

## Program: Biology & Biotechnology

This document outlines the scope of themes, which may be included in the Olympiad tests. The themes are grouped by areas and are followed by a list of recommended references in the Russian and English languages.

### Olympiad winner's skill set by subject

**Analytical skills:** analysis of literature data and study of biological samples.

#### Genetics, cell, and general biology

- You must be **familiar with** the structure of the eukaryotic and prokaryotic cells, the features of the cells of plants, animals, and fungi; the features of the karyotype and genotype of a human cell; the specifics of heredity and variation, conjugation and crossing over, mitosis and meiosis; the fundamentals of ecology and evolution; history of life on Earth; the concepts of species and speciation, biological communities; the ideas of macroevolution and functional evolution of biological systems.
- You must **be able to** identify cell organelles, distinguish mitotic cell division from meiotic; define ecological interactions of organisms.
- You must have **skills** in using a light microscope, working with cell and tissue preparations, and determining structures from photographs, drawings, and diagrams.

#### Physiology and immunology

- You must be **familiar with** the principles of human immune system organization, the basics of the work of internal body organs, and the structures and mechanisms of hormone and neurotransmitter synthesis.
- You must **be able to** compare physiological parameters in health and disease,
- You must have **skills** in employing the methods of immunological basic analysis and analyzing the physiological parameters of the human body, as well as in using medical and electrophysiological instruments.

#### Project-oriented competence:

- You must be able to work in a scientific laboratory to obtain product results or solve applied problems.

#### Biotechnology

- You must be **familiar with** the molecular foundations of biotechnology, modern methods of biotechnology, and their scope of application.
- You must **be able to** select producers of biologically active substances and determine the optimal strategy for developing and purifying biologically active substances.
- You must have **skills** in employing the methods of polymerase chain reaction, restriction analysis, gel electrophoresis, prokaryotic and eukaryotic cell cultivation, recombinant protein isolation, and biochemical analysis.

#### Research competence:

- You must be able to work in research and development, and write reports and

articles.

### **Microbiology and virology**

- You must be **familiar with** the principles of classification and taxonomy of bacteria and viruses, the basics of using bacteria and viruses in biotechnology, and the life cycles of viruses.
- You must have **skills** in working with viral vectors, as well as in employing methods for cultivating prokaryotic cells and isolating plasmid DNA.

### **Biochemistry and molecular biology**

- You must be **familiar with** the structure of the main classes of biological molecules (proteins, lipids, sugars, nucleic acids), the kinetics of enzymatic reactions, the principles of enzyme operation, the central dogma of molecular biology, and the mechanisms of replication, transcription, and translation.
- You must be **able to** design gene constructs and solve plastic and energy metabolism problems.
- You must have **skills** in employing the methods of nucleic acid isolation, chromatography, genetic engineering, bioinformatics analysis, and biochemical analysis.

## **Content**

### **Thematic block 1. Biotechnology**

1. Recombinant DNA technologies. Vectors. Reverse transcription
2. Restriction enzymes. Polymerase chain reaction
3. Expressing cloned genes. Cloning. Transgenic organisms
4. Biomass production. Recombinant protein isolation
5. Biosecurity

### **Thematic block 2. Genetics, cellular, and general biology**

1. Cell division. Mitosis, meiosis, germ cell formation
2. Chromosomal theory of heredity. Chromatin organization
3. History of life on Earth. Variation and selection. Species and speciation. Macroevolution and functional evolution. Species and communities.
4. Diversity of living organisms: plants, animals, fungi. Taxonomy
5. Levels of living system organization. Biological evolution. Ecology

### **Thematic block 3. Microbiology and virology**

1. Viruses. Classification
2. Bacteria and archaea
3. Symbiotic theory of eukaryotic cell origin
4. Light and electron microscopy
5. Bacteria and viruses causing diseases in humans

### **Thematic block 4. Physiology and immunology**

1. Metabolism
2. Neurohumoral regulation

### **Thematic block 5. Biotechnology of polymers and biologically active substances**

1. Nutrients

2. Genetic engineering for protein and non-protein drug production
3. Preparation of organic acids

### Thematic block 6. Physicochemical research methods

1. Research methods in biochemistry

### Thematic block 7. Genetic and cell technologies

1. Structure of nucleic acids
2. The principles of basic techniques in molecular biology and genetic engineering
3. The basics of cell engineering
4. The immune system. Humoral and cellular immunity
5. Vaccines. History and prospects
6. Allergies. Autoimmune processes

