**Chapter 3: Ecosystem Ecology**

**Reading Guide**

**Vocabulary**

Learn the definition of each term. The **bold** words require you to know more than just the definition. For example: Ecosystem service - you should what they are, be able to name several types and describe how we benefit from those services.

Ecosystem

Autotroph

**Photosynthesis**

**Cellular Respiration**

Heterotroph

Primary Consumer

Secondary Consumer

Tertiary Consumer

Trophic Level

Scavengers

Detritivore

Decomposer

**Gross Primary Productivity (GPP)**

**Net Primary Productivity (NPP)**

Biomass

Standing Crop

**Ecological Efficiency**

Biosphere

Biogeochemical Cycles

**Hydrologic Cycle**

Condensation

Precipitation

Transpiration

Evapotranspiration

Runoff

**Carbon Cycle**

Macronutrients

Limiting Nutrient (Limiting Factor)

**Nitrogen Cycle**

**Nitrogen Fixation**

**Ammonification**

**Assimilation**

**Denitrification**

**Nitrification**

Leaching

Disturbance

**Watershed**

**Resistance**

**Resilience**

Restoration Ecology

Instrumental Value

Intrinsic Value

Provisions

**Biomass pyramid**

**Energy pyramid**

**Numbers pyramid**

Chemosynthesis

**Reading Outline**

**Reversing the Deforestation of Haiti**

1. Why does Haiti have a deforestation problem?
2. Describe two negative impacts of deforestation.
3. What is Haiti doing to try and solve the deforestation issue?

**3.1 Interactions between living and non-living**

1. What is an ecosystem? Give 2 examples.
2. Why did scientists have to include land outside of Yellowstone National Park in the plan for managing the Yellowstone ecosystem?

**3.2 Energy flows through ecosystems**

1. What is the reaction for photosynthesis? Cellular respiration? What you notice about the two equations?
2. What kinds of organisms perform photosynthesis? What kinds of organisms perform cellular respiration?
3. What is the difference between a heterotroph and an autotroph?
4. Draw two food chains: one for a terrestrial ecosystem and one for an aquatic ecosystem. (note: “drawing” a food chain just means link words with arrows, not literally sketch the organisms)
5. Complete the following sentences by looking at Figure 3.6:
	1. Grass is a primary producer because it performs . . .
	2. A zebra is a primary consumer because it eats . . .
	3. A lion is a secondary consumer because it eats . . .
	4. A hyena is a scavenger because it eats . . .
	5. A dung beetle is a detritivore because it eats . . .
	6. Bacteria, fungus and earthworms are decomposers because they . . .
6. Define NPP and GPP. What mathematical equation links them?
7. Using Figure 3.8,
	1. Which two continental ecosystems (also called terrestrial ecosystems) are the most productive?
	2. Which three continental ecosystems are the least productive?
	3. Which two marine ecosystems (ocean related ecosystems) are the most productive?
	4. Which marine ecosystem is the least productive?
8. What is the relationship between biomass and NPP?
9. Explain why a slow growing forest can have a very low NPP and yet store a massive amount of biomass.
10. Explain why algae in the ocean can have a very high NPP and a very low amount of stored biomass.
11. Explain why a vegetarian diet is much more ecologically efficient than an omnivorous diet.
	1. **Matter cycles through the biosphere**
12. In cycles there are reservoirs (also called pools) and flows (also called processes). Matter is stored in reservoirs; flows are when matter is moved from one reservoir to another.
13. **The Hydrologic Cycle**: The water cycle is driven by GRAVITY and SOLAR ENERGY. All steps in the water cycle that flow downward are driven by gravity. All steps in the water cycle that flow upwards are driven by solar energy.
	1. List three examples of reservoirs in the water cycle (places where water is stored).
	2. Briefly explain the following steps in the water cycle (flows). Include whether it is driven by solar energy or by gravity.
		1. Evaporation -
		2. Condensation -
		3. Precipitation -
		4. Transpiration -
		5. Runoff -

* 1. What three things can happen to water that falls on land?
	2. Name four ways humans alter the water cycle. Be sure to include how the change impacts the water cycle.
1. **The Carbon Cycle** - As Carbon is the basis of life, this cycle is extremely important. For environmental scientists, it is also very important because the carbon cycle helps us understand global climate change by helping us understand where excess CO2 in the atmosphere might end up and how we might be able to increase storage in reservoirs besides the atmosphere
	1. List three examples of carbon reservoirs (places where carbon is stored). Label whether the reservoir stores carbon for a short while or for a long while.
	2. Fill in the following chart

|  |  |  |  |
| --- | --- | --- | --- |
| **Flow** | **Description** | **Performed by** | **Why is this step important?** |
| ***Photosynthesis***  | *Atmospheric CO2 is converted into sugars* | *Autotrophs* | *Converts abiotic CO2 to biomass (base of food chain)* |
| **Respiration** includes decomposition |  |  |  |
| **Exchange** also called diffusion or flux |  |  |  |
| **Sedimentation** |  |  |  |
| **Extraction** |  |  |  |
| **Combustion** |  |  |  |

