Т.С. Григорьева
Э.Т. Костоусова

Практикум
для студентов IV курса ЛХФ

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Т.С. Григорьева
Э.Т. Костоусова

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Редактор А.Л. Ленская
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CHAPTER 1
SYSTEMS AND ECOSYSTEMS

UNIT 1

1.1. Read the international words and guess what they mean:

natural, complex, geography, process, model, version, type, system, aspect, display, diagram, form, energy, examine, operate, information, transfer, classify, mass, universe, planet, global, balance, dynamic, equilibrium, positive, negative, affect, result.

1.2. Before you read:

- name three parts of the system;
- name two types of the systems.

1.3. Read and translate the text.

Introduction to Systems

The natural world is very complex. Until the 1960s geography was concerned chiefly with describing 'how things were'. Then, in an attempt to understand the complex interrelationships among processes on the earth's surface, geographers introduced the use of models. Models are simplified representations of reality, in much the same way as a model train is a scaled-down version of the real thing. One type of model is a system. A system is a way of identifying an aspect of reality, known as a unit (e.g. a river valley), understanding the relationships between its separate components and then investigating how the unit interacts with the wider environment. A systems model is usually displayed as a flow diagram that, in its simplest form, can be shown as a black box system.

Such models allow us to identify inputs to a system (i.e. the entry of energy and/or matter) and outputs from the system (i.e. the mass, energy or change of state which leaves the system). However, the 'black box' (named because we cannot see into it) does not allow us to examine the processes which operate within the system. A more sophisticated model needs to incorporate information about what is happening internally and might look more like Figure where:

- a store is a part of the system which can hold energy or matter
- a transfer is part of the system which redistributes energy or matter from one point to another
- a flow is any movement within the system.

Systems can be classified as being:

- Closed**:** where there are inputs and outputs of energy but not of mass (or matter). Earth itself is often considered a closed system because it receives energy from the sun and loses heat into space but there is no transfer of matter between the universe and the planet. The global hydrological cycle is also a system of this type.
- Open: where there are inputs and outputs of both energy and matter. Such a system interacts with other, co-existing systems as well as with the surrounding environment.

When a system's inputs and outputs are balanced, it is said to be in a state of dynamic equilibrium**.** If one element in a system changes as a result of an outside influence it upsets the balance and affects other components in the system. This process is called feedback and may be either positive or negative.
Positive feedback occurs when the change has a 'snowball' effect with change becoming greater and greater. This moves the whole system away from equilibrium. Negative feedback occurs when the system acts to lessen the effects of the initial change and the processes within the system then work to restore the balance or equilibrium of the entire system.

1.4. Match these words with their definitions.

1) feedback,
2) interrelationship,
3) environment,
4) flow,
5) equilibrium;

a) response by a system to any change in its inputs;
b) the way in which two or more things affect each often because they are related;
c) the natural world including the land, water, air, plants and animals;
d) a situation in which there is a balance between different forces or aspects;
e) the continues movement.

1.5. Complete these sentences using the words in the box.

Hold, moves, feedback, model, equilibrium, representations, system, identify, flow, unit, open/closed.

1. To understand the complex interrelationships among processes on the earth's surface, geographers introduced the use of … .
2. Models are simplified … of reality.
3. One type of model is a … .
4. An aspect of reality is known as a … .
5. Models allow us to … input to a system and outputs from the system.
6. A store is a part of the system which can … energy a matter.
7. A … is any movement within the system.
8. System can be classified as being … and … .
9. When a system's inputs and outputs are balanced, it is said about a state of dynamic … .
10. … may be either positive are negative.
11. Positive feedback … the whole system away from equilibrium.

1.6. Say if it is true or false.

1. The natural world is very complex.
2. Models are complicated representations of reality.

3. Models allow us to identify inputs to a system and outputs from the system.
4. The “black box” allow us to examine the processes which operate within the system.
5. A transfer is a part of the system which redistributes energy or matter from one point to another.
6. Earth is often considered as an open system.
7. There is no transfer of matter between the universe and the planet.
8. When a system's inputs and outputs are balanced, it is said to be in a state of dynamic equilibrium.
9. Negative feedback moves the whole system away from equilibrium.

1.7. Explain the following terms:

- inputs and outputs,
- an open system,
- dynamic equilibrium,
- feedback.

1.8. Choose the correct form of the verb.

1. The natural world (is/are) very complex.
2. Models (is/are) simplified representations of reality.
3. A system (is/are) a way of identifying an aspect of reality.
4. A system model (is/are) displayed as a flow diagram.
5. Earth (is/are) often considered as a closed system.
6. There (is/are) no transfer of matter between the universe and the planet.
7. The global hydrological cycle (is/are) a closed system.
8. There (is/are) inputs and outputs of both energy or matter.
9. System's inputs and outputs (is/are) balanced.

1.9. Make a short summary of the text.

UNIT 2

2.1. Read the international words and guess what they mean:

adopt, biologists, unique, ecosystem, focus, ecology, biogeographer, organism, individual, region, biosphere, ecosphere, formation, climate, tendency, sensitive, biome, relief, temperature.

2.2. Before you read − Name parts of speech of the following words:

environment, biologist, contribution, ecological, individual, population, physical, different, natural, nature, entirely, partly. identify, environmentally, typify.

2.3. Read and translate the text.

Introductions to Ecosystems

A systems approach to studies of the living environment was adopted by biologists and environmentalists long before geographers incorporated it into

their way of thinking. The unique contribution of ecosystems to our understanding of the natural world is due to its focus on the interactions between living organisms and their environment. In the past, the importance of these interactions was often overlooked and ecological disasters have occurred such as the 'Dust Bowl' of the 1930s in the USA.

Ecology (the biological study of the processes operating within ecosystems) has its own specialized vocabulary, and biogeographers have borrowed many of its key terms. Ecology is the study of organisms. An organism is any individual form of life; groups of similar organisms are known as a species. All of the members of a species living in an area are known as a population. The physical space, region or area in which a population lives is called a habitat and all the different species sharing a population's habitat are known as a community. An ecosystem is created when we consider a community of species interacting with each other and the non-living **(**abiotic) environment of energy and matter. All of earth's ecosystems make up the global component which biogeographers call the biosphere -although other scientists prefer the term ecosphere.