## Recommended literature

### Thematic block 1. Biotechnology

Sources	Topic
<p>1. Alberts B., Johnson A., Lewis J., Morgan D., Raff M., Roberts K., Walter P. Molecular Biology of the Cell Sixth Edition. W. W. Norton &amp; Company, 2014. - 1464 p. <a href="https://www.amazon.com/Molecular-Biology-Sixth-Bruce-Alberts/dp/0815345240">https://www.amazon.com/Molecular-Biology-Sixth-Bruce-Alberts/dp/0815345240</a> – limited access</p>	<p>Recombinant DNA technologies. Vectors. Reverse transcription. Restriction enzymes. Polymerase chain reaction. Expressing cloned genes. Cloning. Transgenic organisms. Biosecurity</p>
<p>2. Campbell N. A., Urry L. A., Cain M. L., Wasserman S. A., Orr R. A., Minorsky P. V., Reece J. B. Biology: A Global Approach – 12th Edition. 1510 p. <a href="https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ">https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ</a> – limited access</p>	<p>Recombinant DNA technologies. Vectors. Reverse transcription. Restriction enzymes. Polymerase chain reaction. Expressing cloned genes. Cloning. Transgenic organisms. Biosecurity</p>

<p>3. El-Mansi, E. M. T., Bryce C. F. A., Arnold L. Demain, Allman A.R.          Fermentation Microbiology and Biotechnology. 3rd Edition, CRC Press          - 2012, 555 p.  <a href="https://www.researchgate.net/publication/320241068_Fermentation_Microbiology_and_Biotechnology">https://www.researchgate.net/publication/320241068_Fermentation_Microbiology_and_Biotechnology</a> – free access</p>	<p>Biomass production.          Recombinant protein separation.</p>
<p>4. Федотова Ю.О. Общая биология.: Учебное пособие. – СПб.: Университет ИТМО; 2017. – 63 с.  <a href="https://books.ifmo.ru/file/pdf/2198.pdf">https://books.ifmo.ru/file/pdf/2198.pdf</a> – free access</p>	<p>Recombinant DNA technologies. Transgenic organisms. Biosecurity</p>
<p>5. Щелкунов С. Н. Генетическая инженерия: Учеб. –справочное пособие. — 2-е изд., испр. и доп. — Новосибирск: Сиб. унив. изд-во, 2004. 496 с  <a href="https://microbius.ru/library/s-n-schelkunov-geneticheskaya-inzheneriya">https://microbius.ru/library/s-n-schelkunov-geneticheskaya-inzheneriya</a> - free access</p>	<p>Recombinant DNA technologies. Vectors. Reverse transcription. Restriction enzymes. Polymerase chain reaction. Expressing cloned genes. Cloning. Transgenic organisms. Biosecurity</p>

### Thematic block 2. Genetics, cell and general biology.

Sources	Topic
<p>1. Alberts B., Johnson A., Lewis J., Morgan D., Raff M., Roberts K., Walter P.          Molecular Biology of the Cell Sixth Edition. W. W. Norton &amp; Company, 2014. - 1464 p.  <a href="https://www.amazon.com/Molecular-Biology-Sixth-Bruce-Alberts/dp/0815345240">https://www.amazon.com/Molecular-Biology-Sixth-Bruce-Alberts/dp/0815345240</a> – limited access</p>	<p>Cell membrane structure.          Eukaryotic cell organelles.          Cell cycle</p>
<p>2. Bowman W. D., Hacker S. D., Cain M. L.          Ecology - 4th Edition. Oxford University Press – 2017, 744 p.  <a href="https://www.amazon.com/Ecology-Michael-Bowman-William-Hardcover/dp/B00NYIWBW0">https://www.amazon.com/Ecology-Michael-Bowman-William-Hardcover/dp/B00NYIWBW0</a> – limited access</p>	<p>Biological evolution. Ecology</p>

