

Program: Earth & Environmental Sciences for Sustainability

This document outlines the scope of themes, which may be included in the Olympiad tests.

The themes are grouped by areas and are followed by the list of recommended references in the Russian and English languages.

Olympiad winner's skill set by Subject

The winner of the Olympiad in the field of "Earth and Environmental Sciences" must have the following skills:

Analytical activities

The winner

- possesses fundamental knowledge in the field of Earth and Environmental Sciences; is able to independently describe the patterns of the main processes occurring on Earth;
- has the skills to process and interpret geological, geophysical, and environmental information.

Project activities

The winner

- is able to independently carry out research in the field of Earth and Environmental Sciences;
- is able to analyze and interpret the results of experimental and theoretical studies;
- knows the methods of processing and analysis of geological, geophysical, geodetic, and environmental data.

Research activities

The winner

- knows modern approaches used in research design in the field of Earth and Environmental Sciences;
- is able to assess the degree of completeness and reliability of information about the properties and structure of the Earth's spheres;
- has the necessary skills to build models of various processes and objects.

Content

Section 1. Geology

1. General and regional geology
2. Petrography and mineralogy
3. Stratigraphy and paleontology
4. Geotectonics and geodynamics
5. Historical geology
6. Hydrogeology

Section 2. 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

Section 3. Environment

1. General ecology
2. Applied Ecology
3. Biotechnology
4. Meteorology and Atmosphere Science
5. Climate Change
6. Agroecology and Soil Science

Section 4. Cartography, geography, geodesy

1. Physical geography
2. Cartography
3. Geography of natural resources
4. Landscape science
5. Earth Science
6. Geodesy
7. Modern methods of obtaining information about the Earth's surface
8. Remote control methods and geographic information systems
9. Space geodesy and remote sensing of the Earth

Section 5. Applied Geology and Mining

1. Geology and exploration of solid mineral deposits
2. Modeling of mineral deposits
3. Mining
4. Geology and exploration of oil and gas fields
5. Drilling technologies
6. Mining of oil and gas

Recommended literature

Section 1. Geology

Sources in English	Topic
1. Frost B.R., Frost C.D. Essentials of Igneous and Metamorphic Petrology. 1st Edition, Kindle Edition, 2013. URL: https://www.geokniga.org/bookfiles/geokniga-essentialsofigneousandmetamorphicpetrologybyfrostbrfrostcdz-liborg.pdf (free access)	Petrography and mineralogy
2. 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 and mineralogy

3. Scotese C.R. Palaeogeography Atlas. Paleomap Progress Report 90-0497, Dept. Geology, Univ of Texas atb Arlington. Texas, 1997. 45 p. URL: http://www.scotese.com/earth.htm (free access)	General and regional geology Stratigraphy and paleontology Historical geology Geotectonics and geodynamics
4. Superplumes. Eds D.A. Yuen, Sh. Maruyama, B.F.Windley. Springer, 2007. 510 p. URL: https://link.springer.com/content/pdf/10.1007/978-1-4020-5750-2.pdf (free access)	Geotectonics and geodynamics
5. The Andes: active subduction orogeny. Ed. Oncek et al. Dordrecht: Springer, 2008. 610 p. URL: https://link.springer.com/content/pdf/10.1007/978-3-540-48684-8.pdf (free access)	General and regional geology Geotectonics and geodynamics

Sources in Russian	Topic
1. Бетехтина А.Г. Курс минералогии: учебное пособие. М.: КДУ, 2007. 721 с. URL: https://www.geokniga.org/bookfiles/geokniga-kurs-mineralogii-uchebnoe-posobie-agbetehtin-2008.pdf (free access)	Petrography and mineralogy
2. Короновский Н.В. Общая геология: учебник. М.: КДУ, 2006. 528 с. URL: https://www.geokniga.org/bookfiles/geokniga-koronovskiyobshchayageologiya2006.pdf (free access)	General and regional geology Hydrogeology
3. 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 Historical geology
4. Хаин В.Е., Ломизе М.Г. Геотектоника с основами геодинамики: учебник – 2-е изд., испр. и доп. – М.: КФУ, 2005. 560 с. URL: https://www.geokniga.org/bookfiles/geokniga-geotektonika-s-osnovami-geodinamiki.pdf (free access)	Geotectonics and geodynamics