Not all ecosystems are natural; reservoirs, agricultural fields and garden ponds are all examples of ecosystems created by human intervention within the natural world. The size of an ecosystem is determined entirely by the requirements of the researchers studying it. For example, an ecosystem may comprise a single tree, woodland or an entire forest stretching across thousands of kilometres, depending on the focus of the study being undertaken.

There are few clear-cut boundaries between different ecosystems. Even the apparently clear interface between land and sea is far from being a distinct boundary; this is partly because some species of animal have adapted to function equally well both in the sea and on land and also because of the formation of ecosystems such as salt marshes which form transition zones (ecotones) between land and sea. Ecotones are often richly populated habitats, supporting communities from both adjacent ecosystems as well as habitat-specific species.

Many ecosystems are extremely fragile; in order to protect them we now recognize the importance of having a detailed understanding of how they function and interact so that we can predict the likely outcomes of human initiatives and interferences, and act to reduce those which are damaging.

Climate patterns are the most important factor in determining which organisms can survive in a particular type of habitat. Certain animal species (most notably humans) have been able to adapt remarkably well to varying climatic conditions, whereas other species (particularly plants) have adapted slowly, over long periods of geological time, to live in very specific habitats and are now restricted to a particular climate and/or soil type. This tendency for plant species to be environmentally sensitive has led biologists to divide the earth's land surface (the biosphere) into large regions typified by distinctive climate and plant-life forms; such regions are called biomes. Within every biome there may

be a range of ecosystems, reflecting plant adaptations to local soils, drainage, relief and micro-climates (i.e. local variations in temperature, moisture and light conditions).

The hydrosphere (earth's surface water) is sub-divided into aquatic life zones instead of biomes, the key factor being water salinity instead of climate. Lakes and streams make up the freshwater life zone, while estuaries, coasts, seas and deep oceans comprise the marine life zone. Both life zones support a range of ecosystems appropriate to the specific local environmental conditions.

2.4. Match the following words with their meaning:

1. Ecology	a) сообщество
2. Habitat	b) биологический вид, вид
3. Organism	c) популяция (биол.), население (демогр.)
4. Species	d) наука, изучающая взаимоотношения живых организмов друг с другом и окружающей средой
5. Population	e) место обитания
6. Community	f) живое существо (человек, животное, растение)
7. Ecotone	g) переходная зона между водой и землей

2.5. Complete these sentences using the words in the box.

Community, adopted, aquatic, species, ecosystem, biomes, ecotones, different, conditions, fragile, determined.

1. A system approach to studies of the living environment was … by biologists and environmentalists.
2. An … is created when we consider a community of species interacting with each other and the … environment.
3. Groups of similar organisms are known as a … .
4. All the different species sharing a population's habitat are known as a … .
5. The size of an ecosystem is … by the requirements of the researcher's studying it.
6. There are few clear cut boundaries between … ecosystems.
7. … are richly populated habitats, supporting communities from both adjacent ecosystems.
8. Many ecosystems are extremely … .
9. Certain animal species have been able to adapt well to varying climatic ….
10. The biosphere is divided into large regions typified by distinctive climate and plant-life forms; they are called … .
11. The hydrosphere is subdivided into … life zones.

2.6. Say if it is true or false.

1. Ecology is the study of organisms.
2. Groups of different organisms are known as a species.
3. All the earth's ecosystems up the biosphere.
4. All ecosystems are natural.
5. An ecosystem may comprise a single tree.
6. There are transition zones between land and sea.
7. There are many clear cut boundaries between different ecosystems.
8. All species are able to adapt well to varying climatic conditions.
9. The earth's land surface is divided into large regions typified by distinctive climate and plant-life forms.
10. Within every biome there may be a range of ecosystems.
11. The hydrosphere is sub-divided into biomes.

2.7. Explain the following terms:

- ecology,
- species,
- population,
- habitat,
- community,
- ecosystem,
- biome,
- hydrosphere,
- aquatic life zone.

2.8. Read this part of the text. Use the words given in capitals to form a word that fits the space.

DETERMINE, ADAPTATION, CLIMATE, SLOW, ENVIRONMENT, BIOLOGY.

Climate patterns are the most important factor in … which organisms can survive in a particular type of habitat. Certain animal species have been able to … well to varying conditions. Other species have adapted … this tendency for plant species to be … sensitive has led … to divide the earth's land surface into large regions(biomes).

2.9. Divide the text into logical parts.

2.10. Make a short summary of the text.

UNIT 3

3.1. Read the international words and guess what they mean:

biotic, biota, autotroph, photosynthesis, chlorophyll, carbon, dioxide, glucose, oxygen, phytoplankton, dominant, producers, consumers, heterotrophs, primary, bacteria.

3.2. Before you read:

- compare the biota and the abiotic environment,
- list consumers.

3.3. Read and translate the text.

Producers and consumers. Autotrophs and heterotrophs

In order for any terrestrial or marine ecosystem to be sustainable over time it must possess both the energy and the nutrients necessary to support its resident organisms, as well as the resources to dispose of and recycle their waste products. The living part of an ecosystem is known as its biotic component and the individual organisms residing there are often referred to as biota. The non-living parts of the ecosystem (e.g. solar energy, water, air and nutrients) are collectively called the abiotic environment. All ecosystems must comprise both biotic and abiotic components. The biotic organisms within ecosystems are categorized according to the way they obtain their food. Autotrophs (self-feeders) are green plants with the ability to produce sugars and other food compounds directly from abiotic nutrients via photosynthesis. During this process, chlorophyll converts solar energy, carbon dioxide and water into chemical energy such as glucose and oxygen. The oxygen by-product of photosynthesis is essential for maintaining most animal life on earth. In the hydrosphere, plants and algae are the main autotrophs in both freshwater and coastal environments. However, in deep oceans, phytoplankton are the dominant autotrophs. Autotrophs are often referred to as primary producers; all other organisms are known as consumers because they must consume other organisms in order to gain energy. Consumers (known more correctly as heterotrophs**)** may be sub-divided into:

- herbivores (also known as primary consumers): these eat only primary producers, i.e. plants;
- carnivores (meat eaters): these may be secondary or tertiary consumers. Secondary consumers eat herbivores while tertiary consumers eat other carnivores;
- omnivores: these are meat and plant eaters; most omnivores are hunters.