<p>3. Campbell N. A., Urry L. A., Cain M. L., Wasserman S. A., Orr R. A., Minorsky P. V., Reece J. B. <i>Biology: A Global Approach</i> – 12th Edition. 1510 p. <a href="https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ">https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ</a> – limited access</p>	<p>Cell membrane structure. Eukaryotic cell organelles. Cell cycle. Diversity of living organisms: plants, animals, fungi. Taxonomy. Levels of living system organization. Biological evolution. Ecology</p>
<p>4. Clark, M. A., Douglas, M., Choi, J. <i>Biology</i> 2E. 2018. - <a href="https://openstax.org/details/books/biology-2e">https://openstax.org/details/books/biology-2e</a> - free access</p>	<p>Biological evolution. Ecology. General biology. Genetics. Fundamentals of biochemistry and molecular biology.</p>
<p>5. Futuyma D. J., Kirkpatrick M. <i>Evolution</i> 4th Edition. Oxford University Press – 2017, 594 p. <a href="https://www.amazon.com/Evolution-Third-Douglas-Futuyma-2013-03-04/dp/B01N3MELOM">https://www.amazon.com/Evolution-Third-Douglas-Futuyma-2013-03-04/dp/B01N3MELOM</a> – limited access</p>	<p>Biological evolution. Ecology</p>
<p>6. Гиляров А. М. <i>Экология биосферы.</i> — М.: Издательство Московского университета, 2018. — 158 с. <a href="https://www.ozon.ru/product/ekologiya-biosfery-uchebnoe-posobie-dlya-studentov-biologicheskikh-spetsialnostey-gilyarov-a-m-267551813/">https://www.ozon.ru/product/ekologiya-biosfery-uchebnoe-posobie-dlya-studentov-biologicheskikh-spetsialnostey-gilyarov-a-m-267551813/</a> – limited access</p>	<p>Biological evolution. Ecology</p>
<p>7. Жимулев, И. Ф. <i>Общая и молекулярная генетика: учебное пособие.</i> Изд. 4-е, стереотип. 3-му. – Новосибирск: Сибирское университетское издательство, 2007. – 480 с. <a href="https://vk.com/wall-120203091_4930">https://vk.com/wall-120203091_4930</a> – free access</p>	<p>Chromosomal theory of heredity. Chromatin organization</p>
<p>8. Северцов А. <i>Теория эволюции: учеб. для студентов вузов.</i> – Владос, 2005. <a href="https://vk.com/doc70981420_458632157">https://vk.com/doc70981420_458632157</a> – free access</p>	<p>Biological evolution. Ecology</p>

<p>9. Федотова Ю.О. Общая биология.: Учебное пособие. – СПб.: Университет ИТМО; 2017. – 63 с.  <a href="https://books.ifmo.ru/file/pdf/2198.pdf">https://books.ifmo.ru/file/pdf/2198.pdf</a> – free access</p>	<p>Diversity of living organisms: plants, animals, fungi. Taxonomy. Levels of living system organization. Biological evolution. Ecology.</p>
<p>10. Ченцов Ю. С., Введение в клеточную биологию. Учебник. Изд. Альянс, 2015. - 496 с. <a href="https://vk.com/wall-120203091_511">https://vk.com/wall-120203091_511</a> – free access</p>	<p>Cell division. Mitosis. Cell division. Meiosis; germ cell formation. Cell membrane structure. Eukaryotic cell organelles. Cell cycle</p>

### Thematic block 3. Microbiology and virology

Sources	Topic
<p>1. Campbell N. A., Urry L. A., Cain M. L., Wasserman S. A., Orr R. A., Minorsky P. V., Reece J. B. Biology: A Global Approach – 12th Edition. 1510 p. <a href="https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ">https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ</a> – limited access</p>	<p>Viruses. Classification. Bacteria and archaea. Symbiotic theory of eukaryotic cell origin. Light and electron microscopy. Bacteria and viruses causing disease in humans</p>
<p>2. Hewlett M. J., Camerini D., Bloom D. C. Basic Virology, Fourth Edition. Wiley-Blackwell, 2021. - 576 p. <a href="https://www.amazon.com/Basic-Virology-Fourth-Edition/dp/1119314054">https://www.amazon.com/Basic-Virology-Fourth-Edition/dp/1119314054</a> – limited access</p>	<p>Viruses. Classification. Bacteria and viruses causing disease in humans.</p>
<p>3. Madigan M. T., Martinko J. M., Bender K. S., Buckley D. H., Stahl D. A., Brock T. Brock Biology of Microorganisms 14th Edition. Pearson, 2014. - 1032 p. <a href="https://www.amazon.com/Brock-Biology-Microorganisms-Michael-Madigan/dp/0134261925">https://www.amazon.com/Brock-Biology-Microorganisms-Michael-Madigan/dp/0134261925</a> – limited access</p>	<p>Bacteria and archaea. Symbiotic theory of eukaryotic cell origin. Light and electron microscopy</p>
<p>4. Гусев М. В., Минеева Л. А. Микробиология. Москва, 2003. - 461 с. <a href="https://vk.com/doc145912791_532760429">https://vk.com/doc145912791_532760429</a> – free access</p>	<p>Bacteria, archaea, viruses. Classification. Bacteria and viruses causing disease in humans</p>

