تغطية مراجعة مبادئ علم البيئة والعلاقات بين الكائنات الحية

	almanahj.com/ae 2026 2027 موقع المناهج الإماراتية

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4	بنك أسئلة مبادئ علم البيئة الوحدة الأولى - بريدج
5	ماكس بلانك في العلوم: التنوع الأحيائي والمحافظة عليه

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MINISTRY OF EDUCATION

End of Term 1 Exam Coverage

Grade 9 General – Science

Academic Year 2026-2027

Inspire

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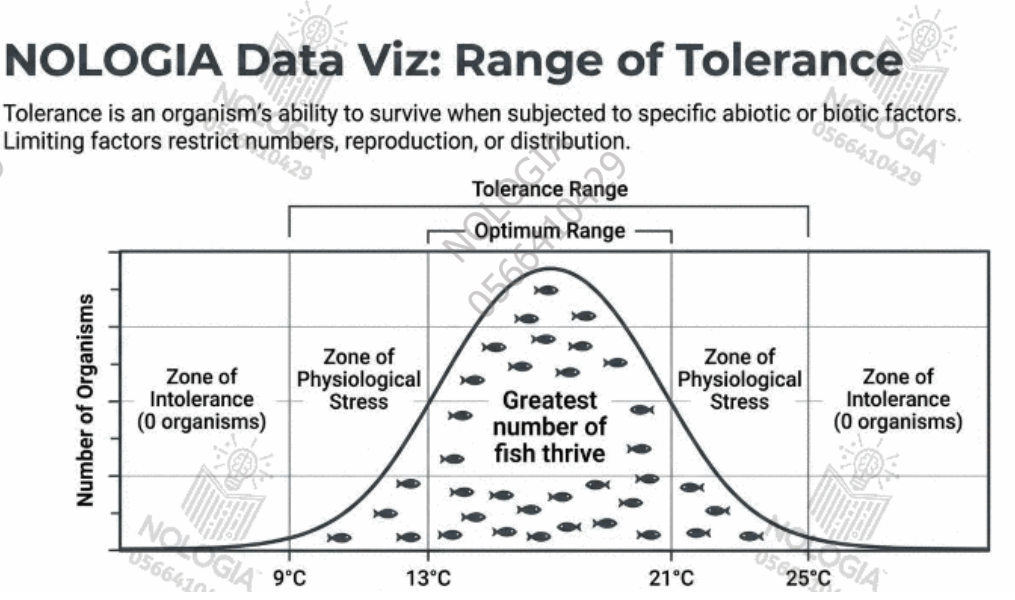
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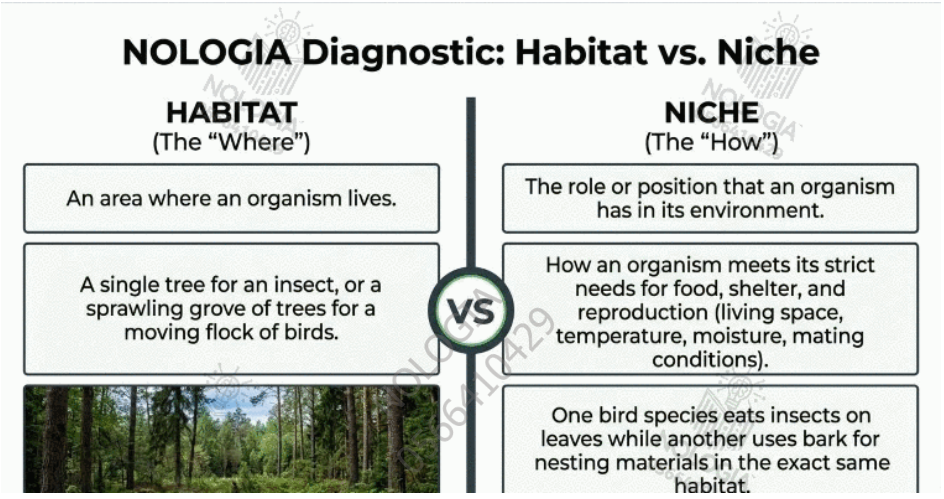
Question 1 : Principles of Ecology – Organisms and Their Relationships

Explain and predict patterns of interactions among organisms across multiple ecosystems.

Page (14).

Multiple Choice Questions - MCQ





NOLOGIA Synthesis: Symbiotic Relationships

Symbiosis is a close relationship when two or more species live together.

(+ / +)	**MUTUALISM** **Mechanism:** Both organisms benefit. **Examples:** Algae & Sloth (algae gets moisture, sloth gets camouflage); Lichens (fungi provide habitat, algae provide food).	
(+ / 0)	**COMMENSALISM** **Mechanism:** One organism benefits, the other is neither helped nor harmed. **Examples:** Clownfish & Sea Anemone (clownfish gets protection, anemone unaffected); Lichens on a tree.	
(+ / -)	**PARASITISM** **Mechanism:** One organism benefits at the expense of ano (host is harmed but usually not killed immediately). **Examples:** External (ticks), Internal (tapeworms), Brood	

Question 1: Identify how temperature is a limiting factor for polar bears.

Answer : Temperature restricts the distribution and survival of polar bears to cold Arctic environments that fall within their range of tolerance; they cannot survive in hot climates.

Question 2: Differentiate between the habitat and niche of an organism that is found in your community.

Answer : A habitat is the physical area where an organism lives (e.g., a tree or desert), whereas a niche is the role or position the organism has in its environment (how it meets its needs for food, shelter, and reproduction).

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Question 3 : Identify how temperature is a limiting factor for polar bears.

A	Polar bears require warm tropical temperatures to digest food.
B	Polar bears hibernate underwater when winter temperatures drop.
C	Temperature restricts polar bears to cold habitats within their range of tolerance.
D	High desert temperatures increase reproduction in polar bears.

Question 4 : Differentiate between the habitat and niche of an organism that is found in your community.

A	A habitat is the role an organism plays, while a niche is the area where it lives.
B	A habitat is the area where an organism lives, while a niche is its role in its environment.
C	A habitat includes only biotic factors, while a niche includes only abiotic factors.
D	A habitat refers to a single individual, while a niche refers to the entire biosphere.

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Question 5 : What is the term for any abiotic or biotic factor that restricts the numbers, reproduction, or distribution of organisms?

A	Limiting factor
B	Optimum range
C	Mutualism
D	Biosphere

Question 6: According to the range of tolerance graph for steelhead trout (Figure 6), what is the optimum water temperature range in which the greatest number of trout thrive?

A	Below 9°C
B	Between 9°C and 13°C
C	Between 13°C and 21°C
D	Above 25°C

Question 7 : What is the ability of any organism to survive when subjected to specific abiotic or biotic factors called?

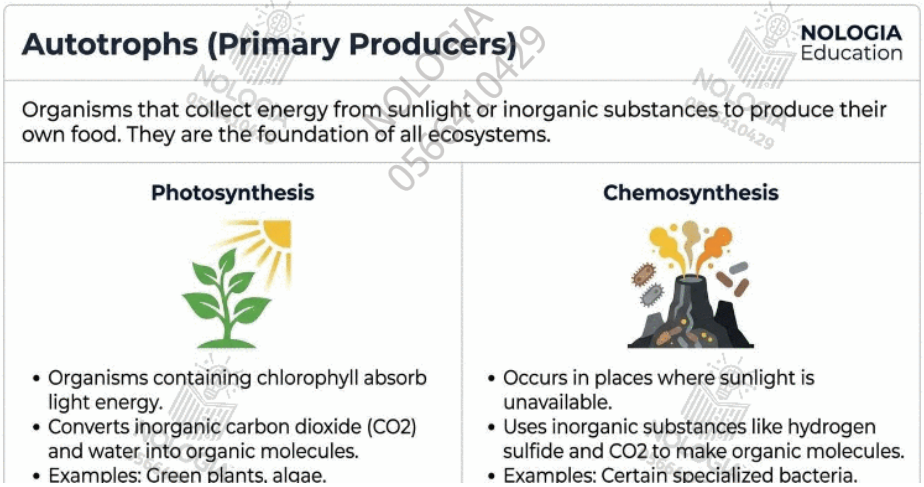
A	Predation
B	Tolerance
C	Commensalism
D	Competition

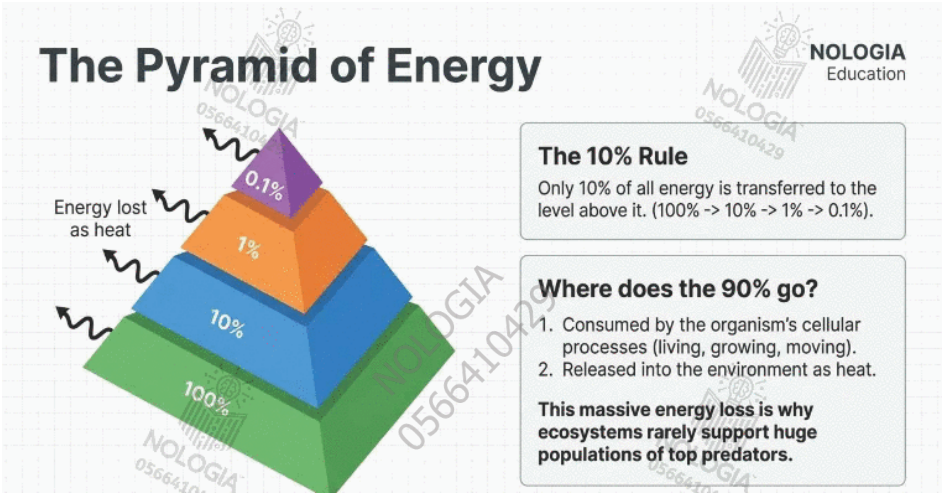
Question 2 : Principles of Ecology – Flow of Energy in an Ecosystem

Describe the complementary process of cellular respiration and photosynthesis with respect to the flow of energy and the cycling of matter within ecosystems.

Page (18).

Multiple Choice Questions - MCQ





Question 1: Explain how photosynthesis and cellular respiration provide energy in each step of a food chain.

Answer : Autotrophs (producers) use photosynthesis to capture solar energy and store it in carbohydrates (food); organisms at each step of the food chain then use cellular respiration to break down those carbohydrates and release energy for cellular functions.

Question 2 : Explain how photosynthesis and cellular respiration provide energy in each step of a food chain.

A	Autotrophs use photosynthesis to store solar energy in food, and organisms use cellular respiration to release that energy.
B	Heterotrophs use photosynthesis to absorb heat, while autotrophs use cellular respiration to produce sunlight.
C	Photosynthesis breaks down food in carnivores, while cellular respiration stores sunlight in green plants.
D	Cellular respiration occurs only in producers, whereas photosynthesis occurs only in decomposers.

Question 3 : Identify the process by which autotrophs at the bottom of the ecological pyramid convert energy from the Sun.

A	Cellular respiration
B	Denitrification
C	Photosynthesis
D	Bioremediation

Question 4 : According to the Pyramid of Energy (10% Rule), what percentage of energy at any trophic level is transferred to the trophic level directly above it?

A	100%
B	90%
C	50%
D	10%

Question 5: What happens to the 90% of energy that is NOT transferred to the next trophic level in an energy pyramid?

A	It is consumed by cellular processes or released into the environment as heat.
B	It is converted into new rocks and minerals at the top of the pyramid.
C	It flows backward from tertiary consumers to primary producers.
D	It is stored permanently in the atmosphere as nitrogen gas.

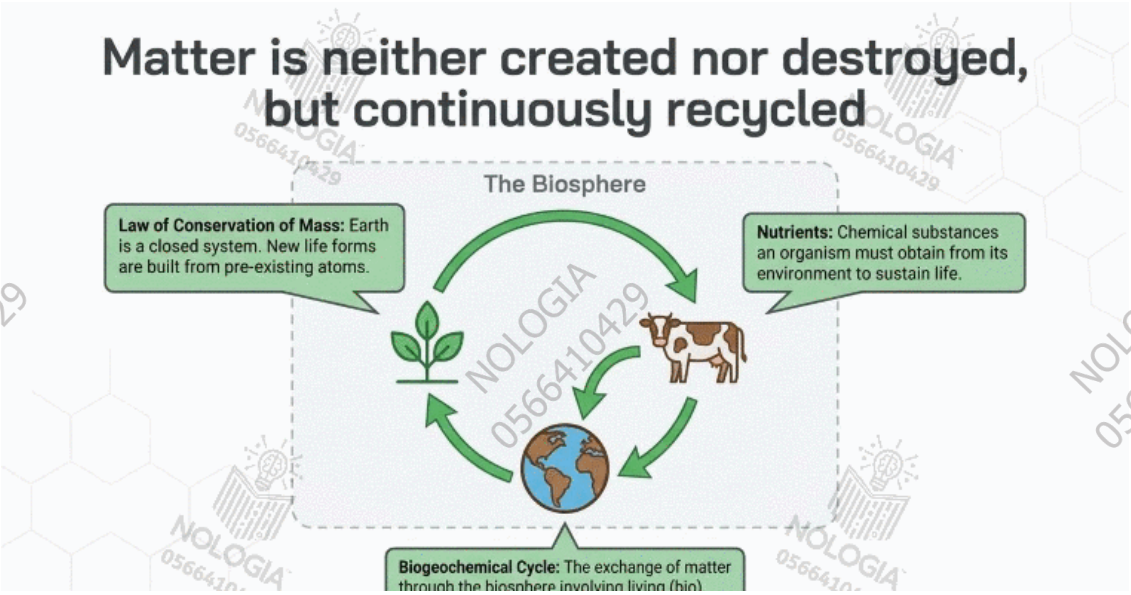
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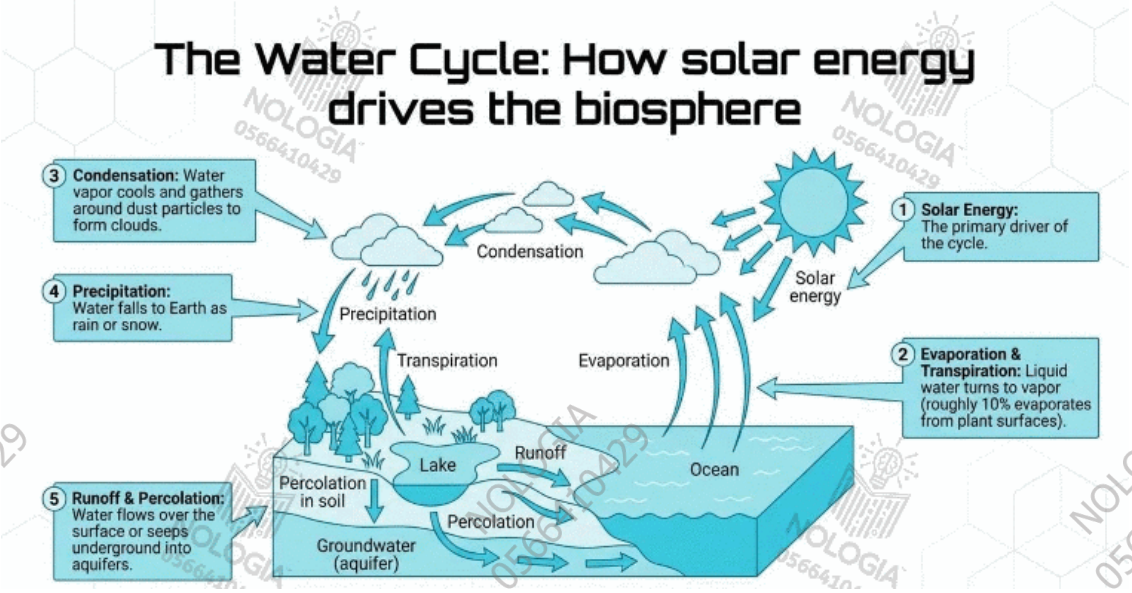
Question 3 : Principles of Ecology – Cycling of Matter

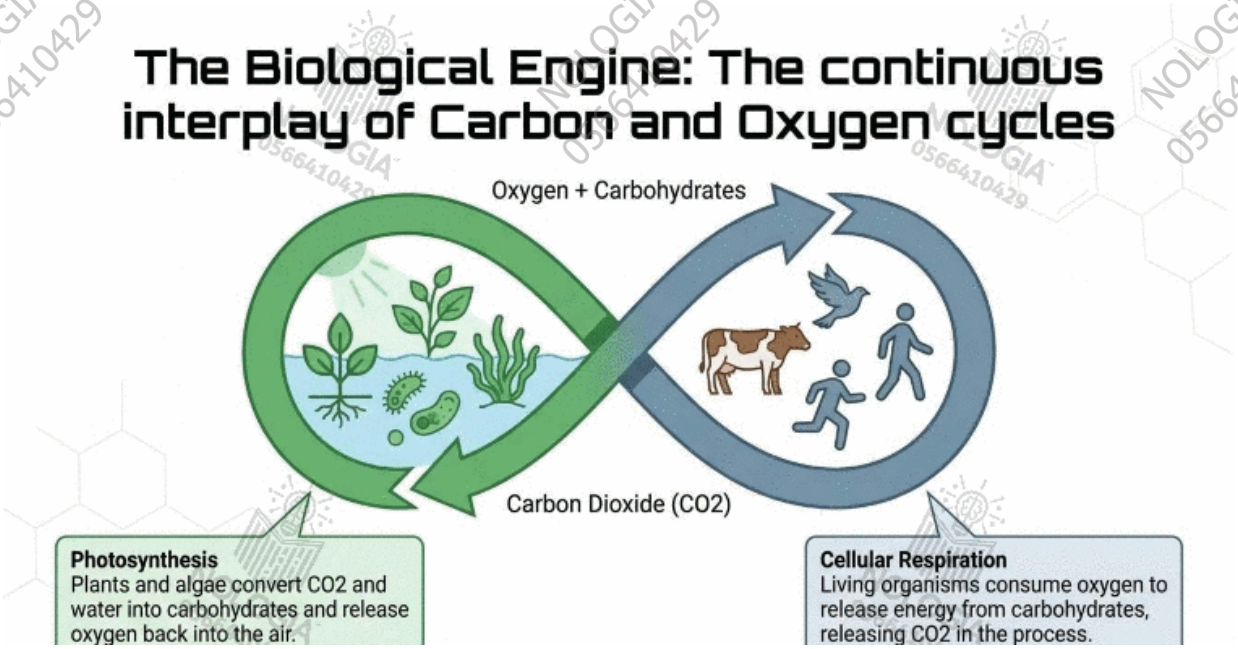
Explain that photosynthesis and cellular respiration are important components of the carbon cycle.

Page (24).

Multiple Choice Questions - MCQ







Question 1: Name four important biogeochemical processes that cycle matter.

Answer : Four important processes that cycle matter are photosynthesis, cellular respiration, decomposition, and nitrogen fixation (or evaporation, transpiration, condensation, and precipitation in the water cycle).

Question 2: Analyze the role of photosynthesis and cellular respiration in the carbon cycle.

Answer : During photosynthesis, plants and algae convert carbon dioxide (CO2) and water into carbohydrates and release oxygen into the air; during cellular respiration, living organisms consume oxygen to break down carbohydrates for energy and release CO2 back into the environment.

Question 3 : Name four important biogeochemical processes that cycle matter.

A	Predation, parasitism, commensalism, and mutualism
B	Photosynthesis, cellular respiration, decomposition, and nitrogen fixation
C	Habitat fragmentation, overexploitation, and edge effects
D	Peer review, blind experiments, and unit conversion

Question 4 : Analyze the role of photosynthesis and cellular respiration in the carbon cycle.

A	Both processes remove oxygen from the air and lock carbon permanently in igneous rocks.
B	Photosynthesis releases CO2 at night, while cellular respiration turns CO2 into fossil fuels.
C	Photosynthesis converts CO2 and water into carbohydrates and oxygen, while cellular respiration consumes oxygen and releases CO2.
D	Both processes convert atmospheric nitrogen gas into calcium carbonate shells.

Question 5 : What is the exchange of matter through the biosphere involving living organisms, geological processes, and chemical processes called?

A	A biogeochemical cycle
B	A pyramid of numbers
C	Biological magnification
D	Habitat fragmentation

Question 6: What is a chemical substance that an organism must obtain from its environment to sustain life and undergo life processes?

A	A pollutant
B	A nutrient
C	A fossil
D	A parasite

Question 7 : In the water cycle, approximately 10% of all water evaporating into the atmosphere evaporates from the surfaces of plants through which process?

A	Percolation
B	Condensation
C	Transpiration
D	Precipitation

Question 8 : How is carbon released back into the atmosphere from long-term storage in buried fossil fuels (coal, oil, and natural gas)?