1. Name two ways humans alter the carbon cycle. Be sure to include how the change impacts the carbon cycle.
2. **The Nitrogen Cycle** - this is the trickiest cycle to learn, but frequently appears on the AP exam, so be sure you know it! It is a critical cycle because most of the nitrogen on earth is stored in the atmosphere, but plants can only absorb nitrogen through the soil. The nitrogen cycle allows atmospheric nitrogen to be converted into a form plants can use.
	1. Explain what is meant by a limiting nutrient. Why is nitrogen often a limiting nutrient?
	2. Where is most of the nitrogen on earth found? In what form? (provide the chemical formula and state)
	3. What two important macromolecules contain nitrogen?
	4. Fill in the following chart:

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Step**  | **Chemical Change** | **Performed by** | **Why is this step important?** |
| Nitrogen Fixation  | N2🡪NH3 or NO3 | Nitrogen fixing bacteria (ie in legume roots) OR fires/lightning OR fertilizer manufacturing | Puts N in the soil, making it available for plants |
| Nitrification  |  |  |  |
| Assimilation |  |  |  |
| Ammonification |  |  |  |
| Denitrification  |  |  |  |

* 1. Excess nitrogen can also cause problems including fertilizer burn, weak plant tissues and eutrophication.
1. **The Phosphorus Cycle** - The only things you need to know about the phosphorus cycle are:
	1. Plants need phosphorus in the form of phosphate (PO43-)
	2. Phosphorus does not cycle through the atmosphere
	3. Phosphorus is typically a limiting factor for plants (along with nitrogen)
	4. Excess phosphorus in aquatic ecosystems leads to eutrophication

1. **The Sulfur Cycle** - the only things you need to know about sulfur are:
	1. Hydrogen sulfide (H2S) is poisonous gas that smells like rotten eggs and comes from anaerobic decomposition.
	2. Sulfur dioxide (SO2) is a colorless gas that comes from burning coal and volcanoes
	3. Sulfuric Acid (H2SO4)is the main component of acid rain - forms when sulfur dioxide and water vapor mix in the atmosphere; often as a result of burning coal

**3.4 Ecosystems respond to disturbance**

1. List 5 natural disturbances and 4 anthropogenic disturbances.
2. When studying Hubbard Brook, what did scientists discover (or confirm) about the impacts of deforestation?
3. What is the difference between resistance and resilience? Provide examples to support your answer.

**3.5 Ecosystems provide valuable services**

1. Provide 5 examples of provisions.
2. Provide 1 example of a regulating service.
3. Provide 2 examples of support systems
4. Provide 1 example of resilience
5. Provide 2 examples of cultural services

Additional Work:

Answer the MC questions at the end of Ch 3 and the FRQs.

**Chapter 4 : Climate and Biomes**

**Reading Guide**

**Vocabulary**

Learn the definition of each term. The **bold** words require you to know more than just the definition. For example: Ecosystem service - you should what they are, be able to name several types and describe how we benefit from those services.

Climate

Troposphere

Stratosphere

Albedo

Saturation Point

**Adiabatic Cooling**

**Adiabatic Heating**

Latent Heat Release

**Convection Cells**

Hadley Cell

Polar Cell

**Intertropical Convergence Zone (ITCZ)**

**Coriolis Effect**

Gyres

Upwelling

**Thermohaline Circulation**

**El Nino-Southern Oscillation (ENSO)**

**Rain Shadow Effect**

Leeward

Windward

Biomes

**Tundra**

Permafrost

**Boreal Forest**

**Temperate Rainforest**

**Temperate Seasonal Forest**

**Shrubland (Chaparral)**

**Temperate Grassland/Cold Desert**

**Tropical Rainforests**

Canopy

Emergent Layer

Understory (subcanopy)

Epiphytes

**Tropical Seasonal Forest & savannah**

**Subtropical Deserts**

Littoral Zone

Limnetic Zone

Profundal Zone

Benthic Zone

**Freshwater Wetlands**

**Salt Marsh**

**Estuary**

**Mangrove Swamps**

**Intertidal Zone**

**Coral Reefs**

**Coral Bleaching**

Photic Zone

Aphotic Zone

**Reading Outline**

**Floods, Droughts and Famines**

1. What were the environmental impacts of the flooding in Kenya?
2. What happened in Northern Kenya at the same time?
3. When (and why) does Kenya usually experience heavy rainfall?
4. Do you think events like this will become more common, less common or stay the same in the future?

