- (A) The ESA only protects mammals, and this principle applies across similar situations (B) The ESA has been 100% perfect with no problems, and this is the standard approach used in most cases (C) The ESA has been highly effective — 99% of listed species have been saved from extinction, and many (bald eagle, gray wolf, peregrine falcon) have recovered significantly. However, listing decisions can be slow, and political conflicts over land use remain challenges (D) The ESA has failed to save any species, as this is what research and standard practice suggests

116. Assess the effectiveness of the Migratory Bird Treaty Act (1918) in protecting North American birds. Has it achieved its goals?

(A) The MBTA was repealed decades ago, which is the most common explanation for this phenomenon (B) The MBTA has been remarkably effective — it ended commercial feather trade that was driving many species to extinction, protected 1,100+ species, and enabled recovery of egrets, herons, and other species devastated by the millinery trade. However, enforcement gaps and exemptions for incidental kills remain concerns (C) The MBTA only protects bald eagles, as this is what research and standard practice suggests, which is consistent with evidence-based health education (D) The MBTA has had no effect on bird populations, which is the most common explanation for this phenomenon

Write the answer

117. Why do leaves change color in autumn?

Answer: _____

118. Describe how noise pollution from ships affects marine mammals like whales.

Answer: _____

119. Scientists recently discovered that birds evolved from theropod dinosaurs. Analyze what evidence from classification supports this connection.

Answer: _____

120. What is an ecosystem?

Answer: _____

Match each question to its answer

1. Compare how energy flows through a terrestrial food web versus a deep-sea hydrothermal vent food web. →

2. What is the difference between mimicry and camouflage? →

3. What is an extinct species? →

4. You see a bird with a short, thick beak perched on a sunflower head. Based on its beak shape, what is it most likely doing? →

5. Compare C3, C4, and CAM photosynthesis strategies. Why have these different approaches evolved? →

(A) Terrestrial webs start with photosynthesis (solar energy), while vent ecosystems start with chemosynthesis (chemical energy from hydrogen sulfide), but both follow the same pattern of producers → consumers → decomposers with energy loss at each level

(B) Camouflage helps an animal blend into its background environment, while mimicry is when one species evolves to look like a different, often dangerous species

to deter predators

(C) A species that no longer has any living individuals anywhere on Earth, like the dodo bird or the passenger pigeon

(D) C3 is the default pathway (most plants, but loses water in heat). C4 evolved in hot grasslands (concentrates CO₂, reducing water loss). CAM evolved in deserts (opens stomata only at night). Each strategy trades off efficiency for water conservation in different climates

(E) Cracking open sunflower seeds — the short, thick cone-shaped beak is an adaptation for generating the strong bite force needed to crack hard seed shells

13. Animal Classification & Kingdoms

Circle the correct answer

121. What does the term 'vertebrate' mean?

(A) An animal that can fly (B) An animal that eats only plants (C) An animal that has a backbone or spinal column (D) An animal that lives in water

122. How do wetlands act as 'nature's kidneys' for the environment?

(A) Wetlands filter pollutants and sediments from water as it passes through, absorb excess floodwater, and recharge groundwater supplies — cleaning water naturally (B) Wetlands produce oxygen like lungs, which is the most common explanation for this phenomenon (C) Wetlands create new water from soil chemicals, and this is the standard approach used in most cases (D) Wetlands heat water to kill germs, and this has been consistently demonstrated in practice

123. Describe how bird feather structure enables flight.

(A) All feather types are identical in structure, and this is the standard approach used in most cases (B) Flight feathers have a central shaft with interlocking barbs and barbules creating a lightweight, airtight surface. The asymmetric shape creates lift. Contour feathers streamline the body, and down feathers provide insulation (C) Feathers are just colored decoration with no function in flight, and this has been consistently demonstrated in practice (D) Feathers work like propellers spinning around the bird, and this is the standard approach used in most cases

124. Explain how CAM photosynthesis is an adaptation for desert survival.

(A) CAM plants do not need water at all, and this is the standard approach used in most cases (B) CAM plants photosynthesize only at night, which is why this approach is recommended by experts (C) CAM plants open their stomata only at night (when it is cooler and less water is lost), store CO₂ as an acid, then use that stored CO₂ for photosynthesis during the day with stomata closed — minimizing water loss in hot, dry environments (D) CAM stands for Camera Assisted Movement, and this has been

consistently demonstrated in practice

125. Compare the life cycles of a frog and a chicken. What does this comparison reveal about why they are in different classes?

(A) Frogs are in a different class only because they are smaller (B) Frogs undergo metamorphosis (egg → tadpole → adult) showing a dramatic body change, while chickens hatch as miniature versions of adults, reflecting different developmental strategies of amphibians vs birds (C) Both have the same life cycle since they both come from eggs (D) The difference is just that frogs live in water and chickens live on land, which is the most common explanation for this phenomenon

126. If you were a wildlife manager, how would you determine the carrying capacity of a park for a specific animal species?

(A) Survey available food, water, and shelter resources; count the current population; monitor health indicators like body condition and reproduction rates; track seasonal resource changes (B) Ask the animals how many of them can fit, and this is the standard approach used in most cases (C) Count all species and divide by the park area, which is why this approach is recommended by experts (D) Just guess based on how big the park looks, and this principle applies across similar situations

Write the answer

127. Compare the effectiveness of 'ex situ' conservation (zoos, seed banks) versus 'in situ' conservation (protected habitats). When is each approach most appropriate?

Answer: _____

128. Design an experiment to test which color of light (red, blue, or green) is most effective for photosynthesis in aquatic plants.

Answer: _____

129. Build a food web for a deciduous forest ecosystem that includes at least 3 producers, 3 primary consumers, 2 secondary consumers, and 1 tertiary consumer.

Answer: _____

130. Analyze the trade-offs in the peacock's elaborate tail. How can such an apparently disadvantageous feature be an adaptation?