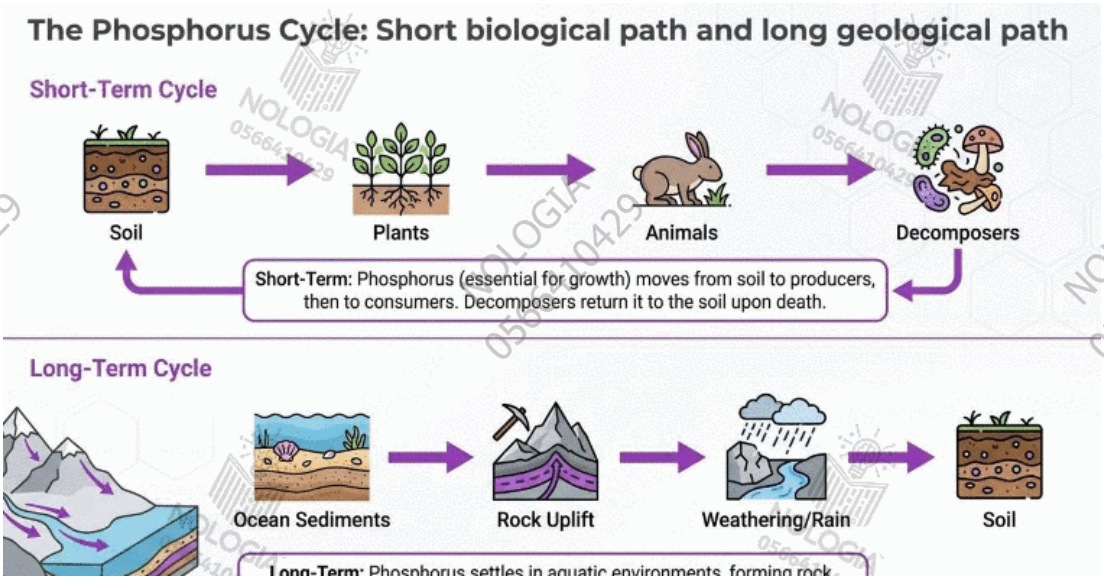
A	When fossil fuels are burned (combustion)
B	When plants absorb sunlight during photosynthesis
C	When water vapor condenses into clouds
D	When nitrogen-fixing bacteria live on plant roots

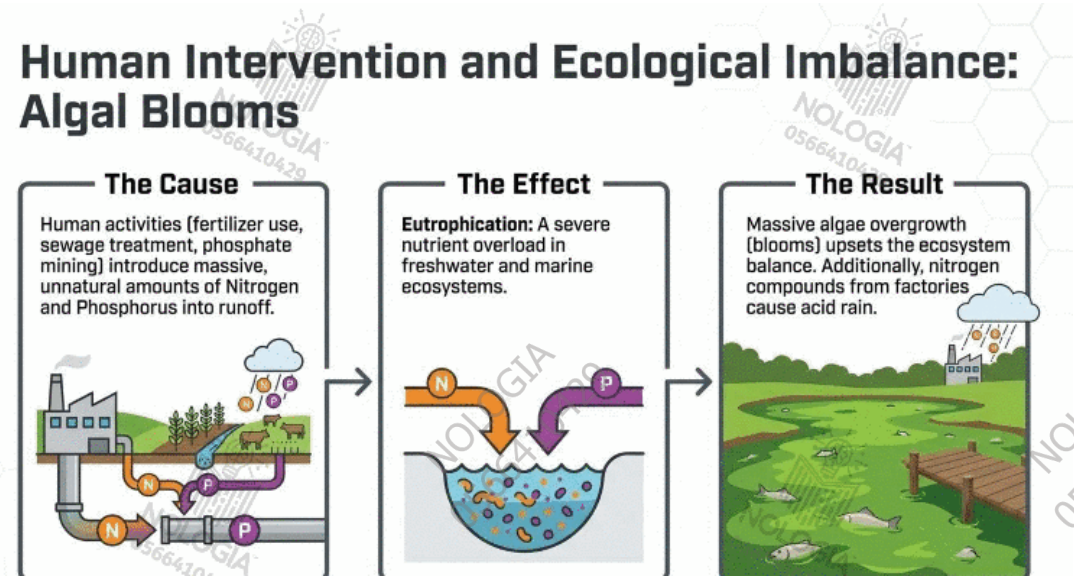
Question 4 : Principles of Ecology – Cycling of Matter

Develop a model to illustrate the role of photosynthesis in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Page (24).

Multiple Choice Questions - MCQ





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احصل على الشرح كاملاً بـ 99 درهم فقط

NOLOGIA Comparison Matrix: Biogeochemical Cycles at a Glance

Cycle	Driver / Energy Source	Biological Role	Long-Term Reservoir
Water	Sun and Gravity	Sustaining life and transporting materials	Oceans and Groundwater
Carbon & Oxygen	Photosynthesis and Cellular Respiration	Essential molecules and energy release	Fossil Fuels and Limestone Rocks
Nitrogen	Bacterial activity and Lightning	Building proteins	Atmosphere (78%)
Phosphorus	Geological Weathering and Erosion	Cellular growth and development	Mineral Rocks and Ocean Sediments

Question 1: Describe how phosphorus moves through the biotic and abiotic parts of an ecosystem.

Answer : In the short-term cycle, phosphates in soil and water (abiotic) are absorbed by producers and passed to consumers (biotic), then returned to the soil by decomposers. In the long-term cycle, phosphates precipitate and settle to form rock, and geological uplift and weathering of rocks slowly release phosphorus back into soil and water.

Question 2: Describe the flow of energy and matter through a food web that begins with algae at the lowest level.

Answer : Algae (primary producers) capture solar energy via photosynthesis and absorb nutrients from water. Energy flows one way through consumers and is lost as heat at each trophic level, whereas matter is conserved and continuously recycled back to the environment by decomposers.

Question 3 : Describe how phosphorus moves through the biotic and abiotic parts of an ecosystem.

A	Phosphorus cycles mainly as an atmospheric gas absorbed through plant leaves.
B	Phosphorus is created by cellular respiration and released into the air.
C	Lightning converts phosphorus gas in the sky into nitrates in rain.
D	Phosphates move from soil to producers and consumers, decomposers return them to soil, and weathering of rocks slowly adds phosphorus back.

Question 4 : Describe the flow of energy and matter through a food web that begins with algae at the lowest level.

A	Algae capture solar energy and nutrients; energy flows one way and is lost as heat, while matter is recycled by decomposers.
B	Both energy and matter are destroyed as soon as primary consumers eat the algae.
C	Energy cycles in a closed loop without loss, while matter flows one way and is lost as heat.
D	Decomposers capture sunlight at the top of the food web and send energy downward to algae.

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Question 5 : How does phosphorus move from the short-term biological cycle into the long-term geological cycle?

A	Through precipitation and sedimentation of phosphates to form rocks on ocean floors
B	Through transpiration of water vapor from tree leaves into clouds
C	Through cellular respiration by land mammals
D	Through denitrification by soil bacteria into atmospheric gas

Question 6 : Which biogeochemical cycle relies on geological weathering and erosion of mineral rocks rather than having a major atmospheric gas phase?

A	The water cycle
B	The carbon and oxygen cycle
C	The nitrogen cycle
D	The phosphorus cycle

Question 7 : According to the Biogeochemical Cycles Comparison Matrix (Slide 41), what is the primary biological role of nitrogen in plants and animals?

A	Building proteins
B	Forming clouds in the sky
C	Melting glacier ice
D	Reflecting solar light

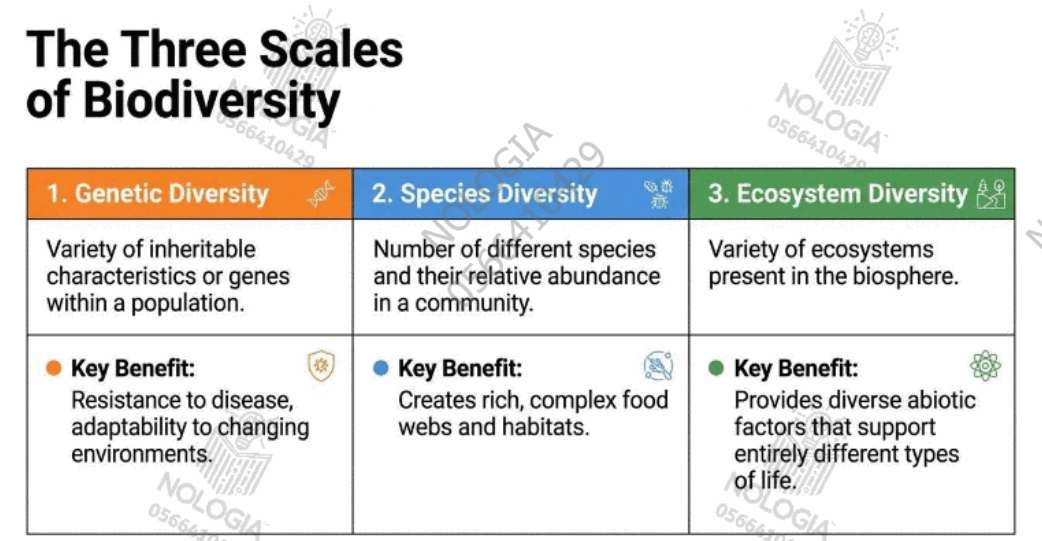
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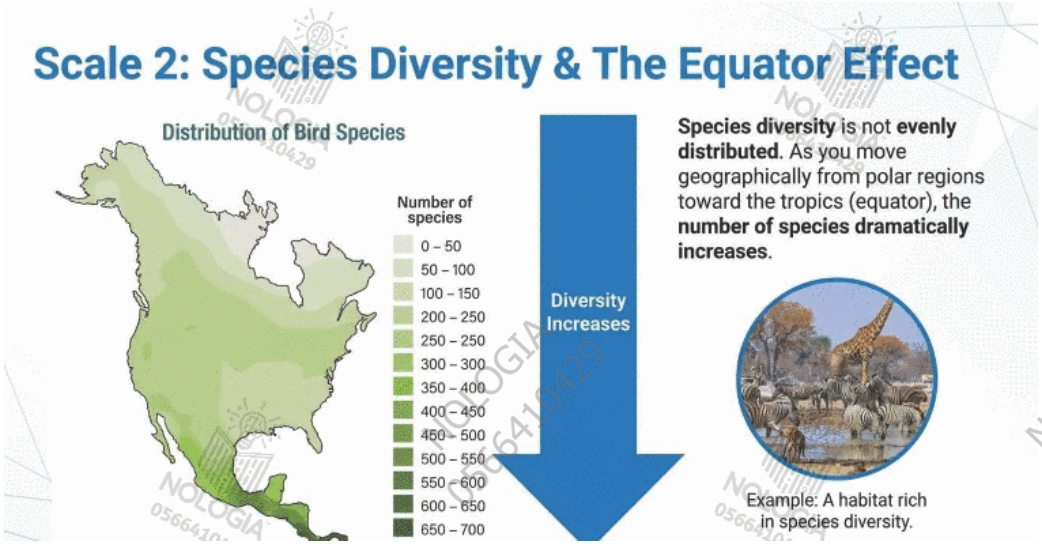
Question 5 : Biodiversity and Conservation – What is Biodiversity?

Conclude that biodiversity is the diversity of life on Earth, including diversity within each type of plant and animal species.

Page (31).

Multiple Choice Questions - MCQ





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احصل على الشرح كاملاً بـ 99 درهم فقط

Question 1: Compare and contrast genetic and species diversity.

Answer : • Similarity: Both are essential levels of biodiversity that increase ecosystem stability and biosphere health.

• Difference: Genetic diversity is the variety of genes or inheritable characteristics within a single population, whereas species diversity is the number of different species and the relative abundance of each species in a biological community.

Question 2 : Compare and contrast genetic and species diversity.

A	Genetic diversity measures abiotic factors, while species diversity measures climate zones.
B	Genetic diversity is the variety of genes in a population, while species diversity is the number and abundance of species in a community.
C	Genetic diversity occurs only in plants, while species diversity occurs only in polar animals.
D	Both terms refer to the exact same level and measure only the physical weight of an organism.

Question 3 : What is the variety of life in an area, determined by the number of different species in that area, called?

A	Biodiversity
B	Extinction
C	Bioremediation
D	Eutrophication

Question 4 : What is the permanent disappearance of a species when the last of its members dies?

A	Succession
B	Extinction
C	Mutualism
D	Tolerance

Question 5 : How does species diversity change as you move geographically from the polar regions toward the equator (tropics)?

A	Species diversity decreases steadily toward the equator.
B	Species diversity stays identical at all latitudes.
C	Species diversity increases dramatically toward the equator.
D	Species diversity exists only at the poles.

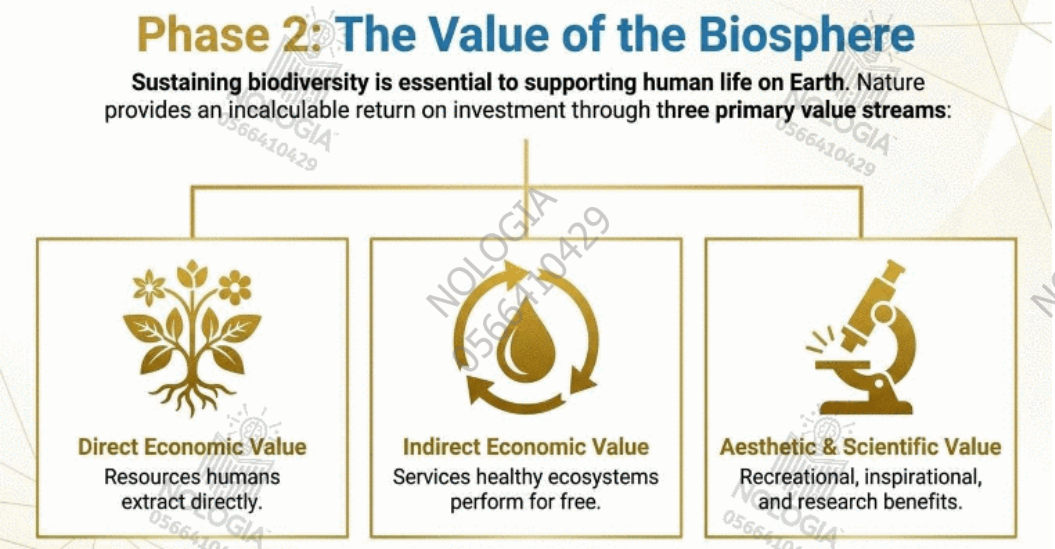
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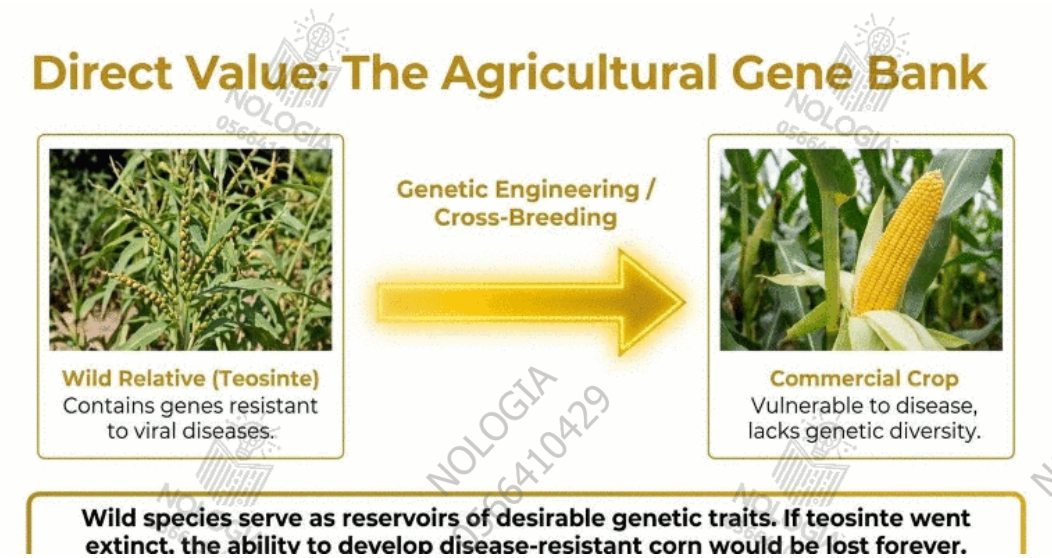
Question 6 : Biodiversity and Conservation – Biodiversity

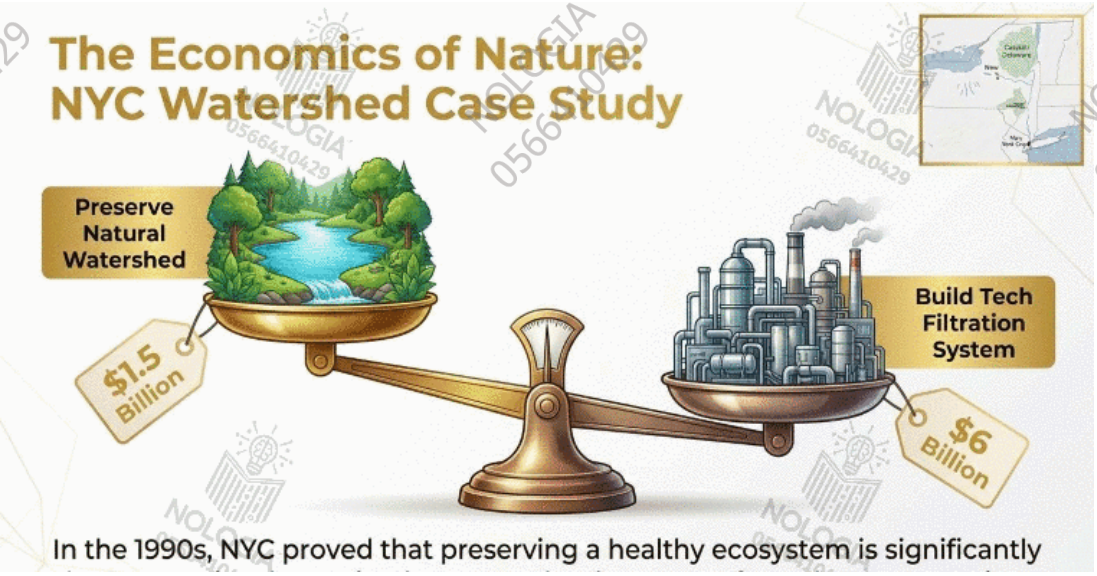
Describe ways in which biodiversity within species is important for maintaining the resilience of those species.

Page (36).

Multiple Choice Questions - MCQ







Question 1: Explain why sustaining biodiversity is essential to supporting and enhancing life on Earth.

Answer : Sustaining biodiversity is essential because it provides direct economic value (food, clothing, energy, medicine, shelter, and a reservoir of desirable genetic traits), indirect economic value (free ecosystem services such as oxygen production, clean drinking water, flood/drought protection, and fertile soil), and aesthetic and scientific value.

Question 2 : Explain why sustaining biodiversity is essential to supporting and enhancing life on Earth.

A	It maintains biosphere health, preserves a gene reservoir for food and medicine, and provides direct and indirect economic value.
B	It replaces all natural forests with concrete water filtration plants.
C	It eliminates wild relatives of crops so only a single plant species survives.
D	It increases fossil fuel combustion and habitat fragmentation.

Question 3: Humans depend on plants and animals to provide food, clothing, energy, medicine, and shelter. Which type of value does this represent?

A	Direct economic value
B	Indirect economic value
C	Aesthetic value
D	Background extinction

Question 4 : Green plants provide oxygen, remove carbon dioxide, and natural processes provide clean drinking water and flood protection. Which value of biodiversity is this?

