

**BSc. Biological Chemistry study programme**  
**State exam Biology of Plants (as compiled/collated 14. 9. 2022)**  
**Students are randomly picking ONE topic.**

1. Cyanobacteria: structure of its prokaryotic cells, photosynthetic apparatus – structure of phycobilisome, cyanobacterial photosynthetic pigments. Nitrogen fixation, symbiosis with other organisms. Ecology importance, water blooms, supporting conditions. Other photosynthetic oxygenic and non-oxygenic bacteria.
2. Endosymbiotic theory. The process, evidence, geological timing, consequences for life on Earth. Primary and serial endosymbiosis, outline of eukaryotic lineages with primary and secondary plastids.
3. Eukaryotic plant cell: its structure, organelles, plant-specific features (cell wall, plastids and their developmental cycle, vacuole, liverwort oil bodies).
4. Non-Archaeplastidan algae, lineages with red algal endosymbiont. Brief characteristics of the major lineages (uni/multicellularity, locomotory apparatus, photosynthetic apparatus), importance of the major groups for global carbon and oxygen production, ecology and human uses.
5. Archaeplastidan algae: brief characteristics of the major lineages (uni/multicellularity, locomotory apparatus, photosynthetic apparatus), ecology and human uses. Relationships with land plants.
6. Basal land plants: origin of Embryophytes, geological timing and circumstances, relationships to algal Streptophytes. Basic characteristics of bryophytes, its 3 main lineages, explaining of the haplo-diplontic life cycle at the example of bryophytes versus polysporangiophytes.
7. Spore-reproducing embryophytes (lycophytes and monilophytes): differences between lycophyte and euphyllophyte lineages, brief characteristics of lycophytes and monilophytes, evolution of heterospory and life cycle of heterosporic lycophytes and ferns, eusporangiate and leptosporangiate monilophytes.
8. Origin of Lignophytes and seed plants. Evolutionary novelties of lateral meristems and seeds, comparisons between spores and seeds, evolution of eustelic vasculature. Development of male and female gametophyte in seed plants, ovules.
9. Gymnosperms: brief characteristics of the major lineages (cycads, ginkgos, conifers I and II, Gnetales), evolution of sperm cell motility, human uses of conifers and gnetales.
10. Origin of angiosperms (flowering plants): geological circumstances and timing, coevolution with pollinators; major synapomorphies of the group, flowers, differences of gametophyte development to gymnosperms.
11. Outline of angiosperm diversity: brief characteristics of major lineages (basal grade, monocots, eudicots), human uses.
12. Plant development: embryogenesis and differences in structure of dicot and monocot seeds, seed germination and dormancy. Tissues in various contexts (primary and secondary, meristematic and persistent, simple and composed).

13. Structure and function of major plant body parts (roots, stem & leaves), secondary wood in conifers and dicots.
14. Regulation of growth and development by hormones: the main hormone classes, their place of synthesis, way of transport through plant body, main effects, co-action between hormones, role of concentration. Mechanism of regulation of plant cell wall expansion, pathway of signal transduction.
15. Plant movements: tropic and nastic responses to external factors (light, mechanic action or obstacle, gravity, moisture gradient), mechanism of individual responses.
16. Phytochrome-based flowering and growth reactions. photoperiodism, basis of flowering response to daylength, effect of wavelength, phytochrome forms and cycle, shade-avoidance syndrome and etiolation.
17. Energy flow in plants: coupling of cellular respiration with photosynthesis. Glucose breakdown: preparatory and pay-off phase of glycolysis, aerobic and anaerobic fate of pyruvate. Uses of alcoholic and lactate fermentation.
18. Photosynthesis: light-dependent reactions (light-harvesting antennae structure, photosynthetic pigments, Z-scheme and cyclic electron flow) and light-independent reactions (Calvin cycle, Hatch-Slack pathway, CAM, countering the photorespiration). Adaptive significance of C3, C4 and CAM pathways and environmental factors affecting the photosynthesis rates.
19. Plant nutrition, roles of macro- and micronutrients, nutrient deficiencies and plant reactions to their mitigation. Cycling and usable forms of nitrogen and phosphorus.
20. Water movement in plants, transport of solutes across membranes, osmosis and osmosis-based movements (guard cells, pulvini).
21. Transpiration stream and its mechanism, from roots to stomatal cavities, comparison to the mechanism of assimilate transport. Environmental effects and active regulation of transpiration.
22. Strategies for water management on dry land – poikilohydry and homoiohydry, desiccation tolerance, mechanisms. Examples from major lineages of land plants.
23. Interactions among plants and between plants and other organisms. Competition, mutualism and symbiosis, lichenism, mycorrhiza, pollination and seed dispersal mechanisms and cooperation with animals. Herbivory and plant defence.
24. Plant communities' assembly. Climatic and substrate-related effects of composition of plant communities, climax, plant succession on newly created/disturbed ground. Major Earth biomes, environmental factors shaping the plant communities in biomes.