

## Master's, Doctoral, and Post-doctoral Track Program: Earth and Environmental Sciences

### 1. Open Doors winner's skill set

Winning the Open Doors competition requires:

- in-depth knowledge in the fields of geology, geophysics, geochemistry, meteorology, ecology, and geography;
- the laws of geology, the principles of electrical and seismic prospecting, and the chemical formulas of minerals; understand the methods of mineral exploration and deposit assessment;
- a solid understanding of the structure of the atmosphere and its interaction with other Earth spheres;

The winner is expected to demonstrate the ability to:

- analyze and interpret geological, geophysical, geochemical, geographical, meteorological, and ecological data;
- conduct measurements of meteorological parameters;
- identify minerals;
- apply remote sensing techniques to study the geographical environment and perform ecological mapping.

### 2. List of degree programs covered by the subject area

#### 2.1. List of doctoral degree programs

- 1.6.1 General and regional geology Geotectonics and geodynamics
- 1.6.9 Geophysics
- 1.6.11 Geology, prospecting, exploration and exploitation of oil and gas fields
- 1.6.12 Physical geography and biogeography, soil geography and landscape geochemistry
- 1.6.18 Atmosphere and climate sciences
- 1.6.20 Geoinformatics, cartography
- 1.6.21 Geoecology

#### 2.2 List of master's degree programs

- 05.04.01 Geology
- 05.04.02 Geography
- 05.04.03 Cartography and geoinformatics
- 05.04.04 Hydrometeorology
- 05.04.06 Ecology and nature resource management
- 21.04.01 Oil and gas engineering

### 3. Content

#### Field of science 1. Geology

**1. Introduction to Geology.** Subject, objectives, and methods of geology. Main branches of geology and their interconnection. The role of geology in human life. Structure and composition of the Earth. Internal structure of the Earth (crust, mantle, core). Minerals and rocks as the basis of the lithosphere. Physical properties of the Earth (gravity, magnetic field, heat). Geological processes: endogenous processes (tectonics, magmatism, metamorphism, earthquakes); exogenous processes (weathering, erosion, sedimentation). The influence of geological processes on landforms. Geochronology and stratigraphy. The age of the Earth and methods for its determination (relative and absolute geochronology). Geological time scale. Basic principles of stratigraphy. Plate tectonics. Theory of lithospheric plates. Types of plate boundaries (divergent, convergent, transform). Examples of modern tectonic processes. Mineral

#### PROGRAM

resources. Classification of mineral resources. Conditions for deposit formation. The main mineral and raw material resources of the world.

**2. Geological structure of the continents.** Major geological structures (platforms, fold belts). Geological features of Eurasia, Africa, North and South America. Geology of Russia and neighboring territories. Major tectonic structures (East European Platform, Siberian Platform, Urals, Caucasus). Main mineral deposits. Geology of the oceans. Structure of the oceanic crust. Mid-ocean ridges and deep-sea trenches. Applied aspects of regional geology. Geological mapping. Assessment of natural hazards (earthquakes, volcanism, landslides).

#### Field of science 2. Geochemistry and Geophysics

**1. Geochemistry.** Introduction to geochemistry. Subject, objectives, and methods of geochemistry. Main branches of geochemistry (isotopic, organic, environmental, etc.). Chemical composition of the Earth and the cosmos. Abundance of elements in the Universe. Composition of the Earth: core, mantle, crust. Geochemical processes: migration of elements (mechanisms, factors), differentiation of matter in geospheres, geochemical cycles (carbon, nitrogen, sulfur, etc.). Isotope geochemistry. Stable and radioactive isotopes. Geochronology. Isotopic indicators in geology and ecology. Organic geochemistry. Geochemistry of oil, gas, and coal. Biomarkers and their significance. The role of living matter in geochemical processes. Applied geochemistry. Geochemical methods of mineral exploration.

**2. Geophysics.** Introduction to geophysics. Subject, objectives, and methods of geophysics. Main branches (exploration, seismology, gravimetry, etc.). The role of geophysics in the study of the Earth and mineral exploration. Physical properties of the Earth. Earth's gravitational field. Magnetic field (paleomagnetism, magnetic anomalies). Earth's thermal field (geothermal gradient, heat flow). Seismology and seismic exploration. Nature of earthquakes, types of seismic waves. Methods of seismic exploration (reflected and refracted waves). Gravity and magnetic exploration. Gravimetric measurements. Magnetic properties of rocks. Application in mineral exploration. Electrical exploration. Resistivity and induced polarization methods. Electromagnetic soundings. Application in hydrogeology and engineering geology. Applied geophysics. Exploration of oil, gas, and solid mineral resources. Geophysical well logging.

#### Field of science 3. Meteorology and Atmospheric Science

**1. Basics of Meteorology.** Introduction to meteorology. Subject, objectives, and methods of meteorology. Main branches of atmospheric sciences. Structure and composition of the atmosphere. Vertical structure (troposphere, stratosphere, mesosphere, thermosphere). Chemical composition of air (constant and variable components). Physical properties of the atmosphere. Atmospheric pressure and the barometric equation. Air temperature and its distribution. Air humidity and its characteristics. Atmospheric thermodynamics. Adiabatic processes in the atmosphere. Cloud formation and condensation.