There are also several other groups of consumers that, while fitting into the above categories, are recognized separately because they fulfill quite different roles within the recycling process:

- scavengers feed on organisms killed by others or which have died from natural causes;
- detritivores live off the waste products of other organisms.
- decomposers (mainly consumers such as bacteria and fungi) complete the recycling of organic materials by breaking them down and releasing the resultant inorganic compounds back into the soil and water - where they become available once again as nutrients for the primary producers.

3.4. Match the words to make phrases:

individual	component
primary	organism
organic	environment
freshwater	oceans
deep	plants
green	products
waste	energy
chemical	ecosystem
terrestrial	producers

3.5. Find English equivalents in the text:

питательные вещества, отходы, внутри экосистем, побочный продукт, водоросли, первичные продукты, консументы, травоядные, плотоядные, всеядные, детритоядные, деструкторы, подразделять, через (посредством).

3.6. Complete these sentences using the words in the box.

Autotrophs, abiotic, living, eat, complete, essential, food, carnivores, dominant, feed, consumers.

1. The … part of an ecosystem is known as it's biotic component.
2. Solar energy, water, air and nutrients are collectively called the … environment.
3. The biotic organisms within ecosystems are categorized according to the way they obtain their … .
4. … are green plants with the ability to produce sugars and other food compounds via photosynthesis.
5. The oxygen by-product of photosynthesis is … for maintaining most animal life on earth.
6. Phytoplankton are the … autotrophs in deep oceans.
7. … must consume other organisms in order to gain energy.
8. Herbivores … only plants.
9. … may be secondary or tertiary consumers.
10. Scavengers … on organisms killed by others.
11. Decomposers … the recycling of organic materials by breaking them down and releasing the resultant in organic _____ back into the soil and water.

3.7. Say if it is true or false.

1. All ecosystems must comprise both biotic and abiotic components.
2. Chlorophyll produced solar energy, carbon dioxide and water.
3. In the hydrosphere, plants and algal are the main autotrophs.
4. Consumers are refereed to as primary producers.
5. Consumers are known as heterotrophs.
6. Herbivores eat only plants.
7. Omnivores are meat eaters.

8. Detritivores live off the waste products of other organisms.

9. In order for any ecosystem to be sustainable it must possess only the nutrients.

3.8. Match the words with their definitions.

1. Carnivores	a) eat only plants
2. Herbivores	b) are meat and plants eaters
3. Omnivores	c) are meat eaters
4. Decomposers	d) life off the waste products of other organisms
5. Detritivores	e) feed on organisms killed by others
6. Scaverngers	f) are mainly consumers such as bacteria and fungi

3.9. Make a short summary of the text.

UNIT 4

4.1. Read the international words and guess what they mean:

atmosphere, tropic, travel, diagram, pyramid, maximum, existence, biomass, calculate, chemical.

4.2. Before you read:

Compare the grazing food web and the detrital food web.

4.3. Read and translate the text.

Food Chains and webs. Trophic Pyramid

Energy flows through an ecosystem via food chains and food webs. In any ecosystem the origin of all its energy is sunlight. Sunlight is converted into energy by plants through the process of photosynthesis. As energy moves upwards through a food chain, much of it is lost - often as heat given out to the atmosphere. The remaining energy passes to the animals that eat the plants, and then to other animals that consume the plant-eaters. In its most simple form, a plant-to-animal food chain might look like the representation.

Biologists refer to each level within a food chain as a feeding level or trophic level**.**

In most ecosystems, the daily flows of energy are far more complex than simple food chains suggest; many animals are components in a large number of food chains and this creates networks of interconnected food chains that may be represented by a food web.

The flow of energy within any ecosystem is a two-way process - up -the food web and back down it - as energy is recycled for the 'next round' of the cycle. Recycling is usually shown as two interconnected food webs:

• the grazing food web, through which energy travels to the top carnivores;

• the detrital food web, which represents the recycling of energy through organic waste materials.

Much energy is lost as it flows through a food chain (or a food web), most of it to the environment as heat. Some residual energy passes straight through the animal unused and is excreted as waste. Often, as little as 10% of the total energy intake is used by the consumer; this energy is digested and converted into the organism's bodily material. The amount of energy actually available at each trophic level declines as the energy travels up the food web. Energy loss is often as great as 90% at each trophic level. This means that if plants capture 1000 units of energy, only 100 units are likely to be available to the herbivore (s) consuming the plant, and a mere 1% of the original energy reaches the carnivore at the next level in the food web. Such transfers and losses are often represented diagrammatically as a trophic pyramid or as an energy flow pyramid. As a result of such a high rate of energy loss, it is very rare for food webs to reach the fifth trophic level; three or four levels are the more usual maximum. Beyond this level, there is so little residual energy left that the top carnivores find it almost impossible to support their own existence.

The total weight of all the dry organic material at any single trophic level in a pyramid is known as its biomass. Scientists calculate dry weight simply because the water which all organisms contain is of no use as either a nutrient source or an energy source. Biomass is used by scientists as a means of representing the chemical energy stored at each trophic level.

