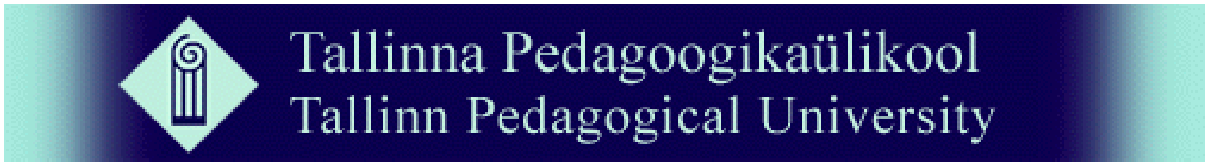


**FACULTY OF MATHEMATICS AND NATURAL SCIENCES**

**DEPARTMENT OF NATURAL SCIENCES**

# SELF-EVALUATION REPORT

**CURRICULUM:**

**BACHELOR OF NATURAL SCIENCES, CODE 6420287**

**Tallinn 2005**

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# Foreword

Natural sciences are one of the main fields of knowledge for perceiving and understanding the environment and material world around us. During the last decades, the world's understanding of natural sciences has radically broadened, great scientific-technical progress has been passed, but at the same time, pollution of nature and danger of a global catastrophe have drastically increased. Therefore an ever-greater need of familiarization with general principles of natural sciences, not only for specialists, but also for everyone who has passed a compulsory school programme.

The curricula of the Estonian compulsory school provide teaching the principles of natural sciences starting from the first study year, first as the subject of Sciences (7 academic years) and later as a specialized subject (Chemistry, Physics, Biology, Geography). The realization of such curricula requires natural sciences teachers with broad knowledge, since in many smaller schools it is not possible to guarantee specialized teachers a full load due to shortage of the respective classes.

Based on the above, at the beginning of the 1990's, TPU started to work out a specialized curriculum for preparing universal natural science teachers. The basic requirements for teacher training at the time provided for the preparation of basic school teachers within the framework of 4-year diploma studies, based on the respective curriculum No. 5141005 for teachers of natural science subjects was worked out. The curriculum specified preparation of teachers in three subjects (Chemistry, Biology, Physics or Geography) during four academic years, which in addition to specialized topics contain also a compulsory block of teacher training. Admission of students for this curriculum started in 1994. During the implementation of the curriculum in the following years, the shortcomings of the curriculum became clear from the feedback from students as well as employers. The main shortcoming was an extreme overload of the curriculum, especially in specialized subjects, which would require use of a more intensive study plan and methods (laboratories, computer-based study, etc.) and also better preparation of the students. These shortcomings became also apparent at the accreditation of the curriculum in 1998, whereby the curriculum was conditionally accredited. Difficulties related to the introduction of the curriculum were partially based on the great changes that took place from 1992-1995, when the course system was changed to the subject system. The curriculum development took place steadily until 2001; admission to the last version (No. 5141014) of the 4-year diploma curriculum was finished with the admission of students in 2000.

In connection with our joining the principles of the Bologna Declaration, in 2001-2002 totally new opportunities opened for future improvement and amendment of the curriculum. The implementation of the 3+2 curricula system permitted a radical review of the contents of the curriculum, as well as the teaching strategy, taking into account comments and recommendations in connection with the 4-year curriculum.

The 3-year Bachelor's degree *Natural Sciences* curriculum No. 6420287 presented for accreditation should be treated as a whole together with the two-year *Basic School Teacher of Natural Sciences* Master's degree curriculum No 7141015, the final objective of which is preparation of highly qualified basic schoolteachers of natural sciences (Appendices 2, 11). Whereas the objective of the Bachelor's degree is to provide an integrated basic education together with a skill for integrating natural sciences. Completing the Bachelor's degree is a prerequisite for future studies at the Master's level. Since there are no graduates of Bachelor's degree curriculum No. 6420287 as yet, some of the statistical information presented in this report is based on graduates of the old 4-year diploma curriculum.

In order to reduce the number of repetitions (a total of 5 curricula will be presented for accreditation to the commission visiting the TPU Department of Natural Sciences in April of 2005) a number of chapters and appendices common to all curricula have been collected in the General Part of the Self-Evaluation Report.

# Introduction

# The Process of Self-Evaluation

The present self-evaluation report focuses on the curriculum of *Natural Sciences* (6420287) *Bachelor's Degree* opened in the Department of Natural Sciences at the Faculty of Mathematics and Natural Sciences of the Tallinn Pedagogical University (TPU). The curriculum was developed and opened after the curricula reform in TPU and run under 3+2 curricula system.

The self-evaluation report is a result of the teamwork during the period January 14, 2004 - February 21, 2005 and was written during the period of January 14, 2005 – February 21, 2005.

The assessment of the learning process and the curriculum and compilation of the self-evaluation report was an intensive work and valuable experience for the group. The Head of the Curriculum led the process of self-evaluation and all the members of the commission were involved in compiling it.

Head of Commission: Ass. Prof. T. Elvisto

Members: Ass. Prof. T. Põder, Ass. Prof. K. Truus, Ass. Prof. K. Pappel, Ass. K. Paas, Sen. Lab. Ass. E. Lausa, M.Sc.student E.Soika, M.Sc.student R. Tuvikene, Teaching Master J. Tamm, Bachelor Degree student K. Part.

Communication between curricula designers (see Chapter 1.2), the self-evaluation work group and co-operation partners inside and outside the University has increased substantially; serious contradictions, as well as positive trends appeared; new ideas and solutions emerged; clear understanding was formed that weak and strong sides, problems and opportunities in a learning process and curriculum development are complex and interdependent; they need systematic solutions, team spirit and teamwork.

In writing the self-evaluation report and in discussions about it several people participated: students of curriculum - *Natural Sciences* (6420287) *Bachelor's Degree*, lecturers, co-operation partners and colleagues outside the Faculty and University and the employers of graduates. We would like to thank them all for their understanding, objective feedback and evaluation, for readiness to listen, discuss and communicate. The self-evaluation report was read and proposals were made by Professor Henn Kukk, Faculty of Natural Sciences and Mathematics; Madis Lepik, Vice-Rector for Open University, Professor Ülo Ugaste, Department of Natural Sciences; Birgit Kuldvee, Study Department of TPU, in elaborating the report. Also we would like to thank for translating the report into English Aleksandr Lamus and

In the compilation of the report the commission was guided by the following sources:

**Sillamaa, H.** 1995. Quality Assurance in Higher Education in Estonia. The Ministry of Culture, Education and Research of the Republic of Estonia. The Ministry of Culture, Education and Research Reporter. *Internet*: www.ekak.archimedes.ee/bulla/bulla.shtml [22.01.2004] (Manual of Quality Assurance in Higher Education in Estonia).

**Kristoffersen, D.; Sursock, A.; Westerheijden, D.** 2000. PHARE: Quality Assurance in Higher Education. Quality Assurance Guide: Procedures and Practice. Project Report November 1998. Editor: Varlamova, G.; Foreword by J. Brennan. Translation into Estonian (translator: Reiska, J.). The Estonian Higher Education Accreditation Centre, Tallinn: Infotrükk. 88. (PHARE: Quality Assurance in Higher Education. Manual of Quality Assurance: Procedures and Practices. 1998.)

As the curriculum under evaluation belongs to the university educational process, brief overviews about the University, the Faculty of Mathematics and Natural Sciences, and the Department of Natural Sciences, and the Chairs of the Department of Natural Sciences are presented in an additional volume (General Part of the Self-Evaluation Report).
The report has been discussed at the meeting of the Council of the Department of Natural Sciences on February 7, 2005; at the Faculty of Mathematics and Natural Sciences on February 10, 2005 and at the meeting of the Study Commission of TPU on February 17, 2005. The self-evaluation report is a public document and is available on the homepage of the Department of Natural Sciences (http://www.tpu.ee/?LangID=2&CatID=790).

# Scientific and Development Work by the Chairs of the Natural Sciences Department

Since all the Chairs of the Natural Sciences Department (Chair of Geo-ecology, Chair of Biology, Chair of Chemistry, Chair of Theoretical Physics and Chair of Applied Physics) participate in the teaching of natural sciences subjects included in the Natural Sciences curriculum (6420287) presented for accreditation, then below we present a short overview the fields of the scientific and development work fostered in these Chairs.

### Chairs of physics

Principal research topics in the chairs of physics are wave processes in curved space-time, application of stochastic processes in the research of open systems, and diffusion processes in binary and multi-component systems. Research in didactics: issues in training teachers of physics under the conditions of comprehensive school curriculum reform, implementation of the new physics curriculum in school: issues and perspectives and use of Concept Mapping (CM) in teaching physics and other sciences. An optimum use of CM dependent on criteria of concept map compilation and pupils' age. Physic and physics didactics are being developed into an inter-related system in the teaching process to overcome earlier relative separation in the chairs of physics.

**Two themes *Stochastic processes in open systems* (theme leader Romi Mankin) and *Didactics problems of teaching physics in the conditions of educational reforms in Estonia* (theme leader Ülo Ugaste) were evaluated by international expert team in 2001.**

The teaching staff have made presentations in many international conferences. Methodologically these have been based on fundamental research (in stochastic processes, incl. diffusion processes, field theory) conducted by the teachers and researchers as well as on student papers they have supervised. More than 30 publications have appeared in peer-reviewed international journals in the last five years as an output of fundamental research. Two Estonian Science Foundation grants are under way and one project co-ordinated by

International Atomic Energy Agency (Contract EST-12060/R0). The Chair's faculty members have also published a series of textbooks for general education schools and universities.

A number of master's papers have been successfully defended (6 papers in the last 3 years), Associate Professor Tõnu Lass defended his PhD at the University of Tartu, assistant teacher A. Haljas is studying in the doctorate programme at the University of Tartu. The teaching staff have extensive international connections – Estonian cooperation partners are Tallinn Technical University, the University of Tartu, the Estonian Maritime Academy, Kiel University in Germany, Helsinki University in Finland, Eindhoven Technical University in Holland, the Institute of Material Sciences of Russian Academy of Sciences, Warsaw Institute of Plasma Physics and Laser Microfusion and single contacts elsewhere.

**Chair of Biology**

The areas of fundamental research in the Chair are the transport of matter and energy in marine ecosystems (in cooperation with the Estonian Marine Institute of TU), the physiology of insects (in cooperation with the EAU), anthropogenic changes in ecosystems, taxonomy, floristics and faunistics. The Chair's members have also participated in the fulfilment of international programmes and projects: prof. Henn Kukk and assoc. prof. Tiina Elvisto teach courses developed by The Baltic University Programme – *The Baltic Sea Environment* and *A Sustainable Baltic Region* – in the TPU (The Baltic University Network secretariat is located at Uppsala University, in Sweden).

Research topics in the field of didactics are *The Field of Teaching Natural Sciences and Geography* and *Objectives in Estonian Comprehensive School.*

During the past five years, over 30 articles in the fundamental research field have been published in international and national journals, of these 22 have been published in pre-reviewed international publications. In years 2000-2004, of the textbooks published for comprehensive schools, the Chair's members have been co-authors on 6 occasions; of the textbooks published by *The Baltic University Programme*, on one occasion; in addition, a total of three titles of other comprehensive school study materials.

In the Chair, post-graduate students have had a choice of five Master's curricula within the 4+2 system: 1) biology (ecology), in which specialisation occurs in one of three study directions – plant ecology, animal ecology or marine biology; 2) Master's of Educational Science (didactics of biology); 3) Master's of Educational Science (didactics of natural sciences); 4) Master's of Pedagogy (didactics of biology); 5) Master's of Pedagogy (didactics of natural sciences). In the years 2000-2004, a Master's of Biology (ecology) was defended by 15 students, a Master's of Educational Science (didactics of natural sciences) by 2, a Master's of Pedagogy (didactics of biology) by 1 and a Master's of Pedagogy (didactics of natural science) by 2; Master's degrees were awarded to a total of 20 students.

Chair's members belong to the Estonian Ministry of Education and Research biology subject council, as part of which they participated in the development of new state subject programmes that were approved in 2002. Chair's members have participated in inservice training for natural studies teachers.

Faculty members T. Ploompuu and T. Paalme are studying in the TPU doctorate programme and faculty member A. Põllumäe in the TU doctorate programme. The faculty members have cooperation partners in Estonia and other countries include the TU Estonian Marine Institute, TUT, Tallinn Botanic Garden, Estonian Museum of Natural History; Uppsala University in Sweden, the health, welfare and sustainable development department of Turku Polytechnic, Armstrong Atlantic State University in Georgia, USA, and others.

## Chair of Geo-ecology

Principal research topics in the Chair of Geo-ecology are the study of long-term development tendencies in landscape and ecosystems. The research takes place in close cooperation with the Ecology Institute. Studies are being completed in two science topics financed by the Estonian Ministry of Education and Research: *Natural and human induced trends of lake trophicity* and *Climate change impact on wetlands, their structure and functioning*, 2 ESF grants (No. 4713 and No. 5584) and within the framework of many international cooperation agreements (incl. EU 5th Framework project *Abrupt climate changes recorded over the European land mass: multi-proxy records of Late-Holocene climate variability in Europe,* and *N Atlantic tele-connections*. During the past 5 years, 75 articles have been published; of these 30 were pre-reviewed international publications. The chair has cooperation agreements with Uppsala University (responsible executor prof. J.-M. Punning) and London University College, as well as, Ionina University (Greece) within the framework of the Erasmus programme. Master's and doctoral students are involved in the research work. Master's theses have been defended by 17 (100%) students and doctor's theses by 4 students. At the current time, there are 7 Master's and 6 doctoral students. Both the master's and doctoral students participate in supervising the students' Bachelor's theses. The abovementioned reflects the activities of the Geo-ecology Chair members in the Chair, as well as at the Ecology Institute (which is a relatively independent scientific institution).

Research in the field of didactics is related to geography textbooks for comprehensive schools. The Chair's members are connected with the development of the new state curriculum for basic and upper secondary schools and are participating in the development of the subject *The Environment* that will cut across the curriculum. They belong to the geography subject council of the Ministry of Education and Research and to the commission that prepares the assignments for the comprehensive school final examination and completes the paper. The Chair's members have participated in the preparation of 2 geography textbooks for comprehensive schools and in inservice training for geography teachers.

## Chair of Chemistry

The research field of the Chair is bio-analytical chemistry (the study of biological objects with modern analytical methods): the dependence of structure-functionality of the polysaccharides of red and brown algae (assoc. prof. Kalle Truus in cooperation with the TUT Chemistry Institute and the Chemical and Biological Physics Institute), environmental analytical chemistry (instrumental analysis of heavy metals in natural objects, lecturer H. Hödrejärv). Research topics are also chemistry didactics (professor emeritus H. Karik and teacher V. Sillaste, lecturer H. Hödrejärv) as well as, the preparation and implementation of teaching materials for nutrition (assoc. prof. K. Pappel), and biochemistry topics – the study of the activity regulation of enzyme lipoproteinlipase (assoc. prof. A. Lõokene). A series of papers are related to the study of the history of chemistry.

The academic staff has actively participated in the preparation of comprehensive school and university-level textbooks. During the past few years the emphasis has been on the publication of chemical lexicons and other reference books (*English-Estonian-Russian Chemistry Dictionary*, 1998; *Chemistry Nomenclature*, 2000).

The Chair cooperates with the TUT Chemistry Institute, TUT Nutrient Institute, Chemical and Biological Physics Institute, and several TU institutes. The Chair's members (K.Truus, H.Karik) are board members of the Estonian Chemical Society. The Chair has scientific

contacts with Turku University, Helsinki University, Turku Polytechnic, Armstrong Atlantic State University (Georgia, USA), etc. K. Truus belongs to the country-wide chemical subject council. The Chair's members have participated in inservice training for chemistry teachers.

Special courses are given by the Chairs of the Department to students, also seminars, and practical work, incl. field work is conducted. The bachelor's theses, pedagogical theses, as well as, proseminar papers on natural sciences and didactical topics are supervised. The students complete subject didactics courses, which are followed by teaching practice supervised by the teaching staff of department.

More detailed information on the structure of the Department of Natural Sciences and composition of the Chairs is provided in the General Part of the Self-Evaluation Report (Appendices G4, G11).

# 1. The Bachelor's Degree Natural Sciences Curriculum (6420287)

## 1.1. Goals and Basic Principles of the Curriculum

**The goals of the curricula to be accredited conform** to the general guidelines of the EU Bologna and Lisbon agreements and the **Single Programming Document** adopted by the Estonian Government on 15.05.2003, decree No 300-k (RTII, 28.05.2003, 13, 58) (http://www.fin.ee//doc.php?6129&PHPSESSID=fbe5ac36d8a 7daf9dd2cc83b19ca4b0a).
According to the Lisbon Strategy, the prioritised fields of research are the curricula of mathematics and natural sciences and the number of graduates should increase by 15% by the year 2010.
The Single Programming Document provides for an educational system which is accessible to everybody and which secures flexible labour, coping and lifelong learning.
The Bachelor studies curriculum of Natural Sciences (6420287) Bachelor's Degree was opened at Tallinn Pedagogical University (TPU) in 2002. The term of the curriculum is six semesters or three years and it belongs to the system 3 + 2. **The objective of the curriculum to: to provide primary professional education which integrates natural sciences with profound environmental expertise enabling the graduate to continue studies in master's programme of *Basic School Teacher of Natural Sciences* or another similar curriculum based on natural sciences and be prepared to work as a lab assistant in general and higher education institutions and research organisations.**
The continuation of the Bachelor's Degree *Natural Sciences* curriculum (6420287) is a two-year Master's Degree *Basic School Teacher of Natural Sciences* curriculum (7141015) worked out by the Tallinn Pedagogical University, which was approved by the TPU Council on 28 January 2002. By today, there are no graduates of the Bachelor's Degree *Natural Sciences* curriculum (6420287), and therefore, there are students who have been admitted to the *Basic School Teacher of Natural Sciences* curriculum(7141015), the **objective of which is provide primary professional competence for commencing the first professional year as a basic schoolteacher of a number of natural science subjects and the further career as an active teacher.**
In addition to acquiring basic knowledge and scills in area of specialisation, during the curriculum, one also acquires such general competence as social, cultural and communicative competences, the ability to analyse and synthesise, the ability to organise and plan, the skill of problem solving, the ability to make decisions and skill of analysing information from different sources. Guided by competences expressed in the objectives of teaching of the curricula subjects, the department members decide the contents of teaching process and choose appropriate methods.
The description and syllabi of the curriculum to be accredited are made public on the TPU website (www.tpu.ee/oppeinfo/index.php). The curriculum is in conformity with *The Law of Universities* (RT I 1995, 12, 119), *The Higher Education Standard* (RTL 2002, 56, 348) and *The Statutes of Tallinn Pedagogical University* (registered by directive No 824 of 15.09.2003 by the Minister of Education and Research). Admission of students takes place according to the state commission. In addition there are student places for fee-paying students, the Board of University approves the corresponding number.

## 1.2. Elaboration of the Curriculum

The following procedures are set up in Tallinn Pedagogical University (TPU) to prepare curricula and assure quality of studies:

- The academic department coordinating the corresponding major prepares a draft curriculum.
- The board of the faculty makes the proposal to the Board of University to approve the curriculum and submits it to the Study Commission of the Board.
- The Study Commission analyses the conformity of the curriculum with the general requirements.
- External experts and research and study commissions of the Board of University assess the draft curriculum.
- The Study Department reviews the draft curriculum.
- The Board of University makes a decision concerning opening of a curriculum at a particular higher education level.
- The university submits an application of acceptance of the curriculum and for inclusion of figures of admission to the Ministry of Education and Research.
- The curriculum is entered in the Estonian Register of Curricula kept in the Ministry of Education and Research.
- The list of fields of study and curricula and admission quotas of the university are formalised by order of the Minister of Education and Research with regard to the Law of Universities Article 22 (5).

The head of the curriculum enters running changes and amendments in the curriculum, involving therefore the whole academic department coordinating the curriculum. The head of the curricula of Natural Sciences is Associate Professor Tiina Elvisto. The board of the department, board of the faculty and finally, the Board of University approve the curriculum.
The Department of Natural Sciences observes the following principles in preparation of the curricula:

- The choice, number and volume of subjects of the curriculum must be sufficient to allow the students achieve the applied qualification.
- The structure and content of the curriculum must correspond to the up-to-date research standards.
- The curriculum must exceed the study material of the corresponding subjects of comprehensive school to the full extent.
- The curricula consider possible changes in the curricula of comprehensive school and the organisation of studies in the course of school reform(s).

Curricula are developed in cooperation with structural units of the faculty and other faculties, whereas the aim is to make maximum use of subjects of natural sciences and educational sciences taught within other curricula of the university. Student questionnaires, feedback from employers and alumni provided by the university and staff have given important feedback information (Chapter 6.2. *Feedback on the Quality of the Studies from Students, Graduates and Employers*). The theachers of the Department also provide some feedback.
With regard to reform provisions based on the Bologna Convention, the 4+2 curricula are being modified into 3+2 curricula.

# 1.3. Bachelor's Degree Natural Sciences Curriculum (6420287)

The described curriculum is the descendant of the 4-year Diploma's curriculum *Teacher of Natural Sciences* (code 5141014), which was opened by the resolution of Tallinn Pedagogical University (TPU) Council in 1996 and the admission of students lasted from 1996 till 2000.
Because of the higher education reform, the admission onto the 4-year Diploma's curriculum stopped in 2001. This was replaced by a new three-year Bachelor's curriculum, code 6420287, (also see Appendix 2). By now its students have completed two thirds of the study yet and the curriculum on käeslevaga esitatud for accreditation.

The volume of the Bachelor's Degree *Natural Sciences* curriculum is 120 credit points (CP); 1 CP=1,5 ECTS. 1 CP means for students 40 hours work, from wich 20 hours is lectures, laboratory or field work with direct supervision of the teaching staff and 20 hours – individual work.

The objective of the curriculum is to provide primary professional education, which integrates natural sciences with profound environmental expertise enabling the graduate to continue studies in a master's programme and be prepared to work as a lab assistant in general and higher education institutions and research organisations. Graduates are prepared for research work and entering a Master's programme. During the Master's programme, the student continues the study of natural sciences completed in the Bachelor's programme from the following list: biology, physics, geography, chemistry. After completing a minor and the subject didactics and pedagogical practice for the respective subject during the Bachelor's programme, the graduate of the Teacher Education Master's programme will possess the competency to teach the selected three subjects in basic school and natural studies from the first to seventh grades. The Teacher Education programme at Tallinn Pedagogical University is uniform.
The general structure of the Bachelor's curriculum: 120 CP, which are divided into:

- general subjects 15 CP
- focus subjects 15 CP
- major 50 CP
- minor 30 CP
- open electives 6 CP
- Bachelor's thesis 4 CP (Figure 1.3.1).

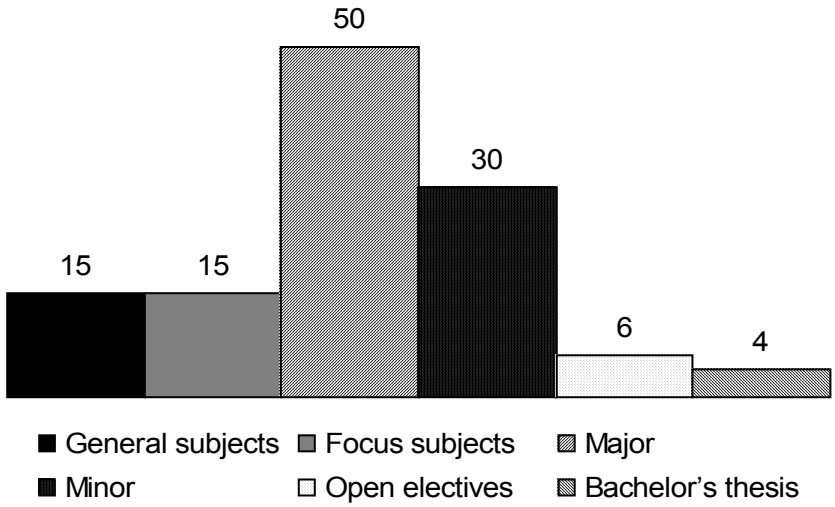


Figure 1.3.1 The general structure of the Bachelor's *Natural Sciences* Curriculum ( - 120 CP), code 6420287.

The aim of general subjects, interdisciplinary electives and focus subjects is to provide the students with a systematic introduction to the field of study and give basic knowledge. General subjects (altogether 12 CP) give a more general overview of natural sciences. The aim of interdisciplinary electives (3 CP) is to provide an overview and skills of subjects important from a comprehensive point of view. General subjects are: *General Biology, Basics of General Geography, General Chemistry, Physical Picture of the World.* Interdisciplinary electives (select at least one of the following subjects), with the aim to support the competency of living and working in the commune, are: *Oral and Written Communication, Intercultural Communication, Studying at University, Information Sources and Retrieval, Introduction to Public Administration, Coping Strategies in Modern Society, Psychology of Communication, Organisational Behaviour, Effectinve Computer Usage, Computer Aided Information Processing, Creation Web Pages, Practical Mathematics, Advanced English, Advanced German, Advanced Russian, Advanced Estonian.* Students from Russian-speaking schools can also study Estonian, if needed.

Focus subjects are: *General Ecology, Geography of Estonia, Environmental Chemistry, Mathematical Methods in the Natural Sciences, Physical Methods in Sciences.* These courses will give advanced integrated basic knowledge about natural sciences.

Major subjects, a total of 50 CP are made of two natural sciences subjects chosen by the student out of a possible four (biology – 25 CP, physics – 25 CP, geography – 25 CP, chemistry – 25 CP). Major subjects until the 2004/2005 academic year are in Biology: *Introduction to Botany, Introduction to Zoology, Environmental Sciences;* and starting in the 2005/2006 academic year: *Basics of Research, Field Works in Floristics and Faunistics, Molecular and Cell Biology, Plant and Animal Physiology, Biodiversity and Conservation Biology, Genetics, The Theory of Evolution*; in Physics: *Mechanics, Heat and Molecular Structure, Electromagnetism, Optics, Structure of Matter, Astronomy;* in Geography: *Introduction to Landform Studies, Climatology and Meteorology, Paleogeography, Introduction to Human Geography, Geographical Information Systems, Field Work in Physical Geography, Physical Geography of the Continents and History of Geographical Discoveries;* in Chemistry: *Inorganic Chemistry I, Inorganic Chemistry II, Organic Chemistry, Bioorganic Chemistry, Biochemistry, Physical and Colloid Chemistry, Analytical*

*Chemistry and Instrumental Analysis*. The aim of major subjects is to give advanced knowledge and skills in the chosen subjects. The major subjects form special theoretical and practical competencies, as well as adjust he students to lifelong studies.

The programme ends with a Bachelor's thesis, which is prepared on a topic related to a major. The Bachelor's thesis is included in the curriculum to help students acquire the habit of studying and doing research and to attain the methodology of research work. The topics for Bachelor's theses are chosen by students together with the supervisors of the papers (also see Appendix 14 ).
In accordance with the study programmes of minor subjects, the students pass the modules chosen by themselves (see Chapter *4.4. Students' Workload and Progress*).

The quantitative parameters of the studies of the curriculum are illustrated in Table 1.3.1

The documents awarded at graduation: a diploma certifying the Bachelor's degree together with a diploma suplement. The degree conferred**:** *Bachelor of Natural Sciences*.

Table 1.3.1
The quantitative parameters of the Diploma curriculum *Teacher of Natural Sciences,* 160 CP, code 5141014 (4+2) and Bachelor's curriculum *Natural Sciences*, 120 CP, code 6420287 (3+2)

| **Parameter** | **Quantitative parameter** | | **Comparison of the programmes** |
|---|---|---|---|
| | **Diploma programme** | **Bachelor's programme** | |
| Nominal duration (years) | 4 | 3 | A year shorter |
| Total volume CP | 160 | 120 | 40 CP less |
| Degree conferred | Diploma | Bachelor of Natural Sciences | The Diploma programme is replaced by the Bachelor's programme |
| Number of compulsory subjects | 42…46 subjects | 30…33 subjects | The number of compulsory subjects has decreased more than by 25 % (+) |
| Number of electives | 2 subjects | 3…4 subjects* | The proportion of electives has increased up to twice |
| Average volume of compulsory subjects CP | 2,4 | 3,4 | The average volume of compulsory subjects has increased by 1 CP |
| Proportion of practical work % | 25,4 | 21,4 | The proportion of practical work is almost the same (a small decrease) |
| Structure of studies: | | | |
| lectures %, | 55,1 | 51,7 | The proportion of lectures, seminars and research work are all almost the same |
| seminars, exercise classes% | 41,7 | 45,4 | |
| research work% | 3,2 | 2,9 | |

| | | | |
|---|---|---|---|
| Total number of exams | 32 | 17-18** | Because of the noticeable increase of the volume of compulsory subjects, the total number of exams has decreased |
| Share of exam types:<br><br>oral and combined %,<br>written % | <br><br>41,8<br>58,2 | <br><br>34,2<br>65,8 | The proportion of written exams has risen. |
| Ratio of auditory and independent work | 5:6 | 5:6 | The ratio of auditory work and independent work is almost the same |

* the opportunity for choosing minor subjects has not been included

** the number of exams in the curriculum depends on the chosen minor.

When comparing the quantitative parameters of the Diploma Curriculum (code 5141014) and Bachelor's Curriculum (code 6420287) the following significant changes can be brought out:

¤ the teacher education block (40 CP) has been transferred to the Master's programme and the nominal study period has been shortened from 4 years to 3 years;
¤ in natural sciences subjects and minors, the volume of the student's preparation has been increased by a total of 15 CP, since the general subjects with a teacher education focus have partially been transferred to the Master's programme and/or are included among electives;
¤ the number of compulsory subjects and examinations has been reduced, since many smaller volume subjects have been combined and replaced with larger volume subjects;
¤ the percentage of written and combination (written+oral) examinations has increased.

Graduates of the *Teacher of Natural Sciences* curriculum in the 4+2 system have used the opportunity to continue their studies in the Master's programme, and some, after graduation, in the Doctoral programme of TPU, or TU. Master's studies have been continued in biology, geo-ecology, physics and natural sciences didactics. In the years 1998-2000, 8 Master's theses have been supervised by the faculty members of the Natural Sciences Department and successfully defended. The number of places for Master's study in didactics has been limited and the number of applicants has always been higher than the number of paid places financed by the state. Currently, four graduates study in Master's Programme *Pedagogy (Didactics of Natural Sciences),* code 7147203 and one in the Programme *Physics*, code 7420302.

In the new 3+2 system, the entire teacher education block has been transferred to the Master's Programme; the Master's *Basic School Teacher of Natural Sciences* curriculum is presented in Appendix 11.

## 1.4. International Dimension of the Curricula

Based on inter-university agreements, the students have the opportunity to study at other university as exchange students. The assessments and examinations completed at the other university will be taken into account for the fulfilment of the applicable TPU curriculum in accordance with the prior decision of the head of the respective chair and department. The opportunity to select subjects from different universities is supported by the agreement of the given curriculum with the natural sciences curricula fixed in other countries.

Curricula similar to this one existe in both Estonia and the rest of the world. A suitable comparison in a foreign country is the chemistry teacher education at Helsinki University, where it is possible to acquire either a biology, physics or computer science and home economics speciality as a second teaching subject. In general structure, the respective curricula are similar to the TPU natural sciences curriculum. The majority of subjects coincide with the those taught at TPU, although there are also differences. For instance, the TPU curriculum is missing the following subjects taught in Helsinki: *The Structure of Atoms and Molecules* (although this is included in the course *General Chemistry*), *Introduction to Polymer* (included in the course *Organic Chemistry*) and *Basics of Radio-Chemistry* (included in the course *General Chemistry*). TPU lacks the subject of *Civil Chemistry*, as it appears at Helsinki University.
In Finnish universities, the teaching of chemistry is generally integrated with physics or biology. When becoming acquainted integration possibilities for natural sciences subjects in European countries and other countries, we see that chemistry is primarily united with biology, chemical technology, environmental technology or natural resource management, as it is at Australia's Newcastle University, and science teacher training is a known practice (see, for instance, *www.iseek.org/sv/* and related links). In addition to the Nordic countries (for instance Stockholm University) the following US universities teach on the principles, which are similar to our curriculum: Bemidji State University, Concordia University, Winona State University, etc.
The Bachelor's curriculum *Natural Subjects*, Tartu University, includes general educational studies (16 CP), subject-based studies (80 CP), minor subjects (12 CP), electives (8 CP) and a Bachelor's thesis (4 CP). Within the framework of subject-based studies, one can choose a biology-chemistry direction, 80 CP, which includes a biology subject block (42 CP), a chemistry subject block (32 CP) and a geography subjects (in the range of 6 CP). The second possibility is to choose two subjects blocks from the following subjects: chemistry (32 CP), physics (32 CP) or geography (32 CP) together with a module of general educational science and psychological subjects (16 CP).
Thereby, by comparing the respective curricula of Tartu University and foreign universities with this curriculum, we can confirm that fundamental similarities exist between the curricula and differences are found in the details (distribution of credit points, emphasis).

In summary we can say that as far as general principles and also subjects, curricula similar to *Natural Sciences* curriculum, code 6420287, and the *Basic School Teacher of Natural Sciences* curriculum, code 7141015, at many universities have shown their vitality, which is a necessary prerequisite for the curriculum's future development and student mobility.

## 1.5. Analysis of the Curricula: Their Strengths and Weaknesses

Volumes of Bachelor's degree conform to regulatory documents (see Chapter 1.2 *Elaboration of the Curricula*) and enable training of specialists.

The results of the questionnaire conducted among students in the spring semester 2004 and in the autumn semester of 2005 show that the topics covered in the subject areas provide the knowledge and skills at the level required from graduates (see Chapter 6.2 *Feedback on the Quality of the Studies from Students, Graduates and Employers*).

The volume of problem-solving and research tasks in the *Natural Sciences* Bachelor Programme is at an almost optimum level (about 20%), including seminars, laboratory and field works and the Bachelor Thesis.

In preparing the Bachelor's programme, it has been treated as a whole with the two-year Master's curriculum *Basic School Teacher of Natural Sciences*, code 7141015, to prepare basic school teachers in many subjects. Therefore, the graduate of the curriculum receives the respective thorough preparation in three subjects, choosing two majors from among biology, geography, chemistry and physics and one minor in addition (which the majority of students have also chosen from the field of natural sciences). In this way, the student receives broad-based preparation to be a basic school teacher in three subjects, which allows him/her to successfully compete in the labour market. At the same time, such preparation gives the student greater opportunities for future specialisation and employment in scientific and educational institutions.

On the other hand, such a curriculum is quite difficult for the students, sometimes causing studies to be lengthened and even dropping out. The thorough learning of three natural sciences subjects is a big challenge for students and sometimes the quality of studies can suffer.

The main strength of curriculum *Natural Sciences*, code 6420287 is the possibility for the integrated acquisition of several natural sciences and the creation of the following competency:

¤ ability to see the natural environment surrounding us as a whole and to understand the processes taking place therein;
¤ perception of global problems and the perception of one's responsibility for solving them;
¤ goal-oriented and critical use of information sources;
¤ ability to act in sustainable way.

The main weaknesses of curriculum *Natural Sciences,* code 6420287 are:

- a large number of different natural sciences disciplines, whereby the thorough acquisition of the subjects may be too difficult for many students;
- the drawing up of students' individual programmes has turned out to be relatively complicated;
- does not sufficiently motivate students to continue their studies in the *Basic School Teacher of Natural Sciences* Master's Programme.

**In connection with the aforementioned weaknesses, it is planned (starting in fall 2005) to further develop curricula *Natural Sciences,* code 6420287 and *Basic School Teacher of Natural Sciences*, code 7141015 into an integrated teacher training curriculum.**

The main advantages of an integrated teacher education curriculum over the current curriculum would be:

¤ the parallel of teacher training and natural sciences subjects starting in the first academic year, which allows the study process to be made more multi-faceted and to reduce the number of sciences subjects to be studied during one academic year;
¤ students, who have completed studies on subject didactics and methodology, better know how to plan their future studies;
¤ by completing teacher training subjects along with studies of one's major starting with the first semester, creates the basis for the students themselves to constructively find their own ways for teaching their speciality in their future work as teachers;
¤ at a relatively early period in their studies, allows students to get a clear idea of their suitability to become a teacher.

During the last years (especially starting in 2001), the condition of the laboratories and auditoriums, as well as, the supply of equipment, in all four main directions – biology, geo-

ecology, physics and chemistry – has significantly improved. The development plan of the department proposes a solution to the problem concerning modernisation and improvement of study facilities – an establishment of an integrative research laboratory. Joint work with a number of research institutions within and outside the university is being intensified through cooperation projects. The department uses its current, fairly new rooms (P-210 and P-211) and redecorated rooms (P-401, P-406, *etc.*) for practical classes and independent work. It also has contracts to use facilities of other institutes (Institute of Ecology of TPU, Estonian Tartu University Marine Institute, Institute of Experimental Biology of Estonian Agricultural University, Institute of Chemistry of Tallinn University of Technology). There are contracts with several other institutions – Tallinn Botanic Garden, Tallinn Zoo, and Estonian Museum of Natural History.

Nevertheless, the development and constant modernisation of the curriculum requires additional rooms and resources. In connection with the completion of the new TPU building in the fall of 2005, there are also plans to expand the Natural Sciences Department, into to the rooms being vacated, which should solve the current lack of space. Special emphasis will be placed on the further development and improvement of the department's integrated scientific laboratory.

# 2. Study Process

## 2.1. Study Methods

Depending on the peculiarity of a subject, lectures and/or seminars and various forms of practical work (both individual and group work) are applied in the studies (e.g. *Field Works in Floristics and Faunistics*, *Field Work in Physical Geography, etc.*). Students can practise the compilation of academic reports and they have a possibility to present these and take part in different discussions. Fieldwork and field trips are applied in various subjects (*Field Works in Floristics and Faunistics*, *Field Work in Physical Geography*, *Field Trip*). Practical classes in the laboratory are used in different subjects of chemistry, physics and biology (*Introduction to Botany, Introduction to Zoology, Mechanics, Optics, Bio-organic Chemistry, Molecular and Cell Biology, Plant and Animal Physiology, Inorganic Chemistry, Organic Chemistry, Biochemistry, Physical and Colloid Chemistry, Analytical Chemistry and Instrumental Analysis*).

The proportion of lectures is relatively big: in most subjects they make up 40-50% of the volume. Big exception from this are individual practical classes, where lectures make up 10 and research work without any lectures. The highest proportion of lectures can be found in theoretical physics and in some theoretical disciplines of geo-ecology (*Basics of General Geography*) and biology (*General Biology*), because this courses deal with general theories and conceptions.

The teachers choose the methods applied in the teaching process with the aim to guarantee formation of basic knowledge, competence and skills formulated in the objectives of teaching the subject. The subject programmes are certified by the Head of the Chair and Head of the Department.
The teaching methods in the Natural Sciences Department are contemporary and student-oriented. An important role is played by collective work methods: discussions (in prepared and unprepared topics), group work, group presentations, project work, roll playing and seminars. Students must prepare essays or reports on many subjects (which are often a prerequisite for examinations) and make presentations. By the time they graduate, students have often made over 10 larger presentations (including a display presentation, poster presentation). Teaching methods are also used which require students to grade the presentations of their fellow students. These teaching methods develop the communicative competence of students, such as the capacity for criticism and self-criticism, readiness for teamwork, communications experience, and also, the readiness to work in interdisciplinary teams and to communicate with experts from other fields.

With in the framework of some subjects, the students must participate in study trips (for instance, to the Tallinn Zoo, Tallinn Botanic Garden, Estonian Museum of Natural History, to parks, etc.) and field trips (as part of field work).

Lecture materials are available to students for copying or ever more often on the Internet. Lectures are constantly amended and updated, and they are supported by extensive demonstration materials (audio-video technology, transparencies, slides, etc.).

Many changes in the study process have been caused by the frequent use of batch lectures (mainly in case of general subjects and interdisciplinary electives) and the use of cycle courses (*Field Work in Floristics and Faunistics*). The launching of batch lectures has hindered the successful organization of studies to some extent. In lectures with a big audience,

the contact between the lecturer and the students is almost non-existent. It may also bring about the skipping of classes by less motivated students and the drop of academic progress. The use of big lecture halls makes it impossible for students to communicate with each other, too. In addition, the lecturer cannot orientate in the level of the students' prior knowledge and their peculiarities. As batch lectures are organized mostly at general and lower levels, the problem is not very serious. In connection with the predicted increase in the space of lecture halls in the main building of the university in 2005, the problem of the lack of middle-sized auditoriums will be solved. Thus, it will be possible to finish such batch lectures. On the other hand, batch lectures reduce the relatively big workload of the academic staff.

The use of cycle courses (especially in case of fieldwork and subjects with a small volume of auditory work) has justified itself. In the future the Department plans to increase the proportion of cycle courses even more.