<p>5. Пиневи́ч А. В., Сироткин А. К., Гаврилова О. В., Потехин А. А. Вирусология: учебник. СПб.: Изд-во С.-Петербург. ун-та, 2012. — 432 с. <a href="https://booksmed.info/mikrobiologiya/4432-virusologija-pinevich-a-v-uchebnik.html">https://booksmed.info/mikrobiologiya/4432-virusologija-pinevich-a-v-uchebnik.html</a> – free access</p>	<p>Viruses. Classification. Light and electron microscopy. Bacteria and viruses causing disease in humans</p>
<p>6. Федотова Ю.О. Общая биология.: Учебное пособие. – СПб.: Университет ИТМО; 2017. – 63 с. <a href="https://books.ifmo.ru/file/pdf/2198.pdf">https://books.ifmo.ru/file/pdf/2198.pdf</a> – free access</p>	<p>Viruses. Classification. Bacteria and archaea. Symbiotic theory of eukaryotic cell origin</p>

#### Thematic block 4. Physiology and immunology

Sources	Topic
<p>1. Campbell N. A., Urry L. A., Cain M. L., Wasserman S. A., Orr R. A., Minorsky P. V., Reece J. B. Biology: A Global Approach – 12th Edition. 1510 p. <a href="https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ">https://www.amazon.com/Biology-Global-Approach-12th-Latest/dp/B09Y93QQMJ</a> – limited access</p>	<p>Metabolism. Neurohumoral regulation. The immune system. Humoral and cellular immunity. Vaccines.: History and prospects. Allergy. Autoimmune processes</p>
<p>2. Marieb E., Hoehn K. Human Anatomy &amp; Physiology. 11th Edition. Pearson, 2018 - 1264 p. <a href="https://www.amazon.com/Human-Anatomy-Physiology-Elaine-Marieb/dp/0134580990">https://www.amazon.com/Human-Anatomy-Physiology-Elaine-Marieb/dp/0134580990</a> – limited access</p>	<p>Metabolism. Neurohumoral regulation. The immune system. Humoral and cellular immunity.</p>
<p>3. Murphy K. M., Weaver C. Janeway's Immunobiology. Ninth Edition. W. W. Norton &amp; Company, 2016 - 924 p. <a href="https://www.amazon.com/Janeways-Immunobiology-Ninth-Kenneth-Murphy/dp/0815345054">https://www.amazon.com/Janeways-Immunobiology-Ninth-Kenneth-Murphy/dp/0815345054</a> – limited access</p>	<p>Metabolism. Neurohumoral regulation. The immune system. Humoral and cellular immunity. Vaccines.: History and prospects. Allergy. Autoimmune processes</p>
<p>4. Барышников С. Д. Лекции по анатомии и физиологии человека с основами патологии. Изд. 2-е. М.: ГОУ ВУНМЦ, 2002. – 416 с. <a href="https://vk.com/doc19546201_621838796">https://vk.com/doc19546201_621838796</a> – free access</p>	<p>Metabolism. Neurohumoral regulation. The immune system</p>

<p>5. Покровский, В. М. Физиология человека: учебник / Под ред. В. М. Покровского, Г. Ф. Коротько - 3-е изд. - Москва : Медицина, 2011. - 664 с. - <a href="https://vk.com/doc-67003026_636340327">https://vk.com/doc-67003026_636340327</a> – free access</p>	<p>Metabolism. Neurohumoral regulation. The immune system. Humoral and cellular immunity. Vaccines.: History and prospects. Allergy. Autoimmune processes</p>
<p>6. Федотова Ю.О. Общая биология.: Учебное пособие. – СПб.: Университет ИТМО; 2017. – 63 с. <a href="https://books.ifmo.ru/file/pdf/2198.pdf">https://books.ifmo.ru/file/pdf/2198.pdf</a> – free access</p>	<p>Metabolism. Neurohumoral regulation. The immune system. Humoral and cellular immunity. Vaccines.</p>

