Postgraduate Track Program: Earth and Environmental Sciences

1. Olympiad winner's skill set by subject

The winner of the Olympiad in the field of Earth and Environmental Sciences should demonstrate a strong understanding of various Earth science disciplines: hydrology, geology, geophysics, geochemistry, mineralogy, meteorology, ecology, biogeography, and geography.
The winner must know the types of water resources and their properties, the peculiarities of the impact of water management activities on water resources, methods of protecting the aquatic ecosystem, and resource conservation.
The winner must know the laws of geology, the features of electrical prospecting and seismic tomography and the chemical formulas of minerals; methods of prospecting and exploration of mineral deposits; have fundamental knowledge of the structure of the atmosphere and its connection with other layers of the Earth.
The winner must be able to analyze and interpret geological, geophysical, geochemical, geographical, meteorological, and environmental information, measure meteorological parameters, identify minerals, and use remote control methods to study the geographic envelope and environmental mapping.

2. List of degree programs covered by the subject area

2.1. List of master's programs

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

2.1. List of doctoral programs

1.3.20 Crystallography, physics of crystals
1.5.6 Biotechnology
1.5.15 Ecology
1.6.1 General and regional geology Geotectonics and geodynamics
1.6.2 Palaeontology and stratigraphy
1.6.4 Mineralogy, crystallography, geochemistry, geochemical methods of mineral exploration
1.6.5 Lithology
1.6.6 Hydrogeology
1.6.9 Geophysics
1.6.10 Geology, prospecting, and exploration of solid minerals, mineralogy
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
1.6.16 Terrestrial hydrology, water resources, hydrochemistry
1.6.18 Atmosphere and climate sciences

1.6.20 Geoinformatics, cartography
1.6.21 Geoecology
2.8.2 Drilling and well completion engineering
2.8.4 Oil and gas field development and operation

3. Content

Water resources

1. Hydrological cycles, fundamentals of hydrology and hydroecology
2. Organization of closed water cycles and resource conservation
3. Water resources protection

Geology

1. General and regional geology
2. Stratigraphy and paleontology
3. Geotectonics and geodynamics
4. Hydrogeology

Geochemistry and geophysics

1. Fundamentals of geochemistry
2. Physics of the Earth
3. Petrophysics
4. Electrical prospecting
5. Seismic tomography
6. Geophysical surveys of wells

Meteorology and Atmosphere Science

1. Meteorology and Atmosphere Science
2. Climate Change

Mineralogy

1. Petrography
2. Mineralogy

Environmental Sciences

1. Remote control methods
2. Geographic information systems

Physical geography

1. Physical geography
2. Cartography
3. Landscape science
4. Earth Science
5. Geography of natural resources

Ecology

1. General Ecology
2. Applied Ecology
3. Agroecology
4. Biotechnology

Mining and Mineral Processing

1. Geology and exploration of mineral deposits

2. Mining and geological information systems
3. Modeling of hydrocarbon fields
4. Petroleum engineering
5. Hydrocarbon exploration and development

4. List of sources recommended references

4.1. Recommended literature

Water resources

Reading list in English	Corresponding topic
1. Beya C.L., Kanwugu O.N., Ivantsova M.N. Modern biotechnological methods in wastewater treatment: a review. Chimica Techno Acta 2022, vol. 9(2), No. 202292S3. URL:// https://elar.urfu.ru/bitstream/10995/116458/1/cta-2022-s-03.pdf (free access)	Organization of closed water cycles and resource conservation. Water resources protection.
2. Dhote J., Ingole S., Chavhan A. Review on wastewater treatment technologies. International Journal of Engineering Research & Technology, 2012. URL:// https://www.ijert.org/research/review-on-waste-water-treatment-technologies-IJERTV1IS5271.pdf (free access)	Organization of closed water cycles and resource conservation. Water resources protection.
3. Makanda, K.; Nzama, S.;Kanyerere, T. Assessing the Role of Water Resources Protection Practice for Sustainable Water Resources Management: A Review. Water, MDPI, 2022. Vol. 14. 3153. URL:// https://www.researchgate.net/publication/364513767_Assessing_the_Role_of_Water_Resources_Protection_Practice_for_Sustainable_Water_Resources_Management_A_Review (free access)	Organization of closed water cycles and resource conservation. Water resources protection.
4. Protecting Water Resources and Managing Stormwater: A Birds Eye View For New Hampshire Communities. J. Peterson, A. Stone, J. Houle (eds.). Great Britain: University of new Hampshire. 48 p. URL:// https://extension.unh.edu/sites/default/files/migrated_unmanaged_files/Resource002615_Rep3886.pdf (free access)	Water resources protection.
5. Water for the Recovery of the Climate - A New Water Paradigm. M. Kravčík, J. Pokorný, J. Kohutiar, M. Kováč, E. Tóth (eds.). 2007. 94 p. URL:// http://www.waterparadigm.org/download/Water_for_the_Recovery_of_the_Climate_A_New_Water_Paradigm.pdf (free access)	Organization of closed water cycles and resource conservation. Water resources protection.
6. Xiao-Yan Li, Dawen Yang and oth. Ecohydrology. In book: The Geographical Sciences During 1986–2015 Publisher: Springer Geography Editors: S. Leng et al URL://	Hydrological cycles, fundamentals of hydrology and hydroecology.

https://www.researchgate.net/publication/306082749_Ecohydrology (free access)	

Reading list in Russian	**Corresponding topic**
1. Бестужева А.С. Гидроэкология. Ч. 1. Общая гидроэкология : курс лекций. М.: НИУ МГСУ, 2015. 18 с. URL:// https://e-univers.ru/upload/iblock/cd4/whdc9hgo770c61gmn8bi7ppgb85kllxk.pdf (free access)	Hydrological cycles, fundamentals of hydrology and hydroecology.
2. Данилов-Данильян В.И., Хранович И.Л. Управление водными ресурсами. М.: Научный мир, 2010. 232 с. URL:// http://cawater-info.net/review/pdf/russia_wm3.pdf (free access)	Organization of closed water cycles and resource conservation. Water resources protection.
3. Никифоров А.Ф., Кутергин А.С., Семенищев В.С., Никифоров С.В. Экологические основы охраны водных ресурсов: учебное пособие. Екатеринбург: Изд-во Урал. ун-та, 2019. 192 с. URL:// https://elar.urfu.ru/bitstream/10995/71151/1/978-5-7996-2603-7_2019.pdf (free access)	Water resources protection.
4. Яковлев С.В., Карелин Я.А.,. Ласков Ю.М., Воронов Ю.В.. Методы и сооружения для очистки промышленных сточных вод (учебное пособие). 1985. 41 с. URL:// https://pnu.edu.ru/media/filer_public/2013/05/21/ochistka-sv_posobie.pdf (free access)	Organization of closed water cycles and resource conservation. Water resources protection.

Geology

Reading list in English	**Corresponding topic**
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 (free access)	General and regional geology. Geotectonics and geodynamics. Hydrogeology.
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 (свободный доступ)	Общая и региональная геология. Геотектоника и геодинамика.
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 (free access)	Stratigraphy and paleontology. Geotectonics and geodynamics.
4. Superplumes. Eds D.A. Yuen, Sh. Maruyama, B.F.Windley. Springer, 2007. 510 p. URL:// https://www.geokniga.org/books/35927 (free access)	Geotectonics and geodynamics.