Section 2. Geochemistry and geophysics

Sources in English	Topic
1. Bacon M., Simm R., Redshaw T. 3D Seismic interpretation. Cambridge University Press, 2007. 224 p. URL: https://www.geokniga.org/bookfiles/geokniga-3-d-seismic-interpretation.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: https://link.springer.com/content/pdf/10.1007/978-3-662-53383-3.pdf (free access)	Geophysical surveys of well Electrical prospecting Seismic tomography
3. Stacey, F.D., Davis, P.M. Physics of the Earth. New York: Cambridge University Press, 2008. 513 p. URL: https://www.studmed.ru/stacey-fd-davis-pm-physics-of-the-earth_7ae119ad4dd.html (free access)	Physics of the Earth
4. Treatise on geochemistry. Ed. by Turekian K.K. and Holland H.D. Elsevier, 2003, v. 1-9. URL: https://www.sciencedirect.com/referencework/9780080983004/treatise-on-geochemistry (free access)	Fundamentals of geochemistry

Sources in Russian	Topic
1. Аплонов С.В., Титов К.В. Геофизика для геологов: учебник. СПб.: Издательство СПбГУ, 2010. 248 с. URL: https://www.geokniga.org/bookfiles/geokniga-aplonov-geofizika-dlya-geologov1.pdf (free access)	Electrical prospecting Seismic tomography Geophysical well surveying Physics of the Earth
2. Барабанов В.Ф. Геохимия. Л.: Недра, 1985. 423 с. URL: https://www.geokniga.org/bookfiles/geokniga_8.pdf (free access)	Fundamentals of geochemistry
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_posobiya/Hmelevskoj_osnovy_geofizicheskikh_metodov.pdf (free access)	Electrical prospecting Seismic tomography Geophysical well surveying Petrophysics

Section 3. Environment

Sources in English	Topic
1. Kim H.Tan, Principles of soil chemistry. New York: Marcel Dekker Inc, 1998. 556 p. URL: https://www.geokniga.org/books/3266 (free access)	Agroecology and Soil Science General ecology
2. 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://www.biotech-asia.org/vol13no1/landfills-problems-solutions-and-	Applied Ecology

de%D1%81ision-making-of-waste-disposal-in-harare-zimbabwe/ (free access)	
3. 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 and Soil Science General ecology
4. 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

Sources in Russian	Topic
1. Бурлакова Л.М., Кауричев И.С., Ковриго В.П. Почвоведение с основами геологии. М.: Колос, 2000. 416 с. URL: https://www.geokniga.org/bookfiles/geokniga-pochvovedenie-s-osnovami-geologii.pdf (free access)	Agroecology and Soil Science 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. 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
4. Миронова Д.Ю., Баранов И.В., Помазкова Е.Е., Румянцева О.Н., Управление проектной деятельностью: применение форсайта и промышленного симбиоза в управлении проектами в целях устойчивого развития. СПб: Университет ИТМО, 2022. 95 с. URL: https://books.ifmo.ru/file/pdf/3070.pdf (free access)	Applied Ecology