4.4. Match the words to make phrases:

1. Food	a) weight
2. Residual	b) energy
3. Bodily	c) level
4. Trophic	d) material
5. Practical	e) chains
6. Dry	f) use
7. Biomass	g) pyramid

4.5. Match the words with their definitions:

1. Trophic level	a) total mass of vegetation within a specific area
2. Trophic pyramid	b) simple model showing energy flows trough an ecosystem
3. Biomass	c) matrix of food chains
4. Food chain	d) group of organisms having the same method of feeding or way of obtaining its energy
5. Food web	e) diagrammatic way of displaying energy flows between trophic levels

4.6. Find opposite words.

- to consume	- to find
- simple	- cold
- large	- to produce
- to lose	- bottom

- heat
- to decline
- each
- high
- top
- small
- complex
- to increase
- all
- low

4.7. Choose the correct form of the verb.

1. Energy (flows/ is flowed) through an ecosystem via food chains and food webs.
2. Sunlight (converts/ is converted) into energy by plants through the process of photosynthesis.
3. Biologists (refer/ are referred) to each level within a food chain as a trophic level.
4. Energy (recycles/ is recycled) fir the next level.
5. Recycling (shows/ is shown) as two interconnected food webs.
6. Much energy (loses/ is lost) as it flows trough a food chain.
7. Such transfers and losses of energy (represent/ are represented) as a trophic pyramid.
8. Scientists (calculate/ are calculated) dry weight.
9. Biomass (uses/ is used) by scientists as a means of representing the chemical energy stored at each trophic level.

4.8. Explain the following terms:

- food chain,
- trophic level,
- the grazing food web,
- the detrital food web,
- trophic pyramid,
- biomass.

4.9. Say if it is true or false.

1. Energy flows through an ecosystem via food chains and food webs.
2. As energy moves upwards through a food chain, much of it is lost-often as oxygen given out to the atmosphere.
3. A plant-to-animal food chain might look like "sun→light→grass→cow→human".
4. In most ecosystems, the daily flows of energy are simple.
5. Many animals are components in a large number of food chains.
6. The flow of energy within any ecosystem is a one-way process.
7. Though the grazing food web energy travels to the top carnivores.
8. If plants capture 1000 units of energy, only 100 units are likely to be available to the herbivores consuming the plant.
9. A mere 10% of original energy reaches the carnivore at the next level in the food web.

4.10. Answer the following questions.

1. What is the origin of all energy in any ecosystem?
2. Why is much energy lost as it flows through a food chain?
3. Is the flow of energy within any ecosystem a one-way process?
4. What are two interconnected food webs?
5. What is a trophic level and a trophic pyramid?
6. How can the scientists calculate dry weight?
7. What is biomass?

4.11. Make a short summary of the text.

UNIT 5

5.1. Read the international words and guess what they mean:
stability, constant, constantly, modification, adapt, static, adaptation, indicator, catastrophic, succession, lava, pioneer, colonize, organic, embryonic.

5.2. Before you read answer the following questions:

- What is ecological succession?
- What do you know about primary (secondary) succession?

5.3. Read and translate the text.

Ecological Succession

One of the most notable features of any community or ecosystem is that it exists in a state not of stability, but of constant change. Such change is gradual and is the inevitable result of the ecosystem perpetually seeking balance. Environmental conditions are constantly subject to modification and ecosystems reflect these changes over time. Individual organisms and species have to adapt to such change or risk extinction. Therefore, a stable ecosystem is not a static one; it continually adapts and rebalances itself in ways which maintain it in a constant state of flux. Plant adaptation is often the first discernable indicator of such change - unless the ecosystem is responding to some sudden, catastrophic event. Adaptation occurs when any organism develops beneficial mutations that allow it to cope more effectively in changing environmental conditions and to produce offspring with the same adaptive traits. In plants, this often enhances the individual's ability to compete for light, space and nutrients. Vegetation adaptations usually have a knock-on effect to the animal communities sharing the habitat. The gradual adjustment process is called ecological succession (or community development).

Primary succession

Ecological succession is of two kinds. Primary succession involves the development of biotic communities in areas lacking soil (or lacking bottom sediment in water). Such environments may include recently cooled lava flows, freshly cut quarry faces and new garden ponds. On land, plants cannot survive without soil; therefore, pioneer species which colonize newly exposed surfaces

are always soil-forming species such as mosses and lichens. Such species are able to take the nutrients that they need directly from the rock surface. As soil begins to form, the area will be colonized by species such as bacteria, fungi and insects which, when they die, will add to the organic content of the embryonic soil. Eventually, short grasses, herbs and ferns are also able to move in. Such colonizing species are known collectively as early successional species. It may take several hundred years for the soil to become deep and fertile enough to support mid-successional species such as taller grasses and shrubs. Eventually, however, trees will begin to colonize the area and grow towards maturity. As the range of plant species increases within an area, so too do the animal species coexisting alongside them; animals can only move in after their sources of food have become secure, and early successional animal species are always small herbivores. Large grazers often arrive much later, long after small predator carnivores have become well established. Provided that primary succession is not interrupted by natural or human interventions, late-successional species ultimately colonize the habitat and reach maturity. The originally barren area will eventually support a stable, complex and mature community.

Nowadays, it is increasingly rare to find undisturbed primary succession communities. Even in our most remote 'wilderness' areas, past interventions by human activity have disturbed the ecosystem in some way.

Secondary succession

Secondary succession is far more common. This occurs where the original natural vegetation has been disturbed or wholly destroyed, but only where the soil has remained in situ. It is unusual for secondary succession to replicate fully the primary community that it replaces. This may be because there will have been subtle changes in the environment which means that slightly different species will now colonize the area. More likely, such changes will occur simply because the whole process is not starting again from scratch. As soil is already in place, the initial colonization process does not have to be repeated; this will therefore create a different evolutionary process, which means an identical succession cannot redevelop in this habitat. If, on the other hand, the soil cover is damaged (e.g. by erosion), it is even less likely that the primary community will be able to re-establish itself. Changes to the soil's composition, depth and fertility will facilitate the development of a new and different succession, with a major knock-on effect to the other animal species moving into the habitat as vegetation cover develops.

Summary

1. A system is a way of modeling reality that allows the separate components and, importantly, the interactions between individual components to be examined. A system may be described as being either «open» or «closed».