**2. Atmospheric Processes and Phenomena.** Atmospheric circulation. Global circulation. Trade winds, monsoons, jet streams. Atmospheric fronts and cyclones. Warm and cold fronts. Cyclones and anticyclones. Tropical cyclones (hurricanes, typhoons). Clouds and precipitation. Cloud classification (by shape and altitude). Mechanisms of precipitation formation. Hazardous meteorological phenomena: thunderstorms, tornadoes, squalls. Hail, ice storms, blizzards. Droughts and abnormal heat.

**3. Climatology and Climate Change.** Fundamentals of climatology. Difference between weather and climate. Climate-forming factors. Climate classification. Global climate processes. Influence of oceans on climate. Climate change. Anthropogenic influence (greenhouse effect, CO<sub>2</sub> emissions). Current climate trends.

#### Field of science 4. Environmental Sciences

#### PROGRAM

1. **Fundamentals of Ecology.** Interaction of organisms with each other and the environment. Properties and structure of populations. Influence of environmental factors on organisms. Ecology of communities. Structure of ecosystems. Succession. Biological diversity. Nature Management: natural conditions and resources. Types of nature management. Ecological and economic approach to solving problems of nature management. Ecological aspects of nature management.
2. Application of geographic information systems (GIS).

#### Field of science 5. Physical geography

1. **Introduction to Physical Geography.** Subject and structure of physical geography. Main branches: geomorphology, climatology, hydrology, biogeography, soil science. Connection with other sciences (geology, ecology, meteorology). Modern research methods (GIS, remote sensing). The biosphere and soil science.
2. **The Biosphere and Its Boundaries.** Distribution of living organisms on Earth. Natural zones of the Earth. Law of geographical zonality. Characteristics of tundra, taiga, steppes, deserts, humid tropical forests. Soils and soil formation. Factors of soil formation (climate, relief, parent rock). Soil classification (chernozems, podzolic soils, lateritic/red soils).
3. **Physical-Geographical Zoning.** Principles of physical-geographical zoning. Taxonomic units (zones, regions, provinces). Landscape-based approach. Physical geography of continents and oceans. Natural features of Eurasia, Africa, North and South America, Australia, Antarctica. Specifics of oceanic landscapes. Physical geography of Russia. Natural zones of Russia. Major physical-geographical regions (East European Plain, the Urals, Siberia, the Far East).
4. **Contemporary Issues in Physical Geography.** Interaction between nature and society. Anthropogenic impact on natural systems. Nature conservation and protected areas. Applied aspects of physical geography. Geographical foundations of natural resource use. Forecasting natural disasters (floods, eruptions, hurricanes). Global environmental changes. Soil degradation, deforestation, desertification. Impact of urbanization on natural landscapes.

#### Field of science 6. Ecology

1. **Fundamentals of Ecology.** Introduction to ecology. Definition, subject, and objectives of ecology. Environmental factors and organism adaptations. Abiotic factors (temperature, light, humidity, soil) and biotic factors. Adaptations of organisms to their habitat. Ecosystems and their structure. Components of ecosystems: producers, consumers, decomposers. Food chains and food webs. Biogeochemical cycles. Cycles of carbon, nitrogen, phosphorus, and water. Role of living organisms in the circulation of matter.
2. **The Biosphere and Global Ecology.** The concept of the biosphere. Boundaries of the biosphere and its evolution. Global environmental problems. Climate change (greenhouse effect, anthropogenic influence). Ozone layer depletion. Biodiversity loss. Natural resources and their use. Classification of resources (renewable and non-renewable).
3. **Anthropogenic Ecology.** Environmental pollution. Air pollution (acid rain, smog, greenhouse gases). Water pollution (oil, heavy metals, microplastics). Soil pollution (pesticides, industrial waste). Urban ecology. The impact of urbanization on natural ecosystems. Problems of noise, air pollution, and green spaces. Industrial ecology. Environmental management at enterprises. Clean technologies and emission reduction.
4. **Nature Conservation and Sustainable Development.** Specially protected natural areas. Nature reserves, national parks, wildlife refuges. Red Books and conservation of rare species. Environmental policy and law. International conventions. Environmental legislation in different countries. Sustainable development. UN Sustainable Development Goals.

#### Field of science 7. Mining and Mineral Processing

#### PROGRAM

**1. Introduction to Mining.** Basic concepts and terminology. Classification of mineral resources (metallic, non-metallic, fuel and energy). Geological exploration and deposit assessment. Methods for prospecting and exploration of mineral deposits. Reserve estimation and assessment of the economic efficiency of deposits. Legal and environmental aspects of extraction. Licensing of subsoil use. Environmental requirements and land reclamation.

**2. Methods of Mineral Extraction.** Open-pit mining. Open-cast mining technologies (quarries, strip mines). Main equipment (excavators, bulldozers, dump trucks). Underground mining. Driving mine workings. Ensuring safety in underground operations. Offshore extraction. Technologies for oil and gas extraction on the continental shelf.