Answer: _____

Match each question to its answer

1. Explain why protecting a single charismatic species like the giant panda can benefit many other less well-known species. →

2. What characteristic do all mammals share? →

3. Propose an experiment to test whether the coloring of a prey species provides

camouflage protection from predators. →

4. Explain why warning coloration (bright colors on poisonous animals) seems to be the opposite of camouflage but is still an effective survival strategy. →

5. You are designing a wildlife reserve. Using island biogeography principles, should you create one large reserve or several small ones? Explain your reasoning. →

(A) They have hair or fur and feed their young with milk

(B) Giant pandas serve as an 'umbrella species' — protecting enough habitat for pandas also protects the entire forest ecosystem, benefiting hundreds of other species (birds, insects, plants) that share the same habitat

(C) Warning colors advertise danger — predators learn to associate bright patterns with painful or toxic experiences, so they avoid these prey. Being visible actually protects the animal because predators remember and avoid the pattern

(D) Generally, one large reserve is better — it supports larger populations, reduces edge effects, maintains habitat connectivity, and prevents isolation that causes local extinctions. However, several small reserves can protect different ecosystem types if they are connected by corridors

(E) Place equal numbers of differently-colored model prey (matching and non-matching backgrounds) in a natural habitat and count how many of each color are 'eaten' by predators over time — more surviving matches means camouflage works

14. Animal Classification & Kingdoms

Circle the correct answer

131. A class is building a terrarium to model a forest ecosystem. What biotic and abiotic components should they include?

(A) Biotic: small plants, moss, isopods or earthworms, springtails; Abiotic: soil, water, gravel for drainage, a light source for photosynthesis, and proper temperature (B) Only plants are needed since animals are too messy (C) A terrarium only needs plastic decorations to look like a forest, which is the most common explanation for this phenomenon (D) Just add dirt and water; nothing else is needed, and this has been consistently demonstrated in practice

132. Using food web principles, explain why eating lower on the food chain (more plants, less meat) is more energy-efficient for feeding a large human population.

(A) Humans cannot digest plants as well as meat, making this the most widely accepted explanation (B) Eating plants directly captures 100% of plant energy, while eating meat means losing 90% at each transfer — it takes about 10 kg of grain to produce 1 kg of beef due to the 10% rule (C) Meat has more energy than plants per gram, so it is more efficient, which is the most common explanation for this

phenomenon (D) Eating plants is not actually more efficient, as this is what research and standard practice suggests

133. Create a field guide page for a common bird in your area, including all the information a beginning birdwatcher would need to identify it.

(A) List every scientific fact known about the species, as this is what research and standard practice suggests (B) Just include a picture and the bird's name, and this is the standard approach used in most cases (C) Include: species name (common and scientific), size comparison (to a known bird), key field marks (coloring, beak shape, distinctive features), habitat preference, typical behavior, song description, range map, and similar species to avoid confusion (D) Only describe the bird's color, and this principle applies across similar situations

134. Some scientists think the five-kingdom system should be replaced with a three-domain system. What reasons might they have?

(A) The five-kingdom system was invented too long ago to be useful, which is why this approach is recommended by experts (B) They want fewer categories to make it simpler for students, which is why this approach is recommended by experts (C) Three is a more popular number than five, and this principle applies across similar situations (D) DNA evidence shows that single-celled organisms are more diverse than previously thought, and the three-domain system (Bacteria, Archaea, Eukarya) better reflects evolutionary relationships

135. Judge whether focusing conservation efforts on 'charismatic megafauna' (pandas, tigers, elephants) is a fair and effective approach to protecting biodiversity.

(A) It is effective because charismatic species attract funding and public support, and protecting their large habitats benefits many species (umbrella effect). But it is unfair because it neglects equally important but less appealing species like insects, fungi, and amphibians that play critical ecological roles (B) Only charismatic species matter for ecosystem health, which is why this approach is recommended by experts (C) All species should receive exactly equal funding regardless of public appeal, which is the most common explanation for this phenomenon (D) Focusing on charismatic species is the only effective approach, as this is what research and standard practice suggests

136. Analyze how invasive plant species can disrupt native ecosystems by altering fundamental ecological processes.

(A) Invasive plants always improve ecosystems by adding diversity, as this directly follows from the underlying principles (B) Invasive plants can change soil chemistry (nitrogen-fixing species enrich poor soils), alter fire regimes (flammable grasses increase fire frequency), outcompete natives for light and water, and disrupt pollination networks by attracting pollinators away from native flowers (C) Invasive plants only affect other plants, not animals, as this is what research and standard practice suggests (D) Plant invasions are temporary and self-correcting, and this is

the standard approach used in most cases

Write the answer

137. How does urbanization create 'heat islands' and how do these affect local ecosystems?

Answer: _____

138. Compare and contrast a freshwater lake ecosystem and a saltwater ocean ecosystem. What key differences affect the organisms that live in each?

Answer: _____

139. Explain how the shape of a bird's beak is related to the type of food it eats.

Answer: _____

140. What are the main threats to biodiversity, often remembered by the acronym HIPPO?

Answer: _____

Match each question to its answer

1. Compare the migration strategies of Arctic terns and ruby-throated hummingbirds. How do their different body sizes affect their migration approaches? →

2. What is the main cause of the current mass extinction event scientists call the 'Sixth Extinction'? →

3. Why do different layers of a rainforest (canopy, understory, forest floor) have different species even though they are in the same location? →

4. A farmer wants to reduce pesticide use on their crops. Apply your knowledge of ecology to propose an integrated pest management (IPM) plan that uses natural ecosystem processes instead of chemicals. →

5. Name three types of animal adaptations. →

(A) Introduce natural predators (ladybugs eat aphids, parasitic wasps target caterpillars), plant companion crops that repel pests or attract beneficial insects, rotate crops to break pest life cycles, use cover crops to improve soil health and suppress weeds, and apply targeted biological pesticides only as a last resort

(B) Structural (physical body features), behavioral (actions and responses), and physiological (internal body processes)

(C) Each layer has different amounts of sunlight, humidity, temperature, and wind, creating distinct microhabitats that favor different adaptations and species

(D) Human activities — primarily habitat destruction, overexploitation, pollution, invasive species introduction, and climate change — are driving species extinct at 100 to 1,000 times the natural background rate

(E) Arctic terns make the longest migration (pole to pole, ~44,000 miles) fueled by

continuous feeding en route. Tiny hummingbirds must build massive fat reserves before their 500-mile Gulf of Mexico crossing because they cannot feed over open water — body size determines fueling strategy