2. The use of systems models allows identification and examination of inputs, outputs, stores and flows (transfers), together with the processes themselves.
3. When inputs and outputs are balanced, a system is described as being in equilibrium; any change, however slight, upsets this balance and creates feedback. Feedback may be positive (if it enhances the introduced change) or negative (if it reduces the change and works to rebalance the system).
4. Geographers use the concept of an «ecosystem» to study communities of plants and animals sharing a habitat, and to gain understanding of the interrelationships between them and their abioticenvironment. Boundaries between ecosystems are rarely fixed; thetransition zones between ecosystems are known as ecotones.
5. Organisms adapt to specific conditions within their habitat. Adaptation takes time and a variety of forms: humans are the most adaptable organisms while plants are the least adaptable to change.
6. Organisms are categorized according to how they are supplied with energy. Autotrophs produce food compounds from the abiotic environment, but all other organisms are consumers.
7. Energy flows around an ecosystem through a network of food chains and webs. As energy moves upwards through these networks, much of it is lost - often as heat.
8. Flows of nutrients also circulate within ecosystems. These may be represented by a Gersmehl Model, which shows stores and transfers of nutrients through the biomass, leaf litter and soil.
9. Primary succession involves the development of biotic communities in areas that lack soil cover. The sequence of events leading to the establishment of soil and stable, mature (climax) communities is known as a prisere. Each stage of succession is referred to as a sere.
10. Secondary succession occurs when vegetation has been disturbed or destroyed but soil cover remains. Such succession is unlikely to replicate the original mature vegetation cover and results in a plagioclimax community.

5.4. Match the following words with their meaning.

1. Feature	a) травоядное
2. Herbivore	b) плотоядное
3. Carnivore	c) мох
4. Moss	d) особенность, характерная черта
5. Lichen	e) благотворный
6. Inevitable	f) лишайник
7. Beneficial	g) вымирание
8. Extinction	h) неизбежный

5.5. Match the words to make phrases

1. Constant	a) intervention
2. Environmental	b) community
3. Beneficial	c) conditions
4. Vegetation	d) change
5. Biotic	e) succession
6. Primary	f) mutations
7. Human	g) adaptation

5.6. Read the text again and choose the correct answer.

1. The gradual adjustment process is called …
   a) plant adaptation
   b) ecological succession
   c) environment.
2. Pioneer species are …
   a) short grasses, herb and ferns
   b) tall grasses and shrubs
   c) mosses and lichens
3. Secondary succession …
   a) develops on sites that have formerly been vegetated
   b) involves the development of biotic communities in areas lacking soil
   c) occupies a site previously unvegetated.
4. The way in which an organism changes in response to abiotic factors is called …
   a) biodiversity
   b) adaptation
   c) feedback.

5.7. Complete these sentences using the words in the box.

Fertile, animal, soil-forming, change, modification, occurs, lacking

1. Any community or ecosystem exists in a state of constant …
2. Environmental conditions are constantly subject to …
3. Adaptation … when any organism develops beneficial mutations.
4. Vegetation adaptations have a knock-on effect to … communities.
5. Primary succession involves the development of biotic communities in areas … soil.
6. Pioneer species are always … species.
7. It may take several hundred years for the soil to become deep and …

5.8. Divide the text into logical parts.

5.9. Make a short summary of the text.

CHARTER 2
BIOMES

UNIT 1

1.1. Read the international words and guess what they mean:
community, environmental, correlation, aquatic, zone, boundary, significant, impression, uniform, vegetation, totally, expanse, reality, classification, characterize, variation, condition, continental, specific, habitat, ecotones, transition, topography, human, intervention.
1.2. Before you read − Name parts of speech of the following words:
identified, characteristic, vegetation, salinity, replace, inflexible, although, change, merely, dominant, species.
1.3. Read and translate the text**.**

Introduction

Biomes are the largest 'ecosystem' unit. They are identified by a shared, characteristic plant community adapted to the specific environmental conditions of the region. There is a strong positive correlation between global biome distribution and world climatic zones because climate is the most influential factor in determining natural vegetation distribution. Water-based units are more accurately known as aquatic life zones**.** Within such zones, salinity replaces climate as the crucial key to adaptation, although temperature, light and nutrients also play important roles. Maps suggest that biomes are fixed regions with inflexible boundaries marking significant changes between adjacent plant communities. They also give the impression that totally uniform vegetation communities cover huge expanses of the planet. Nothing could be further from reality. Biomes are merely convenient classifications of dominant vegetation type, each characterized by variation as well as by similarities. Any sizeable forest, for example, may consist of a range of different trees, shrubs and flowering plants adapted to a range of localized environmental conditions. Biomes that span continental areas may exhibit wide variations in vegetation across the region and may host many varied animal species located within specific habitats. One reason for this is that both within and between continents, soil types may vary considerably according to parent rock, glacial histories and local microclimates. Within any one biome, a wide variety of ecosystems is likely to develop in response to local edaphic conditions and also the degree to which human intervention has taken place. Surprisingly rich and dense ecotones often mark the transition between biomes and between neighbouring ecosystems. As a result, the earth's surface is not covered by uniform 'blankets' of identical communities but by 'patchwork quilts' of ecosystems/eco-tones, with each combination exhibiting its own distinctive, locality based variations.

At the global scale, four natural factors interrelate to produce the biome distribution. These are climate, topography**,** soils and biotic factors, to which the role of human intervention in ecosystem development needs to be added.

1.4. Answer the questions.

1. What are biomes? Give a short description of biomes.
2. Why can one see the strong correlation between global biome distribution and world climatic zones?
3. What factors are included into ecosystem development?

1.5. Say if it is true or false.

1. Biomes don't have common characteristics.
2. The most influential factor in determining natural vegetation distribution is climate.
3. Vegetation communities take small expanses of the planet.
4. Any forest may consist of different trees, flowering plants and shrubs without adaptation to the environment.
5. All biomes my host variation of animal species.
6. Human intervention is a very important factor influencing on the conditions of biomes.
7. Climate, topography and soils are the only main factors that interrelate to produce the biome distribution.