**3. Mineral Processing.** Ore beneficiation. Crushing, grinding, and classification. Gravity, magnetic, and flotation methods of beneficiation. Features of processing various types of ores. Metal leaching (acidic, bacterial). Extraction and electrolysis. Processing of non-metallic mineral resources. Processing of mining and chemical raw materials. Processing of fuel minerals. Coal preparation (sorting, beneficiation). Oil and gas processing.

**4. Development of Oil Fields.** Reservoir drive mechanisms. Water drive, gas drive, elastic, gravity, and mixed. Factors influencing the choice of development system. Development systems. Waterflooding and enhanced oil recovery (EOR) methods. Horizontal wells and multilateral drilling. Hydraulic fracturing (fracking). Well operation. Flowing, gas lift, and pumping methods of production. Production equipment. Enhanced oil recovery methods (EOR). Thermal, chemical, and gas methods. Microbiological stimulation of the reservoir.

#### 4. Preparation materials

##### 4.1. Recommended reading

##### Field of science 1. Geology

###### Reading list in English

1. Earth Science. Allison M.A., DeGaetano A.T., Pasachoff J.M. (eds.). Book. Holt, Rinehart and Winston, 2006. 954 p.

URL://

[https://images.pcmac.org/SiSFiles/Schools/AL/TallasseeCitySchools/TallasseeHigh/Uploads/DocumentsCategories/Documents/ES\\_BOOK.pdf](https://images.pcmac.org/SiSFiles/Schools/AL/TallasseeCitySchools/TallasseeHigh/Uploads/DocumentsCategories/Documents/ES_BOOK.pdf)

2. Kearey P., Klepeis K.A., Vine F.J. Global Tectonics. 3d Edition. Wiley-Blackwell, UK, 2009. 495 p.

URL:// <https://www.geokniga.org/bookfiles/geokniga-global-tectonics.pdf>

3. Scotese C.R. Palaeogeography Atlas. Paleomap Progress Report 90-0497, Dept. Geology, Univ of Texas at Arlington. Texas, 1997. 45 p.

URL:// <http://www.scotese.com/earth.htm>

4. Superplumes. Eds D.A. Yuen, Sh. Maruyama, B.F. Windley. Springer, 2007. 510 p. URL:// <https://www.geokniga.org/books/35927>

##### Field of science 2. Geochemistry and Geophysics

###### Reading list in English

1. Bacon M., Simm R., Redshaw T. 3D Seismic interpretation. Cambridge University Press, 2003. 224 p.

URL:// [https://ahmedrehanhashmi.wordpress.com/wp-content/uploads/2016/06/3d\\_seismic\\_interpretation\\_bacon-et-al.pdf](https://ahmedrehanhashmi.wordpress.com/wp-content/uploads/2016/06/3d_seismic_interpretation_bacon-et-al.pdf)

2. Liu H. Principles and Applications of Well Logging. Berlin: Springer, 2017. 372 p.

URL:// [http://ndl.ethernet.edu.et/bitstream/123456789/16763/1/Hongqi%20Liu\\_2017.pdf](http://ndl.ethernet.edu.et/bitstream/123456789/16763/1/Hongqi%20Liu_2017.pdf)

4. White W.M. Geochemistry. Wiley-Blackwell, 2005. 714 p.

URL:// <https://sbgeo.org.br/books/white%202005.pdf>

**Field of science 3. Meteorology and Atmospheric Science****Reading list in English**

1. Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.). IPCC, 2019. 906 p. URL: <https://research.fit.edu/media/site-specific/researchfit.edu/coast-climate-adaptation-library/global/ipcc-reports/IPCC.--2020.--CC--Land.pdf>
2. Spiridonov V., Čurić V. Fundamentals of Meteorology. Springer Nature Switzerland AG, 2021. 437 p. URL: <https://link.springer.com/book/10.1007/978-3-030-52655-9>
3. The Atmosphere An Introduction to Meteorology. F.K. Lutgens, E.J. Tarbuck, R.L. Herman (eds.). New York: Pearson, 2018. 1912 p. URL: <https://bpb-us-e1.wpmucdn.com/journeys.dartmouth.edu/dist/f/8272/files/2021/12/Meteorology-Textbook-compressed.pdf>

**Field of science 4. Environmental Sciences****Reading list in English**

1. Galperin, M.V. Ecological foundations of nature management: Textbook. 2nd ed. corr. - M.: FORUM: INFRA-M, 2005. - 256 p. URL: <https://api.libraryksu.kg/elibrary/books/Galperin%20M0244.pdf> (free access)
2. Ecology: a textbook / V.A. Deryabin, E.P. Farafontova. - Ekaterinburg: Publishing house of the Ural. University, 2016. - 136 p. URL: [https://elar.urfu.ru/bitstream/10995/40644/1/978-5-7996-1613-7\\_2016.pdf](https://elar.urfu.ru/bitstream/10995/40644/1/978-5-7996-1613-7_2016.pdf) (free access)
3. Fedotova, E. L. Information technologies in science and education: a tutorial / E. L. Fedotova, A. A. Fedotov. - Moscow: FORUM: INFRA-M, 2019. - 335 p. URL: <https://kpfu.ru/portal/docs/F1502929774/GIS.pdf>
4. Tsipileva T.A. Geoinformation systems: Textbook. - Tomsk: Tomsk Interuniversity Centre of Distance Education, 2004. - 162 p. URL: <https://www.geokniga.org/bookfiles/geokniga-geoinformacionnye-sistemyuchebnoe-posobietomsktmcd02004cpileva-ta.pdf> (free access)