Reading list in Russian	Corresponding topic
1. Короновский Н.В. Общая геология: учебник. М.: КДУ, 2012. 552 с. URL:// https://studfile.net/preview/16460671/ (free access)	General and regional geology. Hydrogeology.
2. Михайлова И.А., Бондаренко О.Б. Палеонтология: классический университетский учебник. М.: Издательство МГУ, 2006. 592 с. URL:// https://geo.tsu.ru/content/students/resources/geology/documents/Mikhailova.Bondarenko.2006.Paleontologija.pdf (free access)	Stratigraphy and paleontology.
3. Хаин В.Е., Ломизе М.Г. Геотектоника с основами геодинамики: учебник – 2-е изд., испр. и доп. – М.: КФУ, 2005. 560 с. URL:// http://www.booksshare.net/index.php?id1=4&category=geotectonics&author=hain-v-e&book=1995 (free access)	Geotectonics and geodynamics.

Geochemistry and geophysics

Reading list in English	Corresponding topic
1. Bacon M., Simm R., Redshaw T. 3D Seismic interpretation. Cambridge University Press, 2007. 224 p. URL:// https://ahmedrehanhashmi.wordpress.com/wp-content/uploads/2016/06/3d_seismic_interpretation_bacon-et-al.pdf (free access)	Seismic tomography. Physics of the Earth. Petrophysics.
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 (free access)	Geophysical surveys of wells. Electrical prospecting. Seismic tomography.
3. White W.M. Geochemistry. Wiley-Blackwell, 2005. 714 p. URL:// https://sbgeo.org.br/books/white%202005.pdf (free access)	Fundamentals of geochemistry.

Reading list in Russian	Corresponding topic
1. Костицын В. И., Хмелевской В. К. Геофизика: учебник. Пермь: Перм. гос. нац. исслед. ун-т., 2018. 428 с. URL:// http://www.psu.ru/files/docs/science/books/uchebnie-posobiya/geofozika.pdf (free access)	Electrical prospecting. Seismic tomography. Geophysical surveys of wells. Physics of the Earth.
2. Тиаб Д., Доналдсон Э.Ч. Петрофизика: теория и практика изучения коллекторских свойств горных пород и движения пластовых флюидов. Перевед с английского. М.: ООО «Премиум Инжиниринг, 2009. 868 с. URL:// http://fizikaplasta.ru/wp-content/uploads/pdfs/tiab.pdf (free access)	Петрофизика
3. Хмелевской В.К., Костицын В.И.Основы геофизических методов: учебник для вузов. Пермь: Перм. ун-т, 2010. 400 с. URL:// http://www.psu.ru/files/docs/science/books/uchebnie-	Electrical prospecting. Seismic tomography. Geophysical surveys of wells.

posobiya/Hmelevskoj_osnovy_geofizicheskih_metodov.pdf (free access)	
4. Чертко Н.К. Геохимия: Учебное пособие для студентов геологических специальностей вузов. Мн.: Издательство «ТЕТРА СИСТЕМС», 2007. 254 с. URL:// https://elib.bsu.by/bitstream/123456789/24189/1/geochem07.pdf (free access)	Основы геохимии.

Meteorology and Atmosphere Science

Reading list in English	**Corresponding topic**
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://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SRCCL-Complete-BOOK-LRES.pdf (free access)	Climate Change.
2. Spiridonov V., Ćurić V. Fundamentals of Meteorology. Springer Nature Switzerland AG, 2021. 437 p. URL:// https://link.springer.com/book/10.1007/978-3-030-52655-9 (free access)	Meteorology and Atmosphere Science. Climate Change.
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 (free access)	Meteorology and Atmosphere Science.

Sources in Russian	**Corresponding topic**
1. Богаткина О.Г., Тараканов Г.Г. Основы метеорологии: учебное пособие. Санкт-Петербург: РГГМУ, 2006. 228 с. URL:// http://elib.rshu.ru/files_books/pdf/img-306162302.pdf (free access)	Meteorology and Atmosphere Science.
2. Кислов А.В. Климатология с основами метеорологии. М.: МГУ, 2019. 155 с. URL:// https://teach-in.ru/file/synopsis/pdf/climatology-M.pdf (free access)	Meteorology and Atmosphere Science. Climate Change.
3. Хромов С.П., Петросянц М.А. Метеорология и климатология. М.: МГУ, 2006. 581 с. URL:// http://szf.aviamettelecom.ru/wp-content/uploads/2014/02/%D0%9C%D0%B5%D1%82%D0%B5%D0%BE%D1%80%D0%BE%D0%BB%D0%BE%D0%B	Meteorology and Atmosphere Science. Climate Change.

3%D0%B8%D1%8F-%D0%B8-%D0%BA%D0%BB%D0%B8%D0%BC%D0%B0%D1%82%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D1%8F.pdf (free access)	

Mineralogy

Reading list in English	Corresponding topic
1. Ichiro Sunagawa Crystals. Growth, Morphology, and Perfection. Cambridge University Press, 2005. 295 p. URL:// https://books.google.ru/books?id=CjO2_4-l8xsC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false (free access)	Petrography. Mineralogy.
2. Introduction to Petrology. E.A. Johnson, J. Ch. Liu (eds.). VIVA, 2021. URL:// https://viva.pressbooks.pub/petrology/ (free access)	Petrography.
3. Philpot A.R. Petrography of Igneous & Metamorphic Rocks. First Edition, Kindle Edition, 2018. URL:// https://faculty.ksu.edu.sa/sites/default/files/ebooksclub.org__Petrography_of_Igneous_and_Metamorphic_Rocks_0.pdf (free access)	Petrography. Mineralogy.

Reading list in Russian	Corresponding topic
1. Бетехтина А.Г. Курс минералогии: учебное пособие. М.: КДУ, 2007. 721 с. URL:// https://geo.web.ru/~ujin/books/Betehtin_2008.pdf (free access)	Petrography. Mineralogy.
2. Булах А.Г., Кривовичев В.Г., Золотарёв А.А. Общая минералогия: учебник для студ. высш. учеб. заведений – 4-е изд., перераб. И доп. М.: Издательский центр «Академия», 2008. 416 с. URL:// https://academia-moscow.ru/ftp_share/_books/fragments/fragment_20858.pdf (free access)	Mineralogy.
3. Лодочников В.Н. Главнейшие породообразующие минералы. М.: НКТП Государственное геолого-разведочное издательство, 1974. 249 с. URL:// https://karpinskyinstitute.ru/ru/info/sprav/petro/lodochnikov.pdf (free access)	Petrography. Mineralogy.

Environmental Sciences

Reading list in English	Corresponding topic
1. Geographic information systems. O. Huisman, R.A. de By (eds.).Endschede: ITC, 2009. 540 p. URL:// https://webapps.itc.utwente.nl/librarywww/papers_2009/general/PrinciplesGIS.pdf (free access)	Geographic information systems.

2. Geographic information systems. Volume 1. Principles and Technical Issues. P.A. Longley, M.F. Goodchild, D.J. Maguire, D.W. Rhind (eds.). John Wiley & Sons, Inc, 1999. 1021 p. URL:// https://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/ (free access)	Geographic information systems.
3. Vermeer M. Geodesy: The science underneath. Aalto University publication series, 2019. 576 p. URL:// https://users.aalto.fi/~mvermeer/geodesy.pdf (free access)	Remote control methods. Geographic information systems.