### Thematic block 5. Biochemistry and molecular biology

Sources	Topic
<p>1. Ahern, K., Rajagopal I., Tan, T. Oregon State University. 2018. <a href="https://open.umn.edu/opentextbooks/textbooks/866">https://open.umn.edu/opentextbooks/textbooks/866</a> – free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>
<p>1. Principles of Biochemistry. Wikibooks, 2011. <a href="https://en.wikibooks.org/wiki/Principles_of_Biochemistry">https://en.wikibooks.org/wiki/Principles_of_Biochemistry</a> – free access</p>	<p>Proteins, lipids, nucleic acids. Functions of proteins. Enzymes. Enzyme kinetics. Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>
<p>3. Nelson D. L. Lehninger Principles of Biochemistry 8th Edition. W.H. Freeman, 2021 - 1248 p. <a href="https://www.amazon.com/Lehninger-Principles-Biochemistry-David-Nelson/dp/1319228003">https://www.amazon.com/Lehninger-Principles-Biochemistry-David-Nelson/dp/1319228003</a> – limited access</p>	<p>Proteins, lipids, nucleic acids. Functions of proteins. Enzymes. Enzyme kinetics. Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>



<p>4. Clark, M. A., Douglas, M., Choi, J. Biology 2E. 2018. -  <a href="https://openstax.org/details/books/biology-2e">https://openstax.org/details/books/biology-2e</a> - free access</p>	<p>Proteins, lipids, nucleic acids. Functions of proteins. Enzymes. Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code.</p>
<p>5. Альбертс Б., Джонсон А., Льюис Д., Рэфф М., Робертс К., Уолтер П. Молекулярная биология клетки. В 3 томах. Регулярная и хаотическая динамика, Институт компьютерных исследований.  <a href="https://vk.com/doc28047_409848095">https://vk.com/doc28047_409848095</a> – free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes.</p>
<p>6. Дымшиц Г. М. Основные начала молекулярной биологии: 25 иллюстрированных лекций. Новосибирск: Издательско-полиграфический центр НГУ, 2018.— 179 с.   <a href="https://e-lib.nsu.ru/reader/bookView.html?params=UmVzb3VyY2UtMzQ5OQ/cGFnZTAwMQ&amp;q=%D0%B4%D1%8B%D0%BC%D1%88%D0%B8%D1%86">https://e-lib.nsu.ru/reader/bookView.html?params=UmVzb3VyY2UtMzQ5OQ/cGFnZTAwMQ&amp;q=%D0%B4%D1%8B%D0%BC%D1%88%D0%B8%D1%86</a> - free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes.</p>

### Thematic block 6. Physicochemical research methods

Sources	Topic
<p>1. Ahern, K., Rajagopal I., Tan, T. Oregon State University. 2018.   <a href="https://open.umn.edu/opentextbooks/textbooks/866">https://open.umn.edu/opentextbooks/textbooks/866</a> – free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>