Independent studies are promoted indirectly by the use of individual study programmes of students. Independent work is mainly determined by the interests of a student, but also by a possibility to develop one theme in detail, starting from an academic report (*Basics of Research*) and then a Bachelor's thesis. To improve the acquisition of scientific research methods, the subject, MLB 6007 *Environmental Sciences*, has been replaced by the course, MLB 6003 *Basics of Research* , starting in the 2005/2006 academic year.

The possibilities to use computers in study work have improved considerably. Computers are often used in physics and chemistry laboratory classes (*Mechanics, Physical Methods in Sciences, Inorganic Chemistry, Organic Chemistry, Bioorganic Chemistry, Analytical Chemistry and Instrumental Analysis*) for directing equipment and making assessments. In several subjects (for example *Mathematical Methods in the Natural Sciences*) computers play an important role in data processing. Computers are easily accessible to students in university-wide computer classes.

In order to illustrate more complicated processes, different simulation programmes are used in classes (*Mechanics, Heat and Molecular Structure, Electromagnetism, Organic Chemistry*, *Bioorganic Chemistry, Optics*). In geography classes, students are familiarised with Geographical Information Systems applications. The names of the computer software used by the Natural Sciences Department and data about the university's computer park is provided in Chapter 3.1. *Infrastructure.* The computer skills of admitted students should meet the requirements established by the test of competences.

The Centre of Educational Technology and the Department of Informatics of TPU have jointly created a web-based study environment *IVA* (http://iva.tpu.ee/IVA). The basis of *IVA* is a pedagogic conception which is grounded on a modern socio-constructive treatment of study. According to this, studying is not only acquiring knowledge, but also constructing a personal knowledge base, creating one's own 'world of meanings' in an active and meaningful way. Study according to these principles develops the competence in students to understand the system as a whole, that is, the capacity for independent research work and the ability to adapt to new circumstances. At the moment the Estonian e-university consortium is testing At the moment the Estonian e-university consortium is testing *IVA* with the intention to suggest this as an official e-learning platform for Estonian universities (http://www.e-uni.ee/main.php). In the Chair of Biology *IVA* is being used at the moment in the subject *Introduction to Zoology*.

**In conclusion we can say that the learning methods in the Department of Natural Sciences are modern, versatile and selected according to the taught disciplines and the aims of the curricula.** In the past three years progress has been made especially in the transition to the integrated curricula. There is a tendency to increase the use of student-centred learning methods.

## 2.2. Assessment and Analysis of Academic Results

**The assessment of the knowledge and skills of students is determined by the Tallinn Pedagogical University (TPU) Regulations for the Organization of Studies (Appendix G9). The methods of assessment are given in the curriculum and the syllabus and their aim is to objectively specify the acquired level of a student in a subject.**

The performance of students is assessed continuously during the semester and/or at the end of a course with an exam or assessment. Assessment taking place during the semester differs by subjects. Usually regular tests or intermediate assessments are organized when a part of the subject has been covered. But also reports, projects and research work can be used to grade students. Practical work is assessed on the basis of the summaries (records) of the work done. The academic staff takes into consideration the schedule of students while determining the time of tests during the semester in order to avoid overlapping. The wishes of students are also considered when setting dates for examinations.

While assessing, the instructors pay attention to how students can use academic literature and study materials, how they can apply their knowledge (doing exercises, project methods, finding solutions to problems, *etc.*) and how they can synthesize the content of different subjects.

There is a multi-level analysis of the success and failure of students (instructors, the Chair, The Department of Natural Sciences, the Faculty – see Chapter 6. *Quality Assurance and International Relations*), which helps to determine the reasons for bad or good results. According to different reasons the teaching methods applied in the curriculum might be adjusted or improved (inefficient methods will be replaced by new ones which consider the principles of university didactics).

The type of an exam or other assessment (written, combined or oral) depends on a subject. The type of assessment (written or oral) is determined by the academic staff in the syllabus. When the number of the students who have registered for a course is small, an oral exam is still often used, but the share of written exams is gradually growing. There exist also combined forms (written and oral together). Examination questions depend on the syllabus and the material covered during the course and meet the aims of the subject. In case of a repeated exam, sometimes an oral form is used.

The subject is deemed to have been acquired after having passed the examination or assessment. The teaching staff may establish requirements (prerequisites for sitting examinations), which have to be made known to students at the beginning of the semester (during the first two weeks). Two dates during the examination session and one more date during the week before the next semester or another date during the week of independent work in mid-semester for taking an exam shall be suggested by the teaching staff and agreed upon with the participants one month before the examination session. All students who have registered to be the attendees of a subject have automatically registered for the first

examination too. For later exams one has to register in the Chair at the time determined by the teaching staff.

Assessments are taken in the last lecture/seminar of the semester; exams in most cases are carried out during the examination session, which follows the study of the given subject.

The result of an oral exam or assessment will be announced on the same day, the results of written exams shall be made known within 10 days (usually 2-3 days later).

The system of assessing the performance of students in Tallinn Pedagogical University is based on a six-point scale, taking into consideration the percentage of knowledge (and it was applied in the study year 2000/2001) (Table 2.2.1.).

A student has not passed an exam or assessment if:

- he/she lacks the minimum knowledge of the subject (up to 50 % of the volume of the subject acquired),
- he/she used some external help,
- he/she did not show up for the exam,
- he/she did not answer.

Table 2.2.1.

Assessment system in Tallinn Pedagogical University

| Knowledge of the subject | Grade in words | | Grade in a symbol | |
|---|---|---|---|---|
| | In Latin | In English | former | present |
| **Positive grade** | | | | |
| 91-100 % | *cum laude* | Excellent | "5" | "A" |
| 81- 90 % | *laudatur* | Very good | "4" | "B" |
| 71- 80 % | *optime approbatur* | Good | "3" | "C" |
| 61-70 % | *approbatur* | Satisfactory | "2" | "D" |
| 51- 60 % | *sufficient* | Poor | "1" | "E" |
| **Negative grade** | | | | |
| 0 – 50 % | *insufficient* | Fail | "0" | "F" |

A student who fails to pass an exam has the right to take part in two re-examinations until the last day of the exam session of the next corresponding semester. But if a student withdraws from the last re-exam and registers for the course once again through Open University, he/she has the right to take the exam three more times.

According to the results of questionnaires carried out among students (see Chapter *6.2. Feedback on the Quality of the Studies from Students, Graduates and Employers*) we can conclude that the assessment of study performance is objective and the results reflect quite accurately the level of achievement of study objectives. The organization of exams is flexible and can be checked. There exists a special system settling protests. When evaluating the performance of students, the methods of assessment which develop social competences are

used (oral exams, seminars, group work, *etc.*). When forming examination questions or exercises for students, it should be observed for the sake of objectivity that

- the student understands what he/she has to do;
- the student knows what and how his/her answers will be.

In order to ensure objectivity a three-level assessment system is often used (e.g. in subjects *Field Works in Floristics and Faunistics; Plant and Animal Physiology*): the objective assessment of a student to his/her own work, the assessment of co-students and the assessment of an instructor. The minus of the above-mentioned system is that it is difficult to be applied in case of big study groups. An important aspect in assessing is to determine the relative qualitative rise in the development of an individual (this approach is mostly used in subjects which require a bigger amount of independent work, field works, *etc.*).

According to the TPU Regulations for the Organization of Studies (Appendix G9) there exists a system for settling protests, which gives a student the right to protest about the result of an exam or assessment within 7 workdays after the announcement of grades. For that the student has to present a written application to the instructor of the course or the head of the department. If the student's appeal is refused within 10 days, he/she can appeal further to the head of the faculty within two weeks and so on up to the rector. In the period of 2000-2004 there have been no such appeals by the students of the Department of Natural Sciences in TPU. On some occasions, however, the option of a commission examination has been used (for instance, course *Introduction to Botany*).

## 2.3. Organization of Studies

**The academic calendar regulates the organisation of studies in general. It establishes the beginning and ending date of the semester, dates of examinations, registration for participation in courses, confirmation of the student status on the basis of study load and academic performance (Appendix G10).**

The aim of the timetable is to optimise the use of rooms, and organise students' study load and time as evenly as possible. The timetable for the semester is made public on the notice board and on the website, and in the mailing lists of study groups and of the department a minimum of three weeks before lectures commence. The students who do not follow a standard curriculum thus have enough time to consult the academic counsellor. The teaching staff deliver the syllabi at the first lecture of the semester to the registered students. The syllabus includes the course outline, requirements, required reading, *etc.* The syllabi are available on the website during the semester. Changes, events and closing dates as well as assessment results are made public on the notice board on the third floor of the main building and the department's website. Results are presented together with a study book grade, the name of the student together with the grade is not revealed.

Students participate in some lectures and seminars with students of other curricula e.g. biology, geo-ecology, environmental management and physics.

Preparing timetables is complicated to some extent by insufficient numbers of classrooms. Completion of the new main building is expected to improve the situation considerably (Chapter 3.1 *Infrastructure*).

As we can see in Chapter 2.4 *The Statistics about the Study Process* a timetable is usually valid for one semester in all the curricula of natural sciences. Stable timetables allow students

coordinate the course of their studies and preparation of individual study plans. On the other hand, such timetables complicate uninterfered introduction of special modules (modular studies during the semester in other academic departments or universities) in the studies. Problems, however, are rare as the University of Tartu is the only university to use modular studies on a larger scale. Preliminary information on longer modules allows students prepare their individual study plans without major difficulties.

Study load during the studies is distributed to allow collection of just above 20 CP in the first and just below 20 CP in the last semester (in the studies open electives add 3-4 CP to enable collection of the required amount of credit points 120 CP in the 3-year programme). Collection of more credit points towards the beginning of studies allows focusing on the final paper during the final semesters.

The content of independent work of students and degree students is largely determined by research priorities of the university and demands of employers. Students' personal interest in the chosen topic is equally important, also the opportunity to develop the topic starting with an academic report and continuing it through Bachelor's and Master's thesis.

Load of the teaching staff in supervising Bachelor's theses may be unequal, as students prefer some teachers to others. **The Natural Sciences Department has implemented uniform instructions for theses and term papers (Appendix G13).**

**Curricula of academic levels are integrated**. Degree studies at the university refer to Bachelor's degree , studies based on the integrated curricula of Bachelor's and Master's degree, Master's degree or doctorate studies. The systematic and didactic structure is discussed in the chairs and the department and allows more or less even workload during the studies. In terms of the academic year and subjects the systematic and didactic structure of other curricula of the department is considered as well as timely teaching of prerequisite subjects. An unstable economic situation of the students is a major cause of discord.

A large number, for example in 2004 close to 74% of Bachelor's students of *Natural Sciences* had to work along with their studies. Even though the national allowance system has been introduced (Chapter 4.4), unfortunately, the national policy of social guarantees to students does not allow studies without a hitch. Other, less inhibiting causes of discord are: students´ little activeness in planning their studies, first-year students select subjects randomly, a relatively modest use of counselling and a practice to leave more demanding assessments and examinations (thus less popular among the students) until the end of the studies. Drawbacks become especially evident when students transfer from more strictly established foundation studies into a more freely organised stage of specialisation studies requiring more effort-making and knowledge. Analysis of students' results are demonstrated that a large number of natural sciences students primarily encounter difficulties in higher mathematics. When changing over to the 3+2 curriculum, the curriculum was adjusted to be more appropriate for the specialty (*Mathematical Methods in the Natural Sciences*).

**Integrated curricula enable students from other universities to transfer to TPU smoothly and without major difficulties** (e.g. from the Faculty of Science of Tallinn University of Technology, the Faculty of Biology and Geography and the Faculty of Medicine of University of Tartu, Faculties of Agronomy, Veterinary Medicine and Forestry of Estonian Agricultural University, the Estonian Maritime Academy).

## 2.4. The Statistics about the Study Process

**NATURAL SCIENCES, BACHELOR'S CURRICULUM (6420287)**

1. Number of weekly hours according to the timetable in a semester:
   minimum 3 (6. semester), 13 (without 6. semester)
   average 19 (with 6. semester), 22 (without 6. semester)
   maximum 32
2. Maximum number of subjects during one semester: 8.
3. Average weekly volume of independent work in hours: 27.
4. Size of groups during auditory work (found on the basis of the present II and III year; only subjects of natural sciences were taken into account):
   minimum 10
   average 22
   maximum 35
5. The volume of written independent work given in subjects taught by the Department during the studies: 11...12 (depends on the minor chosen by the student), Bachelor's thesis are among them.
6. Average duration of permanent timetable: semester.
7. The quantity of study-books available:
   a) the proportion of subjects without a study-book (or there are only 1-2 items in different libraries of Tallinn): 9 %;
   b) the proportion of subjects with a study-book in Estonian, which can be freely purchased (or is available for anyone in a library): 67 %;
   c) the proportion of subjects with a study-book in a foreign language for at least a quarter of the students: 15 %;
8. The percentage of graduates who finished in nominal time (calculated on the basis of the number of entrants in a respective year): no graduates yet.
9. The percentage of graduates with *cum laude*: no graduates yet.

## 2.5. Field Work

The Bachelor's curricula in Natural Sciences address the following field works: MLB 6008 *Field Works in Floristics and Faunistics*, MLG 6032 *Field Work in Physical Geography*, and MLG 6033 *Field Trip*.

During biology fieldworks the students learn to gather, determine, herborise plants and fix animals from different biotopes (*Field Works in Floristics and Faunistics*). During geo-ecology fieldworks, different landscape types, soil and wetlands are introduced to the students (*Field Work in Physical Geography, Field Trip*). In all cases, the students are trained to work in real natural conditions. The places for practice have been selected in areas with different soil cover.

**The aim of field studies is to practice work in real field conditions and to provide future scientists, specialists on environment, teachers, *etc.* with knowledge about natural behaviour and practical nature perception, as well as skills they would need in their future activities.**

Field works are arranged in cooperation with local governments, schools, nature reserves and other institutions and organisations (e.g. State Forest Management Centre *etc.*). As a practical

output of the field practice, these institutions get information on the natural resources of the area.

The methods and scientific level of field work meet international requirements. The equipment and methods used in field studies are steadily supplemented. For example, GIS - geographical infosystems (GPS + personal computer) are used.

The curricula have been compiled considering local natural conditions and their scientific study. Students greatly appreciate fieldwork, and they generally feel there should be more fieldwork.
Due to the shortage of financial means both at the university as a whole and in the department it is not possible to arrange field practices outside Estonia. And this is a disadvantage. Hopefully, the situation will improve and the geographical range of field studies will widen considerably. So far, some natural sciences students have participated in fieldwork within the framework of The Baltic University Programme.
**The Natural Sciences Department provides free vaccination against tick encephalitis for the faculty members connected with fieldwork. Students are offered vaccinations at a discounts.**

## 2.6. Strengths and Weaknesses of Study Process

**The results of the Analysis of the chapter stated to the following strengths, weaknesses and opportunities:**

**Strengths**

- Term-based timetable, guaranteeing an even load throughout the entire study period
- The successful implementation of cycle study in a series of subjects.
- Extensive use of computers for studies.
- Successful implementation of e-study in a series of subjects.
- The organization of exams is flexible and can be checked.
- Large share of group work and other forms of active learning methods in core subjects, enabling to use fellow students as a resource for learning.
- The inclusion of several fieldwork programmes, intensively carried out by well-prepared faculty members, in the curriculum.

**Weaknesses**

- The shortage of medium-sized lecture halls.
- Load of the teaching staff in supervising Bachelor's theses may be unequal, as students may prefer some teachers to others.
- A large number of students are forced to work during their studies.
- Fieldwork primarily takes place only in Estonia.
- Students´ little activeness in planning their studies.

**Opportunities**

- An increase in the number of medium-size lecture halls, in connection with the construction of the new university building.
- Carrying out fieldwork abroad.
- Increasing the percentage of student support, to reduce the number of working students.
- Increasing the percentage of academic counselling for students.

# 3. Study Environment

## 3.1. Infrastructure

The total area of the rooms at the disposal of the Department is 1379 $m^2$; of that 1179 $m^2$ are lecture rooms and laboratories. Laboratories take up 513 $m^2$ (228 $m^2$ – at the Chair of Physics,160 $m^2$ – at the Chair of Chemistry, 125 $m^2$ – at the Chair of Biology).

**Lecture rooms.** There are three lecture rooms with a total area of 153 $m^2$ fixed to the department. The lecturers of the department also use these rooms to work with students of other curricula. In the Department of Natural Sciences part of the lectures are held in the general lecture halls of the university and in the lecture rooms of other departments. The total area of the lecture rooms in general use at the Department of Natural Sciences is 1038 $m^2$; the three largest ones – 346, 207 and 122 $m^2$, respectively.

In connection with the rapidly increasing number of students in Tallinn Pedagogical University, the shortage of lecture rooms (especially large ones) has also increased. A solution will be the new building the construction of which will be started in 2004. In 2006, the Faculty of Mathematics and Natural Sciences will get the whole main building at its disposal. Besides, in 2004–2006 the general lecture rooms of the department will be repaired and up-dated.

**Laboratories.** In 2002, two new laboratories were equipped and opened: the laboratory of molecular and cell biology at the Chair of Biology, and the laboratory of organic and biochemistry at the Chair of Chemistry. In 2003, the laboratory of inorganic and analytic chemistry was repaired and up-dated; two laboratories of physics were reorganised. In 2004, the laboratory of classical botany and zoology was repaired and up-dated (see Appendix 8).

Due to the specific goals set up by the curricula to be evaluated in natural sciences, besides the laboratories and lecture rooms in the main campus, the equipment and rooms of the Institute of Ecology at Tallinn Pedagogical University, and also in several other scientific institutions – Tartu University Marine Institute, Institute of Experimental Biology at Estonian Agricultural University, Institute of Chemistry at Tallinn University of Technology, Tallinn Botanic Garden, Tallinn Zoo and Tallinn Nature Museum – are also used.

**Computer classes.** 8 hours a day, seven days a week, two computer classes with a total of 50 computers are open for students. Besides, there is the department's computer room with 12 computers, and it is also possible to use the 23 personal computers and laptops available at the chairs.

For lectures and seminars, computer and audio-video technology together with four data/video-projectors at the disposal of the department (or presentation screens belonging to the general property of the university), overhead projectors with slide sets, different kinds of model and distribution materials and web-based materials, *etc.* are used. The nomenclature of presentation technique will be widened in the nearest future. Lecture materials are available in the Internet in the university data bank or on personal home pages of lecturers and on subject lists. The students can get material for copying. The computer systems are connected to the network of Tallinn Pedagogical University. Internet-connection exists.

Only licensed software is used at the department. The most widely used programmes are: *Interactive Physics*, *Science Workshop*, *Mathematica 4.2*, *MapInfo Professional 7.0*, *Cell*

*Biology Interactive*, *SPSS 10.0*, *Test Point 10.0*, *etc.* Cooperation with the Department of Informatics has provided a possibility to use specific licensed computer software (*Adobe Photoshop 5.5, Adobe Illustrator 8.0, Macromedia Flash 5, CorelDraw 10, CorelDraw Graphics Suite 11 Academic, Macromedia Generator 2, Java2 SDK 1.4.0, Mathematica 4.1, Ghostview 4.2, Ghostscript 7.04, MikTex 0.98, etc.*). Access is available to several internationally acknowledged bibliographical data banks – *EBSCO Hosting*, *OCLCi FirstSearch Service*, *etc.*

Personal computers at Tallinn Pedagogical University use *OpenOffice 1.1.0* software and *Windows* and *Linux* systems. To keep pace with the rapidly advancing technology, the software and ICT is steadily updated both at the university as a whole and in the department. It is planned to introduce the newest software – *Statistics, Statistica, AutoCAD, Thematic Mapper etc.* To sum the above-mentioned up, it may be said that from the standpoint of the curricula, the ICT-park as a study environment is at a high international level.

Most of the students have a computer at home. There is Internet-connection at the hostel. The WiFi network covers the main building of the University and the Language House.

**Equipment.** The devices obtained during the last three years are as follows: Chair of Biology – a new epifluorescence microscope Zeiss Axioskop, 10 microscopes Novex 86.010, GFL Shaking Incubator 3032, digital Eppendorf thermostat TDB 120 Biosan, centrifuge Heraeus, two devices Vortex VN 4. Laminar Telstar Bio-II-A, *etc.* (for more detailed information see Appendix 8). The Chair of Chemistry – freeze-drying system Drywinner 1–60, vacuum pump RZ2, refractometer Refracto 30P Mettler, ph-meter Mettler, *etc.* The Chairs of Physics have obtained several devices for atom and radiation laboratories. A remarkable progress has been made in digitalising scientific and teaching aids and in advancing the ICT-technology-based control.

**At the university, everybody can make copies of study materials at the library or in the publishing department, in the academic departments and at all chairs.**

The state of rooms meets the health protection and safety requirements brought out in different legal acts (Law on Public Health, RT I 1995, 57, 978; 1996, 3, 56; 49, 953; 1997, 37/38, 569; 1999, 30, 415; 88, 804; 2001, 23, 128; Health Protection Requirements at Schools RTL 2000, 86, 1286; Health Protection Requirements for School Timetable and Teaching Regulations RTL 2001, 43, 602 and Health Protection Requirements for Computer Courses and Public Use of Computers RTL 2001, 73, 993). All the rooms used for teaching purposes are provided with up-to-date equipment.

Both the university as a whole and the Department of Natural Sciences has competent personnel keeping the study environment in order, developing and repairing it.

The above-mentioned shows that we have a good potential for carrying out scientific work, for teaching at an acknowledged international level and for achieving the goals addressed by the curricula in Natural Sciences.

Compared to the situation four years ago, the teaching environment has considerably improved from the standpoint of the curricula of Natural Sciences. Updating of scientific and teaching environment is an ongoing process. There is an eight-year development plan for further improvement of the teaching environment and laboratory equipment. As a main goal, the plan addresses the creation of a common laboratory for the Department of Natural Sciences and its joint management (Appendix G7).

## 3.2. Library, Study Aids

**The students and staff of the University may use the library of Tallinn Pedagogical University (TPU) (study library), TPU Academic Library, libraries of different chairs and the National Library.** There is also access to libraries of other universities (Tallinn University of Technology, Estonian Agricultural University, University of Tartu, Estonian Academy of Music, Estonian Academy of Arts, *etc.*).

Both employees and students have access to several internationally acknowledged bibliographical databases – *EBSCO Hosting*, *OCLCi FirstSearch Service*, *Oxford Scholarship Online*, *ISI Web of Knowledge*, quoting databases *Web of Science*, databases of patents *Derwent Innovations Index*, databases of the impact factor of magazines *Journal Citation Reports* and *ISI Essential Science Indicators*, *etc.*

Students have a possibility to use reading rooms, borrow books, visit different branches of the library, use the interlibrary loan service, reference and information services, and electronic databases (EBSCOHost, Science Direct, IOP, Kluwer Online, Oxford Reference, Cambridge University Press, *etc.*). Students have access to the network of Estonian libraries, the joint database of which describes the items of all participating libraries. Usage and booking of these volumes is available via Internet.

The amount of academic literature connected with natural sciences is larger in TPU Academic Library, for at the end of 2003 there was the joining of libraries and TPU Study Library became the library of social sciences and study literature, Academic Library remained orientated to mathematics and natural sciences.

The Academic Library of Tallinn Pedagogical University (former Estonian Academic Library) is a public science library where in the development of collections and services the main attention is paid to satisfying the information needs of scientists and lecturers. So it primarily supports research and development activities as well as academic education. It is important to provide undergraduates, Master and PhD students with information needed for their research work, and to support academic education. In 2003 there were 200 working spaces in the reading rooms, 2,256,989 items in the users' collection, 1,876,104 volumes of books, 114,267 yearly sets of scientific journals and popular-scientific magazines, 13,981 yearly sets of newspapers and 20,630 readers. As a scientific central library in the field of natural sciences (decree 12.12.1994 No 19 of the Estonian Minister of Culture and Education), exhaustive original and mediative information about natural sciences is collected, maintained and made available. The library has to fulfil the tasks of the catalogue centre of items related to natural sciences and the tasks of the centre of interlibrary loan service in the same field. The interlibrary loan service is regulated by a decree of the Minister of Culture and Education (04.01.1995 No 1). All students of TPU, post-graduates and employees are entitled to use all the funds of the library, including the service of home lending. **Thus we can say that the students, researchers and the academic staff have undoubtedly one of the best working conditions in the Republic for successful learning and research work.**

As additional services TPU study library offers printing, photocopying and scanning. The study library has 48 computerized working spaces (38 personal computers and 10 text terminals), 24 of which (15 PCs and 9 terminals) are for the visitors of the library. To all readers of the library is ensured the usage of items, access to electronic databases, information service and counselling by the specialists of the library.

The amount of books in the University's library has increased in years. On January 1, 2004 there were 279,000 items in the library. In addition there are 1,876,104 books in TPU Academic Library.

A large part of voluminous study-books of natural sciences (incl. biology) in foreign languages are presented in TPU Study Library and TPU Academic Library as single copies and therefore are used mainly by lecturers. However, the use of these copies by students is always possible when subscribed. Speciality books in the Estonian language are more numerous in the library. Usually there is enough for each student. At TPU Study Library there are 11 titles of periodicals of natural sciences (Appendix 15). Students have a possibility to read such scientific journals and popular-scientific magazines as *Nature*, *Science*, *National Geographic*. On January 1, 2004, the number of items connected with biology was 314 (38 of them published after the year 2000), chemistry 585 (56 published since 2000), physics 931 (71 published since 2000), geography 844 (48 published since 2000), in total 2,674 items, of which 213 have been published since 2000. In addition to these volumes, there is also the growing number of books connected with environmental sciences.

**Since 2004 80% of the funds of scientific literature in the Academic Library is completed according to the wishes of academic staff and scientists.**

**TPU Academic Library in co-operation with TPU Study Library, National Library and the academic structural units of TPU have launched the system of expertise and counselling of the completion of library funds.**

In addition, study literature of natural sciences can also be found in different chairs of the Department of Natural Sciences. According to the agreement with TPU Study Library curriculum-related literature is concentrated in every chair. All chairs also have the right to order new items of academic literature into the library. It is possible to deposit items of academic literature from TPU Academic Library in different chairs too.

Main study-books of the subjects taught in the Department of Natural Sciences are presented in Appendix 3. In addition to these, most of the study materials compiled by the academic staff of the Chairs are available to students (as rtf, pdf, html, doc and psf files).

## 3.3. Everyday Life at Campus

2 cafe-canteens with the total area of 650 sq metres are at the disposal of students and academic staff. These allow 220 people to dine at the same time. Separate catering is enabled in 3 rooms, the surface areas of which are 8 sq m (in the main building) and 30 sq m and 15 sq m (in the language building).

In students' spare time they have access to 3 gyms (sport games, aerobics and gymnastics) and a fitness centre with locker rooms and showers.

At university's disposal there are 2 training - recreation establishments, which can accommodate 290 people (200 at Värska and 90 at Vana-Otepää).

Students have many possibilities to participate in the work of curriculum unions, hobby groups (music, art, dance, sport, *etc.*), student corporations and associations (http://www.ee/www/Haridus/Ulikoolid/Korporatsioonid_uliopilasorganisatsioonid/) but also in the Student union (www.tpu.ee/editmode/esindus/Lingid.html). A large part of students of natural sciences, including students of different curricula of Natural Sciences, post-graduates

and academic staff participate actively in the work of the Estonian Students' Environmental Protection Union Sorex (www.sorex.ee).

At Tallinn Pedagogical University the accommodation service is dealt with by the institution "Elamu" that is formed on the basis of the university's dormitories (59 Pärnu Road, 17 Karu Street, 15 Karu Street and 8 Raadiku Street). Ensured with accommodation are: a) primarily students of TPU; b) participants of in-service training and distance learning; c) guest lecturers and other guests of TPU; d) students of other universities; e) others.

**According to the assessment of the level of service units present in other European universities, the conditions offered in Tallinn Pedagogical University can be considered satisfactory.**

## 3.4. Financial Resources

The University Council approves of the University budget, which contains financial resources allotted to different faculties. The faculty approves of the faculty budget, in which financial resources are divided between different departments. The annual budget of the Department is confirmed at the meeting of the Council of the Department. The Head of the Department is responsible for financial matters. In 2004 the budget of the Department of Natural Sciences was 6,198,750 EEK. Expenditure for wages made up 81% of the budget, equipment was bought for 0.66 million EEK (10.1%). Expenditures for infotechnology were 2.5%, for special literature 0.5% (in addition to library costs), for student subsidies 2%, and for various other purposes 3.9% (also see Appendix 8).

Budgetary expenditure per student is 14 644 EEK. Balance expenditure of equipment per students is 19 804 EEK. The cost of not state-funded student per annum in 3+2 Bachelor`s curriculum is 20 000 EEK. In the coming years this amount needs to be raised significally because of inflatsioon. One of the possibilities to increase financing is to raise the cost of state-funded and not state-funded student places. But this is complicated due to resources of students and the state.

To some extent studies and scientific work, and the development of the respective infrastructure, is also supported Grants and Dedicated Financing by the Estonian Scientific Fund.

## 3.5. Sterngths and Weaknesses of Study Environment

**The main results of the Analysis of the chapter stated to the following strengths, weaknesses and opportunities:**

**Strengths:**

- The Academic Library of the TPU as a strong research liberary in natural sciences
- Access to the databases of international journals
- Web-based study environment IVA for the creation of study courses
- Psychologically good study environmentsupport by course mates, teachers and administrative personnel
- Interdisciplinary scientific environment of the Natural Sciences Department

**Weaknesses:**

- There are not enough contemporary basic textbooks for all the students

- The number of study laboratories and their equipment do not fulfil the needs of the curriculum
- The relatively small number of study halls does not always allow for the wishes of the students and faculty members to be taken into consideration when drawing up class schedules.
- The small number of students in comparison with the existing possibilities.

**Opportunities:**

- It is possible improve the availability of study materials in the electronic version, also to increase information dissemenation by increasing Web-based support.
- The intensive continuation of the preparation and writing of textbooks for university-level institutions, including in cooperation with other academic institutions, for instance the international cooperation network, The Baltic Sea Programme.
- The realisation of the specified room programme together with the completion of the new TPU main building in the 2005/2006 academic year.
- The planning and development of an integrated scientific laboratory and study laboratory for the department in accordance with the development plan.
- The procurement of supplemental financial resources for acquiring laboratory equipment, by more effectively using the scientific potential of the faculty members (more intensive participation in international cooperation projects, making use of scientific grant opportunities).
- To work out more effective system of advertisement of curriculum.

# 4. Students

## 4.1. Admission to the Area of Specialisation

Starting in 2002, admission to the Bachelor's Degree *Natural Sciences* conducted on the basis of curriculum 6420287 (three-year programme). Before that, in the years 1996-2000 admission was conducted on the basis of *Natural Sciences Teacher* curriculum 5141014 (four-year diploma programme).

Admission to places in Curriculum 6420287 is conducted by public competition based on TPU regulations on the organisation of studies (16. June 2003) and current legislation of the Republic of Estonia. The study direction and cost of the general number of study places, to be created by the state commission, is determined and financed by the Estonian Ministry of Education and Research until the nominal completion of the study term of the study places. The distribution of the study places by areas of specialisation, is approved by the Rector of the University upon the proposal of the Dean of the Department. The study direction and cost of the non-budgetary study places, created outside of the state commission, is determined by the university administration and the physical or legal person ordering the study place pays for it.

Terms of admission to the Diploma Programme (Curriculum 5141014) and Bachelor's Programme (Curriculum 6420287) are identical. Students are admitted on the basis of the order of superiority for their previous studies. A prerequisite for starting studies in the natural sciences programme is the completion of the state examination in one's native language and in two of the following five subjects: geography, biology, chemistry, physics, and mathematics.

Graduates of Russian-language schools, whose grade in the state examination in Estonian is less than 60 points (in a 100-point system), are directed by the admissions commission to the compulsory study of Estonian, obligating them to complete at least an intermediate level of Estonian language studies during the first academic year. The students who are admitted without having completed the state examination in Estonian will present a certificate by the end of the first academic year regarding the completion of the examination for the intermediate level of Estonian language studies. During the past five-year, 21 people have been admitted in department from Russian-language schools, 10 for diploma studies, and 11 for the Bachelor's Programme.

The terms and rules of admission for the area of specialisation are available to everyone on the TPU website: www.tpu.ee; and the handbooks issued every year for the entrants. Summarized information on the terms of admission and introduction of the area of specialisation is also provided in information bulletins and TPU newspapers, which are distributed to potential student candidates before the state examinations. In addition, a orientation day to introduce the area of specialisation takes place during the spring semester.

Admission to the natural sciences area of specialisation has been quite stable from year to year and is shown in Table 4.1.1

Table 4.1.1

Students admitted to the natural sciences area of specialisation

| Year | Applications | Admissions | Competition |
|---|---|---|---|
| 2000 | 87 | 15 | 5.8 |
| 2001 | - | - | - |
| 2002 | 80 | 10 | 8.0 |
| 2003 | 74 | 13 | 5.7 |
| 2004 | 73 | 15 | 4.9 |

In 2001, admission did not take place, since a state commission was not presented; in 2001, admission was conducted to the old curriculum.

During the past few years, only one transfer student has been admitted (2001). No students have transferred out.

The knowledge level of the student candidates generally corresponds with the requirements of the state curriculum for general education schools. Some unevenness in initial knowledge comes from the lower scholastic standards of some upper secondary schools and the insufficiency of a school's study materials, individual peculiarities, etc. The faculty members perform additional work in order to equalize the levels by providing individual consultations and expanding the list of recommended reading related to the subject.

The admission of students to the area of specialisation should increase, since there is quite a large demand for graduates of this area of specialisation, especially in rural areas. In smaller schools there is an acute need for teachers who can teach different natural sciences subjects. In addition, a comprehensive area of specialisation creates the opportunity for integration with regional structures that conduct industrial and research work, and therefore, to provide sufficient application in the labour market. In towns and other larger centres, specialists familiar with different natural sciences subjects are needed for solving different project assignments as well as to teach in general education schools. According to 2003 data from the Estonian Statistics Office, approximately 30% of employed natural sciences teachers lack specialized higher teacher education, and 24% of teachers are older than 55. Taking into consideration the need and possibilities for rationally organising studies, it would be optimal to plan for the admission of 20 students in the next few years.

## 4.2. Composition of the Student Body

At the present time, 47 students are studying in the Natural Sciences Programme. Thirty-one of them are studying based on the Curriculum 6420287. There are no students studying outside the state budget. The percentage of non-citizens among the students is 2.7% (2 students).

**Age composition.** The age of the students basically falls between 18 and 29. Only one student is over 30. The majority (83%) of the students are between 18 and 25 (see table 4.2.1).

Table 4.2.1

**Age composition of the student body by academic year**

| Age | 1st academic year | 2nd academic year | 3rd academic year | 4th academic year | Total |
|---|---|---|---|---|---|
| 18-21 | 11 | 7 | 5 | 0 | 23 |
| 22-25 | 2 | 3 | 4 | 7 | 16 |
| 26-29 | 0 | 0 | 2 | 5 | 7 |
| 30 and older | 0 | 0 | 1 | 0 | 1 |
| Total: | 13 | 10 | 12 | 12 | 47 |

**Gender composition.** The majority of students in the area of specialisation, that is 87%, are female (see table 4.2.2).

Table 4.2.2

**Gender composition of the students by academic year**

| Year | State Budget | | Outside State Budget | | SB+OSB | | Total |
|---|---|---|---|---|---|---|---|
| | W | M | W | M | W | M | |
| I | 11 | 2 | 0 | 0 | 11 | 2 | 13 |
| II | 10 | 0 | 0 | 0 | 10 | 0 | 10 |
| III | 10 | 2 | 0 | 0 | 10 | 2 | 12 |
| IV* | 10 | 2 | 0 | 0 | 10 | 2 | 12 |

* - IV-year students are studying on the basis of the old curriculum.

Compared to previous years, the number of female students has increased by about 10%. The students admitted in 2004 included two young men. This is partially connected to the fact that many young men prefer to go into the army immediately after graduating from upper secondary school. The gender imbalance in the area of specialisation may also be caused by the connection between the area of specialisation and the teaching profession. The prestige of the latter in the society is, unfortunately, low and the compensation is relatively low. This does not satisfy young men, who believe that they must be the chief providers for their families. General education schools, however, in current circumstances need significantly more male teachers.

**Regional background.** Students from almost all of Estonia's counties and larger towns have come to study natural sciences. The majority of students in both diploma studies and the Bachelor's Programme are from Tallinn (29.8%), Harjumaa (8.5%), Saaremaa (8.5%) and Pärnumaa (8.5%). Although it is also possible to study natural sciences subjects at Tartu University, some students from southern Estonia (Valga-, Põlva- and Võrumaa) have chosen TPU. Seventeen percent of the students studying in the Natural Sciences area of specialisation are from southern Estonia.

## 4.3. Counselling

**Student candidates.**
The counselling of student candidates takes place all year. An Admissions Department has been created for this. Information related to admissions is available on the TPU website. Every year, a TPU handbook is issued for entrants. Once a year, usually in March, open-door days take place, where the leading faculty members in the field introduce study conditions and potential work opportunities in the area of specialisation and answer questions. For those who are interested study laboratories and faculty members are introduced. The open-door days are very popular among the entrants every year.
In addition to the above, appearances by teachers at conferences and in the mass media are used to promote the area of specialisation. Through the years, the faculty members in the field have repeatedly supplied promotional articles and advertising materials to schools and have appeared in the press and on the radio in order to introduce the area of specialisation and its necessity. Based on the above, career counselling can be considered to be sufficient.

**Students.**
Students have the opportunity to get sufficient and timely information about study arrangements. The first counselling for students take place in the units teaching the area of specialisation – in the Natural Sciences Department and the Chairs that oversee the major

subjects. Students have the right to speak to the dean's assistants, assistant deans, the dean and the specialists of the respective field in the department, as well as, to the student representation to receive information related to study and to solve other problems (including discrimination). A student tutor also counsels first-year students. The tutoring system is successfully operating in the Department for the fifth year.
Counselling is based on documentation that organises the studies (TPU study regulations, curricula, study programmes; instruction of the Faculty of Mathematics and Natural Sciences, Department of Natural Sciences, and the University administration, *etc.)*.
Counselling is started at the beginning of the academic year with an orientation day, during which the TPU's basic structural units, Department, and Chairs therein are introduced to the students; a overview is provided of the study process and the curriculum for the natural sciences area of specialisation and of the possibilities for realisation within the field; and the rights and obligations of the students. On the orientation day the students meet their instructor-teacher and student teacher, whose help they can use in order to solve problems that may arise.
Students are regularly counselled during the study period. The academic adviser is available to students at specific times, by telephone and by internet. The questions requiring counselling primarily include the organisation of studies and its specific facets, such as the selection of major and minor subjects for the study direction and the corresponding selection of subjects, the design of individual programs and class schedules, *etc*. A second round of questions are related to study difficulties and elimination of deficiencies in one's studies.
Faculty members counsel students on questions related to studying subjects and their completion (choice of study materials, subject programmes, requirements of assessments/examinations, *etc*.), for this, faculty member hours are posted in the Chair.
The academic support staff of the Department/Chair counsels students on questions directly related to the organisation of studies, such as, the class schedule, questions related to lectures and faculty members, the curriculum and its nominal distribution into academic years. Operational information from the Chair/Department (for instance, transfer of lectures, changes in the class schedule, *etc*.) are displayed on the unit's stand and forwarded to study groups by e-mail. The support staff of the Department deals with signing contracts with the students studying in non-budgetary places and with the payment of tuition.
The dean's office of the Department provides information to the students about questions regarding the grading of their studies, the status of the students and the assignment of scholarships. Once a year, upon a student's request, the dean's office issues a fee study card, which shows the study results entered in the student's database.
Supervisors - lecturers (Rando Tuvikene, Kristi Paas, Aivar Lõokene) are mediators and guides between students and lecturers and the administration.

The Study Department counsels students about general issues connected with studies and provides documents about the status of students.

First year Bachelor students are also counselled by a student tutor. The system of tutors has been working effectively in the department already for 5 years. The tutoring service of students in TPU is based on the Law of Universities (Article 42, *etc.*), the decrees of the Ministry of Education and Research *Requirements for Accreditation of University* (Articles 39...47, *etc.*) and other documents that regulate the work of the university. The task of the tutoring service of students is to provide students with necessary information, to help them adjust socially and academically as well as to identify with the university on the level of student to student. The main aim of the tutoring service of students is to help them succeed both socially and academically (especially on the first year), to prevent academic problems, and in cooperation with the Student union to develop university's traditions and democracy.

Therefore, the task of tutors is to help the first-year students to adapt to the new curricula system, introduce the locations of chairs, libraries and other necessary subdivisions, help to understand timetables and counsel them in choosing their electives. Student tutors are senior students who have had the necessary training and have the right to counsel younger students within the limits of their competence. The names and contact information of tutors are available also in the Internet. The tutors in the curricula of *Natural Sciences* are Egle Aas, Kert Martma, the second-year students.

The Student union counsels and protects students' interests in social and economic issues and their intellectual rights and interests. **The Student union stands for the interests of students in the University Board, where they have a plenipotentiary member and in addition there is a representative from every faculty.** The chairperson of the Student union is a plenipotentiary member of the Board of the University. TPU Student union is a member of the Estonian Students' Union (ESU) and has 4 members entitled to vote in ESU Council.

