LECTURE 4

THE ROLE OF LIVING ORGANISMS IN SOIL FORMATION

Plan of the lecture

1. The role of microorganisms in soil formation
2. The role of higher plants in soil formation
3. Plant formations in nature
4. Participation of animals in soil formation

1. The role of microorganisms in soil formation

Bacteria, algae, lichens and fungi take part in the process of soil formation.

Bacteria are the most numerous and diverse group of microorganisms that inhabit the soil. About 50 genera and 250 species of soil bacteria are known.

Fungi - lower organisms that make up a special kingdom of wildlife. In nature, they are spread everywhere. The main function in soil formation is the decomposition of organic residues. Representatives of all classes take part in this process. Molds are the most common in soils.

Soil algae - these plant organisms have the ability to use solar energy to form organic matter and accumulate it in the soil. Species of individual algae, such as green, blue-green and diatoms, grow well on solid media (rocks). Blue-green algae can often be observed on the surface of various rocks, and especially in the cracks of porous limestones, in which water is retained; they form dark or even black spots on them.

Lichens are a special group of living organisms whose body consists of two components: a fungus and an alga. They do not belong to soil microorganisms, but they participate in soil formation.

Lichens settle on stationary substrates (rocks, stones, trees) or grow on the soil surface. They emit complex organic acids, which are called lichen. These acids destroy minerals and thus create favourable conditions for soil formation.

2. The role of higher plants in soil formation

Table 1. Indicators of the biological productivity of the main types of vegetation (L. S. Rudin and N. I. Bazylevych, 1965)

Types of vegetation	Biomass			Growth, %	Shedding, c/ha	Forest litter (steppe mat), c/ha
	c/ha	Aboveground part, %	Roots, %			
Arctic tundras	50	30	70	10	10	35
Shrub tundras	280	17	83	25	24	835
Spruce forests of the northern taiga	1000	78	22	45	35	300
Spruce forests of the southern taiga	3300	78	22	85	55	350
Oak woods	4000	76	24	90	65	150
Meadow steppes	250	32	68	137	13	120
Dry steppes	100	15	85	42	42	15
Deserts of temperate zone	43	13	87	12	12	-
Savannah (Ghana)	666	94	6	120	115	13
Humid tropical forest	5000	82	18	325	250	20

3. Plant formations in nature

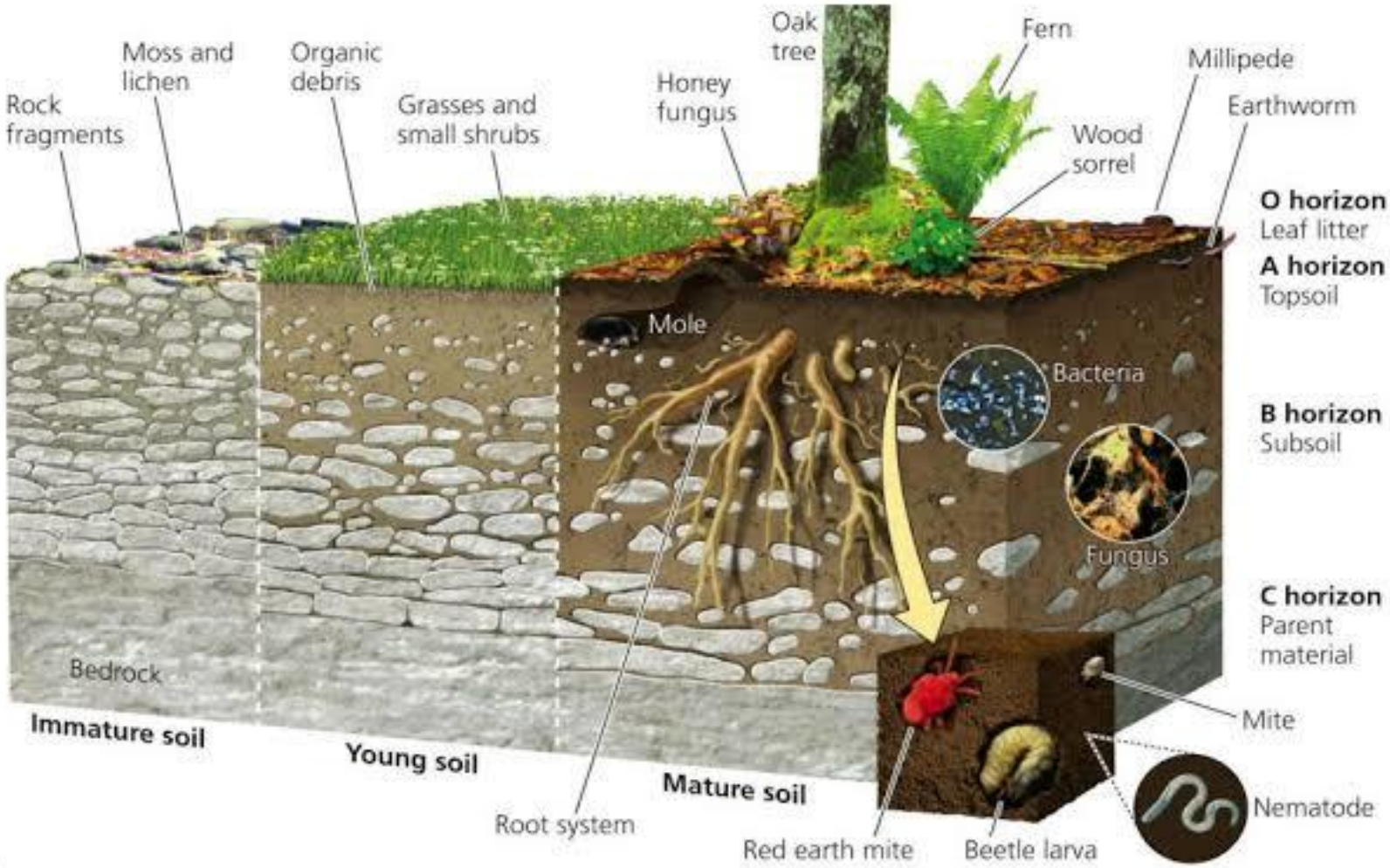
There is a close connection between higher plants and microorganisms. Coexistence of higher green plants with lower chlorophyll-free ones is the main factor of soil formation. Academician V. R. Williams called such natural combinations as plant formations, there are four of them:

