STUDIES AT FACULTY OF SCIENCE, MASARYK UNIVERSITY, BRNO

MATHEMATICS

INFORMATION FOR PROSPECTIVE INTERNATIONAL PH.D. STUDENTS

http://www.sci.muni.cz/graduate

PH.D. STUDIES

REASONS FOR CHOOSING TO STUDY MATHEMATICS AT MASARYK UNIVERSITY

- Internationally recognized research groups
- New campus facilities
- Students in the programs in the Czech language are eligible for a monthly stipend
- International students may apply for an additional dean’s stipend
- Student life in Brno – the city of several universities

CONTACT

Department of Mathematics and Statistics
Faculty of Science
Masaryk University
Kotlarska 2, 611 37 Brno, Czech Republic
http://www.sci.muni.cz/phd-mathematics
FEATURES AND GOALS OF THE PROGRAM
The Department of Mathematics and Statistics offers several Ph. D. scholarships in pure and applied mathematics.

AREAS OF STUDY AND RESEARCH
- Algebra, Number theory and Mathematical logic
- Mathematical Analysis
- Geometry, topology and global analysis
- Probability, statistics and modeling
- History of mathematics

RESEARCH FACILITIES
- Library
- Electronic access to a wide variety of mathematical journals
- Mathematical databases – abstracts, reviews and etc.
for their complexing properties
- synthesis and application of polymer stabilizers
- polymer and biopolymers arrangements

Physical Chemistry
- structure and function of molecules by spectroscopic & electrochemical methods
- kinetics of chemical & electrochemical reactions
- computations of phase diagrams
- thermodynamic properties of metals
- bio-electrochemical and mathematical methods in biological research
- bio & electrochemical processes and interfaces

RESEARCH FACILITIES
- 600, 500 and 300 MHz NMR spectrometers
- IR and Raman spectroscopy, fluorescence and time-resolved fluorescence, UV-Vis
- ICP-MS, ICP-OES, laser ablation ICP-MS, laser induced breakdown spectroscopy, AAS, ETAAS
- GC-AFS, GC-ICP-MS, HPLC-ICP-MS
- HPLC, HPLC/CD, preparative HPLC, GC
- capillary & gel electrophoresis, isotachophoresis
- HRMS, MALDI-MS, LC-MS, GC-MS
- Femtosecond and nanosecond kinetic flash photolysis
- TG/DSC-FTIR, Single crystal X-ray diffraction, nitrogen absorption isotherm – BET
- microwave and sonochemistry instrumentation

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PH.D. STUDIES
REASONS FOR CHOOSING TO STUDY CHEMISTRY AT MASARYK UNIVERSITY
- Internationally recognized research groups
- State-of-the-art research equipment
- New campus facilities / Recently furnished laboratories
- Students in programs in the Czech language are eligible for a monthly stipend
- International students may apply for an additional dean's stipend
- Student life in Brno, the city of universities
FEATURES AND GOALS OF THE PROGRAM

This doctoral study program aims at training highly skilled specialists in the below-mentioned fields of study, and is based on research and independent creative activity in particular fields of research or development, while the main focus remains either on independent and creative experimental activity, or theoretical pursuits supervised by the advisor. The program requires a thorough theoretical knowledge of chemistry. A student acquires this knowledge by completing compulsory optional courses, updated with the latest information in the given area, and through optional courses for gaining experimental technique skills, as well as learning new methods. In addition, the programme contributes to developing the abilities of students to critically evaluate findings gained from literature and pass these and their own findings on to the public by means of seminars, and finally by assisting in teaching students of the bachelor and master programs. The purpose of this study is to facilitate the achievement of significant scientific results that can be published in prestigious journals, learning to relay one’s findings in English with the aim of publishing them, and compiling one's findings in a doctoral dissertation.