**TPU Career and Counselling Centre (project manager Ms K. Laur, student counsellor Ms M. Märtsin) consults students about learning problems, professional suitability and career planning and coordinates the activities of tutors. Student candidates and school-leavers have a possibility to get information and consultations about specialities taught at the university as well as admission requirements.**

## 4.4. Students' Workload and Progress

The basis for organising the teaching activities is the TPU study regulations, which is based on the decisions of the TPU Council and Administration, the TPU statutes, and is in compliance with the Estonian Republic's Universities Act and the higher education standards of the Republic of Estonia. The new TPU study regulations were approved in 2003. It is available on the Internet (see Appendix G9). The academic calendar that is the basis of the studies is also presented in the handbook issued to entrants every year.

The students' workload is regulated with the goal of every year collecting, as evenly as possible, the number of credit points needed to graduate from the university course (CP).
In case of Curriculum 6420287 the nominal study period is 3 years and the number of points necessary is 120 CP. During the studies, specialisation will take place in accordance with the choice of a major. It is possible to choose between four majors (biology, chemistry, physics, geo-ecology). The choice is made during the spring semester of the first academic year. In the case of a Bachelor's Programme, one can choose two majors from the following list: biology, physics, geography, chemistry and one minor (study volume of 30 CP). It is recommended that a minor be chosen from the field of natural sciences, although a minor can be chosen from among all the areas of specialisation offered at the university. During the spring semester of the 2002/2003 academic year, 70% of the students chose geo-ecology as a minor, 30% chose chemistry.
In addition to a major and minor subject, the students have the right to chose electives totalling 6 CP from among all the subjects offered at TPU. The favourite electives among students studying Natural Sciences are foreign languages and computer training. Based on the requirements enacted at the university, the foreign language proficiency for Bachelor's students must be B2 advanced level, and the computer skills must comply with the requirements developed in the Computer Science Department, approved by the Council of the University, and confirmed by an order of the assistant dean. Study of a foreign language does not have to be supplemented by students whose state examination grade is at least 80 points. In addition to opportunities for studying in the electives and interdepartmental electives

module, every student has the right to improve his/her foreign language and computer skills outside of the university and to take placement examinations as an external student.
Students have the possibility to choose a suitable study pace and volume by studying as a full-time or part-time student. In case of full-time study, students must fulfil 75% of the nominal study load (40 CP) by the end of the academic year; in case of part-time study not less than 20 CP per academic year. Currently, all the Natural Sciences students are studying full-time.
Based on the selection of major and minor subjects and the nominal distribution of the curriculum, class schedule and his/her own possibilities each student draw up his/her won individualised study plan. Whereby one is guided by the standard study plan prepared by the department. The study plan must be presented to the dean's office of one's department by the deadline specified in the academic calendar. Until this deadline students have the right to change their study plan as they wish. After this *red line* day, the study plan becomes compulsory and it can be changed only in special cases with the written approval of the department's dean's office and department head. Based on the complexity of the area of specialisation and the abundance of prerequisites, compiling individualised study plans is quite difficult. During the 2003/2004 academic year, all the students studying Natural Sciences used standard study plans. Students may chose a subject for his/her study plan if he/she has previously completed the prerequisites for the subject. Registration of the subjects is organised by the Chairs teaching the subject. There are two period for registration for studies: pre-registration at the end of the previous semester at a time allocated in the academic calendar, and at the beginning of the semester until the end of the changes for study plans. Students may also register to listen to subjects electronically.
In order to complete the nominal study term, the volume of a student's studies must average 20 CP per semester or 40 CP per academic year. The volume of subjects being studied in any given semester may not total less than 10 CP. When drawing up a study plan, one must also take into account that some subjects may be taught only every other year (the respective information is on the subject card).
In accordance with the standard study plan, Natural Sciences students study for one academic year on the basis of a unified standard study plan, which in addition to major and minor subjects, in the first semester also natural sciences subjects totalling 12 CP, and in the second and third semester includes 11 CP and 6 CP respectively of natural sciences subjects.
Based on the standard study plan, the yearly load of auditory work is greatest during the first and second academic year, and smallest during the last academic year. The average volume of auditory work for a Bachelor's Programme is 24 CP during the first academic year, 22 CP during the second, 15-16 CP during the third, of which 4 CP is contributed by the Bachelor's thesis.
The load of independent work increases every year. It differs from one area of specialisation to another, and the approximate volume is designated in the programme for each subject. The amount of independent work is greater in the Bachelor's Programme than in Diploma studies. In Diploma studies, independent work contributes 51% of the students' workload; in the Bachelor's Programme, 60% (minor in chemistry) to 65% (minor in geo-ecology), depending on the choice of minor subject.
The study plan is updated (amended) in the Chair at the end of the academic year, or before the beginning of the new academic year. Changes in the organisation of studies are directed at levelling out the student's load during the course of the entire study period, while keeping in mind that the students' independent work will increase every year.
The general assessment of the fulfilment of the study plan takes plan in the dean's office of the Faculty of Mathematics and Natural Sciences. The assessment is based on the grade sheets (protocols) that record the results of examinations and assessments. Grading sheets are kept in the dean's office of the Department for at least twice the length of time covered by the

student's study plan. These are the basis for determining the student's status according to study success and volume. The assessment for the length of the subject is kept in each Chair. At the end of the semester, analysis of the student's load and reasons for failure is made and based on this, the study organisation is supplemented.
Some students encounter difficulties in fulfilling their study plans. The dropouts during the last three years have totalled 7 students that is about 20%. This included 5 students with study deficiencies. An average of 2 students per year have been reinstated. The main reason among first year students is incapability to adjust to the university study environment. The study difficulties of older students are basically related to economic difficulties: the majority of students are forced to work, either part-time or even full-time, while studying. In order to improve the situation, many measures have been implemented. Firstly, the progress analysis and counselling system for students has been made more effective. In order to track study results corresponding computer programmes and databases have been implemented, and development work is being dealt with to make information available to every student. Students can speak with the Department's academic counsellor, faculty member teaching the subject, as well as the personnel in the dean's office about questions related to the elimination of study deficiencies. The academic counsellor constantly tracks the success of the students' work, and if necessary, invites them to interviews and arranges times for supplemental consultations with faculty members. In addition, each faculty member has definite office hours, when if needed, the necessary consultations can be obtained.
In connection with putting the student loan and support system in order, it can be hoped that the economic situation of the students will improve. State study support is assigned at the order of the dean for one semester, and students have the right to receive this if they have fulfilled 75% of the volume of the curriculum and the weighed average grade is > 3.5. In the 2004 fall semester, Natural Sciences 6 students in the Bachelor's Programme received support (weighed average 4.05). The size of the support for main studies was 800 EEK.

## 4.5. Academic Mobility

At every stage of their studies, students are guaranteed the opportunities for academic mobility in both Estonia and abroad. This is specified in inter-university agreements. Students must compare the curricula of respective areas of specialisation and complete the intermediate deficiencies.
The opportunities to study at Tartu University, Tallinn University of Technology, Estonian Agricultural University, Estonian Academy of Art, Estonian Academy of Music as a guest student are specified by the minutes of the meeting of the rectors of Estonia's public universities on 17 September 1995, entitled *Studying as a Guest Student*. Studying at private institutions of higher learning is specified in the agreement between TPU and the partner institute of higher learning. Studying abroad can take place as a student exchange, upon personal initiative or on an international organisation, programme, government, fund or university scholarship. Therefore, the potential opportunities for student mobility are good. As a guest student at another university, it is possible to study one or more subjects. The student receives a directing letter from his/her academic department, gets the subjects to be studied approved by the curriculum director of the accepting university, and registers for studies. The grading sheet with the study results is presented to the dean's office of the TPU Faculty of mathematics and natural sciences.
Questions related to the academic mobility of students in TPU are specified in the document: The Regulation of the Organisation of Studies in Tallinn Pedagogical University (Appendix G10). During the past five year, 1 student has been admitted to Diploma studies in the course of a transfer; no students have been admitted to the Bachelor's Programme in the course of a

transfer. During the past five years there have been no students who transferred to areas of specialisation at other universities. At the moment there are not guest or foreign students studying the field Natural Sciences. The mobility of students was greater during earlier years. In previous years some students have started their studies in Tartu University and followed in Tallinn Pedagogical University or *vice versa*. Relatively low mobility of students can be explained by their contentment of the searching process. They have changed university only for very important reasons, mainly as connected with marrige.

Currently students have been given a chance to apply for various grants for studying at universities abroad, *e.g* SOCRATES within the framework of the ERASMUS sub-programme of higher education, DAAD, *The Baltic University Programme*, *etc.* The aim of the grants received is to develop cooperation in the sphere of higher education in Europe in order to increase professional qualification of the people in the participating countries. A period of studies abroad of the student is treated as an equal part of the curriculum at the home University.

## 4.6. Graduates

One hundred and twenty students have graduated from the Natural Sciences area of specialisation at TPU, of them three graduated *cum laude*. During the past five years, 106 have graduated (see table 4.6.1), of them 27 became teachers of gymnasium environmental science and basic school natural sciences (5-year Bachelor's degree curriculum 6141058), 60 teachers of basic school natural sciences (4-year Diploma studies curriculum 5141014). Since the admissions to the three-year Bachelor's degree curriculum 6420287 did not start until 2002, then there are no graduates yet.

Table 4.6.1

**Number of graduates per year**

| Year | *BSc* degree | Diploma | Total |
|---|---|---|---|
| 2000 | 14 | 4 | 18 |
| 2001 | 8 | 9 | 17 |
| 2002 | 1 | 25 | 26 |
| 2003 | 2 | 25 | 27 |
| 2004 | 0 | 18 | 18 |

The ratio of the number of graduates to the number of entrants by year, varied from 0.12 in 1999 to 0.8 in 2002. The low ratio is partially caused by the fact that until 2000 the students were able to choose their study pace almost freely, whereby the study period for many stretched out much longer than the nominal period. By now a payment system has been implemented for each year that one studies over the nominal period, which forces students to be more committed to their studies. In addition a system has been created at the level of the dean's office and academic counsellor for tracking and evaluating the progress of students. If necessary, the counsellor will inform the profiled Chair and faculty of the area of specialisation of problems that have arisen.

The low ratio of graduates in comparison to entrants was also caused by an badly organised system of study supports, whereby many students are forced to work full-time. The new study support system was not implemented until this academic year.

## 4.7 Forms and Organisations for Student union

Students actively participate in the activities of the community, department and university, and they are broadly represented in the different levels of TPU governing bodies.

**Student union.**
In order to guarantee the interests of the students (study conditions, organisation of studies and hobbies, etc.) the TPU student union, which includes 21 students from different faculties. The student union protects the interests of the students during the course of their studies, represents them at the university, organises different types of events, etc. Starting in 2003, Starting in 2003, the first group of supporting members (up to 15) participate in the student union committees and Federation of Estonian Student Unions seminars. The TPU student union is a member of the Federation of Estonian Student Unions (EÜL) and has four voting members in the EÜL council.

In 2005, there are plans to convene the first 2005. student union consisting of students from the Faculty of Mathematics and Natural Sciences. This is the representational body of the Faculty's students, which deals with the problems of the students in this Faculty, passes on information between the students, student union and university administration, and organises cultural events.

**Representation in the governing bodies of the university.**
Students are involved in the more important TPU decision-making bodies, the University Board (students fill 5 out of 34 places). Based on the Universities Act (§ 14) student representatives form at least 1/5 of the composition of the University Board. According to the statutes, a student representative also belongs to the university administration. The highest managerial body of the Faculty is the Faculty Council, and of the 19 council members four are students (all departments are represented). Students participate actively in the work of the Council. Representation in these bodies allows to get feedback from the student body and to operatively take this into account when organising the work of the entire university.

**Clubs and activities.**
One of the most important organisations that unite students from the different fields of natural sciences (geo-ecology, biology, environmental organisation, etc.) in TPU and also across Estonia, is the Estonian Society for Environmental Protection SOREX that was founded in 1997. Geo-ecology students formed the society at the time and its main goal is the development of ecological awareness and interest in nature, the formation of an environmentally friendly mentality among young people and the organisation of environmental protection and education events. During the year, over 20 meetings and events (fall school, seminars, meeting in Ministries, etc.) take place.

The Geo-ecologists' Club was created in 1999 and it connects see geo-ecology students, post-graduates, doctoral students and faculty members. As of the beginning of 2005, the club has 113 members and its own website, regular activates occur twice a month. One of the club's annual traditions is Fall Days, during which a 2-3-day trip is organised to some naturally beautiful area of Estonia. Other supplemental events have been organised within the framework of the Fall Days, for instance, one of the projects at the Geo-ecologists' Fall Days in 2001 was the Sustainable Estonia 2001 seminar. In 2003 KEKO (The Audit of the Implementation and Development of the National Environmental Convention in Estonia) was carried out, where the connection of the international framework convention with Estonian legislation was discussed.

Many natural sciences students studying for Bachelor's degrees participate actively in the Geo-ecologists' Club.
An important activity of the club is travel (of geo-ecologists as well as students of other natural sciences fields), including study trips (recently, for instance, in July-August of 2004 to the Spitzbergen).

## 4.8 Strengths and Weaknesses Connected to Students

**The main results of the analysis of the chapter stated to the following strengths, weaknesses and oppurtunities.**

**Strengths**

- High motivation of the learners caused by great shortage of science teachers
- Many-sided teaching process enables the students to acquire a wide-spread nature-consciousness for various potential needs
- Existence of the support and counselling system in the department and at the university level
- Supporting the development of the group

**Weaknesses**

- Different experience and different level of the entrants in natural sciences
- Uneven computer skills, impending the utilization of web-based studies
- Weak foreign language skills, impending the reading of respective textbooks and scientific journals
- Work-load of students because of their financial difficulties, hindering the study process
- Low ratio of male students

**Opportunities**

- To increase availability of the web-based support and information
- To guide students to test their foreign language command and computer skills and if necessary to use credits for elective subjects to study some foreign language and improve computer operating skills
- Development of tutor system
- Expanding possibilities for laboratory and field works
- To advertise the speciality more intensively to gymnasium students
- To enlarge the number of state-commissioned study places

# 5. Academic and Administrative Personnel

## 5.1. The Personnel and its Workload

**There are 34 faculty members working in the Department of Natural Sciences**., 25 of them are involved in the preparation of Bachelor level students in Natural Siences, curricula 6420287, and that means 19,75 equivalent full teachers positions.

The teachers of the so-called traditional subjects of natural sciences work full-time for Tallinn Pedagogical University. New specific subjects are taught mostly by guest teachers or teachers who have a temporary contract. **Academic staff from Tallinn Pedagogical University (TPU) Institute of Ecology and Tallinn University of Technology are involved in teaching the special courses. At the same time our teachers are regularly involved in the work of other higher educational institutions** (for example, professor H. Kukk and assistant lecturer T. Ploompuu also lectures at the Gene Technology Institute of Tallinn University of Technology.)

The list of the academic personnel is given in Appendix 6. The administrative and technical personnel of the Department of Natural Sciences consists of 10 people, which is 0.34 employees per teacher. Therefore the workload of the administrative and technical personnel is quite significant. The relatively inadequate number of presently employed administrative and technical personnel is about to grow in the next few years in connection with the structural changes foreseen in the development plan of the department. On the other hand, the professional approach of the administrative personnel makes up for the mentioned shortcomings.

Presented statistics show the academic and administrative personnel connected to curricula under accreditation. As the Bachelor's curriculum (6420287) include also blocks of general subjects and interdisciplinary electives then the lists of academic personnel connected to them is presented in Appendix 7.

**Most of the members of the teaching staff (24, i.e. 86 %), teaching subjects of the curricula, have a academic degree** (Appendix 6). 18 of them (64%) have a *PhD* or an equivalent degree in science: *DSc* – 2, *PhD* – 5, *Cand Sci* – 11), 6 teachers have an *MSc*, *MA* or *MD*. Therefore the requirement presented in the documentation, that at least 50% of the teachers involved in Bachelor's level must have a *PhD* or an equivalent degree, is completely met. The average age of the academic personnel is 49,2 years. The age composition of the teaching staff is given in Table 5.1.1.

**The average continuous teaching service of the academic personnel is 14 years**. 11% of them have more than 24 years of teaching experience.

Table 5.1.1

Age composition of the teaching staff of Natural Science

(in 2004)

| | … - 40 | 40-49 | 50-59 | 60-69 | 70 - … | Substantive employment | Equivalent employment |
|---|---|---|---|---|---|---|---|
| Professor | 0 | 0 | 1 | 3 | 0 | 4 | 3,5 |
| Ass. Prof. | 1 | 4 | 3 | 2 | 0 | 10 | 8,5 |
| Lecturer | 2 | 3 | 0 | 0 | 0 | 5 | 3,25 |
| Assistant | 3 | 1 | 1 | 0 | 0 | 5 | 3,5 |
| Teacher | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Part-time academic staff | 1 | 0 | 0 | 0 | 2 | 3 | 0 |
| **Total** | **8** | **9** | **5** | **5** | **2** | **28** | **19,75** |

**The average annual auditory workload of the academic staff according to the position** (see Table 5.1.2) **meets the requirements given in Resolution 3 of TPU Government in 2002.**

Table 5.1.2

Average annual workload of the academic staff

| | Average weekly auditory workload | Average annual auditory workload | Preparation, exams/ assessments, correcting tests | Supervising professional placement and/or research work | Average total annual workload |
|---|---|---|---|---|---|
| **Professor** | 5 | 160 | 240 | 400 | 800 |
| **Ass. Prof.** | 7 | 224 | 336 | 350 | 910 |
| **Lecturer (with research obligation)** | 10 | 320 | 480 | 310 | 1110 |
| **Lecturer (without research obligation** | 14 | 448 | 672 | 200 | 1320 |
| **Teacher** | 16 | 512 | 768 | 150 | 1430 |

50% of teachers (14 persons) work full-time, 28,6% (8 people) work half-time and 10,7% (3 persons) part-time (0.25 workload). Of the Department's faculty members, 11% are paid hourly.

The average auditory workload of the teachers of the Department of Natural Sciences in 2004/2005 was 335 hours. In addition to auditory work the teachers are also occupied with supervising term papers, graduation papers and Bachelor's theses. 4 teachers are also involved in leading the department. In addition to that Prof. J.-M. Punning is the Head of the Institute of Ecology; Prof. Ü. Ugaste leads the Department of Natural Sciences and Prof. H. Kukk is the Dean of the Faculty of Mathematics and Natural Sciences.

It is difficult to bring out the objective relationship between students and teachers when it comes to the curricula under accreditation, because the teachers involved in teaching Natural Sciences also teach according to different curricula in other departments and other faculties. According to the average auditory workload and taking into consideration their equivalent fulltime positions, we get 18.2 as the student-teacher ratio, of which the fulfilment of Bachelor's curricula is 9.4.

The strong sides of the academic staff teaching the subjects of the curricula are:

- teachers are good specialists of the curriculum, having wide and versatile knowledge;
- teachers are involved in various activities according to their specialities within the university and also elsewhere;
- strong relations concerning scientific studies have been established between different scientific institutions and universities in Estonia and abroad;
- teachers are qualified for their specialities pedagogical-didactically and use modern educational technology and its means in their everyday work.

The weak sides are: lack of administrative and engineer-technical personnel as mentioned earlier; inadequate resources for the remuneration of specialists from elsewhere (supervising research work, writing reviews). Although in the period 2003-2005, the number of teacher aids has increased by two.

24 teachers of interdisciplinary electives of general subjects (10.5 equivalent full positions), 13 - with a scientific degree (see Appendix 7), are connected to the Bachelor's curriculum (6420287). 5 of them are doctors (*PhD* and *Cand. Sci*), 8 have an *MS* or *MA*. The average age of teachers is 39.7 years, average teaching experience 10 years. Interdisciplinary electives of general subjects (4 ECTS) form 2.2% of the entire curriculum.

The relations between students, academic staff and other employees are good, based on mutual understanding and the code of academic ethics.

**Scientific research.** Compared with the previous evaluation which was carried out in 1998, the research activity and quality of the teaching staff has considerably grown, in particular since 2000, even despite the relatively high teaching load. So, for example, while in 1998 the teachers participating in teaching curricula of natural sciences published only 4 papers in peer-reviewed journals of broad distribution (referenced in the *ISIWeb of Knowledge Trials*), in 2004 the corresponding number was 18. The total number of scientific papers published in international peer-reviewed journals from 2000-2004 is 115 (73 of those in journals of broad distribution). 35 teaching aids were published for schools of general education and universities. About 60 papers were delivered to international scientific conferences.

In 2002-2004 the following members of the department acted as principal investigators of the Estonian Science Foundation Grants:

1. J.-M. Punning. ETF 5584. *Spatio-temporal regularities of sediment formation in Estonian small lakes.*
2. J.-M. Punning. ETF 5580. *Distribution of the plant macro-fossils in the sediments of Estonian small lakes.*
3. E. Karofeld. ETF 4713. *Degeneration of sphagnum masses and formation of mud-bottoms-development dynamics and role in raied bog ecosystems.*
4. H. Kukk. ETF 5071. *Formation, development and distribution of loose-lying macro-algal mats in Estonian coastal waters.*

5. K. Truus. ETF 4179. *Research of structure-function conditionalities in polysaccharides of brown algae from Baltic Sea.*
6. A. Lõokene. ETF 4925. *Molecular mechanisms regulating the functioning of lipoprotein lipase.*
7. A. Lõokene. ETF 4930. *The role of cytoskeleta/cytosolic proteins in regulation of mitochondria in vivo: proteomic aspects*.
8. Ü. Ugaste. ETF 5080. *Interdiffusion in ternary metal systems: Optimum methodology for experimental investigation.*
9. R. Mankin. ETF 4042. *Wave propagation in stochastic space-times: Nonequilibrium fluctuation-induced transport.*
10. R. Mankin. ETF 5943. *Colored-noise-induced phase transitions and transport phenomena in nonlinear systems.*

At present the teaching staff participates in 2 international specifically funded projects and in 5 projects funded specifically by Estonian Ministry of Education and Science:

- *Stochastic processes at dense plasma beams interaction with construction materials.* International Atomic Energy Agency Grant No 302 FI-EST-12062 (Chief scientific investigator: Ü. Ugaste).
- European Commission 5$^{th}$ Framework Project ACCROTELM. *Abrupt climate changes recorded over the European land mass: multi-proxy records of Late-Holocene climate variability in Europe, and North Atlantic teleconnections.* European Commission Contract No EVK2-2002-00166 (Estonian sub-project leader: E. Karofeld).
- *The effect of temporal and spatial variability of coastal processes on the biological and functional diversity in the NE Baltic Sea* (Project leader: H.Kukk); Contract: SF 0182578s03.
- *Climate change impact on wetlands, their structure and functioning* (Project leader: E. Karofeld); Contract: SF 0282121s02.
- *Structural and medical proteomics* (Project leader: A. Lõokene); Contract: SF 0142501s03.
- *Towards a philosophy of relevance in Science education and factor influencing its operationalization* (Project leader in TPU: P. Reiska); Contract: SF 0182529Bs03.
- *Natural and human-induced trends of the lake trophicity development in the Holocene: reconstructions and projections* (Project leader: J.-M. Punning); Contract: SF 0282120s02.

Despite the last years' advancements the research achievements are not yet in complete accord with the academic staff`s intellectual potential either in quality or quantity. There are some inhibiting circumstances like:
• Excessive fragmentation of the research topics. More of the Department's potential should be channelled in inter-disciplinary fields.
• A relatively high teaching load of the academic staff.
• Weak laboratory basis for performing modern scientific research.
• Small number of full researchers (except in the Chair of Geo-Ecology, which carries out an intense collaboration with the Institute of Geo-Ecology of the TPU).

Major fields of research activities:

- Establish prioritised research fields and form larger inter-institutional research groups. Create favourable conditions for development of interdisciplinary research.
- Increase the ratio of researchers to 20% of the academic staff by 2006; involve additional means, mostly from implementation of research.
- Establish an inter-university centre of excellence in natural sciences.

- Support participation in international cooperation projects (primarily in the EU research and development programmes) and extension of funding science from outside Estonia.
- Introduce a system to motivate research done by the teaching staff and researchers. Support international publication of research results and implementation thereof.
- Create opportunities for doctoral students to work in research groups.
- Establish a system of research quality monitoring and support.

## 5.2. Personnel Policies

**Academic personnel is chosen through a public contest according to the Law of Universities of the Estonian Republic, the Standard of Higher Education of the Estonian Republic and official documentation (election decree, *etc.*) established in Tallinn Pedagogical University (TPU).** The basis for becoming elected is meeting the qualification standards of a certain position. The criteria for the choice are a candidate's level of education, scientific and teaching abilities as well as practical knowledge in the field. The most important criterion, however, is the productivity of the candidate's scientific work (the amount and quality of publications). Candidate's suitability for the position is first evaluated by a specially constructed assessment commission. The final decision is made by secret ballot in the University or Faculty Council (depending on the rank of the position). A temporary contract (1 – 5 years) will be drawn up with the chosen employee.

The actual range of choice, when it comes to the academic personnel, is quite limited as the circle of suitable and compatible individuals in our small Republic is quite narrow. Limited financial resources minimize the possibility of inviting guest lecturers (from other universities and institutions). In connection with the rearrangement of the Master's and doctorate studies (increasing the amount of students admitted, raising student allowances, *etc.*) it can be hoped that the choice of academic personnel will widen in the future.

The administrative personnel in different Chairs (Appendix G12) have permanent contracts. The whole administrative personnel has got higher education. Additional schooling and vocational courses are regularly (1 - 2 times per year) arranged.

**The system of regular and specific (to the occupation) health check-ups and risk analyses is functioning in accordance with national Occupational Healthcare Regulations.** First and foremost, the personnel working outdoors (as well as others) go through a series of vaccinations annually (for any diseases that can be connected to their occupation).

Some of the most essential orientations in the personnel policies of the Department of Natural Sciences of TPU for the coming years are:

- To work out a support system to ensure the next generation of instructors and researchers, in cooperation with the partners of the University of Tallinn abroad.
- To establish joint professorships with other universities.
- To involve more visiting instructors in the studies, to introduce the system *Visiting Fellows.*

A constant policy of the department has been to raise the qualification of the academic staff and to increase the number of full-time personnel. For the continuous modernization of learning methods, Tallinn Pedagogical University organizes regular in-service training courses for the academic staff. Faculty members have supplemented their learning at specialised events in summer schools, at scientific conferences and seminars, in Estonia as well as abroad. During the past 5 years, 8 faculty members have supplemented their learning

during an extended period (study in doctoral programmes, in Master's programmes, apprenticeships, etc.). In the field of methodology and didactics, about ten faculty members have supplemented their learning, which is plainly too little, and the Faculty has decided to start regularly monitoring and supporting the methodological and didactical training of faculty members.

Article 15.7 of the Statutes of Tallinn Pedagogical University enacts that in every five years a regular lecturer is entitled to a teaching-free semester with the preservation of the salary. This time can be used for raising one's qualification. The corresponding schedule for the next academic year is compiled every March. So in autumn term 2004 the teaching-free semester has had prof R. Mankin and in spring term 2005 ass. lect T.Ploompuu has a teaching-free semester.

The high average age of the academic staff (ca 50 years) and the relatively big number of part-time (workload less than 0,5) teachers (at the moment the percentage is 21) are the negative indicators. At first the number of full-time teachers is limited because the capacity of subjects in the curriculum is small. The qualification of the personnel meets quite well the needs of the curricula, but still there is some room for development. The most successful in raising the next generation of academic staff during the past five years has been the branch of geo-ecology, positive tendencies can be seen also in the Chair of Physics. But quite a lot of work in preparing new academic staff is still to be done. More opportunities should be found to send degree students to study in foreign universities for at least one semester. The number of young teachers and researchers might increase in connection with the planned improvement of the laboratories. The biggest change in personnel policies will be the creation of the position of a researcher (senior researcher) in Chairs – this is one of the most important prerequisites for the development of the Department. The average need for researchers is two full positions in each chair. The realization of this plan depends on two things: how quickly the laboratory park in the Department of Natural Sciences can be constructed and if there will be a breakthrough in the formation of competitive research groups in the nearest future.

## 5.3. Raising the Qualification of the Academic Staff

**The faculty members of the Department take an active part in international conferences, seminars, symposia and summer schools.** Participation in international scientific meetings is financed from Estonian Science Foundation grants and target projects. During the last years (2001–2004), the lecturers of the Department of Natural Sciences attended 86 scientific conferences, seminars and symposia, 56 of them in scientific events of international level (Appendix G6).
Studing and working abroad as a guest scientist with a duration up to 2 months have taken place within the frames of joint international projects (R. Mankin, Ü. Ugaste, P. Reiska *et al*). The lecturers visit other universities and scientific institutions. Also meetings are arranged to discuss possible co-operation.

**Young lecturers with an *MSc* degree are encouraged to continue their studies at doctoral level in other universities**, e.g. Arno Põllumäe 1999–2004, Astrid Rekker (Haljas) 2001–2005, Tõnu Laas 1998–2002 at University of Tartu, Priit Reiska 1996-2002 at the University of Kiel, *etc.*

For the sake of steady modernization of teaching methods the University systematically arranges in-service training courses for lecturers. Internal university training includes self-education in e-training (*IVA* environment training) and contemporary methodical training (higher education teaching, compiling teaching resources on the computer, *etc*.)

Of faculty members from the Natural Sciences Department, 15 members have supplemented their specialised learning in the past five years: 9 in Estonia; and 6 abroad. Six faculty members have participated in methodological courses. In addition, the faculty base is supplemented by young people studying in the Master's and doctoral programmes. In the near future, 3 department members will complete their Master's studies and 4 Doctoral studies.

Sometimes participation in the courses is difficult, because the teaching load of the academic staff is big enough (see Chapter 5.1).

Scientific seminars are regularly held in the Department of Natural Sciences, its Chairs and in the Institute of Ecology. At these seminars ongoing investigations are discussed, and the newest world literature is introduced. Among the participants are also *BSc* and *MSc* students.

Among the part-time lecturers of the Department there are researchers, senior researchers or some other leading specialists (director) from several research institutions: Institute of Ecology of Tallinn Pedagogical University, National Institute of Chemical Physics and Biophysics, Institute of Gene Technology at Tallinn University of Technology, Institute of Chemistry at Tallinn Institute of Technology, *etc.*

The development plan of the Department (Appendix G7) addresses the creation of a laboratory for interdisciplinary studies in the field of natural sciences in 2004–2005. The main subject matter of the laboratory relates to integrated projects of different chairs in the overlapping fields of biology, chemistry, geo-ecology and physics (e.g. study of plant metabolites, analysis of geological stages, *etc.*). The aim is to increase the proportion of researchers in the academic personnel to at least 20% by the year 2006. Systematic application of the rotation principle of lecturers and researchers would also contribute to the improvement of qualification of the academic staff.

## 5.4. Cooperation with the University Administration

**The problems relating to teaching are discussed in reversed hierarchical order: chair (lectureship) – department – faculty – university. Proceeding from the level of management: head of the chair – head of the department – council of the department – dean – council of the faculty – vice-rectors – university council – expanded Board of University – rector.**

There is mutual information exchange between the University management and the Department of Natural Sciences. In accordance with the Statutes of Tallinn Pedagogical University and other relevant documents, the cooperation takes place through the following main structures:

- 2 members of the Department of Natural Sciences (Professors H. Kukk and J.-M. Punning) are members of the Board of TPU. The department is also represented in the Research and Development Commissions of Tallinn Pedagogical University: Prof. J.-M. Punning is the Chairman of the Development Commission. The Council can discuss only these problems which the commissions have proposed.
- Prof. H. Kukk represents the Department in the Government of the University. The Government carries out the decisions made by the Board of University and deals with other current general problems.
- The Dean serves as a link between the Department and the University management. The Dean's office keeps account on study results; the Study Department uses this data to keep account on dismissed and admitted students. The department is responsible for the quality of teaching.

Since 1996, the faculties and academic departments are completely free to solve the problems falling within their competence. However, making their decisions they must naturally follow the documents regulating the university life (*Statutes of the University*, *etc.*).

The first signal about discords in teaching comes either from students or academic staff propose to apply some changes. The shortcomings are reported at the meetings of the Chair which are held every week. Feedback takes place in the form of resolutions or written orders.

Cooperation with the University management is aimed at finding possibilities for integration with institutions of natural sciences and other universities to strengthen the scientific and material level.

To inform the public about scientific and teaching activities, developments, *etc.* in the University as a whole, in the Faculty of Mathematics and Natural Sciences, in the Department of Natural Sciences and in the Chairs, surveys are printed in the form of booklets or in newspapers; information is also available in the internet.

The personnel of the University can learn about the problems relating to the university life from the *Unilist* in the Internet. Heads of academic departments and their assistants are switched into the web-based interactive document management programme *Postipoiss*. **Thus, information is operative and available at all levels**.

## 5.5 Strengths and Weaknesses Connected to Academic and Administrative Personnel

**The main results of the analysis of the chapter stated to the following strengths, weaknesses and opportunities:**

**Strengths**

- Cooperation between the academic staff in different modules of natural sciences
- The publication of scientific articles in high-quality journals (CC journals)
- The successful international evaluation of the topics of many scientific works
- The existence of international scientific grants and ETF grants, multi-faceted international academic cooperation
- Active work on teaching methodology: compiling textbooks for comprehensive schools and for university level, participation in national subject councils.

**Weaknesses:**

- The high average age of the faculty members
- The professorship of the Chemistry Chair is vacant
- Proper researcher positions are lacking

**Opportunities:**

- The directing of young faculty members and holders of Master's degrees into doctoral studies (also at other universities) and their financial support
- In the 2005/2006 academic year, it is expected that at least four young faculty members will defend their Doctor's theses (A. Rekker, A. Põllumäe, A. Sauga, T. Paalme, *etc*.)
- The increase in the attractiveness of faculty positions that accompanies the formation of Tallinn University, (enacted by the Parliament on 16 February 2005) will promote competition for vacant faculty positions

- The introduction of Physics doctorial studies in the 2005/2006 academic year
- The creation of proper researcher positions in the department at the integrated scientific laboratory in accordance with the development plan; the introduction of the rotation of researchers and faculty members.

# 6. Quality Assurance and International Relations

## 6.1. The System of Quality Assurance

Quality assurance of scholastic proficiency in Estonian universities is regulated by certain regulative documents (*The Law of Universities, Higher Education Standard*, Estonian Government's regulation from October, 2003).

Quality assurance for the curricula of Natural Sciences Bachelor's Degree is based on the *Statute of Curricula* and the *Regulations for the Organization of Studies*. Councils of curricula are formed in accordance with the resolution by the Estonian Government in October, 2003.

The following methods are used for quality assessment:

- analysis of curriculum
- analysis of study activities and organization of studies
- analysis of resources
- analysis of feedback from students
- analysis of academic achievement of students
- analysis of feedback from employers
- analysis of feedback from graduates.

There has been started a discussion on the level of academic departments to work out general principles for quality assurance, to formulate the extent of contribution and responsibility for every party involved in the studies and to describe the procedures that would assess the following of the agreement. The outcome is expressed in *The Fundamentals of Quality Management in Tallinn Pedagogical University*, the document scheduled for discussion and confirmation in the TPU Board during the spring semester in 2005. At the same time there is a university-wide electronic evaluation system in development to assess teaching, subject courses, organization of studies and job market subsistency for alumni.

A comparison of the levels of graduation, Bachelor's and Master's theses between different Estonian and European higher education institutions is constantly carried out as the above-mentioned papers are reviewed mutually, participation in corresponding examining boards takes place, *etc.*

The quality assurance of the development of the curricula in the faculty (including the co-operation between alumni, employers and guilds) is good. There is constant communication between alumni and the representatives of the Ministry of Education and Research taking place in the frameworks of Subject Teachers' Days and teacher trainings.

Quality assurance of studies (the methodology of studies, the organization of individual study and the improvement of learning material) also has a lot of room for development. The quality assurance in the TPU Faculty of Mathematics and Natural Sciences is still at the early stage of development, just like in other Estonian universities. In the past few years there have been improvements in the counselling system, in tutoring, in organizing methodical seminars for lecturers and feedback polls for students about their subjects in previous semesters.

The development plan of the Department for assuring the quality of studies and research is given in Appendix G7.

**The efficiency of studies and quality assurance are of very high priority in Tallinn Pedagogical University.**

Initial signal about the inconsistencies in studies comes either from students, graduates, employers, boards of the curricula of natural sciences or the proposals for changes are done by faculty members. (see Chapter 1.2. *Elaboration of the Curricula*).

**Questionnaires for students are regularly carried out by the department at the end of each semester to get feedback on the quality of studies**. The results are taken into consideration in compiling syllabi and analyzing teachers' work (see Chapter 6.2. *Feedback on the Quality of the Studies from Students, Graduates and Employers*; Appendices 10, 13). The results of the questionnaires are not public and the faculty members find out about them individually from the Head of their Chair. According to their own initiative, with the goal of more effectively managing the teaching process, the faculty members conduct surveys of the students within the framework of the current courses.

Problems in study process are regularly discussed at meetings and seminars of the Department and the Chairs.

**The collection, analysis and systematization of the data about graduates are dealt with the TPU Career and Counselling Centre.** Beginning in autumn 2004, the alumni have the opportunity to give feedback via Internet. So far the collected results indicate that the majority of graduates proceed to work in the fields connected with their speciality, or instead continue their studies.

Important links in the quality assurance system are the boards of the curricula. The boards of the curricula follow the provisions of Regulation No 265 *Procedures of Accreditation of Universities and Institutions of Professional Higher Education and Their Curricula and Requirements for Accreditation*". All 3+2 system Bachelor's and Master's curricula and doctorate programmes have the curriculum boards which consist of teachers leading the curriculum, teachers from other departments and representatives of employers, alumni and students. The curriculum board of the curricula of Bachelor studies curriculum of Natural Sciences (6420287), includes:

Ass. Prof. Tiina Elvisto, Head of the curriculum;
Prof. Ülo Ugaste, Head of the Department of Natural Sciences;
*DrScPaed* Priit Reiska, Dean of the Department of Teacher Education;
Lea Koppel, geography specialist, State Examination and Qualification Centre;
*PhD* Viiu Sillaste, Director of the Tehno-ecological Chair, Tallinn Higher Technical School;
*BSc* of Natural Sciences Maris Mikkus, teacher, Tallinn Old Town Educational Committee;
Helen Kaljurand, Bachelor student of Natural Sciences.

The assignments of the curriculum council are:

- to analyse the content of the curriculum in accordance with the goals of competency;
- to evaluate the analysis of the feedback results (student, graduate, employer feedback) and to make proposals for the development of the curriculum;
- to analyse the compliance of the teaching environment with the goals of the curriculum and to make proposals to the department or the university council, if necessary, for the improvement of the teaching environment;
- to analyse the involvement of the academic departments participating in the realisation of the curriculum in the development of the curriculum;

- to make proposals for updating the curriculum and to involve specialists from outside the university in teaching;
- to participate in process to develop the self-analysis report.

**Procedure for selecting members of teaching staff in TPU is based on a public contest,** the main element of which is a habilitation committee, consisting of leading scientists and teachers in their speciality from outside of TPU. The elections for professors are held in TPU Board, other teachers are assigned to their positions by the Faculty Council. This system rules out the enrolment of teachers with a low professional level.

## 6.2. Feedback on the Quality of the Studies from Students, Graduates and Employers

To obtain feedback from students, the Department of Natural Sciences conducts a survey *Feedback on the Studies* at the end of each term. During the 2004/05-fall semester, 18 natural sciences students answered the questionnaire. A total of 142 evaluations were given to different subjects. Nineteen faculty members and 20 subjects were evaluated. Students evaluated different aspects of studies in the 5-point scale („1“ being lowest and „5“ highest) (see Appendix 10 for the questionnaire; Tables 6.2.1 and 6.2.2 for the results of the survey).

Table 6.2.1.

The results for the student survey *Feedback on the Studies* conducted by the Department of Natural Sciences of Tallinn Pedagogical University (TPU). Average assessments given by questions.

| | |
|---|---|
| The syllabus was available. | 4,56 |
| The lecturer followed the given syllabus. | 4,61 |
| Lectures/seminars started and ended at a specified time. | 4,32 |
| The criteria to sit an examination/assessment were known. | 4,48 |
| The composition of the lecture/seminar was logical and well structured. | 4,20 |
| The lecturer presented the subject in a clear and understandable way. | 4,12 |
| The lecturer used relevant materials, up-to-date research results and examples. | 4,35 |
| Sufficient illustrative materials for the given subject were used. | 4,21 |
| The required literature and additional resources given in the syllabus were available. | 4,18 |
| Students were given a chance to actively participate in the lecture/seminar. | 4,53 |
| Students were treated fairly and objectively. | 4,46 |
| Opportunities to get in contact with the lecturer were good. | 4,29 |
| Considering that 1CP = 40 hours of the student’s work, the workload for the given subject met the volume of credit points received. | 4,61 |
| The subject was essential from the viewpoint of my area of specialisation. | 4,51 |
| The percentage of actual studies that took place. | 99,57 |
| The percentage of a student’s participation in lectures/seminars. | 90,27 |

Table 6.2.2.