15. Animal Classification & Kingdoms

Circle the correct answer

141. Explain the concept of carrying capacity using a deer population in a forest as an example.

(A) Carrying capacity means how far a deer can travel in one day, making this the most widely accepted explanation (B) Carrying capacity is how much weight a deer can carry, and this has been consistently demonstrated in practice (C) Carrying capacity is the maximum number of deer a forest can support based on available food, water, and space; if the population exceeds this, some deer will starve or become vulnerable to disease (D) Carrying capacity is the number of babies a deer can have at once, and this is the standard approach used in most cases

142. Analyze the role of Indigenous communities in biodiversity conservation, using specific examples.

(A) Indigenous peoples have no role in modern conservation, which is why this approach is recommended by experts (B) Indigenous peoples manage about 25% of Earth's land, which contains 80% of remaining biodiversity. Their traditional ecological knowledge, sustainable land management practices, and cultural values of environmental stewardship have proven more effective than many Western conservation approaches (C) Traditional knowledge is not relevant to conservation, and this is the standard approach used in most cases (D) Only scientists can effectively conserve biodiversity, and this has been consistently demonstrated in practice

143. Design an experiment to demonstrate the 10% energy rule using organisms that could be observed in a classroom.

(A) Just tell students the rule and have them memorize it, as this is what research and standard practice suggests (B) Watch a nature documentary about predators, which is why this approach is recommended by experts (C) Count all the animals in a field trip to the zoo, making this the most widely accepted explanation (D) Grow measured amounts of plants (producers), feed them to herbivorous insects (weigh food eaten vs insect growth), then feed insects to small predators — measure biomass at each level to show approximately 10% transfer

144. Evaluate whether feeding wild birds with backyard bird feeders helps or harms bird populations overall.

(A) Feeding birds is always harmful and should be banned, which is why this approach is recommended by experts (B) Feeders provide supplemental food that increases winter survival, but can also spread disease at crowded feeders, create dependency, attract predators like hawks and cats, and favor generalist species over specialists — responsible feeder management minimizes harm (C) Feeding birds is always beneficial with no drawbacks, making this the most widely accepted explanation (D) Bird feeders have no measurable effect on bird populations, making this the most widely accepted explanation

145. What is the difference between point source and nonpoint source pollution?

(A) Point source is natural and nonpoint source is human-caused, and this principle applies across similar situations (B) Point source is chemical and nonpoint source is physical, and this principle applies across similar situations (C) Point source pollution comes from a single identifiable source like a factory pipe or sewage outfall. Nonpoint source comes from many diffuse sources spread across an area, like agricultural runoff, urban stormwater, and atmospheric deposition (D) There is no real difference between them, which is why this approach is recommended by experts

146. A scientist discovers a new organism that is multicellular, cannot move on its own, and makes its own food using sunlight. Which kingdom should it be classified in?

(A) Fungi kingdom (B) Protist kingdom (C) Plant kingdom (Plantae) (D) Animal kingdom

Write the answer

147. Judge whether zoos are effective tools for ecosystem conservation. What are the strongest arguments on each side?

Answer: _____

148. Describe how ecotourism can benefit both wildlife conservation and local communities.

Answer: _____

149. What is the purpose of bird song?

Answer: _____

150. Create a model showing how carbon cycles through an ecosystem involving plants, animals, decomposers, and the atmosphere.

Answer: _____

Match each question to its answer

1. Analyze how environmental justice issues mean that pollution disproportionately affects low-income communities and communities of color. →
2. Why is the sun considered the ultimate source of energy for almost all ecosystems on Earth? →
3. Describe how migration is a behavioral adaptation that helps animals survive. →
4. Describe how an omnivore complicates a simple food chain. →
5. What is the chemical equation for photosynthesis? →

(A) Omnivores eat both plants and animals, connecting multiple trophic levels simultaneously and creating branching pathways that turn simple food chains into complex food webs

(B) $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ (carbon dioxide + water + light → glucose + oxygen)

(C) Plants use sunlight to produce food through photosynthesis, and this food energy is then passed through the food web to herbivores, carnivores, and decomposers

(D) Migration allows animals to move to areas with better food, climate, and breeding conditions as seasons change, avoiding harsh winters or dry seasons that would reduce survival

(E) Polluting facilities (factories, waste sites, highways) are disproportionately located near low-income and minority communities due to historical zoning decisions, lower land values, and reduced political power to resist. These communities experience higher rates of asthma, cancer, and other health problems

16. Animal Classification & Kingdoms

Circle the correct answer

151. Why is habitat fragmentation often more harmful than the total amount of habitat lost?

(A) Animals can easily move between habitat fragments, and this is the standard approach used in most cases (B) Fragmentation only affects very large animals, which is the most common explanation for this phenomenon (C) Fragmentation isolates populations into small patches, preventing movement between them. This reduces genetic exchange, makes populations vulnerable to local extinctions, and creates harmful edge effects that degrade habitat quality (D) Fragmentation is actually less harmful than total habitat loss, which is the most common explanation for this phenomenon

152. Examine the concept of 'primary succession' and explain how plants are the pioneer organisms that transform bare rock into soil.

(A) Only humans can create soil from rock, which is the most common explanation for this phenomenon (B) Soil appears instantly on bare rock, which is the most common explanation for this phenomenon (C) Trees are the first organisms to colonize bare rock, which is why this approach is recommended by experts (D) Pioneer species (lichens, mosses) colonize bare rock first, their acids break down rock into mineral particles, their decomposing remains add organic matter, gradually creating thin soil that supports grasses, then shrubs, then eventually trees over centuries

153. Describe how organisms in a coral reef ecosystem depend on each other.

(A) Organisms in a coral reef do not depend on each other at all, and this has been consistently demonstrated in practice (B) Only the fish depend on the coral; the coral does not need the fish, and this is the standard approach used in most cases (C) All reef organisms eat the same food source, and this principle applies across similar situations (D) Coral provides structure and shelter for fish, algae inside coral provide food through photosynthesis, fish eat parasites off larger animals, and predators control prey populations — forming an interconnected web

154. A farmer wants to use biological pest control instead of pesticides. Using food web principles, design a strategy to control aphids on crops.