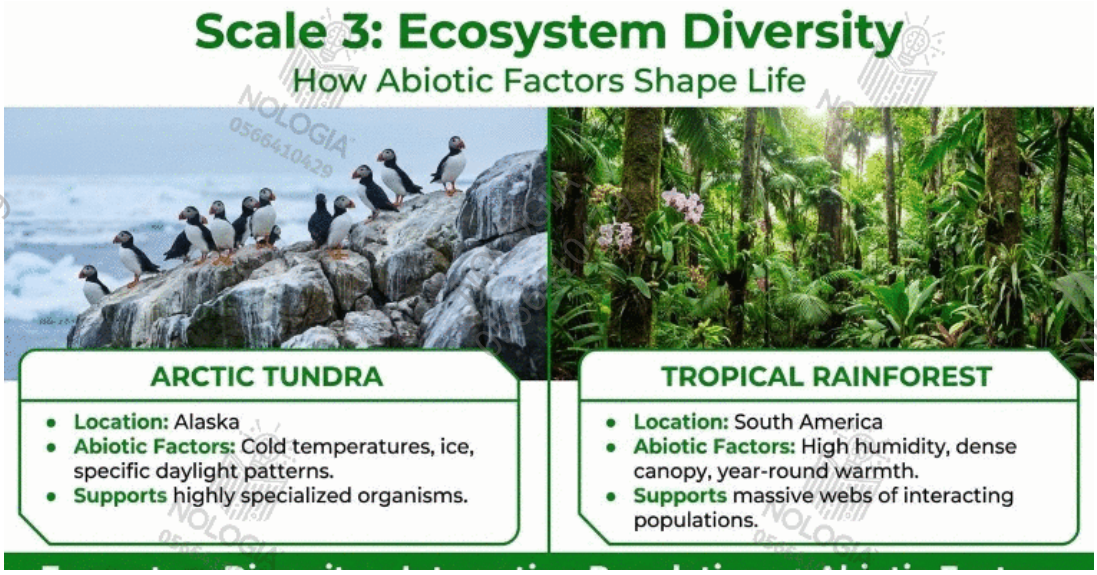
A	Direct economic value
B	Indirect economic value
C	Overexploitation value
D	Biological magnification

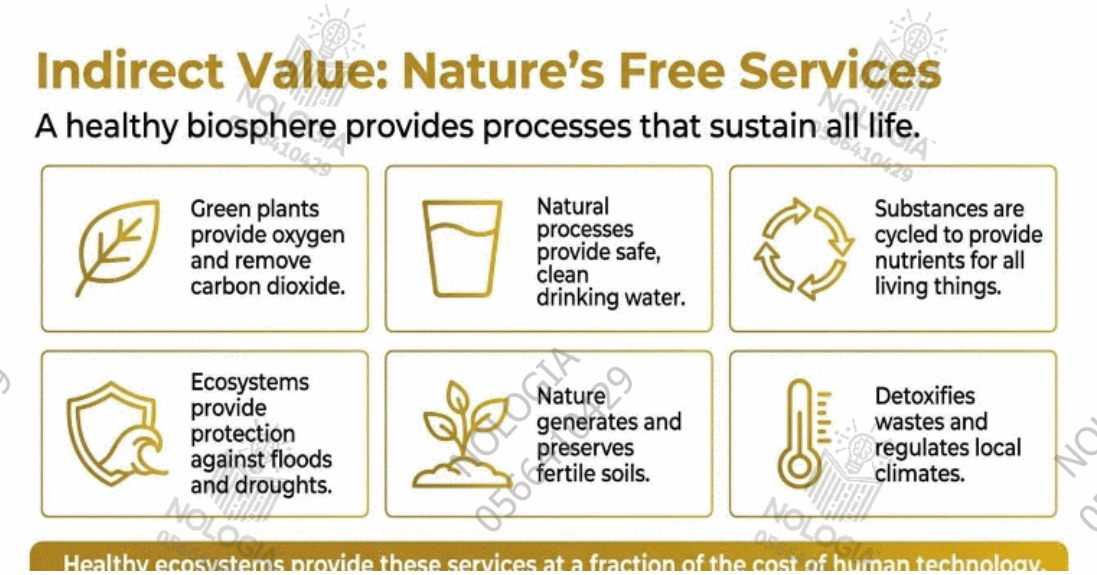
Question 7 : Biodiversity and Conservation – Biodiversity

Describe ways in which biodiversity within and among communities is important for maintaining the resilience of these communities.

Page (32 , 36).

Multiple Choice Questions - MCQ





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احصل على الشرح كاملاً بـ 99 درهم فقط

Question 1: Explain why the health of a species is closely tied to the health of the habitat.

Answer : An ecosystem consists of interacting populations and the abiotic factors that support them; therefore, if a habitat is degraded or destroyed, the species living there lose the food, shelter, and abiotic conditions required for their survival.

Question 2: Design a course of action for the development of a building project in your community, such as a housing development, city park, or highway, that provides for the maintenance of biodiversity in the plan.

Answer : Preserve large unfragmented patches of native vegetation, include protected green buffer zones and wildlife corridors (underpasses/bridges across highways), plant native species, and control pollution and water runoff.

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Question 3: Explain why the health of a species is closely tied to the health of the habitat.

A	A species survives independently of the abiotic and biotic factors in its habitat.
B	An ecosystem consists of interacting populations and supporting abiotic factors, so habitat damage removes what species need to survive.
C	Habitat health depends only on artificial chemicals rather than on living communities.
D	A species immediately turns into a new species whenever its habitat is destroyed.

Question 4: Design a course of action for the development of a building project in your community, such as a housing development, city park, or highway, that provides for the maintenance of biodiversity in the plan.

A	Clear all native trees, drain wetlands, and pave the entire area.
B	Introduce fast-growing invasive plants to replace native trees.
C	Divide the forest into tiny isolated patches surrounded by highways.
D	Preserve native habitats, include protected buffer zones and wildlife corridors, and control runoff and pollution.

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Question 5: What is the variety of ecosystems present in the biosphere called?

A	Ecosystem diversity
B	Genetic diversity
C	Overexploitation
D	Biological augmentation

Question 6 : According to Figure 4 (Page 32) and Slide 50, which abiotic factors in Alaska support Dall sheep and arctic birds?

A	Hot desert sand dunes and zero annual rainfall
B	Year-round tropical warmth and dense rainforest canopy
C	Cold temperatures, ice, and specific daylight patterns (Arctic tundra)
D	Deep ocean hydrothermal vents with hydrogen sulfide

Question 7: Which free service is provided by intact, healthy ecosystems according to Page 34 and Slide 54?

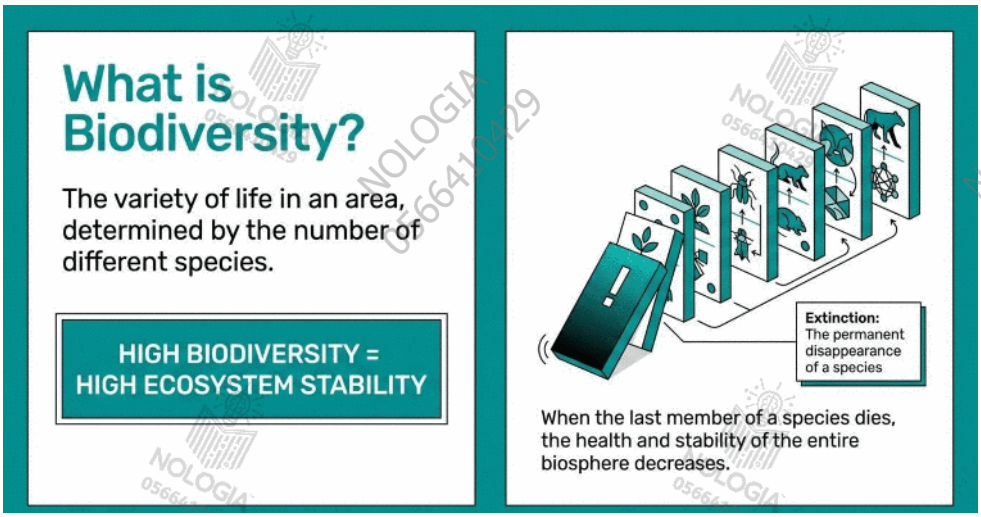
A	Fragmenting native forests into smaller edge habitats
B	Production of nonrenewable fossil fuels within a single day
C	Increasing biological magnification of DDT in fish-eating birds
D	Protection against floods and droughts, fertile soil generation, and waste detoxification

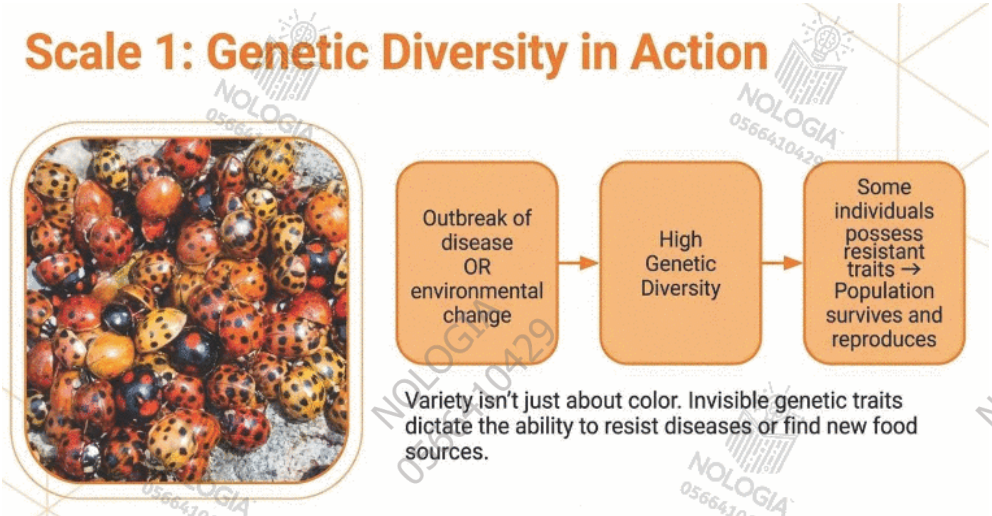
Question 8 : Biodiversity and Conservation – Biodiversity

Construct an explanation based on evidence to describe how the genetic variation of the traits among populations increases the survival probability of some individuals in a specific environment.

Page (36).

Multiple Choice Questions - MCQ





Question 1: Explain how extinction affects biodiversity.

Answer : When the last member of a species dies (extinction), that species and its unique genetic traits are lost forever, which directly reduces biodiversity and decreases the stability of the ecosystem and the health of the biosphere.

Question 2: Write an argument that describes the importance of maintaining genetic diversity in domesticated animals, such as dogs, cats, pigs, cattle, and chickens. Include the advantages and disadvantages in your report.

Answer : • Advantage of high genetic diversity: It increases the chance that some individuals possess traits that resist diseases or tolerate changing environmental conditions, allowing the population to survive and reproduce.

• Disadvantage of low genetic diversity: Uniform breeds share the same vulnerabilities, so a single disease outbreak can wipe out the entire population.

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Question 3 : Explain how extinction affects biodiversity.

A	When the last member of a species dies, the species is lost forever, decreasing biodiversity and biosphere health.
B	Extinction increases genetic diversity by creating clones of the same organism.
C	Extinction affects only nonliving rocks and never changes biological communities.
D	Extinct species automatically reappear the next year in larger numbers.

Question 4 : Write an argument that describes the importance of maintaining genetic diversity in domesticated animals, such as dogs, cats, pigs, cattle, and chickens.

A	Low genetic diversity guarantees that all livestock survive every viral disease.
B	High genetic diversity increases disease resistance and survival during environmental change, whereas low diversity leaves uniform breeds vulnerable.
C	Genetic diversity prevents domesticated animals from reproducing.
D	Breeding identical animals ensures that climate change has no effect on farms.

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Question 5: How does high biodiversity affect the stability of an ecosystem?

A	High biodiversity increases the stability of an ecosystem and contributes to biosphere health.
B	High biodiversity causes immediate collapse of all food webs.
C	High biodiversity eliminates all primary producers from the ecosystem.
D	High biodiversity prevents nutrients from cycling through soil.

Question 6 : Besides visible traits like body color, what invisible genetic traits are mentioned on Page 31 and Slide 48 as critical for survival?

A	The ability to survive without water or oxygen for centuries
B	Resistance to a particular disease or the ability to digest a new food source
C	The ability to convert sunlight into rocks
D	The ability to cause acid precipitation

Question 7 : What would have happened if the wild corn relative teosinte had gone extinct before scientists discovered its resistance to viral diseases?

A	Viral diseases in plants would have disappeared on their own.
B	Commercial corn would have become resistant to all viruses automatically.
C	The genetic variation needed to develop disease-resistant corn would have been lost forever.
D	Corn plants would have turned into carnivores.

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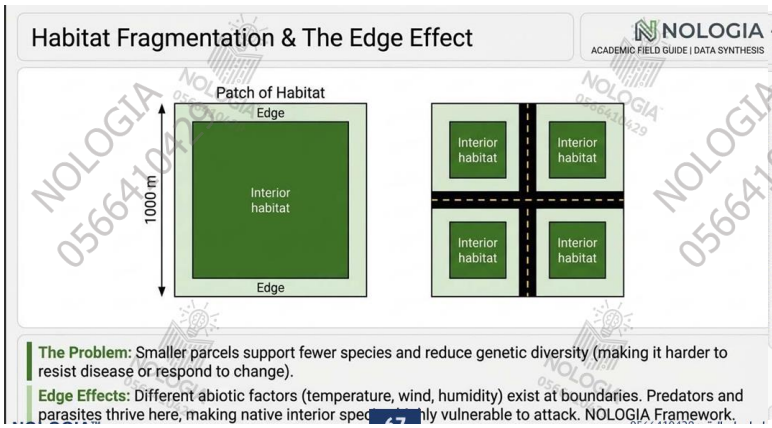
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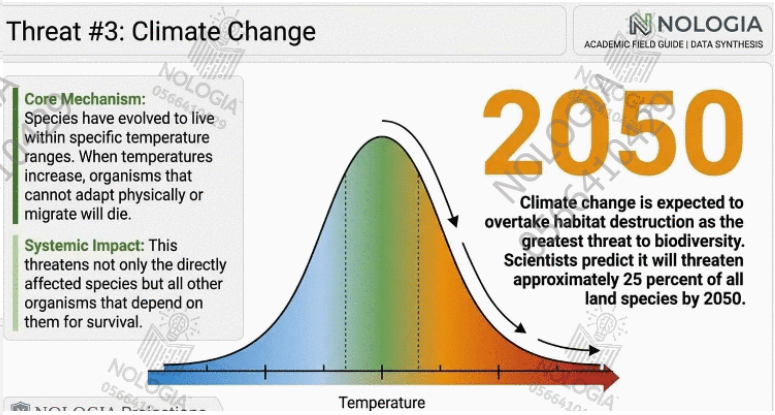
Question 9 : Biodiversity and Conservation – Threats to Biodiversity

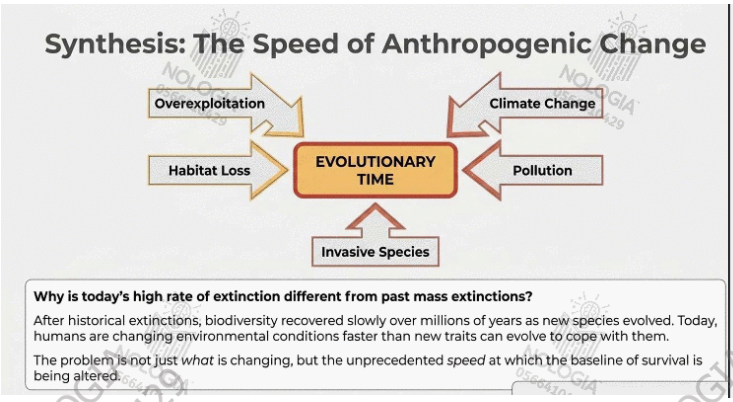
Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect its populations.

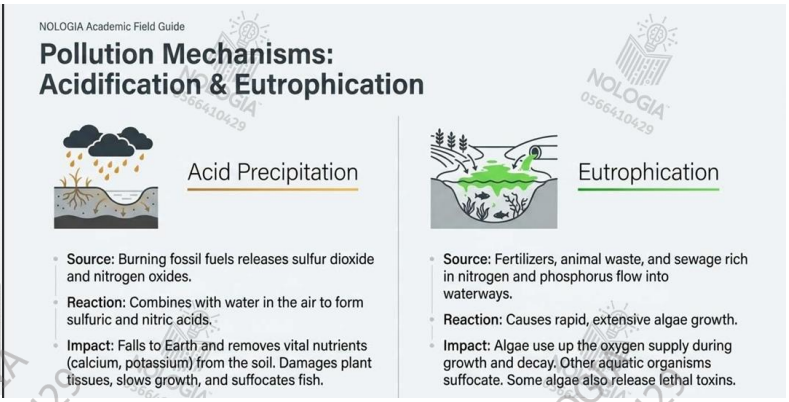
Page (42 , 44).

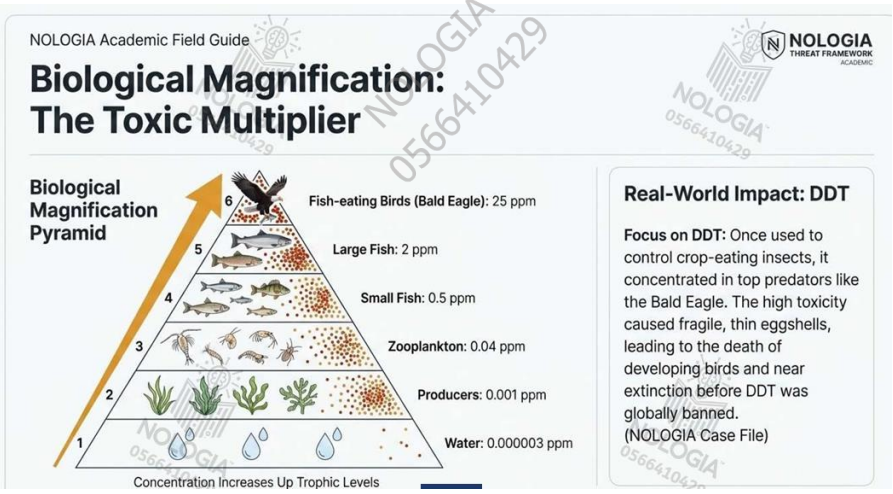
Multiple Choice Questions - MCQ











Question 1: Explain how an increase in global temperatures threatens biodiversity.

Answer : Species have evolved to live within specific temperature ranges. When global temperatures increase, individuals that cannot adapt physically or migrate die, threatening both that species and other organisms that depend on it for survival.

Question 2: Choose one of the factors that threatens biodiversity and suggest one way in which biodiversity can be preserved in a real-life scenario.

Answer : • Threat: Habitat fragmentation (dividing forests with roads).

• Solution: Build wildlife habitat corridors (such as bridges or underpasses over highways) and establish protected nature reserves so animals can move safely between patches and maintain genetic diversity.

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Question 3 : Explain how an increase in global temperatures threatens biodiversity.

A	Higher temperatures allow all species to expand their habitats without competition.
B	Rising temperatures eliminate edge effects and remove pollutants from food webs.
C	Species live within specific temperature ranges; when temperatures rise, members that cannot adapt die, threatening them and dependent species.
D	Rising temperatures affect only nonliving rocks and never affect living populations.

Question 4 : Choose one of the factors that threatens biodiversity and suggest one way in which biodiversity can be preserved in a real-life scenario.

A	Threat: Sustainable use; Solution: Increase hunting of endangered species.
B	Threat: Genetic diversity; Solution: Introduce invasive fire ants into forests.
C	Threat: Bioremediation; Solution: Spray more DDT into rivers.
D	Threat: Habitat fragmentation; Solution: Establish protected reserves and connect patches with wildlife corridors.

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Question 5 : What is the increasing concentration of toxic substances (such as DDT or PCBs) in organisms as trophic levels increase in a food chain or food web called?

A	Biological magnification
B	Nitrogen fixation
C	Primary succession
D	Sustainable use

Question 6 : In the biological magnification pyramid (Slide 70), which group of organisms accumulates the highest concentration of the pesticide DDT (25 ppm), causing fragile eggshells?

A	Producers (algae and plants)
B	Zooplankton
C	Small fish
D	Top predators / fish-eating birds (such as the bald eagle)

Question 7 : How is acid precipitation formed in the atmosphere?

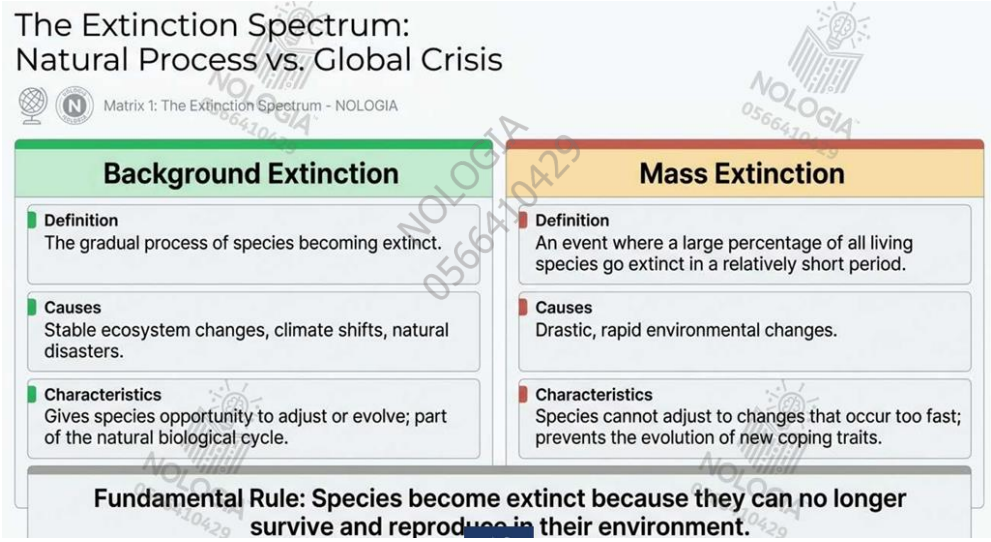
A	Burning fossil fuels releases sulfur dioxide and nitrogen oxides that react with water in the air to form sulfuric and nitric acids.
B	Green plants release oxygen during photosynthesis that freezes in clouds.
C	Ocean waves evaporate salt crystals into the stratosphere.
D	Decomposers release enzymes into underground aquifers.