**Field of science 5. Physical Geography****Reading list in English**

1. Current Trends in Landscape Research. L. Mueller, F. Eulenstein (eds.). Book. Springer Nature Switzerland, 2019. 680 p. URL: <https://link.springer.com/book/10.1007/978-3-030-30069-2> (free access)
2. Earth Science. Allison M.A., DeGaetano A.T., Pasachoff J.M. (eds.). Book. Holt, Rinehart and Winston, 2006. 954 p. URL: [https://images.pcmac.org/SiSFiles/Schools/AL/TallasseeCitySchools/TallasseeHigh/Uploads/DocumentsCategories/Documents/ES\\_BOOK.pdf](https://images.pcmac.org/SiSFiles/Schools/AL/TallasseeCitySchools/TallasseeHigh/Uploads/DocumentsCategories/Documents/ES_BOOK.pdf) (free access)
3. Fundamentals of Physical Geography. J. Petersen, D. Sack, R.E. Gabler (eds.). Brooks/Cole. 2nd edition, 2014. 479 p. URL: <https://www.geokniga.org/books/37865> (free access)
4. Mapping Empires: Colonial Cartographies of Land and Sea. A.J. Kent, S. Vervust, I.J. Demhardt, N. Millea (eds.). 7th International Symposium of the ICA Commission on the History of Cartography. Springer Nature Switzerland, 2018. 321 p. URL: <https://content.e-bookshelf.de/media/reading/L-12676699-1a6955472a.pdf8> (free access)

**Field of science 6. Ecology****Reading list in English**

1. Mehra R.K. Textbook of Soil Science. Indian Council of Agricultural Research, 2004. 486 p. URL:// <https://archive.org/details/textbookofsoilsc00unse/page/24/mode/2up>
2. Odum E. P. Ecology, the link between the natural and the social sciences. Oxford and IBH Publishing, 1975. – 260 p. URL: <https://archive.org/details/ModernBiologySeriesEugenePleasantsOdumEcologyTheLinkBetweenTheNaturalAndTheSocial/page/n5/mode/2up>
3. Tomich T.P., Brodt S., Ferris H., Galt R., Horwath W.R., Kebeab E., Leveau J.H.J., Liptzin D., Lubell M., Merel P., Michelmore R., Rosenstock T., Scow K., Six J., Williams N., Yang L. Agroecology: A Review from a Global-Change Perspective. Annu. Rev. Environ. Resour., 36. 2011. p. 193–222. URL:// [https://www.researchgate.net/publication/228243656\\_Agroecology\\_A\\_Review\\_from\\_a\\_Global-Change\\_Perspective](https://www.researchgate.net/publication/228243656_Agroecology_A_Review_from_a_Global-Change_Perspective)

**Field of science 7. Mining and Mineral Processing****Reading list in English**

1. Fanchi J.R., Christiansen R.L. Introduction to Petroleum Engineering. Hoboken: Wiley, 2017. 335 p. URL:// <https://content.e-bookshelf.de/media/reading/L-8110201-84ac76ca03.pdf>
2. Geological Methods in Mineral Exploration and Mining. Second Edition. R. Marjoribanks (ed.). Springer-Verlag Berlin Heidelberg, 2010. 248 p. URL:// <https://www.geokniga.org/bookfiles/geokniga-geological-methods-mineral-exploration-and-mining.pdf>
3. Kessler H., Turner A.K., van der Meulen M.J. Applied multidimensional geological modeling. Wiley Blackwell, 2021. 674 p., ISBN: 978-1119163121. URL:// <https://www.geokniga.org/books/24778>
4. Marjoribanks R. Geological methods in mineral exploration and mining. Springer, 2010. 247 p. URL:// <https://www.geokniga.org/books/22451>
5. Tricks to creating a resource block model. WSP, 2015, 75. URL:// <https://www.geokniga.org/books/34831>
6. Yang X.-Sh. Mathematical modelling for Earth sciences. Dunedin, 2008. 320 p., ISBN: 978-1-903765-92-0. URL:// <https://www.geokniga.org/books/27617>

**4.2. Recommended online courses****Field of science 1. Geology**

Online courses in English	Link	Course description
An introduction to geology	<a href="https://www.open.edu/openlearn/science-maths-technology/an-introduction-to-geology/content-section-overview?active-tab=description-tab">https://www.open.edu/openlearn/science-maths-technology/an-introduction-to-geology/content-section-overview?active-tab=description-tab</a>	This course introduces key geological processes that shape everyday life, revealing connections such as the link between volcanic activity and mobile phone components, and the role of microscopic marine organisms in the plastics industry. Students will examine various rock types and investigate how, where, and why different rocks and natural resources form across the Earth. The course also addresses