1. Tree plant formation is the coexistence of woody plants and fungi, actinomycetes and anaerobic bacteria. In this formation, podzolic soils are formed.
2. Meadow-herbaceous plant formation is characterized by the coexistence of meadow herbaceous green plants with aerobic bacteria, but with a sharp advantage of anaerobic bacteria.

Chernozems and meadow soil are the main soils that predominate in this formation.

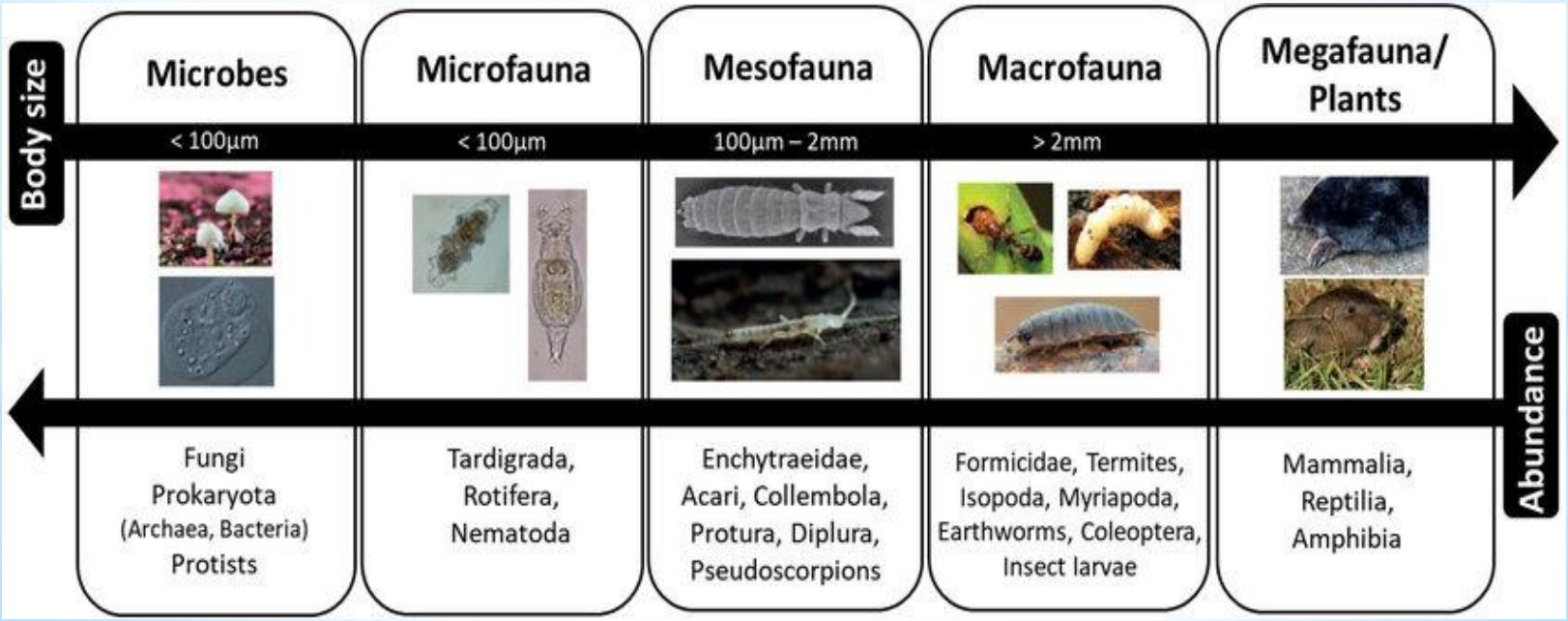
3. Steppe plant formation consists mainly of herbaceous green plants, common in the steppes, where aerobic bacteria predominate. Southern chernozems and chestnut soils are formed in this formation.
4. Desert plant formation differs from steppe in that mainly chymotrophic bacteria and algae play the role in creating organic matter, except some plants, and aerobic and anaerobic bacteria and fungi destroy the remnants in these soils.

Soil Formation Over Time



4. Participation of animals in soil formation

The soil fauna is divided into four groups according to the size: nano-, micro-, meso-, macrofauna and megafauna. Each group of animals is adapted to certain living conditions, to a certain interaction with the environment. The total stocks of zoomass in soils relative to phytomass are insignificant - on average 1–2 %.



Invertebrates predominate among the animals inhabiting the soil. Their total biomass is 1000 times higher than the total biomass of vertebrates. Earthworms, enchitreids, mites, springtails, etc. live in the soil. They significantly accelerate the biological cycle of substances by eating plant residues.

A significant number of larvae of different insects, termites, ants, etc. live in the soil. They also intensively mix the soil mass, form a large number of passages in it and thus improve the water and air properties of the soil.

Among vertebrates, steppe rodents (voles, marmots, moles, gophers, etc.) take an active part in soil formation processes.

Thank you for listening