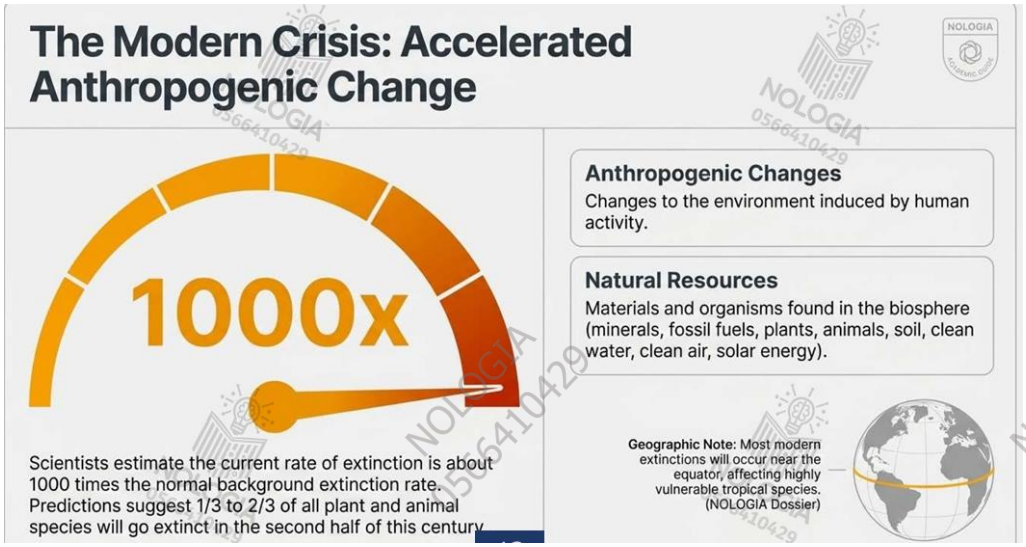
Question 10 : Biodiversity and Conservation – Threats to Biodiversity

Conclude that disruptions to any physical or biological component of an ecosystem can lead to shifts in some or all of its populations.

Page (39 , 44).

Multiple Choice Questions - MCQ







Question 1: Explain the term overexploitation as it relates to species extinction.

Answer : Overexploitation is the excessive use (hunting, harvesting, or logging) of species that have economic value, which drastically reduces their populations and increases the current rate of species extinction.

Question 2: Describe what happens when species cannot adapt to ecosystem changes that are too fast.

Answer : When environmental changes occur faster than new coping traits can evolve, the species can no longer survive and reproduce in its environment, causing its members to die and the species to become extinct.

Question 3 : Explain the term overexploitation as it relates to species extinction.

A	Overexploitation is the excessive use of species that have economic value, which increases the current rate of extinction.
B	Overexploitation is the gradual evolution of new species over millions of years.
C	Overexploitation is the legal protection of endangered species inside megareserves.
D	Overexploitation is the use of bacteria to clean up oil spills.

Question 4 : Describe what happens when species cannot adapt to ecosystem changes that are too fast.

A	The species immediately develops new organs within a single day.
B	When changes occur faster than new traits can evolve, members cannot survive and reproduce, leading to extinction.
C	The population size doubles because predators disappear.
D	The species converts from a heterotroph into an autotroph.

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Question 5 : What is an event in which a large percentage of all living species become extinct in a relatively short period of time?

A	Background extinction
B	Mass extinction
C	Commensalism
D	Nitrification

Question 6 : Scientists estimate that the current rate of species extinction is approximately how many times higher than the normal background extinction rate?

A	About 2 times higher
B	About 10 times higher
C	About 1,000 times higher
D	Equal to the normal background rate

Question 7 : What are all materials and organisms found in the biosphere, including minerals, fossil fuels, plants, animals, soil, clean water, clean air, and solar energy, called?

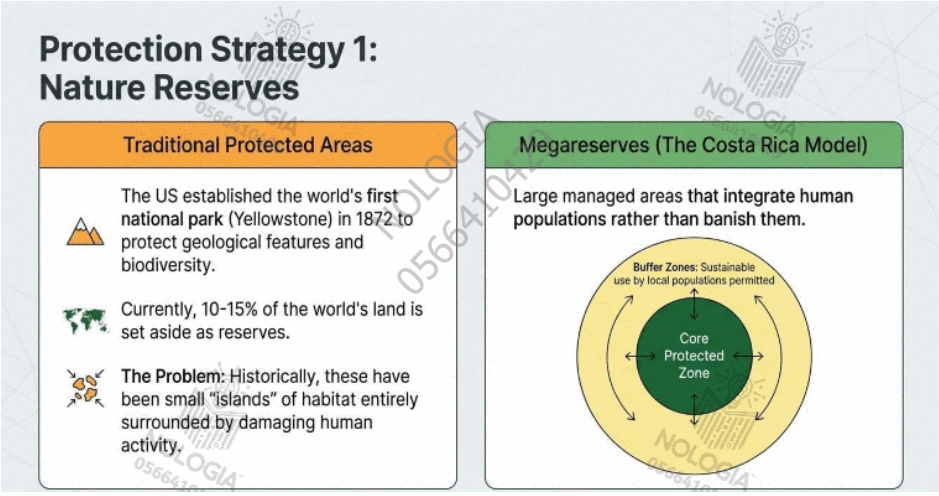
A	Natural resources
B	Synthetic pollutants
C	Invasive species
D	Edge effects

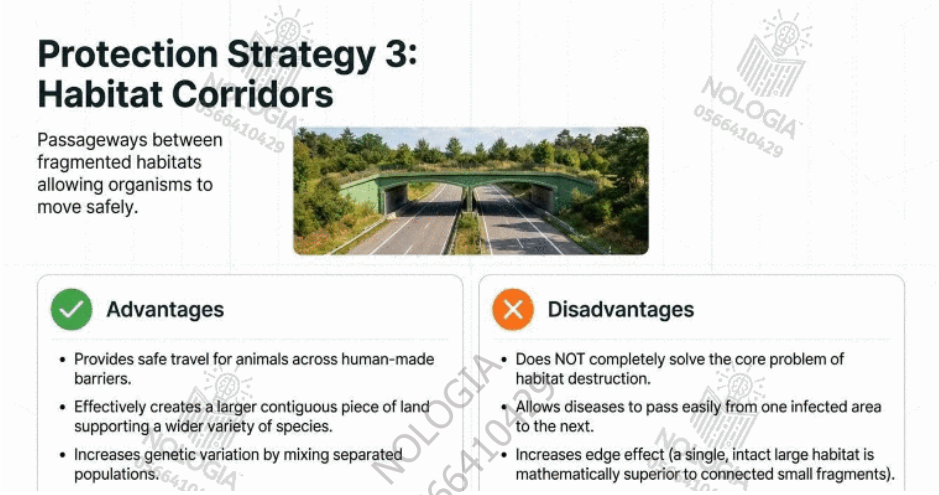
Question 11 : Biodiversity and Conservation – Conserving Biodiversity

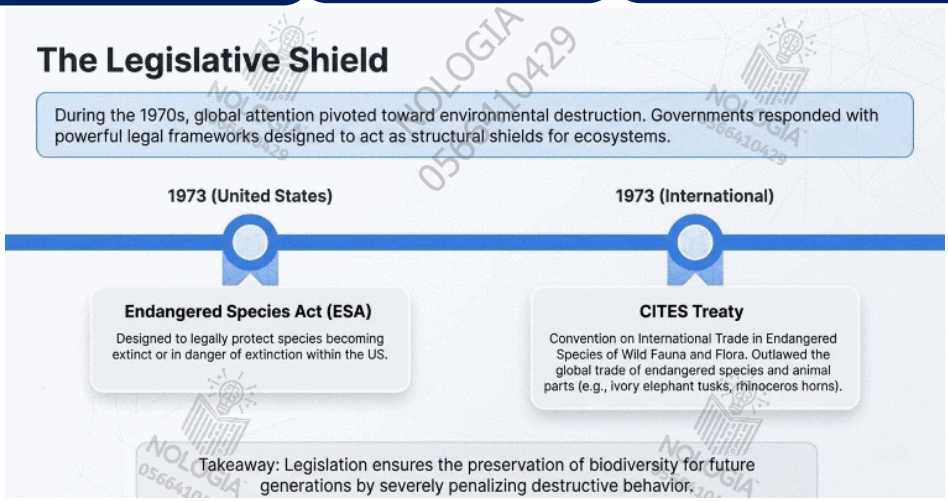
Explain that the completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

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Multiple Choice Questions - MCQ







Question 1: Explain how protected areas preserve biodiversity.

Answer : Protected areas (such as national parks and international megareserves) preserve biodiversity by shielding core habitats from destructive human activities and surrounding them with buffer zones where sustainable use of natural resources is permitted.

Question 2: Describe three approaches used to slow down the rate of extinction or to preserve biodiversity.

Answer : 1) Sustainable use of natural resources (using resources at a rate at which they can be replaced or recycled).

2) Establishing protected areas (national parks, megareserves, biodiversity hotspots) and connecting fragments with habitat corridors.

3) Passing protective environmental laws/treaties (such as the Endangered Species Act and CITES) and restoring damaged ecosystems (bioremediation and biological augmentation).

Question 3 : Explain how protected areas preserve biodiversity.

A	Protected areas allow unrestricted logging so invasive species replace native species.
B	Protected areas relocate all wild animals into industrial factories.
C	Protected areas and megareserves shield core habitats from human destruction and use buffer zones for sustainable resource use.
D	Protected areas divide forests into tiny patches to maximize edge effects.

Question 4 : Describe three approaches used to slow down the rate of extinction or to preserve biodiversity.

A	Increasing overexploitation, fragmenting forests, and introducing invasive predators
B	Burning fossil fuels, increasing fertilizer runoff, and removing buffer zones
C	Replacing endemic plants with a single crop and repealing environmental laws
D	Practicing sustainable resource use, establishing protected areas and corridors, and restoring ecosystems (or passing laws)

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Question 5 : What was the world's first national park, established in the United States in 1872 to protect geological features and biodiversity?

A	Yellowstone National Park
B	Lake Tahoe Park
C	Catskill Watershed Park
D	Mobile Alabama Reserve

Question 6 : What is a major advantage of building habitat corridors (passageways) between fragmented habitats?

A	They block sunlight from reaching native plants.
B	They completely eliminate all edge effects and diseases in the forest.
C	They prevent animals from breeding with members in other patches.
D	They allow animals to move safely between fragments and increase genetic variation by mixing populations.

Question 7 : Which law was enacted in the United States in 1973 to legally protect species that were becoming extinct or in danger of extinction?

A	The Metric Conversion Act
B	The Montreal Protocol
C	The Endangered Species Act (ESA)
D	The Clean Energy Act

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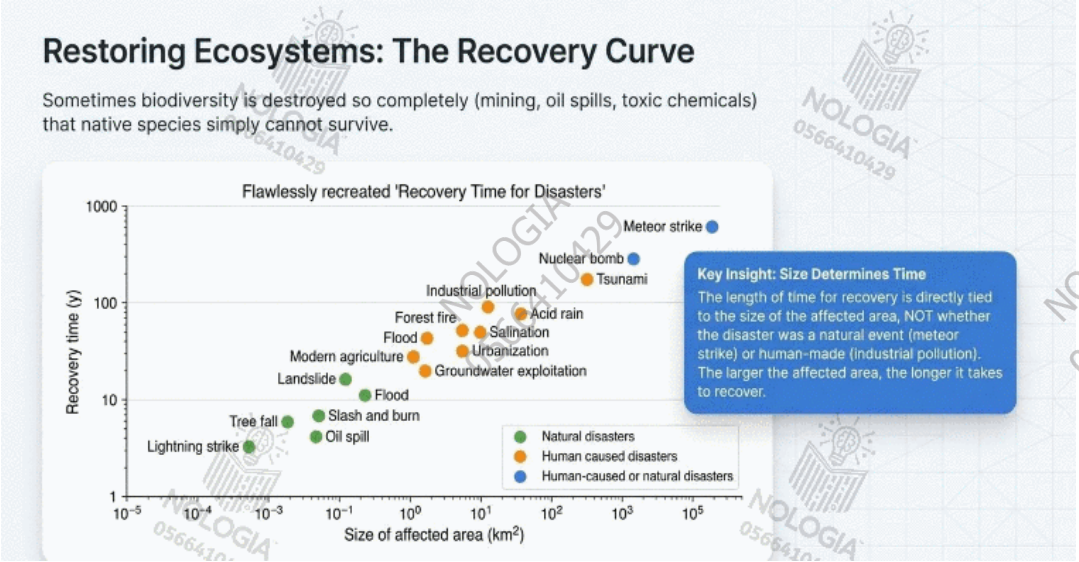
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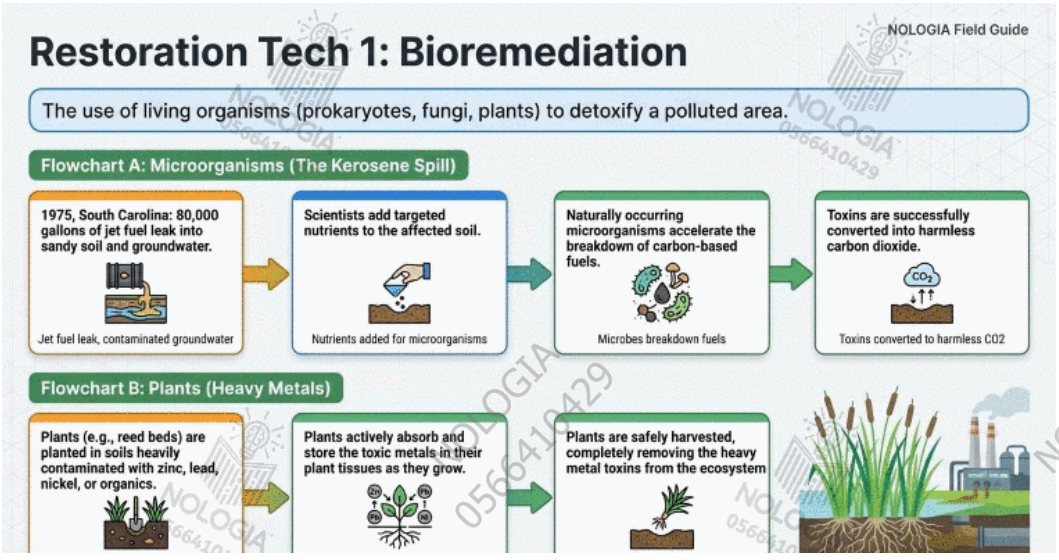
Question 12 : Biodiversity and Conservation – Conserving Biodiversity

Explain that ecosystems are dynamic in nature and that their characteristics can vary over time.

Page (52).

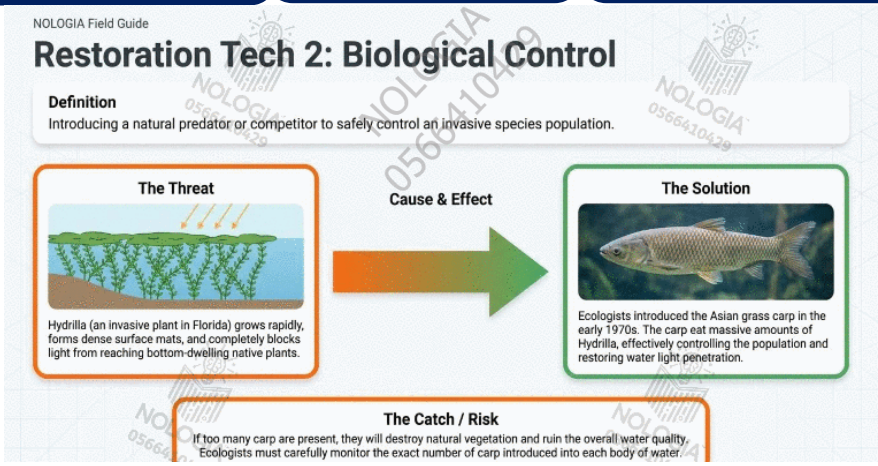
Multiple Choice Questions - MCQ





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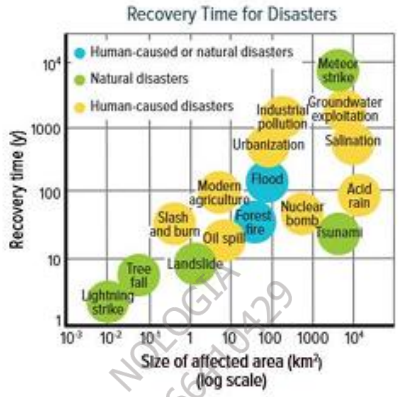


Figure 21 The recovery time for disasters is dependent upon the size of the area affected and on the type of disturbance.

Question 1 : Choose a human-caused disaster from Figure 21. Discuss the methods that could be used to restore biodiversity.

Answer : • Human-caused disaster: An oil/fuel spill or industrial pollution (soil contaminated with heavy metals).

• Restoration methods: Use bioremediation—adding nutrients to stimulate soil microorganisms to break down carbon-based fuels into harmless carbon dioxide, or planting specialized plants (such as reed beds) to absorb toxic heavy metals (zinc, lead, nickel) from contaminated soil—along with biological augmentation to restore ecosystem balance.

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Question 2 : Choose a human-caused disaster from Figure 21. Discuss the methods that could be used to restore biodiversity.

A	For an oil spill or industrial pollution, use bioremediation (microorganisms or plants to detoxify pollutants) and biological augmentation.
B	Leave industrial pollution untreated and introduce invasive fire ants into the site.
C	Clear-cut the surrounding healthy forest and build highways to increase edge effects.
D	Dump excess phosphorus fertilizer into the polluted water to cause an algae bloom.

Question 3 : What is the use of living organisms—such as prokaryotes, fungi, or plants—to detoxify a polluted area called?

A	Bioremediation
B	Biological magnification
C	Overexploitation
D	Eutrophication

Question 4 : In the 1975 South Carolina kerosene jet-fuel leak case study ,how did scientists accelerate the breakdown of carbon-based fuels in the soil into harmless carbon dioxide?

A	By adding targeted nutrients to the soil to stimulate naturally occurring microorganisms
B	By burning the entire sandy aquifer with explosives
C	By introducing imported fire ants from South America
D	By spraying DDT pesticide over the water table

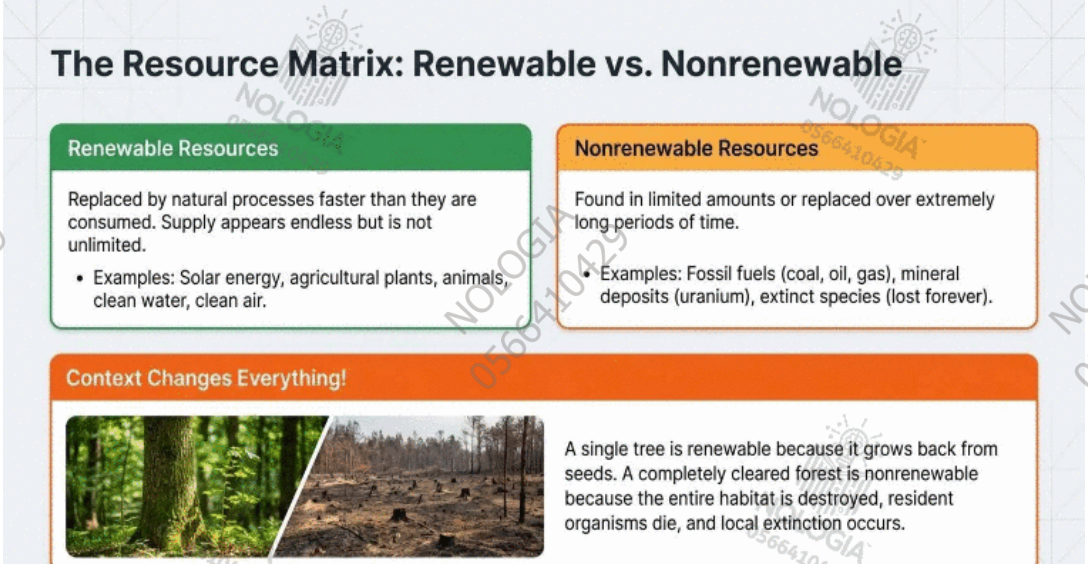
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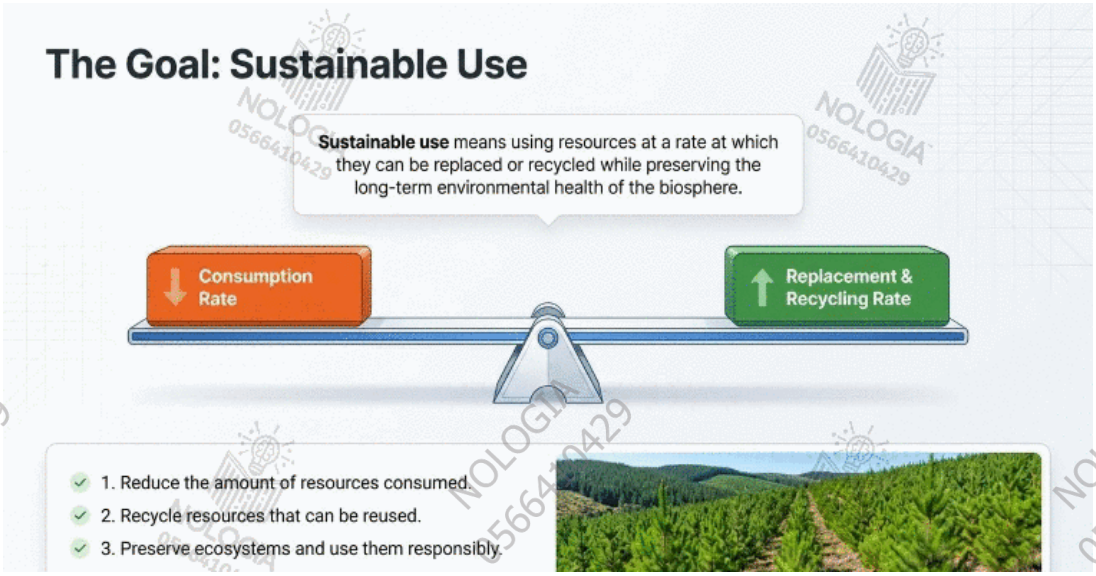
Question 13 : Biodiversity and Conservation – Conserving Biodiversity

Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

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Multiple Choice Questions - MCQ





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Question 1: Define the two classes of natural resources.