AREAS OF STUDY AND RESEARCH

Department of Chemistry
Research Centre for Environmental Chemistry and Ecotoxicology http://www.recetox.muni.cz/

Analytical Chemistry
– development of analytical instrumentation
– analytical plasmas, optical & mass spectroscopy
– separations & spectroscopy in life sciences
– optical & mass molecular spectroscopy
– complex equilibria in life sciences & environment
– selected analytical chemistry methods applied to geology, biology, materials chemistry, archaeology, environmental chemistry

Inorganic Chemistry
– synthesis of molecular metallophosphates, phosphonates, and silicates
– transition metal complexes with S/Se/Te ligands
– synthesis and structural characterization of coordination polymers

Organic Chemistry
– organic synthesis and structure elucidation
– photochemistry

Materials Chemistry
– sustainable chemistry synthesis
– theoretical structural chemistry and molecular modeling
– all the above topics are oriented towards application in medicinal, material and green chemistry

Environmental Chemistry
– chemical analysis of persistent organic compounds, toxic metals, and polar contaminants
– research and modeling of environmental processes including photochemistry
– development of new sampling and analytical techniques for determination of various types of environmental chemicals

Macromolecular Chemistry
– synthesis of polymers with application of new synthesized catalysts
– synthesis of supramolecular structures and search
RESEARCH FACILITIES

- 2 x 3DCE instrument
- HP 1200 HPLC instrument
- 6320 Ion Trap MS
- Bioreactor Biostat B-DCU
- Genetic analyzer 3100
- GS-800 VIS scanner
- Large format high capacity 2D-PAGE
- Pharos FX Plus fluoro+phosphoimager
- qPCR-ABI 7300

PH.D. STUDIES
REASONS FOR CHOOSING TO STUDY BIOCHEMISTRY AT MASARYK UNIVERSITY

- Internationally recognized research groups
- State-of-the-art research equipment
- New campus facilities / Recently refurbished laboratories
- Students in the programs in the Czech language are eligible for a monthly stipend
- International students may apply for an additional dean’s stipend
- Student life in Brno – the city of several universities
FEATURES AND GOALS OF THE PROGRAM

PhD programme Biochemistry provides research opportunities and training for graduate students who wish to study for a 4-year PhD degree. The students will acquire the detailed knowledge and practical skills needed for the study of the molecular mechanisms of metabolic processes that take place in various solutions and in biological membranes, and during the various types of biochemical analysis (identification of bio-molecular structures and analysis of their composition, continuous monitoring of substrates and products in ongoing enzyme reactions, or analysis using biological principles of detection). Experienced personnel at the Department of Biochemistry provide specialized instruction in the areas of metabolism of bacteria and fungi (aerobic respiration and identification, bacterial oxidation of sulfur-based materials, interaction of parasitical fungi with plants) and biochemical analysis (development of new methods of separation, use of biosensors in measuring environmental pollutants, and clinically important metabolites).

AREAS OF STUDY AND RESEARCH

**Analytical biochemistry**
(Zdeněk Glatz, glatz@chemi.muni.cz)
- Application of capillary electrophoresis for drug metabolism studies
- Application of capillary electrophoresis in metabolomics
- Study of enzymes by EMMA (Electrophoretically Mediated MicroAnalysis)
- Application of capillary electrophoresis for analyses of biologically active compounds in medicinal plants
- Application of capillary electrophoresis in clinical chemistry
- Application of capillary electrophoresis-MS combination

**Biochemistry of denitrification bacteria**
(Igor Kučera, ikucera@chemi.muni.cz)
- Dynamics of electron transport in branched respiratory chains
- Enzymology of bacterial flavin oxidoreductases
- Cellular responses to changed growth conditions

**Biosensors**
(Petr Skládal, skladal@chemi.muni.cz)
- Enzyme electrodes
- Electrochemical, piezoelectric and optical immunosensors
- Studies of bioaffinity interactions using biosensors
- Bioanalytical applications (detection of nerve agents and bioagents, bioelectronic tongue for wine control, immunoassays for pesticides and clinical markers

**Environmental biotechnology**
(Martin Mandl, mandl@chemi.muni.cz)
- Enzymes in oxidation of inorganic sulfur substances
- Microbial kinetics and mechanism of substrate oxidation
- Proteomics in iron and sulfur biooxidation
- PCR methods in detection of bacterial strains
- Bioleaching of sulfide wastes

**Glycobiochemistry**
(Michaela Wimmerová, michaw@chemi.muni.cz)
- Structure-functional studies on lectins

**Molecular phytopathology**
(Tomáš Kašparovský, tomas@chemi.muni.cz)
- Molecular basis of plant protection
- Study of molecules (elicitors) playing a role in recognition of pathogens by plants
- Design and construction of elicitors with altered function
- Identification of pathogens by DNA techniques
- Measurements of transcriptome changes after elicitor treatment