<p>2. Principles of Biochemistry. Wikibooks, 2011.  <a href="https://en.wikibooks.org/wiki/Principles_of_Biochemistry">https://en.wikibooks.org/wiki/Principles_of_Biochemistry</a> – free access</p>	<p>Proteins, lipids, nucleic acids.          Functions of proteins. Enzymes.          Enzyme kinetics. Cell metabolism, cellular respiration, photosynthesis.          DNA replication, DNA repair.          DNA sequencing. Transcription.          Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>
<p>3. Nelson D. L. Lehninger Principles of Biochemistry 8th Edition. W.H. Freeman, 2021 - 1248 p.  <a href="https://www.amazon.com/Lehninger-Principles-Biochemistry-David-Nelson/dp/1319228003">https://www.amazon.com/Lehninger-Principles-Biochemistry-David-Nelson/dp/1319228003</a> – limited access</p>	<p>Proteins, lipids, nucleic acids.          Functions of proteins. Enzymes.          Enzyme kinetics. Cell metabolism, cellular respiration, photosynthesis.          DNA replication, DNA repair.          DNA sequencing. Transcription.          Regulation in prokaryotes and eukaryotes. Translation. Genetic</p>
<p>4. Clark, M. A., Douglas, M., Choi, J. Biology 2E. 2018. - <a href="https://openstax.org/details/books/biology-2e">https://openstax.org/details/books/biology-2e</a> - free access</p>	<p>Proteins, lipids, nucleic acids.          Functions of proteins. Enzymes.          Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair.          Transcription. Regulation in prokaryotes and eukaryotes.          Translation. Genetic code.</p>
<p>5. Альбертс Б., Джонсон А., Льюис Д., Рэфф М., Робертс К., Уолтер П. Молекулярная биология клетки. В 3 томах. Регулярная и хаотическая динамика, Институт компьютерных исследований.  <a href="https://vk.com/doc28047_409848095">https://vk.com/doc28047_409848095</a> – free access</p>	<p>DNA replication, DNA repair.          DNA sequencing. Transcription.          Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes.</p>
<p>6. Дымшиц Г. М. Основные начала молекулярной биологии: 25 иллюстрированных лекций. Новосибирск: Издательско- полиграфический центр НГУ, 2018.— 179 с. —   <a href="https://e-lib.nsu.ru/reader/bookView.html?params=UmVzb3VyY2UtMzQ5OQ/cGFnZTAwMQ&amp;q=%D0%B4%D1%8B%D0%BC%D1%88%D0%B8%D1%86">https://e-lib.nsu.ru/reader/bookView.html?params=UmVzb3VyY2UtMzQ5OQ/cGFnZTAwMQ&amp;q=%D0%B4%D1%8B%D0%BC%D1%88%D0%B8%D1%86</a> – free access</p>	<p>DNA replication, DNA repair.          DNA sequencing. Transcription.          Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes.</p>

### Thematic block 7. Genetic and cell technologies.

Sources	Topic
<p>1. Ahern, K., Rajagopal I., Tan, T. Oregon State University. 2018.</p> <p><a href="https://open.umn.edu/opentextbooks/textbooks/866">https://open.umn.edu/opentextbooks/textbooks/866</a> – free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>
<p>2. Principles of Biochemistry. Wikibooks, 2011. <a href="https://en.wikibooks.org/wiki/Principles_of_Biochemistry">https://en.wikibooks.org/wiki/Principles_of_Biochemistry</a> – free access</p>	<p>Proteins, lipids, nucleic acids. Functions of proteins. Enzymes. Enzyme kinetics. Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>
<p>3. Nelson D. L. Lehninger Principles of Biochemistry 8th Edition. W.H. Freeman, 2021 - 1248 p. <a href="https://www.amazon.com/Lehninger-Principles-Biochemistry-David-Nelson/dp/1319228003">https://www.amazon.com/Lehninger-Principles-Biochemistry-David-Nelson/dp/1319228003</a> – limited access</p>	<p>Proteins, lipids, nucleic acids. Functions of proteins. Enzymes. Enzyme kinetics. Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes</p>
<p>4. Clark, M. A., Douglas, M., Choi, J. Biology 2E. 2018. - <a href="https://openstax.org/details/books/biology-2e">https://openstax.org/details/books/biology-2e</a> - free access</p>	<p>Proteins, lipids, nucleic acids. Functions of proteins. Enzymes. Cell metabolism, cellular respiration, photosynthesis. DNA replication, DNA repair. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code.</p>
<p>5. Альбертс Б., Джонсон А., Льюис Д., Рэфф М., Робертс К., Уолтер П. Молекулярная биология клетки. В 3 томах. Регулярная и хаотическая динамика, Институт компьютерных исследований. <a href="https://vk.com/doc28047_409848095">https://vk.com/doc28047_409848095</a> – free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes.</p>

<p>6. Дымшиц Г. М. Основные начала молекулярной биологии: 25 иллюстрированных лекций. Новосибирск: Издательско- полиграфический центр НГУ, 2018.— 179 с. —</p> <p><a href="https://e-lib.nsu.ru/reader/bookView.html?params=UmVzb3VyY2UtMzQ5OQ/cGFnZTAwMQ&amp;q=%D0%B4%D1%8B%D0%BC%D1%88%D0%B8%D1%86">https://e-lib.nsu.ru/reader/bookView.html?params=UmVzb3VyY2UtMzQ5OQ/cGFnZTAwMQ&amp;q=%D0%B4%D1%8B%D0%BC%D1%88%D0%B8%D1%86</a> – free access</p>	<p>DNA replication, DNA repair. DNA sequencing. Transcription. Regulation in prokaryotes and eukaryotes. Translation. Genetic code. Regulation of protein synthesis by ribosomes in prokaryotes and eukaryotes.</p>
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## Recommended online courses