The results of the student survey *Feedback on the Studies* conducted by the Department of Natural Sciences of Tallinn Pedagogical University (TPU). Average assessments are given by questions.

| | |
|---|---|
| The average for questions 1-14. | 4,39 |
| Following of the Regulations of the Organization of Studies (the average for questions 1, 2, 3, 4, 9, 13). | 4,48 |
| Methodical competence of lecturers (the average for questions 5, 6, 7, 8, 10, 11). | 4,31 |

As it appears, the values for all questions are near the total average – 4.39. The highest values (4.61) came from the questions that deal with the how the faculty members follow the subject programme and how the work volume completed in order to complete the subject corresponds to the credit points assigned to the course. The lowest result (4,12) came from the question that deals with the clarity and understandability of the subject presentation. In addition, the students found that the teaching literature (availability of the required study literature and additional material) was not ideally available to them (result, 4.18). Comments were added about 17 subjects, pointing out shortcomings in teachers' work (10 comments), the main complaints being about the multitude of study materials required, the necessity to take excessive notes and difficulties in understanding the subject. Occurrences of positive emotions were fewer (4), approving interesting lectures and teachers with an excellent command of their subject. The rest of the comments (7) were about suggestions for changing the studies, for example reducing the content of some subjects, making study materials accessible over the Internet, having more interesting experiments and a variety of teaching methods.

According to the results of the survey we can conclude that:

- the academic work of teachers and the Chairs is highly appreciated;
- more attention needs to be paid to the availability of required study literature and additional materials, and notifying students about the corresponding information. The analysis showed that difficulties of obtaining the required materials appeared primarily among the students who were often absent.

The refining of the curricula in *BSc* studies is carried out gradually due to the fact that none of the students of the Department of Natural Sciences have finished their Bachelor's degree in 3+2 curricula system yet. In the future, a considerable amount of information for the modification of the curricula will come from *BSc* graduates and their employers. Another important source for determining the substantial alterations in the curricula are natural sciences itself, the observation of the general evolution of its branches, pedagogics and didactics of natural sciences in a global scale, giving us the opportunity to be proactive (the strategy has proven to be a forte in developing a curriculum).

The students at the Bachelor's level have shown medium progress (Appendix 9), but the rate of dropping out (7 students within 3 years, i.e., c. 20%) is still tolerable considering the intensity of studies.

**In the Department of Natural Sciences there are close contacts with the alumni of all curricula.** Lecturers and alumni get together in the Estonian Teachers' Union, at in-service trainings, conventions of the Biology Teachers' Union and Association of School Physics, in chemistry teachers' club of the Estonian Chemistry Society, *etc.*

**Surveys for alumni are carried out periodically by the Career and Counselling Centre of TPU,** the results being differentiated by departments, including the Department of Natural Sciences. In addition, periodically alumni surveys are also conducted by the TPU Natural Sciences Department, generalisations are made by areas of specialisation. For example, in 2004 year questionnaire was conducted to find out about the assessment of graduates on specialized studies and for suggestions to make the curricula more attractive (see Appendix 13). The form that was sent out was answered by 16 alumni of the natural science diploma studies (there are no graduates of the 3+2 system yet). From the alumni questionnaire, it is evident that 87% of the graduates work at or have worked at specialised (related to natural sciences) work, and the precondition for this has been the completion of the natural sciences curriculum. The alumni currently working at specialised work (75%) pointed out that they can use quite a lot of the knowledge they received at university at their present jobs, and to be successful in their field (75%). Those who chose non-specialised work (13%) confirmed that completing the natural sciences curriculum also helped them be successful at other work (100%). As a result, it turned out that the alumni are satisfied with the quality of studies and can successfully put their acquired knowledge to practice, both in their speciality and in other lines of work.

There were also pointed out some shortages, for example:

- the ratio of laboratory and fieldwork could be greater
- insufficient professional language practice
- little training for expressiveness in the native language to manage as a teacher.

Those deficiencies are constantly corrected in the process of studies when possible. The two new science laboratories opened in September 2000, along with the modernization of the old ones, surely give more potential for practical laboratory work. According to the development plan of the Department, further elimination of those mentioned shortcomings is planned (see Appendix G7). Specialised foreign languages have been introduced more and more at during lecture courses; the use of foreign language textbooks has been expanded.

Feedback from school directors regarding the specialised preparation and success of natural sciences teachers (diploma studies) who have graduated from TPU are overwhelmingly positive. An example is the results of the survey conducted in January 2005 that are shown in Appendix 16.

**As a result of the regular surveys we can say that both students and academic staff value primarily the qualification of teaching staff and the level of teaching, showing us that the lecturers in this specific field are professionals and the attitude is passed on to the students. The knowledge obtained is also estimated highly by graduates which makes it possible to be successful in the labour market.**

## 6.3. International relations

In the years 2001-2004, department' faculty members participated in the following international scientific projects: prof. Ü. Ugaste – INCO-Copernicus, contract no. ER BIC 15cT980811; prof. Ü. Ugaste, prof. R. Mankin, assoc. prof. A. Ainsaar, assoc. prof. T. Laas, A. Haljas – IAEA (International Atomic Energy Agency), project *Stochastic processes at dense plasma beams interaction with construction materials*, Contract No EST-12062; assoc. prof. T. Elvisto, prof. H. Kukk – The Baltic University Programme: A Regional University Network; assoc. prof. K. Truus – international project *Baltic Sea Sustainable Development Network* initiative group member, assoc. prof. E. Karofeld – European Commission 5th

framework project ACCROTELM: *Abrupt Climate Changes, Recorded Over The European Land Mass: multi proxy records of Late-Holocene climate variability in Europe*. European Commission Contract No EVK2-2002-00166; assoc. prof. A. Lõokene – project *Folding and activity regulation of lipoprotein lipase*; assist. T. Ploompuu – international project *Quantification of alkaline and acidifying deposition loads from Estonian Industry*; senior researcher P. Reiska – Kiel University research project *Physiklernen und Handeln*. The departmental faculty members cooperate with Uppsala and Umea Universities in Sweden and Ionina Unversity in Greece, London University College and other study and research institutions.
The following have done scientific work and given lectures in foreign universities: prof. J.-M. Punning (Agrinio University, Greece), prof. Ü. Ugaste (Warsaw Plasmaphysics and Laser Microsynthesis Institute, Poland), assoc. prof. A. Lõokene (Umea University, Sweden), assoc. prof. T. Elvisto (Turku Polytechnic, Finland), P. Reiska (Kiel University, Germany), and others.

Prof. J.-M. Punning is a member of the General Assembly of the International Geography Union; prof. H. Kukk, member of the Marine Biology of the Baltic Sea (MBM) Committee; prof. Ü. Ugaste, member of the Pre-University Section of European Physical Society; assoc. prof. T. Elvisto, member of the EUROBIO Council.

## 6.4. Changes in the Curriculum Development Compared to the Previous Accreditation

At the previous evaluation of Tallinn Pedagogical University (TPU) curricula of Diploma studies *Teacher of Natural Sciences*, code 5141005 (which was the first version of curriculum *Natural Sciences*, code 6420287 presented for accreditation before the curriculum reform of 2002) in 1998 the main complaints of the commissions of experts and the Estonian Higher Education Assessment Council were about the modernization of laboratories and their equipment, also about the lack of sufficient academic and educational literature. It was also pointed out that the organization of studies was based mainly on the staff of only one Chair and therefore it was considered necessary to increase the number of personnel with various specialities. The expert teams members were:

Geology and Geography

1. Prof. Dr Etienne Paulissen, Katholieke Universiteit Leuven, Belgium
2. Prof. Dr Patric Jacobs, University of Gent, Belgium
3. Prof. Dr Stig Jonsson, Stockholm University, Sweden

Biology

1. Prof. Dr Elmars Grens, University of Latvia, Latvia
2. Prof. Dr Per Rosenkilde, University of Copenhagen, Denmark
3. Prof. Dr Aija Sadurskis, Stockholm University, Sweden
4. Prof. Dr Jozef Toldi, Jozef Attila University, Hungary

The resolutions and opinions of the Estonian Higher Education Assessment Council are shown in Table 6.3.1.

Table 6.3.1

The recommendations of the expert commissions (in 1998) and their implementation

| | Comments | What have been done |
|---|---|---|
| Curriculum | • Fewer but more substantial courses through integration of related topics | • The amount of subjects with low credit points has been remarkably reduced. While in 1998 there was 2,1 ECTS per subject on average then in 2004 the figure is 4,9 ECTS. |
| | • The structure of the different programmes is very complicated | • The curriculum has been simplified (see Appendix 2, and Table 1.3.1). There are two majors instead of three. The structure of the curriculum complies with the requirements of the TPU study regulations (see Appendix G9, Chapter 2.3). |
| | • Courses on human geography, planning, geoinformatics and cartography are lacking | • The shortcomings of the curriculum have been eliminated. For instance, the following subjects have been added: *Introduction of Human Geography* (6,0 ECTS), *Geographical Information Systems* (3,0 ECTS), *etc*. |
| Study process | • The teaching relies heavily on lectures | • The volume of practical and independent work has been significantly increased (see Table 1.3.1). Compared to 1998, the volume of independent work has increased from 42 to 56 percent. The volume of fieldwork has been tripled (in 1998 – 3 ECTS; in the current curriculum – 10.5 ECTS). By today, there is feedback on almost all subjects through seminars, practical and group work, and practical work reports. Practical and group work is done during classes or fieldwork; the students are informed of the topic in advance. Also popular are the presentation and discussion of |

| | | |
|---|---|---|
| | | reports compiled by students. |
| | • Oral examinations are conducted, the grading standards of which are hard to check | • Mainly written and combined examinations are conducted (see Table 1.3.1). If oral examinations (about 70%) dominated in 1998, then now written (about 66%) and combined (oral and written; about 30%) examinations are in the majority. |
| | • Don´t have information about academic mobility and credit transfer provision | • Academic mobility is used in the department more often than before, which is also promoted by the broadening of opportunities for open studies. The students' academic mobility and transfer of credit points is regulated by the TPU study regulations (see Appendix G9, Chapters 3.6-3.8 ). |
| | • No details about study load planning and monitoring | • Regulated throughout the university. Load planning and monitoring is specified in detail in the TPU study regulations (see Appendix G9, Chapters 3.1-3.5 ). |
| | • There does not appear to exist a system for standardised description of the courses | • Regulated throughout the university. Uniform forms and requirements have been implemented on subject cards and subject programmes. These are listed in the TPU study regulations (see Appendix G9, Chapter 2.4). |
| | • Detailed information on the course content is lacking though | • Regulated throughout the university. Considerably more detailed information (compared to the subject card) on the content of the courses can be obtained by the student from the subject programme. The subject programme is available to the students at the beginning of the semester on the Internet or is distributed during the first lecture. Requirements for the drawing |

| | | |
|---|---|---|
| | | up of the subject cards and subject programmes are presented in the TPU study regulations (see Appendix G9, Chapter 2.4). |
| | • There does not exist a formal student union in official University bodies | • Regulated throughout the university. In accordance with the TPU statutes, the student union forms at least 20% of the University Board. All faculties and students at all levels must be represented. A student body representative also belongs to the university administration. The university statutes specify the right of the student body to its own government, also what occurs through the student union and the elected executive office. The council of the Faculty of Mathematics and Natural Sciences includes four students (one from every department of the faculty). |
| Academic staff | • Most of the academic staff should have Master or *PhD* degree, scientific activity is not high enough | • Many lecturers have received an *MSc* or *PhD* (*MSc* Tõnu Ploompuu, *PhD* Edgar Karofeld, *PhD* Reimo Rivis, *PhD* Andres Kratovitš, *PhD* Tõnu Laas). Lecturers with a degree have been employed (*MSc* Arno Põllumäe) instead of the ones without. 64,3% of the academic staff hold *PhD* degrees and 21,4% *MSc* degrees and 14,3% of the faculty members are post-graduates. The amount of researches done and published in degree studies has increased. For instance, if in 1998, only four scientific publications with extensive international distribution published by faculty members of the Natural Sciences Department, then in 2004 the |

| | | |
|---|---|---|
| | | respective publications number was 18 (for 2004 only the faculty members participating in curriculum 6420287 were considered (see Appendices 1, 6). |
| | • Do decrease the teaching work load reform the programme so that less people will be involved in teaching and training | • In connection with curriculum developments and the integration of small volume subjects with larger volume subjects, the number of subjects has significantly decreased. During the 1998 accreditation the curriculum for basic school natural sciences teachers No. 5141005 included about 74 different subjects (if not to consider the teachers` education block with a volume of 60 ECTS). This curriculum has about 34 different subjects, that is more than two times less than before (see Table 1.3.1). |
| | • New teacher training programmes have to be developed | • The development of teacher training programmes has been constantly dealt with both at the university level and within the department. With decision no. 22 of the TPU Board dated 16 June 2003 the TPU teacher training board was created (in the TPU Pedagogy Department). The main assignment of the board is the development of the field of teacher training (incl. curricula) and the coordination of the activities in the field in the academic structural units, based on the teacher education strategy of TPU. |
| | • Too many subjects are taught descriptively | • Laboratories and ICT systems have improved, the importance of individual work, seminars and |

| | | |
|---|---|---|
| | | workshops has increased, in some subjects practical trainings are organized in environmental protection organizations, urban and natural environments (*A Sustainable Baltic Region, etc*.), natural enviroments are explored during fieldworks. Different simulation programs are used in lectures and seminars to illustrate more complicated processes (*Organic Chemistry, Bio-organic Chemistry, Heat and Molecular Structure, Structure of Matter*, *Electromagnetism, etc*.). (See Chapter 2) |
| | • The number of specialized faculty members must be increased. The organisation of studies was based mainly of the staff of only one Chair | • The amount of lecturers with various specialisation (Andres Kratovitš, Aivar Lõoke, Ats Metsis, Arno Põllumäe, Reimo Rivis, Astrid Rekker) has grown and in the next few years (due to the foundation of Tallinn University) the staff will grow even more (Appendix 6). The teaching of natural sciences subjects is carried out by four Chairs in almost equal percentages. |
| | • At least one full-time staff member should be fully involved with the didactics of geo-ecology training | • A full-time geography didactic has been hired, lecturer Sirje Siska. |
| Study enviroment | • The facilities are extremely poor and unable to support an adequate training in this discipline, not an example for future teachers | • The conditions of laboratories has improved (see Chapter 3.1 *Infrastructure*). New laboratories have been built and equipped – P-210 and P-211. There have been built and equipped two new laboratories; one for molecular and cellular biology, the other for organic and biochemistry research both with modern equipment. The existing laboratories have |

| | | |
|---|---|---|
| | | also been reformed, the rooms have been repaired and modernized (e.g., chemistry lab), some new equipment installed in physics labs. For lectures and seminars, computer and audio-video technology together with four data/video-projectors are at disposal of the department, overhead projectors with slide sets, different kinds of model and distribution materials and web-based materials are used. |
| | • There are insufficient textbooks and specialised literature in the library | • A great number of academic and educational literature has been obtained, largely due to one of Estonian´s largest libraries of natural sciences – Estoninan Academic Library – merging into the structure of TPU. Availability of electronic databases and scientific journals has increased. In conjunction with the union of the academic Library, availability of liturature for studies and research is rated best in Estonia (see Chapter 3.2. *Library, Study Aids*). Modern textbooks are provided for students in many subjects (*Mechanics, Structure of Matter, Electro-magnetism, A Sustainable Baltic Region, etc.)* |
| | • Classrooms are poor in quality | • During the 2003/2004 academic year, a complete overhaul of the main building was carried out, during which the study halls used by the Natural Sciences Department were also renovated. |
| Quality assurance | • Random feedback from students | • Regular analysis of student feedback on the organization of studies by subjects is carried out, both university-wide by the Chairs at the end |

| | | |
|---|---|---|
| | | of the course and by teachers during the studies. Infomation about the career of graduates is also systematically analyzed. During the fall semester of the 2004/2005 academic year, an electronic system for evaluating the success of graduates in the labour market was implemented. An electronic feedback system on the teaching of the students' subject courses was created, which is ready and open for testing. (see Chapter 6 *Quality Assurance and International Relations*). |

## 6.5. Conclusion

**The main results of the analysis of the chapter stated to the following strengths, weaknesses and opportunities:**

**Strengths**

- An university-wide quality assurance system is being developed and its principles are established by several regulative documents (*Study regulations; Curriculum statutes; Job descriptions for faculty members; Regulations for appointing faculty members; The conditions and system for providing free semesters,* University administration regulation no. 9 of 19 November 2001; *Regulations for TPU scientific and development activities, etc*.)
- The development of the curriculum is continuous and conscious
- The many-sided system of methods for quality assessment is in use (Curriculum Council has been formed, system of regular and systematic feedback safeguards the quality of teaching activities and the organization of studies, *etc*.)
- The quality of study work is being guaranteed by way of regular self-analysis

**Weaknesses**

- Co-operation with employers is in a formation stage
- Employers are not correctly informed about the essence of the new 3+2 curricula
- Few in number of responds to questionnaires (passivity of the students)

**Opportunities**

- A university-wide quality assurance system is being developed
- Feedback provides an opportunity to evaluate and secure the quality of the curriculum from the point of view of employers
- There is a possibility to use feedback results as an initial basis for training needs of the academic staff
- Expanding availability of web-based study materials and information
- Mutual roundtables with employers are planned, incl. to introduce the 3+2 system.

# Summary

A short description of the problems as well as strong sides related to the curricula *Natural Sciences* at the Tallinn Pedagogical University are listed in the table below:

| Advantages | Problems |
|---|---|
| A - national level | |
| Curricula are competence based; In the implementation specialists from other institutions are involved. | The universities and science on the whole in Estonia do not get enough support from the state to develop their infrastructure; the number of state- financed study places does not correspond to the need. |
| B - university level | |
| Curriculum development proceeds in concordance with the objectives of the University; the University gives support for running the curricula *Natural Sciences*. | There are some minor problems with the coordination of the studies with other departments (mainly related to accommodating general courses to the needs of our curricula). |
| C - department level | |
| There are fairly good conditions for implementing the curricula; high professional level of the teaching staff. | Because of the relatively low salary level and high overload at the university it is difficult to employ motivated descendants. |
| D - student level | |
| Student-centered possibilities to adapt the curricula to personal needs and interests; relatively small study groups; excellent student-teacher personal relations. | Lack of the scholarship to support studies, which is the reason why many students have to have jobs in parallel with studies. |

The main emphasis in the activities of the Department of Natural Sciences during the past few years has been the curriculum development. The priorities for the coming years are: first of all, initiation of and participation in both Estonian and European research programmes, but also continuous support to young faculty members pursuing their academic degrees. The next *PhD* thesis will be defended during the year 2005 (T. Drevs, T. Paalme, A. Põllumäe, A. Rekker, A. Sauga).

# Appendix 1

# Publications (2000-2004) of Teaching Staff from Department of Natural Sciences, Tallinn Pedagogical University involved in Natural Sciences Curriculum

## I SCIENTIFIC PUBLICATIONS

### IA – WITH WIDE-SPREAD INTERNATIONAL DISTRIBUTION

***2004***

1. Charman, D.J., Brown, A.D., Hendon, D. & **Karofeld, E**. 2004. Testing the relationship between Holocene peatland palaeoclimate reconstructions and instrumental data. *Quaternary Science Reviews*, 23, 137-143.
2. **Haljas A., Mankin R.**, Sauga A., Reiter E. 2004. Anomalous mobility of Brownian particles in a titled symmetric sawtooth potential. *Physical Review* E, 70, 041107, 1-12.
3. **Karofeld, E.** 2004. Mud-bottom hollows - exeptional features in carbon accumulating bogs? *The Holocene*, 14 (1), 119-124.
4. Kropman D., Kärner T., Abru U., **Ugaste Ü.** & Mellikov E. 2004. Interaction between Point Defects, Extended Defects and Impurities in the Si - $SiO_2$ System during the Process of its Formation. *Thin Solid Films,* 459 (1-2), 53-57.
5. Kropman D., Kärner T., Abru U., **Ugaste Ü.,** Mellikov E., & Kauk, M. 2004. Interaction between Point Defects, Extended Defects and Impurities in the Si - $SiO_2$ System during the Process of its Formation. *Material Science and Engineering B* (114-115), 295-298.
6. **Lõokene, A**., Zhang, L., Hultin, M. & Olivecrona, G. 2004. Rapid subunit exchange in dimeric lipoprotein lipase and properties of the inactive monomer. *J Biol Chem*. Nov 26; 279 (48): 49964-72.
7. **Mankin R.**, Sauga A., **Ainsaar A., Haljas A.** & Paunel K. 2004 *Colored-noise-induced discontinuous transitions in symbiotic ecosystems*. *Phys. Rev*. E, 69, 1, 061106, 1-8.
8. **Metsis, A**., Andersson, U., Bauren, G., Ernfors, P., Lönnerberg, P., Montelius, A., Oldin, M., Pihlak, A. & Linnarsson, S. 2004. Whole-genome expression profiling through fragment display and combinatorial gene identification. *Nucleic Acids Research*, 32 (16).
9. Muzyka, V., Scheepers, P.T.J., Bogovski, S., Lang, I., Schmidt, N., Ryazanov, V. & **Veidebaum T.** 2004. Porphyrin metabolism in lymphocytes of miners exposed to diesel exhaust at oil shale mine. *Sci.Total Environm.*, 322, 41-50.
10. **Punning, J.-M.,** Alliksaar, T., Terasmaa, J. & Jevrejeva, S. 2004. Recent patterns of sediment accumulation in a small closed lake revealed by the sediment records. *Hydrobiologia*, 529 (1) 71-81.
11. **Punning, J.-M.,** Koff, T., Sakson, M. & Terasmaa, J. 2004. Human impact on the ecosystem of Lake Ruusmäe (Southern Estonia) traced in the sediments. *Polish Journal of Ecology*, 52, 3, 285-299.
12. Puurmann, E., Ratas, U., **Rivis, R.** 2004. Diversity of Estonian Coastal Landscapes: Past and Future. In: Palang, H.; Sooväli, H.; Antrop, M.; Setten, G. (Eds.) *European Rural Landscapes: Persistence and Change in a Globalising Environment.* Springer, 411-424.
13. **Põllumäe, A**., 2004. Does Invasive Cercopagis pengoi correlate in the late summer zooplankton community in the Gulf of Finland (Baltic Sea)? *Biol. Mar. Medit*., 11(3), 43.

14. Tammelo R., **Laas T., Mankin R.** 2004. On electromagnetic wave tails in curved spacetimes. *Comm. Phys.-Math. Soc. Sci. Fennica,* 166, 201-208.
15. Torn, K., Martin, G., **Kukk, H**., Trei, T. 2004. Distribution of charophyte species in Estonian coastal water (NE Baltic Sea). *Scientia Marina*, 68, 129-136.
16. **Truus, K.,** Vaher, M., Koel, M., **Mähar**, **A**. & Taure, I. 2004. Analysis of bioactive ingredients in the brown alga *Fucus vesiculosus* by capillary electrophoresis and neutron activation analysis. *Analytical and Bioanalytical Chemistry,* 379, 849-852.
17. **Ugaste Yu.E.,** Kodentsov A.A., van Loo F. 2004. Interdiffusion and Kirkendall effect in the Co-Ni-Fe system. I. Redistribution of component concentrations in the diffusion zone and shift of inert markers. - *Phys. Met. Metallography,* 97 **(**3) 298-306.
18. **Ugaste Yu.E**., Kodentsov A.A., van Loo F. 2004. Interdiffusion and Kirkendall effect in the Co-Ni-Fe system. II. Effective and partial coefficients of interdiffusion.- *Phys. Met. Metallography,* 97 **(**5), 495-501.

***2003***

1. Gribkov, V., Pimenov, V., Ivanov, l., Dyomina, E., Maslyaev, S., Miklaszewski, R., Scholz, M., **Ugaste, Ü.,** Doubrovsky, A., Mezzetti, F., Kulikauskas V., Zatekin V. 2003. Interaction of high temperature deuterium plasma streams and fast ion beams with stainless steels in dense plasma focus device. *Journal of Physics* D: Applied Physics, 36, 1817-1825.
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## II CONFERENCE THESESIS

### International conferences and symposiums

### 2004

1. **Haljas, A., Mankin,** R., Tammelo, R. 2004. Mechanism of hypersensitive transport in tilted sharp ratchets. In: 20th General Conference of the EPS Condensed Matter Division *Frontier of Quantum and Mesoscopic Thermodynamics*. Prague, Book of Abstracts, 80-81.
2. Kropman, D., Kärner, T., Abru, U., **Ugaste, Ü.,** Mellikov, E., Heinmaa, I. & Samoson, A. 2004 Point defect interaction with extended defects and impurities in the Si - $SiO_2$ system during the process of its formation. In: *Recent Advances in Ultra Shallow Junctions*. ITC-irst, Povo-Trento, Italy, November, 24-25, 2004, 24-25.
3. Mägi, A., **Ugaste, Ü.,** Pimenov, V., Mankin, R., Demina, E., Gribkov, V. & Dubrovski A. 2004. The superposition method of thin layer stochastic dissipation and its application to the light elements diffusion problem in finite space. Abstracts of the international conference DIMAT-2004 held in Cracow (Poland) on July, 18-22, P1-24.
4. Priimets, J., **Ainsaar, A., Ugaste, Ü.** 2004. Calculating of diffusion paths in ternary systems using effective interdiffusion coefficients of components. Abstracts of the international conference DIMAT-2004 held in Cracow (Poland) on July, 18-22, P3-21.
5. **Põllumäe, A.,** 2004. Does Invasive Cercopagis pengoi correlate in the late summer zooplankton community in the Gulf of Finland (Baltic Sea)? 39th European Marine Biology Symposium, July 21-24, 2004. Genoa, Italy.
6. Sauga, A., **Mankin, R., Haljas, A.** 2004. Colored-noise-induced discontinuous transitions in symbiotic ecosystems. In: Joint Conference MPD 7 - *De Sto Bio 3 Computational and Mathematical Population Dynamics*, Trento, Book of Abstracts, 130.
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10. Грибков В.А., Дубровский А.В., Миклашевский Р., Падух М., Томашевский К.,. Шольц М, Пименов В.Н., **Угасте Ю.Э.,.** Садовский М.Я, Складник-Садовская Э., Малиновский К. & Царенко А.В. 2004. Экспериментальные исследования процесса взаимодействия ионных и плазменных потоков с мишенями на основе углерода, расположенными в катодной части установки Плазменный фокус. Труды XVI-й материаловедению. Алушта, Крым, 6-11 сентября 2004, 297-298.

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3. **Haljas**, **A., Mankin, R.,** Tammelo, R. 2003. A new mechanism of hypersensitive transport in tilted sharp ratchets. In: Proc. of the Third International Workshop and School on *Plasma Physics, Diagnostics and Plasma Related Applications* Kudowa Zdroj, Poland, Juny 23-28, 2003, 438-444.
4. Kotta, J., Orav-Kotta, H., Paalme, T., Kotta, I. & **Kukk, H.** 2003. Role of physical, chemical and ecological controls on the activity of mesograzers in the northern Baltic Sea. In: *Baltic Sea Science Congress*, August 24-28, 2003, University of Helsinki, Finland, Abstract Publication, 41.
5. Kropman, D., Abru, U., Paomets, V., Kärner, T., **Ugaste Ü.** & Mellikov E. 2003. Point defect interaction with extended defects in the Si - $SiO_2$ system during the process of its formation. In: Abstracts of *European Vacuum Congress* EVC-8, Berlin, June 23-26, 2003, 222-223.
6. **Laas**, T., Mankin, R., Tammelo, R. 2003. A new method for solving covariant wave equations by means of higher-order fundamental solutions. In: Seminar of Theoretical Physics, 26 August 2003, University of Helsinki.
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11. **Haljas, A., Mankin, R., Ainsaar, A.** 2003. Trichotomous noise: Applications to noise-induced transitions in nonlinear systems. In: Dense plasma interaction with material. Proc. of International seminar on October 9-11, 2003, Tallinn, Estonia. *Acta Universitatis Scientiarum Socialum et Artis Educandi Tallinnensis* B2, 87-95.
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11. Пименов, В.Н., Грибков, В.А., Иванов, Л.И., Шольц, М., **Угасте, Ю.Э.,** Демина, Е.В, Масляев, С.А., Дубровкий, А.В., Миклашевский, Р., Колман, Б., Куликаускас, В.С., Затекин, В.В. 2002.
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7. Paalme, T., Martin, G., **Kukk, H**. & Torn, K. 2001. Primary production rates of two different forms of *Furcellaria lumbricalis.* In: Abstracts 36th *European Marine Biology Symposium*, 17-22 September, Mao, Spain.
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9. Pimenov, V.N., Dyomina, E.V., Ivanov, L.I., Maslyaev, S.A., Gribkov, V.A., Miklaszewski, R., Scholz, M., Dubrovsky, A.V., Volobuev, I.V., **Ugaste, Yu. E.,** Mezzetti, F., De Chiara, P., Pizzo, L. & Szydlowski, A. 2001. Damage of structural materials for fusion devices under pulsed ion and high temperature plasma beams. In: Abstracts of 10-th *International Conference on Fusion Reactor Materials*, Baden – Baden, Germany, 14-19 October, 2001, 395.

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**TEXT-BOOKS, HANDBOOKS, TEACHING MATERIALS, MONOGRAPHS AND COMPENDIUMS**

***2005***

1. **Mankin, R.,** Reiter, E. 2005. Statistiline termodünaamika I. Tallinn TTÜ Kirjastus.

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1. **Elvisto, T**., Kuurme, M., Laug, V. & Maaste, K. 2004. Loodusõpetus 3. klassile. Tallinn, AS Bit.
2. **Elvisto, T**., Maaste, K. 2004. Loodusõpetuse töövihik 3. klassile: 1 osa. Tallinn, AS Bit.
3. **Ugaste, Ü.,** Saukas, J. 2004. Füüsika gümnaasiumile. Küsimusi & ülesandeid III. Tallinn, Avita.

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1. **Elvisto, T.** 2003. Wooded meadows: Case Box, Chapter 7. In: Rydén, L., Migula, P., Andersson, M. (Eds). Environmental Science: *Understanding, Protecting, and Managing the Environment in the Baltic Sea Region*. The Baltic University Press, Uppsala, 210-211.
2. **Elvisto, T.-A.,** Gornaja, L, Kask, Ü. & Kivinukk, A. jt (koost.). 2003. *Säästva arengu alased programmemid vabahariduslikuks koolituseks*. Tallinn, SA REC Estonia.
3. **Elvisto, T.,** Kuurme, M., Laug, V. & Maaste, K. 2003. Loodusõpetus: Õpik 2. klassile: I osa (tõlge vene keelde). Tallinn: AS Bit

4. **Elvisto, T.,** Kuurme, M., Laug, V. & Maaste, K. 2003. Loodusõpetuse iseseisvad tööd 2. klassile. Tallinn: AS Bit.
5. Harak, M., **Jõgi, J.,** Kont, A., Pihlak, L.-K., **Punning, J.-M.,** Ratas, U. & **Rivis, R.** 2003. Üldgeograafia gümnaasiumile. Tallinn, AS BIT.
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7. Pihlak, L.-K., Tõnisson, A. & **Jõgi, J.** 2003. Geograafia põhikoolile. Maailma loodus- ja ühiskonnageograafia. Tallinn, Koolibri.
8. **Ugaste, Ü.,** Saukas, J. 2003. Füüsika gümnaasiumile. Küsimusi & ülesandeid, II. Tallinn, Avita.
9. ак, Л.-К., Тыниссон, А., **Йыги, Я.** 2003. География для основной школы. Физическая и общественная география шара. Таллинн, Коолибри.
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2. **Elvisto, T.,** Kuurme, M. & Laug, V. 2002. Loodusõpetus 4. Klassile. Tallinn, AS BIT.
3. **Elvisto, T.,** Kuurme, M., Laug, V. & Maaste, K. (2002). Loodusõpetus: tööraamat 2. klassile: 2. osa. Tallinn, AS Bit.
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7. **Ugaste, Ü.,** Saukas, J. 2002. Füüsika gümnaasiumile. Küsimusi & ülesandeid I. Tallinn, Avita.
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2. **Elvisto, T.,** Maaste, K., Laug, V. 2001. Loodusõpetus: õpik-tööraamat 1. klass. Tallinn, Avita, AS Bit.
3. Karik, H., **Kuiv, K.-K., Truus, K.** 2001. Käsiraamat: Keemia. Tallinn, Ilo.
4. **Lukki T.** 2001. Füüsika. Ruum, aeg, aine, jõud. Tallinn, Ilo - seeria Ilo koduõpetaja.
5. **Lukki, T.** 2001. Loodusõpe kui süsteem. Tallinn, Ilo - seeria Õpetajalt õpetajale.
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7. **Ugaste, Ü.** 2001. Füüsika gümnaasiumile I. Mehaanika. Molekulaarfüüsika. Tallinn, Avita.
8. **Punning, J.-M.,** Terasmaa, J. et al. (2001). Third Estonian National Report to UN FCCC.

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3. **Ploompuu, T.** 2003. Eesti vajab eugeenikat. Sirp, 43, 3.

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7. **Laas, T.** 2002. Propagation of waves in curved spacetimes. Dissertationes Physicae Universitatis Tartuensis, 38.
8. **Ploompuu, T.** 2002. Lilli ja liblesid kevadiselt Lahemaalt. Loodus, 2, 36-38.
9. **Ploompuu, T.** 2002. Märkamatud niidiksamblad. Samblasõber, 5, 10-13, URL http://moritz.botany.ut.ee/bruoloogia
10. **Ploompuu, T.** 2002. Soontaimed. Peil, T., Ratas, U. & Nilson, E. (ed.-s) Alasti maailm: Kolga lahe saared, 25-30.
11. Puurmann, E., Ratas, U., **Rivis, R.** 2002. Rannikumaastike seire. In: Roose, A. (Comp.) Eesti Keskkonnaseire 2001 (Riiklik Keskkonnaseire programmem), 114-116; 186-187.
12. Ratas, U., Puurmann, E., **Rivis, R.** 2002. Maastikud maa ja mere piiril. Eesti Loodus, 5, 202–206.
13. Ratas, U., **Rivis, R.** 2002. Maastikud. In: Kään, H., Mardiste, H., Nelis, R. & Lember, A. (Toim.) Saaremaa. Loodus, aeg, inimene I. Tallinn, Eesti Entsüklopeediakirjastus 188-197.

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2. **Punning, J.-M.**2001. Mammutid ja nende elukeskkond. Eesti Loodus, 11/12.

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2. **Ploompuu T.** 2000. Mitmesse riiki jaguneb elusloodus? I. *Eesti Loodus*, 8, 332-333.
3. **Ploompuu T.** 2000. Mitmesse riiki jaguneb elusloodus? II. *Eesti Loodus*, 9, 368-369.
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5. **Punning, J.-M.** 2000. 10 aastat akadeemilist teadust Kirde-Eestis. Rmt: *Kirde-Eesti osakond 1990-2000*. Ökoloogia Instituut ,Tallinna Pedagoogikaülikool, Tallinn, 5-7.
6. **Punning, J.-M.,** Alumäe, S., Merikalju, L. 2000. Eesti Geograafia Selts. Rmt: *Teadusseltsid ühiskonnas*. Seminari materjalid. Tallinn, Eesti Teaduste Akadeemia. 31-35.

Manuscripts, Internet resourses and CD ROM-s made for contributing of teaching process are not included in list.

**Appendix 2**

# Natural Sciences (6420287) Bachelor Degree Curriculum

# TALLINN PEDAGOGICAL UNIVERSITY

Faculty: Mathematics and Natural Sciences

| 6420287 |
|---|
| (curriculum code) |

**Name of the curriculum in Estonian**
**LOODUSTEADUSED**

| 01.11.2001 |
|---|
| (approved by faculty) |

**Name of the curriculum in English**
**NATURAL SCIENCES**

| 28.01.2002 |
|---|
| (approved by university board) |

Level**: Bachelor**
Curriculum accreditation**:**
Load**: 180 ECTS**
Standard period of study in years**: 3**

Admission requirements: secondary education; state examinations: mother tongue and two state examinations out of the following five: biology, geography, physics, chemistry, mathematics.

Objectives: To provide primary professional education which integrates natural sciences with profound environmental expertise enabling the graduate to continue studies in master's programme of Basic School Teacher of Natural Sciences or another similar curriculum based on natural sciences and be prepared to work as a lab assistant in general and higher education institutions and research organisations.

Curriculum outline
General subjects 22 ECTS
Focus subjects 23 ECTS
Major (choose two subjects from natural sciences) 75 ECTS
Minor 45 ECTS
Electives (open) 9 ECTS
Bachelor's thesis 6 ECTS
Students choose two of the listed subjects of the major: biology, physics, geography, chemistry. It is recommended to choose natural science subjects for the minor.
Courses are given in the form of lectures, seminars, practical classes and independent work.
Graduation requirements: completion of the curriculum and defence of the bachelor's thesis.