1.6. Give the Russian equivalents:

anthropogenic factors, aquatic life zone, effective moisture, growing season, soil erosion, removal of topsoil, combined effect, precipitation, adjacent ecosystems, positive correlation.

1.7. Give the English equivalents:

неограниченное поступление воды, питательные вещества, устойчивые границы, удобная классификация, сходные черты, условия окружающей среды, виды животных, микроклимат, вмешательство человека, взаимосвязь.

1.8. Find synonyms to the following words:

- amount	- allocation
- to occur	- weighty
- adjacent	- to happen
- specific	- extensive
- similarities	- quantity
- important	- peculiar
- significant	- neighboring
- merely	- considerable
- to exhibit	- to display
- wide	- only
- distribution	- common features

1.9. Fill in the blanks with the appropriate article where necessary.

1. Biomes are ___ largest ecosystem unit.
2. There is ___ strong correlation between biome distribution and world climatic zone.
3. ___ temperature, light and ___nutrients play ___ important role in adaptation.
4. Any sizable forest may consist of ___ range of different trees, ___ shrubs and ___ flowering plants.
5. ___ earth's surface is not covered by uniform blankets of ___ ecotones.
6. Four natural factors are ___ climate, ___ topography, ___ soils and ___ biotic factors.

UNIT 2

2.1. Read the international words and guess what they mean:

important, determinant, polar, quantity, season, equatorial, prolonged, savanna, xerophytic, resistant, budget, adaptation, minimum, tolerance, produce, potential, optimum, protect, disperse, ultraviolet, reason, erosion, permanently.

2.2. Before you read answer the following question:

What types of climate do you know?

2.3. Read and translate the text**.**

Climate

Precipitation is the single most important determinant of vegetation type, be it forest, grassland or desert; coupled with temperatures and soil type, it influences whether a region's vegetation is tropical, temperate or polar.

a) Precipitation

The importance of precipitation extends far beyond annual totals; of greater importance is the distribution of precipitation throughout the year. For example, large quantities of rainfall in one season, followed by prolonged drought will favour one type of mature (climax) community, whereas precisely the same total of annual rainfall distributed evenly throughout the year will lead inevitably to the dominance of a totally different plant community. Even so, precipitation needs to be considered in relation to ambient temperatures because the demands of evapotranspiration are an essential consideration for plant successions. Where (and when) temperatures are high, evapotranspiration demands are also high and this is critical in determining whether or not the rainfall totals and distribution patterns are able to sustain vegetation growth. For example, in areas where rain falls all year round and temperatures are high, forest growth is possible; in equatorial areas, heavy rains throughout the year offset the high evapotranspiration demands of the high temperatures. Yet low precipitation totals in cold, high latitudes also support forests because the evapo-

transpiration demands on available moisture are significantly less in such locations. Where prolonged droughts (particularly summer droughts) coincide with high rates of evapotranspiration - as in the savanna grassland biomes, plants must be xerophytic (drought resistant) in order to survive. The relationship between precipitation and biomes is not simply about quantity and distribution but is about effectiveness.

Effective moisture is the term used to describe the net soil moisture available for the vegetation to use as and when it is required. Effective soil moisture reflects the balance between the input of precipitation *(P)* and the demand for water for evapotranspiration *(eT).* When precipitation exceeds evapotranspiration (i.e. when $P > eT$) then surplus moisture is stored in the soil and the soil moisture budget is described as being positive. When evapotranspiration exceeds precipitation ($eT > P$), plants will initially use the stored soil moisture, but once this has been exhausted, the soil moisture budget is described as being negative. Plants colonizing areas experiencing negative soil moisture budgets need adaptations in order to survive. Evapotranspiration rates are at their highest during the «high-sun» (or summer) season, although this does not necessarily mean that evapotranspiration is low during the «low-sun» (or winter) season, only that it is lower than at other times. When precipitation occurs, soil moisture may be recharged during times of lower water demand and in many (but not all) regions of the world, precipitation is sufficiently abundant across the year to replenish the soil moisture store at some point.

b) Temperature

In addition to influencing evapotranspiration, temperature affects plant adaptation and survival. All plants have maximum and minimum temperature tolerances within which growth can take place. This tolerance range varies quite widely between plant species but, generally, plants cease to function (i.e. produce chlorophyll) and so become dormant when the air temperature falls below 6°C; ideally, temperatures should exceed 10°C for effective photosynthesis to take place. The growing season is determined by the number of months (or weeks) when temperatures are high enough for plant growth to occur, i.e. are above 6°C. Where temperatures exceed 15°C throughout the year, there is the potential for a continuous growing season, although plants often exhibit distinct signs of stress when temperatures exceed 35°C. For most plants, the optimum mean annual temperature for growth is 25°C; beyond this temperature, the plants' water requirements increase greatly. Wherever winter temperatures fall below 6°C for up to 5 months of the year, trees adapt by shedding their leaves to protect themselves from frost damage. Where temperatures fall below 6°C for more than 6 months of the year, tree adaptation is to retain their leaves in order to maximize photosynthesis as soon as temperatures rise above the critical temperature. The influence of temperature on vegetation is not usually experienced in isolation, but operates in conjunction with other factors such as humidity, precipitation and light intensity. For example, well-established olive groves have

the ability to survive periods of extreme cold provided that the weather remains dry; yet fairly short spells of cold, wet conditions can be extremely damaging.

c) Light

The availability of light determines the rate at which photosynthesis occurs. Light availability and its intensity vary considerably between places and at different times. Both factors are influenced by latitude, season, local relief, climate (especially cloud cover) and the proximity of nearby plants. As light decreases, fewer plants are able to exist and so they become more widely dispersed. Light quality is also an important factor and high ultraviolet light levels seem to be a significant reason why the range of plant species is greatly reduced in mountainous areas.

d) Wind

Atmospheric movements also affect ecosystem and biome development. Wind direction and strength influence both evapotranspiration rates and air temperatures. In colder climates, the wind-chill factor can lower the effective temperature by many degrees. Wind can also hasten the drying-out of soil in exposed locations, leading to a reduction in effective soil moisture and a marked increase in the potential for soil erosion. Permanently windy habitats invariably support grassland rather than tree cover, partly because grasses have adaptations allowing them to bend easily without damage to their internal structures.