Section 4. Cartography, geography, geodesy

Sources in English	Topic
1. Fundamentals of Physical Geography. J. Petersen, D. Sack, R.E. Gabler (eds.). Brooks/Cole. 2nd edition, 2014. 479 p. URL:	Physical geography

http://www.physicalgeography.net/fundamentals/contents.html (free access)	
2. Rockville M. Basic Geodesy. National Oceanic and Atmospheric Administration, 1977. 40 p. URL: https://geodesy.noaa.gov/PUBS_LIB/basgeo.pdf (free access)	Geodesy
3. Vermeer M. Geodesy: The science underneath. Aalto University publication series, 2019. 576 p. URL: https://users.aalto.fi/~mvermeer/geodesy.pdf (free access)	Geodesy Modern methods of obtaining data about the Earth's surface Remote control methods and geographic information systems Space geodesy and remote sensing of the Earth

Sources in Russian	Topic
1. Голованов А.И., Кожанов Е.С., Сухарев Ю.И. Ландшафтоведение: учебник. – 2-е изд., испр. и доп. Санкт-Петербург: Лань, 2022. 224 с. URL: https://e.lanbook.com/book/211880 (free access)	Landscape science
2. Ермаков Ю.Г., Куракова Л.И., Романова Э.П. Природные ресурсы мира: учебное пособие. М.: МГУ, 1993, 304 с. URL: https://www.geokniga.org/books/343 (free access)	Geography of natural resources Earth Science
3. Паровов В.В. Картография с основами топографии. Часть 2. Картография: учебно-методическое пособие. – Томск: Изд-во ГОУ ВПО «Томский государственный педагогический университет», 2010. 132 с. URL: https://www.tspu.edu.ru/oldfiles/libserv/files/Paromov_Kartografiya_s_osnovami_topografii.pdf (free access)	Cartography
4. Попов В.Н., Чекалин С.И. Геодезия: Учебник для вузов. М.: Горная книга, 2007. 518 с. URL: https://www.geokniga.org/bookfiles/geokniga-popov-vn-chekalin-vi-2007.pdf (free access)	Geodesy Modern methods of obtaining data about the Earth's surface Remote control methods and geographic information systems Space geodesy and remote sensing of the Earth.

Section 5. Applied Geology and Mining

Sources in English	Topic
1. Abzalov, M. Applied mining geology. Springer International Publishing Switzerland, 2016. 441 p.	Mining Modeling of mineral deposits

URL: https://zarmesh.com/wp-content/uploads/2021/10/Applied-Mining-Geology.pdf (free access)	Drilling technologies
2. Bhattacharya J., Das A.K., Kayal J.R., Moitra A.K., Mukerji B. Innovative exploration methods for minerals, oil, gas, and groundwater for sustainable development. Elsevier, 2022. 540 p., ISBN: 978-0-12-823998-8. URL: https://www.geokniga.org/books/30865 (free access)	Geology and exploration of oil and gas fields Drilling for oil and gas Drilling technologies
3. Gelfgat, M.Y., Gelfgat, Y.A., Lopatin, Y.S. Advanced Drilling Solutions. Volume 1. Lesson from the former Soviet Union. Pennwell Books, 2003. 325 p. URL: https://www.geokniga.org/books/23480 (free access)	Drilling technologies
4. 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 mineral deposits
5. 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 solid mineral deposits Drilling technologies Mining
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 mineral deposits

Sources in Russian	Topic
1. Авдохин В.М. Основы обогащения полезных ископаемых: Учебник для вузов в 2 т. Том 1. Обогачительные процессы. М.: Горная книга, 2018. 420 с. URL: https://www.geokniga.org/books/26661 (free access)	Mining
2. 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 mineral deposits Drilling for oil and gas
3. Булатов А.И., Качмар Ю.Д., Макаренко П.П., Яремийчук Р.С. Освоение скважин: Справочное	Drilling technologies