Documents issued at graduation: bachelor's diploma and academic report

Degree: Bachelor of Natural Sciences

## NATURAL SCIENCES

### General subjects in natural sciences 22 ECTS

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| MLB6001 | General Biology | 4.5 | E |
| MLG6001 | Basics of General Geography | 4.5 | E |
| MLK6001 | General Chemistry | 4.5 | *E* |
| MLR6001 | Physical Picture of the World | 4.5 | E |
| | **Interdisciplinary electives (choose 4 ECTS)** | | |
| FEL6008 | Oral and Written Communication | 4,0 | G |
| FEL6009 | Intercultural Communication | 4.0 | G |
| EAK6005 | Studying at University | 4,0 | G |
| SII6001 | Information Retrieval and Methods | 4.0 | G |
| SAP6002 | Introduction to Public Administration | 4.0 | G |
| SPI6014 | Coping Strategies in Society | 4.0 | G |
| SPK6002 | Psychology of Social Skills and Interpersonal Communication | 4.0 | G |
| SPK6004 | Organisational Behaviour | 4.0 | G |
| MIA6001 | Effective Computer Usage | 4.0 | G |
| MIA6005 | Computer Aided Information Processing | 4.0 | G |
| MIA6008 | Creating Web Pages | 4.0 | G |
| MMD6004 | Practical Mathematics | 4.0 | G |
| FKV6016 | English (Advanced) | 4,0 | G |
| FKV6019 | German (Advanced) | 4,0 | G |
| FKV6020 | Russian (Advanced) | 4,0 | G |
| FKE6036 | Estonian (Advanced) | 4,0 | G |

### Focus subjects in natural sciences 23 ECTS

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| MLB6902 | General Ecology | 4.5 | E |
| MLG6901 | Geography of Estonia | 4.5 | E |
| MLK6901 | Environmental Chemistry | 5.0 | E |
| MLT6901 | Mathematical Methods in the Natural Sciences | 4.5 | G |
| MLT6902 | Physical Methods in Sciences | 4.5 | G |

### Major 75 ECTS (choose two subjects) + bachelor's thesis 6 ECTS

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| | **Biology 37.5 ECTS** | | |
| MLB6005 | Introduction to Botany | 4.5 | E |
| MLB6006 | Introduction to Zoology | 6.0 | E |
| MLB6007 | Environmental Sciences | 3.0 | G |
| MLB6008 | Field Works in Floristics and Faunistics | 3.0 | G |
| MLB6010 | Molecular and Cell Biology | 4.5 | E |
| MLB6011 | Plant and Animal Physiology | 6.0 | E |
| MLB6012 | Biodiversity and Conservation Biology | 4.5 | G |
| MLB6013 | Genetics | 3.0 | E |
| MLB6014 | The Theory of Evolution | 3.0 | G |

| | | | |
|---|---|---|---|
| | **Physics 37.5 ECTS** | | |
| MLR6003 | Mechanics | 7.5 | E |
| MLR6004 | Heat and Molecular Structure | 4.5 | E |
| MLR6005 | Electromagnetism | 7.5 | E |
| MLR6006 | Optics | 6.0 | E |
| MLR6007 | Structure of Matter | 7.5 | E |
| MLR6008 | Astronomy | 4.5 | E |
| | **Geography 37.5 ECTS** | | |
| MLG6021 | Introduction to Landform Studies | 6.0 | E |
| MLG6023 | Climatology and Meteorology | 6.0 | E |
| MLG6024 | Paleogeography | 6.0 | E |
| MLG6027 | Introduction to Human Geography | 6.0 | E |
| MLG6030 | Geographical Information Systems | 3.0 | E |
| MLG6032 | Field Work in Physical Geography | 4.5 | G |
| MLG6036 | Physical Geography of the Continents and History of Geographical Discoveries | 6.0 | E |
| | **Chemistry 37.5 ECTS** | | |
| MLK6003 | Inorganic Chemistry I | 6.0 | E |
| MLK6004 | Inorganic Chemistry II | 6.0 | E |
| MLK6005 | Organic Chemistry | 6.0 | E |
| MLK6007 | Bio-organic Chemistry | 3.0 | G |
| MLK6008 | Biochemistry | 4.5 | E |
| MLK6009 | Physical and Colloid Chemistry | 6.0 | E |
| MLK6010 | Analytical Chemistry and Instrumental Analysis | 6.0 | E |
| MLB6100<br>MLG6100<br>MLR6100<br>MLK6100 | **Bachelor Thesis** | 6.0 | |

E – examination
G – graded assessment

## NATURAL SCIENCES: MINOR CURRICULA OF BACHELOR STUDIES

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| | **Geography** | | |
| MLG6021 | Introduction to Landform Studies | 6.0 | E |
| MLG6023 | Climatology and Meteorology | 6.0 | E |
| MLG6024 | Paleogeography | 6.0 | E |
| MLG6026 | Environmental Issues and Nature Preservation in Estonia | 4.5 | E |
| MLG6027 | Introduction to Human Geography | 6.0 | E |
| MLG6030 | Geographical Information Systems | 3.0 | E |
| MLG6032 | Field Work in Physical Geography | 4.5 | G |
| MLG6034 | Field Trip | 3.0 | G |
| MLG6036 | Physical Geography of the Continents and History of Geographical Discoveries | 6.0 | E |
| | **Chemistry** | | |
| MLK6003 | Inorganic Chemistry I | 6.0 | E |
| MLK6004 | Inorganic Chemistry II | 6.0 | E |
| MLK6005 | Organic Chemistry I | 6.0 | E |
| MLK6006 | Organic Chemistry II | 3.0 | G |
| MLK6007 | Bio-organic Chemistry | 3.0 | G |
| MLK6008 | Biochemistry | 4.5 | E |
| MLK6009 | Physical and Colloid Chemistry | 6.0 | E |
| MLK6010 | Analytical Chemistry and Instrumental Analysis | 6.0 | E |
| MLK6020 | Food Chemistry | 4.5 | E |

E – examination
G – graded assessment

# Appendix 3

# Natural Sciences (6420287) Bachelor Degree Subject Catalogue with Literature Lists

## General Subjects in Natural Sciences

**MLB 6001 GENERAL BIOLOGY**
4,5 ECTS 3 45-0 E Autumn Semester
***Objective:*** General subject. Generalizing survey of all kinds of life based on the newest scientific achievements. In the field under consideration attention focuses on biodiversity and its base in evolutional history.
***Course Outline:*** Introductional overview about all kinds of life through the newest scientific achievements. During the course special attention is paid to the biodiversity and its base in evolutional history. The main subjects are as follows. Forms of life organization. Basis of life processes – useful energy, persistance and changing of life - genetics and evolution. Diversity of life forms: Viruses, Bacteria, animals, fungi, plants; causes of their evolution and characteristics. Co-life of organisms – ecology.
***Learning Methods:*** Lections, seminars, small tests.
***Methods of Assessment:*** Written examination.
***Prerequisite:*** **-**
***Teacher:*** Assistant Lecturer Tõnu Ploompuu
MLB 6001 Üldbioloogia
**Required Reading:**
1**.** Biology. Solomon E.P., Berg L.R., Martin D.W. 1999 or
2. Biology: life on earth. Audesirk T., Audesirk G. 1999.
3. Botaanika I, II, III. Ed. Masing, V. Trass, H ja Kalda, A. Tallinn: Valgus. (1965-1976)
**Recommended Reading:**
1**.** Materials and links on homepage of lecturer: http://www.tpu.ee/~toenu/tonu.htm

**MLG 6001 BASICS OF GENERAL GEOGRAPHY**
4,5 ECTS 3 30-15 E Autumn Semester
***Objective:*** General subject. To provide the students with an understanding of the origin and development of the planet. Our location in space and the main characteristics of Earth.
***Course Outline:*** The location of Earth in space and the solar system, the development and main parameters of planet Earth. Regularities in the geospherical concept. The detailed study of Earth geospheres: atmosphere, hydrosphere, lithosphere, pedosphere, biosphere - their definitions, characteristics and peculiarities. Interactions between the geospheres and their unity.
***Learning Methods:*** Mostly lectures, independent work with literature to prepare for discussions in the workshops.
***Methods of Assessment:*** Examination.
***Prerequisite:*** **-**
***Teacher:*** Associate Professor Jaan Jõgi
MLG 6001 *Geograafia alused*
**Required Reading:**
1. Conte, D.J., Thompson, D.J., Moses, L.L. (1997) Earth Science. An integrated perspective. Second Ed. WCB Publ.
2. Getis, A., Getis, J., Fellmann, J.D. (1996) Introduction to geography. WCB Publ.
3. Jõgi, J., Tõnisson, A. (1996). Sissejuhatus üldgeograafiasse. Tallinn: TPU Kirjastus.

**MLK 6001 GENERAL CHEMISTRY**
4,5 ECTS 3 30-15 E Autumn Semester
***Objective:*** General subject. To deal with the chemical foundations of the material world, so as to begin to provide a fundamental understanding of the nature of substances. Practical applications and skills on the basis of quantitative methods are developed.
***Course Outline:*** A brief history of chemistry. Principles of the classification of the nomenclature of compounds. Structure of atoms, s-, p-, d- and f-elements. Promotion and hybridisation. Types of chemical bond. Complex

compounds. Aggregative states. Gas laws. Crystal lattices. The periodic system. Chemical kinetics. Le Chateliers principle. Thermochemistry. Surface phenomena. Catalysis. Dispersoids, sols. Roasts law. Osmosis. Electrolytic dissociation pH. Hydrolysis. Redox reactions. Electrochemistry. Exercises and training: structure of the chemical bonds of atoms and molecules, the periodic system, kinetics. Assessments of molar concentration, masses and yields of reagents. Exercises concerning gas laws, solutions, hydrolysis, redox reactions, electrolysis, etc.
***Learning Methods:*** Lectures and seminars. The course is divided into three cycles, each of which ends with a written progress-test. Quantitative stems are learned in the seminars.
***Methods of Assessment:*** Written exam. To take the final exam, each student has to pass the progress-tests and actively participate in seminars.
**Prerequisite:** -
***Teacher:*** *Associate* Professor Kalle Truus
MLK 6001 *Üldkeemia*
**Required Reading:**
1. Ebbing, D.D., Gammon, S.D. (1999). General Chemistry. 6th Ed. Boston, New York: Hougton Mifflin Company.
2. Hill, G.C., Holman, J. S. (1996). Chemestry in Context. Walton-on-Thames: Nelson.
3. Karik, H., Palm, U., Past, V. (1981). Üldine ja anorgaaniline keemia. Tallinn: Valgus.

**MLR 6001 PHYSICAL PICTURE OF THE WORLD**
4,5 ECTS 3 30-15 E Autumn Semester
***Objective:*** General subject. To provide an overview of the main branches of physics and build a basis for the study of physics special courses.
***Course Outline:*** The subject and method of physics. Physics through unity of thesis and antithesis: flat and curved space, linearity and nonlinearity, the continual and discrete worlds, legality and occasionality, stability and nonstability, macroscopic and microscopic, symmetric and non-symmetric, absolute and relative, ultimate and infinite world. Lectures and seminars alternate. In seminars students present their reports on freely selected themes within different subjects.
***Learning Methods:*** Contrast-study. Different branches of physics contain antagonistic processes, the relativity of whose antagonism and the absolutism of whose unity can be shown.
***Methods of Assessment:*** Assessment is based on comprehension of physical processes and methodical integrity of reports.
***Prerequisite:*** -
***Teacher:*** Assistant Lecturer Tiit Lukki
MLR 6001 *Füüsikaline maailmapilt*
**Required Reading:**
1. Ü.Ugaste. Füüsika gümnaasiumile III. Ptk. Nüüdisaegne füüsikaline maailmapilt.
2. H.Õiglane. Füüsika (10. and 11. klassile).

## Interdisciplinary Electives

**FEL 6008 ORAL AND WRITTEN COMMUNICATION**
4,0 ECTS 3 20-25 G Autumn Semester
***Objective:*** Interdisciplinary elective. To provide a combination of textual knowledge and skills in using Estonian language study aids. To consciously improve proficiency in Estonian as a mother tongue in all its components (skills in reading and listening functionally, expressing oneself orally and in writing). If the student speaks another mother tongue, the person may practise all previously mentioned sub-skills and learn to consciously avoid the misuse occasionally taught by official and institutional language via bad texts.
***Course Outline:*** An overview of the forms of Estonian and how to choose between them in different situations to encode the message effectively, appropriately and according to the situation. A brief introduction to common types of official texts. The comprehensive practical study including individual work is focused on objective (neutral and official) communication and text types. Common errors of expression in practical official usage and disadvantages arising when taking foreign texts as examples (e.g. in studies) are brought out. Skills in oral and written expression are improved, usage of sources of linguistic self-supervision (dictionaries, grammar textbooks, information from the Internet, linguistic advice) is practised, attention is given to common problems of style and correct usage.
***Learning Methods:*** The course starts with a series of lectures (five weeks) that form the basis for active participation in practical classes in groups and preparation of individual assignments (nine weeks, up to 20 people per group). Individual, group and pair work using different methods is completed in the practical classes,

presentations are given in a certain imaginary role, the form of role play etc. is used, fellow students work is analysed.
***Methods of Assessment:*** Current work is assessed with the participation of fellow students. In order to qualify for the final assessment it is necessary to have passed all assignments, their late submission must be well-explained or known in advance. A pass-fail assessment.
***Prerequisite*** -
***Teacher:*** Assistant Lecturer Krista Kerge
FEL 6008 *Suuline ja kirjalik kommunikatsioon*
**Required Reading:**
1. Eesti keele sõnaraamat ÕS 1999 (1999). Tallinn: Eesti Keele Sihtasutus (EKSA) (see võimalusel ka www.eki.ee - keelenõuanne ÕS 1999 vigade parandus)
2. Eesti kirjakeele seletussõnaraamat (1988–). Tallinn: KKI / EKSA.
3. Eesti keele käsiraamat (1997 jj trükid). Tallinn: EKSA; see www.eki.ee/raamatud.

**FEL 6009 INTERCULTURAL COMMUNICATION**
4,0 ECTS 3 33-12 G Autumn/Spring Semester
***Objective:*** Interdisciplinary elective of intercultural communication provides basic theoretical knowledge of cultural differences and how they influence communication. Relationships between conversation behaviour and culture are addressed. Students get to know their own culture and cultural behaviour, how to adjust to a foreign culture and how to communicate with a person from another culture.
***Course Outline:*** Culture and cultural differences. Relationships between language and culture. Stereotypes. Adjustment to a foreign culture. Cultural dimensions: individualism and collectivism, bearing, insecurity, power, distance, masculinity and femininity. Reflection of dimensions in communication. Western and eastern attitudes and their influence on communication. Time and space relations. Conversation behaviour and culture. Estonian conversation behaviour. Theory of culture games.
***Learning Methods:*** Class work in the form of lectures and practical classes - discussions of issues addressed in lectures, doing exercises, viewing videos.
***Methods of Assessment:*** Graded assessment. Test.
***Prerequisite*** -
***Teacher:*** Associate Professor Hille Pajupuu
FEL 6009 *Kultuuridevaheline kommunikatsioon*
**Required Reading:**
1. Kuidas kohaneda võõras kultuuris. Hille Pajupuu (2001). Tallinn: EKSA.
2. Kultuuridevahelised erinevused. Kuidas edukalt ületada kultuuribarjääri. Richard D. Lewis (2003). Tallinn: TEA Kirjastus.
3. Eesti and eestlased võrdlevas perspektiivis. Kultuuridevahelise kommunikatsiooni uurimusi 20. sajandi lõpust**.** (2002). TÜ Euroopa Kolledþ. Tartu: TÜ Kirjastus.

**EAK 6005 STUDYING AT UNIVERSITY**
4,0 ECTS 3 22-23 G Autumn Semester
***Objective:*** The subject Studying at university is an interdisciplinary elective of Bachelor's degree with the objective to support students' studies at university. Students learn to plan and analyse their studies as well as employ appropriate learning methods and strategies that support critical reading and writing and public speaking.
***Course Outline:*** Factors affecting learning. Styles of learning. Strategies of learning. Learning skills. Reading skill as a learning skill. Understanding the text and factors influencing it. Critical reading: objectives and possibilities. Reading special texts. Understanding, assessment, analysis and expansion of the text. Writing as a process. Stages of the writing process. Formation of arguments; different models. Argumentative essays. Critical, independent and creative thinking. How to be successful in solving problems – organisation of thinking. Public speaking. Speech, speaker and audience.
***Learning Methods:*** The course is constructed on the basis of the principles of active learning. In course of lectures and seminars, students have the opportunity to participate in discussions as well as practice different learning methods and strategies.
***Methods of Assessment:*** The assessment comprises an oral and a written part. In order to qualify for the final assessment it is necessary to have submitted the writing assignments (the essay and analysis of articles), to have given a presentation on a freely chosen topic and to have attended 75% of lectures.
***Prerequisite*** -
***Teacher:*** Lecturers K.Poom-Valickis, M.Karm or M.Normak
EAK 6005 *Õppimine kõrgkoolis*
**Required Reading:**
1. Õpi õppima. Bruun, B; Dombernowsky, S. (1996). Tallinn: EV Haridusministeerium.

2. Õppima õppimine. Juhend õppimisoskuse arendamiseks. Lindberg, J. (2001). Tallinn: TPU.
3. Kirjutamise kunst: tekstiõpetuse õpik. Ehala, M. (2000) Tallinn: Künnimees.

**SII 6001 INFORMATION RETRIEVAL AND METHODS**
4,0 ECTS 21-24 G Spring Semester
***Objective:*** To provide the students with an understanding of the more important traditional and electronic information sources needed in studies and theoretical information retrieval strategies and tactics. To obtain skills in analytical description and information retrieval in the practical use of sources.
***Course Outline:*** Formulation of information requests, ascertaining information sources and retrieval methods to ensure satisfaction of information requests, locating relevant information from information sources, evaluating and analysing information sources and information.
***Learning Methods:*** Lectures and demonstrations. Practical problem solving.
***Methods of Assessment:*** The assessment is in three parts. The first part consists of the presentation of a discourse paper composed in groups. The second part consists of a written test with multiple-choice answers. The third part consists of presenting a completed individual assignment for evaluation.
***Prerequisite:***
***Teacher:*** Assistent Lecturer Anne Uukkivi
SII 6001 *Infootsing: allikad ja meetodid*
***Required Reading:***
1. Information seeking in the online age: principles and practice. Large, A. (1999). London [etc.]: Bow.
2. The invisible Web: uncovering information sources search engines cant see. Sherman, C. (2002). Medford, N.J.: CyberAge Books.
3. Arvuti lauaraamat 2002. Mägi, A., Septer, A. (2002). Tallinn: Arvutikirjastus.
4. Microsoft Access: andmebaaside loomine: näidisandmebaase MS Access 97 alusel. Linntam, A. (2000). Tallinn: Külim.
5. Microsoft Office 2000. II: käsiraamat. Mägi, A. (1999). Tallinn: GT Tarkvara.

**SAP 6002 INTRODUCTION TO PUBLIC ADMINISTRATION**
4,0 ECTS 3 30-15 G Spring Semester
***Objective:*** This is first course about public administration for BA students. To provide an overview of different aspects of public administration, the mechanisms of the public sector and the problems of management in the public sector. The course should develop a clear vision about public administration and the operations of it. This is an introduction course so the goals of seminars is not analysis but comparison of different values in public administration.
***Course Outline:*** Introduction to the subject: public administration as the development story of discipline. Philosophy of public administration. The basic doctrines of public administration: What? (Structure), Who? (civil servants), How? (Dilemmas of management). The overall model of governing: horizontal balances and top executives. The overall model of governing: administrative apparatus and vertical balances. The definition and models of bureaucracy. The structure of organisations and evolution of management paradigms. The Civil Service. The ethics of the Civil Servant. The borders and cooperation between the public and private sector. The State and Money."
***Learning Methods:*** Lectures will provide a theoretical overview of the subject. Independent reading in preparation for the seminars. The group work carried out in seminars will help the student to gain a deeper understanding of the subject.
***Methods of Assessment:*** Half of the assessment is based on tests conducted in the seminars and the other half will be based on memos compiled for the seminars.
***Prerequisite:*** -
***Teacher:*** Assistent Lecturer Viola Soiver
SII 6001 *Sissejuhatus avalikku haldusesse*
**Required Reading:**
1. Avaliku sektori juhtimine: Euroopa riikide kogemused Eliassen, Kjell A. & Kooiman, Jan (2002) Tallinn: Eesti Keele Sihtasutus

**SPI 6014 COPYING STRATEGIES IN SOCIETY**
4,0 ECTS 30-15 G Autumn/Spring Semester
***Objective:*** The objective is to give the students competence in recognizing factors influencing everyday health behavior. Having passed the course, students can analyze situations from the aspect of health and coping and master simple strategies for managing stress.
***Course Outline:*** Psychosocial and environmental aspects of health and coping; the role of lifestyle and everyday habits in health; the relationships between personality and health; factors influencing coping with everyday-life

stress and health problems; psychological difficulty of searching help and helping. The course offers practical experience in applying creative activities for coping with stress.
***Learning Methods:*** Theoretical lectures combined with practical classes.
***Methods of Assessment:*** Graded written assessment.
***Prerequisite:*** **-**
***Teacher*:** Lecturer Eha Rüütel
SPI 6014 *Toimetulekustrateegiad tänapäeva ühiskonnas*
***Required Reading:***
1. Stressi teejuht. Kuidas saada lahti liigsest pingest? Elenurm, T., Kasmel, A., Kidron, A., Rüütel, E., Teiverlaur, M., Traat, U. (1997). Talinn: Eesti Tervisekasvatuse Keskus.
2. Kuidas juhtida stressi 60 sekundiga. Goliszek, A. (1997). Tallinn: Ilo.
3. Stress and health: A reversal theory perspective. Svebak, S., Apter, M.J. (1997). Washington, DC: Taylor & Francis.

**SPK 6002 PSYCHOLOGY OF SOCIAL SKILLS AND INTERPERSONAL COMMUNICATION**
4,0 ECTS 3 30-15 G Autumn Semester
***Objective:*** Interdisciplinary elective. The objective of the course is to give knowledge about factors influencing communication which helps to analyze communication situations and one's own communication experiences and thereby direct one's behavior.
***Course Outline:*** Introduction of the filed. The nature and functions of communication. Perception, influencing and information sharing. The impact of social environment on self-image and relationships. Rules of perception. Manipulations, games, techniques of persuasion. E.Berne's transactional model. Conflict, constructive criticism. Different communication styles. Non-verbal level: paralinguistic signals and body language. Proxemics.
***Learning Methods:*** Lectures. Groups are formed at seminars where raised questions are discussed and video material is analyzed.
***Methods of Assessment:*** Assessment is in written form. It requires answering questions that were discussed in lectures. The prerequisite of taking the assessment is participating in seminars.
***Prerequisite:*** -
***Teacher:*** Assistant Lecturer Katrin Kullasepp; Lecturer Elena Espe
SPK 6002 *Suhtlemispsühholoogia*
**Required Reading:**
1. Igapäevaoskused Bolton, R. (2002) Tallinn: Väike Vanker.

**SPK 6004 ORGANISATIONAL BEHAVIOUR**
4,0 ECTS 3 15-30 G Spring Semester
***Objective:*** Give an overview of the main topics of organizational behaviour. Having passed the course, the student is able to analyze work-related situations from the psychological perspective.
***Course Outline:*** History and developmental directions of organizational behaviour. Personnel policy. The role of personnel manager. Planning human resources. Working with personnel. Studies of organizations. Job analysis. Job description. Personnel recruitment. Screening and selecting applicants. Adjustment with organization. Personnel assessment. Assessment methods. Criteria. Assessment errors. Personnel development and training. Job evaluation and salary administration. quality of professional life. Values. Personnel motivation. Motivation theories. Factors influencing job satisfaction. Work administration. Working environment. Working hours. Indirect indicators of unsatisfaction. Increasing satisfaction. Organizational culture. Concepts, functions, values, development/ formation and influence, changes, links with general cultural context. Client satisfaction. Job stress. Stressors. Coping with stress.
***Learning Methods:*** Lectures and independent reading.
***Methods of Assessment:*** Graded assessment consists of two tests or the written assessment.
***Prerequisite:*** -
***Teacher:*** Researcher Kadi Liik, Assistant Lecturer Eva-Maria Talts
SPK 6004 *Organisatsioonipsühholoogia*
**Required Reading:**
1. Personali juhtimine. Alas, R. (2001). Tallinn: Külim.
2. Organisatsioon ja organisatsioonikultuur. Siimon, A., Vadi, M. (1999). Tartu Ülikooli Kirjastus.
3. Grupid organisatsioonis. Vadi, M. (2001) Grupid organisatsioonis. Tartu Ülikooli Kirjas.

**MIA 6001 EFFECTIVE COMPUTER USAGE**
4,0 ECTS 15-30 G Autumn/Spring Semester
***Objective:*** This subject is optional or facultative.A purpose of this subject is to provide the students with advanced knowledge and competence for more successful activity in contemporary environment, that is

significantly based on computer technologies. Content of the subject depends to a considerable extent on the specific needs of our students, and creates prerequisites so of optimal using of the computer technologies in their works, as of their passing the overlapping disciplines.
***Course Outline:*** Working in a Windows environment. File system and operations. Working in a network environment. Word processing, more sophisticated methods of creating documents. Support of printing. Importing the objects to the text: pictures, logos, tables, charts, mathematical formulae. Dividing the text documents. Inserting of table of contents and page numbers. Headers and footers. Assessments of tables. Creating, adding and deleting of columns and rows. Bordering of the cells. Creating of math formulae. Creating of databases, their sorting and reports. Graphic presentations. Creating of the slides, adding of visual effects. Working with Internet. Searching. File transportation. E-mail and it's accessibility in education. Newsgroups. Browsing of e-mail. User's safety.
***Learning Methods:*** In practical studies, individual tasks issued by the teacher for every topic, are to be solved. For original work, integrated teaching theme-orientated material is issued.
***Methods of Assessment:*** To pass classification test, the student must solve the task (tasks) issued by the teacher for every topic of the disciplne and defend his/her original work. The The test must be passed at the last practical study (2 x 45 minutes). The general mark of the test depends on the sum of accumulated points for each of the parts of the test (100 points maximum) Test is passed with no less than 51 points. Use of individual abstracts of lectures during the classification test is allowed.
**Prerequisite:** **-**
***Teacher:*** Lecturer Rein Ruus, Lecturer Svetlana Tolbast, Lecturer Kalle Kivi
MIA 6001 *Arvuti töövahendina*
**Required Reading:**
1. Office 2000 I osa. Mägi, A. (1999). Tallinn.
2. Office 2000 II osa. Mägi, A. (1999). Tallinn.
3. Arvutiõpik OpenOffice.org 1.1. Tilk, T. (2003). Tallinn.
4. Arvutiõpik OpenOffice.org 1.1. Tilk, T. (2003). Tallinn.
5. OpenOffice.org. Mägi, A. (2002). Tallinn.
6. Tasuta tarkvara käsiraamat. Kesa, M., Orav, K. (2003). Tallinn: Leksiko
7. Arvutikasutaja sõnastik inglise-eesti. Hanson, V., Tavast, A. (2003). Tallinn.
8. INTERNET 2000. Pihlau, J. (2000). Külim.
9. Infotehnoloogia käsiraamat koolidele ja iseõppijatele. Pihlau, J. (1998). Külim.
10. EXCEL Windows 2000. Langer, M. (2001). KOGE.
11. WORD Windows 2000. Langer, M. (2001). KOGE.
12. Arvutiõpik II Failihaldus, arvuti hooldamine ja täiendamine. Tilk, T. (2000).
13. Üliõpilastööd ja nende vormistamine. Roomets, S. (2000). Tallinn.

**MIA 6005 COMPUTER AIDED INFORMATION PROCESSING**
4,0 ECTS 15-30 G Autumn/Spring Semester
***Objective:*** Obtain theoretical knowledge and practical skills for processing different kind of information. As we feel, quite often we need to integrate with MS Office information processing possibilities some other kind of information, such as audio, video, graphical and interactive Web pages.
***Course Outline:*** Introduction to virtual learning environments. Individual and collaborative knowledge building. Web – based learning. Web pages basic objects, interactive and dynamic Web pages. Web pages design principles and technologies. Homepage files uploading and downloading. Graphical information processing. Basic principles of composition, design and colour theory. Vector and raster graphics. Graphic file formats and application areas. Digital photography, Web – cameras and digital cameras. Audio file formats, MIDI and wav – audio. Audio information processing. Video information and video file formats. Video information processing on desktop computers, configuration requirements.
***Learning Methods:*** Mostly lecture with selected examples and practical training on computers. Additionally individual work with literature and individual creative work on some project – from idea to solution. Virtual learning environment is used as supporting environment for collaboration and discussion.
***Methods of Assessment:*** Final mark is formed on basis of three sources: the quality of executed individual project, the current state during term, conversation between student and lecturer on subject area.
***Prerequisite:*** MIA 6001
***Teacher:*** Lecturer Olev Räisa
MIA 6005 *Infotöötlus arvutil*
***Required Reading:***
1. Värviõpetus teoorias. Tammert, M. (2002). Tallinn, OÜ Aimwell.
2. http://www.webopedia.com
3. http://www.webstyleguide.com

***Recommended Reading:***
1. Rich Media StudioLab: Video and Sound. (2001).
2. JavaScript v Web – dizaine. Dronov, V. (2001). BHV – Peterburg.
3. Dizain reklamõ: pokolenije NEXT. Pavlovskaja, E. (2003). PITER.
4. Desktop Digital Video Production. Jones, F. (1999). Prentice Hall..

**MIA 6008 CREATING WEB PAGES**
4,0 ECTS 15-30 G Autumn Semester
***Objective:*** The objective of the course is to provide theoretical knowledge and practical skills to analyse, plan, create and maintain web sites.
***Course Outline:*** Web development principles and options. File formats. HTML, CSS. Standards. HTML-editors. Planning a web site. JavaScript possibilities, syntax. Using VBA and PHP in Web development. XML.
***Learning Methods:*** The course includes lectures, work in computer labs and discussion lessons. Solving different kinds of problems and creating specific web pages. The exercises have more than one solution because students in this course have differing backgrounds.
***Methods of Assessment:*** Assessment is based on results of tests, individual exercises, and theory seminar.
***Prerequisite:*** MIA 6001
***Teacher:*** Lecturer Jaagup Kippar
MIA 6008 *Veebilehtede loomine*
***Required Reading:***
1. http://minitorn.tpu.ee/~jaagup/kool/java/loeng/kogujs/kogujs.rtf

**MMD 6004 PRACTICAL MATHEMATICS**
4,0 ECTS 30-15 G Spring Semester
***Objective:*** To develop basic skills for understanding the most important mathematical methods in economics, social and life sciences. Core subject of the optional programme "Mathematics in Economics."
***Course Outline:*** Sources and types of data, tabulation and graphical presentation of data, relations. Time value of money. Equations and matrix manipulation. Leontief input-output analysis. Exponential and logistic growth. Optimization problems in economics. Least squares fitting in data analysis.Linear programming problems.Basic ideas of probability, probability distributions. Normal distribution.
***Learning Methods:*** Lectures, practical classroom work and homework.
***Methods of Assessment:*** The two homework tasks give 20 %, the two tests in classroom give 50% and the written assessment gives 30% of the total sum of credit points.
***Prerequisite:*** Basics of school mathematics
***Teacher:*** Professor Andi Kivinukk
MMD 6004 *Praktiline matemaatika*
***Required Reading:***
1. Rakendusmatemaatika (loengukonspekt) A. Kivinukk. (2001) TPU.
***Recommended Reading:***
1. Quantitative Methods for Business Decisions. J. Curwin, R. Slater. (1995, 2000). Chapman&Hall
2. Majandusmatemaatika elemendid. J. Afanasjev. (2001). Avita

**FKV 6016 ENGLISH (ADVANCED)**
4,0 ECTS 0-45 G Autumn/Spring Semester
***Objective:*** An advanced course of English (B2, see Europen language map). Integrated development of the four language skills: reading, listening, writing and speaking. Presuption of B2 language level is the comprehension of lengthy discussions and reports, ability to speak spontaneously and fluently, and express and argument one's ideas in oral and written speech.
***Course Outline:*** Systematic improvement of grammar skills: tenses, conditional sentences, time clauses, passive voice. Enlargement of vocabulary. Discussions on general and speciality issues. Lexical-grammatical exercises, role plays, idiomatic assignments. Homereading of speciality texts and reporting the summaries. Thematic texts from media publications: oral and written presentations. Coursebook is supplemented with the teacher's didactic study materials.
1CP contains the treatment of speciality texts.
***Learning Methods:*** Individual and group work.
***Methods of Assessment:*** The course ends with a credit test comprising grammar tasks and translating and presenting 30 pages of speciality text.
***Prerequisite:*** -
***Teacher*** Lecturers J. Kallonen, S. Kivihall, A. Taiger, D. Mironov, E. Mängel
FKV6016 *Inglise keel edasijõudnutele (B2)*

***Required Reading:***

1. "New Headway Upper-Intermediate Student Book". Soars, J. (1998) CUP
2. "New Headway Upper-Intermediate Workbook". Soars, J. (1998) CUP
3. " New Progress to First Certificate" Jones, L. (1997) CUP Murphy, R. (1997)
4. "English Grammar in Use: intermediate". Murphy, R. (1997) CUP
5. "Wordbuilder". Wellman, G. (1997) Heineman
6. "Everyday Topics" Läänemets, U. (1999) Koolibri
7. "English Panorama I". O'Dell, F. (2000) CUP
8. Tekstid ajakirjadest "Reader's Digest", "Cosmopolitan", "In Time", "Club", "Current"

**FKV 6019 GERMAN (ADVANCED)**
4,0 ECTS 0-45 G Autumn/Spring Semester
***Objective:*** An advanced course of German (B2, see Europen language map). Integrated development of the four language skills: reading, listening, writing and speaking. Presuption of B2 language level is the comprehension of lengthy discussions and reports, ability to speak spontaneously and fluently, and express and argument one's ideas in oral and written speech.
***Course Outline:*** Taking and analysing of placement tests. Grammar exercises. Work with dictionary. Discussions on general and speciality issues. Homereading of speciality texts and reporting the summaries. Thematic texts from media publications: oral and written presentations. Coursebook is supplemented with the teacher's didactic study materials. 1CP contains the treatment of speciality texts.
***Learning Methods:*** Individual, pair, group and independent work.
***Methods of Assessment:*** Written lexical-grammatical test on the material learned during the course. Translating and presenting speciality text. One component of evaluation is the students active participation in the course.
***Prerequisite:*** -
***Teacher:*** Teacher Õie Kirs
FKV 6019 *Saksa keel edasijõudnutele (B2)*
***Required Reading:***
1. em Hauptkurs Deutsch als Fremdsprache für die Mittelstufe. Perlmann-Balme,M.,Schwalb,S.(2000) Max Hueber Verlag.
2. em Hauptkurs Deutsch als Fremdsprache für die Mittelstufe Perlmann-Balme,M.,Schwalb,S. (2000) Max Hueber Verlag.
3. Mittelstufen-Grammatik für Deutsch als Fremdsprache. Eggers, Dietrich (1996) Max Hueber Verlag.
4. Der Spiegel. www. spiegel.de
5. www.deutshland-magazin.de

**FKV 6020 RUSSIAN (ADVANCED)**
4,0 ECTS 0-45 G Autumn/Spring Semester
***Objective:*** An advanced course of Russian (B2, see Europen language map). Integrated development of the four language skills: reading, listening, writing and speaking.
***Course Outline:*** Daily situations in the context of the Russian language. Discussions on general and speciality issues. Reading texts of media publications, simpler literary works and speciality publications. Systematic grammar instruction. Morphology: verbs, nouns, adjectives, pronouns, numerals, adverbs, prepositions and conjunctions. Syntax: parts of speech and the order of words in sentences. Homereading of 30 pages of speciality text.
***Learning Methods:*** Group, pair and individual work, role plays.
***Methods of Assessment:*** Course ends with oral and written credit exam which comprises: 1. check of oral and written knowledge (is carried out through the course); 2. 3 written tests on the covered material; 3. translating 30 pages of homereading text with the help of the dictionary compiled by the reader and presentation of the summary.
***Prerequisite:*** -
***Teacher:*** Lecturer Jelena Raudla
FKV 6020 *Vene keel edasijõudnutele (B2)*
***Required Reading:***
1. Russki jazõk – moi drug i pomostsnik –1. Utsebnõe materialõ dlja estontsev, izutsajustsih russki jazõk. Raudla, J. (2001). Tallinn.
2. Recommended Reading: S – Peterburg. Pojehali. Russki jazõk dlja vzroslõh. Tsernõsov, S. (2002).
3. Vestleme. Metsa, A., Vissak H. (1994). Tallinn.
4. Sbornik uprazneni po grammatike russkogo jazõka. Zadorina, A., Golubeva, A., Kozevnikova, L. (2002). S – Peterburg.

**FKE 6036 ESTONIAN (ADVANCED)**
4,0 ECTS 0-45 G Autumn/Spring Semester
***Objective:*** The advanced course of Estonian (B2, see European language map). The objective of the course is the development of oral and written communication skills and the integrated improvement of the four language skills – reading, listening, writing and speaking. The course aims to extend the skills of reading, translating and reviewing of Estonian texts and increase the knowledge of grammar.
***Course Outline:*** Advanced treatment of Estonian grammar: tenses, moods, voices, case functions, syntax. Enlargement of vocabulary through the reading and listening of varied texts. Discussions on general and speciality issues. Argumentation of statements. Lexical-grammatical exercises, role plays. Completion of different types of written assignments.
***Learning Methods:*** individual and group work.
***Methods of Assessment:*** The course ends with a credit test comprising lexical-grammatical tasks.
***Prerequisite:*** -
***Teacher:*** Lecturer Ingrid Krall
FKE6036 *Eesti keel edasijõudnutele (B2)*
***Required Reading:***
1. Avatud uksed (õpperaamat, töövihik ja kassett). materjalid erinevatest meediaväljaannetest M. Kitsnik, L. Kingisepp.2002 Tallinn
2. Eesti keele töövihik edasijõudnuile. M. Sooneste. 1999 Tallinn
3. 160 eesti keele harjutust M. Loodus. 1999. Tallinn

## Focus Subjects in Natural Sciences

**MLB 6902 GENERAL ECOLOGY**
4,5 ECTS 3 43-2 E Autumn Semester
***Objective:*** Focus subject. To explain the complicated relationships that exist between living and non-living nature.
***Course Outline:*** Course on basic notions and regularities of ecology. Fitting of organisms and environments. Life and death of organisms with unitary and modular structure. Migration and dispersal in time and space. Intraspecies competition. Feeding types. Mutualism. Abundance. Communities and the energy flow through the communities.
***Learning Methods:*** Lectures. Focus on students independent work, interpretation of problems, collection and analysis of Internet materials. At least one written paper has to be composed and defended at a seminar.
***Methods of Assessment:*** written examination. Knowledge of essentials is needed.
***Prerequisite:*** **-**
***Teacher:*** Professor Henn Kukk
MLB 6902 *Üldökoloogia*
**Required Reading**
1. Subrahmanyam, N. (1999). Ecology. New Dehli, London, Calcuta: Narosa Publishing House.
**Recommended Reading**
1. Botaanika III.(1979). Koost. V. Masing. Tallinn.
2. Begon, M., Harper, J.L., Downsend, C.R. (1990) . Ecology. Tallinn: Eesti Akadeemiline Raamatukogu.
3. Ökoloogialeksikon.(1992). Koost. V. Masing. Tallinn: Eesti Entsüklopeediakirjastus.

**MLG 6901 GEOGRAPHY OF ESTONIA**
4,5 ECTS 3 30-15 E Spring Semester
***Objective:*** Focus subject. To provide an overview of Estonian physical geography, as well discuss topical environmental problems.
***Course Outline:*** Natural and geopolitical aspects of the Estonian geographical position. The Baltic Sea, the geological development and structure of the Estonian region, the surface layer. Climate and characteristics of inland waters. Soils and flora. Natural resources, their use and the environmental problems caused. Population and settlement. Introduction to economic geography. The structure of the Estonian economy.
***Learning Methods:*** Lectures. Independent work with literature. Preparing and presenting an academic report.
***Methods of Assessment:*** Written exams. In order to qualify to sit the exam, participation in seminars and lectures and presenting academic reports is required.
***Prerequisite:*** -
***Teacher:*** Assistant Lecturer Andres Kratovitš, Lecturer Sirje Siska
MLG 6901 *Eesti loodus- ja majandusgeograaafia*

**Required Reading:**

1. Raukas, A. (koostaja). (1995). Eesti Loodus. Tallinn: Eesti Entsüklopeediakirjastus.606 lk. (valitud peatükid).
2. Eesti Entsüklopeedia väljaanded.
3. Mäemets, A. (toim.). (1968). Eesti järved.Eesti NSV Teaduste Akadeemia, zooloogia ja botaanika instituut, 548 lk.

**MLK 6901 ENVIRONMENTAL CHEMISTRY**

5,0 ECTS 3 30-0 E Autumn Semester

***Objective:*** Focus subject. To study the environment and modern environmental problems in terms of chemical principles. The course includes topics of atmospheric, aquatic and soil chemistry.

***Course Outline:*** Global and local problems of environmental chemistry. Main characteristics of biosphere. Protection of nature and the environment. Anthrosphere. Cycles of matter. Atmospheric chemistry. Air and air pollutants. Background radioactivity. Nitrogen and nitrogen oxides. Acid rain. Exhaust. Carbon oxides. Greenhouse gases and greenhouse effect. Aerosols. Ozone layer destruction. Aquatic chemistry. Water pollution. Main types of water pollutants, Water treatment and purification. Sewages. Chemistry of pedosphere. Soil chemistry. Pollution of soil. Biofunctions of chemical elements. Dispersion of micro- and macro elements in the environment. Toxicants (toxic metals, organochlorine compounds, dioxins). Hazardous and E-series additives in nutrients.

***Learning Methods:*** Lectures and seminars. In seminars the material presented in lectures and reports prepared by students will be discussed.

***Methods of Assessment:*** Written exam. To take the final exam, each student has to pass three tests and has to present reports in seminars.

***Prerequisite:*** -

***Teacher:*** Associate Professor Aivar Lõokene, Lecturer Karl-Kristjan Kuiv, Lecturer Andres Mähar

MLK 6901 *Keskkonnakeemia*

**Required Reading:**

1. Environmental Chemistry. Baird, C. (1994). New York: W. H. Freeman, Pangbourne.
2. Environmental Chemistry. Manahan, S. E. (2000). London: Lewis Publisher.
3. Fundamental Concepts of Environmental Chemistry. Sodhi, G.S. (2000). Pangbourne: Alfa Science International Ltd.

**MLT 6901 MATHEMATICAL METHODS IN THE NATURAL SCIENCES**

4,5 ECTS 4 30-30 G Spring Semester

***Objective:*** Focus subject. To provide an overview of applications of basic mathematical methods in the natural sciences. Acquaintance with basic mathematical skills for understanding, study and construction of mathematical models.

***Course Outline:*** Graphics. Applications of vectors and matrices in natural sciences. Leslie matrix. Functions. Search for functional dependencies of experimental data. Applications of differential and integral calculus for analysis of biological and physical systems. Application of differential equations for investigation of processes in natural sciences. Use of the theory of probability and statistics in biology, chemistry and physics.

***Learning Methods:*** Lectures. Class work and discussions for the solution of problems. Individual and group work in solving exercises and problems in seminars.

***Methods of Assessment:*** Grade of the exam depends on tests (80%) and home work (20%). Student may write one final test also.

***Prerequisite:*** -

***Teacher:*** Associate Professor Tõnu Laas, Assistant Lecturer Astrid Rekker

MLT 6901 *Matemaatilised meetodid loodusteadustes*

**Required Reading:**

1. Neuhauser, C. (2000). Calculus for biology and medicine. New Jersey: Prentice Hall.
2. Piskunov, N. (1981). Diferentsiaal- ja integraalarvutus I Tallinn: Valgus.
3. Piskunov, N. (1983). Diferentsiaal- ja integraalarvutus II. Tallinn: Valgus.
4. Reimers, E. (1988). Matemaatilise analüüsi praktikum I. Tallinn: Valgus.

**Recommended Reading:**

1. Papula, L. (1982). Mathematik für ChemikerStuttgart: Ferdinant Enke Verlag.
2. Brachelet, E. (1979). Introduction to Mathematics for Life Scientists. Berlin: Springer-Verlag.
3. Mansfield, M., OSullivan, C. (1999). Understanding Physics. John Wiley&Sons.