Sources in Russian	**Corresponding topic**
1. Книжников Ю.Ф., Кравцова В.И., Тутубалина О.В. Аэрокосмические методы географических исследований: учебник. М.: Академия, 2011. 416 с. URL:// https://academia-moscow.ru/ftp_share/_books/fragments/fragment_17433.pdf (free access)	Remote control methods.
2. Ковин Р.В., Марков Н.Г. Геоинформационные системы: учебное пособие. Томск: Изд-во Томского политехнического университета, 2008. 175 с. URL:// https://kpfu.ru/portal/docs/F1502929774/GIS.pdf (free access)	Geographic information systems.
3. Попов В.Н., Чекалин С.И. Геодезия: Учебник для вузов. М.: Горная книга, 2007. 518 с. URL:// https://lib.intuit.kg/wp-content/uploads/2020/06/%D0%9F%D0%BE%D0%BF%D0%BE%D0%B2-%D0%92.%D0%9D.-%D0%A7%D0%B5%D0%BA%D0%B0%D0%BB%D0%B8%D0%BD-%D0%92.%D0%98.-%D0%93%D0%B5%D0%BE%D0%B4%D0%B5%D0%B7%D0%B8%D1%8F-2007.pdf (free access)	Remote control methods. Geographic information systems.

Physical geography

Reading list in English	**Corresponding topic**
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)	Landscape science.
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 (free access)	Earth Science. Geography of natural resources.
3. Fundamentals of Physical Geography. J. Petersen, D. Sack, R.E. Gabler (eds.). Brooks/Cole. 2nd edition, 2014. 479 p. URL:// http://www.physicalgeography.net/fundamentals/contents.html (free access)	Physical geography.

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)	Cartography.

Reading list in Russian	**Corresponding topic**
1. Алексеева Н.Н., Климанова О.А. Физическая география материков. Общие закономерности: Учебное пособие. М.: Географический факультет МГУ, 2012. – 152 с. URL:// http://media.geogr.msu.ru/Library/Books/alexeeva_klimanova_2012_fiz_geographia_materikov.pdf (free access)	Physical geography. Landscape science.
2. Бичеоол Т.Н. Картография с основами топографии: учебно-методическое пособие. Кызыл: Изд-во ТувГУ, 2020. 92 с. URL:// https://tuvgurep.elpub.ru/xmlui/bitstream/handle/123456789/420/%D0%BA%D0%B0%D1%80%D1%82%D0%BE%D0%B3%D1%80%D0%B0%D1%84%D0%B8%D1%8F%20%D1%81%20%D0%BE%D1%81%D0%BD%D0%BE%D0%B2%D0%B0%D0%BC%D0%B8%20%D1%82%D0%BE%D0%BF%D0%BE%D0%B3%D1%80%D0%B0%D1%84%D0%B8%D0%B8.pdf?sequence=1&isAllowed=y (free access)	Cartography.
3. Марцинкевич Г.И. Ландшафтоведение: Пособие. Мн.: БГУ, 2005. 200 с. URL:// https://elib.bsu.by/bitstream/123456789/41192/1/%D0%A3%D1%87%D0%B5%D0%B1%D0%BD%D0%BE%D0%B5%20%D0%BF%D0%BE%D1%81%D0%BE%D0%B1%D0%B8%D0%B5%20%D0%BF%D0%BE%20%D0%BB%D0%B0%D0%BD%D0%B4%D1%88%D0%B0%D1%84%D1%82%D0%BE%D0%B2%D0%B5%D0%B4%D0%B5%D0%BD%D0%B8%D1%8E.pdf (свободный доступ)	Landscape science.
4. Романова Э.П., Куракова Л.И., Ермаков Ю.Г. Природные ресурсы мира: учебное пособие. М.: МГУ, 1993, 304 с. URL:// https://t-library.net/read/1698 (free access)	Geography of natural resources. Earth Science.

Ecology

Reading list in English	**Corresponding topic**
1. Kharlamova M.D, Mada S.Y, Grachev V.A. Landfills: Problems, Solutions and Decision-Making of Waste Disposal In Harare (Zimbabwe). Biosci Biotech Res Asia, 2016, vol. 13, iss. 1. 307–3018 pp. URL:// https://biotech-asia.org/download/7979/ (free access)	Applied Ecology.

2. 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 (free access)	Agroecology. General Ecology.
3. Tambovceva T., Titko J. Introduction to Circular Economy. Ekonomikas un kulturas augstskola, 2017. 127 p. URL:// https://www.augstskola.lv/upload/book_Introduction_to_Circular_Economy_2020.pdf (free access)	Biotechnology.
4. Tomich T.P., Brodt S., Ferris H., Galt R., Horwath W.R., Kebreab 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 (free access)	Agroecology.

Reading list in Russian	**Corresponding topic**
1. Каллас Е.В. Почвоведение с основами геологии и агроэкологического землепользования. Часть I. Общее почвоведение с основами геологии (Учебное пособие). Томск, 2011. 334 с. URL:// https://soil.tsu.ru/wp-content/uploads/2020/05/%D0%9F%D0%BE%D1%87%D0%B2%D0%BE%D0%B2%D0%B5%D0%B4%D0%B5%D0%BD%D0%B8%D0%B5-%D1%81-%D0%BE%D1%81%D0%BD%D0%BE%D0%B2%D0%B0%D0%BC%D0%B8-%D0%B3%D0%B5%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B8-%D0%B8-%D0%B0%D0%B3%D1%80%D0%BE%D1%8D%D0%BA%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D1%87%D0%B5%D1%81%D0%BA%D0%BE%D0%B3%D0%BE-%D0%B7%D0%B5%D0%BC%D0%BB%D0%B5%D0%BF%D0%BE%D0%BB%D1%8C%D0%B7%D0%BE%D0%B2%D0%B0%D0%BD%D0%B8%D1%8F-%D0%A7%D0%B0%D1%81%D1%82%D1%8C-1.pdf (свободный доступ)	Agroecology. General Ecology.
2. Мукминов М.Н., Шуралев Э.А., Бадрутдинов О.Р. Основы экологии и природопользования: учебное пособие по курсу «Экология» для студентов гуманитарных специальностей. Казань: Казан. ун-т, 2017. 146 с. URL:// https://kpfu.ru/staff_files/F1270956712/UchebPosobEkologiya.pdf (free access)	General Ecology. Applied Ecology.

3. Сазыкин Ю.О., Орехов С.Н., Чакалева И.И. Биотехнология: учебное пособие для студентов высших учебных заведений. М.: Издательский центр «Академия», 2008. 256 с. URL:// https://library.tou.edu.kz/fulltext/buuk/b1031.pdf (free access)	Biotechnology.
4. Третьякова, Н. А. Основы общей и прикладной экологии: учеб. пособие / Н. А. Третьякова ; [науч. ред. М. Г. Шишов] ; М-во образования и науки Рос. Федерации, Урал. федер. ун-т. — Екатеринбург : Изд во Урал. ун та, 2015. — 112 с. URL:// https://elar.urfu.ru/bitstream/10995/34812/1/978-5-7996-1442-3.pdf (free access)	General Ecology. Applied Ecology.

Mining and Mineral Processing

Reading list in English	**Corresponding topic**
1. Fanchi J.R., Christiansen R.L. Introduction to Petroleum Engineering. Hoboken: Wiley, 2017. 335 p. URL:// http://182.72.188.194:8080/jspui/bitstream/123456789/1493/1/Introduction%20to%20Petroleum%20Engineering%20by%20John%20R.%20Fanchi.pdf (free access)	Hydrocarbon exploration and development. Petroleum engineering.
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 (free access)	Mining and geological information systems.
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 (free access)	Modeling of hydrocarbon fields. Mining and geological information systems.
4. Marjoribanks R. Geological methods in mineral exploration and mining. Springer, 2010. 247 p. URL:// https://www.geokniga.org/books/22451 (free access)	Geology and exploration of mineral deposits.
5. Tricks to creating a resource block model. WSP, 2015, 75. URL:// https://www.geokniga.org/books/34831 (free access)	Mining and geological information systems.
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 (free access)	Modeling of hydrocarbon fields.