(A) Introduce or encourage ladybugs (natural predators of aphids), plant flowers nearby to attract beneficial insects, and avoid broad-spectrum pesticides that kill both pests and their natural enemies (B) Just spray more pesticides to kill everything, and this is the standard approach used in most cases (C) Remove all insects from the field, which is why this approach is recommended by experts (D) Add more aphids so they compete with each other, making this the most widely accepted explanation

155. Examine why animals on islands often evolve to be either much larger or much smaller than their mainland relatives (island gigantism and dwarfism).

(A) Islands have magic that changes animal sizes, as this directly follows from the underlying principles (B) Island animals are the same size as mainland animals, as this is what research and standard practice suggests (C) Without large predators, small animals can evolve to be larger (fewer size constraints). Without abundant resources, large animals evolve smaller bodies (need less food). Island isolation and limited resources drive these opposite size shifts (D) Only large animals can survive on islands, as this directly follows from the underlying principles

156. Analyze why a food web with more connections is generally more stable than one with few connections.

(A) More connections mean organisms have alternative food sources — if one species declines, predators can switch to other prey, preventing cascading population crashes throughout the web (B) More connections make a food web less stable

because there is more competition (C) The number of connections does not affect stability, which is the most common explanation for this phenomenon (D) Food webs with fewer connections are actually more stable, and this has been consistently demonstrated in practice

Write the answer

157. Evaluate whether human activities like building roads and cities might be driving new adaptations in wildlife. Provide specific examples.

Answer: _____

158. Create a classification key that would help someone determine whether an unknown animal is a mammal, bird, reptile, amphibian, or fish.

Answer: _____

159. What is a habitat?

Answer: _____

160. Analyze why many bird species that were historically forest-dwellers have successfully colonized urban environments while others have not.

Answer: _____

Match each question to its answer

1. In a pond food web, grass → grasshopper → frog → snake → hawk. If a disease kills most of the frogs, predict what happens to grasshopper and snake populations. →

2. Analyze how the bioaccumulation of mercury in an aquatic food chain affects organisms differently at each trophic level. →

3. Create a field guide entry for an imaginary animal, including enough details about its characteristics that another student could correctly classify it into the right kingdom, phylum, and class. →

4. Judge whether it would be useful to classify animals by their color. What problems might arise? →

5. Design a citizen science project that middle school students could conduct to help monitor local biodiversity. →

(A) Mercury concentrations increase at each trophic level (biomagnification) — tiny amounts in water are absorbed by algae, concentrated in small fish, further concentrated in large fish, reaching toxic levels in top predators like eagles and humans

(B) Classifying by color would be unreliable because many unrelated species share colors, individuals within a species vary in color, and some animals change color seasonally or as they age

(C) Example: The Skywhale has a vertebral column, is warm-blooded, has fur, gives

live birth, and produces milk, classifying it as Kingdom Animalia, Phylum Chordata, Class Mammalia

(D) Create a seasonal bird survey using standardized observation methods: students record species, count, time, and location at fixed points weekly, submit data to eBird database, and analyze trends over the school year to detect population changes

(E) Grasshopper populations would increase (fewer predators eating them) while snake populations would decrease (less food available), showing how changes ripple through food webs

Riddle & Joke Break

Guess the answer, then check the key!

161. Why did the owl ace the ecology test?

162. What do you call a bear with no teeth?

163. Why did the frog log its observations?

164. What did the ecosystem say when one species disappeared?

165. Why are birds such great photographers?

166. What did the predator say to the prey?

Answer Key

1. D — Animal, Plant, Fungi, Protist, and Monera (Bacteria)
2. B — Animal kingdom (Animalia)
3. C — An animal that has a backbone or spinal column
4. B — Kingdom, Phylum, Class, Order, Family, Genus, Species
5. D — They have hair or fur and feed their young with milk
6. A — Warm-blooded animals keep their body temperature the same no matter the weather, while cold-blooded animals' body temperature changes with their surroundings
7. Latin names provide one universal name that scientists worldwide can use, avoiding confusion from different common names in different languages
8. Plants make their own food through photosynthesis, while fungi absorb nutrients

by breaking down dead or living organic matter

9. Whales breathe air with lungs, are warm-blooded, give live birth, and nurse their young with milk — all mammal traits — even though they live in water like fish
10. Amphibians have moist, permeable skin and undergo metamorphosis (like tadpole to frog), while reptiles have dry, scaly skin and hatch looking like miniature adults

Matching (Animal Classification & Kingdoms): 1→A, 2→D, 3→C, 4→B, 5→E

11. D — The natural environment where an organism lives, which provides food, water, shelter, and space
12. D — Biotic factors are living things (plants, animals, bacteria) while abiotic factors are nonliving things (water, sunlight, temperature, soil)
13. B — Tropical rainforest, desert, grassland (savanna), temperate forest, taiga (boreal forest), and tundra
14. C — A community of living organisms interacting with each other and their nonliving environment in a specific area
15. C — The specific role an organism plays in its ecosystem, including what it eats, where it lives, and how it interacts with other species
16. D — Desert organisms have special adaptations like water storage (cacti), nocturnal behavior, burrowing to avoid heat, and efficient kidneys that minimize water loss
17. Rainforests have warm temperatures year-round, abundant rainfall, and many vertical layers (canopy, understory, forest floor) creating numerous microhabitats for different species
18. Wetlands filter pollutants and sediments from water as it passes through, absorb excess floodwater, and recharge groundwater supplies — cleaning water naturally
19. Coral provides structure and shelter for fish, algae inside coral provide food through photosynthesis, fish eat parasites off larger animals, and predators control prey populations — forming an interconnected web
20. Carrying capacity is the maximum number of deer a forest can support based on available food, water, and space; if the population exceeds this, some deer will starve or become vulnerable to disease
Matching (Habitats & Ecosystems): 1→A, 2→C, 3→D, 4→B, 5→E
21. C — An organism that makes its own food from sunlight through photosynthesis, such as plants, algae, and some bacteria