**MLT 6902 PHYSICAL METHODS IN SCIENCES**
4,5 ECTS 6 30-60 G Spring Semester
***Objective:*** Focus subject. To provide an overview of the chosen physical methods.
***Course Outline:*** Lectures and seminars will take place alternately. The lectures present methods of investigation processes in the atmosphere, hydrosphere, lithosphere and biosphere. In the seminars students present their independent work with study-literature and academic reports.
***Learning Methods:*** Problem-study. The selection of investigative methods will be deduced from the nature of the processes.
***Methods of Assessment:*** Evaluation will be based on the degree of understanding of the processes as shown in the academic report.
***Prerequisite:*** -
***Teacher:*** Assistant Lecturer Tiit Lukki
MLT 6902 *Füüsikalised meetodid loodusteadustes*
**Required Reading:**
1. Jürissaar, M. (1998). Meteoroloogia. Tartu Lennukolledz.
2. Kaljurand, M., Kaldvee, R. (1997) Instrumentaalanalüüs 1 - 3. TTÜ Kirjastus.

**Recommended Reading:**
1. Encyclopedia of Marine Sciences. (1992). Berlin: Springer.
2. Eesalu, H. (1996). Astronoomialeksikon. Tallinn: EE Kirjastus.
3. Arold, I. (1987). Geoloogia alused. Tallinn.

## Major and Minor + Bachelor´s Thesis

**MLB 6005 INTRODUCTION TO BOTANY**
4,5 ECTS 3 15-30 E Autumn Semester
***Objective:*** To provide an overview of the construction of a plants body and the diversity in the plant world. The topic also covers the systems in the plant kingdom.
***Course Outline:*** Course about general botany. Introduction to plant cytology, plant anatomy, plant morphology and systematics. Main themes: plant cells and their structure, the characteristics of plant tissues, organs and their structural system in the kingdom of plants, morphology, biology and diversity of mosses, ferns, gymnosperms and angiosperms.
***Learning Methods:*** Lectures with discussions, practical classes to acquire skills.
***Methods of Assessment:*** In order to qualify to sit the examination students must have passed the class test.
***Prerequisite:*** -
***Teacher:*** Assistant Lecturer Tõnu Ploompuu
MLB 6005 *Botaanika*
**Required Reading:**
1. Botaanika II. (1979). Tallinn: Valgus.
2. Eesti sammalde määraja. (1998). Koostajad: N. Ingerpuu, K. Vellak Tartu: Eesti Loodusfoto.
3. Eesti taimede määraja. 1966). Tallinn.
4. Eesti taimede määraja. (1999). Tartu: Eesti Loodusfoto.
5. Kukk, T. (1996). Soontaimede anatoomia väike praktikum. Tartu: TÜ Kirjastus.

**Recommended Reading:**
1. Eesti suursamblikud. (1995). Tartu: Greif.
2. Hrżanovski, Ponomarenko. (1988). Botaanika. Tallinn: Valgus.
3. Taimede välimääraja. (1975 or 1972). Tallinn: Valgus.

**MLB 6006 INTRODUCTION TO ZOOLOGY**
6,0 ECTS 3 30-15 E Spring Semester
***Objective:*** Obligatory course for marine biologist and science teachers. The course will present the diversity of the animal kingdom. All animal phyla will be introduced. The morphology and taxonomy of the most important and largest groups will be studied in greater depth.
***Course Outline:*** General zoology: different fields of zoology, taxonomy, classification. The progress of animal evolution. Some protist groups, traditionally dealt as animals. All animal phyla will be introduced. Sponges, coelenterates, flatworms, roundworms, annelids, molluscs, arthropods, echinodermates and chordates will be studied in greater depth. The major classes of arthropods and chordates will also be studied in depth: arachnids, crustaceans, insects, fish, amphibians, reptiles, birds and mammals.

***Learning Methods:*** Teaching includes lectures, laboratory exercises and individual work. Participation in laboratory exercises is obligatory. An excursion to Tallinn Zoo is organised during the course.
***Methods of Assessment:*** The course will end with a written test. The taxonomy of groups used in laboratory exercises will be assessed with an ungraded test.
***Prerequisite:*** -
***Teacher:*** Lecturer Arno Põllumäe
MLB 6006 *Zooloogia*
**Required Reading:**
1. Abrikossov, G. jt. (1960). Selgrootute zooloogia. Tallinn: Valgus.
2. Aul, J., Ling, H. (1969). Selgroogsete zooloogia. Tallinn: Valgus.
3. Barnes, R.S.K., Calow, P & Olive, P.J. (1993). The Invertebrates. A New Synthesis. Blackwell Science.

**Recommended Reading:**
1. Loomade elu: I köide. Selgrootud I. (1981). Toimetanud A. Järvekülg. Tallinn.
2. Loomade elu: II köide. Selgrootud II. (1982). Toimetanud A. Järvekülg. Tallinn.
3. Loomade elu: III köide. Selgrootud III. (1984). Toimetanud H. Remm. Tallinn
4. Loomade elu: IV köide. Kalad. (1979). Toimetanud E. Pihu. Tallinn.
5. Loomade elu: V köide. Kahepaiksed ja roomajad. (1985). Toimetanud I. Veldre. Tallinn.
6. Loomade elu: VI köide. Linnud. (1980). Toimetanud R. Ling. Tallinn.
7. Loomade elu: VII köide. Imetajad. (1987). Toimetanud L. Poots. Tallinn.

**MLB 6007 ENVIRONMENTAL SCIENCES**
3,0 ECTS 2 22-8 G Spring Semester
***Objective:*** To learn to analyse some basic processes connected with environmental problems.
***Course Outline:*** The structure of the biosphere, mineral cycles and ecological energetics, the origins of global problems and methods of solving and reducing them, the concept of sustainable development. The history of nature conservation. Protection of biodiversity and natural resources and environmental monitoring.
***Learning Methods:*** Lectures, seminars, excursion.
***Methods of Assessment:*** Graded assessment. In order to qualify for the graded assessment the students must have passed one test and have taken part in the seminars.
***Prerequisite:*** MLB 6902
***Teacher:*** Associate Professor Tiina Elvisto
MLB 6007 *Inimene ja keskkond*
**Required Reading:**
- Anttila, P. jt. (1996). Globaalsed keskkonnaprobleemid. Tartu: Eesti Loodusfoto.
- Botaanika III. (1992). Koost. V. Masing. Tallinn: Valgus.
- Säästva arengu sõnaseletusi. (2000). Tallinn: SEI väljaanne nr. 1.
- Tohver, V. (1980). Lämmastikuringe, biosfäär ja inimene. Eesti Loodus, 557-563.
- Tohver, V. (1985). N2O ehk dilämmastikoksiid – naerugaas füsioloogiliselt, mitte aga ökoloogiliselt. Eesti Loodus, 488–493.
- Ökoloogialeksikon. (1992). Koost.. V. Masing. Tallinn: Eesti Entsüklopeediakirjastus.

**Recommended Reading:**
1. Brown, L., Flavin, Ch., French, H. (1999). Maailm aastal 1999. Tallinn: SEI
2. Brown, L., Flavin Ch., French, H. (2001). Maailm aastatel 2000 ja 2001. Tallinn: SEI.
3. Eesti 21. sajandil: Arengustrateegiad, visioonid, valikud. (1999). Koost. A. Oja. Tallinn: TA Kirjastus.
4. Eesti Punane Raamat: ohustatud seened, taimed ja loomad. (1998). Tartu: Looduskaitse Komisjon.
5. Kohalik Agenda 21. (2000). Koost.: Ü. Vaht, P. Kuldna, A. Oja. Tallinn: SEIväljaanne nr. 2.
6. Looduskaitse. (1973). Koost. E. Kumari. Tallinn: Valgus.
7. Nature Conservation in Estonia: General Data and Protected Areas. (1994). Comp. K. Peterson. Tallinn: Huma.
8. Santti, R. jt. (1995). Muutuv keskkond ja tervis. Tartu: Eesti Loodusfoto.

**MLB 6008 FIELD WORKS IN FLORISTICS AND FAUNISTICS**
3,0 ECTS 3 4-36 G Spring Semester
***Objective:*** Major subject. To learn the most common species of Estonian flora and fauna. Students should be able to recognise in the field the most common species of different groups. The skill of using different identification keys or handbooks of plants and animals is developed through individual work.
***Course Outline:*** The course will be organised in summer outside Tallinn. During one week processes for collecting, determining and fixing plants and animals from various biotopes will be learned and practised. The students will prepare a collection of plants and animals (invertebrates) for assessment.

***Learning Methods:*** Participation in excursions is required. The collection and preparation of plants and animals is done individually.
***Methods of Assessment:*** The recognition of organisms studied in the field and the quality and familiarity of prepared collections will be evaluated.
***Prerequisite:*** MLB 6006
***Teacher:*** Lecturer Arno Põllumäe, Assistant Lecturer Tõnu Ploompuu
MLB 6008 *Floristika ja faunistika välipraktikum*
**Required Reading:**
1. Eesti sammalde määraja. (1998). Koost. N. Ingerpuu, K. Vellak. Tartu: Eesti Loodusfoto.
2. Eesti suursamblikud. (1995). Tartu: Greif.
3. Eesti taimede määraja.(1999). Tartu: Eesti Loodusfoto.
4. Martin, M. (1990). Selgrootute loomade süsteem. Tartu.
5. Remm, H. (1983). Materjale selgrootute zooloogia õppimiseks. Tartu.
6. Taimede välimääraja. (1973 or 1975). Tallinn: Valgus.

**MLB 6010 MOLECULAR AND CELL BIOLOGY**
4,5 ECTS 3 39-6 E Autumn Semester
***Objective:*** Major subject. To give an overview of the main principles in molecular biology of the cell.
***Course Outline:*** Prokaryotic and Eukaryotic Cells. Nucleic Acids. Protein Structure. Proteins as Catalysts. Genetic code. Translation. Recombinant DNA Technology. Viruses, Plasmids, and Transposable Genetic Elements.Membrane Structure. The Cell Nucleus. The Structure of Chromosomes. Chromosome Replication. Intracellular Compartments and Protein Sorting. The Compartmentalization of Higher Cells The Endoplasmic Reticulum. The Golgi Network. Vesicular Traffic. Energy Conversion: Mitochondria. Energy Conversion: Chloroplasts Cell Signaling. The Cell-Division Cycle. Cellular Mechanisms of Development. Cell Diversification Differentiated Cells and the Maintenance of Tissues.
***Learning Methods:*** Practicing lessons (4-5 during the course).
Methods of Assessment: write examination
***Prerequisite:*** MLK 6008
***Teacher:*** Associate Professor Ats Metsis
MLB 6010 *Molekulaar- ja rakubioloogia*
**Required Reading:**
1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J. D. (1994). Molecular Biology of the Cell. 3rd ed. Garland Pub.
2. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D., Darnell, J. (1999). Molecular Cell Biology. 4th ed. W H Freeman & Co.
3. Molekulaarne rakubioloogia. (1999). Tartu: Ilmamaa.

**MLB 6011 PLANT AND ANIMAL PHYSIOLOGY**
6,0 ECTS 3 34-16 E Spring Semester
***Objective:*** Major subject. To provide an overview of plant and animal physiology (about the important processes of anabolism and catabolism).
***Course Outline:*** Half of the course is about main functions of plants - about life processes in plants from the membrane and hormonal level through to the organism and environmental signal level, and about physiological adaptations to various environments. Main themes: water exchange, mineral nutrition, photosynthesis, growth and development, growth regulators. Growth and development of animals and different processes in organisms like mammals and human.
***Learning Methods:*** Lectures (attendance recommended), seminar and discussions (attendance compulsory). Every student must prepare a short lecture on specific theme.
***Methods of Assessment:*** Test and presentation about animal physiology.
***Prerequisite:*** MLB 6006
***Teacher:*** Assistant Lecturer Tõnu Ploompuu, Lecturer Toomas Põld
MLB 6011 *Taime- ja loomafüsioloogia*
**Required Reading:**
1. Miidla, H. (1984). Taimefüsioloogia. Tallinn.
2. Vander, A., Sherman, J., Luciano, D. (1990). Human Physiology. USA, 724.
3. Weston, T. (1985). Atlas of Anatomy. London: Marshall Cavendish Books.

**Recommended Reading:**
1. Animal Physiology. (1999). London.

**MLB 6012 BIODIVERSITY AND CONSERVATION BIOLOGY**
4,5 ECTS 2 24-6 G Autumn Semester
***Objective:*** Major subject. The aim is to provide the students with knowledge needed for the interpretation of biological principles of environmental protection.
***Course Outline:*** Short description. Fundamentals of Biodiversity and Conservation Biology (BCB). A survey of the development of environment protection, ideas and formation of BCB as a science. Theoretical principles of species protection and their application: factors causing the extinction of species, paradigm of small populations, paradigm of dying populations, principles concerning population, vitality analysis and drawing up of conservation management plans. The basis for the management of ecosystems protection. Scientific basis for the foundation of environment protection areas: problems relating to the size of nature reserves and the distance between them, green corridors. Problems relating to environment protection legislation at an international and local scale. Relationship between economy and environment protection policies.
***Learning Methods:*** Lectures and seminars. Independent work with compulsory literary sources. Assessing knowledge by means of a written test.
***Methods of Assessment:*** Only those who have compiled a paper, defended it and passed the preliminary test successfully are allowed to take the exam.
***Prerequisite:*** -
***Teacher:*** Professor Henn Kukk
MLB 6012 *Looduskaitsebioloogia*
**Required Reading:**
1. Eesti keskkonnastrateegia. (1997). Toimetas A. Raukas. Tallinn.
2. Kaitsealad elule. (1994). Euroopa kaitsealade tegevuskava lühikokkuvõte. Tallinn.
3. Vuorisalo, T. (1995). Keskkonnaökoloogia. Keskonnakaitse põhialused ja ürglooduse kaites. Tartu: Eesti Loodusfond.

**Recommended Reading:**
1. Eesti keskkonnaseisund XXI sajandi lävel. (2000). Tallinn: Keskkonnaministeeriumi info- ja tehnokeskus.
2. Meffe, K. G., Carrol, C. R. (1994). Principle of Conservation Biology. Massachusetts.

**MLB 6013 GENETICS**
3,0 ECTS 2 28-2 E Autumn Semester
***Objective:*** Major subject. To provide an overview of the principles of genetics.
***Course Outline:*** General course on genetics, which gives an overview of the history of genetics, its main trends and laws - Mendelian genetics and its cellular basis, sex determination and linkage, crossing over and chromosome mapping. Genetic material - properties and replication. Recombination in prokaryotes and transposable elements. Mutations. Gene expression. Quantitative traits. Evolutionary and population genetics.
***Learning Methods:*** Each student prepares a paper on a given subject using Internet databases and literature. For homework student solve segregation and linkage problems.
***Methods of Assessment:*** The final examination will be in the form of a written test. Re-examination is verbal. The written exam consists of three questions, an oral ticket and one genetics task.
***Prerequisite:*** -
***Teacher:*** Associate Professor Toomas Veidebaum
MLB 6013 *Geneetika*
**Required Reading:**
1. Brown, T. A. (1999). Genomes. BIOS Scientific Publishers, pp. 472.
2. Gardner, E. J., Simmons, M. J., Snustad, D. P. (1991). Principles of genetics. Wiley.

**Recommended Reading:**
1. Ayala, Kiger (1989). Sovremennaja genetika. Mir.

**MLB 6014 THE THEORY OF EVOLUTION**
3,0 ECTS 2 26-4 G Spring Semester
***Objective:*** Major subject. The theory of evolution is the most important theory in contemporary biological sciences. To provide students with knowledge of the main principles of evolutionary biology and in so doing give them a real basis from which to understand biological processes on all organisational levels of life. Modern or synthetic evolutionary biology is important for understanding the natural history and biological diversity of Earth.
***Course Outline:*** The course gives an overview of the rise of evolutionary ideas, the theories of Darwin and modern synthesis. Four main areas are covered: evolutionary genetics, adaptation and natural selection, biological diversity and the concept of species and macroevolution. The concepts of the origins of life and human evolution are also covered.

***Learning Methods:*** Students write an essay on different topics of evolutionary biology, which form a pre-requisite for sitting the final exam.
***Methods of Assessment:*** The written final exam consists of 10 short questions and two major topics of evolutionary biology discussed beforehand. An essay written by the student on one given topic during the course is a pre-requisite for sitting the final examination. Re-examination is verbal.
***Prerequisite:*** MLB 6013
***Teacher:*** Associate Professor Toomas Veidebaum
MLB 6014 *Evolutsiooniteooria*
**Required Reading:**
1. Evolution. Collection of selected papers. (1997). Ed. ByMark Ridley. Oxford readers. Oxford Univ.Press, 430 p.
2. Futuyama, D. J. (1998). Evolutionary Biology. Sinauer Assaciates, Inc. 763 p.
3. Mayr, E. (1962). Species concepts and their application. Animal species and evolution. Cambridge.
4. Patterson, C. (1999). Evolution. Second edition. Cornell University Press, N.Y. 166 p.
5. Ridley, M. (1996). Evolution. Blacwell Science, 720 p.

**Recommended Reading:**
1. Dobzhansky, T. (1973). Nothing in biology makes sense except in the light of evolution Amer. Biol.Teacher, 35, 125-129.
2. Mono, J. L. (1974). On the molecular theory of evolution. Problems of scientific revolution. Oxford University Press.
3. Simpson, G. G. (1961). One hundred years without Darwin. Teachers College Records, 60, 617-626.

**MLR 6003 MECHANICS**
7,5 ECTS 30-60 E Autumn Semester
***Objective:*** The goal of the subject is to give a systematic overview of the principles of mechanics and to develop mechanical problem solving skills.
***Course Outline:*** Kinematics of the issue of points and rigid bodies. Dynamics of translatory motion. Newtons laws. Force. Mass. Gravitation. Statics. Work and mechanical energy. Dynamics of rotational motion. Laws of conservation. Mechanics of fluids and gases.
***Learning Methods:*** Lectures. Problem solving exercises. Laboratory work.
***Methods of Assessment:*** Control work. Laboratory work reports. Class tests. Final examination.
***Prerequisite:*** **-**
***Teacher:*** Professor Ülo Ugaste, Assistant Lecturer Marko Reedik
MLR 6003 *Mehaanika*
***Required Reading:***
1. Physics. D.C.Giancoli. (1998). Prentice Hall.
2. Füüsika. Üldkursus näidetega bioloogiast ja meditsiinist. P.Holmberg jt. (1997). TPU, 1997.
3. Füüsika üldkursus I. I.Saveljev. (1977). Tallinn "Valgus."

***Recommended Reading:***
1. Füüsika gümnaasiumile I. Ü.Ugaste. (1997). Tallinn "Avita" (2.tr. 2001).
2. Füüsika praktikum I. Mehaanika, molekulaarfüüsika. J.Hendre. (1993). Tallinn TPU.
3. Füüsika ülesannete kogu. L.Juul, G.Mets, K.Schults. (1985). Tallinn. Valgus.

**MLR 6004 HEAT AND MOLECULAR STRUCTURE**
4,5 ECTS 30-30 E Spring Semester
***Objective:*** To obtain a systematic overview of the physics of heat and the basics of thermodynamics and skills to solve basic problems in this matter.
***Course Outline:*** Ideal gases. Laws of thermodynamics. Introduction to the kinetic theory of gases. The basics of statistical physics: temperature and pressure as statistical quantities, Maxwells and Boltzmanns distributions. Real gases and vapours. Fluids. Crystalline and amorphous substances. Polymers. Questions and problems. Laboratory activities.
***Learning Methods:*** Lectures. Group work and class work to investigate and solve different problems and exercises in seminars. A project about radioactivity. Individual and group work to solve of exercises and problems. In laboratory classes experiments will be carried out in groups of 2-3 people. The results of practical works will be presented individually.
***Methods of Assessment:*** Two tests on problems. Accepted tests, individual (home) works and laboratory activities are preconditions for passing to the oral exam. Final grade depends on the results of tests (33%) and the grade of the final exam (67%).
***Prerequisite:*** **-**
***Teacher:*** Associate Professor Tõnu Laas, Assistant Lecturer Marko Reedik

MLR 6004 *Soojusõpetus*

***Required Reading:***

1. Physics. Giancoli, D.C. (1998). New Jersey: Prentice Hall.
2. Füüsika. Üldkursus näidetega bioloogiast ja meditsiinist. II. Holmberg, P., jt. (1998). Tallinn: TPU Kirjastus.
3. Füüsika üldkursus I. Saveljev, I. (1977). Tallinn: Valgus.

***Recommended Reading:***

1. University Physics. Reese, R.L. (2000). Brooks/Cole Publishing Company.
2. Füüsika praktikum I. Mehaanika, molekulaarfüüsika. Hendre, J. (1993). Tallinn: TPU Kirjastus.
3. Füüsika ülesannete kogu. Juul, L., Mets, G., Schults, K. (1985). Tallinn: Valgus.

**MLR 6005 ELECTROMAGNETISM**

7,5 ECTS 30-60 E Spring Semester

***Objective:*** The goal of the subject is to give an overview of electromagnetism and the elementary skills in problem solving.

***Course Outline:*** Electrical fields in a vacuum and in dielectrics, conductors in an electrical field. The laws of direct current. Magnetic fields in a vacuum and materials. Magnetic properties of materials. Electromagnetic induction phenomena: the motion of charged particles in magnetic and electrical fields, electrical oscillations and electromagnetic fields. Laboratory works on the main problems of electromagnetism.

***Learning Methods:*** Lectures. Problem solving exercises. Laboratory work.

***Methods of Assessment:*** Control work. Laboratory work reports. Class tests. Final examination.

***Prerequisite:*** **-**

***Teacher:*** Professor Ülo Ugaste, Assistant Lecturer Tiit Lukki, Viljo Korsen

MLR 6005 *Elektromagnetism*

***Required Reading:***

1. Physics. D.C.Giancoli. (1998). Prentice Hall.
2. Füüsika. Üldkursus näidetega bioloogiast ja meditsiinist. II. P.Holmberg jt. (1998). TPU.
3. Füüsika üldkursus II. I.Saveljev. (1978). Tallinn "Valgus"

***Recommended Reading:***

1. Füüsika gümnaasiumile II. Ü.Ugaste. (1998). Tallinn "Avita."
2. Füüsika ülesannete kogu. L.Juul, G.Mets, K.Schults. (1985). Tallinn, Valgus.

**MLR 6006 OPTICS**

6,0 ECTS 30-60 E Autumn Semester

***Objective:*** The goal of the subject is to form a more adequate understanding of optical phenomena and their laws in the students´ worldview.

***Course Outline:*** Geometrical optics and photometry. Optical instruments. Wave optics: interference, diffraction, polarisation. Interaction between light and matter, dispersion. Spectra and spectral analysis. Scattering of light. Laws of radiation and the birth of quantum physics. Quantum optics: photoelectrical effect, Compton´s effect. Lab classes on geometrical optics and photometry, the eye, interference of light, diffraction, polarisation and dispersion, photoelectrical effect. Experiments with lasers, holography and fibre optics.

***Learning Methods:*** Lectures. Problem solving exercises. Laboratory works.

***Methods of Assessment:*** Tests. Laboratory work reports. Class tests. Final examination.

***Prerequisite:*** **-**

***Teacher:*** Professor Ülo Ugaste, Assistant Lecturer Astrid Rekker

MLR 6006 *Optika*

***Required Reading:***

1. University Physics. Reese, R.L. (2000). Brooks/ Cole Publ. Comp.
2. Füüsika. Üldkursus näidetega bioloogiast ja meditsiinist. III. Holmberg, P. jt. (1999). TPU
3. Füüsika üldkursus III. Saveljev, I. (1978). Tallinn, Valgus

***Recommended Reading:***

1. Physics. Giancoli D.C. (1998). Prentice Hall
2. Füüsika gümnaasiumile II. Ugaste, Ü. (1998). Avita
3. Füüsika 11. klassile. Voolaid, H. (1999). Optika. Koolibri

**MLR 6007 STRUCTURE OF MATTER**

7,5 ECTS 30-80 E Spring Semester

***Objective:*** The aim is to give a systematic overview of the structure of matter, atomic and nuclear physics, the generation of different nuclear and atomic radiation, interactions of radiation with matter and with the human body.

***Course Outline:*** The basics of atomic physics: Bohr´s atomic model, quantum-mechanical view of an atom, X-ray radiation, Moseley´s law. The basics of nuclear physics: radioactivity, nucleus of an atom, nuclear forces, binding energy, nuclear reactions. Elementary particles. Interaction of radiation and matter, measurement of radiation.
***Learning Methods:*** Lectures. Solving problems and carrying out exercises relating to the topic in class and group work. Research project on radioactivity. Carrying out exercises and solving problems in groups and individually. In laboratory classes the experiments will be carried out as group work in groups of 2-3. The results of practical work will be presented individually.
***Methods of Assessment:*** Two tests - problem solving tasks. A prerequisite for sitting the oral exam is acceptable passes in class tests, individual work and laboratory exercises. Final grades depend on the results of tests (33%) and the exam grade (67%).
***Prerequisite:*** **-**
***Teacher:*** Associate Professor Ain Ainsaar, Teacher Anneli Roode, Assistant Lecturer Astrid Rekker
MLR 6007 *Aine struktuur*
***Required Reading:***
1. Physics. New Jersey: Giancoli, D.C. (1998). Prentice Hall.
2. Füüsika. Üldkursus näidetega bioloogiast and meditsiinist. III. Holmberg, P. jt. (1999). Tallinn: TPU Kirjastus.
3. Füüsika üldkursus III. Saveljev, I. (1978). Tallinn: Valgus.

***Recommended Reading:***
1. Aatomimaailma seadused. Rõdnik, V. (1983). Tallinn: Valgus.
2. Füüsika gümnaasiumile III. Ugaste, Ü. (2000). Tallinn: Avita.
3. Füüsika ülesannete kogu. Juul, L., Mets, G., Schults, K. (1985). Tallinn: Valgus.
4. Experiments in Nuclear Science. AN34. Duggan., L.J. (1984). Laboratory Manual. EG&G Ortec.
5. Experiments in Nuclear Science. Chase, G.D., Rituper, S., Sulcoski, J.W. (1971). Burgess International Group, Inc./Alpha Editions.

**MLR 6008 ASTRONOMY**
4,5 ECTS 30-30 E Spring Semester
***Objective:*** Major and minor subject. To provide basic knowledge of classical astronomy and problems of modern cosmology in connection with the birth and evolution of the Universe.
***Course Outline:*** Celestial coordinates. Calendar and chronology. Movement of the planets and satellites. The Kepler laws. Physical parameters of the Sun, planets and moons. Solar and lunar eclipses. Tides and ebbs. Evolution of stars. Structure of galaxies. Position of the Solar system in the Meta-galaxy. Cosmological hypotheses, Big Bang.
***Learning Methods:*** Lectures, seminars, tests, excursion to an observatory.
***Methods of Assessment:*** Written tests, oral exam.
***Prerequisite:*** -
***Teacher:*** Associate Professor Ain Ainsaar, Professor Romi Mankin
MLR 6008 *Astronoomia*
***Required Reading:***
1. Kosmoloogia. Füüsika XII klassile. J. Jaaniste. ( 1999). Koolibri.
2. Kooliastronoomia põhivara T. Soopalu. (1994).
3. Täheatlas J. Jaaniste, E. Saar. ( 1990). Valgus.
4. Universum pähklikoores S. Hawking. (2002). Eesti Entsüklopeediakirjastus.

***Recommended Reading:***
1. Fizika kosmosa, Malenkaja entsiklopedija (vene k.) (1986).
2. P. I. Bakulin et al. Kurs obshtshei astronomii, (vene k.) (1989).
3. Universum. Koguteos. Horisont 1997 (1997).
4. "Horisondi" kosmoloogia-alased artiklid.
5. Astronomy: the evoling universe. M. Zeilik. (2002). Cambridge University Press, Cambridge.

**MLG 6021 INTRODUCTION TO LANDFORM STUDIES**
6,0 ECTS 4 45-15 E Autmn Semester
***Objective:*** Minor subject. To provide a holistic understanding of the natural environment. Demonstrate relationships within nature and explain the human factor in landscape evolution. To provide an overview of the diversity and value of landscapes, their protection and management.
***Course Outline:*** The concept of landscape. Land-forming components and their interrelation. Landscape boundaries. Hierarchical levels of landscape. The development and dynamics of hierarchical elements. Landscape maps and quantitative characteristics. Land use and cultural landscape. Landscape diversity.

Landscape values. Landscape protection, maintenance, management and sustainable usage.
***Learning Methods:*** Lectures. Independent work with literature, completion of an academic report.
***Methods of Assessment:*** In order to qualify to sit the examination students must have passed all their tests successfully.
***Prerequisite:*** MLG 6001
***Teacher:*** Lecturter Reimo Rivis
MLG 6021 *Maastikuteaduse alused*
**Required Reading:**
1. Forman, R. T. (1995). Land mosaics. Cambridge.
2. Palang, H., Sooväli, H. (toimetajad) (2001). Maastik: loodus and kultuur. Maastikukäsitlus Eestis. Tartu: TÜ Geography Instituut Publicationes Instituti Geographici Universitis Tartuensis 91.
3. Hansen; A. J., F. di Castri eds. (1992). Landscape boundaries. Ecological Sudies, 92. Vol. 92. Spring-Verlag.

**MLG 6023 CLIMATOLOGY AND METEOROLOGY**
6,0 ECTS 4 45-15 E Spring Semester
***Objective:*** Minor subject. To provide an overview of the concepts as well as the development and importance of meteorology and climatology. To develop the skill to relate climatic conditions to geographical systems, geographical zones and landscapes.
***Course Outline:*** Terminology of climatology and meteorology, relationships between these and other disciplines. The effect of climate forming factors on the creation of weather and climate. The formation of climatic elements and their distribution on Earth. The hierarchy of climatic systems and their relationship to the landscape. Most commonly used systems of climatic regionalisation. Methods of climatic monitoring and research.
***Learning Methods:*** Lectures, independent work with literature. Academic reports, presentations in class.
***Methods of Assessment:*** Written exams, the precondition of which is participation in seminars.
***Prerequisite:*** MLG 6001
***Teacher:*** Associate Professor Jaan Jõgi
MLG 6023 *Klimatoloogia ja meteoroloogia*
**Required Reading:**
1. Avaste, O. (1990). Klimatoloogia. Tartu, 103 lk.
2. Blüthgen, I. (1966). Allgemeine klimageographie. Berlin, (vene keelne tõlge aastast 1973)- I osa 428.
3. Calder, N. (1987). Ilmaköök. Tallinn. - 200 lk.

**MLG 6024 PALEOGEOGRAPHY**
6,0 ECTS 3 30-15 E Autumn Semester
***Objective:*** Minor subject. To introduce the students to an interdisciplinary analysis of the principles of physical geography, physics, biology and archaeology. To reconstruct the development of landscapes and geospheres in the past and predict their future.
***Course Outline:*** The concept of temporal-spatial scale and its application in paleogeography, methods for reconstructing Holocene environments, palaeoecological techniques. An overview of the modern advances in the field of paleoclimatology, pleistocene glaciations.
***Learning Methods:*** Class work, academic reports on the given topic and discussions. Participation in class work is recommended, attendance of seminars and discussions is mandatory.
***Methods of Assessment:*** In order to qualify to sit the examination students must have presented and defended their academic reports successfully. The examination grade is based on the academic reports and knowledge on the topics discussed in lectures.
***Prerequisite:*** MLG 6001
***Teacher:*** Professor Jaan-Mati Punning
MLG 6024 *Paleogeography*
**Required Reading:**
1. Berglund, B. (1986). Handbook of Holocene paleoecology and paleohydrology. New-York, (valitud ptk).
2. Raymond, S. Bradley. Paleoclimatology: reconstructing climates of the Quaternary. 1999. Academic press, San Diego, 613 pp.
3. Roberts, N. (1993). An environmental history. Oxford.

**MLG 6026 ENVIRONMENTAL ISSUES AND NATURE PRESERVATION IN ESTONIA**
4,5 ECTS 3 45-15 E Spring Semester
***Objective:*** Minor subject. To provide an overview of the main environmental problems in Estonia, to evaluate their origin, peculiarities and possibilities for mitigation. The purpose and methods of modern environmental protection - goals and actions.

***Course Outline:*** The human impact on the environment. The main natural resources and environmental problems in Estonia. The origin of environmental problems, the possibilities for mitigation and avoidance. The development of environmental protection, goals and current situation in Estonia. Legislation and international cooperation in environmental protection.
***Learning Methods:*** A basic overview will be given in the lectures, independent work with literature for writing an academic paper and for preparing for the workshop discussions on special set topics.
***Methods of Assessment:*** Examination. In order to qualify for the examination, participation in workshops and writing the academic paper is mandatory.
***Prerequisite:*** MLG 6001
***Teacher:*** Assocaite Professor Edgar Karofeld
MLG 6026 *Keskkonnaprobleemid ja looduskaitse Eestis*
**Required Reading:**
1. Sepp, K. (koostaja) (1996) Eesti looduskaitse. Tallinn: Keskkonnaministeerium, Huma.
2. Eesti keskkonnastrateegia. (1997) Kinnitatud Riigikogu otsusega 12. III. 1997. a. Tallinn.
3. Eesti keskkonnaseisund XXI sajandi lävel. (2000). Tallinn: Keskkonnaministeeriumi Info- ja Tehnokeskus.

**MLG 6027 INTRODUCTION TO HUMAN GEOGRAPHY**
6,0 ECTS 4 45-15 E Autumn Semester
***Objective:*** Minor subject. To provide an overview of the main theoretical approaches to human geography, the different fields, developments and current situation. To develop skills of written and oral communication by preparing and presenting presentations related to topics studied.
***Course Outline:*** General overview of population geography, cultural geography, spatial geography, economic geography, political geography, geography of natural resources and others. The development of human geography in Estonia is also touched upon.
***Learning Methods:*** Lectures and seminars, where students present their written research papers on topics touched upon in lectures.
***Methods of Assessment:*** Written exam and results of the research paper.
***Prerequisite:*** **-**
***Teacher:*** Assistant Lecturer Andres Kratovitš
MLG 6027 *Sissejuhatus inimgeograafiasse*
**Required Reading:**
1. Getis, A., Getis, J., Fellmann, J.D. (1985). Human Geography. Culture and Environment.
2. Getis, A., Getis, J., Fellmann, J.D. (1996). Introduction to Geography.
3. Jauhiainen, J. S., Kulu, H. (2000). Inimesed, ühiskonnad ja ruumid. Inimgeograafia Eestis. Tartu: TÜ Kirjastus.

**MLG 6030 GEOGRAPHICAL INFORMATION SYSTEMS**
3,0 ECTS 2 15-15 E Autumn Semester
***Objective:*** Now what is a map and cartography. To provide theoretical knowledge and practical skills for maping and and map using. To provide basic knowledge of the GIS and its using.
***Course Outline*** Classical cartography. Structure of cartography and relationship with other sciences. Map elements, conventional signs. Base and thematic maps. Map projections and geographical grid system (latitude, longitude). Using of maps. GIS and its development. Elements of GIS - data input, software, hardware, and users.
***Learning Methods:*** Lectures, practical works.
***Methods of Assessment:*** Examination, students must have passed all their practical works.
***Prerequisite:*** MLG 6001
***Teacher:*** Lecturer Reimo Rivis
MLG 6030 *Geograafilised infosüsteemid*
Required Reading:
11. Jagomägi, T. (1999). Geoinfosüsteemid praktikule Regio, 191.
12. Jõgi, J., Tõnisson, A. (1996). Sissejuhatus üldgeograafiasse Tallinn, 245.
13. Kala, V. (2001). Kartograafia alused. TTÜ Kirjastus, 148.

**MLG 6032 FIELD WORK IN PHYSICAL GEOGRAPHY**
4,5 ECTS 3 5-40 G Spring Semester
***Objective:*** Minor subject. To give theorethical and practical basics to select the methods to solve current research topics. To obtaining in hands on practice the main methods in geoecological field studies in field course. Basics in data analysis and presentation.

***Course Outline:*** In field course the main methods for geoecological field studies will be evaluated and obtained in practical use. Independent field work to carry on the studies about current research topic. Data analysis and their presentation.
***Learning Methods:*** Independent work to prepare for field studies on given research topic. Field studies in field course followed by data analysis and presentation.
***Methods of Assessment:*** Assessment. In order to qualify for assessment the participation in field course, data analysis and presentation is mandatory.
***Prerequisite:*** -
***Teacher:*** Assocaite Professor Edgar Karofeld
MLG 6032 *Loodusgeograafia kompleksprаktika*
**Required Reading:**
1. Arhangelskii, A. M. (toim.) (1972) Metodika polevõh fiziko-geografitcheskih issledovanii. Moskva.(vene k.).
2. Berglund, B. E. (Ed.) (1986). Handbook of Holocene Palaeoecology and Palaeohydrology. John Wiley & Sons.
3. Hannus, M., Loigu, E. (koostajad) (1996). Pinnavete seire metoodiline juhend. EV Keskkonnaministeerium, Info- and Tehnokeskus, Eesti Keskkonnauuringute Kesklabor. Tallinn.
4. Kink, H., Kont, A., Ratas, U., Zobel, M. (1988). Maastiku kompleksprofiili koostamise metoodiline juhend. ENSV Riiklik Looduskaitse ja Metsamajanduse Komitee. Tallinn.

**MLG 6034 FIELD TRIP**
3,0 ECTS 0-40 G Spring Semester
***Objective:*** Minor subject. To introduce the main landscape regions, most pronounced landscape objects and environmental problems in North-Estonia in situ and to confirm and deepen understanding of material from the lectures and workshops.D45.
***Course Outline:*** Field course for becoming acquainted with the main natural regions of North-Estonia. Overview of the geological development of the region, main environmental problems, their origin, peculiarities and possibilities for mitigation.
***Learning Methods:*** Based on the recommended reading students will compose an overview of the region and complete the discussion satisfactorily.
***Methods of Assessment:*** In order to qualify for the assessment, participation in field work and discussions is mandatory.
***Prerequisite:*** -
***Teacher:*** Associate Professor Edgar Karofeld
MLG 6034 *Õppeekskursioon*
**Required Reading:**
1. Will be dispersed for students depending from course route and referate topic.

**MLG 6036 PHYSICAL GEOGRAPHY OF THE CONTINENTS AND HISTORY OF GEOGRAPHICAL DISCOVERIES**
6,0 ECTS 4 45-15 E Autumn Semester
***Objective:*** Minor subject. Aim of which is to give an overview physical condition of Continents (relationship between different components of landscape and relationship between people and nature in different bioms).
***Course Outline:*** Physical Conditions of Continents (location, relief connected with geological structure and development, climate, water, soil, natural zones). Relationships between people and nature on different continents. The development of geographical global vision of the Europeans.
***Learning Methods:*** Lectures. Students must have present their academic reports.
***Methods of Assessment:*** Oral assesment topics covered in lectures.
***Prerequisite:*** MLG 6001
***Teacher:*** Lecturer Sirje Siska
MLG 6036 *Maailma loodusgeograafia ja geograafiliste avastuste ajalugu*
**Required Reading:**
1. Attenborough, D. (1989). The living Planet. L-N-Y.460 p.
2. Nilson, O. (1975). Maa avastamine. Tallinn.
3. Waugh, D. (1995). Geography an integrated approach. Walton-om-Thames. Melbourne-Scarborough, 1995. 593 p.

**MLK 6003 INORGANIC CHEMISTRY I**

6,0 ECTS 5 30-45 E Autumn Semester

***Objective:*** Minor subject. To present the chemistry of the elements in the main groups. Practical skills and experience of laboratory work will be obtained.

***Course Outline:*** Dealing with the elements in conformity with the IUPAC system (groups 1-18) on the basis of filling electron subshells (s-, p-, d- and f-elements). Treatment of the elements within the bounds of the Periodic System (main groups): characterisation of groups, the individual elements, their chemical properties and compounds, technological aspects and utilisation, biological function, etc. General requirements, equipment and methods for laboratory work. Practical tasks: the determination of atomic and molar masses, the velocity and equilibrium of chemical reactions, solution chemistry and electrochemistry.

***Learning Methods:*** Lectures and lab work. The lecture course is divided into three cycles, each of which ends with a written progress-exam.

***Methods of Assessment:*** Written exam. To take the final exam, each student has to pass the progress-exams and actively participate in lab work.

***Prerequisite:*** MLK 6001

***Teacher:*** Associate Professor Kalle Truus, Lecturer Helvi Hödrejärv

MLK 6003 *Anorgaaniline keemia I*

**Required Reading:**

1. Hödrejärv, H., Truus, K. (2002). Üld- ja anorgaanilise keemia praktikum. Tallinn: TPU Kirjastus.
2. Karik, H., Truus, K. (2003). Elementide keemia. Ülikooliõpik anorgaanilisest keemiast. Tallinn: Kirjastus Ilo.

**Recommended Reading:**

1. Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann, M. (1999). Inorganic Chemistry. 6th Ed. New York e.a.: John Wiley & Sons.

**MLK 6004 INORGANIC CHEMISTRY II**

6,0 ECTS 5 30-45 E Autumn Semester

***Objective:*** Minor subject. The course deals with the chemistry of minor group elements. The course offers practical skills and experience of laboratory work.