Reading list in Russian	**Corresponding topic**
1. Билибин С.И., Денисов С.Б., Золоева Г.М. Геолого-геофизическое моделирование залежей нефти и газа. М.: МАКС Пресс, 2008. 172 с., ISBN: 978-5-317-02420-8. URL:// https://www.geokniga.org/books/13541 (free access)	Modeling of hydrocarbon fields.

2. Бородушкин А.Б., Дворецкая Ю.Б., Макаров В.А., Самородская М.А., Самородский П.Н. Конспект лекций по курсу "ГИС и ГГИС в геологии". 89 с. URL:// https://www.geokniga.org/books/899 (free access))	Mining and geological information systems.
3. Ермолов В.А. Геология. Учебник для вузов. Часть 2. Разведка и геолого-промышленная оценка месторождений полезных ископаемых. М.: Издательство Московского государственного горного университета, 2005. 392 с., ISBN: 5-7418-0396-2. URL:// https://www.geokniga.org/books/31339 (free access)	Geology and exploration of mineral deposits.
4. Игнатов Ю.М. Геоинформационные системы в горном деле. КузГТУ им. Т.Ф. Горбачева, Кемерово, 2012, 204 с. URL:// https://www.geokniga.org/books/14074 (free access)	Mining and geological information systems.
5. Коршак А.А., Шаммазов А.М. Основы нефтегазового дела: Учебник для вузов.—3-е изд., испр. и доп. Уфа: ООО «ДизайнПолиграфСервис», 2005. 528 с. URL:// https://www.geokniga.org/books/8140 (free access)	Petroleum engineering.
6. Милосердова Л.В. Геология, поиски и разведка месторождений нефти и газа. Книга 1. М.: РГУ нефти и газа имени И.М. Губкина, 2015 . 216 с., ISBN: 978-5-91961-144-8. URL:// https://www.geokniga.org/books/23888 (free access)	Geology and exploration of mineral deposits.
7. Наговицын О.В., Лукичев С.В. Горно-геологические информационные системы, область применения и особенности построения. Горный информационно-аналитический бюллетень. 2016. № 7. С. 71–83. URL:// https://cyberleninka.ru/article/n/gorno-geologicheskie-informatsionnye-sistemy-oblast-primeneniya-i-osobennosti-postroeniya.pdf (free access)	Mining and geological information systems.
8. Оника С.Г., Нарыжнова Е.Ю., Бильдюк Е.В. Геоинформационные системы в горном деле. БНТУ, Минск, 2023. 109 с. URL:// https://www.geokniga.org/bookfiles/geokniga-geoinformacionnyesistemyvgornomdele.pdf (free access)	Mining and geological information systems.
9. Юшков И.Р., Хижняк Г.П., Илюшин П.Ю. Разработка и эксплуатация нефтяных и газовых месторождений : учеб.-метод. Пособие. Пермь : Изд-во Перм. Нац. Исслед. Политехн. Ун-та, 2013. 177 с. URL:// https://pstu.ru/files/file/gnf/razrabotka_i_ekspluataciya_neftyanyh_i_gazovyh_mestorozhdeniy_dlya_bngs_.pdf (free access)	Hydrocarbon exploration and development.

4.2. Recommended online-courses

Water resources

Online-courses in English	Link	Summary

Drinking Water: Quality and Treatment Systems	https://stepik.org/course/89161	This course delves into the practical aspects of water quality assessment and management. It addresses critical questions about the safety of our drinking water and explores effective purification methods. Participants will engage with key concepts and techniques to evaluate and ensure water safety, gaining insights into the processes and solutions for maintaining clean, potable water.
Irrigation Efficiency: more food with less water	https://www.edx.org/learn/water/ku-leuven-irrigation-efficiency-more-food-with-less-water?index=product&queryID=22590c86e46dc1f73712085b865b2c15&position=1&results_level=first-level-results&term=Water+Resource&objectID=course-32d73afc-c9ce-4c63-8702-1e7b6f0ee998&campaign=Irrigation+Efficiency%3A+more+food+with+less+water&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch	This course provides a comprehensive overview of the irrigation supply chain, covering everything from water sources to the root zone. Participants will learn how to calculate the precise water requirements for optimal crop health and yield, and understand the processes through which water is delivered from its source to the plant roots. The course will examine how efficiency impacts the design and operation of water application and conveyance components within irrigation systems. Towards the end, real-world systems, such as drip and surface irrigation, will be explored. Insights from irrigation experts will offer diverse perspectives on improving efficiency in irrigation practices.
Land, Water, Food, And Climate	https://ocw.mit.edu/courses/1-74-land-water-food-and-climate-fall-2020/	This reading seminar examines land, water, food, and climate in a changing world, with an emphasis on key scientific questions about the connections between natural resources and food production. Students read and discuss papers on a range of topics, including water and land resources, climate change, demography, agroecology, biotechnology, trade, and food security. The readings are supplemented by short lectures that provide context and summarize the main points.
Surface Water Quality: management and modeling	https://stepik.org/course/66372	The course contains sections on modeling surface water pollution and how to prevent and eliminate it, taking into account water

		quality standards and pollutant characteristics.
Technologies of water treatment	https://stepik.org/course/89365	This course offers a comprehensive study of the fundamentals of biological water treatment. Tailored for students in analytical chemistry and environmental engineering, it provides essential tools for understanding the overarching processes involved. The course distinguishes itself by covering an extensive range of topics related to biological water treatment. It spans from fundamental concepts regarding wastewater characteristics to advanced methodologies in biological treatment. By the end of the course, participants will gain a thorough understanding of both basic and advanced aspects of biological water treatment.
Water Resource Systems	https://ocw.mit.edu/courses/1-731-water-resource-systems-fall-2006/	This course focuses on quantitative methods for addressing large-scale water resource challenges. It encompasses the design and management of facilities for river basin development, flood control, water supply, groundwater remediation, and other water-related activities. The course provides in-depth analysis techniques and practical approaches for effectively managing and developing water resources.
Water Science and Water Management	https://stepik.org/course/198492/promo?search=4651337272	This course offers a comprehensive exploration of the hydrological cycle and water resource management. It covers precipitation's role, including its types, rates, infiltration, and the formation of surface runoff. The course examines surface runoff as a crucial component of the hydrological cycle and its implications for water use, along with diffuse runoff and its quality. It also addresses rivers and groundwater as essential natural resources, discussing their roles in water use and management. Additionally, the course explores river catchments, including their structure, water use, and impact on water quality, as well as techniques for river flow

		measurement, including units, accuracy, and various global measurement systems.
Online-courses in Russian	**Link**	**Summary**
Водные ресурсы мира	https://foxford.ru/wiki/geografiya/vodnie-resursi-mira?utm_referrer=https%3A%2F%2Fwww.yandex.ru%2F	The online textbook briefly discusses key concepts: water resources, river flow resources, and water consumption structure.
География. Раздел 6. Гидросфера – водная оболочка Земли	https://resh.edu.ru/subject/lesson/799/	The course features a curated collection of video materials covering key topics in the school geography curriculum, with a particular focus on the structure of the Earth's hydrosphere.
Гидрология	https://teach-in.ru/course/hydrology-dobrolubov	The course explores fundamental patterns in hydrospheric processes, detailing the geographical distribution of water bodies and reviewing key methods for studying these bodies and related hydrological processes. It also examines the impact of water bodies on human populations, economic activities, and aquatic ecosystems.
Рациональное использование водных экосистем	https://rutube.ru/video/a715af41a993c41c9f6d388fb9d6746f/	A series of lectures by V. Petrosyan, a leading scientist from Moscow State University, addresses key issues in water use and the pollution of water bodies by blue-green algae and cyanobacteria. The course examines how human economic activities negatively impact aquatic ecosystems, focusing on the resulting ecological challenges.