**Molecular physiology**
(Omar Šerý, omarsery@sci.muni.cz)
- Pathogenesis of schizophrenia, alcoholism, attention deficit hyperactivity and other disorders
- Diagnosis of viral and bacterial diseases from clinical material

**Proteomics**
(Pavel Bouchal, bouchal@chemi.muni.cz)
- Protein markers of physiological and pathological processes
- Detection of proteins involved in adaptation processes
- Proteomics in molecular oncology
- New proteomic methods
PH.D. STUDIES

REASONS FOR CHOOSING TO STUDY BIOLOGY AT MASARYK UNIVERSITY

- Internationally recognized research groups
- State-of-the-art research equipment and laboratories
- Basic research in biology as well as interdisciplinary areas and applied sciences
- New university campus facilities / Recently refurbished laboratories
- Students in programs in the Czech language are eligible for tuition waivers and a monthly stipend
- International students may apply for an additional dean’s stipend
- Student life in Brno – the city of several universities

INFORMATION FOR PROSPECTIVE INTERNATIONAL PH.D. STUDENTS

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CONTACT

Department of Anthropology, Department of Botany and Zoology, Department of Experimental Biology
Faculty of Science, Masaryk University
Kotlářská 2, CZ61137 Brno, Czech Republic
Phone: +420-549 49 3278, email: int@sci.muni.cz
http://www.sci.muni.cz/phd-biology

– Electrophoresis and chromatography, mass spectrometry
– Experimental animal facilities for invertebrates and vertebrates
– Culture and exposure rooms and incubators for microbiological, plant and algal research
– Czech Collection of Microorganisms with over 3,000 strains of bacteria and fungi
– Herbarium since 1921 (600,000 specimens of mainly vascular plants)
– Botanical garden containing extensive plant collection in greenhouses and outdoor areas
– Zoological collections namely of arthropods, molluscs and small mammals
– Up to date equipment, technology and software for advanced methodology in biological/skeletal/forensic anthropology: MicroScribe and MicroScan digitizers, microscopy, advanced computing HW and SW
– Professional osteometric and anthropometric instruments, extensive and unique collection of casts of human body parts and photographic material from various parts of the world
FEATURES AND GOALS OF THE PROGRAM

Ph.D. studies in Biology at Faculty of Science, Masaryk University offer a broad range of research areas, from molecular and cellular levels, to individuals, populations, communities and ecosystems as well as research in taxonomy, ecology, ecotoxicology and anthropology.

Besides basic research oriented areas, interdisciplinary cooperation (including combinations of biology with chemistry and biochemistry, mathematics and biostatistics or environmental sciences) is encouraged and promoted. Graduates of the Biology program extend their preexisting knowledge and experiences in all major biology disciplines (molecular biology, general biology and physiology, botany, zoology, ecology etc.), and they become outstanding experts within the specific selected research area. The PhD studies are based on individual research projects aiming to develop new state-of-the-art knowledge in the field, supported by high-impact peer reviewed publications. Study curricula of individual research areas and programs also include a range of lectures, seminars, practical courses as well as laboratory and field exercises.

AREAS OF STUDY AND RESEARCH

Department of Experimental Biology
http://www.sci.muni.cz/UEB/indexEN.html

Plant Physiology and Anatomy
– stress physiology, photosynthesis
– transport processes and mineral nutrition
– mycorrhiza, physiology of lichens

General and Molecular Genetics
– genetics of tumors
– molecular cytogenetics of human diseases
– population genetics in animals
– genetics of plants

Molecular and Cell Biology
– molecular biology of cancer
– molecular mechanisms of cell differentiation and programmed cell death

Animal Physiology
– cell signaling, stem cell research
– immunology and free radical research
– physiology and immunology of insects

Microbiology
– environmental microbiology & bioremediation
– ecology of bacterial and viral pathogens
– bacterial taxonomy
– molecular methods of detection and diagnosis of bacteria

Genomics and proteomics
– Structure and dynamics of chromosomes and chromosome domains
– Genomics and proteomics of plant developmental processes
– Genomics and proteomics in molecular medicine