***Course Outline:*** Metals of groups 3-10 (d-elements): detailed treatment and generalisations. Non-metals in the Periodic system, the structure and properties of elements and their compounds. Metals in the Periodic system. Technology, properties and uses of metals. Polymorphism, electrochemical series and metal alloys. Binary compounds of metals: oxides, hydrides, etc. The most relevant complex compounds. Practical works: alkali metals and the copper group. Magnesium, alkaline-earth metals. Elements of groups 4-16: a choice of experiments. A systematic chemical analysis of cations and anions.

***Learning Methods:*** Lectures and lab work. The lecture course is divided into three cycles, each of which ends with a written exam.

***Methods of Assessment:*** Written examination. To take the final exam, each student has to pass mid-course exams and has to actively participate in lab work.

***Prerequisite:*** MLK 6003

***Teacher:*** Associate Professor Kalle Truus, Lecturer Helvi Hödrejärv

MLK 6004 *Anorgaaniline keemia II*

**Required Reading:**

1. Hödrejärv, H., Truus, K. (2002). Üld- and anorgaanilise keemia praktikum. Tallinn: TPU Kirjastus.
2. Karik, H., Truus, K. (2003). Elementide keemia. Ülikooliõpik anorgaanilisest keemiast. Tallinn: Kirjastus Ilo.
3. Truus, K. (2000). Anorgaaniline keemia II. Tallinn: TPU Kirjastus.

**Recommended Reading:**

1. Greenwood, N. N., Earnshaw, A. (1998). Chemistry of the Elements. 2nd Ed. Oxford e.a.: Butterworth-Heinemann.

**MLK 6005 ORGANIC CHEMISTRY I**

6.0 ECTS 5 30–45 E Autumn Semester

***Objective:*** Minor subject. To introduce the basic principles of organic chemistry and give an overview of the most important organic compounds. The practical section introduces the principle techniques used in analysis, purification and synthesis of organic compounds. A knowledge of organic chemistry is required for studies of bio-organic chemistry, biochemistry and environmental chemistry.

***Course Outline:*** Molecular structure of organic compounds. Chemical bonding. Hybridisation. Classification and nomenclature. Reaction mechanisms in organic chemistry: reactions of radicals, electrophiles and nucleophiles. Hydrocarbons (alkanes, alkenes, alkynes, cycloalkens, arenes). Alkyl halides. Organic oxygen

compounds (hydroxyl and oxocompounds). Organic nitrogen and sulphur compounds. Heterocycles. Experimental section: separation, purification and analysis of organic compounds. Chemical properties of organic compounds. Synthesis of 2-3 organic compounds.
***Learning Methods:*** Lectures, seminars and laboratory work. Each student must prepare a report that will be presented in a seminar. Participation in seminars and laboratory work is compulsory.
***Methods of Assessment:*** Written examination. To take the final exam, each student must pass two progress examinations and must defend reports of laboratory work.
***Prerequisite*:** MLK 6001
***Teacher:*** Lecturer Karl-Kristjan Kuiv, Master Student Rando Tuvikene
MLK 6005 *Orgaaniline keemia I*
**Required Reading:**
1. Talvik, A.-T. (1996). Orgaaniline keemia. Tartu.
2. McMurry, J. (2000). Organic Chemistry. Brooks/Cole.

**Recommended Reading:**
1. Vollhardt, K. P., Schore, N. E. (1999). Organic Chemistry. New York: W. H. Freeman and Company.

**MLK 6006 ORGANIC CHEMISTRY II**
3,0 ECTS 2 30-0 G Spring Semester
***Objective:*** Minor subject. The course deals with theoretical aspects of organic chemistry.
***Course Outline:*** Chemical bonds and molecular structure. Electron effects: induction, conjugation and resonance. Mesomeric structures. Aromaticity. Hetero-aromatic compounds. Electrophilic substitution reactions of aromatic compounds, rules of orientation. Stereochemistry. Configuration and conformation. Optical Activity. Chirality. Acid-based characteristics of organic compounds. Redox reactions in organic chemistry. Element- and metallo-organic compounds. a-Substitution and condensation. Reactions of carbonyl compounds. Nucleophilic substitution. Reactions of carboxylic acid derivatives. Bifunctional carboxylic acids (hydroxy-, oxy- and amino acids). High molecular organic compounds (polymers). Biopolymers.
***Learning Methods:*** Introductory and consultation lectures. Discussion of reports presented by students.
***Methods of Assessment:*** The graded preliminary test includes two parts: oral (justification of reports) and written. Results of these tests will contribute towards a final grade.
***Prerequisite:*** MLK 6005
***Teacher:*** Lecturer Karl-Kristjan Kuiv
MLK 6006 *Orgaaniline keemia II*
**Required Reading:**
1. Graham Solomons, T. W. (1990). Fundamentals of Organic Chemistry. New York: John Wiley and sons.
2. McMurry, J. (2000). Organic Chemistry. Brooks: Cole.
3. Vollhardt, K. P., Schore, N.E. (1999). Organic Chemistry. Structure and Function. New York: W.H. Freeman and Company.

**Recommended Reading:**
1. Holum, J. R. (1996). Organic and Biological Chemistry. New York: John Wiley and sons.
2. Talvik, A.-T. (1996). Orgaaniline keemia. Tartu.

**MLK 6007 BIO-ORGANIC CHEMISTRY**
3,0 ECTS 3 15-15 G Spring Semester
***Objective:*** Minor subject. Bio-organic chemistry links chemistry and biochemistry. The current course deals with the structure and reactivity of biomolecules.
***Course Outline:*** Bio-elements. Biologically essential organic compounds. Biopolymers and their complexes. The structure of biomolecules: configuration, cis/trans and optical isomeria, conformation and conformational changes. Heterofunctional organic compounds. Saccharides and proteins. The hierarchy of protein structures: primary, secondary, tertiary and quaternary structure. Enzymes. Heterocycles and nucleotides. Lipids (fatty acids, triglycerides, steroids and prostaglandins). Lipid aggregates: micells and lipoproteins. Bioregulators (hormones and vitamins). Physiologically active artificial compounds. Central biochemical reactions in human body. Experimental section: the purification and analysis of proteins, lipids and nucleic acids. The kinetics of enzyme catalysis.
***Learning Methods*** Lectures, seminars and laboratory pracs. Participation in seminars and laboratory pracs is compulsory.
***Methods of Assessment:*** Written preliminary exam. To take the exam, each student has to actively participate in seminars and has to adhere to laboratory protocols.
***Prerequisite:*** MLK 6006
***Teacher:*** Associate Professor Aivar Lõokene, Master Student Rando Tuvikene
MLK 6007 *Bioorgaaniline keemia*

**Required Reading:**
1. Metzler, D.E. (2001). Biochemistry. The chemical reactions of living cells. Harcourt: Academic Press.

**Recommended Reading:**
1. McMurry, J., (2000). Organic chemistry. Brooks/Cole.
2. Zilmer, M., Karelson, E., Vihalemm, T. (2001). Meditsiiniline biokeemia I. Tartu.

**MLK 6008 BIOCHEMISTRY**

4,5 ECTS 4 40–0 E Spring Semester

***Objective:*** Minor subject. The course deals with molecular basis of living matter and gives an overview of the main chemical reactions in organisms. This knowledge is needed for the studies of other biological subjects.

***Course Outline:*** The chemical composition of living matter. Biological structures: cells and tissues. Biomolecules (proteins, saccharides, lipids, nucleic acids). The role of water and inorganic ions in biological processes. Biomembranes and membrane transport. Receptors. The regulation of enzyme catalysis. Vitamins. Hormones. Metabolic-matter and energy exchange of living organisms. Biological oxidation. High energy compounds (ATP). Oxidative phosphorylation. Coenzymes. The metabolism of saccharides, lipids, proteins and nucleic acids. Biochemical processes in muscle contraction and in nerve signal transduction. Blood biochemistry. The biological functions of the kidney and liver.

***Learning Methods:*** Lectures and seminars. The course is divided into four sections. Each section ends with a written progress exam. In addition, each student is required to present a report on a topic to be given by the lecturer.

***Methods of Assessment:*** Written exam. To take the final exam each student has to pass the progress exams and has to actively participate in seminars.

***Prerequisite*:** MLK 6005

***Teacher:*** Associate Professor Aivar Lõokene

MLK 6008 *Biokeemia*

**Required Reading:**
1. Zilmer, M., Karelson, E., Vihalemm, T. (2001). Meditsiiniline biokeemia I. Tartu.
2. Zilmer, M., Karelson, E., Vihalemm, T. (1999). Meditsiiniline biokeemia II. Tartu.

**Recommended Reading:**
1. Lehninger, A. L., Nelson, D. L., Cox, M.,M. (2000). Principles of Biochemistry. New York.
2. Metzler, D. E. (2001). Biochemistry. The Chemical Reactions of Living Cells. Harcourt: Academic Press.

**MLK 6009 PHYSICAL AND COLLOID CHEMISTRY**

6,0 ECTS 5 45-30 E Spring Semester

***Objective:*** Minor subject. To acquire knowledge of physical and colloid chemistry and the application of it in interpreting the results of laboratory work.

***Course Outline:*** The properties of gases. Principles of thermodynamics. Thermochemistry. Phase equilibrium. The properties of mixtures. Chemical equilibrium. Solutions, the properties of dilute solutions. Electrochemical cells and electrode potential. Reaction rate and catalysis. Molecular structure and properties. Practical works: molar mass determination, surface phenomena and absorption on interface, formation and properties of colloids, spectrophotometry, pH measurement.

***Learning Methods:*** Lectures, independent work and laboratory work. Compilation of the reports of laboratory experiments.

***Methods of Assessment:*** In order to qualify to sit the examination students must have finished all laboratory work, successfully defended laboratory reports and passed four tests. Students must pass the examination.

***Prerequisite:*** MLK 6001

***Teacher:*** Lecturer Andres Mähar

MLK 6009 *Füüsikaline ja kolloidkeemia*

**Required Reading:**
1. Atkins, P. (2001). The Elements of Physical Chemistry. 3rd ed. Oxford: Oxford University Press.
2. Palm, U., Past, V. (1974). Füüsikaline keemia. Tallinn: Valgus.
3. Raukas, M. jt. (1997). Kolloidkeemia praktikum.

**Recommended Reading:**
1. Brdicka, R. (1990). Grundlagen der physikalischen Chemie. Berlin: Deutscher Verlag der Wissenschaften.

**MLK 6010 ANALYTICAL CHEMISTRY AND INSTRUMENTAL ANALYSIS**

6,0 ECTS 5 30-45 E Autumn Semester

***Objective:*** Minor subject. To develop the knowledge and skills needed to perform a chemical analysis of different objects. A review of the contemporary methods and directions of analytical chemistry.

***Course Outline:*** Principles of the methods of analytical chemistry. Qualitative analysis of cations, anions, alloys and minerals. Volumetry. Gravimetry. Methods of instrumental analysis: photometry, electrochemical analysis, chromatography, mass-spectrometry, thermal analysis. Separation and concentration methods: extraction, distillation, co-precipitation. Chemical analysis of natural objects. Sensitivity and accuracy of chemical analysis. Statistical analysis of the data.
***Learning Methods:*** Lectures and laboratory work. Compiling reports of laboratory experiments.
***Methods of Assessment:*** Written exam. The precondition for the exam is the finishing of all laboratory work and the successful defence of laboratory reports.
***Prerequisite:*** MLK 6001
***Teacher:*** Lecturer Helvi Hödrejärv
MLK 6010 *Analüütiline keemia ja instrumentaalanalüüs*
**Required Reading:**
1. Hödrejärv, H. (2000). Kvantitatiivne keemiline analüüs. Tallinn: TPU Kirjastus.
2. Hödrejärv, H., Truus, K. (2002). Üld- and anorgaanilise keemia praktikum. Tallinn: TPU Kirjastus.

**Recommended Reading:**
1. Kellner, R., Mermet, J-M., Widmer, O. M. (1998). Analytical Chemistry: the Approved text to thr FECS Curriculum Analytical Chemistry. Weinheim, Ney York, Chichester, Brisbane, Toronto, Singapore, Wiley-VCA.

**MLK 6020 FOOD CHEMISTRY**
4,5 ECTS 3 30-15 E Autumn Semester
***Objective:*** Minor subject. The development of the concept about the chemical composition of foodstuffs and the changes taking place by processing of them. The explanation of the factors determining the nutritive value of foodstuffs. The subject extends the information received by studying the main subjects in chemistry.
***Course Outline:*** The chemical composition of foodstuffs. Macro and micro nutrients. Food additives. Preservatives, food color, antioxidants, sweeteners, intensifiers of flavor and taste, emulsifiers, stabilizers, gelling agents e.c. Classification of foodstuffs and general characterization. Water in foodstuffs. Water activity. The chemical composition of raw material of foodstuffs: milk, meat, fish, cereals, fats and oils e.c. The chemical and physical changes by food processing. Micro nutrients in food. The factors influencing the activity of vitamines. Artificial foodstuffs. Practical works: introduction to the basic methods of analysis of foodstuffs; analysis of milk, meat and bread products and refreshing drinks.
***Learning Methods:*** Lectures and practical works. Individual work with literature.
***Methods of Assessment:*** Written exam.
***Prerequisite:*** -
***Teacher:*** Associate Professor Kaie Pappel
MLK 6020 *Toiduainekeemia*
**Required Reading:**
1. Belitz, H.-D., Grosch W. (1992). Lehrbuch der Lebensmittelchemie. 4. Aufl. Berlin Heidelberg: Springer.
2. Belitz, H.-D., Grosch W. (1999). Food Chemistry. 2rd ed. Berlin Heidelberg: Springer.
3. Timotheus, H. (1999). Praktiline keemia. Tallinn: Avita.

**Recommended Reading:**
1. Fennema, O. R. (1996). Food Chemistry. 3rd ed. N-Y: Marcel Dekker.
2. Fortin, F. et al (1996). The Visual Food. Food and Cooking Encyclopedia. N-Y: Macmillian.
3. The Cook`s Thesaurus (2001). http://www.foodsubs.com

**MLB 6100 BACHELOR THESIS**
6.0 ECTS 0–0 G Spring Semester
***Objective:*** The goal of the bachelor thesis is to enable the student to conduct in advanced research and analysis of chosen problems, relying on contemporary theories and research methods.
***Course Outline:*** Consists essentially of individual scientific research. Contains both literature analysis and original research experiment (collection and analysis of data, building up methodology etc.) (Deadline determined by course schedule).
***Learning Methods:*** Individual work under supervision.
***Methods of Assessment:*** Bachelor thesis is defended at a professional board and the andience.
***Prerequisite:*** All other curriculum subjects
***Teacher:*** Teaching staff of chair
MLB6100 Bakalaureusetöö
**Required Reading**
1. Internet: TPU Loodusteaduste osakonna proseminari- and lõputöö vormistamise and kaitsmise juhend. (1999). http://www.tpu.ee/ editmode/akastruktuur/matemaatika/loodusteadused//juhend.doc)(07.05.03.).

**Recommended Reading**

1. Internet: Instructions to authors. Proceedings of the Estonian Academy of Sciences. Biology. Ecology. http://www.kirj.ee/a-juh-u.htm (07.05.03.).
2. Üliõpilaste kirjalikud uurimistööd. TÜ majandusteaduskond. Kaldaru, H., Paas, T., Sikk, J., Reiljan, E., Tamm, K. (2000). Internet: http://infutik.mtk.ut.ee/Ope/KirTJuh00.pdf (07.05.03.).

**MLG 6100 BACHELOR THESIS**

6,0 ECTS 0-0 G Spring Semester

***Objective:*** Compulsory subjects, gives experiences about the structure, principles and methodology of the research projects. A skill to write reports and uses scientific literature.

***Course Outline:*** Research paper on the field of geo-ecology, with main orientation to the analyse of the special literature and writing scientific papers.

***Learning Methods:*** Individual work under the supervision.

***Methods of Assessment:*** In order to qualify for the exam the students must have passed the defence of report. The quality of presented work and argued discussion will taken into consideration.

***Prerequisite:*** All other curriculum subjects

***Teacher:*** Teaching staff of chair

MLG 6100 *Bakalaureusetöö*

**Required Reading:**

- TPU Loodusteaduste osakonna proseminari- and lõputöö vormistamise and kaitsmise juhend. (2003).
- Internet:http://www.tpu.ee/editmode/akastruktuur/matemaatika//loodusteadused//juhend.doc [07.05.03].
- The scientific literature on the topic of term paper.

**MLR 6100 BACHELOR THESIS**

6,0 ECTS 0-0 G Spring Semester

***Objective:*** The goal of the bachelor thesis is to enable the student to conduct in advanced research and analysis of chosen problems, relying on contemporary theories and research methods.

***Course Outline:*** Consists essentially of individual scientific research. Contains literature overview and analysis with research experiment (collecting and analysis of data, building up experimental strategy, etc.) and discussion of results.

***Learing Methods:*** Individual work under supervision.

***Methods of Assessment:*** Bachelor thesis is defended at a professional board and the andience.

***Prerequisite:*** All other curriculum subjects

***Teacher:*** Teaching staff of chair

MLR 6100 *Bakalaureusetöö*

**Required Reading:**

1. P. Reiska. (2005). Experimente und Computersimulationen im nature wissenschaftlichen Unterricht. Peter Lang GmbM. Frankfurt am Main.
2. TPU loodusteaduste osakonna proseminari- and lõputöö vormistamise and kaitsmise juhend 2003.a.
3. The scientific literature on the topic of term paper.

**MLK 6100 BACHELOR THESIS**

6,0 ECTS 0-0 G Spring Semester

***Objective:*** The goal of the bachelor thesis is to enable the student to conduct in advanced research and analysis of chosen problems, relying on contemporary theories and research methods.

***Course Outline:*** Consists essentially of individual scientific research. Contains literature overview and analysis with research experiment (collecting and analysis of data, building up experimental strategy, etc.) and discussion of results.

***Learing Methods:*** Individual work under supervision.

***Methods of Assessment:*** Bachelor thesis is defended at a professional board and the andience.

***Prerequisite:*** All other curriculum subjects

***Teacher:*** Teaching staff of chair

MLR 6100 *Bakalaureusetöö*

**Required Reading:**

1. Literature sources according to the research topic.
2. TPU loodusteaduste osakonna proseminari- and lõputöö vormistamise and kaitsmise juhend 2003.a.

## Appendix 4

# Natural Sciences: The standard division of the subjects of the curriculum into semesters

**1. Semester 03/04 Autumn**

| | Subject Code | ECTS | E/G | T/W |
|---|---|---|---|---|
| **till 13.30** | MLB6001 General Biology | 4,5 | E | 3 |
| | MLG6001 Basics of General Geography | 4,5 | E | 3 |
| | MLK6001 General Chemistry | 4,5 | E | 3 |
| | MLR6001 Physical Picture of the World | 4,5 | E | 3 |
| | MLB6005 Introduction of Botany | 4,5 | E | 3 |
| | MLR6003 Mechanics | 7,5 | E | 6 |
| | | 30,0 | | |

**2. Semester 03/04 Spring**

| | Subject Code | ECTS | E/G | T/W |
|---|---|---|---|---|
| **till 13.30** | MLG6901 Geograpfy of Estonia | 4,5 | E | 3 |
| | MLT6901 Mathematical Methods in Natural Sciences | 4,5 | G | 4 |
| | MLT6902 Physical Methods in Sciences | 4,5 | G | 4 |
| **till 14.00** | | | | |
| | MLB6006 Introduction to Zoology | 6,0 | E | 3 |
| | MLB6008 Field Works in Floristics and Faunistics | 3,0 | G | |
| | MLR6004 Heat and Molecular Structure | 4,5 | E | 4 |
| | MLR6005 Electromagnetism | 7,5 | E | 6 |
| | | 34,5 | | |

2003/2004. **Major subjects: Biology and Physics (BF)**

**3. Semester 04/05 Autumn**

| | Subject Code | ECTS | E/G | T/W |
|---|---|---|---|---|
| **till 13.30** | MLB6902 General Ecology | 4,5 | E | 3 |
| | MLK6901 Environmental Chemistry | 5.0 | E | 3 |
| **till 14.00** | | | | |
| | MLB6013 Genetics | 3,0 | E | 2 |
| | MLR6006 Optics | 6,0 | E | 4 |
| | | 18,5 | | |
| | ***Minor CHEMISTRY*** | | | |
| | MLK6003 Inorganic Chemistry I | 6.0 | E | 5 |
| | MLK6004 Inorganic Chemistry II | 6,0 | E | 5 |
| | | 12,0 | | |
| | ***Minor GEOGRAPHY*** | | | |
| | MLG6021 Introduction to Landform Studies | 6,0 | E | 4 |
| | MLG6036 Physical Geography of the Continents and History of Geographical Discoveries | 6,0 | E | 4 |
| | | 12,0 | | |
| | **BFK** | **30,5** | | |
| | **BFG** | **30,5** | | |

**4. Semester 04/05 Spring**

| | Subject Code | | ECTS | E/G | T/W |
|---|---|---|---|---|---|
| | MLR6007 Structure of Matter | | 7,5 | E | 6 |
| | MLB6007 Environmental Sciences | | 3,0 | G | 2 |
| | MLB6014 The Theory of Evolution | | 3,0 | G | 2 |
| | MLB6011 Plant and Animal Physiology | | 6,0 | E | 4 |
| | | | 19,5 | | |
| | ***Minor CHEMISTRY*** | | | | |
| | MLK6009 Physical and Colloid Chemistry | | 6,0 | E | 5 |
| | | | 6,0 | | |
| | ***Minor GEOGRAPHY*** | | | | |
| | MLG6026 Enviromental Issues and Natural Preservation in Estonia | | 4,5 | E | 3 |
| | MLG6034 Field Trip | | 3,0 | G | 2 |
| | | | 7,5 | | |
| | | **BFK** | **25,5** | | |
| | | **BFG** | **27,0** | | |

**5. Semester 05/06 Autumn**

| | Subject Code | | ECTS | E/G | T/W |
|---|---|---|---|---|---|
| **till 13.30** | | | | | |
| **till 14.00** | MLB6010 Molecular and Cell Biology | | 4,5 | E | 3 |
| | MLB6012 Biodiversity and Conservation Biology | | 4,5 | G | 2 |
| | MLR6008 Astronomy | | 4,5 | E | 4 |
| | | | 13,5 | | |
| | ***Minor CHEMISTRY*** | | | | |
| | MLK6005 Organic Chemistry I | | 6,0 | E | 5 |
| | MLK6006 Organic Chemistry II | | 3,0 | G | 2 |
| | MLK6010 Analytical Chemistry and Instrumental Analysis | | 6,0 | E | 5 |
| | | | 15,0 | | |
| | ***Minor GEOGRAPHY*** | | | | |
| | MLG6024 Paleogeography | | 6,0 | E | 5 |
| | MLG6030 Geographical Information Systems | | 3,0 | E | 2 |
| | MLG6027 Introduction to human Geography | | 6,0 | E | 4 |
| | | | 15,0 | | |
| | | **BFK** | **28,5** | | |
| | | **BFG** | **28,5** | | |

**6. Semester 05/06 Spring**

| Subject Code | | ECTS | E/G | T/W |
|---|---|---|---|---|
| Interdisciplinary Electives | | 4,0 | | |
| Bachelor´s Thesis | | 6,0 | | |
| Electives (open) | | 9,0 | | |
| | | 19,0 | | |
| ***Minor CHEMISTRY*** | | | | |
| MLK6007 Bio-organic Chemistry | | 3,0 | G | 3 |
| MLK6008 Biochemistry | | 4,5 | E | 4 |
| MLK6020 Food Chemistry | | 4,5 | E | 4 |
| | | 12,0 | | |
| ***Minor GEOGRAPHY*** | | | | |
| MLG6023 Climatology and Meteorology | | 6,0 | E | 3 |
| MLG6032 Field Work in Physical Geography | | 4,5 | G | 3 |
| | | 10,5 | | |
| | **BFK** | **31,0** | | |
| | **BFG** | **29,5** | | |
| | **TOTAL:** | | | |
| | **BFK** | **180,0** | | |
| | **BFG** | **180,0** | | |

BFK-Biology, Physics, Chemistry
BFG-Biology, Physics, Geoecology

**Appendix 5**

# Natural Sciences Bachelor Curricula Timetable for 2004/2005 Academic Year

**Autum Semester**

| | | L-11 | L-21 | L-31 |
|---|---|---|---|---|
| MONDAY | 8.00 | MLG6001 Basics of General Geography K-311 J. Jõgi | | |
| | 10.00 | | | MLR6008 Astronomy P-223 A. Ainsaar |
| | 12.00 | MLR6001 Physical Picture of the World P-324 T. Lukki | | MLG6024 Paleogeography (k) P-304 J.-M. Punning |
| | 14.00 | | MLK6003 Inorganic Chemistry I (k) P-304 K. Truus | |
| | 16.00 | | MLK6003 Inorganic Chemistry I lab P-401 H. Hödrejärv | |
| | 18.00 | | | |
| TUESDAY | 8.00 | | | |
| | 10.00 | | MLB6902 General Ecology P-223 H. Kukk | |
| | 12.00 | MLK6001 General Chemistry K-311 K. Truus | | |
| | 14.00 | MLK6001 General Chemistry P-223 K. Truus | MLK6004 Inorganic Chemistry II lab (k) P-401 H. Hödrejärv | MLB6010 Molecular and Cell Biology P-405 K. Järve |
| | 16.00 | | MLG6021 Introduction to Landform Studies(k) P-304 R. Rivis | |
| | 18.00 | | | |
| WEDNESDAY | 8.00 | MLR6003 Mechanics lab P-209/202 M. Reedik | MLG6027 Introduction to Human Geography (k) P-304 A. Kratovitš | |
| | 10.00 | | | MLB6012 Biodiversity and Conservation Biology P-223 H. Kukk |
| | 12.00 | | MLK6901 Environmental Chemistry P-223 K Kuiv, A.Lõokene, A Mähar | |
| | 14.00 | | MLG6021 Introduction to Landform Studies(k) P-304 R. Rivis | MLR6008 Astronomy P-405 A. Ainsaar |
| | 16.00 | | | |
| | 18.00 | | | |

| | | | | |
|---|---|---|---|---|
| THURSDAY | 8.00 | MLB6005 Introduction to Botany 5. weeks P-223 T. Ploompuu | MLB6013 Genetics P-405 T. Veidebaum | |
| | 10.00 | | MLK6004 Inorganic Chemistry II (k) P-304 K. Truus | |
| | 12.00 | MLR6003 Mechanics P-223 Ü. Ugaste | | MLG6030 Geographical Information Systems P-304 R. Rivis |
| | 14.00 | MLR6003 Mechanics ex P-223 A. Rekker | | MLK6020 Food Chemistry (k) P-405 K. Pappel |
| | 16.00 | | | MLK6020 Food Chemistry lab (k) P401/211 K. Pappel |
| | 18.00 | | | |

| | | | | |
|---|---|---|---|---|
| FRIDAY | 8.00 | | | Interdisciplinary electives |
| | 10.00 | MLB6001 General Biology K-316 T. Ploompuu | | |
| | 12.00 | MLB6005 Introduction to Botany lab P-406 T. Ploompuu | | MLK6010 Analytical Chemistry and Instrumental Analysis (k) |
| | 14.00 | | MLR6006 Optics lectures 8. weeks* P-405 Ü. Ugaste | lectures and laboratory |
| | 16.00 | | MLR6006 Optics lectures 8. weeks* P-405 Ü. Ugaste | P-304, 401/211 H. Hödrejärv |
| | 18.00 | | | |

L-21 * Optics lab since 9. week K-123 A. Rekker
K-Minor

## Spring Semester

| | | L-11 | L-21 | L-31 |
|---|---|---|---|---|
| MONDAY | 8.00 | | | Interdisciplinary electives |
| | 10.00 | | | |
| | 12.00 | MLR6004 Heat and Molecular Structure P-405 T. Laas | | |
| | 14.00 | MLB6006 Introduction to Zoology P-318 A. Põllumäe | MLB6011 Plant and Animal Physiology (10 weeks) P-405 E. Meier, T. Põld | |
| | 16.00 | MLB6006 Introduction to Zoology lab P-406 A.Põllumäe | | |
| | 18.00 | | | |
| TUESDAY | 8.00 | MLR6005 Electromagnetism lab (I group) P-512 V.Korsen (since 29.03) | | |
| | 10.00 | MLR6005 Elektromagnetism lect* P-304 Ü. Ugaste (7 weeks) | MLG6026 Environmental Issues and Nature Preservation in Estonia (k) (10 weeks) P-223 E. Karofeld | MLG6026 Environmental Issues and Nature Preservation in Estonia (10 weeks) P-223 E. Karofeld |
| | 12.00 | MLR6005 Electromagnetism P-304 T. Lukki | | |
| | 14.00 | MLG6901 Geography of Estonia P-223 S. Siska | MLB6011 Plant and Animal Physiology P-405 E. Meier, T. Põld (10 weeks) | |
| | 16.00 | | MLK6009 Physical and Colloid Chemistry (k) P-405 A. Mähar | Interdisciplinary electives |
| | 18.00 | | | |
| WEDNESDAY | 8.00 | | | |
| | 10.00 | MLR6005 Electromagnetism lab (II group) P-512 V. Korsen (since 30.03) | MLR6007 Structure of Matter lab (since 16.03) 5 weeks K-123 A. Roode | |
| | 12.00 | MLR6005 Electromagnetism lect** K-123 Ü. Ugaste (7 weeks) | MLB6007 Environmental Sciences P-304 T.Elvisto | |
| | 14.00 | MIA6001 Effective Computer Usage P-302 S. Tolbast | MLR6007 Structure of Matter lect (5 weeks) P-304 A. Ainsaar | |
| | 16.00 | | | |
| | 18.00 | | | |

**THURSDAY**

| | | | |
|---|---|---|---|
| 8.00 | | MLB6014 The Theory of Evolution (10 weeks) P-405 T. Veidebaum | |
| 10.00 | MLT6901 Mathematical Methods in the Natural Sciences P-223 T. Laas | MLR6007 Structure of Matter lab since 16.03 (5 weeks) K-123 A. Roode | |
| 12.00 | MLT6901 Physical Methods in Sciences lab P-223 A. Rekker | | |
| 14.00 | MLR6004 Heat and Molecular Structure lab P-209 M. Reedik | MLR6007 Structure of Matter lect (5 weeks) P-223 A. Ainsaar | |
| 16.00 | | | |
| 18.00 | | | |

**FRIDAY**

| | | | |
|---|---|---|---|
| 8.00 | | | Interdisciplinary electives |
| 10.00 | MLT6902 Physical Methods in Sciences (10 weeks) P-405 Tiit Lukki | MLR6007 Structure of Matter P-304 A. Rekker | |
| 12.00 | | | |
| 14.00 | | MLK6009 Physical and Colloid Chemistry (k) lab P-211/401 A. Mähar | |
| 16.00 | | | |
| 18.00 | | | |

L-11 *MLR6005 Electromagnetism lab (I group) (since 29.03)
P-512 V. Korsen

L-11 **MLR6005 Electromagnetism lab (II group) (since 30.03)
P-512 V. Korsen

**L-11** MLB6008 Field Works in Floristics and Faunistics - in the Summer

**L-21** MLG6034 Field Trip in May for minor Geo-ecology students

**L-31** Interdiscplinary electives and Elective (open) for 6 CP (9 ECTS)

**Appendix 6**

# Teaching Staff of Department of Natural Sciences involved in Natural Sciences Bachelor Curriculum in Tallinn Pedagogical University

(As in January 2005)

| | Name | Occupation | Speciality | Subject taught in Natural Sciences at BSc level | CP | Degree | Year of Birth | Pedagogical experience |
|---|---|---|---|---|---|---|---|---|
| 1 | Ainsaar, Ain | Associate Professor 1,0 | Physics | Astronomy, Structure of Matter | 5,0 | *Cand. Physics-Math* | 1938 | 13 |
| 2 | Elvisto, Tiina | Associate Professor 1,0 | Biology | Environmental Sciences | 2,0 | *Cand. biol* | 1957 | 13 |
| 3 | (Haljas) Rekker, Astrid | Assistant Lecturer 0,5 | Physics | Mathematical Methods in the Natural Sciences, Optics, Structure of Matter | 4,5 | *MSc, Physics* | 1972 | 2 |
| 4 | Hödrejärv, Helvi | Lecturer p.t | Chemistry | Inorganic Chemistry I, II, Analytical Chemistry and Instrumental Methods of Chemical Analysis | 8,0 | *Cand. chem* | 1931 | 48 |
| 5 | Jõgi, Jaan | Associate Professor 1,0 | Climatology (Physical Geography) | The Basics of General Geography, Meteorology and Climatology | 7,0 | *Cand. geogr* | 1950 | 11 |
| 6 | Karofeld, Edgar | Associate Professor 0,5 | Biology | Environmental Issues and Nature Protection in Estonia, Field Work In Physical Geography, Field trip I | 8,0 | *PhD, Ecology* | 1959 | 11 |
| 7 | Kratovits, Andres | Assistant Lecturer 0,5 | Biology | Introduction to Human Geography; Geography of Estonia | 5,5 | *PhD, Ecology* | 1966 | 3 |
| 8 | Kuiv, Karl-Kristjan | Lecturer p.t | Chemistry | Organic Chemistry, Environmental Chemistry | 4,0 | *Cand. techn* | 1929 | 27 |
| 9 | Kukk, Henn | Professor 1, 0 | Biology | Biodiversity and Conservation Biology, General Ecology | 6,0 | *Cand. biol* | 1942 | 18 |
| 10 | Laas, Tõnu | Associate Professor 1,0 | Physics | Mathematical Methods in the Natural Sciences, Heat and Molecular Structure | 3,0 | *PhD, Physics* | 1969 | 9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11 | Lukki, Tiit | Assistant Lecturer 1,0 | Physics | Physical Picture of the World, Electromagnetism, Physical Methods In Sciences | 8,5 | *MSc, Physics* | 1948 | 13 |
| 12 | Lõokene, Aivar | Associate Professor 0,5 | Chemistry | Bio-organic Chemistry, Biochemistry, Environmental Chemistry | 4,0 | *Cand. chem* | 1960 | 8 |
| 13 | Mankin, Romi | Professor 1,0 | Theoretical Physics | Astronomy | 3,0 | *Cand. Physics-Math* | 1947 | 29 |
| 14 | Metsis, Ats | Associate Professor 0,25 | Biology | Molecular and Cell Biology | 3,0 | *PhD, Cytology* | 1961 | 6 |
| 15 | Mähar, Andres | Lecturer 0,25 | Chemistry | Physical and Colloid Chemistry, Environmental Chemistry | 5,0 | *Dipl. chem.* | 1957 | 5 |
| 16 | Pappel, Kaie | Associate Professor 1,0 | Technologist of Foodstuffs | Food Chemistry | 3,0 | *Cand. Techn* | 1942 | 16 |
| 17 | Ploompuu, Tõnu | Assistant Lecturer 1,0 | Biology, Plant Physiology | Introduction to Botany, Plant and Animal Physiology, General Biology, Field Works in Floristics and Faunistics | 9,5 | *MSc, Biology* | 1960 | 21 |
| 18 | Punning, Jaan- Mati | Professor 0,5 | Physical Geography | Paleogeography | 4,0 | *Dr. Sci., Geography* | 1940 | 19 |
| 19 | Põld, Toomas | Lecturer 0,5 | Medical Doctor, Psychology | Plant and Animal Physiology | 2,0 | *MD* | 1961 | 14 |
| 20 | Põllumäe, Arno | Lecturer 0,5 | Zoology | Introduction to Zoology, Field Works in Floristics and Faunistics | 5,5 | *MSc, hydrobiology* | 1972 | 11 |
| 21 | Rivis, Reimo | Lecturer 1,0 | Geo-ecology | Introduction to Landscape Studies, Geographical Information Systems | 6,0 | *PhD ecology* | 1974 | 2 |
| 22 | Reedik, Marko | Assistant Lecturer 0,5 | Teacher of Physics | Mechanics, Heat and Molecular Structure | *4,0* | *BSc Phys* | 1978 | 1 |
| 23 | Roode, Anneli | Teacher 1,0 | Teacher of Physics | Structure of Matter | 2,0 | *Dipl. Phys* | 1968 | 7 |
| 24 | Siska, Sirje | Lecturer 1,0 | Physical Geography | Geography of Estonia, Physical Geography of the Continents and History of Geographical Discoveries | 5,5 | *MA* | 1957 | 22 |
| 25 | Ugaste, Ülo | Professor 1,0 | Physics | Mechanics, Electromagnetism, Optics | 7,0 | *Dr. Sci. Phys.* | 1939 | 28 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | *& Math.* | | |
| 26 | Tuvikene, Rando | Teacher p.t | Teacher of Nat Science | Organic Chemistry I, Bio-organic Chemistry, | 3,0 | *Dipl. Nat Sc* | 1981 | 1 |
| 27 | Truus, Kalle | Associate Professor 1,0 | Chemistry | General Chemistry, Environmental Chemistry, Inorganic Chemistry | 7,0 | *Cand. Chem. Organic Chemistry* | 1949 | 39 |
| 28 | Veidebaum, Toomas | Associate Professor 0,25 | Molecular Biology | Genetics, The Theory of Evolution | 4,0 | *Cand. biol* | 1946 | 11 |

## Appendix 7

# Teaching Staff from other university departments involved in Natural Sciences Bachelor Curriculum in Tallinn Pedagogical University

(As in January 2005)

| | Name | Occupation | Speciality | Subject taught in Geo-ecology at BSc level | Degree | Year of Birth | Pedagogical experience |
|---|---|---|---|---|---|---|---|
| 1. | Espe, Elena | Lecturer | Psychology | Psychology of Social Skills & Interpersonal Communication | *Dipl. Psych* | 1972 | 7 |
| 2. | Kallonen, Jelena | Teacher | Philology | English (Advanced) | *Dipl. Eng. Philology* | 1946 | 30 |
| 3. | Kerge, Krista | Associate Professor | Pedagogics | Oral and Written Communication | *PhD, Estonian Philology* | 1952 | 17 |
| 4. | Kippar, Jaagup | Lecturer | Computer science | Creating web pages | *MSc, Informatics* | 1976 | 8 |
| 5. | Kirs, Õie | Teacher | Philology | German (Advanced) | *MA German Studies* | 1953 | 27 |
| 6. | Kivi, Kalle | Lecturer | Teacher of crafts and informatics | Effective Computer Usage | *Higher education (5 years programme)* | 1968 | 12 |
| 7. | Kivinukk, Andi | Professor | Mathematics | Practical mathematics | *Cand. Physics & Mathematics* | 1948 | 12 |
| 8. | Krall, Ingrid | Lecturer | Philology | Estonian (Advanced) | *Dipl. Philology* | 1956 | 13 |
| 9. | Kullasepp, Katrin | Assistant Lecturer | Psychologist | Psychology of Social Skills & Interpersonal Communication | *MSc, Psychology* | 1974 | 5 |
| 10. | Liik, Kadi | Lecturer | Psyhology | Organisational Behaviour | MSc , Psychology | 1966 | 12 |
| 11. | Mängel, Eha | Teacher | Philology | English (Advanced) | *Dipl. Eng. Philology* | 1955 | 12 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12. | Mironov, Deniss | Teacher | Philology | English (Advanced) | *MA , Pedagogy* | 1976 | 10 |
| 13. | Normak, Mai | Lecturer | Pedagogics | Studying at university | *MSc, Pedagogics* | 1956 | 19 |
| 14. | Pajupuu, Hille | Associate Professor | Psychologist | Intercultural Communication | *Cand. psych.* | 1956 | 19 |
| 15. | Poom-Valickis, Katrin | Lecturer | Pedagogics | Studying at University | *MSC, Pedagogics* | 1969 | 6 |
| 16. | Räisa, Olev | Lecturer | Engineer (area: electronic computers) | Computer Aided Information Processing | *Higher education (5 years programme)* | 1948 | 13 |
| 17. | Raudla, Jelena | Lecturer | Philology | Russian (Advanced) | *PhD, Russian Philology* | 1956 | 24 |
| 18. | Rea-Soiver, Viola | Assistant Lecturer | Public administration | Introduction to Public Administration | *Dipl. Socio.* | 1978 | 4 |
| 19. | Ruus, Rein | Lecturer | Teacher of mathematics and informatics | Effective Computer Usage | *MSc, Informatics* | 1955 | 23 |
| 20. | Rüütel, Eha | Lecturer | Economy Engineer, Psychologist | Copying Strategies in Society | *MSc, Psychology* | 1956 | 9 |
| 21. | Talts, Eva-Maria | Assistant Lecturer | Public administration | Organisational Behaviour | *Dipl. Socio.* | 1979 | 3 |
| 22. | Tolbast, Svetlana | Lecturer | Engineer (area: electronic computers) | Effective Computer Usage | *PhD* | 1949 | 15 |
| 23. | Uukkivi, Anne | Assistant Lecturer | Information Science | Basics Of Information Technology | *MA Information Sci.* | 1972 | 6 |

## Appendix 8

# Laboratory and field-work equipment investments of Department of Natural Sciences (B - biology, C - chemistry, P - physics, G - geo-ecology), since 2000 to 2004

**2000:**

| | Article | Chair | Cost (EEK) |
|---|---|---|---|
| 1. | Automatic (optical) level Leica NA 730 | (G) | 24179.00 |
| 2. | Hand-held laser meter DISTO classic Leica | (G) | 11500.00 |
| 3. | Vortex VM 4 | (B) | 8000.00 |
| 4. | Magnetic stirrer | (B) | 16800.00 |
| 5. | Balances Mettler PB602-s | (C) | 22160.00 |
| 6. | Analytical balances Precisa XT220A | (C) | 3788.00 |
| 7. | Analytical balances Precisa XT320M | (C) | 12154.00 |
| 8. | Rotary evaporator R-114 | (C) | 35000.00 |
| 9. | Garmin 12 GPS-receiver + data cable | (G) | 4500.00 |
| Sum | | | 138081.00 |

**2001:**

| | Article | Chair | Cost (EEK) |
|---|---|---|---|
| 1 | pH-metre Knick portative | (G) | 6000.00 |
| 2 | Cooler Fuge Heraeus | (B) | 66564.75 |
| 3 | Minifuge Tomy 400552 | (B) | |
| 4 | Minifuge Strip Tomy 400542 | (B) | |
| 5 | Eppendorf Thermostat, analogue SHT 100 Stuart | (B) | 53843.40 |
| 6 | Blocks for Thermostat Stuart | (B) | |
| 7 | Eppendorf Thermostat, digital TDB 120 Biosan | (B) | |
| 8 | Blocks for Thermostat Biosan | (B) | |
| 9 | Vortex, constant speed V-1 Biosan | (B) | |
| 10 | Transilluminator 302nm filter 20X20 GVM20-E | (B) | |
| 11 | Incubator GFL-3032 | (B) | 117110.00 |
| 12 | Laminar Telstar Bio-II-A | (B) | 99950.00 |
| 13 | Electronic weather stations WM918 (2) | (G) | 12000.00 |
| Sum | | | 355468.15 |

**2002:**

| | Article | Chair | Cost (EEK) |
|---|---|---|---|
| 1. | Microscope Zeiss Axioskope 40 FL + | (B, G) | 306858.30 |
| 2. | Microscopes (6) Novex 86.010 | (B) | 27200.00 |
| 3. | Equipment of Atomic & Radiation Physics laboratory | (P) | 160432.00 |
| 4. | pH meter Mettler | (C) | 12980.00 |

| | | | |
|---|---|---|---|
| 5. | Vacuum pump, Kit 22 Kit 23 | (C) | 38053.00 |
| 6. | Freeze-drying system Drywinner 1-60 | (C) | 76903.00 |
| 7. | Laboratory thermostat | (C) | 38302.00 |
| 8. | Refractometer REFRACTO 30P Mettler | (C) | 27057.00 |
| 9. | Telescope | (P) | 8430.00 |
| 10 | Magellan Meridian Platinum GPS-receiver | (B) | 11300.00 |
| 11 | Garmin 12 GPS-receiver | (G) | 3600.00 |
| Sum | | | 711115.30 |

**2003:**

| | **Article** | **Chair** | **Cost (EEK)** |
|---|---|---|---|
| 1 | Equipment of Atomic & Radiation Physics laboratory | (P) | 8374.00 |
| 2 | Software UV Probe for spectrophotometer | (C) | 49050.00 |
| 3 | Magnetic stirrer V0720 | (C) | 5600.00 |
| 4 | Water bath V0742 | (C) | 8900.00 |
| Sum | | | 147293.00 |

**2004:**

| | **Article** | **Chair** | **Cost (EEK)** |
|---|---|---|---|
| 1 | Radiometer PAKRI-E | (G) | 20307.80 |
| 2 | Fridge-freezer | (B) | 7390.00 |
| 3 | Perkin-Elmer Series 200 HPLC system | (C) | 405577.80 |
| Sum | | | 433275.60 |

**TOTAL SUM since 2000 to 2004: 1 785 233.05 EEK (~114100 EUR)**

In the same interval 4 laptop computers (for 100 thousand EEK) and 4 data projectors have been received. Also the hard- and software of the Department's computer class is renovated (160 thousand EEK). In addition, investments (150 thousand EEK) into computers of the chair's staff (for laboratory and individual use) have been made. Totally, about 530 thousand EEK (~33900 EURO) have been invested into computer and lecture presentation technology.