Geology

Online-courses in English	**Link**	**Summary**
An introduction to geology	https://www.open.edu/openlearn/science-maths-technology/an-introduction-geology/content-section-overview?active-tab=description-tab	This course introduces essential geological processes that influence daily life, revealing connections such as the link between volcanoes and mobile phones, and explaining the role of marine microorganisms in the plastics industry. Participants will explore various rock types, understanding how and where different rocks and natural resources form across the

		Earth. Additionally, the course addresses environmental and sustainability considerations critical for geologists involved in the extraction and processing of these resources.
Geology – Geoscience and the Origins of the Earth	https://www.classcentral.com/classroom/youtube-geology-geoscience-and-the-origins-of-the-earth-137865/64097d7e73668	In this course, you will explore the concept of geological time and the methods geologists use to define it. You will also examine the Earth's structure and the types of rocks that compose our planet.
Petrology	https://ocw.mit.edu/courses/12-109-petrology-fall-2005/	This undergraduate petrology course provides an overview of the distribution, chemical composition, and mineral associations within rocks found in the Earth's crust and upper mantle. It examines how these aspects relate to various tectonic environments, with a strong focus on applying principles of chemistry and physics to interpret rock-forming processes.
Physical Geology	https://study.com/academy/course/physical-geology-course.html	This course provides a comprehensive exploration of geological studies, focusing on the various branches of the field. Students will develop the ability to compare and contrast the physical properties of metals, minerals, and rocks, including sedimentary, igneous, and metamorphic types. Emphasis is placed on understanding how these materials contribute to sustaining life on Earth. Through detailed analysis, the course aims to enhance knowledge of the roles and characteristics of geological substances and their impact on the environment.
Relative Dating	https://www.youtube.com/watch?v=Tpg6M3W8-sg&ab_channel=SethHorowitz	This video explores 8 rules used by geologists and paleontologists when trying to determine the relative age of rocks, fossils, and various geologic events.
Seismic tomography	https://openedu.ru/course/nsu/Seismography/?session=2024_apt_dec	By the end of this course, participants will gain a fundamental understanding of seismology and practical skills in using relevant technical instruments and software. Complex concepts are presented in clear, accessible language, making the material approachable for a diverse audience.

		Geophysicists, mathematicians, geologists, geochemists, petrologists, engineers, and other interested individuals will benefit from new insights and gain access to author-developed research methods and scientific algorithms employed by seismologists globally.
Online-courses in Russian	**Link**	**Summary**
Введение в геологию полезных ископаемых	https://openedu.ru/course/spbu/GEOLOGYMIN/?session=spring_2021	The course provides knowledge in the field of mineral geology, including the formation, patterns of location, and features of solid mineral deposits, as well as about geological and industrial types of deposits within the framework of genetic classification.
Введение в литологию. Лекция профессора О.В.Япаскурта (МГУ)	https://www.youtube.com/watch?v=PL51hNhbd7k&ab_channel=%D0%9F%D0%B5%D1%80%D0%B2%D1%8B%D0%B9%D0%93%D0%B5%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D1%87%D0%B5%D1%81%D0%BA%D0%B8%D0%B9	The course covers examples of sedimentary rocks, stages of rock formation, textures and layers of sedimentary rocks, examples of bioturbation, and secondary processes in sedimentary rocks.
Принципы в стратиграфии	https://www.youtube.com/watch?v=_Tj9vxqfmzk&t=395s&ab_channel=%D0%98%D0%BD%D1%81%D1%82%D0%B8%D1%82%D1%83%D1%82%D0%B3%D0%B5%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B8%D0%B8%D0%BD%D0%B5%D1%84%D1%82%D0%B5%D0%B3%D0%B0%D0%B7%D0%BE%D0%B2%D1%8B%D1%85%D1%82%D0%B5%D1%85%D0%BD%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B9%D0%9A%D0%A4%D0%A3	This course provides an introduction to the discipline of Stratigraphy, covering its fundamental principles and methods of stratigraphic research. Participants will explore how stratigraphy is used to study rock layers and geological formations, gaining insights into its application and significance in understanding Earth's history.

Geochemistry and geophysics

Online-courses in English	**Link**	**Summary**
Earthquake Seismology	https://www.edx.org/course/earthquake-seismology?index=product&queryID=f742750d47bea40a1e13afc5b4eab8c3&position=1	The course explores the processes that cause earthquakes, as well as the methodologies used by seismologists to analyze seismograms, measure source parameters, and simulate the seismic wave impact at the Earth's surface.
Essentials of Geophysics	https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/	This course provides a comprehensive overview of the various subdisciplines of geophysics, including geodesy, gravity, geomagnetism, seismology, and geodynamics. It also explores how these fields relate to and are relevant for the study of other planets.
Introduction to the Applied Geostatistics	https://www.youtube.com/watch?v=HgqBocDr3G0&list=PLhQwqg2sX-z1bVKAqahyyyY16myeDTe1o	The course covers the basics of mathematical statistics, interpolation, and stochastic modeling methods.
Seismic to well tie	https://www.youtube.com/watch?v=mDdvOrIU6K8&list=PLhQwqg2sX-z3rgS_fd5pbwoYaUHIJBdwY	This course offers theoretical insights into seismic data interpretation, complemented by practical skills in both kinematic and dynamic analysis of seismic data.
Trace-Element Geochemistry	https://ocw.mit.edu/courses/12-479-trace-element-geochemistry-spring-2013/	This course focuses on using trace element geochemistry to investigate the origin and evolution of igneous rocks. It emphasizes the parameters influencing the partitioning of trace elements between different phases and aims to develop models for this partitioning, particularly between minerals and melt, within igneous systems.
Well log interpretation. Introduction to well logging	https://www.youtube.com/watch?v=ARgTIgeUhuE&list=PLhQwqg2sX-z34sjrZzYxWeuQrLaQP3EA0	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.
Online-courses in Russian	**Link**	**Summary**
Введение в геохимию	https://www.youtube.com/watch?v=mfHot1dZCL0&ab_channel=%D0%98%D0%BD%D1%81%D1%82%D0%B8%	This course introduces the concept of geochemistry, outlines its key tasks, identifies the objects of geochemical

	D1%82%D1%83%D1%82%D0%B3%D0%B5%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B8%D0%B8%D0%BD%D0%B5%D1%84%D1%82%D0%B5%D0%B3%D0%B0%D0%B7%D0%BE%D0%B2%D1%8B%D1%85%D1%82%D0%B5%D1%85%D0%BD%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B9%D0%9A%D0%A4%D0%A3	research, and traces the stages of its development.
Обзорное видео по проведению геофизических исследований скважин. Основные понятия и оборудование	https://www.youtube.com/watch?v=Tgj8LV7gDR8	The aim of this video course is twofold: first, to explore the goals and objectives, fundamental concepts, and classification of GIS equipment; and second, to provide a general overview of logging work within wells.
Основы интерпретации ГИС	https://www.youtube.com/watch?v=8QQOlXx86qo&ab_channel=%D0%98%D0%BD%D1%81%D1%82%D0%B8%D1%82%D1%83%D1%82%D0%B3%D0%B5%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B8%D0%B8%D0%BD%D0%B5%D1%84%D1%82%D0%B5%D0%B3%D0%B0%D0%B7%D0%BE%D0%B2%D1%8B%D1%85%D1%82%D0%B5%D1%85%D0%BD%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D0%B9%D0%9A%D0%A4%D0%A3	This course covers contemporary methods for processing and interpreting oil and gas well logging data, along with automated interpretation techniques using modern software tools.