**4.1 Global processes determine weather and climate**

1. What is the difference between weather and climate. Define each one and give 2 examples of each.
2. List the 5 major processes that drive climate on earth.
3. Fill in the chart below using Figure 4.1. You should list the ozone layer and exosphere, but can leave the temperature boxes blank. *For altitude, the number ranges in the text are more accurate than the ones in the chart.*

|  |  |  |
| --- | --- | --- |
| **Layer** | **Altitude Range** | **Temperature trend as altitude increases** |
| Troposphere | 0-10 km | Decreases  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. What happens to the air pressure as you move from the troposphere to the exosphere?
2. What are the three main causes of uneven warming of the earth? Briefly explain each one.
3. Properties of Air
4. Density – Less dense air RISES / SINKS More dense air RISES / SINKS
5. Cold air is MORE / LESS dense than warm air and thus RISES / SINKS
6. Warm air is MORE / LESS dense than cold air and thus RISES / SINKS
7. Saturation
8. Warm air holds MORE / LESS water than cold air, so as air temperature INCREASES / DECREASES the saturation point increases.
9. When air cools, the saturation point INCREASES / DECREASES resulting in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. Adiabatic heating and cooling
11. When air sinks, the pressure INCREASES / DECREASES which causes the volume to INCREASES / DECREASES which INCREASES / DECREASES the temperature. This is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
12. When air rises, the pressure INCREASES / DECREASES which causes the volume to INCREASES / DECREASES which INCREASES / DECREASES the temperature. This is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
13. Latent heat release
14. Going from a liquid to a gas is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and REQUIRES / RELEASES heat energy.
15. Going from a gas to a liquid is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ REQUIRES / RELEASES heat energy.
16. What are convection currents?
17. *The* ***Intertropical Convergence Zone (ITCZ)****- Around the equator, there is a zone of dense clouds, intense thunderstorms and heavy rainfall. The zone follows the sun’s most direct rays and thus moves up and down across the equator (See picture for location in July versus January). This creates a pattern of SEASONAL PRECIPITATION in the tropics.*
18. What is the Coriolis Effect?
19. What causes the seasons?
20. List the 5 factors drive the ocean currents?
21. What are upwellings? What benefits do they bring?
22. Water circulation:
23. Cold water is MORE / LESS dense than warm water and thus RISES / SINKS
24. Warm water is MORE / LESS dense than cold water and thus RISES / SINKS
25. Fresh water is MORE / LESS dense than salt water and thus RISES / SINKS
26. Salt water is MORE / LESS dense than fresh water and thus RISES / SINKS
27. Draw a picture of the rain shadow effect, labeling the windward and leeward sides of the mountain and labeling which side is rainy and which side is dry.

4.2 Variations in climate determine the terrestrial biomes

1. Read about each biome and fill in the details below. Try to give VERY BRIEF responses that fit in the boxes. We will cover each biome more thoroughly in class and in an activity.

| **Biome** | **Other names** | **Location** | **Climate** | **Vegetation** | **Limiting Factors/ Adaptations** | **Soil** |
| --- | --- | --- | --- | --- | --- | --- |
| *Tundra* | *Arctic Tundra* *Antarctic tundra* *Alpine tundra (top of mountains)* | *Near poles* | *Cold year round with a short summer and low rainfall year round* | *Low growing vegetation: small shrubs, mosses and lichens* | *Freezing temps, slow decomp., slow soil formation, low soil nutrients* | *Thin soil that is nutrient depleted and frozen or waterlogged* |
| Boreal Forest |  |  |  |  |  |  |
| Temperate Rain Forest |  |  |  |  |  |  |
| Temperate Seasonal Forest |  |  |  |  |  |  |
| Woodland/ Shrubland |  |  |  |  |  |  |
| Temperate Grassland/ Cold Desert |  |  |  |  |  |  |
| Tropical Rain Forest |  |  |  |  |  |  |
| Tropical Seasonal Forest/ Savanna |  |  |  |  |  |  |
| Subtropical Desert |  |  |  |  |  |  |

4.3 Aquatic biomes are categorized by salinity, depth, and water flow

1. Fill in the chart below about the aquatic biomes. Try to use one or two words per box (except for the important characteristics box). We will go over these more in class.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Biome** | **Salt water, freshwater or both** | **Deep, shallow or varies** | **Rate of water flow: high, medium, low** | **Important Characteristics** |
| *Stream* | *Fresh* | *Shallow* | *Varies* | *Streams often lead into rivers and carry organic matter downstream* |
| *River* | *Fresh* | *Varies/Deep* | *Varies* | *Rivers carry organic matter downstream, rapids mix oxygen into the water to support fish* |
| Lake |  |  |  |  |
| Pond |  |  |  |  |
| Freshwater wetland |  |  |  |  |
| Salt March |  |  |  |  |
| Mangrove Swamp |  |  |  |  |
| Intertidal Zone |  |  |  |  |
| Coral Reef |  |  |  |  |
| Open Ocean |  |  |  |  |

Additional Work:

Answer the MC questions and FRQs at the end of Ch 4.