## PROGRAM

		environmental and sustainability considerations relevant to the extraction and processing of these resources.
Geology – Geoscience and the Origins of the Earth	<a href="https://www.classcentral.com/classroom/youtube-geology-geoscience-and-the-origins-of-the-earth-137865/64097d7e73668">https://www.classcentral.com/classroom/youtube-geology-geoscience-and-the-origins-of-the-earth-137865/64097d7e73668</a>	This course offers an introduction to geological time, including how it is defined and measured by geologists. Students will also explore the internal structure of the Earth and examine the types of rocks that make up the planet.
Petrology	<a href="https://ocw.mit.edu/courses/12-109-petrology-fall-2005/">https://ocw.mit.edu/courses/12-109-petrology-fall-2005/</a>	This undergraduate petrology course surveys the distribution, chemical composition, and mineral associations in rocks of the Earth's crust and upper mantle, and establishes its relation to the tectonic environment. The emphasis of the course is on the use of chemistry and physics to interpret rock-forming processes.
Physical Geology	<a href="https://study.com/academy/course/physical-geology-course.html">https://study.com/academy/course/physical-geology-course.html</a>	Upon completion of this course, students will be able to identify and describe the various branches of geological study. Students will also be able to compare and contrast the physical properties of metals, minerals, and rocks—including sedimentary, igneous, and metamorphic types—and understand the roles they play in sustaining life on Earth.
Relative Dating	<a href="https://www.youtube.com/watch?v=Tpg6M3W8-sg&amp;ab_channel=SethHorowitz">https://www.youtube.com/watch?v=Tpg6M3W8-sg&amp;ab_channel=SethHorowitz</a>	This video explores 8 rules used by geologists and paleontologists to determine the relative age of rocks, fossils and various geologic events.
Seismic tomography	<a href="https://openedu.ru/course/nsu/Seismography/?session=2024_apr_dec">https://openedu.ru/course/nsu/Seismography/?session=2024_apr_dec</a>	The course provides an introduction to the fundamentals of seismology, including practical applications of technical tools and software. It is designed for geophysicists, mathematicians, geologists, geochemists, petrologists, engineers, and other interested individuals. Participants will gain access to the author's research methods and scientific algorithms widely employed by seismologists globally.

## Field of science 2. Geochemistry and geophysics

Online courses in English	Link	Course description
Earthquake Seismology	<a href="https://onlinecourses.nptel.ac.in/noc23_ce104/preview">https://onlinecourses.nptel.ac.in/noc23_ce104/preview</a>	The course explores the processes that cause earthquakes, as well as the methodologies used by seismologists to analyze seismograms, to measure source parameters,



# PROGRAM

		and to simulate the seismic wave impact at the Earth's surface.
Essentials of Geophysics	<a href="https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/">https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/</a>	This course is designed to be a survey of the various subdisciplines of geophysics (geodesy, gravity, geomagnetism, seismology, and geodynamics) and how they might relate to or be relevant for other planets.
Introduction to Applied Geostatistics	<a href="https://www.youtube.com/watch?v=HgqBocDr3G0&amp;list=PLhQwqg2sX-z1bVKAqahyyyY16myeDTelo">https://www.youtube.com/watch?v=HgqBocDr3G0&amp;list=PLhQwqg2sX-z1bVKAqahyyyY16myeDTelo</a>	The course covers the fundamentals of mathematical statistics, interpolation techniques, and stochastic modeling methods.
Seismic to well tie	<a href="https://www.youtube.com/watch?v=mDdvOrIU6K8&amp;list=PLhQwqg2sX-z3rgS_fd5pbwoYaUHIJBdwy">https://www.youtube.com/watch?v=mDdvOrIU6K8&amp;list=PLhQwqg2sX-z3rgS_fd5pbwoYaUHIJBdwy</a>	In this course, students will acquire theoretical knowledge in the field of seismic data interpretation, as well as practical skills in kinematic and dynamic interpretation of seismic data.
Trace Element Geochemistry	<a href="https://ocw.mit.edu/courses/12-479-trace-element-geochemistry-spring-2013/">https://ocw.mit.edu/courses/12-479-trace-element-geochemistry-spring-2013/</a>	This course focuses on the application of trace element geochemistry to investigate the origin and evolution of igneous rocks. Emphasis is placed on examining the physicochemical parameters that control the partitioning of trace elements between different phases, particularly between minerals and melt. The course also covers the development and application of quantitative models to describe and interpret trace element distribution in igneous systems.
Well log interpretation. Introduction to well logging	<a href="https://www.youtube.com/watch?v=ARgTlgeUhuE&amp;list=PLhQwqg2sX-z34sjrZzYxWewQrLaQP3EA0">https://www.youtube.com/watch?v=ARgTlgeUhuE&amp;list=PLhQwqg2sX-z34sjrZzYxWewQrLaQP3EA0</a>	Upon completion of this course, students will gain knowledge about modern methods of processing and interpreting well logs, as well as automated interpretation of well logging data in modern software products.