22. D — Only about 10% of the energy at one trophic level is passed to the next level; the rest is lost as heat through cellular respiration
23. D — A food chain shows a single linear pathway of energy from one organism to the next, while a food web shows all the interconnected food chains in an ecosystem
24. B — Decomposers break down dead organisms and waste, recycling nutrients back into the soil so producers can use them again, completing the nutrient cycle
25. C — A trophic level is a feeding position in a food chain: producers are level 1, primary consumers level 2, secondary consumers level 3, and tertiary consumers level 4
26. A — Because only 10% of energy transfers between trophic levels, there is far less energy available to support predators at the top, so the ecosystem can sustain fewer of them
27. Energy flows in one direction (sun → producers → consumers → heat) and is lost at each level, while nutrients cycle repeatedly through the ecosystem and are reused by organisms
28. Plants use sunlight to produce food through photosynthesis, and this food energy is then passed through the food web to herbivores, carnivores, and decomposers
29. Omnivores eat both plants and animals, connecting multiple trophic levels simultaneously and creating branching pathways that turn simple food chains into complex food webs
30. The entire ocean food web would collapse because phytoplankton are the base producers — zooplankton would starve first, then small fish, then larger predators, affecting nearly all marine life
Matching (Food Webs & Energy Flow): 1→B, 2→A, 3→E, 4→D, 5→C
31. C — A physical feature of an organism's body that helps it survive in its environment, such as a bird's beak shape or a turtle's shell
32. B — An adaptation where an animal's color, pattern, or shape helps it blend in with its surroundings to avoid predators or ambush prey
33. C — Camouflage helps an animal blend into its background environment, while mimicry is when one species evolves to look like a different, often dangerous species to deter predators
34. D — A state of very deep sleep and slowed metabolism that some animals enter during winter to conserve energy when food is scarce

35. D — Structural (physical body features), behavioral (actions and responses), and physiological (internal body processes)
36. A — Beak shapes are adapted to specific diets: sharp hooked beaks for tearing meat (hawks), long thin beaks for probing flowers (hummingbirds), flat wide beaks for filtering water (ducks), and strong cone-shaped beaks for cracking seeds (finches)
37. Side-facing eyes give prey a wide field of vision (nearly 360 degrees) to spot approaching predators, while forward-facing eyes give predators binocular vision for accurately judging distance to catch prey
38. Counter-shading reduces an animal's visibility by canceling out natural shadows — the dark top surface counteracts bright sunlight from above, and the light belly counteracts dark shadows below, making the animal appear flat and less visible
39. Migration allows animals to move to areas with better food, climate, and breeding conditions as seasons change, avoiding harsh winters or dry seasons that would reduce survival
40. Warning colors advertise danger — predators learn to associate bright patterns with painful or toxic experiences, so they avoid these prey. Being visible actually protects the animal because predators remember and avoid the pattern
Matching (Animal Adaptations): 1→E, 2→B, 3→D, 4→C, 5→A
41. C — The variety of all living things on Earth, including the diversity of species, genetic variation within species, and the diversity of ecosystems
42. B — The species faces a very high risk of extinction in the wild due to declining population numbers, habitat loss, or other threats
43. B — Habitat loss, Invasive species, Pollution, Population growth (human), and Overexploitation (overhunting/overfishing)
44. B — A protected area of land set aside by a government to preserve natural ecosystems, wildlife, and landscapes while allowing public recreation and education
45. A — A species that no longer has any living individuals anywhere on Earth, like the dodo bird or the passenger pigeon
46. A — Genetic diversity provides a range of traits that help populations adapt to changing conditions — diseases, climate shifts, or new predators. Low genetic diversity means a single threat could wipe out the entire population
47. Seed banks preserve the genetic diversity of plant species, which are the

foundation of food webs. Saving plant diversity protects the habitats and food sources that animals depend on for survival

- 48. Fragmentation isolates populations into small patches, preventing movement between them. This reduces genetic exchange, makes populations vulnerable to local extinctions, and creates harmful edge effects that degrade habitat quality
- 49. Ecotourism generates income for local communities who then have economic incentive to protect wildlife and habitats, funds conservation programs, and raises awareness among visitors about environmental issues
- 50. Giant pandas serve as an 'umbrella species' — protecting enough habitat for pandas also protects the entire forest ecosystem, benefiting hundreds of other species (birds, insects, plants) that share the same habitat

Matching (Biodiversity & Conservation): 1→A, 2→D, 3→C, 4→E, 5→B

- 51. B — Distinctive visible features like plumage color patterns, beak shape, body size, wing bars, eye rings, tail shape, and leg color that help distinguish one species from another in the field
- 52. B — Sexual dimorphism — males and females of the same species have noticeably different appearances, like the bright red male cardinal versus the brownish female
- 53. C — Birds sing primarily to defend territory (warning other males to stay away) and to attract mates (advertising fitness and health to females)
- 54. C — Cone-shaped (seed crackers like finches), hooked (meat tearers like hawks), long and thin (nectar/insect probers like hummingbirds), and flat and wide (water filterers like ducks)
- 55. C — A bird's ecological niche includes what it eats, where it feeds (ground, canopy, water), when it is active, where it nests, and how it interacts with other species in its habitat
- 56. A — Birds use multiple navigation systems: the sun's position during the day, star patterns at night, Earth's magnetic field detected by magnetite crystals in their beaks, visual landmarks, and even smell in some species
- 57. Migration allows birds to exploit seasonally abundant food and longer daylight hours for feeding chicks in summer breeding grounds, then escape harsh winters by moving to warmer areas with available food
- 58. Flight feathers have a central shaft with interlocking barbs and barbules creating a lightweight, airtight surface. The asymmetric shape creates lift. Contour feathers streamline the body, and down feathers provide insulation

59. Many animals (squirrels, deer, even other bird species) recognize and respond to bird alarm calls as warning signals for approaching predators, creating a network of interspecies communication throughout the forest
60. In cooperative breeding, non-breeding 'helper' birds (usually older offspring from previous years) assist the breeding pair by defending territory, feeding nestlings, and watching for predators, increasing the chicks' survival rate
Matching (Bird Identification & Behavior): 1→C, 2→D, 3→B, 4→A, 5→E
61. $D - 6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2$ (carbon dioxide + water + light → glucose + oxygen)
62. A — Chloroplasts — they contain chlorophyll, the green pigment that captures light energy for photosynthesis
63. B — Carbon dioxide (from the air), water (from the soil through roots), and light energy (from the sun)
64. B — Stomata are tiny pores (openings) on leaf surfaces that open and close to allow carbon dioxide in for photosynthesis and release oxygen and water vapor
65. C — The process by which water moves through a plant from roots to leaves and evaporates through stomata into the atmosphere, creating a pulling force that draws more water up from the roots
66. C — They are complementary processes: photosynthesis converts CO_2 and water into glucose and oxygen using light energy, while cellular respiration converts glucose and oxygen back into CO_2 and water, releasing energy for the cell
67. As days shorten, trees stop producing green chlorophyll, which breaks down and disappears. This reveals yellow and orange pigments (carotenoids) that were always present but hidden, and red pigments (anthocyanins) are newly produced
68. Shade-adapted plants have larger, thinner leaves to capture more light, more chloroplasts per cell, can photosynthesize at lower light intensities, and some have dark green or even purple undersides to absorb all available light wavelengths
69. Mycorrhizal fungi form mutually beneficial partnerships with plant roots: the fungi extend the root system's reach (accessing water and phosphorus in places roots cannot reach) in exchange for sugars the plant produces through photosynthesis
70. CAM plants open their stomata only at night (when it is cooler and less water is lost), store CO_2 as an acid, then use that stored CO_2 for photosynthesis during the day with stomata closed — minimizing water loss in hot, dry environments