Answer : • Renewable resources: Resources that are replaced by natural processes faster than they are consumed (such as solar energy, agricultural plants, animals, clean water, and clean air).
• Nonrenewable resources: Resources found on Earth in limited amounts or replaced by natural processes over extremely long periods of time (such as fossil fuels, mineral deposits, and extinct species).

Question 2: Create a script of dialogue that could occur between a conservationist and a person who lives in a biodiversity hotspot. The local person wants to use the natural resources to provide a living for his or her family. The dialogue should include a compromise in which both sides are satisfied with the use of resources. Consider the social, cultural, and environmental impacts of the compromise.

Answer : Compromise solution: Establish a megareserve with protected core zones to safeguard endemic species in the hotspot, surrounded by buffer zones where local families are permitted to harvest resources sustainably (at a rate where resources are replaced or recycled) and earn income from ecotourism.

Question 3: Define the two classes of natural resources.

A	Renewable resources include fossil fuels and uranium, whereas nonrenewable resources include solar energy.
B	Renewable resources are synthetic laboratory chemicals, whereas nonrenewable resources are living plants.
C	Renewable resources are replaced by natural processes faster than consumed, whereas nonrenewable resources exist in limited amounts or take extremely long times to replace.
D	Both classes of natural resources exist in unlimited quantities and can never be depleted.

Question 4 : Which compromise best satisfies both a conservationist and a local resident who needs to earn a living in a biodiversity hotspot?

A	Clear-cut the entire hotspot forest for timber until all endemic species go extinct.
B	Ban all human residents from the country and deny families access to food or income.
C	Replace all endemic vascular plants with open-pit mines and factories.
D	Establish a megareserve with protected core zones and surrounding buffer zones where local residents practice sustainable resource use.

Question 5 : Which of the following is an example of a nonrenewable resource?

A	Solar energy
B	Fossil fuels and mineral deposits (such as radioactive uranium)
C	Agricultural crop plants
D	Clean air and wind

Question 6 : Why can a single tree be considered a renewable resource while an entire cleared forest is considered nonrenewable?

A	A single tree can be regrown from seeds, but clearing an entire forest destroys the habitat so resident organisms die or go extinct locally.
B	A single tree takes millions of years to grow, whereas an entire forest grows in one hour.
C	Individual trees are made of mineral rock, whereas forests are made of coal.
D	Cleared forests have higher species diversity than intact forests.

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Question 7 : What is using natural resources at a rate at which they can be replaced or recycled while preserving the long-term environmental health of the biosphere called?

A	Overexploitation
B	Sustainable use
C	Habitat fragmentation
D	Biological magnification

Question 8 : What are species that are found only in one specific geographic area and nowhere else in the world called?

A	Invasive species
B	Endemic species
C	Cosmopolitan species
D	Decomposer species

Question 9 : What two criteria must a region meet to be classified as a biodiversity hotspot?

A	It must have at least 1,500 species of endemic vascular plants and must have lost at least 70% of its original habitat.
B	It must have zero plant species and be covered entirely by polar ice.
C	It must contain only nonnative invasive species and have 100% of its original habitat intact.
D	It must be located in the deep ocean where sunlight never reaches.

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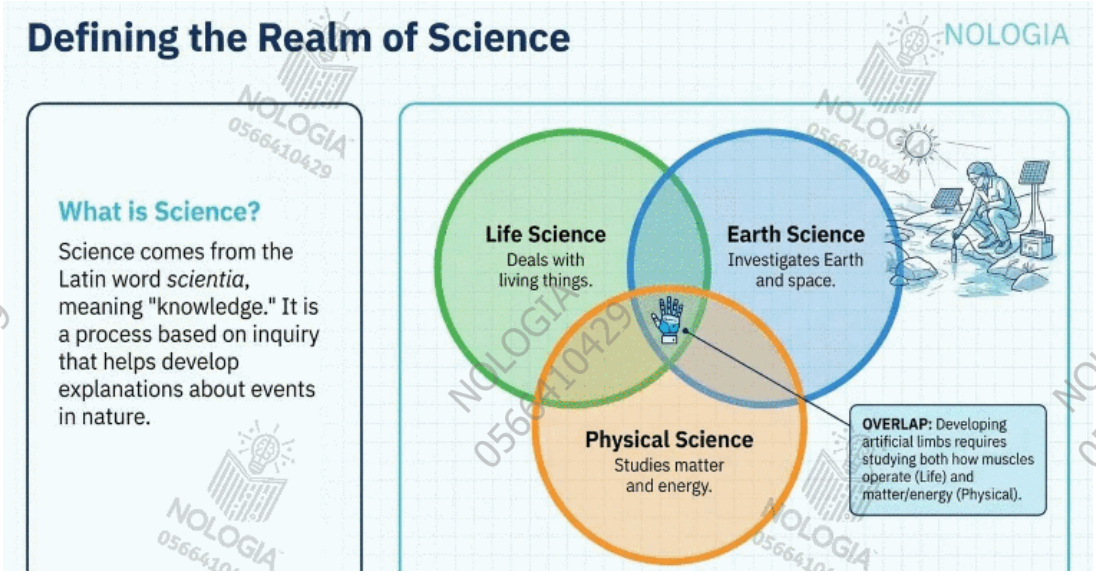
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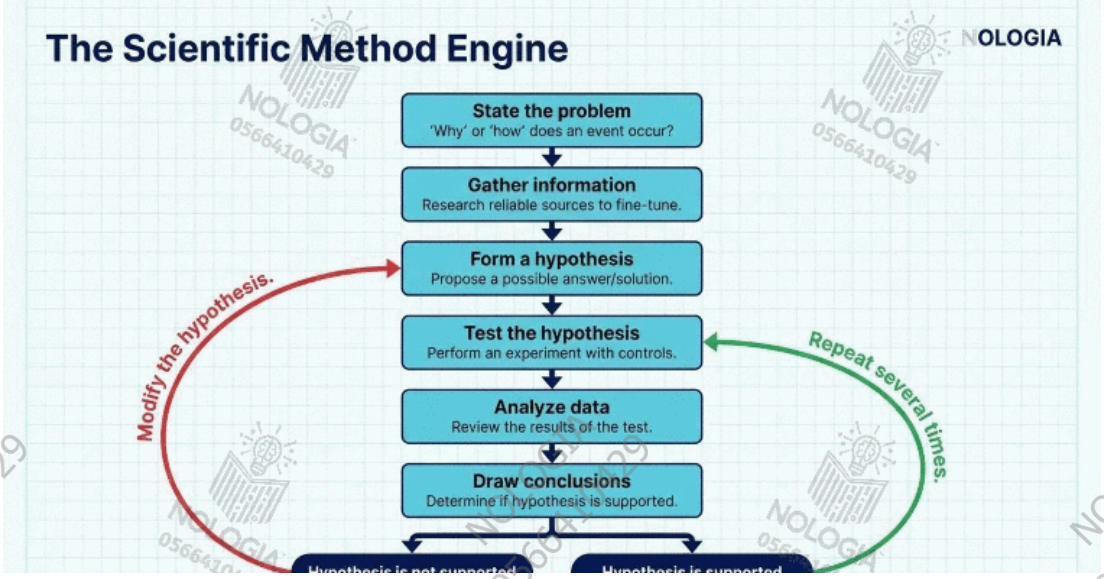
Question 14 : The Nature of Science– The Methods of Science

Analyze data obtained from experiments.

Page (60).

Multiple Choice Questions - MCQ





Question 1: Identify What is the first step in a scientific investigation, and what form does it usually take?

Answer : The first step in a scientific investigation is to state the problem, and it usually takes the form of a question of "why" or "how" an observed event in nature occurs.

Question 2 : Identify What is the first step in a scientific investigation, and what form does it usually take?

A	The first step is to state the problem, and it usually takes the form of a question of "why" or "how" an event occurs.
B	The first step is to draw conclusions, and it usually takes the form of a scientific law.
C	The first step is to analyze data, and it usually takes the form of a circle graph.
D	The first step is to modify the hypothesis, and it usually takes the form of a simulation.

Question 3: what step should a scientist take when the drawn conclusions show that the hypothesis is NOT supported?

A	Change the experimental numbers so they match the hypothesis.
B	Modify the hypothesis and repeat the investigation to test it.
C	Declare the unsupported hypothesis to be a scientific law.
D	Destroy all laboratory records and never test again.

Question 4 : Which main branch of science studies matter and energy (including chemistry and physics)?

A	Physical science
B	Life science
C	Earth science
D	Botany

Question 5 : Why do scientists research and gather information from reliable sources before forming a hypothesis?

A	To learn what is already known about the problem and fine-tune their question
B	To avoid performing any experiments or observations
C	To copy personal opinions about art and music
D	To replace SI units with subjective hand measurements

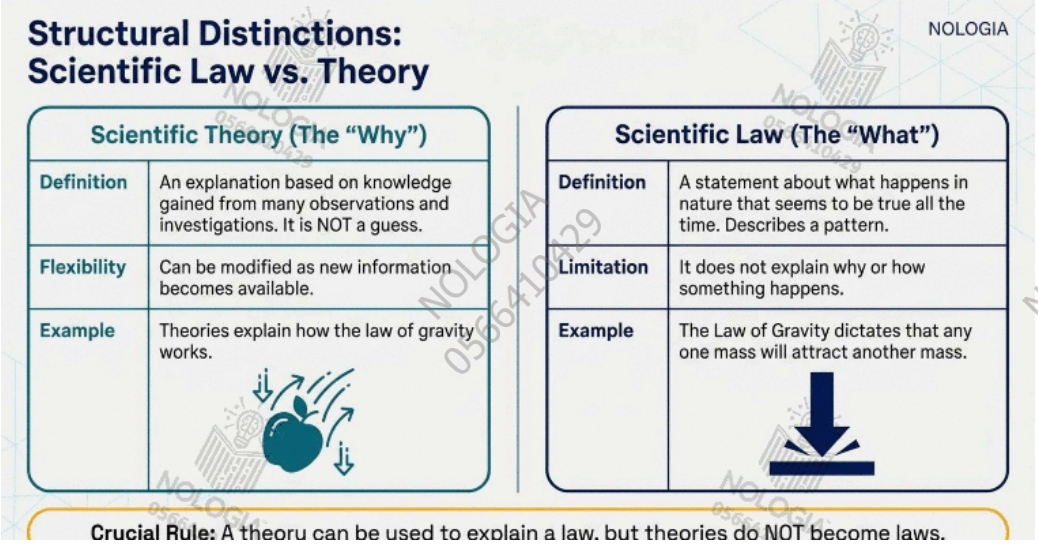
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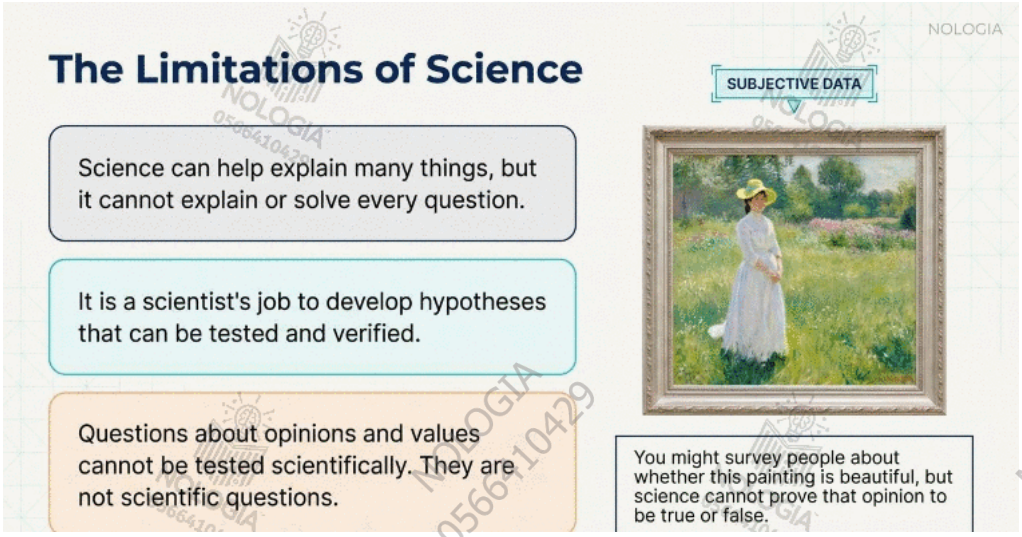
Question 15 : The Nature of Science– The Methods of Science

Using proper research data, formulate testable hypotheses.

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Multiple Choice Questions - MCQ





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Question 1 : Explain what a law is, what a theory is, and why a theory cannot become a law.

Answer : • Scientific law: A statement about what happens in nature that seems to be true all the time (it describes a relationship or pattern but does not explain why).

• Scientific theory: An explanation of why or how things happen based on knowledge gained from many observations and investigations.

• Why a theory cannot become a law: They serve different purposes– a theory is used to explain a law, so theories never become laws.

Question 2 : Explain what a law is, what a theory is, and why a theory cannot become a law.

A	A scientific law is an unproved guess, and when enough evidence is collected, it becomes a theory.
B	Both theories and laws are personal opinions about art that cannot be tested by experiments.
C	A law states what happens in nature, while a theory is an explanation based on many observations and investigations; theories explain laws and do not become laws.
D	A theory describes a pattern without explaining why, and it becomes a law after one experiment.

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Question 3 : What is an explanation of things or events based on knowledge gained from many observations and investigations ?

A	A constant
B	A scientific law
C	A scientific theory
D	A conversion factor

Question 4 : What is a statement about what happens in nature that seems to be true all the time, without explaining why or how it happens?

A	A bias
B	A hypothesis
C	A subjective opinion
D	A scientific law

Question 5 : What can happen to a scientific theory if new information or evidence becomes available that does not support it?

A	The scientific theory can be modified.
B	New scientific evidence must always be ignored.
C	The theory automatically turns into a law.
D	Scientists stop using the scientific method.

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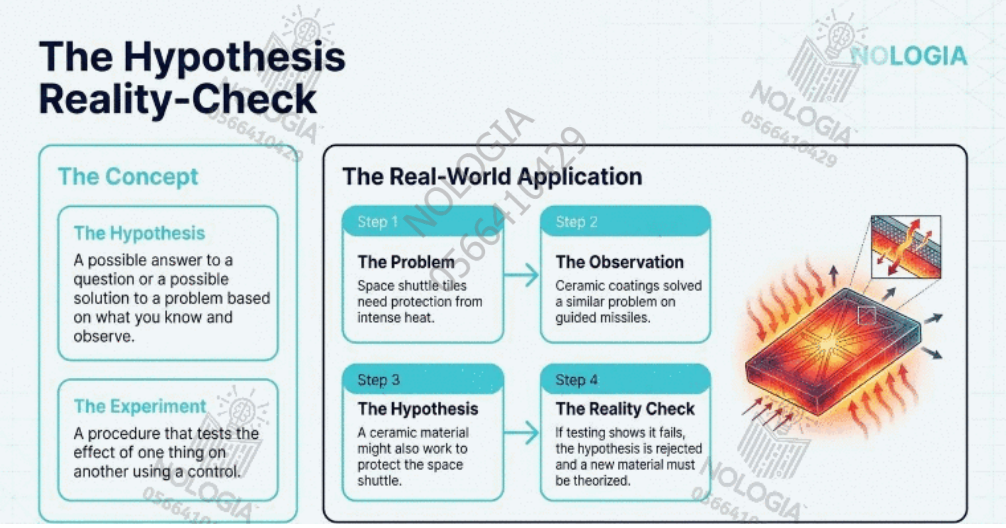
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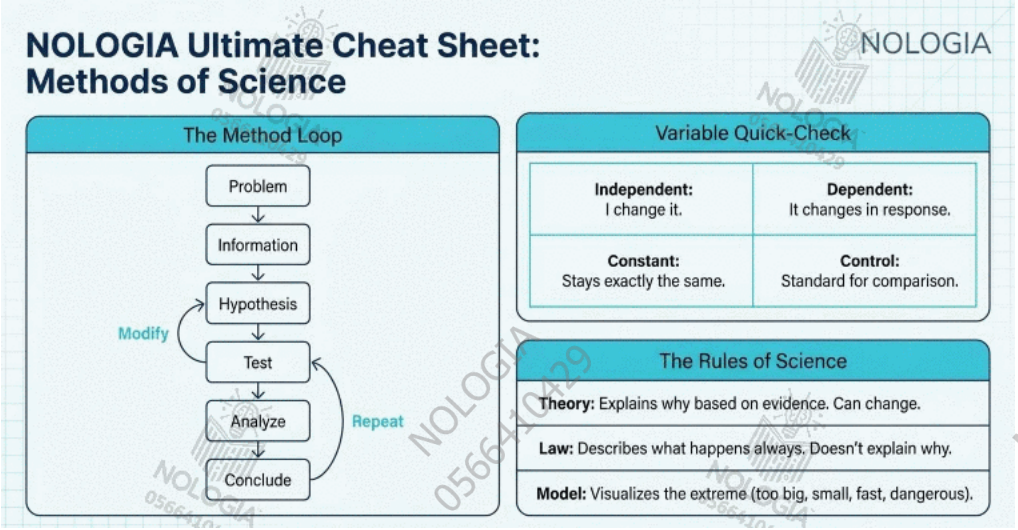
Question 16 : The Nature of Science– The Methods of Science

Follow the common steps of scientific methods in proposing solutions to problems, systematically test them and evaluate the results of tests.

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Multiple Choice Questions - MCQ





Question 1: Define Summarize the steps you might use to carry out an investigation using scientific methods.

Answer : The six common steps of scientific methods are:

1) State the problem (ask how or why an event occurs).

2) Gather information (research reliable sources).

3) Form a hypothesis (propose a testable answer or solution).

4) Test the hypothesis (perform a controlled experiment or make observations).

5) Analyze data (record and organize measurements in tables/graphs).

6) Draw conclusions (determine whether the data support the hypothesis and repeat or modify as needed).

Question 2 : Define Summarize the steps you might use to carry out an investigation using scientific methods.

A	State the problem, gather information, form a hypothesis, test the hypothesis, analyze data, and draw conclusions.
B	Draw conclusions first, publish a theory, ignore research, and avoid testing the hypothesis.
C	Form a scientific law, select only favorable results, skip data measurement, and state the problem last.
D	Build a circle graph, change all variables at once without a control, and accept the hypothesis without data.

Question 3 : What is a possible explanation for a problem using what you know and what you observe?

A	A hypothesis
B	A constant
C	A base unit
D	A bias

Question 4 : In an experiment, what is the variable that is deliberately changed by the scientist to see how it affects other variables?