**Appendix 9**

# Grade Point Average of Natural Sciences Bachelor´s Students

(As in 31.01.2005)

| | | |
|---|---|---|
| 1. Seema, Reena | L-31 | 4,56 |
| 2. Part, Kristin | L-31 | 4,03 |
| 3. Pungas, Karin | L-21 | 3,7 |
| 4. Toome, Marit | L-21 | 3,67 |
| 5. Sepper, Kaja | L-21 | 3,65 |
| 6. Ilosaar, Alge | L-31 | 3,63 |
| 7. Kõlli, Lii | L-31 | 3,53 |
| 8. Prohhorenko, Žanna | L-21 | 3,47 |
| 9. Kaljurand, Helen | L-31 | 3,31 |
| 10. Rannamaa, Maru | L-21 | 3,21 |
| 11. Tulk, Jaana | L-21 | 3,15 |
| 12. Kostal, Kristel | L-21 | 3,11 |
| 13. Lauri, Jaana | L-21 | 3,1 |
| 14. Kask, Keili | L-31 | 3,03 |
| 15. Pai, Aare | L-31 | 3,02 |
| 16. Rõõmussaar, Helen | L-31 | 2,76 |
| 17. Laidla, Maarja | L-21 | 2,71 |
| 18. Lepik, Liia-Liis | L-21 | 2,57 |
| 19. Aedviir, Tiit | L-11 | |
| 20. Enson, Madis | L-11 | |
| 21. Ikart, Anna-Liisa | L-11 | |
| 22. Jensen, Jonna | L-11 | |
| 23. Madisson, Marika | L-11 | |
| 24. Merzin, Mary-Meeriki | L-11 | |
| 25. Muromskaja, Tatjana | L-11 | |
| 26. Orusalu, Krõõt | L-11 | |
| 27. Rebane, Sirli | L-11 | |
| 28. Sarv, Merit | L-11 | |
| 29. Savitševa, Jekaterina | L-11 | |
| 30. Sepp, Triin | L-11 | |
| 31. Sinisalu, Katre | L-11 | |

Grade Point Avarage (Exams with Graded Assessments) of Natural Sciences Bachelor´s Students

GPA – Grade point avarage

**Appendix 10**

# Course Feedback Questionnaire

**Dear Student!**

Please give your assessment to the subject read during the previous term. In order to assess the statements below circle the number indicating your opinion: 5-fully agree; 4-mostly agree; 3-partly agree, partly disagree; 2- mostly disagree; 1-fully disagree. Your frank answers will be help at better organisation of academic work.

| | **Name and code of the subject, name of the lecturer** | | | | | |
|---|---|---|---|---|---|---|
| 1. | Subject syllable was available to me | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 2. | Lecturer followed respective subject syllabus | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 3. | Lectures/seminars started and ended at the time stated in the timetable | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 4. | The criteria of being allowed to take the exam/preliminary exam were known to me | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 5. | The lecture/seminar was logical and well structured | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 6. | The lecturer presented the subject clearly and understandably | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 7. | The lecturer used up-to-date material, research data and examples | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 8 | The use of teaching aids (board, transparencies, illustrations, copies, information technology) was sufficient for the given subject | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 9 | The textbooks and study materials listed by the subject syllabus were available | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 10 | Students were able to actively participate in the lecture/seminar (dialogue with the lecturer, discussions, group work) | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 11 | The lecturer treated students fairly and objectively | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 12. | Options to contact the lecturer in case of need were good | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 13. | Taking into account that 1 CP=40 hours of student's work, the load of work necessary for reading this subject was in proportion with the credit points receive | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 14. | The subject was necessary from the point of view of my speciality | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 15. | The planned academic work that actually took place % | | | | | |
| 16. | I participated in the lectures/seminars % | | | | | |

Comment, remarks and suggestions about the courses:……..……
……

Thank you!

**Appendix 11**

# Basic School Teacher of Natural Sciences (7141015) Master Degree Curriculum

# TALLINN PEDAGOGICAL UNIVERSITY

| | |
|---|---|
| Faculty: Mathematics and Natural Sciences | 7141015 |
| | (curriculum code) |
| Name of the curriculum in Estonian<br>**PÕHIKOOLI LOODUSTEADUSLIKE AINETE ÕPETAJA** | 01.11.2001 |
| | (approved by faculty) |
| Name of the curriculum in English<br>**BASIC SCHOOL TEACHER OF NATURAL SCIENCES** | 28.01.2002 |
| | (approved by university board) |

Level**: Master**
Curriculum accreditation**:**
Load**: 120 ECTS**
Standard period of study in years**: 2**

Admission requirements: bachelor's degree in natural sciences or a corresponding qualification.
Entrance examination: a career suitability test.

Objectives: To provide primary professional competence for commencing the first professional year as a basic schoolteacher of a number of natural science subjects and the further career as an active teacher.

Curriculum outline

| | |
|---|---|
| Subject studies | 22.5 ECTS |
| General pedagogy, psychology and subject-specific didactics and professional placement | 69 ECTS |
| Interdisciplinary elective | 4 ECTS |
| Electives (open) | 9.5 ECTS |
| Master thesis | 15 ECTS |

Students continue studies of the two subjects of natural sciences taken in the bachelor's programme: biology, physics, geography or chemistry. Students of the teacher-training master programme who take a minor in the bachelor's programme with the corresponding subject-specific didactics and professional placement are competent to teach three subjects in basic school and natural sciences in primary school.
Courses are given in the form of lectures, seminars, practical classes and independent work.
Graduation requirements: completion of the curriculum and defence of the master thesis.

Documents issued at graduation: master diploma and academic record

Degree and qualification: Master of Education, basic school teacher of natural sciences

**BASIC SCHOOL TEACHER OF NATURAL SCIENCES**

**Subject studies 22.5 ECTS**

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| | **Choose according to the major 15 ECTS** | | |
| MLB7014 | A Sustainable Baltic Region | 7.5 | E |
| MLR7007 | History of Physics | 3.0 | G |
| MLR7008 | Astronomy | 4.5 | E |
| MLG7026 | Wetlands Ecology | 5.0 | E |
| MLG7027 | Basics of Soil Science | 3.0 | G |
| MLK7004 | Demonstration Experiments in Chemistry | 5.0 | G |
| MLK7018 | Organic Chemistry | 2.5 | G |
| | Electives (choose 7.5 ECTS) | | |
| MLB7004 | Microbiology | 3.0 | G |
| MLB7015 | Developmental Biology | 4.5 | G |
| MLG7031 | Field Trip | 3.0 | G |
| MLG7033 | Environmental Issues and Nature Preservation in Estonia | 4.5 | E |
| MLF7007 | Hydrodynamics | 4.5 | G |
| MLT7010 | Cosmology | 3.0 | G |
| MLT7011 | Thermodynamics and Statistical Physics | 4.5 | E |
| MLK7008 | Revolutionary Chemical Experiments and Theories | 4.5 | G |
| MLK7009 | Bioinorganic Chemistry | 3.5 | G |

**General pedagogy, psychology and subject-specific didactics and professional placement 69 ECTS**

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| | **General pedagogical and psychological subjects 31 ECTS** | | |
| ETT7001 | School and Teacher in Society | 4.5 | G |
| ETT7002 | Development and Learning | 5.5 | E |
| ETT7003 | Design and Development of the Learning Environment | 4.5 | E |
| ETT7004 | Education and Information Technology at School | 3.0 | G |
| ETT7005 | The Teacher as Counsellor | 4.5 | E |
| ETT7006 | Science and Philosophy of Education | 4.5 | E |
| ETT7007 | Teacher as a Researcher | 1.5 | G |
| EAA7021 | Pedagogy and Didactics in Primary Education | 3.0 | G |
| | **Subject-specific didactics 14 ECTS** | | |
| MLK7094 | Introduction to Didactics of Natural Sciences | 2.5 | G |
| MLB7095 | Didactics of Biology | 6.0 | E |
| MLR7095 | Didactics of Physics | 6.0 | E |
| MLG7095 | Didactics of Geography | 6.0 | E |
| MLK7095 | Didactics of Chemistry | 6.0 | E |

| | | | |
|---|---|---|---|
| | **Professional placement 15 ECTS** | | |
| ETT7008 | **Observation Placement** | 3.0 | P-F |
| MLB7098<br>MLG7098<br>MLK7098<br>MLR7098 | Pedagogical Professional Placement I | 6.0 | G |
| MLB7099<br>MLG7099<br>MLK7099<br>MLR7099 | Pedagogical Professional Placement II | 6.0 | G |
| | **Didactics of the Minor** | 6.0 | E |
| | **Professional placement in the minor**<br>• Choose two subject-specific didactics out of four according to the subjects selected in natural sciences. | 3.0 | G |

**Interdisciplinary electives (choose 4 ECTS)**

| Subject Code | Subject | ECTS | Assessment |
|---|---|---|---|
| FEL7003 | Argumentation and Rhetoric | 4.0 | G |
| EKA7002 | Andragogy | 4.0 | G |
| EKT7018 | The Teaching of Values | 4.0 | G |
| EAK7005 | Education in Multicultural Society | 4.0 | G |
| MIA7002 | Data Analysis | 4.0 | G |
| MIA7008 | Advanced Used of Application Software | 4.0 | G |
| SFF7001 | Contemporary Social Philosophy | 4.0 | G |
| SII7028 | Electronic Publishing | 4.0 | G |
| SAP7035 | EU Politics and Institutions | 4.0 | G |
| SOT7002 | Project Design and Management | 4.0 | G |

| | | | |
|---|---|---|---|
| MLB7101<br>MLG7101<br>MLK7101<br>MLR7101 | Master Thesis | 15.0 | |

E – examination
G – graded assessment
P-F – pass-fail assessment

## Appendix 12

# Employments and occupations of people graduated from TPU as teachers of Natural Sciences

(As in January 2005)

| No. | Year | Name | Institution | Occupation |
|---|---|---|---|---|
| 1. | 2000 | Kerde, Merle | Ministry of Agriculture | Specialist |
| 2. | | Kukk, Kadi | | |
| 3. | | Luik, Anneli | Vaida Basic School | Teacher of Biology, Geography and Science |
| 4. | | Vaik, Diana | | |
| 5. | 2001 | Brusnikina, Anna | Pelgulinn Gymnasium | Teacher of Chemistry |
| 6. | | Ionikina, Olga | | |
| 7. | | Lessin, Gennadi | Institute of Marine Systems of TUT | Engineer |
| 8. | | Maksimova, Anna | | |
| 9. | | Meier, Elle | | TU Doctor course student |
| 10. | | Milk, Kady | | |
| 11. | | Möll, Merje | Keila Gymnasium | Teacher of Physics and Science |
| 12. | | Sepp, Liina | | |
| 13. | | Tõnsing, Riina | | |
| 14. | 2002 | Adler, Kadi | Kohila Gymnasium | Teacher of Geography |
| 15. | | Balašov, Dimitri | North Private Gymnasium | Teacher of Biology |
| 16. | | Boroznjak, Roman | No job | |
| 17. | | Fatejeva, Marina | | |
| 18. | | Gagen, Olga | Almadoor Ltd | Logistic |
| 19. | | Gorelikova, Jelena | In United Kingdom | |
| 20. | | Heinma, Katri | Liivalaia Gymnasium | Teacher |
| 21. | | Janson, Ööle | Social Ministry | |
| 22. | | Kask, Kersti | Tallinn Paekaare Kindergarten | Teacher |
| 23. | | Kjahrenov, Vladimir | | |
| 24. | | Kjahrenova, Julija | | |
| 25. | | Käsper, Kadi | | |
| 26. | | Lessing, Marge | Tallinn Paekaare Kindergarten | Teacher |

| | | | | |
|---|---|---|---|---|
| | | | Lagedi Basic School | Teacher of Geography |
| 27. | | Logovoi, Külli | Holstre Basic School | Teacher of Science Subjects |
| 28. | | Luks, Kaja | K-PC-Saloon | Laboratory assistant |
| 29. | | Lõoke, Liina | | |
| 30. | | Lüütsepp, Karis | Kiili School | Teacher of Science and Geography |
| 31. | | Miil, Maris | Tõstamaa Secondary School | Teacher of Chemistry and Physics |
| 32. | | Männi, Margo | Pihel Ltd | Teacher at homes |
| 33. | | Naissoo, Tiina | — | Mother vacation |
| 34. | | Ostroglazova, Svetlana | | |
| 35. | | Tiits, Kaido | Tallinn School of Service | Teacher of Chemistry |
| 36. | | Tõnisson, Hannes | Inst. of Ecology, Dept. of Land Design | Researcher |
| 37. | | Tõnisson, Karoliina | Järveots Gymnasium | Teacher of Geography |
| 38. | | Viiberg, Gunneli | Tallinn Rõõmupesa Kindergarten | Teacher |
| 39. | | Väljataga, Katrin | | |
| 40. | | Ailt, Helina | Tallinn Lilleküla Gymnasium | Teacher of Biology |
| 41. | | Haugas, Raili | Estonian Agricultural Academy | Mother vacation, MSc student |
| 42. | | Ivanov, Pavel | No job | |
| 43. | | Jevsejeva, Irina | — | Mother vacation |
| 44. | | Karro, Anna | Tallinn Pelguranna Gymnasium | Teacher of Science (6$^{th}$ form), Biology (7-8th form), Geography (7-10th form) |
| 45. | | Kongas, Kristel | Abestock Ltd | Sales manager |
| 46. | | Kuuse, Elin | Rocca al Mare School | Teacher of Biology and Science, assistant form-master |
| 47. | | Kuustik, Rando | Westholm Gymnasium | Teacher of Biology |
| 48. | | Kübarsepp, Marko | Entrepreneur | |
| 49. | | Leemet, Ingrid | — | Mother vacation |
| 50. | 2003 | Ljalko, Natalja | — | Mother vacation |

| | | | | |
|---|---|---|---|---|
| 51. | | Luukas, Anne | Sõle Gymnasium | Teacher of Biology (7-8th form) and Physics (8-9th form) |
| 52. | | Mazepina, Svetlana | | |
| 53. | | Meleško, Marina | | |
| 54. | | Mäekask, Kristel | Tallinn Lilleküla Gymnasium | Teacher of Biology |
| | | | Tallinn Ristiku Basic School | Teacher of Physics and Science |
| 55. | | Niidas, Aadu | Ministry of Environment, Dept. of Nature Conservation | Specialist |
| 56. | | Nimmerfeldt, Inge | SEB Group Bank | Assistant |
| 57. | | Padur, Gairit | Lavassaare Nursery School | Teacher |
| 58. | | Purgas, Anneli | No job | |
| 59. | | Sepp, Elle | Jüri Gymnasium | Teacher of Biology (7-12th form) and Science (6th form) |
| 60. | | Soika, Katrin | Tallinn Basic Gymnasium | Teacher of Chemistry and Science |
| 61. | | Tammekänd, Karin | Tallinn ARTE Gymnasium | Teacher of Geography |
| 62. | | Tikerpalu, Estelle | Järveotsa Gymnasium | Teacher of Biology |
| 63. | | Tuvikene, Rando | TPU | MSc student |
| 64. | | Vaht, Riina | TPU Institute of Ecology, Dept. of North-East Estonia | Assistant |
| 65. | | Vahtramäe, Kairi | Tallinn Kivimäe Basic School | Teacher of Science |
| 66. | | Vilen, Martin | Journal “Aed” | |
| 67. | | Adamenko, Arina | Little Free-School, Pärnu Rääma Basic School | Teacher of Science |
| 68. | | Allemann, Merlin | Baby nursery “Päkapikk” | Junior teacher |
| 69. | | Jahilo, Kairi | Tallinn Tehnical Gymnasium | Teacher of Biology |
| 70. | | Kukkur, Pille | Pirita Gymnasium of Economics | Teacher of Geography (7-11th form) |
| 71. | | Kõlamets, Lauri | Paide Musical School | Teacher |
| 72. | | Leek, Kadri | Tallinn Konstantin Päts Open Air School | Teacher |

| | | | | |
|---|---|---|---|---|
| 73. | | Leitmaa, Ruth | Electronics shop | Seller |
| 74. | | Lember, Triinu | Tabasalu Joint Gymnasium | Teacher of Physics and Science |
| 75. | | Mäeveer, Heidi | Ministry of Finances | Minister's referent |
| 76. | | Pärt, Erica | Paldiski Gymnasium | Teacher of Science (5-7$^{th}$ form), Biology and Geography (7-9$^{th}$ form), Physics (8, 9$^{th}$ form) |
| 77. | | Rosen, Eliis-Beth | Kallavere Secondary School | Teacher of Biology |
| 78. | | Urgard, Terje | Turba Gymnasium | Teacher of Biology, Geography and Physics(7-9$^{th}$ form) |

78 students have completed the speciality of Teacher of Natural Sciences in the period 2000-2004. 38 from these work as teachers; three take studies of Master or Doctor courses; seven graduates work on jobs connected with natural sciences (engineers, researchers etc); five graduates have mother vacations; six work on places not connected with their specialities; two are not employed and about 17 we have no information (some are abroad). It can be said that now at least 62% of graduates work or study in the fields connected with their specialities.

# Appendix 13

# Graduates Feedback Questionnaire

**Dear TPU graduate in natural sciences:**

We would highly appreciate your answering the questions presented below. The information arising from the questionnaire is aimed at assessing the competition ability of the curriculum and the quality of the teaching process.
To mark the appropriate answer, please, draw a circle around the number infront of it.

**1. Is (was) your job closely related to your speciality?**

1- yes, it is
2- yes, it was earlier
3- no, it is not

**2. You have completed the curriculum in natural sciences. Have you been because of that successful…**
A) in getting a job according to your speciality? B) in getting a job in any other speciality?

| | |
|---|---|
| 1 – yes | 1 – yes |
| 2 – partly | 2 – partly |
| 3 – no | 3 – no |

**3. To which extent can you use the knowledge obtained at the university in you current job?**

1 – very much
2 – much enough
3 – to some extent
4 – very little
5 – not at all

**4. If you are working directly in your speciality, has the knowledge obtained at the university enabled you to be in your work**

1- very successful
2- successful
3- to manage
4- of no help

**5. If you are not working directly in your speciality, has the knowledge obtained at the university enabled you to be in your work**

1- very successful
2- to manage
3- of no help

**6. To which extent the biology curriculum provided you with the knowledge of the processes and relations in the environment?**

1- very well
2- sufficiently
3- satisfactorily
4- insufficiently

**7. To which extent the minor subject currricula supplemented and supported the major curriculum?**

1- very much
2- much enough
3- to some extent
4- very little
5- not at all

**8. Was the proportion of practical work (incl. reports, proseminar papers and diplom thesis) in the natural sciences curriculum in comparison with class work…**

1- too large
2- appropriate
3- too small

**9. Which subjects in the natural sciences curriculum do you consider unnecessary (name them).**

…….
…….
…….
…….

**10. Which subjects, in your opinion, ought to be added to the biology curriculum (name the disiplines or fields)**

……
……
……
……
……

**11. How did the teaching quality satisfy you?**

1- very much
2- satisfied
3- did not satisfy
4- did not satisfy at all
5- difficult to say

**12. Name the greatest disadvantages in teaching.**

……..
……..
……..
……..
……..

**13. To which extent the knowledge obtained at the university answered your expectations?**

1- surpassed my expectations
2- answered my expectations
3- partially did not answer my expectations
4- did not answer my expectations at all.

**14. What did you expect to get at the university (but did not get) and what is this you feel the greatest need for at work/at home?**

……
……
……
……

15. How would you evaluate the lecturers'

a) level in their specialiy

| | Most of them | Part of them | Some |
|---|---|---|---|
| *Very high* | 1 | 1 | 1 |
| *High* | 2 | 2 | 2 |
| *Medium* | 3 | 3 | 3 |
| *Low* | 4 | 4 | 4 |
| *Absent* | 5 | 5 | 5 |

b) teaching ability (skill)

| | Most of them | Part of them | Some |
|---|---|---|---|
| *Very high* | 1 | 1 | 1 |
| *High* | 2 | 2 | 2 |
| *Medium* | 3 | 3 | 3 |
| *Low* | 4 | 4 | 4 |
| *Absent* | 5 | 5 | 5 |

**16. Was the amount of the literature during the studies**

1- too large
2- satisfactory
3- too little

**16a. Was the access to literature**

1- very good
2- good
3- satisfactory
4- not satisfactory

**17. Do you consider the computer study level for your speciality (e.g. statsitics, GIS etc.)**

1- very good
2- good
3- satisfactory
4- not satisfactory

**18. How importand do you consider field practice in the studies?**

1- very important
2- important
3- of little importance
4- not important

**19. Do you intend to continue studies in TPU in the future?**

1- yes
2- no
3- don't know

**20. In which subjects would you (your institution) be ready to help TPU (e.g. provide a base for practical training)?**

……..
……..
……..
……..
……..

Thank you for your co-operation.

## Appendix 14

# List of theses defended in the years 2003-2004 for natural sciences teachers' area of specialisation

**2003**

**Bachelor's theses**

1. Structure and distribution of benthic macrofauna in the Bay of Kõiguste in 1972-1999 - Elle Sepp
2. Cardiovascular system. Studybook for Universities - Rando Kuustik

**Diploma theses**

1. Elementary fluorine and its compounds - Rando Tuvikene
2. Illustrating by visual aids of reaction mechanisms in form 8 chemistry using Microsoft Powerpoint Programme - Katrin Soika
3. Constructed wetland of Kurna and its affect as a biocleaner - Kristel Kongas
4. Invertebrates in bog ponds and their relations to environmental conditions - Aadu Niidas
5. The industrial residue of oil shale and the influence of natural - Riina Vaht
6. The analysis of the presence and nesting results of barn swallow (*Hirundo rustica* L.*)* in the Central Estonia between 1995 and 2002 - Helina Ailt
7. The effects of wood ash on scots pine (*Pinus sylvestris*) increase - Raili Haugas
8. Application of groupe work method in teaching science within 2 th and 3 th grades of basic school - Anna Karro
9. The possibilities to implement the active teaching methods in the biology classes of 7 th and 8 th grades - Elin Kuuse
10. Studying aircraft noise in the Tallinn Airport - Ingrid Leemet
11. Possibilities of involving the role plays in teaching science within 2 th and 3 th grades of basic school - Natalja Ljalko
12. Environmental education in Botanic Garden – manula for teachers. Biological themes in Estonian basic schools that can be illustrated by visiting Tallinn Botanic Garden - Anne Luukas
13. Variants of teaching sonics in Physics of the 8$^{th}$ form - Marina Meleško
14. Travelling and geographical knowledge of students of elementary school - Kristel Mäekask
15. The exploitation history of the Tolkuse bog - Gairit Padur
16. The noise pollution and it´s influence to pupils - Estelle Tikerpalu
17. The re-use of waste as fuel – environmental and economic aspects on the example of Tallinn - Karin Tammekänd
18. Integration of environmental education and mathematics in basic and secondary school - Kairi Vahtramäe
19. Health awareness of pupils and teachers - Martin Vilen
20. Winter diet of Wolf (*Canis lupus* L. 1758) in Alam-Pedja Nature Reserve and its neighbourhood areas, Estonia - Marko Kübarsepp
21. Influence of the solar radiation to the human organism - Svetlana Mazepina
22. Blood chemistry and a selection of the teaching material - Irina Jesejeva
23. The teaching material "The chemistry of pedosphere" - Pavel Ivanov
24. Phytobentos of Gulf of Riga - Inge Nimmerfeldt
25. The metabolism and the functional nutrition - Anneli Purgas

**Pedagogical theses**

1. Television in our children's lives – Ingrid Leemet
2. Cognitive and social study motives in basic school students – Anna Karro, Jelena Pavlova
3. The formation of motivational attitudes of sixth and ninth grade students based on the example of the biology course – Julja Terehhova, Natalja Ljalko
4. "Children at Risk" as a social-pedagogical problem – Irina Kirkora
5. Working instruction for teaching of vegetation zones in Tallinn Botanic Garden. - Rando Tuvikene
6. Bog Field Tour for Sixth Grade Students - Niidas, A.
7. The illustration of reaction equation mechanisms in 8$^{th}$ grade chemistry using the Microsoft Powerpoint programme – Soika, K.
8. The teaching programme "Green Chemistry" - Gorelikova, J.
9. The chemofobia and the chemical hazard - Leitmaa, R.
10. Use tests for control pupil`s knowledges and on their base possibilities to effincy of the teaching process on the course of chemistry of the ground school - Livenko, I.
11. The elements of environmental chemistry in school chemistry: environmental impact caused by road transport - Bergmann, K.
12. Methodics of the learning environmental problems on the Nature trail of the Rocca al Mare Openair Museum - Ailt, H.
13. Nature trail on Nõmme-Mustamäe landscape reserve and it using in schoolwork - Haugas, R.
14. Biorhythms and their impact to mental capacity and learning ability of school students - Ivanov, P.
15. Exercise sheets for teaching the topic „Reptiles" in the VII grade - Kuuse, E.
16. Methodics of carrying out faunistic and floristic excursion on Alam-Pedja Nature Reserve Kirna hiking trail - Kübarsepp, M.
17. Methodics of excursion to study lichens, mosses and wood decay fungies in Tallinn Botanic Garden (TBG) - Luukas, A.
18. Use and principles of Ecological Education in elementary school Science Class. - Mazepina, S.
19. Methodics of educational trip to the Bogs in the sixth form of the basic school - Niidas, A.
20. Use and effectiveness of active learning methods in biology teaching at basics school 9 th grade - Purgas, A.
21. Additional materials on proccessing of municipal waste and on the field trip of the basic school basing Väätsawaste diasposal site - Tammekänd, K.
22. The role of individual learning and teachings processes as key to studyng effectiveness - Tikerpalu, E.
23. Individual work by using worksheets for illustration the ninth grade of basics school biology curriculum on base of Tallinn Zoo - Uiboleht, U.
24. The integration of environmental and sustainable management subject with mathematical studies in the 7$^{th}$ grade - Vahtramäe, K.
25. Indentity crisise of the teenagers caused by the biological and psychological changes - Vilen, M.
26. The geographical knowledge of students after the second school degree - Kristel Kongas
27. The use of Bloom's taxonomy in geography workbooks of ground school - Kati Klippberg

**2004**

**Diploma theses**

1. Functions of Antioxidants in Us and in Surroundings - Kairi Bergmann
2. Biochemistry of Alcoholism - Mare Pent
3. Biochemistry of Sweeteners - Sirle Kolk
4. *Safety of the Chemistry in the SchoolChemistry* - Ruth Leitmaa
5. Morphology, Phenology and Population Structure of *Cypripedium calceolus* at Some Populations of Läänemaa District (Estonia) - Triinu Lember
6. The Behavior of European Mink Litter in Different Enclosures Types - Eliis-Beth Rosen
7. The Bryophyta of Plant Communities with the Grand-Lichen in the Bogs of North and West Estonia - Kadri Leek
8. Ephemeroids in Estonian Gardens - Pille Kukkur
9. Development of the Suprasaline Coastal Meadows into Paludifield Grasslands - Kairi Jahilo
10. The Forming of the Saline Zone into a Poor Fen - Merilin Allemann
11. Students Knowledges of Herbs - Heidi Mäeveer
12. Feeding Ecology of European Mink (*Mustela lutreola*) Population in Island Hiiumaa 2000-2003 -Lauri Kõlamets
13. Vegetation Site Types of the Surroundings of the Valjala Earthen Stronghold Nature Trail and the Potential of Their Use in Nature Study -Erica Pärt
14. The Possibilities of Formal Education at Tallinn Zoo on the Basis of Worksheets -Terje Urgard
15. Vegetation of the Surroundings of the Nature Trail Kungla Boat Harbour – Roosu Oak, Valjala Community, Saare County -Arina Adamenko
16. Teaching History of Physics at School -Irina Kirkora
17. Applications of Differential Equations on Natural Sciences. Examples of Biology and Physics -Merike Rosin
18. Solution of Physics Exercises with the Assistance of LOTA Programme, Based Onto the Example of the 8$^{th}$ Grade -Kaili Kilp-Jegorov

**Pedagogical theses**

1- Nature trail “Kungla Harbour-Oak Roosu” (island Saaremaa) and teaching activities on it for the school´s 3 grade biology - Adamenko, A.
2- Relatio of individual practical work in the biology curriculum of Estonian secondary school - Kõlamets, L.
3- Practical work in the form of worksheets to go through the programme of 7 th grade biology basing on Tallinn Zoo - Urgard, T.
4- Workpapers in teaching of vegetation zones topic - Kadri Leek
5- The opportunities of using the films to illustrate topics of the zones of nature - Triinu Lember
6- An analysis of two parallel 7$^{th}$ grade geography textbooks. - Eliis-Beth Rosen

## Appendix 15

# Journals in the field of Natural Sciences in Tallinn Pedagogical University Library

(Ordered for year 2005)

Tallinn Pedagogical University has 1) a study library (location: Narva mnt 25) and 2) an academic library (location: Rävala pst 10). The latter is one of the biggest libraries of natural sciences in Estonia, where single journals as well as large databases (ScienceDirect, Kluwer, etc) are presented. From the databases full texts of articles are available through computers of University. A selection of some databases and journals mostly used in Department is given below.

1. **Journal of College Science Teaching.** National Science Teachers Association. Washington (USA).
2. **Journal of Chemical Education** / ACM. New York (USA).
3. **Naturwissenschaften im Unterricht. Physik.** Seelze (DEU).
4. **Naturwissenschaften im Unterricht. Chemie.** Seelze (DEU).
5. **School Science Review.** Association for Science Education. London (GBR).
6. **Science and Children.** National Science Teachers Association. Washington (USA).
7. **Science Education.** Wiley. Salem (USA).
8. **Science Education Suppliers.** National Science Teachers Association. Washington (USA).
9. **Science Scope**. **Journal for Middle/Junior High Scholl Science. Teachers**. National Science Teachers Association. Washington (USA).
10. **Science Teacher.** National Science Teachers Association. Washington (USA).
11. **Chaos, Solitons and Fractals.** Pergamon Press. London (GB).
12. **Journal of the Royal Society, Interface: Physical and Life Sciences.**
13. **Nature.** Macmillan Magazines. London (GB).
14. **Philosophical Transactions: Mathematical, Physical and Engineering Sciences.** Royal Society. London (GB).
15. **Physica A, B, C, D, E.** North Holland. Amsterdam (Netherland).
16. **Physical Review A, B, C, D, E, Letters.** American Institute of Physics. New York (USA).
17. **Baltic Astronomy.** Institute of Theoretical Physics and Astronomy. Vilnius. (Lithuania).
18. **Chinese Physics Letters.** Science Press. Beijing. (China).
19. **Comptes Rendus de l'academie des Sciences/Mecanique-Physique-Chimie-Astronomie.** Elsevier. Paris (France).
20. **Comptes rendus de l'academie des sciences/Physique. Astrophysique.** Elsevier. Paris (France).
21. **Environmental Management.** United States Environmental Protection Agency. Washington (D.C.).
22. **National Geographic.** National Geographic Society. Washington (D.C.).
23. **Ecology.** University Press. New York. Oxford.
24. **Journal of Ecology.** The British Ecological Society. Blackwell. Oxford.
25. **Biogeochemistry: an International Journal.** Kluwer Academic Publishers. Dordrecht. (Netherlands).

26. **Water, Air and Soil Pollution: an International Journal of Environmental Pollution.** Kluwer Academic Publishers. Dordrecht. (Netherlands).
27. **Ambio: a Journal of the Human Environment.** The Royal Swedish Academy of Sciences. Royal Swedish Academy of Sciences. Stockholm.
28. **Limnology and Oceanography.** American Society of Limnology and Oceanography. American Society of Limnology and Oceanography. Lawrence (KS).
29. **Chemical Physics Letters.** Elsevier Science Limited.
30. **Chemistry of Natural Compounds.** Consultants Bureau. Kluwer Academic Publishing. Dordrecht. (Netherlands).
31. **Chemistry and Ecology.** Taylor & Francis Ltd. Abingdon. Oxfordshire. (United Kingdom).
32. **Landscape Ecology: an International Journal / The International Association for Landscape Ecology.** Kluwer Academic Publishers. Dordrecht. Boston. London.
33. **Landscape and Urban Planning an International journal of Landscape Ecology, Landscape Planning and Landscape Design.** Elsevie. Amsterdam.
34. **Computers & Geosciences: an International Journal.** Pergamon Press. Elsevier Science. Oxford (UK).

In Russian:

1. **Biofizika.** Nauka/Interperiodika. Moskva (Russia).
2. **Fizika gorenija i vzrõva.** Izdatel'stvo SO RAN. Novosibirsk (Russia).
3. **Fizika v Shkole.** Shkola-Press. Moskva (Russia).
4. **Khimija v Shkole.** Shkola-Press. Moscow, Russia.
5. **Fizika tverdogo tela.** Nauka. St. Peterburg (Russia).
6. **Geologija i geofizika.** Izdatel'stvo SO RAN. Novosibirsk (Russia).
7. **Izvestiya RAN. Serija fizika atmosferõ i okeana.** Nauka. Moskva (Russia).
8. **Izvestiya RAN. Serija fizitsheskaja**. Nauka. Moskva (Russia).
9. **Izvestiya RAN. Serija mehanika zhidkosti i gaza.** Nauka. Moskva (Russia).
10. **Izvestiya RAN. Serija mehanika tverdogo tela.** Nauka. Moskva (Russia).
11. **Zhurnal eksperimentalnoj i teoretitsheskoj fiziki.** Nauka. Moskva (Russia).
12. **Uspehi fizitsheskih nauk.** Nauka. Moskva (Russia).

In Estonian:

1. **Horisont. Inimene. Loodus. Universum. MTÜ Loodusajakiri.** Tallinn.
2. **Akadeemia.** Eesti Üliõpilasseltside Liit. Tartu.
3. **Loodus.** Kodumaa uudised. Maailma maad and rahvad. MTÜ Loodusajakiri. Tallinn.
4. **Eesti Loodus.** Haridusministeerium.Tartu.

**Online journals and magazines in the field of biology, geography, chemistry and physics in main campus and library from the following databases and publishers:**

1. Institute of Physics (incl for example Journal of Physics A, B, D, G, Classical and Quantum Grav etc.)
2. The American Physics Society (Physical Review A,B,C,D,E; Reviews of Modern Physics etc).
3. Cambridge University Press - over 180 journals.
4. SpringerLink (Applied Physics A, B; Astronomy and Astrophysics, The European Physical Journal A, B, C, D, E etc)

5. ScienceDirect (Physica A,B,C,D,E; Physics Letters A,B; Chaos, Solitons and Fractals etc.); variety of journals on chemistry and biochemistry and biological sciences (over 1800 journals).
6. Blackwell Synergy – contains over 700 journals from Blackwell.
7. Kluwer Online Journals – over 680 e-journals.

## Appendix 16

# Employer's feedback on alumni of speciality Teacher of Natural Sciences, working as active teachers

| | Alumnus | Place of work | Evaluation* | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| 1. | Adler, Kadi | Kohila Gymnasium | 5 | 5 | 5 |
| 2. | Ailt, Helina | Lilleküla Gymnasium of Tallinn | 5 | 4 | 5 |
| 3. | Balašov, Dmitri | North Tallinn Private Gymnasium | 5 | 5 | 5 |
| 4. | Brusnikina, Anna | Pelgulinna Gymnasium | 5 | 4 | 4 |
| 5. | Karro, Anna | Pelguranna Gymnasium of Tallinn | 4 | 4 | 5 |
| 6. | Kuuse, Elin | Rocca al Mare School | 4 | 4 | 5 |
| 7. | Lessing, Marge | Primary School of Lagedi | 4 | 4 | 4 |
| 8. | Logovoi, Külli | Primary School of Holstre | 4 | 5 | 5 |
| 9. | Luukas, Anne | Sõle Gymnasium | 5 | 4 | 4 |
| 10. | Miil, Maris | Secondary School of Tõstamaa | 4 | 5 | 5 |
| 11. | Mäekask, Kristel | Lilleküla Gymnasium of Tallinn | 5 | 4 | 5 |
| 12. | Soika, Katrin | Tallinn Common Gymnasium | 5 | 5 | 5 |
| 13. | Tiits, Kaido | Tallinna Servicing High School | 5 | 4 | 5 |
| 14. | Tõnisson, Karoliina | Järveotsa Gymnasium | 5 | 5 | 5 |
| 15. | Vahtramäe, Kairi | Kivimäe Primary School of Tallinn | 5 | 4 | 5 |
| | | | | | |
| | | Average | 4,67 | 4,4 | 4,8 |

Evaluation scale:

5 – "very good"
4 – "good"
3 – "satisfactory"
2 – "poor"
1 – "fail"

* Assessment according to questions:

**1 –**How do you evaluate the special preparation of students (alumni) in Natural Sciences?
**2 –** How do the alumni cope with educational problems, discipline, etc?
**3** – How does the alumnus get on well with the collective body, does he (she) participate in school life, etc.