Meteorology and Atmosphere Science

Online-courses in English	**Link**	**Summary**
Climate change	https://www.edx.org/learn/climate-change	Climate patterns are often predictable within a given region, with only slight

		variations from year to year. However, climate change encompasses long-term alterations in global weather patterns. Although some changes are natural, human activities also play a significant role in driving these shifts. This course explores the primary causes of climate change and examines the ways in which the Earth's climate is changing.
Climate change	https://www.open.edu/openlearn/nature-environment/climate-change/content-section-0?active-tab=description-tab	Climate change is a key issue on today's social and political agenda. This course explores the basic science that underpins climate change and global warming.
Climate Change	https://www.youtube.com/watch?v=3stTozERusk&ab_channel=StanfordUnderstandEnergy	This lecture, part of the Stanford "Understand Energy" course, focuses on the interplay between energy and climate change. The aim is to deepen understanding of energy as a multifaceted system that profoundly affects human development, environmental conditions, and economic factors. The lecture will cover a range of energy resources, from fossil fuels such as oil and coal to renewable sources like wind and solar power, enhancing literacy in how these resources impact and interact with climate change.
Introduction to Wind, Clouds, and Weather Services	https://alison.com/course/introduction-to-wind-clouds-and-weather-services	This free online meteorology course delves into the different forces associated with wind, which can significantly affect events on land and sea. We show you how to measure wind speed and pressure as we examine the Beaufort scale of wind force and Buys Ballot’s law.
Retaining an Atmosphere	https://www.youtube.com/watch?v=Gie8L8slnSs&list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s	This course explores the following topics: Here is the revised list using sentence case: Part 1: Mechanisms of pressure perception Part 2: Understanding escape velocity Part 3: Molecular velocities and their implications Part 4: Atmospheric presence on planets: Causes and conditions Part 5: The relationship between planetary characteristics and their atmospheres

		Part 6: The vertical temperature profile of the atmosphere
Online-courses in Russian	**Link**	**Summary**
Метеорология и климатология Лекция 1	https://www.youtube.com/watch?v=5EqTzSVMcA8&ab_channel=MeteoKPFU	This lecture introduces fundamental concepts in meteorology and climatology, explores methods for studying climate, and provides insights into the operation and functions of weather stations.
Метеорология и климатология Лекция 6	https://www.youtube.com/watch?v=4Bemw4QzsgU&ab_channel=MeteoKPFU	This lecture covers the temporal variation in atmospheric pressure, the forces influencing the atmosphere, the vertical changes in wind patterns, atmospheric scaling, and the general circulation of the atmosphere.
Экологический мониторинг: зачем и как следить за окружающей средой?	https://www.youtube.com/watch?v=LhysiSsD6hI&ab_channel=%D0%A4%D0%B0%D0%BA%D1%83%D0%BB%D1%8C%D1%82%D0%B5%D1%82%D0%BF%D0%BE%D1%87%D0%B2%D0%BE%D0%B2%D0%B5%D0%B4%D0%B5%D0%BD%D0%B8%D1%8F%D0%9C%D0%93%D0%A3	This lecture will explore the necessity and significance of environmental monitoring, examining the different types of monitoring systems available. It will cover the criteria for selecting appropriate indicators to assess various environmental objects and discuss methods for interpreting and utilizing the results of these monitoring activities.

Mineralogy

Online-courses in English	**Link**	**Summary**
An introduction to minerals and rocks under the microscope	https://www.open.edu/openlearn/science-maths-technology/an-introduction-minerals-and-rocks-under-the-microscope/content-section-0?active-tab=description-tab	This free course offers an exploration of mineral study through the use of a polarizing microscope. Although advanced techniques such as electron or ion beam chemical analysis are now employed, the polarizing microscope remains the primary tool for examining rock-thin sections. It serves as the foundational method for learning to recognize, characterize, and identify various types of rocks.
Crystal Habit, Mineral Color, Luster, Cleavage, Hardness, Density,	https://www.classcentral.com/classroom/youtube-crystal-habit-mineral-color-luster-cleavage-hardness-density-	This course provides an in-depth exploration of minerals, focusing on their crystal structure, composition, and hardness.

Solubility – Mineralogy	solubility-mineralogy-geo-girl-137421	
Minerals and the crystalline state	https://www.open.edu/openlearn/science-maths-technology/minerals-and-the-crystalline-state/content-section-0?active-tab=content-tab	Rocks are made of minerals and, as minerals are natural crystals, the geological world is mostly a crystalline world. This free course introduces the study of minerals and crystal structures, using online texts and interactive activities, including questions and answers, video clips, slides, and a digital kit.
Mineral Weathering – How and Why Rocks Weather and How Microbes Drive Weathering	https://www.classcentral.com/classroom/youtube-mineral-weathering-how-why-rocks-weather-how-microbes-drive-weathering-geo-girl-137400	This video provides a comprehensive overview of mineral weathering, including both microbial and abiotic processes.
Structure of Earth Materials	https://ocw.mit.edu/courses/12-108-structure-of-earth-materials-fall-2004/	This course provides a comprehensive introduction to crystalline structure, crystal chemistry, and bonding in rock-forming minerals. It introduces the theory relating crystal structure and crystal symmetry to physical properties such as refractive index, elastic modulus, and seismic velocity. It surveys the distribution of silicate, oxide, and metallic minerals in the interiors and on the surfaces of planets, and discusses the processes that led to their formation. It also addresses why diamonds are hard and why micas split into thin sheets
Symmetry Operations, Types of Twinning, and Miller Indices of Crystal Planes – Mineralogy	https://www.classcentral.com/classroom/youtube-symmetry-operations-types-of-twinning-miller-indices-of-crystal-planes-mineralogy-geo-girl-137414	This video explores the fundamental symmetry operations and various types of twinning, in minerals.
Online-courses in Russian	**Link**	**Summary**
Кристаллография и минералогия	https://www.youtube.com/watch?v=UWsgWcx1XYU&ab_channel=%D0%93%D0%B5%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D1%8F%D0%B8%D1%80%D0%	This course, provides an introduction to the disciplines of crystallography and mineralogy, focusing on the properties of minerals and the structure of crystal lattices.

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Кристаллография. Лекция 1, вводная лекция. Введение в кристаллографию	https://www.youtube.com/watch?v=DQgeYg4vW9o&ab_channel=%D0%9F%D1%80%D0%BE%D1%84%D0%B5%D1%81%D1%81%D0%BE%D1%80%D0%A7%D1%83%D0%BF%D1%80%D1%83%D0%BD%D0%BE%D0%B2	This course explores the concept of crystallography, its objectives, and the various research subjects within the field.
Учимся определять минералы	https://www.youtube.com/watch?v=Ddk9JUeIdGI&ab_channel=%D0%9A%D0%B0%D0%BC%D0%BD%D0%B5%D0%B2%D0%B5%D0%B4%D1%8B	This practical exercise focuses on fundamental mineral determination techniques, providing hands-on experience in diagnosing unknown minerals. It is an invaluable activity for anyone seeking to develop practical skills in mineral identification.