2.4. Give the English equivalents:

тип, полярный, в течение всего года, зрелый, неизбежный, считать, возместить, широта, истощать, достаточно, прекращаться, терпимость, превышать, ущерб, период, возможность, расти, обеспечивать, рассеиваться, ускорять.

2.5. Give the Russian equivalents:

precipitation, temperate, annual, prolonged drought, to favour, to demand, moisture, coincide, efficient, to replenish, survival, growth, to produce chlorophyll, ideally, shedding the leaves, frost, fairly, to cease, dormant, proximity.

2.6. Make the pointed part of speech.

1. important – noun
2. to follow – adjective
3. relation – verb
4. possible – noun
5. to distribute – noun
6. available – noun
7. location – verb
8. to describe – noun
9. effect – adjective
10. to adapt – noun
11. to experience – adjective
12. simple – adverb

13. resistant – noun
14. to survive – noun
15. function – adjective
16. to shed – noun
17. intensity – verb
18. to require – noun
19. effective – noun
20. wide – adverb

2.7. Retell the text about precipitation according to the following sentences.

1. Precipitation is … .
2. Precipitation is very important because … .
3. Large quantities of rainfall in one season, followed by prolonged drought will favour… .
4. In areas where rain fall all year round and temperatures are high, … .
5. Low precipitation totals in cold, high latitudes support forests because… .
6. Effective moisture is … .
7. Effective soil moisture reflects the balance between … .
8. Positive soil moisture is … .
9. Negative soil moisture is … .
10. If precipitation is sufficiently abundant across the year … .

2.8. Fill in the blanks with the words from the text.

1. Temperature ____ plant adaptation and survival.
2. All plants have maximum and minimum temperature ____.
3. The growing season is ____ by the number of months or ____.
4. 25ºC is the optimum mean ____ temperature for growth.
5. When trees are shedding their leaves they try to protect ____ from frost damage.
6. High ultraviolet light level seems to be a ____ reason why the range of plant species is ____ in mountainous areas.

UNIT 3

3.1. Read the international words and guess what they mean:

tend, reduction, exposure, gradient, texture, acidity, drainage, orientation, delicate, inorganic, specific, predominantly, structure, population, demonstrate, myxomatosis, endemic, dramatically.

3.2. Before you read − Name parts of speech of the following words:

succession, increase, result, relief, growth, acidity, less, higher, soils, continued, regional, classification, content, influence, additional, successful, establishment.

3.3. Read and translate the text.

Topography

Topography (or relief) can influence vegetation successions in several ways. Increases in altitude are closely correlated to decreases in temperature and so increased altitude tends to result in stunted plant growth, fewer plant species and a consequent reduction in protective soil cover. Relief may also increase an area's exposure to (or indeed, protect it from) heavy rainfall and strong winds. Gradient (or angle of slope) also affects soil depth, texture, acidity and drainage, with most steep slopes having thinner, but less waterlogged soils. Aspect can be important locally. Within the Northern Hemisphere, south-facing slopes are more favourable locations for plant growth as the orientation increases access to sunlight, leads to higher temperatures and reduces susceptibility to frosts.

Edaphic Factors

The equilibrium between soils and vegetation is extremely delicate. The availability of organic and inorganic matter within the soil is important for the continued well-being of the entire biome. While biomes may be characterized by specific soil types, considerable variations can occur as a result of local differences in soil and/or underlying parent rock. Britain provides an excellent example of such variation; although the regional classification is 'temperate deciduous forest', the mature vegetation across large tracts of the British countryside is predominantly grassland and heathland owing to underlying chalk and limestone giving rise to local variations in soil type. Vegetation cover is also affected by local variations in the soil cover such as texture, structure, acidity and depth as well as by water retention, oxygen and nutrient content.

Biotic Factors

The most important biotic factor affecting biomes is the interplant competition for light, root space and water. Such competition is often fierce in the lower latitudes where vegetation cover is particularly dense and a greater numbers of species is involved. However, grazers and browsers also exert a considerable influence on vegetation development. Herbivores and primary consumers are frequently responsible for pollination and seed dispersal, as well as the close-cropping of the vegetation itself. Second and higher-order predators are influential by controlling the populations of herbivores and primary predators such as insects. Animal diseases are an additional factor as was clearly demonstrated by the unintentional introduction of myxomatosis to Britain in the 1950s. Myxomatosis is a viral infection of rabbits endemic only in South America. However, it was deliberately introduced into Australia in the 1950s as a means of dramatically reducing the rabbit population and was inadvertently transmitted to Britain at about the same time, decimating the rabbit population there as well. The unexpected rabbit cull led to record rates of grass growth, increased crop yields and successful sapling establishment.

3.4. Give the Russian equivalents:

altitude, stunted, yields, limestone, retention, underlying, consumer, fierce, grazer, browser, pollination, unintentional, establishment, dispersal, deliberately.

3.5. Give the English equivalents:

подверженность, заболоченный, уклон, известняк, пустошь, вещество, листопадный, урожай, саженец, эндемический.

3.6. Fill in the blanks with the words from the text.

1. Relief can ____ vegetation succession in some ways.
2. Relief may also increase an area's ___ to heavy rainfall and strong winds.
3. The most important biotic factor is the interplant ____ for light, root space and water.
4. The equilibrium ____ soils and vegetation is very delicate.
5. Animal ____ can be considered as additional factor.
6. The vegetation cover is particularly ____ in the lower latitudes.
7. Myxomatosis can be explained as a ____ infection of rabbits.
8. In 1950s myxomatosis influenced much on rabbits' ____.