Код поля изменен

Код поля изменен

## Field of science 3. Meteorology and Atmospheric Science

Online courses in English	Link	Course description
Climate change	<a href="https://www.open.edu/openlearn/nature-environment/climate-change/content-section-0?active-tab=description-tab">https://www.open.edu/openlearn/nature-environment/climate-change/content-section-0?active-tab=description-tab</a>	Climate change is a key issue on today's social and political agenda. This free course explores the basic science that underpins climate change and global warming.
Climate Change Lecture	<a href="https://www.youtube.com/watch?v=3stTozERusk&amp;ab_channel=StanfordUnderstandEnergy">https://www.youtube.com/watch?v=3stTozERusk&amp;ab_channel=StanfordUnderstandEnergy</a>	This lecture explores the interconnections between energy and climate change, emphasizing energy as a complex system that profoundly influences human development, environmental sustainability, and economic processes. It aims to enhance



#### PROGRAM

		energy literacy by examining a wide range of energy sources—from fossil fuels like oil and coal to renewable resources such as wind and solar power.
Introduction to Wind, Clouds, and Weather Services	<a href="https://alison.com/course/introduction-to-wind-clouds-and-weather-services">https://alison.com/course/introduction-to-wind-clouds-and-weather-services</a>	This free online meteorology course delves into the different forces associated with wind, which can significantly affect events on land and sea. The course demonstrates how to measure wind speed and atmospheric pressure, introducing the Beaufort scale of wind force and Buys Ballot's law. It is particularly beneficial for aspiring seafarers, pilots, and meteorologists, as it examines the formation of clouds and fog and assesses their impact on visibility.
Retaining an Atmosphere	<a href="https://www.youtube.com/watch?v=Gie8L8slnSs&amp;list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s">https://www.youtube.com/watch?v=Gie8L8slnSs&amp;list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s</a>	This course covers the following topics: mechanisms of pressure perception; escape velocity and molecular velocity distributions; the presence or absence of atmospheres on various planets and the underlying causes; planetary characteristics relevant to atmospheric retention; and the vertical temperature profile of planetary atmospheres.

#### Field of science 4. Environmental Sciences

Online courses in English	Link	Course description
Environmental Standards and Norms for Sustainability	<a href="https://stepik.org/course/74537/promo">https://stepik.org/course/74537/promo</a>	The course focuses on the key issues related to the development and implementation of environmental standards and regulations aimed at promoting sustainable development. It is designed to reflect the latest advances, considering the rapidly evolving information about the state of the environment and emerging theories on the interaction between human society and the natural world. Additionally, the course emphasizes the importance of understanding the progress of environmental standardization and legislation across different countries.
Climate change and renewable energy	<a href="https://www.open.edu/openlearn/nature-environment/environmental-studies/climate-change-and-renewable-energy/content-section-0?active-tab=description-tab">https://www.open.edu/openlearn/nature-environment/environmental-studies/climate-change-and-renewable-energy/content-section-0?active-tab=description-tab</a>	This course describes the basic science of the greenhouse effect and how it has been modified by human activities such as the burning of fossil fuels. It describes the large cuts in greenhouse gas emissions that will be required to stabilise the global climate, the role of international climate change negotiations and the need for an energy

# PROGRAM

		transition away from fossil fuels to renewable energy sources.
Could we control our climate?	<a href="https://www.open.edu/openlearn/science-maths-technology/could-we-control-our-climate/content-section-overview?active-tab=description-tab">https://www.open.edu/openlearn/science-maths-technology/could-we-control-our-climate/content-section-overview?active-tab=description-tab</a>	This free course explores a future scenario in which humanity has taken radical measures to address the climate crisis by employing climate engineering—using technology to ‘adjust the planet’s thermostat.’ The course aims to enhance understanding of the complexities surrounding humanity’s response to climate change. It provides a foundational introduction to the mathematics of climate science to clarify the nature of the problem, followed by an examination of potential engineering solutions.

## Field of science 5. Physical Geography

Online courses in English	Link	Course description
Aeolian (Arid & Deserts) Geomorphology. Physical Geography with Professor Patrich	<a href="https://www.youtube.com/watch?v=c1nr-8SdRFc">https://www.youtube.com/watch?v=c1nr-8SdRFc</a>	This lecture introduces the classification of aridity and the landforms characteristic of arid environments. It covers processes such as erosion, transportation, and deposition of sediments, along with the geomorphic features resulting from these processes. Additionally, the lecture examines sand transport mechanisms, the morphology of dunes, and the identification of six distinct dune types in the field.
Cartography	<a href="https://www.classcentral.com/classroom/youtube-cartography-59085">https://www.classcentral.com/classroom/youtube-cartography-59085</a>	This is a series of tutorials and quick tips and tricks for making maps, including how to create an animated route on a map using Photoshop and export it to video; how to quickly import a spreadsheet and create an interactive map in Google Fusion Tables; an introduction to the Werner and Bonne map projections; and an overview of the different elements that make up a map, such as the map frame, inset or locator map, title, legend, scale bar, north arrow or compass rose, and neatline.
Introduction to Biogeography	<a href="https://alison.com/course/introduction-to-biogeography">https://alison.com/course/introduction-to-biogeography</a>	The course explores the intricacies of species distribution, environmental impacts, and conservation issues. It provides skills that enable innovative solutions and foster meaningful contributions to the field of biogeography.
Introduction to Physical Geography. OER	<a href="https://www.youtube.com/watch?v=A-4-_0-jD2g">https://www.youtube.com/watch?v=A-4-_0-jD2g</a>	This lecture introduces the concepts of latitude and longitude, grids, and