**Chapter 5 : Evolution**

**Reading Guide**

**Vocabulary**

Learn the definition of each term. The **bold** words require you to know more than just the definition. The *italicized* words are not in the textbook (see lecture for explanations). For example: Ecosystem service - you should what they are, be able to name several types and describe how we benefit from those services.

Ecosystem Diversity

Species Diversity

Genetic Diversity

Species Richness

Species Evenness

Microevolution

Macroevolution

Speciation

**Mutation**

**Artificial Selection**

**Natural Selection**

Fitness

**Adaptations**

Geographic Isolation

Reproductive Isolation

**Genetically Modified Organisms**

**Range of Tolerance**

**Fundamental Niche**

**Realized Niche**

Species Distribution

Generalists

Specialists

**Mass Extinction**

Sixth Mass Extinction

*Background extinction*

*Coevolution*

*Resource Partitioning*

*Competitive Exclusion Principle*

**Reading Outline**

 **5.1 Earth is home to a tremendous diversity of species**

1. Approximately how many species do scientists think live on earth? How many have been identified? Why is it hard to determine the number of species on earth?
2. Analyze the following data sets and rank (1 – most; 3 - least) each site in terms of richness, evenness and overall diversity. Explain your answer for the site that is most diverse.

|  |  |
| --- | --- |
| **Species** | **Absolute Abundance** |
|  | **Site A** | **Site B** | **Site C** |
| Ant | 76 | 8 | 143 |
| Beetle | 3 | 0 | 2 |
| Centipede | 8 | 0 | 3 |
| Cricket | 1 | 0 | 1 |
| Earwig | 39 | 7 | 75 |
| Millipede | 10 | 6 | 2 |
| Pill Bug | 20 | 9 | 3 |
| Slug | 1 | 0 | 0 |
| Snail | 2 | 0 | 1 |
| Spider | 1 | 6 | 2 |
| Wood lice | 53 | 0 | 68 |
| Worm | 2 | 0 | 1 |
| **Species richness** |  |  |  |
| **Species evenness** |  |  |  |
| **Overall diversity** |  |  |  |

**5.2 Evolution is the mechanism underlying biodiversity**

1. Define natural selection and artificial selection. What is the difference between natural selection and artificial selection? What are some concerns about artificial selection?
2. What are the key elements of Darwin’s Theory of Natural Selection?

**5.3 Speciation and extinction determine biodiversity**

1. Define geographic isolation and reproductive isolation. Describe how each results in speciation.
2. For each factor, determine which choice supports the claim

|  |  |  |
| --- | --- | --- |
| **Factor** | **Species adapt fastest when [factor] is** | **Populations are most likely to survive when [factor] is** |
| Rate of Environmental change | FAST or SLOW | FAST or SLOW |
| Genetic Variation | HIGH or LOW | HIGH or LOW |
| Population Size | LARGE or SMALL | LARGE or SMALL |
| Generation Time | LONG or SHORT | LONG or SHORT |

1. Is Genetic engineering faster or slower than natural selection? Explain.

**5.4 Evolution shapes ecological niches and determines species distributions**

1. What is the difference between a fundamental and a realized niche?
2. What is the difference between a generalist and a specialist? List some characteristics of each.
3. Which type of species (generalist or specialists) do better when:

a. Environmental conditions are changing?

b. Environmental conditions are stable?

1. Use Figure 5.2 to explain how changing environmental conditions can cause the distribution of species to change.
2. Explain how climate change might impact the distribution of spruce trees. (You have to THINK – look at how the melting of the ice over the last 18,000 years changed the distribution and then apply that information to climate change). Would the range get larger or smaller? Would it be found in more places or less places? Where would the range be in the future?
3. What differences are there between the 5 previous mass extinctions and the one occurring now? How long does it typically take for biodiversity to “recover” after a mass extinction?

Additional Work:

Answer the MC questions and FRQ #2. I recommend watching the following video to help you with the FRQ: <http://www.pbs.org/wgbh/evolution/educators/teachstuds/svideos.html> Video #6: Why does Evolution Matter Now.