Department of Botany and Zoology
http://botzool.sci.muni.cz/?lang=en

Botany
– plant ecology
– vegetation diversity
– plant genome
– taxonomy of vascular plants

Hydrobiology
– macroinvertebrate ecology and biology
– genetic diversity of freshwater invertebrates
– fish aquaculture

Zoology
– invertebrate (incl. insect) and vertebrate biosystematics, molecular phylogeny and biodiversity
– population biology, ecology and behavior of selected animal species

Ecology
– ecosystem biodiversity and its changes
– palaeoecology research
– bioindication of anthropogenic stresses

Parasitology
– structural and genetic parasite diversity
– ecology & evolution of parasite-host systems
– parasitism & diversification of MHC genes

Department of Anthropology
http://anthrop.sci.muni.cz/page.yhtml?id=319

Skeletal and Biological Anthropology
– assessment of age, sex, body characteristics, ethnic (population) affinity and other characteristics based on human skeletal remains
– research and study in the areas of functional anthropology and human variability

Morphology and Forensic Anthropology
– currently important issues of biological/skeletal/forensic anthropology by using advanced methodology:
– shape and image analysis
– research of sexual dimorphism by geometric morphometrics
– virtual anthropology
– 3D virtual modelling

Socio-cultural anthropology
– paleoethnology: theoretical bases of reconstructing past human societies, with emphasis on the hunter-gatherers
– anthropology of dying – burial rites in pre-historical, historical and current cultures of the world

Research Facilities

– Molecular and cell biology devices for quantitative real-time PCR, animal and plant cell culturing, DNA manipulation and cell transfection, pulse-field gel electrophoresis
– Range of microscopical techniques and flow cytometry applications
– Automated readers such as Bioscreen C or microplate luminometers and fluorometers
– Genomics and proteomics equipment including automated DNA sequencing, oligonucleotide synthesis, protein expression and purification,
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CONTACT

Department of Geography
Faculty of Science
Masaryk University
Kotlářská 2, 611 37 Brno, Czech Republic
e-mail: brazdil@sci.muni.cz
http://www.sci.muni.cz/phd-geography

PH.D. STUDIES

REASONS FOR CHOOSING TO STUDY GEOGRAPHY AT MASARYK UNIVERSITY

- Internationally recognized research groups
- State-of-the-art research equipment
- Recently refurbished spaces of the department
- Students in the programs in the Czech language are eligible for a monthly stipend
- International students may apply for an additional dean’s stipend
- Student life in Brno, the city of universities
- Participation in Czech and EU research projects
- Internationally experienced teachers
FEATURES AND GOALS OF THE PROGRAM

The department of geography offers Ph.D. studies in Physical Geography, Regional Geography and Regional Development, Cartography, Geoinformatics and Remote Sensing. It reflects basic directions of research at the department related to physical geography, cartography, human and regional geography.

AREAS OF STUDY AND RESEARCH

Cartography and Geoinformatics
- dynamic visualisation (in early warning and emergency management)
- web applications, mapping and services, sensor networks
- cartographic symbology and modeling
- spatial data infrastructures (SDI), INSPIRE

Human Geography
- regional development
- urban geography
- geography of societal transformation
- political geography

Physical Geography
- fluvial geomorphology, biogeomorphology
- climate variability and change, historical climatology, climate impacts
- temporal and spatial variability of floods and their impacts
- biogeography and ecology

Polar Ecology
- surface energy balance of glaciated and non-glaciated areas
- ultraviolet radiation and its impacts on ecosystems
- climate change and its reflection in recent deglaciation
- climate change modeling and impacts on polar biota

RESEARCH FACILITIES

- Laboratory of geoinformatics and cartography
- Laboratory of environmental geography
- Centre for regional development
INFORMATION FOR PROSPECTIVE INTERNATIONAL PH.D. STUDENTS

http://www.sci.muni.cz/graduate

CONTACT

Department of Geological Sciences
Faculty of Science
Masaryk University
Kotlářská 2, 611 37 Brno, Czech Republic
http://www.ugv.cz/
e-mail: losos@sci.muni.cz
http://www.sci.muni.cz/phd-geology