A	The constant
B	The dependent variable
C	The independent variable
D	The control group

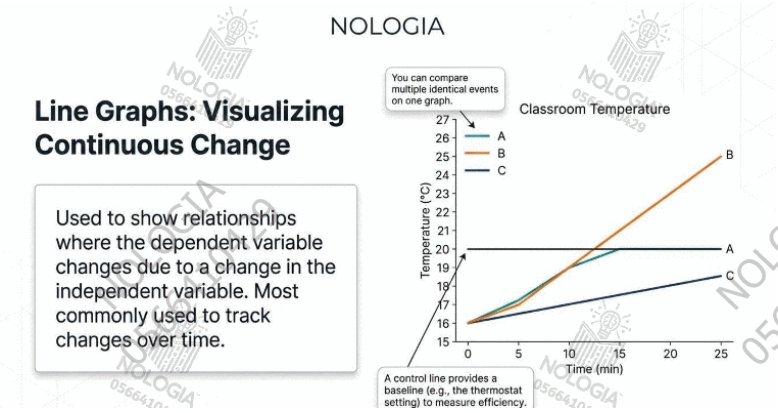
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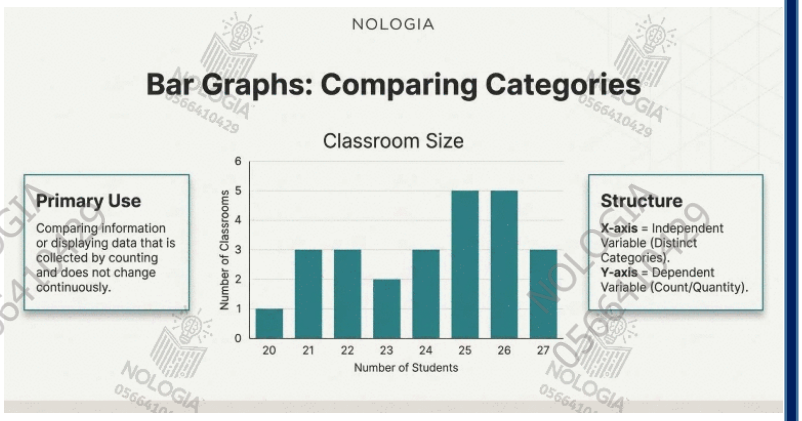
Question 17 : The Nature of Science– Communicating with Graphs

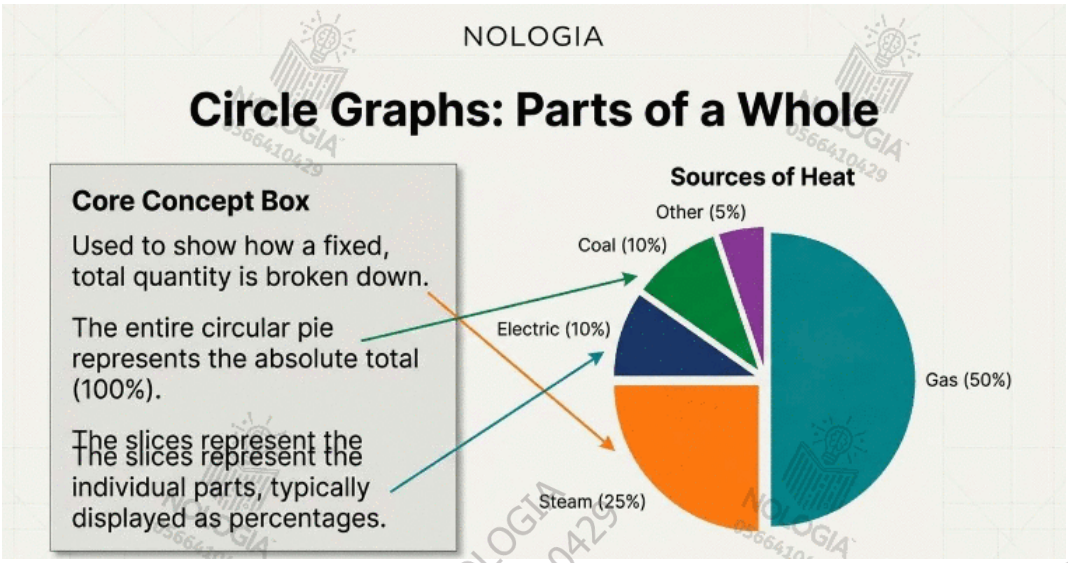
Use adapted arithmetic to the given data to build logical interpretations about the natural phenomena.

Page (74).

Multiple Choice Questions - MCQ







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The Math Connection: Calculating Circle Graph Angles

Step 1: Part ÷ Total = Decimal

18 buildings using steam ÷ 72 total buildings = 0.25

Step 2: Decimal × 360° = Angle

0.25 × 360° = 90° on the circle graph.

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The Ultimate NOLOGIA Master Matrix

Graph Type	Best Used For	X-Axis Represents	Y-Axis Represents
Line Graph	Relationship between variables / continuous change over time.	Independent Variable (e.g., Time).	Dependent Variable (e.g., Temperature).
Bar Graph	Comparing counted information / non-continuous discrete data.	Independent Variable (Distinct Categories)	Dependent Variable (Count / Amount)
Circle Graph	Breaking down a fixed total into parts (percentages).	N/A (Represents the 100% Total)	N/A (Slices represent percentage parts)

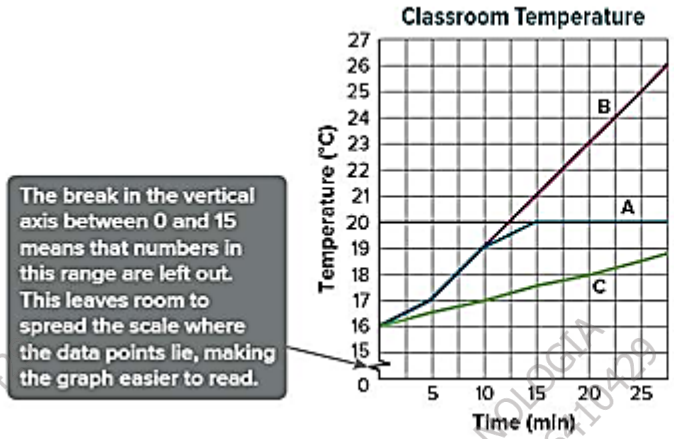


Figure 14 The builder's graph compares the time the furnace has been running with the temperature in each of three rooms, A, B, and C. The black line at $y = 20°C$ shows the thermostat setting.

Question 1: Identify the thermostat that reached 20°C first (Figure 14).

Answer : Thermostat B reached 20°C first (its line crosses the 20°C horizontal control line before 15 minutes, reaching 21°C at 15 minutes, whereas Thermostat A reaches 20°C at 15 minutes).

Question 2: Identify the kind of graph that would best show the results of a survey of 144 people, of which 75 ride a bus, 45 drive cars, 15 carpool, and 9 walk to work.

Answer : A circle graph (pie chart) or a bar graph: a circle graph shows how the fixed total quantity of 144 people is broken into parts, and a bar graph compares the counted numbers in each category.

Question 3 : Identify the thermostat that reached 20°C first (Figure 14).

A	Thermostat A
B	Thermostat B
C	Thermostat C
D	All three thermostats reached 20°C at the exact same time.

Question 4 : Identify the kind of graph that would best show the results of a survey of 144 people, of which 75 ride a bus, 45 drive cars, 15 carpool, and 9 walk to work.

A	A line graph, because the survey measures continuous temperature over time
B	An ecological pyramid, because the survey measures heat loss
C	A circle graph (or bar graph), because a fixed total of 144 people is broken into parts or counted categories
D	A flight simulator, because the survey tests a hazardous process

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Question 5 : What is a visual display of information or data used by scientists to detect patterns?

A	A graph
B	A hypothesis
C	A prefix
D	A constant

Question 6 : On a standard graph, which variable is plotted on the horizontal axis (x-axis) and which is plotted on the vertical axis (y-axis)?

A	Independent variable on the x-axis; dependent variable on the y-axis
B	Dependent variable on the x-axis; independent variable on the y-axis
C	Constants on both the x-axis and y-axis
D	Control group on the x-axis; bias on the y-axis

Question 7 : When constructing a line graph from experimental data points, how should the line be drawn?

A	Draw a smooth line or curve that fits best among the points (never play connect-the-dots).
B	Draw a sharp zigzag line connecting every single dot directly.
C	Draw vertical bars around each point.
D	Connect only the first and last point and erase the rest.

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Question 18 : The Nature of Science– Standards of Measurement

Explain the scientific tools and techniques used to conduct accurate measurements.

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Multiple Choice Questions - MCQ

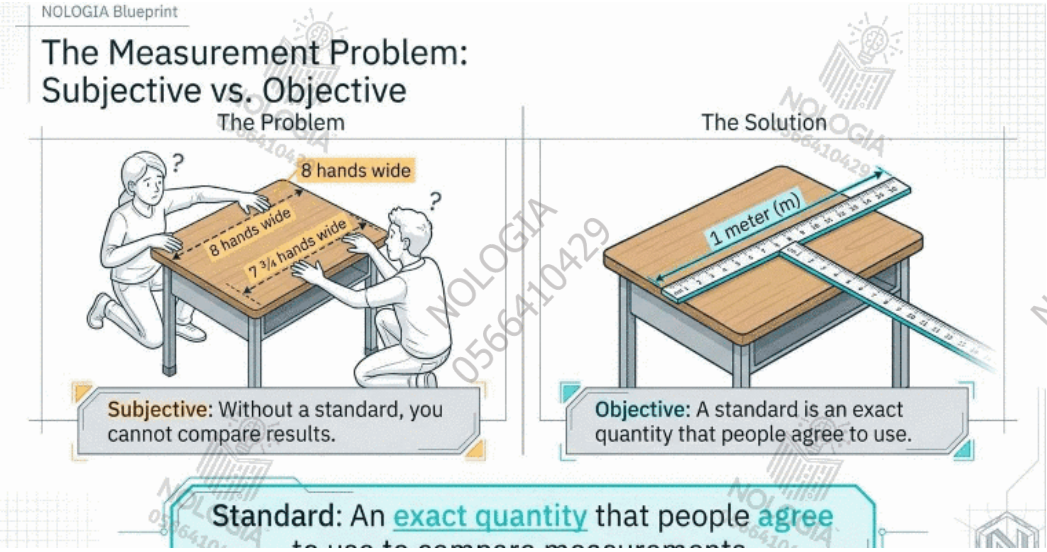
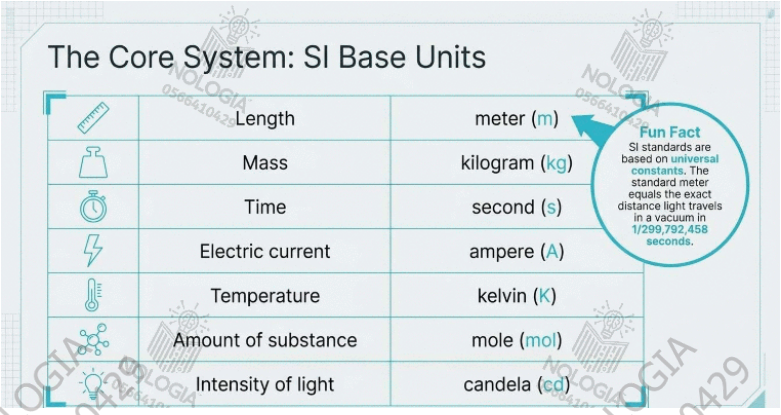
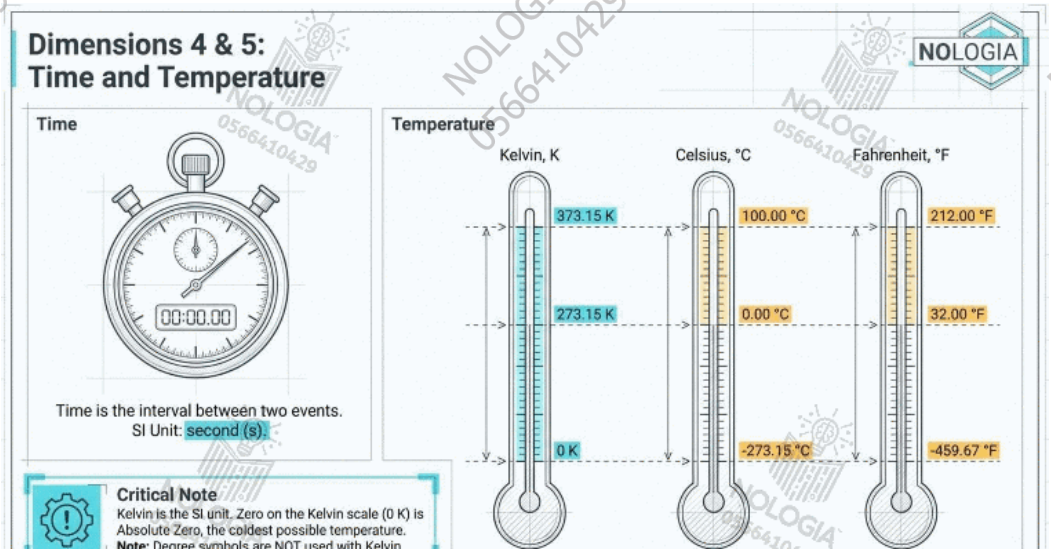


Table 3 Common SI Prefixes

Prefix	Symbol	Multiplying Factor
Kilo-	k	1,000
Deci-	d	0.1
Centi-	c	0.01
Milli-	m	0.001
Micro-	μ	0.000 001
Nano-	n	0.000 000 001





EXAMPLE Problem 1

CONVERT UNITS How long, in centimeters, is a 3075-mm rope?

Identify the Unknown: rope length in cm

List the Knowns: rope length in mm = 3075 mm
1 m = 100 cm = 1000 mm

Set Up the Problem: $\text{length in cm} = \text{length in mm} \times \frac{100\ \text{cm}}{1000\ \text{mm}}$

Solve the Problem: $\text{length in cm} = 3075\ \text{mm} \times \frac{100\ \text{cm}}{1000\ \text{mm}} = 307.5\ \text{cm}$

Check the Answer: Millimeters are smaller than centimeters, so make sure your answer in mm is greater than the measurement in cm. Because SI is based on tens, the answer in mm should differ from the length in cm by a factor of ten.

Question 1 : Explain why it is important to have exact standards of measurement.

Answer : Exact standards of measurement (such as the International System of Units, SI) provide agreed-upon quantities that allow people and scientists everywhere to compare measurements accurately, share data, and avoid confusion.

Question 2 : If your pencil is 11 cm long, how long is it in millimeters?

Answer : Since 1 cm = 10 mm, multiply 11 cm × (10 mm / 1 cm) = 110 mm.

Question 3 : Explain why it is important to have exact standards of measurement.

A	Exact standards allow each scientist to invent private units so no one can verify their results.
B	Exact standards make conversion factors equal to 100 instead of 1.
C	Exact standards eliminate the need for metersticks, balances, or thermometers.
D	Exact standards (like SI) provide agreed-upon quantities needed to compare measurements accurately and reduce confusion.

Question 4 : If your pencil is 11 cm long, how long is it in millimeters?

A	110 mm
B	1.1 mm
C	11 mm
D	1,100 mm

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Question 5 : According to Table 2 (Page 66) and Slide 103, what are the SI base units for length, mass, time, and temperature?

A	Length: meter (m); Mass: kilogram (kg); Time: second (s); Temperature: kelvin (K)
B	Length: foot; Mass: pound; Time: hour; Temperature: Fahrenheit (°F)
C	Length: liter; Mass: candela; Time: mole; Temperature: ampere
D	Length: hand; Mass: gram; Time: day; Temperature: Celsius (°C)

Question 6 : In the SI system, which prefix represents a factor of 1,000 and which prefix represents 0.001 (one-thousandth)?

A	kilo- (k) = 1,000; milli- (m) = 0.001
B	centi- (c) = 1,000; deci- (d) = 0.001
C	nano- (n) = 1,000; kilo- (k) = 0.001
D	milli- (m) = 1,000; micro- (μ) = 100

Question 7 : What is a ratio that is equal to one and is used to change one unit to another without changing the value of the measurement (such as 1,000 mL / 1 L)?

A	A conversion factor
B	A dependent variable
C	A scale break
D	A control group

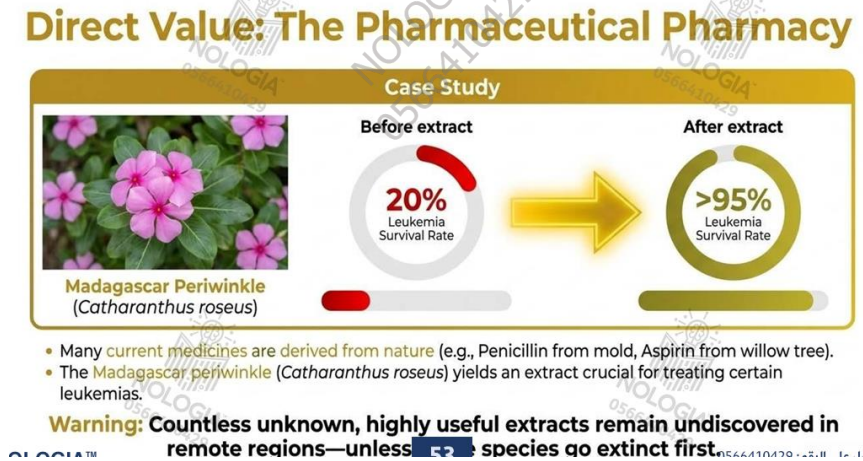
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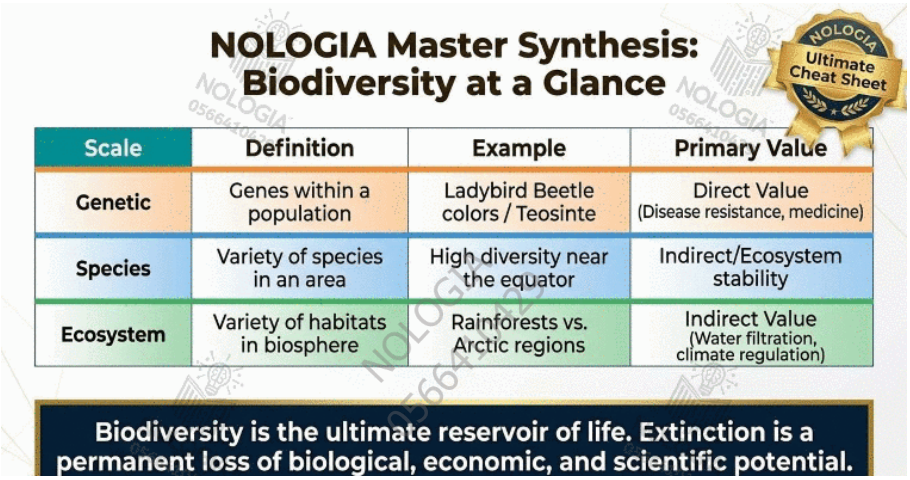
Question 19 : BIODIVERSITY AND CONSERVATION– BIODIVERSITY

Construct an explanation based on evidence to describe how the genetic variation of the traits among populations increases the reproduction probability of some individuals in a specific environment.

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Multiple Choice Questions - MCQ





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Question 1 : Evaluate and discuss the importance of maintaining biodiversity for future medical needs.

Answer : Many vital medicines are derived from wild organisms (such as penicillin from bread mold, aspirin from willow bark, and leukemia treatments from Madagascar periwinkle). Because many species have not yet been identified or studied, maintaining biodiversity preserves unknown extracts and useful genes needed to cure future human diseases.

Question 2 : Evaluate and discuss the importance of maintaining biodiversity for future medical needs.

A	Wild plants and fungi have never been used to make medicines.
B	Many medicines come from organisms (like penicillin and Madagascar periwinkle), so preserving biodiversity protects unstudied species that may provide future cures.
C	Reducing species diversity makes it easier to discover new medicines in extinct plants.
D	Maintaining biodiversity is useful only for tourism and has no connection to medicine.

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Question 3 : From which living organism was the potent antibiotic penicillin discovered?

A	Imported fire ants
B	Wild Mexican corn (teosinte)
C	Asian grass carp
D	Bread mold (fungi)

Question 4 : The painkiller salicin (now synthesized in laboratories as aspirin) was originally derived from which plant?

A	Giant kelp
B	Prickly pear cactus
C	The willow tree
D	Hydrilla

Question 5 : According to the Biodiversity Master Synthesis table ,extracting medicines and disease-resistant genes from wild species is classified under which primary value?

A	Direct economic value (from genetic diversity)
B	Indirect water filtration value
C	Aesthetic landscape value
D	Habitat fragmentation

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Question 20 : The Nature of Science– The Methods of Science

Show that some scientific investigations lead to the development of technology that can improve our lives and the world around us.

Page (63 , 64).