Sources in Russian	Topic
пособие. М.: ООО «Недра-Бизнесцентр», 1999. 473 с. URL: https://www.geokniga.org/books/4754 (free access)	
4. Габриэлянц Г.А. Геология, поиски и разведка нефтяных и газовых месторождений. М.: Недра, 2000. 587 с., ISBN: 5-247-03870-3 URL: https://www.geokniga.org/books/20016 (free access)	Geology and exploration of oil and gas fields
5. Гладков Е.А. Геологическое и гидродинамическое моделирование месторождений нефти и газа. Томск: Томский политехнический университет, 2012. 99 с. URL: https://www.geokniga.org/books/25995 (free access)	Modeling of mineral deposits. Drilling for oil and gas
6. 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 solid mineral deposits
7. Закревский К.Е. Геологические 3D моделирование. М.: ООО ИПЦ Маска, 2009. 376 с., ISBN: 978-5-91146-279-6. URL: https://www.geokniga.org/books/6335 (free access)	Modeling of mineral deposits Drilling for oil and gas
8. Зенько Д.К., Кузьмин Е.В., Хайрутдинов М.М. Основы горного дела. М.: ООО «Артпринт+», 2007. 472 с. URL: https://www.geokniga.org/books/16296 (free access)	Mining
9. 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 oil and gas fields
10. Норман Дж. Х. Геология, разведка, бурение и добыча нефти. М.: Олимп-Бизнес, 2008. 726 с., ISBN: 978-5-9693-0135-1. URL: https://www.geokniga.org/books/3379 (free access)	Geology and exploration of oil and gas fields Drilling for oil and gas Drilling technologies

Recommended online courses

Section 1. Geology

1. Crystallography and Mineralogy. URL: <https://learn.planet-geology.com/courses/crystallography-mineralogy>
2. Emergence of Life. URL: <https://www.coursera.org/learn/emergence-of-life>
3. Mineralogy and Petrology. URL: <https://www.epictraining.ca/technical-exams/online-courses/GEOL-A1/mineralogy-and-petrology-distance/13928/>
4. Minerals and the crystalline state. URL: <https://www.open.edu/openlearn/science-maths-technology/minerals-and-the-crystalline-state/content-section-0?active-tab=content-tab>
5. Online Petrographic Analysis Explained. URL: <https://www.scotlime.org/skills-training/courses/petrographic-analysis-explained/>
6. Origins - Formation of the Universe, Solar System, Earth and Life. URL: <https://www.coursera.org/learn/origins-universe-solarsystem>
7. Our Earth: Its Climate, History, and Processes. URL: <https://www.coursera.org/learn/our-earth>
8. Petrology. URL: <https://www.classcentral.com/course/swayam-petrology-14084>
9. Physical Geology. URL: <https://www.udemy.com/course/geology-fundamentalz/>
10. Planet Earth...and You! URL: <https://www.coursera.org/learn/planet-earth>

Section 2. Geochemistry and geophysics

Online course:

1. Earthquake Seismology. URL: <https://www.edx.org/course/earthquake-seismology?index=product&queryID=f742750d47bea40a1e13afc5b4eab8c3&position=1>
2. Geology: Basic Principles of Geochemistry. URL: <https://www.udemy.com/course/geology-basic-principles-of-geochemistry/>
3. Geology – Geochemistry. URL: https://onlinecourses.swayam2.ac.in/cec22_mm02/preview
4. Geophysical Surveying Methods: An Introduction. URL: <https://www.udemy.com/course/geophysical-surveying-methods-an-introduction/>
5. Geophysics for Non Geophysicist. URL: <https://www.udemy.com/course/geophysics-for-non-geophysicist/>
6. Trace-Element Geochemistry. URL: <https://ocw.mit.edu/courses/12-479-trace-element-geochemistry-spring-2013/>

Video lectures:

1. Introduction into the Applied geostatistics. URL: <https://www.youtube.com/watch?v=HgqBocDr3G0&list=PLhQwqg2sX-z1bVKAqahyyyY16myeDTe1o>
2. Seismic to well tie. URL: https://www.youtube.com/watch?v=mDdvOrIU6K8&list=PLhQwqg2sX-z3rgS_fd5pbwoYaUHIJBdwY
3. Well log interpretation. Introduction to well logging. URL: <https://www.youtube.com/watch?v=ARgTIgeUhuE&list=PLhQwqg2sX-z34sjrZzYxWeuQrLaQP3EA0>