Environmental Sciences

Online-courses in English	**Link**	**Summary**
Advanced Diploma in Geographic Information Systems	https://alison.com/course/advanced-diploma-in-geographic-information-systems	This free online course offers a comprehensive introduction to geographic information systems (GIS). It covers how to represent real-world data using GIS and explores the ways in which GIS can be utilized. Participants will learn about data flow, various databases and models, and the diverse opportunities within the GIS field. The course also includes training on different types of data analyses and the software tools essential for mastering GIS.
Environmental Standards and Norms for the Sustainability	https://stepik.org/course/74537/promo	This course has been designed to provide insight into the importance of environmental standards, including their creation and application.
Geographic Information Systems (GIS): Free Online GIS Training	https://research.lib.buffalo.edu/gis-courses/gis-training	This course provides a comprehensive guide to mapping data using open-source GIS tools. It covers GIS concepts and terminology, data analysis and symbolization, map creation, and working

		with projections, as well as vector and raster data.
Learn geographic information systems	https://www.edx.org/learn/gis-geographic-information-systems	GIS, or geographic information systems, is a technology that integrates spatial data, such as maps and satellite imagery, with analysis to understand patterns, relationships, and trends in a geographic context. It enables users to visualize, query, and interpret data to make informed decisions about location-based problems or challenges.
Online-courses in Russian	**Link**	**Summary**
Геоинформационные системы	https://www.youtube.com/watch?v=KkMVDvh3_Zg&ab_channel=%D0%93%D0%B5%D0%BE%D0%B1%D0%BE%D1%82%D0%B0%D0%BD%D0%B8%D0%BA%D0%B0%D0%9F%D1%80%D0%B0%D0%BA%D1%82%D0%B8%D0%BA%D1%83%D0%BC	The course introduces students to the fundamentals of geoinformatics, instructs them on working with spatial data and creating geo-applications, and provides guidance on accurately interpreting map information.
Геоинформационные системы. Лекция 10	https://www.youtube.com/watch?v=fj27G8r3jek&ab_channel=%D0%90%D0%BD%D0%B4%D1%80%D0%B5%D0%B9%D0%A1%D0%B0%D0%B2%D0%B5%D0%BB%D1%8C%D0%B5%D0%B2	This course provides an introduction to Geographic Information Systems (GIS). It is designed for specialists in spatial data analysis, cartographers, geologists, ecologists, cadastral engineers, builders, logisticians, and anyone working with geographically referenced information.
Практическое применение геоинформационных систем	https://www.youtube.com/watch?v=spCDE4kOaVo&ab_channel=%D0%90%D0%BD%D0%B4%D1%80%D0%B5%D0%B9%D0%9A%D1%83%D1%88%D0%BD%D0%B0%D1%80%D0%B5%D0%BD%D0%BA%D0%BE	This course is designed for individuals seeking to integrate GIS into their professional work. It covers the application of GIS for analyzing and visualizing spatial data, creating maps and plans, and addressing various issues in fields such as geography, ecology, agriculture, and beyond.

Physical geography

Online-courses in English	**Link**	**Summary**
Aeolian (Arid & Deserts)	https://www.youtube.com/watch?v=c1nr-8SdRFc	This lecture introduces the classification of aridity and the distinctive landforms of arid

Geomorphology. Physical Geography with Professor Patrich		regions. It addresses key processes such as erosion, transportation, and deposition of materials, and the resulting landforms. The lecture also explores the dynamics of sand movement, the anatomy of dunes, and techniques for identifying six different types of dunes in the field.
Cartography	https://www.classcentral.com/classroom/youtube-cartography-59085	This set of tutorials provides comprehensive guidance on map creation and enhancement. Participants will learn to design animated routes on maps using Photoshop and export them as videos. The course also covers techniques for importing spreadsheets to create interactive maps with Google Fusion Tables. Additionally, it delves into the Werner and Bonne map projections, offering insights into their applications. Finally, the tutorials explore essential map components, including the map frame, inset or locator maps, titles, legends, scale bars, north arrows or compass roses, and neatlines.
Introduction to Biogeography	https://alison.com/course/introduction-to-biogeography	This course offers an opportunity to achieve mastery in GIS by exploring the complexities of species distributions, environmental impacts, and conservation challenges. Participants will develop the skills necessary to propose innovative solutions and make significant contributions to the field of biogeography.
Introduction to Physical Geography. OER Units 1-4 Overview	https://www.youtube.com/watch?v=A-4-_0-jD2g	This lecture introduces the methods and concepts of physical geography, covering topics such as latitude and longitude, grid systems, and spatial locations both on Earth and in the cosmos. It also highlights the multifaceted nature of geography as a discipline.
Introduction to Physical Geography. Physical Geography with Professor Patrich	https://www.youtube.com/watch?v=f4KrefebLxg&t=71s	This lecture introduces students to geography as an academic discipline, highlighting key contributors to the field and the range of courses offered. It also emphasizes the importance of critical thinking and its application to the scientific method within the context of geography.

Introduction to Your Course. Physical Geography with Prof. Jeremy Patrich 2021	https://www.youtube.com/watch?v=vBHr6XCPIRo&list=PLZKcAeoj7_LIAXsuw7h89jxYjmI3h17Ms	This course is a spatial study of the Earth's dynamic physical systems and processes. Topics include Earth-sun geometry, weather, climate, water, landforms, soil, and biosphere. Tools of geographic inquiry are also briefly covered; they may include: maps, remote sensing, Geographic Information Systems (GIS), and Global Positioning Systems (GPS).
Reasons for Earths Seasons | Physical Geography with Professor Patrich	https://www.youtube.com/watch?v=R9YsgF-EywY	This lecture introduces the multifaceted concepts of the seasons. Discussed are the Earth's tilt, length of daylight, solar intensity and duration, the aphelion, and perihelion.
301 Physical Geography Lectures. Anisa Zafar	https://www.youtube.com/playlist?list=PLAQDR9nebkU7L_hzEScNorggVXsyWz5-V	The video provides a concise overview of temperature, distinguishing between heat and temperature, and explaining different temperature scales including Celsius, Fahrenheit, and Kelvin. It also covers instruments used to measure temperature, such as mercury and alcohol thermometers, and discusses key temperature controls, including latitude, elevation/altitude, and the influence of land and water.
Online-courses in Russian	**Link**	**Summary**
География	https://openedu.ru/course/nsu/geo/?session=2024_apr_dec	The course explores contemporary methods of geographical research and the rationale behind these studies. It examines patterns in the distribution of continents and oceans, their implications, and the reasons behind varying climate conditions across the globe. The course also covers the different types of water bodies on Earth and assesses potential environmental threats to humanity, among other topics.
Онлайн-школа абитуриента ТГУ: География	https://ido.skills.tsu.ru/enrol/index.php?id=129	This course systematizes knowledge in the main sections of Geography and includes theoretical and practical classes, as well as test tasks to check knowledge.
Страноведение и география городов	https://openedu.ru/course/hse/STRANGEO/?session=2023	In this online course, participants will examine the contemporary political and geographical map of the world, focusing on state borders. The course will explore key

		concepts related to defining "city" and "urban lifestyle," and trace the development of urban agglomerations and the emergence of megalopolises.

Ecology

Online-courses in English	**Link**	**Summary**
Agriculture – GIS in Ag-Essentials and Applications	https://www.classcentral.com/classroom/youtube-agriculture-gis-in-ag-essentials-and-applications-gis-47528	The course teaches how to use geographic information systems in agriculture. It covers the fundamentals of GIS and its applications for analyzing, planning, and managing agricultural resources.
Biotechnology	https://www.classcentral.com/classroom/youtube-biotechnology-102674	The course provides an overview of biotechnologies, their applications, and development prospects. It covers the main areas and methods of biotechnology.
Ecology	https://www.youtube.com/watch?v=sjE-Pkjp3u4&list=PL8dPuuaLjXtNdTKZkV_GiIYXpV9w4WxbX&ab_channel=CrashCourse	The course will explore how living organisms interact with each other and their environment. It will provide insights into the functioning of living systems, tracing their origins, development, and diversification over the past 4.5 billion years of Earth's history.
Ecology: from cells to Gaia	https://stepik.org/course/114944/promo	This course will review major ecological concepts, identify the techniques used by ecologists, provide an overview of local and global environmental issues, and examine individual, group, and governmental activities important for protecting natural ecosystems.
Environment: understanding atmospheric and ocean flows	https://www.open.edu/openlearn/nature-environment/environment-understanding-atmospheric-and-ocean-flows/content-section-0?active-tab=description-tab	This free course investigates atmospheric processes with a focus on the role of wind. It begins by introducing the fundamental principle of global atmospheric circulation, where warm air rises and cold air descends. The course examines the practical effects of this principle on atmospheric dynamics and water flow. Students will explore how global movements of water, heat, and pollution influence the Arctic region and contribute to broader environmental changes.