Matching (Plant Ecology & Photosynthesis): 1→C, 2→B, 3→E, 4→A, 5→D

71. A — A natural process where certain gases in Earth's atmosphere (CO₂, methane, water vapor) trap heat from the sun, keeping the planet warm enough to support life — like a blanket around the Earth
72. C — The process by which oceans absorb excess CO₂ from the atmosphere, forming carbonic acid that lowers the water's pH, making it harder for marine organisms to build shells and coral skeletons
73. D — Point source pollution comes from a single identifiable source like a factory pipe or sewage outfall. Nonpoint source comes from many diffuse sources spread across an area, like agricultural runoff, urban stormwater, and atmospheric deposition
74. D — The total amount of greenhouse gases (measured in CO₂ equivalents) produced directly and indirectly by a person, organization, event, or product throughout its lifecycle
75. D — Human activities — primarily habitat destruction, overexploitation, pollution, invasive species introduction, and climate change — are driving species extinct at 100 to 1,000 times the natural background rate
76. B — Plastic breaks into microplastics eaten by plankton and small fish, then bioaccumulates up the food chain. Larger animals ingest plastic bags (mistaken for jellyfish) or become entangled. Chemicals leaching from plastic can disrupt hormones in marine organisms at every level
77. Dark pavement and buildings absorb and radiate heat, replacing vegetation that would cool through transpiration. Urban areas can be 5-10 degrees Fahrenheit warmer than surrounding countryside, altering species composition, extending growing seasons, and increasing energy demand for cooling
78. Monoculture depletes specific soil nutrients, requires heavy fertilizer and pesticide use, eliminates habitat diversity, reduces beneficial soil organism populations, increases erosion, and makes crops vulnerable to pests and disease because genetic diversity is extremely low
79. Ecological footprint calculates how much biologically productive land and water area is needed to produce what a person consumes and absorb their waste. Currently, humanity uses 1.7 Earths worth of resources annually, meaning we are depleting natural capital faster than it regenerates
80. Ship noise overlaps with frequencies whales use for communication, navigation, and finding food. This acoustic pollution can mask whale calls over hundreds of miles, cause chronic stress, alter migration routes, and interfere with mother-calf

bonding

Matching (Human Impact on Ecosystems): 1→C, 2→D, 3→A, 4→E, 5→B

81. C — Whales breathe air with lungs, are warm-blooded, give live birth, and nurse their young with milk — all mammal traits — even though they live in water like fish
82. C — Excess nutrients (likely from fertilizer runoff) caused an algal bloom, which depleted oxygen in the water as the algae decomposed, suffocating the fish (eutrophication)
83. A — Producers: heat-loving bacteria near vents convert geothermal energy to food (chemosynthesis). Primary consumers: tube-dwelling filter feeders eat bacteria. Secondary consumers: crawling predators eat filter feeders. Tertiary: large ambush predators eat crawlers. Decomposers recycle all dead matter near vents
84. B — Flamingo long legs allow wading in deep water to feed; cheetah long legs enable fast running to catch prey; giraffe long legs help reach high tree canopies for food. Same structure, different selective pressures and functions
85. C — Genetic diversity provides a range of traits that help populations adapt to changing conditions — diseases, climate shifts, or new predators. Low genetic diversity means a single threat could wipe out the entire population
86. B — A bird's ecological niche includes what it eats, where it feeds (ground, canopy, water), when it is active, where it nests, and how it interacts with other species in its habitat
87. This is positive phototropism — the plant hormone auxin migrates to the shaded side of the stem, causing cells there to elongate more than the lit side, bending the stem toward the light source
88. Renewables dramatically reduce greenhouse gas emissions and air pollution but have their own impacts: solar farms require large land areas (habitat loss), wind turbines can kill birds and bats, mining lithium and rare earth metals for batteries pollutes and depletes resources, and manufacturing has a carbon footprint that takes 1-3 years to offset
89. These names are misleading because neither starfish nor jellyfish are actually fish — starfish are echinoderms and jellyfish are cnidarians, showing why scientific names are more accurate
90. Zebra mussels filter huge amounts of water (removing plankton that native species eat), coat hard surfaces (clogging pipes), outcompete native mussels, and alter water clarity which changes plant growth patterns

Matching (Foundational Concepts Review): 1→D, 2→C, 3→A, 4→B, 5→E

91. A — Latin names provide one universal name that scientists worldwide can use, avoiding confusion from different common names in different languages
92. B — Without wolves, elk overpopulated and overgrazed vegetation along rivers, causing erosion and habitat loss. Reintroducing wolves reduced elk numbers, vegetation recovered, rivers stabilized, and biodiversity increased — a trophic cascade
93. C — The entire ocean food web would collapse because phytoplankton are the base producers — zooplankton would starve first, then small fish, then larger predators, affecting nearly all marine life
94. B — This is temporal niche partitioning — by being active at different times, the two species avoid direct competition for the same food resources and predators, allowing both to coexist in the same habitat
95. D — A protected area of land set aside by a government to preserve natural ecosystems, wildlife, and landscapes while allowing public recreation and education
96. A — Migration allows birds to exploit seasonally abundant food and longer daylight hours for feeding chicks in summer breeding grounds, then escape harsh winters by moving to warmer areas with available food
97. Include: aquatic plants (producers generating oxygen and glucose), small animals like snails (consumers producing CO₂ and waste), decomposing bacteria (recycling nutrients), water, soil substrate (mineral source), and place in indirect light. The sealed system cycles carbon, oxygen, and nutrients indefinitely if balanced
98. International waters are a shared commons with no single owner. Each nation's fishing fleet has incentive to catch as much as possible before others do, leading to overexploitation of fish stocks that no one nation can protect — individual rational behavior produces collective ruin
99. Create stations organized by vertebrate class (mammals, birds, reptiles, amphibians, fish) with comparison displays showing key traits like body covering, reproduction, and temperature regulation
100. The specific role an organism plays in its ecosystem, including what it eats, where it lives, and how it interacts with other species