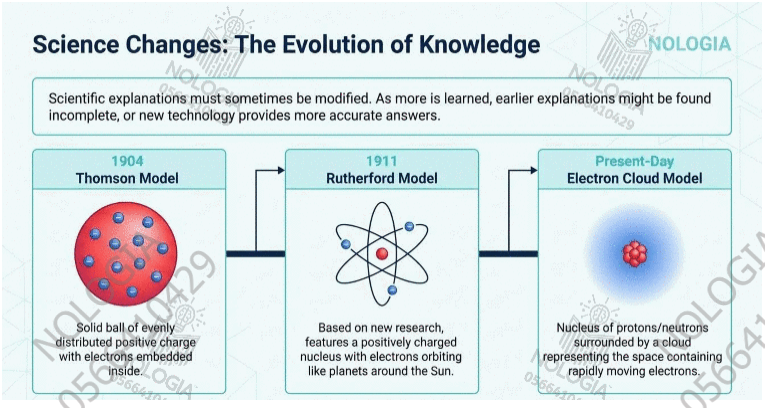
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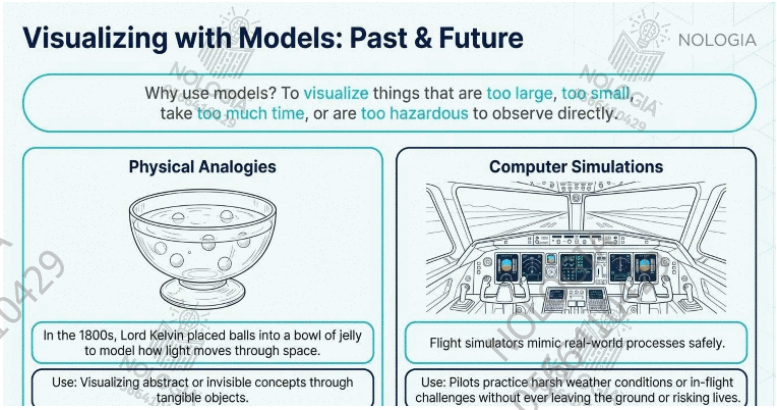
Being objective

Scientists also have a responsibility to minimize bias in their investigations. **Bias** occurs when a scientist's expectations change how the results are analyzed or conclusions are formed. Bias might cause a scientist to select a result from one trial over those from other trials. An example of bias would be presenting positive test results to promote a product and withholding unfavorable results.

Scientists can reduce bias by running as many trials as possible and by keeping accurate notes of each observation made. **Figure 6** shows a scientist who is researching a medication's effectiveness. One way to reduce bias in this case would be to conduct the experiment so that the researchers didn't know which group was the study group and which group was the control. This is called a blind experiment.

Valid experiments must also have data that are measurable. For example, a scientist performing a global warming study must base his or her data on accurate measures of global temperature. This allows others to compare the results to data they obtain from similar experiments. Most importantly, the experiment must be repeatable. Findings are supportable when other scientists around the world perform the same experiment and get the same results.





Question 1: Define What is bias in science?

Answer : Bias occurs when what a scientist expects changes how the results of an experiment are viewed/analyzed or how conclusions are formed.



Figure 7 This is a computer simulation of an aircraft landing on a runway. The image on the screen in front of the pilots mimics what they would see if they were landing a real plane.

Question 2: Identify models in your classroom.

Answer : Classroom models include a globe or world map, a 3D model of an atom or molecule, a model of the solar system, a human skeleton/organ model, and computer simulations.

Question 3 : Define What is bias in science?

A	Having independent scientists review an experiment before publication
B	Running multiple trials and blind experiments to keep data objective
C	When a scientist's expectations change how the results are analyzed or conclusions are formed
D	Converting measurements from millimeters to centimeters using SI units

Question 4 : Identify models in your classroom.

A	Models are personal opinions and artistic values that cannot be tested.
B	Models are SI base units of measurement such as the meter and kilogram.
C	Models are natural laws that never change when new information is found.
D	Models represent an idea, event, or object to help people understand it (such as a globe, atomic model, skeleton model, or computer simulation).

Question 5 : How can scientists lessen bias when conducting an investigation?

A	By running as many trials as possible, keeping accurate notes, and using blind experiments and peer review
B	By selecting only the results that support their favorite hypothesis
C	By hiding their experimental data from other scientists
D	By performing only a single trial without a control

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Question 6 : Why do scientists use models in scientific investigations?

A	To visualize things that are too large, too small, take too much time, or are too hazardous to observe directly
B	To avoid collecting any measurements or experimental data
C	To prove personal opinions about paintings and music
D	To replace the International System of Units (SI)

Question 7 : In the 1800s, why did Lord Kelvin place balls into a bowl of jelly ?

A	To create a physical model of how light moves through space
B	To measure the boiling point of water in kelvins
C	To test ceramic tiles for the space shuttle
D	To calculate the density of gold

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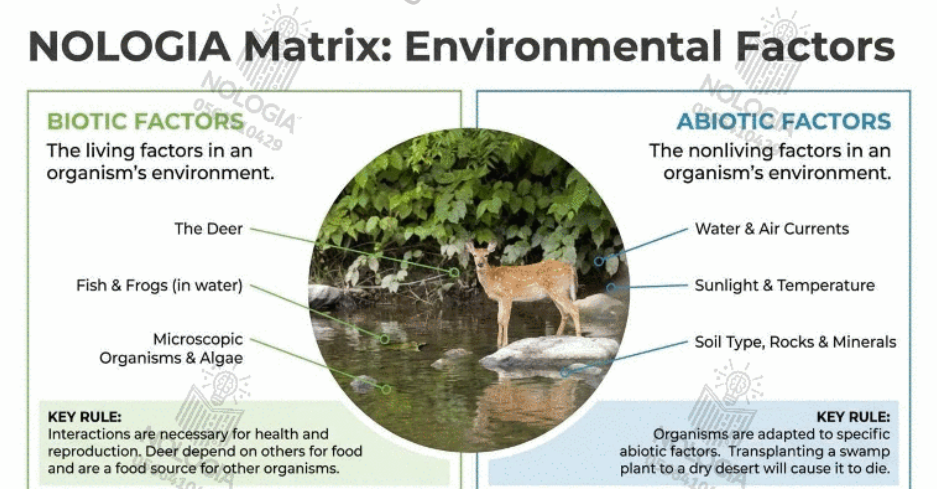
Question 21 : Principles of Ecology– Organisms and Their Relationships , Cycling of Matter

• Compare and contrast biotic and abiotic characteristics of sustainable and unsustainable terrestrial and aquatic ecosystems.

• Explain how matter is recycled within the environment and how it promotes sustainability.

Page (8 , 21 , 24).

Free Response Questions - FRQ



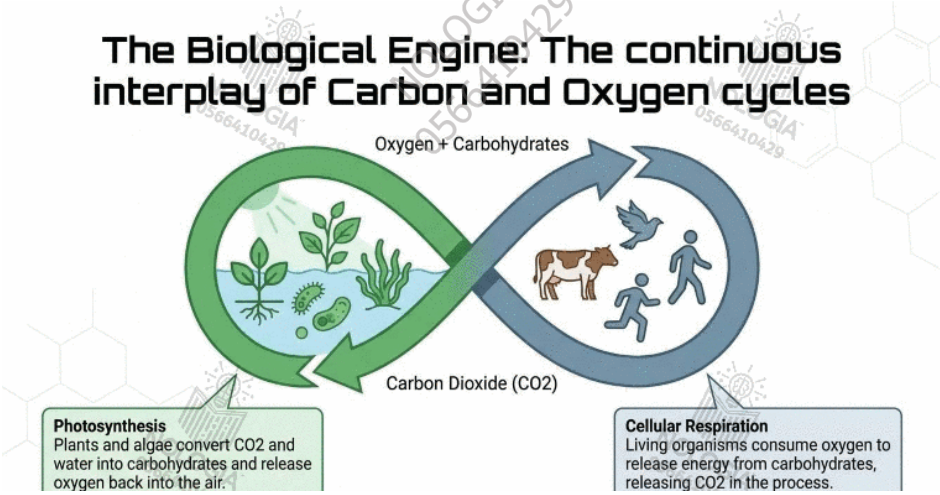
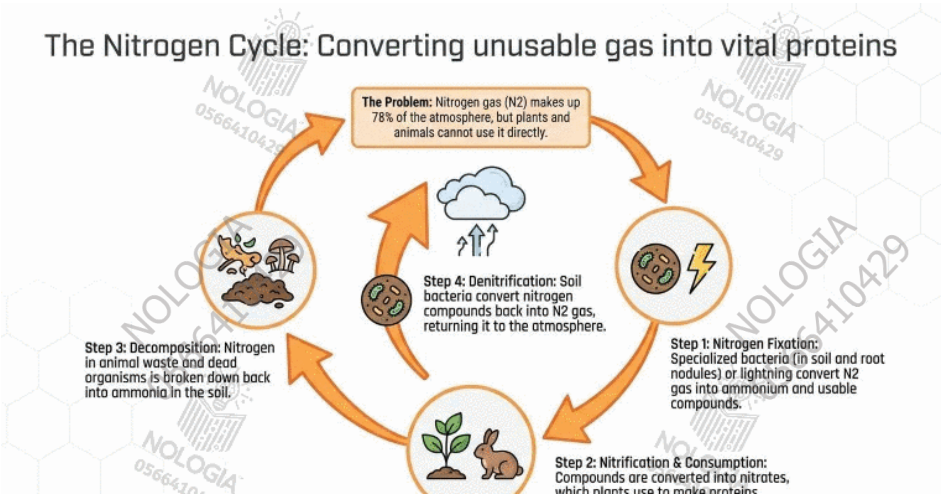




Figure 5 The deer standing on this rock is a biotic factor in this stream community. Other organisms in the water, such as frogs and algae, also are biotic factors.



Question 1: Explain how organisms are dependent on other organisms (Figure 5).

Answer : Organisms depend on other organisms for survival and reproduction. For example, deer need other members of their own species to reproduce, depend on plants for food, and serve as a food source for predators.

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Question 2: Compare and contrast abiotic and biotic factors shown in the photo at the beginning of this module.

Answer : • Similarity: Both are environmental factors in an ecosystem that interact and are essential for the survival of organisms.

• Difference: Biotic factors are the living components (such as deer, fish, frogs, plants, algae, and microorganisms), whereas abiotic factors are the nonliving components (such as sunlight, water, air currents, temperature, rocks, and soil nutrients).

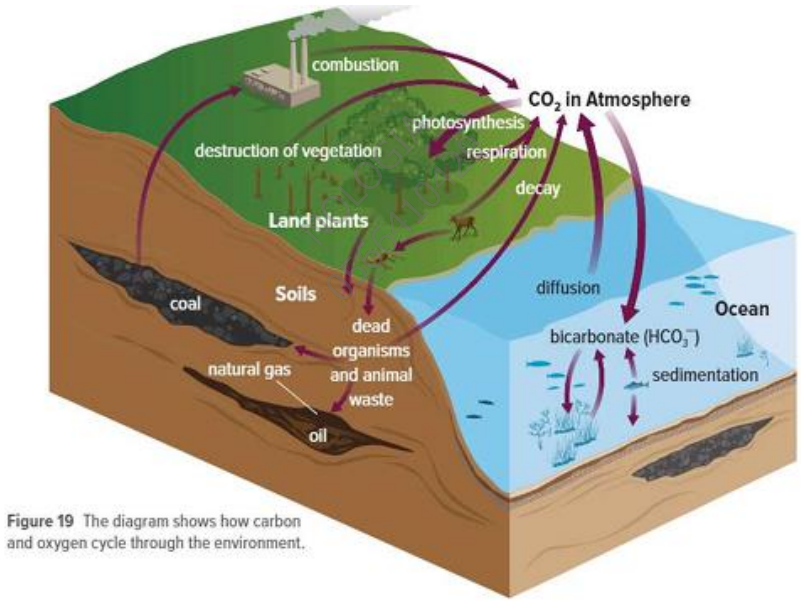


Figure 19 The diagram shows how carbon and oxygen cycle through the environment.

Question 3: Describe how carbon moves from the abiotic to the biotic parts of the ecosystem (Figure 19)..

Answer : During photosynthesis, green plants and algae absorb carbon dioxide (CO2) from the atmosphere or water (abiotic) and use sunlight to convert it and water into carbohydrates inside living tissues (biotic).

Question 4: Identify the living and nonliving parts of the nitrogen cycle.

Answer : • Living (biotic) parts: Nitrogen-fixing bacteria, nitrifying and denitrifying bacteria, plants (producers), animals (consumers), and decomposers.

• Nonliving (abiotic) parts: Atmospheric nitrogen gas (N_2), ammonium (NH_4^+), nitrites (NO_2^-), and nitrates (NO_3^-) in soil and water, and lightning.

Question 5: Compare and contrast the role of plants in the carbon and nitrogen cycles.

Answer : • Similarity: In both cycles, plants take in inorganic compounds from the abiotic environment and build essential organic molecules (carbohydrates and proteins) for consumers.

• Difference: In the carbon cycle, plants absorb CO_2 gas directly from the air through their leaves during photosynthesis; in the nitrogen cycle, plants cannot use N_2 gas directly and must absorb fixed nitrogen compounds (nitrates/ammonium) from the soil or water through their roots.

Question 6 : What happens if a plant that normally grows in a lush, swampy area is transplanted to a dry desert? Explain why.

Answer : The plant will likely die because organisms are adapted to the specific abiotic factors (such as moisture, soil, and temperature) of their natural environment and cannot adjust quickly to the dry desert conditions.

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Question 22 : Principles of Ecology– Flow of Energy in an Ecosystem

Explain that as energy flows through different organizational levels of living systems, chemical elements are recombined to form different products, and energy is transferred from one system to another.

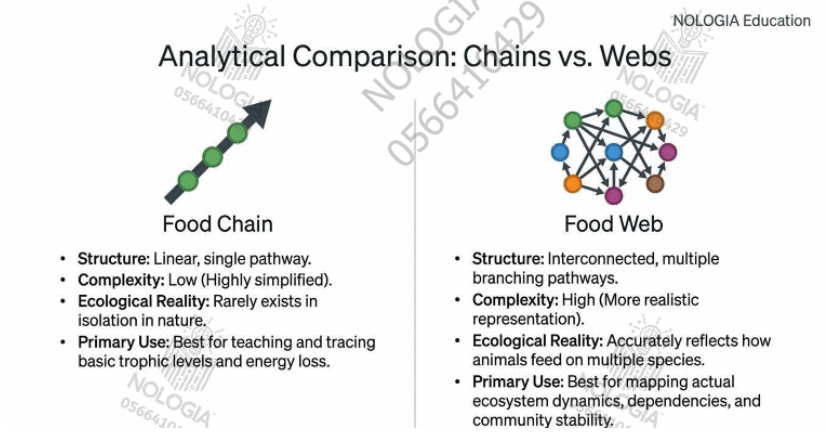
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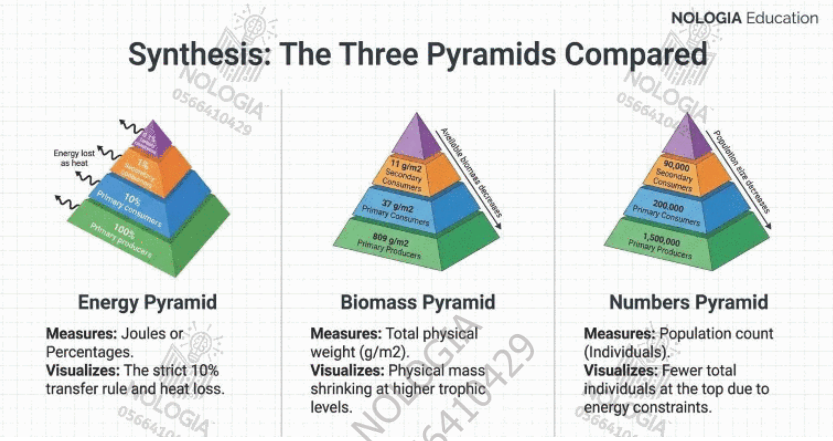
Free Response Questions - FRQ

The Consumer Matrix

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Classification	Definition	Examples	Ecosystem Role
Herbivore	Eats only plants	Cow, rabbit, grasshopper	Primary Consumer
Carnivore	Preys on other heterotrophs	Wolf, lion, lynx	Secondary/Tertiary Consumer
Omnivore	Eats both plants and animals	Bears, humans, mockingbirds	Variable Consumer
Detritivore	Eats fragments of dead matter	Worms, aquatic insects on stream bottoms	Nutrient Recycler
Decomposer	Breaks down dead organisms via enzymes	Fungi, bacteria	Chemical Recycler





Question 1: Distinguish producers, consumers, and decomposers from one another.

Answer : • Producers (autotrophs): Organisms that capture energy from sunlight or inorganic chemicals to produce their own food (e.g., green plants and algae).

• Consumers (heterotrophs): Organisms that get energy by consuming other organisms (herbivores, carnivores, omnivores, detritivores).

• Decomposers: Organisms (fungi and bacteria) that break down dead organisms using digestive enzymes and return nutrients to soil, air, and water.

Question 2: Classify a pet dog as an autotroph or heterotroph and as an herbivore, carnivore, or omnivore. Explain.

Answer : A pet dog is a heterotroph because it must consume other organisms for energy. It is classified as an omnivore (or carnivore) because although dogs are naturally adapted to eat meat, domestic pet food contains both animal meat and plant ingredients.

Question 3: Create and use a simple food web to identify producers, consumers, and decomposers in your community.

Answer : • Community Food Web: Grass & Shrubs → Grasshoppers & Rabbits → Lizards → Falcons & Foxes → Decomposed by Bacteria & Fungi.

• Producers: Grass and shrubs.

• Consumers: Grasshoppers and rabbits (primary consumers), lizards (secondary consumers), falcons and foxes (tertiary consumers).

• Decomposers: Soil bacteria and fungi.

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Question 4: MATH Connection Draw an energy pyramid for a food chain made up of grass, a caterpillar, tiger beetle, lizard, snake, and a roadrunner. Assume that 100 percent of the energy is available for the grass. At each stage, calculate and show how much energy is lost and how much is available to the next trophic level.

Answer : By the 10% Rule (90% of energy is lost as heat at each step, and 10% is transferred):

1) Grass (Producer): 100% available (90% lost; 10% transferred).

2) Caterpillar (1st consumer): 10% available (9% lost; 1% transferred).

3) Tiger beetle (2nd consumer): 1% available (0.9% lost; 0.1% transferred).

4) Lizard (3rd consumer): 0.1% available (0.09% lost; 0.01% transferred).

5) Snake (4th consumer): 0.01% available (0.009% lost; 0.001% transferred).

6) Roadrunner (5th consumer): 0.001% available.

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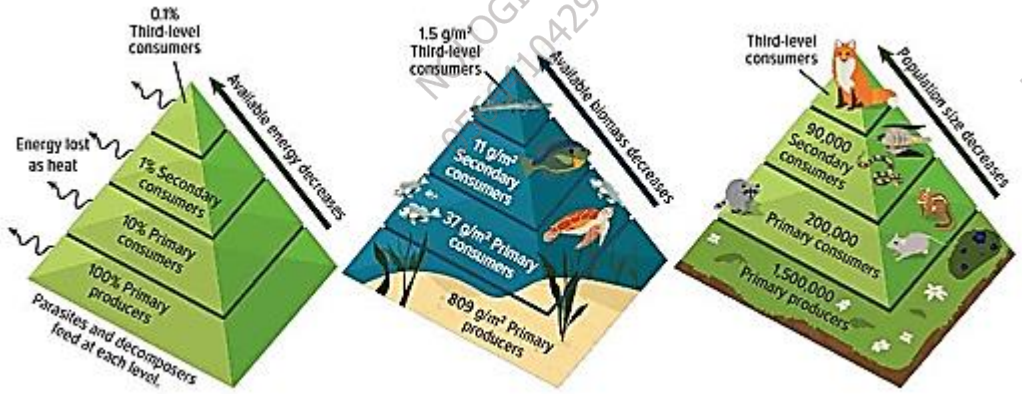


Figure 16 Ecological pyramids are models used to represent trophic levels in ecosystems.

Question 5: WRITING Connection Write a paragraph that explains the pathway of energy transfer through the pyramid of energy shown in Figure 16.

Answer : In the pyramid of energy (Figure 16), primary producers at the base capture solar energy via photosynthesis and hold 100% of the available energy. At each transfer to primary consumers (10%), secondary consumers (1%), and third-level consumers (0.1%), 90% of the energy is used for cellular processes or lost to the environment as heat, while only 10% passes to the next trophic level.

Question 6 : Define a trophic level and state which group of organisms always makes up the first trophic level in all ecosystems.

Answer : Each step in a food chain or food web is called a trophic level. Autotrophs (primary producers) always make up the first trophic level in all ecosystems, and heterotrophs make up all remaining levels.

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Question 23 : Biodiversity and Conservation – Threats to Biodiversity

• Explain the importance of biodiversity in maintaining the ecosystem continuity.