PH.D. STUDIES

REASONS FOR CHOOSING TO STUDY GEOLOGY AT MASARYK UNIVERSITY

- Internationally recognized research groups
- State-of-the-art research equipment
- New reconstructed buildings in Kotlářská campus / Recently refurbished laboratories
- Students in programs in the Czech language are eligible for a monthly stipend
- International students may apply for an additional dean’s stipend
- Student life in Brno, the city of universities
FEATURES AND GOALS OF THE PROGRAM

The principal activities of the department involve:

- Education in geological and related natural and social scientific disciplines at Bachelor's, Master's and doctoral degree level;
- Scientific research in selected fields of geology and related scientific disciplines. Research includes the study of geological processes in the earth's crust as well as on its surface, and environmental processes controlling living conditions, mainly in regions polluted by industry.

AREAS OF STUDY AND RESEARCH

- Geodynamic development in the Bohemian Massif and Western Carpathians interface. This comprehensive project is focused on geological processes along the contact of the Variscides and Alpides and their position in the wider context of the orogen's evolution.
- Geological processes in magmatic and metamorphic rocks including crystal chemistry of rock-forming minerals, geochemistry and behaviour of fluids. Mineralogy of late magmatic to postmagmatic (pegmatites) and hydrothermal assemblages, alteration processes, crystal-chemistry and spectroscopy of relevant minerals.
- Phanerozoic evolution, focusing on evolutionary processes in geological structures and life in Paleozoic and Cenozoic rocks, which are widespread in the Moravian region. It includes systematic study of fossil associations, and their paleoeocological, paleobiogeographical and biostratigraphical interpretations.
- The migration and mobility of inorganic pollutants in the environment, the geochemical evolution of the environment influenced by human activity. This field includes environmental geochemistry and mineralogy, hydrogeology, and the study of geological and biological hazards in close relation to biological disciplines and environmental problems. Applied geology involves petrographic and mineralogical study of a variety of technical materials, rocks and minerals used in industry.
- Geoarchaeology and landscape development in the Quaternary. This project is focused on processes operating on the earth's surface in the Quaternary, including the evolution of karst regions and geomorphology. Close cooperation with biological disciplines and with archaeology.

RESEARCH FACILITIES

- Electron Microscopy and Microanalysis laboratory (microprobe CAMECA SX-100, scanning electron microscope JEOL 6490 LV)
- XRD-powder diffraction laboratory (transmission diffractometer Stadi P, STOE)
- CL-microscopy laboratory (CL-microscope Neuser HC-2)
- Fluid inclusion laboratory (microscope Nicon Eclipse 80i with Lincam THMSG600 chamber)
- Fluorescent microscopy
- Optical microscopy laboratory
- Chemical laboratory and experimental laboratory
- Gammaspectrometric laboratory (gammaspectrometer GR 320, GEORADIS)
- Sedimentologic laboratory (laser granulometer Cilas 1064)
- Pollutant migration laboratory
- Experimental geochemistry laboratory
PH.D. STUDIES

REASONS FOR CHOOSING TO STUDY BIOMOLECULAR CHEMISTRY AT MASARYK UNIVERSITY

- Internationally recognized research groups
- State-of-the-art research equipment
- New campus facilities / Recently furnished laboratories
- Students in programs in the Czech language are eligible for a monthly stipend
- International students may apply for an additional dean’s stipend
- Student life in Brno, the city of universities

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CONTACT

National Centre for Biomolecular Research
Faculty of Science
Masaryk University
Kamenice 5/A4, 625 00 Brno, Czech Republic
http://ncbr.chemi.muni.cz
e-mail: jkoca@chemi.muni.cz
http://www.sci.muni.cz/phd-biomolecular_chemistry
FEATURES AND GOALS OF THE PROGRAM

The PhD programme in Biomolecular Chemistry provides research opportunities and training for graduate students who wish to study for a 4-year PhD degree. Field of study Biomolecular Chemistry is oriented on characterization of biomacromolecules and relationships between their structure and function. Students will develop skills on structural methods such as NMR and X-ray diffraction analysis, on the computation chemistry, molecular modelling, bioinformatics, molecular biology methods and microbiology.