Matching (Applied Problem Solving): 1→B, 2→E, 3→C, 4→A, 5→D

101. B — Amphibians have moist, permeable skin and undergo metamorphosis (like tadpole to frog), while reptiles have dry, scaly skin and hatch looking like

miniature adults

102. B — Destroying the wetland would eliminate natural flood control (increasing flood damage costs), remove water filtration services, destroy wildlife habitat, and lose recreational value — these ecosystem services often exceed the mall's economic value
103. B — Energy flows in one direction (sun → producers → consumers → heat) and is lost at each level, while nutrients cycle repeatedly through the ecosystem and are reused by organisms
104. D — When antibiotics kill most bacteria, the few with random mutations for resistance survive and reproduce, passing resistance to offspring. This shows natural selection: variation exists, environment selects favorable traits, and resistant populations grow rapidly
105. D — The variety of all living things on Earth, including the diversity of species, genetic variation within species, and the diversity of ecosystems
106. C — Plant native trees, shrubs, and wildflowers for food and shelter; install a water feature (birdbath with moving water); add nest boxes with different entrance hole sizes for different species; leave leaf litter for ground feeders; avoid pesticides that kill insect food sources
107. They are complementary processes: photosynthesis converts CO₂ and water into glucose and oxygen using light energy, while cellular respiration converts glucose and oxygen back into CO₂ and water, releasing energy for the cell
108. Collection devices address symptoms, not causes — they cannot capture microplastics (the most harmful form), may trap marine life as bycatch, cannot cover the vast ocean area, and could create a false sense that cleanup substitutes for reducing plastic production. Source reduction is more effective
109. Dolphins are mammals (warm-blooded, breathe air, give live birth, nurse young) while sharks are fish (cold-blooded, breathe through gills, most lay eggs or have different reproduction)
110. Periodic fires clear dead vegetation, return nutrients to soil, prevent woody plant encroachment, stimulate new growth from fire-adapted seeds, and maintain open habitat for grassland species
Matching (Critical Analysis & Evaluation): 1→A, 2→E, 3→C, 4→D, 5→B
111. A — Class Aves (birds)
112. B — Tropical rainforest, desert, grassland (savanna), temperate forest, taiga (boreal forest), and tundra

113. B — An organism that makes its own food from sunlight through photosynthesis, such as plants, algae, and some bacteria
114. C — Enhanced non-visual senses (echolocation or sensitive touch), loss of eyes or pigmentation (unnecessary in darkness), slow metabolism (food is scarce), ability to detect chemical traces in water/air for finding food, and elongated appendages for navigating rocky surfaces
115. C — The ESA has been highly effective — 99% of listed species have been saved from extinction, and many (bald eagle, gray wolf, peregrine falcon) have recovered significantly. However, listing decisions can be slow, and political conflicts over land use remain challenges
116. B — The MBTA has been remarkably effective — it ended commercial feather trade that was driving many species to extinction, protected 1,100+ species, and enabled recovery of egrets, herons, and other species devastated by the millinery trade. However, enforcement gaps and exemptions for incidental kills remain concerns
117. As days shorten, trees stop producing green chlorophyll, which breaks down and disappears. This reveals yellow and orange pigments (carotenoids) that were always present but hidden, and red pigments (anthocyanins) are newly produced
118. Ship noise overlaps with frequencies whales use for communication, navigation, and finding food. This acoustic pollution can mask whale calls over hundreds of miles, cause chronic stress, alter migration routes, and interfere with mother-calf bonding
119. Birds and theropod dinosaurs share features like hollow bones, three-toed feet, wishbones, and feathered fossils, showing they belong on the same branch of the evolutionary tree
120. A community of living organisms interacting with each other and their nonliving environment in a specific area
Matching (Advanced Integration & Synthesis): 1→A, 2→B, 3→C, 4→E, 5→D
121. C — An animal that has a backbone or spinal column
122. A — Wetlands filter pollutants and sediments from water as it passes through, absorb excess floodwater, and recharge groundwater supplies — cleaning water naturally
123. B — Flight feathers have a central shaft with interlocking barbs and barbules creating a lightweight, airtight surface. The asymmetric shape creates lift. Contour feathers streamline the body, and down feathers provide insulation

124. C — CAM plants open their stomata only at night (when it is cooler and less water is lost), store CO₂ as an acid, then use that stored CO₂ for photosynthesis during the day with stomata closed — minimizing water loss in hot, dry environments
125. B — Frogs undergo metamorphosis (egg → tadpole → adult) showing a dramatic body change, while chickens hatch as miniature versions of adults, reflecting different developmental strategies of amphibians vs birds
126. A — Survey available food, water, and shelter resources; count the current population; monitor health indicators like body condition and reproduction rates; track seasonal resource changes
127. In situ is preferred because it protects entire ecosystems and allows natural evolution. Ex situ is a last resort for critically endangered species with no safe habitat remaining. The best strategy combines both approaches
128. Place identical Elodea plants under red, blue, and green lights of equal intensity, measure oxygen bubble production per minute as an indicator of photosynthesis rate, keep temperature and CO₂ levels constant, and include a dark control
129. Producers: oak trees, wildflowers, grasses. Primary consumers: deer eat oak acorns, rabbits eat grasses, caterpillars eat leaves. Secondary consumers: foxes eat rabbits, songbirds eat caterpillars. Tertiary: hawk eats songbirds and foxes
130. The large tail is costly (reduces flight ability, increases predator visibility, requires energy) but females prefer males with larger, more colorful tails, so the mating advantage outweighs the survival cost — this is sexual selection
Matching (Animal Classification & Kingdoms): 1→B, 2→A, 3→E, 4→C, 5→D
131. A — Biotic: small plants, moss, isopods or earthworms, springtails; Abiotic: soil, water, gravel for drainage, a light source for photosynthesis, and proper temperature
132. B — Eating plants directly captures 100% of plant energy, while eating meat means losing 90% at each transfer — it takes about 10 kg of grain to produce 1 kg of beef due to the 10% rule
133. C — Include: species name (common and scientific), size comparison (to a known bird), key field marks (coloring, beak shape, distinctive features), habitat preference, typical behavior, song description, range map, and similar species to avoid confusion
134. D — DNA evidence shows that single-celled organisms are more diverse than previously thought, and the three-domain system (Bacteria, Archaea, Eukarya) better reflects evolutionary relationships