• Identify various factors related to human activity that have an impact on ecosystems, and explain how these factors affect the equilibrium and survival of ecosystems.

• Explain the ways in which human activities and technologies alter balances and interactions in the environment.

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Free Response Questions - FRQ



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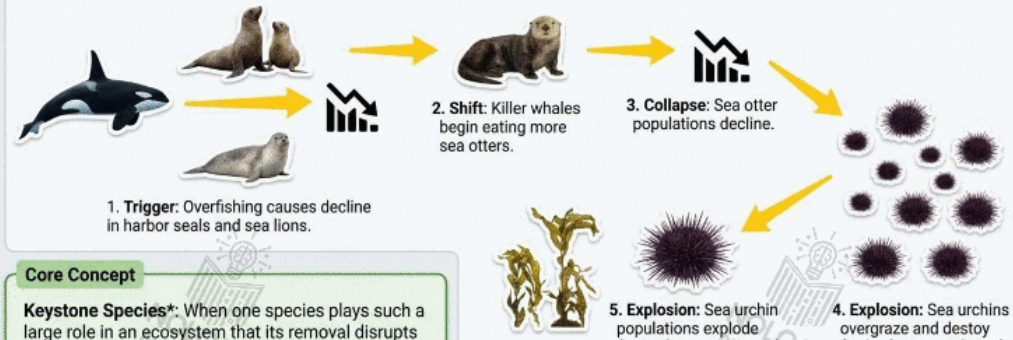
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Habitat Disruption: The Keystone Domino Effect

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Domino-Effect Flowchart

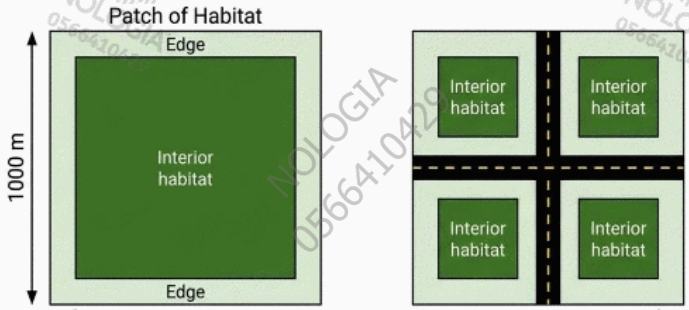


Core Concept

Keystone Species*: When one species plays such a large role in an ecosystem that its removal disrupts the entire food web (e.g., the sea otter).

Habitat Fragmentation & The Edge Effect

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The Problem: Smaller parcels support fewer species and reduce genetic diversity (making it harder to resist disease or respond to change).

Edge Effects: Different abiotic factors (temperature, wind, humidity) exist at boundaries. Predators and

Threat #5: Invasive Species

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THREAT FRAMEWORK
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Definition

Nonnative species intentionally or unintentionally transported to a new habitat. Because they are relocated without their natural controlling factors (predators, parasites, and native competition), they reproduce in massive numbers and disrupt the ecosystem.

40%

Invasive species are responsible for an estimated 40% of all extinctions since 1750, costing billions

Case Study



The Imported Fire Ant: Accidentally introduced to Mobile, Alabama in the 1920s via cargo ships from South America. Lacking natural predators, they spread rapidly, attacking native wildlife like newborn deer and ground-nesting birds. (NOLOGIA Biological Record)

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Question 1: Explain three ways that anthropogenic changes threaten biodiversity.

Answer : 1) Habitat loss (clearing tropical rainforests or fragmenting habitats with roads).

2) Pollution (toxic chemicals like DDT/PCBs causing biological magnification, acid rain, and eutrophication).

3) Overexploitation (excessive hunting/harvesting of economically valuable species) and introducing invasive species.

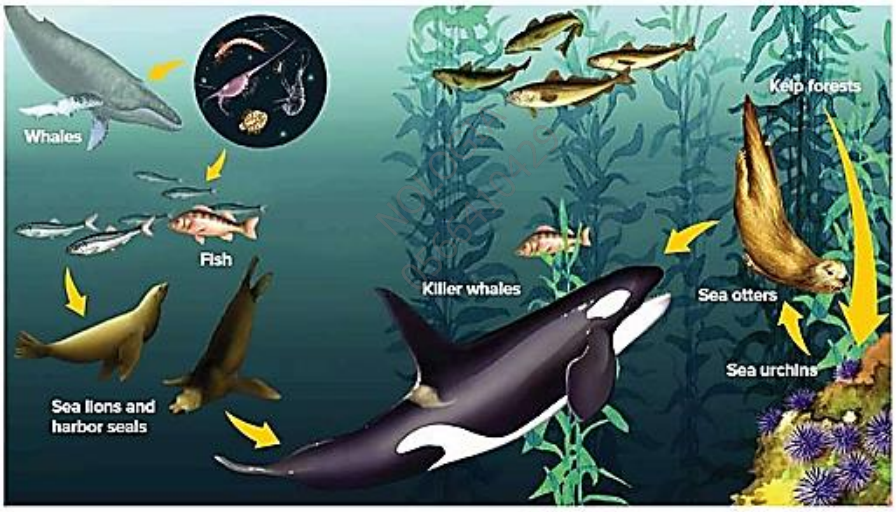


Figure 12 A declining population of one species can affect an entire ecosystem. When the number of harbor seals and sea lions declined, killer whales ate more sea otters. The decline in sea otter population led to an increase in sea urchins, which eat kelp. This led to the ultimate decline in kelp forests.

Question 2: Summarize how the overharvesting of a single species, such as the fish eaten by sea lions, can affect an entire ecosystem.

Answer : Overharvesting fish reduces food for sea lions and harbor seals, causing their populations to decline. Killer whales then shift to eating sea otters. As sea otters decline, sea urchins multiply rapidly and overgraze kelp, destroying the kelp forest ecosystem.

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Question 3: Design a planned community that preserves biodiversity and accommodates the human population. Work in small groups to accomplish this task.

Answer : A planned community should preserve large, unfragmented patches of native habitat to minimize edge effects, connect habitat fragments with wildlife corridors, surround protected core zones with sustainable-use buffer zones, plant native vegetation, and prevent sewage and fertilizer runoff.



Figure 15 Invasive species, such as the fire ant, can negatively affect biodiversity.

Question 4: Explain how invasive species, such as the imported fire ant shown in Figure 15, negatively affect biodiversity when introduced into a new habitat.

Answer : In a new habitat, invasive species lack their natural predators, parasites, and competitors. As a result, they reproduce in huge numbers, outcompete native species for resources, and prey on native wildlife (such as fire ants attacking newborn deer and ground-nesting birds).

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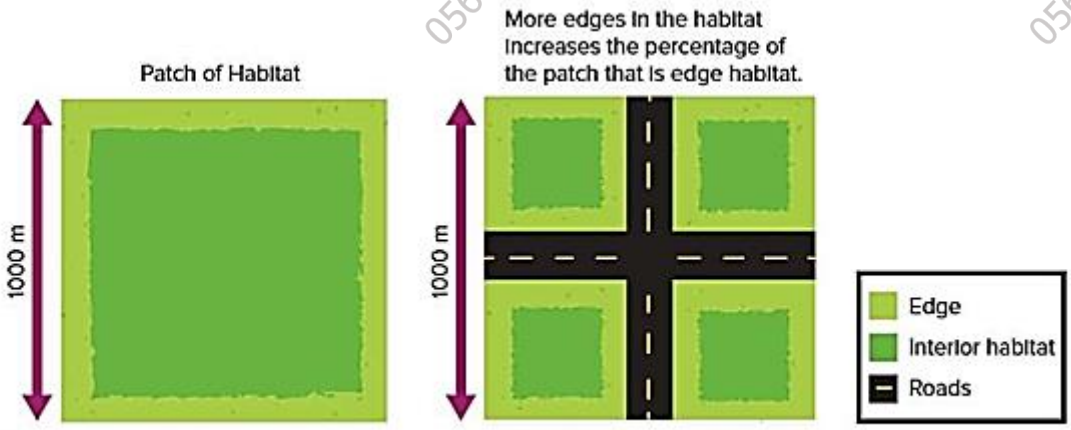


Figure 13 The smaller the habitat size, the greater percentage of the habitat that is subject to edge effects.

Question 5: Explain how dividing a patch of habitat with roads (habitat fragmentation) affects the percentage of edge habitat and the species living there. (Figure 13)

Answer : Dividing a habitat with roads creates smaller parcels with more edges, increasing the percentage of habitat exposed to edge effects (higher temperature and wind, lower humidity, and more predators and parasites along boundaries), which causes interior-adapted species to perish.

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Question 6: Besides edge effects, list two other problems caused when a large ecosystem is separated into small parcels by habitat fragmentation.

Answer : 1) Smaller parcels of land support fewer species and smaller populations.
2) Fragmentation prevents animals from moving between patches to breed, which reduces genetic diversity and makes populations less resistant to disease or environmental changes.

Question 7: Approximately what percentage of all animal extinctions since 1750 have been caused by invasive species?

Answer : Invasive species are responsible for an estimated 40 percent (40%) of all animal extinctions that have occurred since 1750.

Question 8: Define a keystone species and identify the keystone species in the kelp forest food web (Figure 12).

Answer : A keystone species is a species that plays such a large role in an ecosystem that its removal disrupts the entire food web. In the kelp forest ecosystem (Figure 12), the sea otter is the keystone species because it keeps sea urchin populations from destroying the kelp forest.

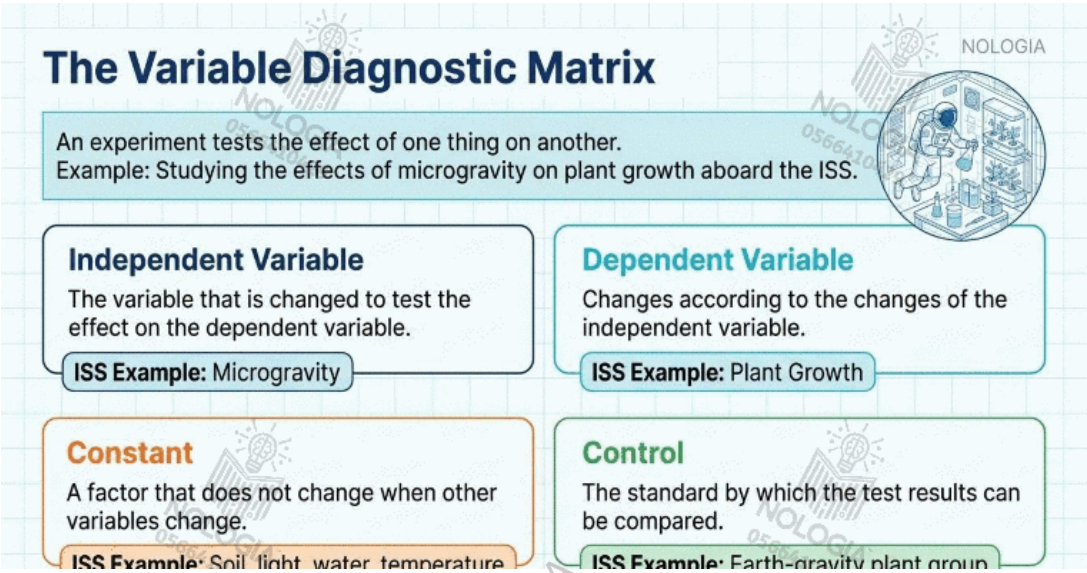
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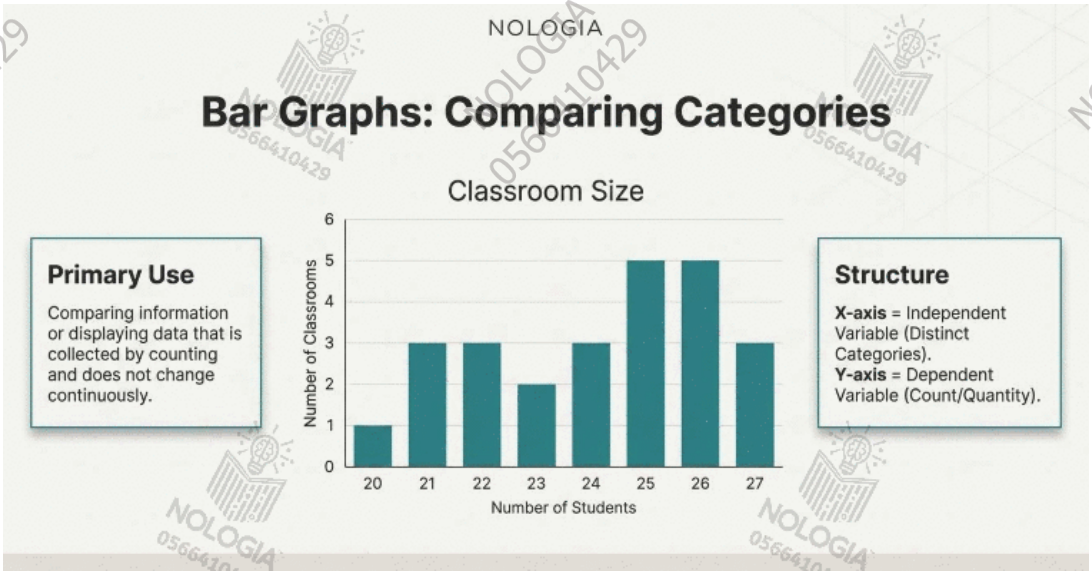
Question 24 : The Nature of Science – The Methods of Science , Communicating with Graphs

- Design and perform a controlled experiment to accept or reject a given hypothesis.
- Use models and computer simulations to represent systems and clarify concepts.
- Use tables, graphs and visual forms to present and analyze scientific data.

Page (62 , 65 , 75 , 76).

Free Response Questions - FRQ





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The Ultimate NOLOGIA Master Matrix

Graph Type	Best Used For	X-Axis Represents	Y-Axis Represents
Line Graph	Relationship between variables / continuous change over time.	Independent Variable (e.g., Time).	Dependent Variable (e.g., Temperature).
Bar Graph	Comparing counted information / non-continuous discrete data.	Independent Variable (Distinct Categories)	Dependent Variable (Count / Amount)
Circle Graph	Breaking down a fixed total into parts (percentages).	N/A (Represents the 100% Total)	N/A (Slices represent percentage parts)

Question 1: Identify What is the purpose of a control in an experiment?

Answer : A control is the standard by which test results in an experiment can be compared.

Question 2: Analyze What is the dependent variable in an experiment that shows how the volume of a gas changes with changes in temperature?

Answer : The dependent variable is the volume of the gas (because gas volume changes in response to changes in temperature, which is the independent variable).

Question 3: MATH Connection An experiment to determine how many breaths a squirrel takes per minute yields this data: minute 1: 65 breaths; minute 2: 73 breaths; minute 3: 67 breaths; minute 4: 71 breaths; minute 5: 62 breaths. Calculate the average number of breaths per minute.

Answer : Average = (65 + 73 + 67 + 71 + 62) ÷ 5 = 338 ÷ 5 = 67.6 breaths per minute.

APPLY SCIENCE

Make and Use Graphs

Line graphs are useful tools for showing the relationship between an independent and a dependent variable. In an experiment, you checked the air temperature at certain hours of the day and recorded it in the data table shown here.

Time	Temperature
8:00 A.M.	27°C
12:00 P.M.	32°C
4:00 P.M.	30°C

Identify the Problem

time = independent variable

temperature = dependent variable

Temperature is the dependent variable because it varies with time. Graph time on the *x*-axis and temperature on the *y*-axis. Mark equal increments on the graph and include all measurements. Plot each point on the graph by finding the time on the *x*-axis and moving up until you find the recorded temperature on the *y*-axis. Continue placing points on the graph. Then, connect the points from left to right.

Question 4: Why is a line graph a useful tool for viewing this data?

Answer : A line graph is useful because it shows the relationship between an independent variable (time on the x-axis) and a dependent variable (temperature on the y-axis) and clearly displays how continuous data change over time.

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Table 7 Classroom Size

Number of Students	Number of Classrooms
20	1
21	3
22	3
23	2
24	3
25	5
26	5
27	3

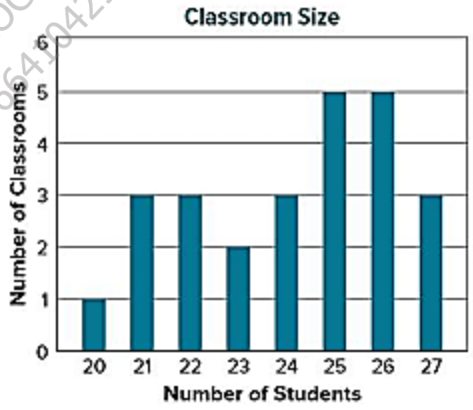


Figure 16 The height of each bar corresponds to the number of classrooms having a particular number of students.

Question 5: Describe possible data for which using a bar graph would be better than using a line graph.

Answer : A bar graph is better for comparing information collected by counting or displaying separate categories that do not change continuously–such as the number of students in different classrooms (Table 7), comparing crop or oil production across regions, or comparing product costs.

Question 6: What must a scientist do before plotting measurements that were recorded in different units (such as some temperatures in Fahrenheit and others in Celsius) on the same graph?

Answer : All measurements must be converted into the same consistent unit before plotting them on the graph.

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Question 7: In the International Space Station (ISS) plant growth experiment ,identify the independent variable, dependent variable, constants, and control.

Answer : • Independent variable: Microgravity (weightlessness vs. normal Earth gravity).
• Dependent variable: Plant growth.
• Constants: Soil type, light, water, and temperature.
• Control: The group of plants grown on Earth under normal gravity.

Question 8: Why is a zigzag scale break sometimes used on the axis of a line or bar graph ?

Answer : A scale break is used to skip empty space on the axis where no data points exist (such as between 0°C and 15°C), allowing the data points to be spread out so the graph is easier to read.

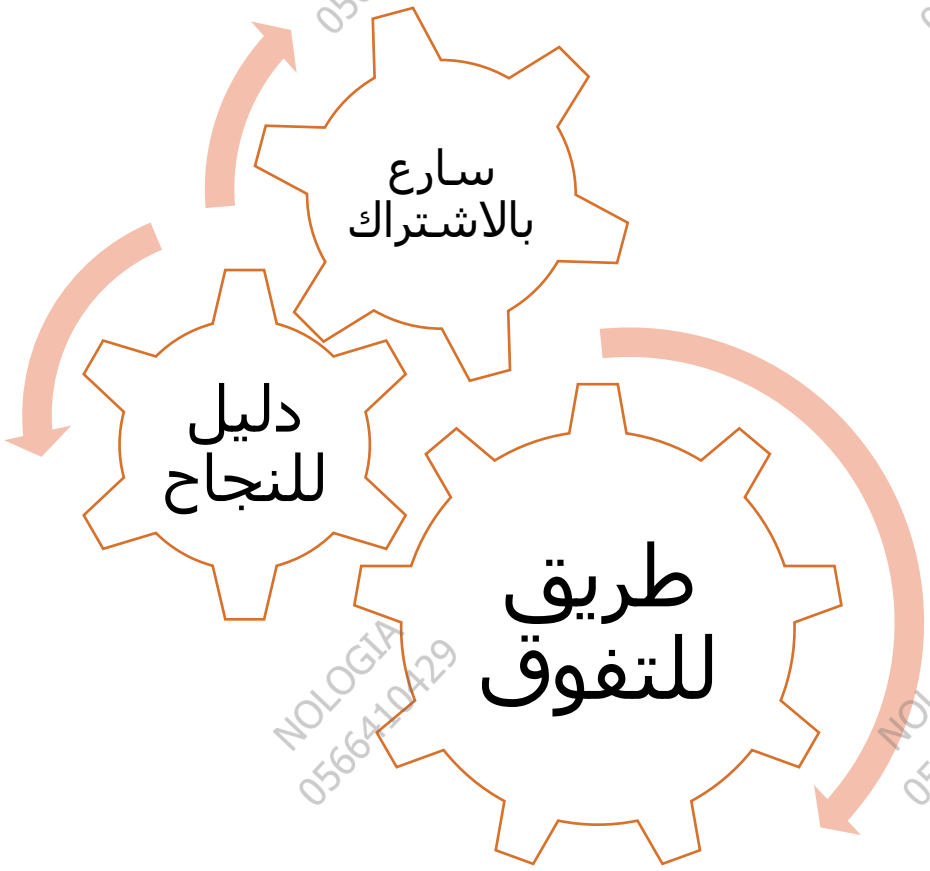
Question 9: According to the Classroom Size bar graph, which variable is plotted on the x-axis and which is plotted on the y-axis?

Answer : • Horizontal x-axis (independent variable): Number of students in each classroom (distinct categories: 20 to 27 students).
• Vertical y-axis (dependent variable): Number of classrooms having that student count.

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النهاية...