AREAS OF STUDY AND RESEARCH

Computational chemistry and molecular modelling
- Molecular dynamics of proteins and nucleic acids
- Quantum chemical calculations
- Free energy calculations
- Protein-ligand docking
- Software development

NMR spectroscopy of biomolecules
- QM calculations of NMR parameters
- NMR technique developments
- Structure and dynamics of biomolecules
- Study of proton transfer processes

Glycobiology
- Structure-functional studies of glycosyltransferases
- Structure-functional studies on lectins

RNA/protein interactions
- Studies of RNA interference
- Studies of protein-RNA complexes involved in RNA quality control

RNA processing and degradation
- Studies of the TRAMP-mediated RNA surveillance mechanism
- Mechanisms of RNA quality control in yeast nucleus

DNA repair
- Study of mechanisms of DNA double-strand breaks repair

Nanobiotechnology
- Development of sensing technique for rapid detection of bioagents
- Nanotechnological and bioanalytical detection of the DNA damage

RESEARCH FACILITIES

- 600, 500 and 300 MHz NMR spectrometers Bruker
- Computational cluster of approx. 100 nodes
- Access to computer capacities of Academic Supercomputer Centre
- Computational chemistry software AMBER, Turbomol, Gaussian, ICM, AutoDock and others
- Surface plasmon resonance Biacore3000
- VP-ITC VP-DSC microcalorimeters Microcal
- Rapid quench flow QFM-400, Stopped flow SFM-20
- Crystallisation robot Mosquito
- Scanning Probe Microscope Ntegra Vita
- Dynamics Light Scattering Plate Reader
- Colony picker PM-1s
INFORMATION FOR PROSPECTIVE INTERNATIONAL PH.D. STUDENTS

http://www.sci.muni.cz

CONTACT

Faculty of Science, Masaryk University
Kotlářská 2, CZ61137 Brno, Czech Republic
Phone: +420-549 49 3278, email: int@sci.muni.cz
Masaryk University, initially composed of 4 faculties, including the Faculty of Science, was established on January 28, 1919, not long after the foundation of an independent Czechoslovak state. The university, located in Brno, is now the second-largest public university in the Czech Republic and the leading higher education institution in Moravia. It consists of 9 faculties with more than 200 departments, institutes, research centres, and clinics.

One of the top priorities of Masaryk University is scientific research. The university has attained a leading position in competitions for research grants, is making considerable financial investments in its facilities, and successfully develops tools to support research and innovation. Masaryk University places a strong accent on international cooperation with prestigious foreign universities and research scientific centres. It sustains a continuous exchange of knowledge, ideas, information, researchers, instructors, and students throughout the world, and it assures equal chances of access to education.

The Faculty of Science provides a higher education in all fundamental fields of natural sciences, such as biochemistry, biology, chemistry, geography, geology, mathematics, and physics. There are about 130 accredited fields of study in the Bachelor’s, Master’s and graduate study programmes. More than 3500 students currently attend the Faculty of Science, from which about 800 are the graduate students. Masaryk University provides a number of services for students, such as dormitory accommodation, cafeteria meals, sports and cultural activities, and offers special activity programmes for foreign students.

The primary goal of the graduate studies is to prepare students to engage in original research after acquiring deep knowledge and understanding of a discipline. All graduate programmes are focused on scientific research and independent, creative practical or theoretical work in fundamental and applied research and development. The standard period of the graduate study is 4 years, which may be extended to a maximum period of 7 years. Studies are pursued according to an individual study plan under the guidance of a supervisor, and are completed by passing a standard examination and defence of the dissertation.

### DOCTORAL STUDY

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<td>Ecology</td>
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<td>Ecotoxicology</td>
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<td>General and Molecular Genetics</td>
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<td>Genomics and Proteomics</td>
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<td>Hydrobiology</td>
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<td>Biochemistry</td>
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<td>Chemistry of Macromolecular Compounds</td>
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<td>Regional Geography and Regional Development</td>
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<td>Geology</td>
<td>Geological Sciences</td>
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<td>Mathematics</td>
<td>Algebra, Number Theory and Mathematical Logic</td>
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<td>General Problems of Mathematics</td>
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<td>Geometry, Topology and Global Analysis</td>
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<td>Mathematical Analysis</td>
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