### Thematic block 1. Biotechnology

1. Chemical Biology (Coursera) <https://coursera.org/learn/chemical-biology>
2. Drug Development Product Management (Coursera) <https://coursera.org/specializations/drug-development-product-management>
3. Industrial Biotechnology (Coursera) <https://www.coursera.org/learn/industrial-biotech>
4. Industrial Biotechnology (Coursera) <https://www.coursera.org/learn/industrial-biotech>
5. Systems Biology and Biotechnology (Coursera) <https://www.coursera.org/specializations/systems-biology>

### Thematic block 2. Genetics, cellular, and general biology

1. Anatomy Specialization (Coursera) <https://www.coursera.org/specializations/anatomy>
2. Big Stuff: Evolution and Ecology (Coursera) <https://www.coursera.org/learn/the-big-stuff-evolution-and-ecology>
3. Ecology: Ecosystem Dynamics and Conservation (Coursera) <https://www.coursera.org/learn/ecology-conservation>
4. Genomics: Decoding the Universal Language of Life (Coursera) <https://coursera.org/learn/genomics-research>
5. Introduction to Genetics and Evolution (Coursera) <https://www.coursera.org/learn/genetics-evolution>
6. Science of Stem Cells (Coursera) <https://www.coursera.org/learn/stem-cells>
7. Understanding Plants - Part I: What a Plant Knows (Coursera) <https://coursera.org/learn/plantknows>
8. Understanding Plants - Part II: Fundamentals of Plant Biology (Coursera) <https://coursera.org/learn/plant-biology>

### Thematic block 3. Microbiology and virology

1. Bacteria and Chronic Infections (Coursera) <https://www.coursera.org/learn/bacterial-infections>
2. Biology Everywhere (Coursera) <https://coursera.org/specializations/biology-everywhere>
3. Epidemics - the Dynamics of Infectious Diseases (Coursera) <https://www.coursera.org/learn/epidemics>
4. Immunology: Immune system and Infectious Diseases (Coursera) <https://www.coursera.org/learn/immunology-immune-system-and-infectious-diseases>

**Thematic block 4. Physiology and immunology**

1. Biochemical Principles of Energy Metabolism (Coursera)  
<https://coursera.org/learn/energy-metabolism>
2. Fundamentals of Immunology (Coursera)  
<https://www.coursera.org/specializations/immunology>
3. Fundamentals of Immunology: T Cells and Signaling (Coursera)  
<https://coursera.org/learn/immunologyfundamentalstcellssignaling>
4. Introductory Human Physiology (Coursera) <https://www.coursera.org/learn/physiology>

**Thematic block 5. Biotechnology of polymers and biologically active substances**

1. Biochemical Principles of Energy Metabolism (Coursera)  
<https://www.coursera.org/learn/energy-metabolism>
2. Chemical Biology (Coursera) <https://coursera.org/learn/chemical-biology>
3. Industrial Biotechnology (Coursera) <https://coursera.org/learn/industrial-biotech>
4. Biochemistry Open & Free (Carnegie Mellon University)  
<https://oli.cmu.edu/courses/biochemistry-open-free/>

**Thematic block 6. Physicochemical research techniques**

1. Biochemical Principles of Energy Metabolism (Coursera)  
<https://www.coursera.org/learn/energy-metabolism>
2. Chemical Biology (Coursera) <https://coursera.org/learn/chemical-biology>
3. Industrial Biotechnology (Coursera) <https://coursera.org/learn/industrial-biotech>
4. Principles of Biochemistry (Harvard University) <https://pll.harvard.edu/course/principles-biochemistry-1>

**Thematic block 7. Genetic and cell technologies**

1. Biochemical Principles of Energy Metabolism (Coursera)  
<https://www.coursera.org/learn/energy-metabolism>
2. Chemical Biology (Coursera) <https://coursera.org/learn/chemical-biology>
3. Industrial Biotechnology (Coursera) <https://coursera.org/learn/industrial-biotech>
4. Cell Culture Technologies (IIT Kanpur)  
<https://www.classcentral.com/course/swayam-cell-culture-technologies-12891>