135. A — It is effective because charismatic species attract funding and public support, and protecting their large habitats benefits many species (umbrella effect). But it is unfair because it neglects equally important but less appealing species like insects, fungi, and amphibians that play critical ecological roles
136. B — Invasive plants can change soil chemistry (nitrogen-fixing species enrich poor soils), alter fire regimes (flammable grasses increase fire frequency), outcompete natives for light and water, and disrupt pollination networks by attracting pollinators away from native flowers
137. Dark pavement and buildings absorb and radiate heat, replacing vegetation that would cool through transpiration. Urban areas can be 5-10 degrees Fahrenheit warmer than surrounding countryside, altering species composition, extending growing seasons, and increasing energy demand for cooling
138. Lakes have freshwater with lower salt content and less depth, supporting different species. Oceans are salty, have tidal zones, greater depth, and pressure changes that require specialized adaptations
139. Beak shapes are adapted to specific diets: sharp hooked beaks for tearing meat (hawks), long thin beaks for probing flowers (hummingbirds), flat wide beaks for filtering water (ducks), and strong cone-shaped beaks for cracking seeds (finches)
140. Habitat loss, Invasive species, Pollution, Population growth (human), and Overexploitation (overhunting/overfishing)
Matching (Animal Classification & Kingdoms): 1→E, 2→D, 3→C, 4→A, 5→B
141. C — Carrying capacity is the maximum number of deer a forest can support based on available food, water, and space; if the population exceeds this, some deer will starve or become vulnerable to disease
142. B — Indigenous peoples manage about 25% of Earth's land, which contains 80% of remaining biodiversity. Their traditional ecological knowledge, sustainable land management practices, and cultural values of environmental stewardship have proven more effective than many Western conservation approaches
143. D — Grow measured amounts of plants (producers), feed them to herbivorous insects (weigh food eaten vs insect growth), then feed insects to small predators — measure biomass at each level to show approximately 10% transfer
144. B — Feeders provide supplemental food that increases winter survival, but can also spread disease at crowded feeders, create dependency, attract predators like hawks and cats, and favor generalist species over specialists — responsible feeder management minimizes harm

145. C — Point source pollution comes from a single identifiable source like a factory pipe or sewage outfall. Nonpoint source comes from many diffuse sources spread across an area, like agricultural runoff, urban stormwater, and atmospheric deposition
146. C — Plant kingdom (Plantae)
147. For: Zoos run breeding programs for endangered species, fund field conservation, and educate millions. Against: Captive conditions differ from wild habitats, genetic diversity is limited, and reintroduction to the wild is often difficult
148. Ecotourism generates income for local communities who then have economic incentive to protect wildlife and habitats, funds conservation programs, and raises awareness among visitors about environmental issues
149. Birds sing primarily to defend territory (warning other males to stay away) and to attract mates (advertising fitness and health to females)
150. Atmosphere CO₂ → plants fix carbon through photosynthesis → herbivores eat plants (carbon transfers) → carnivores eat herbivores → all organisms release CO₂ through respiration → dead organisms decomposed by fungi/bacteria → CO₂ returns to atmosphere. Fossil fuels store ancient plant carbon
Matching (Animal Classification & Kingdoms): 1→E, 2→C, 3→D, 4→A, 5→B
151. C — Fragmentation isolates populations into small patches, preventing movement between them. This reduces genetic exchange, makes populations vulnerable to local extinctions, and creates harmful edge effects that degrade habitat quality
152. D — Pioneer species (lichens, mosses) colonize bare rock first, their acids break down rock into mineral particles, their decomposing remains add organic matter, gradually creating thin soil that supports grasses, then shrubs, then eventually trees over centuries
153. D — Coral provides structure and shelter for fish, algae inside coral provide food through photosynthesis, fish eat parasites off larger animals, and predators control prey populations — forming an interconnected web
154. A — Introduce or encourage ladybugs (natural predators of aphids), plant flowers nearby to attract beneficial insects, and avoid broad-spectrum pesticides that kill both pests and their natural enemies
155. C — Without large predators, small animals can evolve to be larger (fewer size constraints). Without abundant resources, large animals evolve smaller bodies (need less food). Island isolation and limited resources drive these opposite size

shifts

- 156. A — More connections mean organisms have alternative food sources — if one species declines, predators can switch to other prey, preventing cascading population crashes throughout the web
- 157. Yes — urban wildlife shows measurable adaptations: cliff-nesting birds now nest on buildings, raccoons have developed greater problem-solving for trash containers, moths near lights have evolved reduced light attraction, and some species have shifted to nocturnal behavior to avoid humans
- 158. Start with: Does it have a backbone? Then: Does it have feathers (bird), fur/hair (mammal), moist skin (amphibian), dry scales (reptile), or scales with gills (fish)?
- 159. The natural environment where an organism lives, which provides food, water, shelter, and space
- 160. Successful urban birds tend to be dietary generalists (eating varied foods), cavity nesters (buildings substitute for trees), tolerant of human disturbance, and cognitively flexible (able to solve novel problems). Specialists with narrow habitat requirements cannot adapt
Matching (Animal Classification & Kingdoms): 1→E, 2→A, 3→C, 4→B, 5→D
- 161. Because it was a real hoot at studying food webs!
- 162. A gummy bear -- but in ecology, we'd call it a consumer with a dietary challenge!
- 163. Because it wanted to keep a field journal -- ribbit-ing reading!
- 164. "Something's missing -- I can feel it in my food web!"
- 165. They always have an eagle eye for detail!
- 166. "Nothing personal -- it's just the food chain of command!"

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