Topics for the entrance exam and interview for the Biological Therapeutics program

1. **Organization of living matter and cytophysiology** – structure and functions of prokaryotic and eukaryotic cells, basic life processes at the cellular level.
2. **Basics of molecular and cell biology** – structure and functions of eukaryotic cells; mechanisms of gene expression and regulation of transcription and translation; basic knowledge of the structure, chemical composition, and functions of proteins and nucleic acids.
3. **Biotechnology and genetic engineering** – knowledge of basic molecular biology methods for cloning, production, and purification steps of recombinant proteins; classical genetic engineering and genome engineering using CRISPR/Cas9 methods.
4. **Biological and biosimilar drugs** – definition and types; basic knowledge of therapeutic RNA types; characteristics of biological and biosimilar drugs; basic knowledge of antibodies: structure, mechanisms of action, therapeutic and research applications.
5. **Modern technologies in biological drug development** – basic knowledge of nucleic acid sequencing techniques.
6. **Immunology** – basics of immune system function: main types of immune cells and organs; mechanisms of innate and adaptive immunity; antibodies and their role in biological therapy; basics of immunogenicity of biological drugs.
7. **Biophysics** – understanding basic concepts in the biophysics of proteins and nucleic acids, and biophysical methods used to study their properties.
8. **Calculations** – ability to perform basic calculations related to converting percentage and molar concentrations, volumes, and unit conversions for mass, volume, and amount of substance.
9. **Basic skills in working with nucleic acids** – designing primers for PCR reactions, complementary sequences (e.g., probes), and basic analysis methods.
10. **Nucleic acids and proteins** – structure, chemical properties, reactivity, and physicochemical basis of interactions.
11. **Basics of spectroscopy** – mass spectrometry, nuclear magnetic resonance, absorption, and fluorescence.
12. **Organic chemistry** – basics of reactivity and synthesis methods of organic compounds; fundamentals of organic reaction mechanisms.

Read before the exam:

- *Basics of molecular genetics*, e.g., *Genetyka. Krótkie wykłady* (*Genetics: Short Lectures*), *Genes*, or *Genomes* — chapters on genetic information expression and nucleic acids.
- *Basics of immunology*, e.g., *Immunologia. Krótkie wykłady* (*Immunology: Short Lectures*) — chapters on mechanisms of innate immunity, humoral immunity, and vaccines.

Articles and resources:

- Zhu, Y., Zhu, L., Wang, X. et al. RNA-based therapeutics: an overview and prospectus. *Cell Death & Disease* 13, 644 (2022). https://doi.org/10.1038/s41419-022-05075-2

- Li, T., Yang, Y., Qi, H. et al. CRISPR/Cas9 therapeutics: progress and prospects. *Signal Transduction and Targeted Therapy* 8, 36 (2023). https://doi.org/10.1038/s41392-023-01309-7
- Adli, M. The CRISPR tool kit for genome editing and beyond. *Nature Communications* 9, 1911 (2018). https://doi.org/10.1038/s41467-018-04252-2
- National Cancer Institute: Immunotherapy — https://www.cancer.gov/about-cancer/treatment/types/immunotherapy