3.7. Find opposite words.

- to increase	- darkness
- access	- seldom
- light	- to decrease
- variation	- monotony
- great	- incomplete
- unintentional	- prohibition
- to reduce	- intentional
- frequently	- to enlarge
- frost	- small
- entire	- heat

3.8. Make nouns from verbs:

to influence, to success, to reduce, to increase, to affect, to develop, to compete, to cover, to classify, to consume.

3.9. Give an extensive answer.

1. The influence of relief on plant growth.
2. The process of equilibrium between soils and vegetation.
3. The interplant competition for light, root space and water as the most important biotic factor.

UNIT 4

4.1. Read the international words and guess what they mean:

urban, manipulate, human, categorize, carbon, ozone, radiation, sulphur, nitrogen, emission, economic, agriculture, degradation, destruction,

re-colonization, pesticides, herbicides, fungicides, combine, accelerate, colonize, maximize.

4.2. Before you read

Give the definition of the word «anthropogenic».

4.3. Read and translate the text

Anthropogenic Influences

In addition to the above mentioned natural influences, the role of human activity should not be underestimated. Very few areas of the world support 'undisturbed' mature (climax) communities or biomes and in many places, particularly the major urban conurbations, the natural biome has been either totally destroyed or very comprehensively manipulated in order to meet the perceived needs of the local human population. Human interventions in the natural world may be categorized as being of three distinct types:

- In the atmosphere, the delicate balances of carbon dioxide and ozone within the lower and upper atmospheres respectively are being destroyed, leading to temperature rises and increased ultra violet radiation. The current rates of sulphur dioxide and nitrogen oxide emissions are devastating large areas of forest biomes through the effects of acid rain.
- On land, our pursuit of economic activities has led to rapidly increasing urban sprawl as well as widespread stripping of natural vegetation to provide additional land for both building and large-scale agriculture. Subsidence, soil exhaustion, topsoil erosion, deforestation, fire and flooding are just some of the many factors currently responsible for biome modification, degradation and destruction. Even reafforestation programmes can bring about major ecological change, particularly where huge stands (clusters) of single species evergreens are planted to replace deciduous or mixed woodlands. Such 'new' species cannot host the previous animal communities as they do not replace the food supply and living space of the natural woodland. Furthermore, over a period of time, the natural soil cover of the area becomes affected by the input of acidic leaf litter and increased leaching and consequently degenerates, becoming unable to support the original forest succession even if re-colonization is attempted.

Disturbance of the ecological balance has taken place owing to the widespread use of increasingly potent fertilizers, pesticides, herbicides and fungicides. Such disturbance, combined with overgrazing by animal herds, has led to changes in the inputs and outputs of the natural systems and created new, unnatural, feedback loops. Often, this feedback is positive, resulting in increasingly rapid movement away from equilibrium and accelerated rates of change.

Summary

1. Climate patterns are the most important factor in determining adaptation. Large areas typified by distinctive climates and plant forms are known as biomes.
2. Precipitation is the single most important determinant of the three vegetation types: forest, grassland or desert. Coupled with temperature and soil type, precipitation also determines whether vegetation is tropical, temperate or polar. Hence, there are nine primary biome classifications.
3. Temperature influences the rate of evapotranspiration, which in turn determines effective soil moisture - the moisture available for plant growth. Plants colonizing areas experiencing negative soil moisture budgets must adapt in order to survive.
4. Temperature determines the length of the growing season. Plants cease to function when temperatures fall below 6°C; ideally, temperatures should remain above 10°C for effective photosynthesis. If temperatures exceed 15°C throughout the year, the growing season is continuous. Where temperatures are below 6°C for up to 5. Months, trees adopt a deciduous habit; where more than 6 consecutive months are below 6°C, trees become «evergreen» in order to maximize photosynthesis opportunities.
6. Relief can affect plant growth because although temperatures decrease with increasing altitude, precipitation is greater. Strong winds, edaphic conditions and water logging are also influenced by relief. Aspect may be an additional, locally important factor. Plant adaptation is also affected by a range of edaphic factors, which are discussed at length.

Animals also affect vegetation cover and adaptation, many playing a significant role in pollination and seed dispersal, while grazers and browsers crop vegetation cover. This is an important factor in inhibiting tree colonization/regeneration.

Human intervention affects nearly every ecosystem on earth. Such interference may take the form of atmospheric pollutants (e.g. acid rain), biome modification (e.g. through the removal of vegetation cover) and ecological disturbance (e.g. usage of pesticides), all of which introduce positive feedback loops, accelerating change away from natural equilibrium.

4.4. Give the Russian equivalents:

to underestimate, either… or, emissions, to increase, leaching, herd, loops, fertilizers, to categorize, to lead.

4.5. Give the English equivalents:

опустошить, вечнозеленый, сообщество, естественный, особенно, истощение, оседание почвы, наводнение, хрупкий, определенный тип.

4.6. What are three distinct types of human interventions?

4.7. Name parts of speech of the following words:

natural, human, three, delicate, additional, modification, previous, activity, cover, acidic, rapidly, both, increasingly, rapid, away.

4.8. Find corresponding words and expressions from the text.

- human	- type
- distinct	- supply
- lower	- dioxide
- carbon	- programmes
- mixed	- activity
- nitrogen	- agriculture
- reafforestation	- atmospheres
- food	- oxide
- natural	- woodlands
- large-scale	- systems

4.9. Say if it is true or false.

1. Forest, grassland and desert are important factors of vegetation type classification.
2. Human intervention doesn't play a significant role in ecosystem on earth.
3. Soil influences the rate of evapotranspiraion.
4. Biomes are known as plant forms and large areas typified by distinctive climates.
5. Animals can be viewed as a major factor in inhibiting tree regeneration.

4.10. Explain the following terms:

1) ecotone
2) edaphic
3) effective soil moisture
4) evapotranspiration
5) growing season
6) negative soil moisture
7) soil erosion
8) soil moisture recharge.

4.11. «Biomes reflect the pattern of world climate and soils». To what extent do you agree with this statement?