Section 3. Environment

1. Drones for Environmental Science. URL: <https://www.coursera.org/learn/drones-for-environmental-science>
2. Global Warming I: The Science and Modeling of Climate Change. URL: <https://www.coursera.org/learn/global-warming>
3. Introduction to Biology: Ecology, Evolution, & Biodiversit. URL: <https://www.coursera.org/specializations/introduction-to-biology>
4. Municipal Solid Waste Management. URL: https://www.youtube.com/watch?v=cjIacnNRLHE&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv
5. Municipal Solid Waste Management in Developing Countries. URL: <https://www.coursera.org/learn/solid-waste-management?>
6. Population, Food, and Soil. URL: <https://www.coursera.org/learn/population-food-and-soil>
7. Retaining an Atmosphere. URL: https://www.youtube.com/watch?v=Gie8L8slnSs&list=PLkUjvobcQS8YGbXinRsEY_2WabKqrPJ4s
8. Science and Engineering of Climate Change. URL: <https://www.coursera.org/learn/science-and-engineering-of-climate-change>
9. What is Climate Change? URL: <https://www.coursera.org/learn/what-is-climate-change>

Section 4. Cartography, geography, geodesy

Video lectures:

1. Aeolian (Arid & Deserts) Geomorphology. Physical Geography with Professor Patrich. URL: <https://www.youtube.com/watch?v=c1nr-8SdRFc>
2. Introduction to Physical Geography. OER Units 1-4 Overview. URL: <https://www.youtube.com/watch?v=A-4-0-jD2g>
3. Introduction to Physical Geography. Physical Geography with Professor Patrich. URL: <https://www.youtube.com/watch?v=f4KrefebLxg&t=71s>
4. Introduction to Your Course. Physical Geography with Prof. Jeremy Patrich 2021. URL: https://www.youtube.com/watch?v=vBHR6XCPIRo&list=PLZKcAeoj7_LIAXsuw7h89jxYjmI3h17Ms
5. Reasons for Earths Seasons | Physical Geography with Professor Patrich. URL: <https://www.youtube.com/watch?v=R9YsgF-EywY>
6. 301 Physical Geography Lectures. Anisa Zafar. URL: https://www.youtube.com/playlist?list=PLAQDR9nebkU7L_hzEScNorggVXsyWz5-V

Section 5. Applied Geology and Mining

1. Digital Transformation of Mining. URL: <https://www.edx.org/course/digital-transformation-of-mining>
2. Minerals and Mining in a Sustainable World. URL: <https://www.edx.org/course/minerals-and-mining-in-a-sustainable-world>
3. Natural gas. URL: <https://www.coursera.org/learn/natural-gas>
4. Natural Resources for Sustainable Development. URL: <https://www.edx.org/course/natural-resources-for-sustainable-development?>
5. Oil & Gas Industry Operations and Markets. URL: <https://www.coursera.org/learn/oilandgas>

6. Operational Foundations of Mining. URL: <https://www.edx.org/course/operational-foundations-of-mining>
7. Reservoir Geomechanics. URL: <https://www.edx.org/course/reservoir-geomechanics>
8. The Business of Mining. URL: <https://www.edx.org/course/the-business-of-mining>
9. The Future of Mining? URL: <https://www.edx.org/course/the-future-of-mining?>
10. The Minerals and Mining Business. URL: <https://www.edx.org/course/the-minerals-and-mining-business>
11. Introduction to Mineral Geology. URL: <https://openedu.ru/course/spbu/GEOLOGYMIN/>
12. Engineering Geology. URL: <https://openedu.ru/course/misis/ENGCEO/>
13. Fundamentals of oil and gas engineerings. URL: <https://openedu.ru/course/spbstu/BASOIL/>