#### PROGRAM

Units 1-4 Overview		understanding spatial position on Earth and in space.
Introduction to Physical Geography. Physical Geography with Professor Patrich	<a href="https://www.youtube.com/watch?v=f4KrefebLxg&amp;t=71s">https://www.youtube.com/watch?v=f4KrefebLxg&amp;t=71s</a>	This lecture provides a comprehensive overview of geography's contributions to the scientific disciplines, presents the range of courses offered within the field, and explores the role of critical thinking as applied through the scientific method.
Introduction to Your Course. Physical Geography with Prof. Jeremy Patrich 2021	<a href="https://www.youtube.com/watch?v=vBHr6XCPIRo&amp;list=PLZKcAeoj7_LIAXsuw7h89jxYjmI3h17Ms">https://www.youtube.com/watch?v=vBHr6XCPIRo&amp;list=PLZKcAeoj7_LIAXsuw7h89jxYjmI3h17Ms</a>	This course offers a spatial analysis of the Earth's dynamic physical systems and processes. Key topics include Earth-Sun geometry, weather patterns, climate dynamics, hydrology, landforms, soil characteristics, and the biosphere. Additionally, essential tools of geographic inquiry are introduced, encompassing maps, remote sensing, Geographic Information Systems (GIS), and Global Positioning Systems (GPS).
Reasons for Earth's Seasons   Physical Geography with Professor Patrich	<a href="https://www.youtube.com/watch?v=R9YsgF-EywY">https://www.youtube.com/watch?v=R9YsgF-EywY</a>	This lecture introduces the multifaceted concepts of the seasons. The discussion covers the Earth's axial tilt, variations in daylight duration, solar intensity and its temporal distribution, as well as the orbital positions of aphelion and perihelion.
Physical Geography Lectures with Anisa Zafar	<a href="https://www.youtube.com/playlist?list=PLAQDR9nebkU7L_hzEScNorggVXsyWz5-V">https://www.youtube.com/playlist?list=PLAQDR9nebkU7L_hzEScNorggVXsyWz5-V</a>	The video introduces temperature terminology, various temperature scales (Celsius, Fahrenheit, Kelvin), instruments for measuring temperature such as mercury and alcohol thermometers, and the fundamental principles of temperature regulation.

#### Field of science 6. Ecology

Online courses in English	Link	Course description
Biological Diversity	<a href="https://stepik.org/course/114959">https://stepik.org/course/114959</a>	The course offers a comprehensive overview of the theoretical foundations of biological diversity, evolution, and ecosystem dynamics, alongside the methodologies used for calculating and estimating biodiversity. It covers essential techniques for assessing alpha, beta, and gamma diversity estimation techniques.
Environmental Standards and Norms for Sustainability (Stepik)	<a href="https://stepik.org/course/74537">https://stepik.org/course/74537</a>	The course addresses the fundamental challenges involved in developing and applying environmental standards and regulations to ensure sustainable development.

# PROGRAM

Ecology	<a href="https://www.youtube.com/watch?v=sjE-Pkjp3u4&amp;list=PL8dPuuaLjXtNdTKZkV_GiIYXpV9w4WxbX&amp;ab_channel=CrashCourse">https://www.youtube.com/watch?v=sjE-Pkjp3u4&amp;list=PL8dPuuaLjXtNdTKZkV_GiIYXpV9w4WxbX&amp;ab_channel=CrashCourse</a> or <a href="https://rutube.ru/video/25c319db3e0430d3a378bb100eff9fa2/?r=wd">https://rutube.ru/video/25c319db3e0430d3a378bb100eff9fa2/?r=wd</a>	The course examines the interactions among living organisms and their influence on one another and the environment. It provides an understanding of how living systems function, as well as their origin, development, and diversification throughout the 4.5 billion-year history of the Earth.
Ecology: from cells to Gaia	<a href="https://stepik.org/course/114944">https://stepik.org/course/114944</a>	This course reviews fundamental ecological concepts, introduces the methodologies employed by ecologists, provides an overview of both local and global environmental challenges, and examines the roles of individuals, communities, and governments in the conservation of natural ecosystems.
Environment: understanding atmospheric and ocean flows	<a href="https://www.open.edu/openlearn/nature-environment/environment-understanding-atmospheric-and-ocean-flows/content-section-0?active-tab=description-tab">https://www.open.edu/openlearn/nature-environment/environment-understanding-atmospheric-and-ocean-flows/content-section-0?active-tab=description-tab</a>	This course examines key mechanisms of atmospheric transport, with wind serving as the fastest carrier. It is grounded in the fundamental principle of global atmospheric circulation: warm air rises while cold air sinks. The course explores how this principle practically influences atmospheric dynamics and the movement of water. Using the polar bear as an emblematic case study, it investigates how global flows of water, heat, and pollutants impact the Arctic region and drive broader environmental changes worldwide.
Ice and climate change	<a href="https://www.youtube.com/watch?v=F8IK-Ja7qtI&amp;list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s&amp;index=25&amp;ab_channel=YaleCourses">https://www.youtube.com/watch?v=F8IK-Ja7qtI&amp;list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s&amp;index=25&amp;ab_channel=YaleCourses</a> or <a href="https://oyc.yale.edu/geology-and-geophysics/gg-140/lecture-25">https://oyc.yale.edu/geology-and-geophysics/gg-140/lecture-25</a>	This lecture addresses paleoclimate, with a focus on climatic changes over the past five million years. Topics include mountain glaciers, trends in Greenland's ice sheets, satellite-based ice measurements, geomorphological evidence, the Last Glacial Maximum, and the application of stable water isotopes in climate reconstruction.
Introducing the environment: Ecology and ecosystems	<a href="https://www.open.edu/openlearn/nature-environment/environmental-studies/introducing-the-environment-ecology-and-ecosystems/content-section-0?intro=1">https://www.open.edu/openlearn/nature-environment/environmental-studies/introducing-the-environment-ecology-and-ecosystems/content-section-0?intro=1</a>	This course begins with an examination of ecosystems and their living and non-living components. Humans are both members and manipulators of the ecosystems they inhabit, intrinsically connected to the biosphere. We have been shaped by it, live within it, and are increasingly altering it in ways not yet fully comprehended. The course concludes by introducing the concept of 'ecological