Ice and climate change	https://www.youtube.com/watch?v=F8IK-Ja7qtI&list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s&index=25&ab_channel=YaleCourses	Ice on Earth is highly sensitive to climate change, and its role in climate processes is significant. Recent trends in the Greenland ice sheet illustrate this sensitivity: over the past two decades, the extent of surface meltwater has increased, and satellites have observed a reduction in the ice sheet's overall mass. The lecture also covers paleoclimate, focusing on climatic changes over the last 5 million years.
Introducing the environment: Ecology and ecosystems	https://www.open.edu/openlearn/nature-environment/environmental-studies/introducing-the-environment-ecology-and-ecosystems/content-section-0?intro=1	This course initiates an exploration of ecosystems, delving into their living and non-living components. It addresses the role of humans as both integral members and active modifiers of these ecosystems, acknowledging their position within the biosphere, their origins from it, and their ongoing impact on its dynamics. The course concludes by examining the concept of 'ecological health,' emphasizing the detrimental effects of intensified resource exploitation on the sustainability and self-regulation of ecosystems.
Plant Protection	https://stepik.org/course/74464	This course introduces strategies for protecting cereal crops from various environmental threats through integrated pest management. It covers fundamental concepts of crop protection within agricultural systems, focusing on methods to safeguard crops from pests and other environmental challenges.
Renewable Energy	https://www.youtube.com/watch?v=lQuyMgwQqM0&list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s&index=34&ab_channel=YaleCourses	This course discusses renewable energy sources. These include wind energy, solar energy, biomass energy, and geothermal energy.
Online-courses in Russian	**Link**	**Summary**
Зимин М.В. Земля из Космоса: мониторинг экологического	https://www.youtube.com/watch?v=u5kxayxampI&ab_channel=msugeograph	The rapidly evolving world necessitates that geographers not only document changes but also comprehend the dynamics of these processes and forecast their future developments. This lecture explores how satellite imagery is employed to address

состояния планеты		both practical and scientific issues related to ecology and global changes on Earth.
Учебный курс Экология	https://www.youtube.com/watch?v=gNo8YB_MB5I&list=PLnoqqvUiV24V6a5EGtW0V58md1XQXzwDP&ab_channel=%D0%9A%D0%B0%D1%84%D0%B5%D0%B4%D1%80%D0%B0%22%D0%AD%D0%BA%D0%BE%D0%BB%D0%BE%D0%B3%D0%B8%D1%8F%D0%B8%D0%BF%D1%80%D0%BE%D0%BC%D1%8B%D1%88%D0%BB%D0%B5%D0%BD%D0%BD%D0%B0%D1%8F%D0%B1%D0%B5%D0%B7%D0%BE%D0%BF%D0%B0%D1%81%D0%BD%D0%BE%D1%81%D1%82%D1%8C%22%D0%9C%D0%93%D0%A2%D0%A3%D0%B8%D0%BC.%D0%9D.%D0%AD.%D0%91%D0%B0%D1%83%D0%BC%D0%B0%D0%BD%D0%B0	This course explores the historical evolution of the relationship between society and nature, focusing on the various types of habitats and the biotic factors that influence environmental conditions. It examines the different forms of biological interactions within ecosystems and delves into the principles and techniques of environmental monitoring. Additionally, the course covers biogeochemical cycles and their crucial role in maintaining ecological balance.
Экология и окружающая среда	https://openedu.ru/course/spbu/ECOENV/?session=spring_2021	The goal of this online course is to develop a comprehensive understanding of fundamental concepts in ecology and environmental protection among students. It aims to provide foundational knowledge in autoecology, population ecology, and synecology, while addressing major contemporary environmental issues. Additionally, the course offers theoretical insights into the structure, composition, and mineral resources of the Earth's lithosphere..

Mining and Mineral Processing

Online-courses in English	**Link**	**Summary**
Digital Transformation of Mining	https://www.edx.org/course/digital-transformation-of-mining	This course provides an overview of applications of digital technology across the value chain, including automation,

		monitoring, and remote operations, to optimize the value extracted from a mineral deposit.
Introduction to petroleum engineering	https://portal.tpu.ru/ceor/mooc	This course covers essential concepts related to oil and gas production, including reservoir energy and forces, petroleum deposit drainage, development systems, and well operation techniques. Participants will gain a comprehensive understanding of the field life cycle and learn about the interdisciplinary approaches necessary for effective petroleum field development and operation.
Management of Energy Resources	https://stepik.org/course/172611	Course topics include: 1. Introduction. Sustainable energy development as a base of global sustainability. Sustainable development goals and trajectory of the energy sector. Global strategies. 2. Energy resources: distribution of different energy sources, availability, and sustainability issues. Energy poverty as a global challenge. Global tendencies. 3. Energy security and energy efficiency: levels of evaluation, models, management instruments. State regulation and social initiatives. Energy management. “Green standards”. 4. Green energy. The energy sector as a source of environmental damage. Models and assessments. 5. Management of environmental risk in the energy sector. Concept of environmental risk. Environmental risk of energy sources: renewables and non-renewables. Energy management. Waste as the “secondary resources”: recycling. 6. Energy sector and global climate policy. Greenhouse gases emissions: modern assessments and scenarios.
Minerals and Mining in a	https://www.edx.org/course/minerals-and-mining-in-a-sustainable-world	This course provides an overview of the role of minerals in society, the history of the sustainable development agenda, and the

Sustainable World		emerging focus on the relationship between mineral development and the Sustainable Development Goals.
Natural Resources for Sustainable Development	https://www.edx.org/course/natural-resources-for-sustainable-development	This 12-week course provides an in-depth exploration of sustainable management practices for extractive industry investments. Participants will gain a comprehensive understanding of the complex and interconnected aspects of natural resource governance. The course aims to engage individuals in a global movement dedicated to leveraging the transformative potential of natural resources responsibly and effectively.
Operational Foundations of Mining	https://www.edx.org/course/operational-foundations-of-mining	This course offers a comprehensive overview of the technical components involved in a mining system, focusing on the processes that transfer valuable material from its in-ground state to a beneficiated product.
Online-courses in Russian	**Link**	**Summary**
Введение в геологию полезных ископаемых	https://openedu.ru/course/spbu/GEOLOGYMIN	This course provides an in-depth understanding of mineral geology, covering the formation, distribution patterns, and characteristics of solid mineral deposits. It explores the geological and industrial types of deposits within the framework of genetic classification.
Информационные технологии в геологии	https://stepik.org/course/206794/promo?search=4695217560	The goal of the course is to equip students with the fundamental technologies used in the production of geological work across various stages and phases. This includes activities conducted by government agencies, scientific organizations, and private firms involved in the exploration, predictive assessment, and development of mineral deposits.
Основы нефтегазового дела	https://openedu.ru/course/spbstu/BASOIL/?session=fall_2024	The course covers essential aspects of prospecting and exploration work, including the physical and chemical properties of oil, types of oil and gas fields, and the processes involved in drilling wells. It also addresses the development and operation of oil fields,

		field collection and preparation of oil, gas, and water, as well as capital and underground repairs of wells. Additionally, the course explores long-distance transport and storage of oil and gas.