## PROGRAM

		health,' highlighting concerns that escalating resource exploitation threatens ecosystems' capacity for self-sustainability
Plant Protection	<a href="https://stepik.org/course/74464">https://stepik.org/course/74464</a>	This course introduces the fundamentals of protecting cereal crops from various environmental challenges through integrated pest management strategies. It also covers the basic principles of crop protection within agricultural systems, emphasizing sustainable and effective approaches.
Renewable Energy	<a href="https://www.youtube.com/watch?v=IQuyMgwQqM0&amp;list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s&amp;index=34&amp;ab_channel=YaleCourses">https://www.youtube.com/watch?v=IQuyMgwQqM0&amp;list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s&amp;index=34&amp;ab_channel=YaleCourses</a> or <a href="https://oyc.yale.edu/geology-and-geophysics/gg-140/lecture-34">https://oyc.yale.edu/geology-and-geophysics/gg-140/lecture-34</a>	This course discusses renewable energy sources. These include wind energy, solar energy, biomass energy and geothermal energy.

## Field of science 7. Mining and Mineral Processing

Online courses in English	Link	Course description
Network Analysis for Mines and Mineral Engineering	<a href="https://www.careers360.com/university/indian-institute-of-technology-kharagpur/network-analysis-for-mines-and-mineral-engineering-certification-course">https://www.careers360.com/university/indian-institute-of-technology-kharagpur/network-analysis-for-mines-and-mineral-engineering-certification-course</a>	This course introduces learners to network analysis techniques as applied in mining and mineral engineering, with a focus on optimizing operational efficiency and resource management.
Introduction to petroleum engineering	<a href="https://portal.tpu.ru/ceor/moo">https://portal.tpu.ru/ceor/moo</a>	This course covers key concepts in oil and gas production, including reservoir energy and forces, drainage of petroleum deposits, development systems, and well operation techniques. Students will gain an understanding of the full field life cycle and the interdisciplinary approaches involved in the development and operation of petroleum fields.
Surface Mining Technology	<a href="https://www.careers360.com/university/indian-institute-of-technology-kharagpur/surface-mining-technology-certification-course">https://www.careers360.com/university/indian-institute-of-technology-kharagpur/surface-mining-technology-certification-course</a>	This course is designed for mining engineering students and provides essential knowledge of primary mining technologies in the industry. Participants will explore the challenges of near-surface depletion and socio-environmental constraints, as well as innovative strategies to improve profitability and sustainability. During the course, participants will gain a thorough understanding of the principles, techniques and advances in surface mining, ensuring

#### PROGRAM

		that students are well prepared for the complexities of modern mining operations.
Introduction To Mineral Processing	<a href="https://www.careers360.com/university/indian-institute-of-technology-kharagpur/introduction-mineral-processing-certification-course">https://www.careers360.com/university/indian-institute-of-technology-kharagpur/introduction-mineral-processing-certification-course</a>	This 12-week course introduces fundamental concepts of mining with a focus on delivering more concentrated materials for extractive metallurgy processes. By completing the course, students will gain a solid understanding of mining techniques, enhancing their ability to prepare mineral resources efficiently for subsequent metallurgical extraction.
Mineral Resources: Geology, Exploration, Economics and Environment	<a href="https://www.careers360.com/university/indian-institute-of-technology-kharagpur/mineral-resources-geology-exploration-economics-and-environment-certification-course">https://www.careers360.com/university/indian-institute-of-technology-kharagpur/mineral-resources-geology-exploration-economics-and-environment-certification-course</a>	This course introduces key concepts of ore geology as applied to mineral exploration. It includes case studies of the discovery of world-class mineral deposits, methods for evaluating mineral resources, and discussions on international trade, policy frameworks, and natural resource pricing.