

Physics education in Slovakia

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- Who is responsible for what
- How to achieve a career in physics
- **Physics as a teaching subject**
- Pre-service teacher training
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- Popularization of science (physics) in society
- What we are doing for gifted children
- International cooperation

How our system
of education works

How our system of education works

Pre-school training and education (children aged 2 – 6 years)

- Part of the pre-school training and education of children is preparation of the child for compulsory school attendance.

Elementary training and education (children aged 7 – 15 years)

- is based on scientific knowledge in accordance with principles of patriotism, humanity and democracy,
- provides moral, aesthetic, working, health, physical, traffic and ecology education,
- enables religious education and sport preparation.

How our system of education works

Secondary general education and training (youth aged 16 – 19 years)
(Gymnasium)

- General preparation for study at universities,

Secondary professional education and training (youth aged 16 – 19 years)
(Secondary professional schools)

- preparation for professional occupations, including technical, economic, pedagogic, health care, social and legal, administrative, artistic and cultural, as well as for study at universities.

How our system of education works

Higher education (standard length 2 + 3 + 4 years)

the study programmes at three levels:

- The **Bachelor's study** programme which takes three years at least and four years at most (architecture, fine art and design).
- The **Magister's, Engineer's and Doctor's study** programme which takes one year at least and four years at most, so that the standard length of study according to the Bachelor's study programme represented in total five years at least.
- The **PhD. study** programme which takes three years in full-time form is at least and four years at most, in part-time five years.

How our system of education works

Credit system (since Academic year 2002/2003)

- The standard load of the student for the entire academic year is expressed by number of 60 credits, for semester 30 credits.
- The grading is on a scale of A-FX:

A (excellent) = 1 (able achievements)

B (very good) = 1,5 (above-average achievements)

C (good) = 2 (average achievements)

D (laudable) = 2,5 (acceptable achievements)

E (satisfactory) = 3 (achievements fulfil only the minimum criteria)

FX (unsatisfactory) = 4 (achievements do not fulfil even the minimum criteria)

How our system of education works

Examina rigorosa

- The holders of the academic degree of magister may take *examina rigorosa*, which includes also the defence of a *rigorosa* thesis. After its successful completing the higher education institutions award the academic degrees in:
 - natural science study programmes RNDr.
 - pharmacy study programmes PharmDr.
 - social science and art science study programmes PhDr.
 - law study programmes JUDr.
 - teacher training and sports study programmes PaedDr.
 - theological study programmes ThDr.

How our system of education works

15.09.2010

• Basic school	2063		
	28 278 teachers	413 718 pupils	
• Gymnazium	251		
	5961 teachers	89 336 pupils	
• Vocational school	489		
	13 359 teachers	181 334 pupils	
• University	32		
• Faculty	125		
	10 970 teachers	136 121 (Bc. + Mgr.) students	
		12 182	PhD. students

Who is responsible
for what

Who is responsible for what

Ministry of Education, Science, Research and Sport of the Slovak Republic

State Pedagogical Institute

- carries out curricular changes, applied educational research, professional and methodological consulting,
- provides experimental verification of educational projects, reforms and changes in the content of education,
- covers professional and methodological management of schools in particular by developing educational programs, preparation of pedagogical documentation for schools and school facilities in the field of education and training of teaching staff.

Institute of Information and Prognosis in Education

- provides operation of the state information system, methodology development and complex information processing in the field of education,

State Vocational Education Institute

- provides professional and methodological management of secondary schools, curriculum projects, ensuring of technical-pedagogical and educational activities to dealing with issues of secondary vocational education.

Who is responsible for what

National Institute for Certified Educational Measurements

- implementation of certified educational measurements at national level,
- preparation of international measurements in accordance with programmes where the Slovak Republic participates and fully complies with the rules,
- research and development in the area of measurements and evaluation of the quality of education,
- continuous monitoring of the results of education, conditions and development of education at national level as well as its international comparison,
- evaluation of the quality of education at primary and secondary schools at the level of national educational programmes.

Who is responsible for what

Methodology and Pedagogy Centre

(Institution for in Service Teachers' Education and Training)

- provides continual education for pedagogical employees and professional employees in schools and school facilities and prepares school leadership,
- provides expert methodological activities in the area of continual education of pedagogical and non-pedagogical staff,
- carries out research activities in the field of continual education of pedagogical and non pedagogical staff,

Regional Offices for Education

(Bratislava, Trnava, Trenčín, Nitra, Banská Bystrica, Žilina, Prešov, Košice)

Who is responsible for what

IUVENTA Slovak Youth Institute

- offers educational, methodical and informational activities for various target groups,
- perform tasks resulting from the state policy towards children and youth,
- coordinates and implements activities to promote and develop research in the field of youth,
- administrates grant programs of the Ministry of Education, Science, Research and Sport of SR (ADAM) and the European Union (Youth in Action),
- operates in the sphere of work with talented youth (Olympiads and school subject competitions),

Who is responsible for what

Slovak Research and Development Agency (SRDA)

- is the instrument for distribution of public finances for research and development on the competitive basis in Slovakia,
- is responsible for research and development promotion in all research fields, including international research cooperation.

How to achieve a career in physics

How to achieve a career in physics

Public universities:

- **Comenius University in Bratislava**
- **Pavol Jozef Šafárik University in Košice**
- Constantine the Philosopher University in Nitra
- Matej Bel University Banská Bystrica
- Trnava University in Trnava
- University of Žilina
- University of Prešov in Prešov
- Slovak University of Technology in Bratislava
- The Technical University of Košice

How to achieve a career in physics

Faculty of Mathematics Physics and Informatics Comenius University in Bratislava

- Bachelor degree in Physics
 - Physics
 - Biomedical Physics
 - Renewable Energy Sources and Environmental Physics
- Master degree in Physics
 - Astronomy and Astrophysics
 - Biomedical Physics
 - Biophysics and Chemical Physics
 - Environmental Physics and Renewable Energy Sources
 - Meteorology and Climatology
 - Nuclear and Sub-nuclear Physics
 - Optics, Lasers and Optical Spectroscopy
 - Physics of the Earth and Planets
 - Plasma Physics
 - Solid State Physics
 - Theoretical Physics

Faculty of Science P. J. Šafárik University in Košice

- Bachelor degree in Physics
 - Physics
- Master degree in Physics
 - Biophysics
 - Nuclear and Subnuclear Physics
 - Physics
 - Physics of Condensed Matter

How to achieve a career in physics

**Faculty of Mathematics Physics and Informatics
Comenius University in Bratislava**

- **PhD degree in Physics**

Environmental Physics

General Physics and Mathematical Physics

New and Renewable Energy Sources

Condense Matter Physics and Acoustics

Quantum Electronics, Optics and Optical

Spectroscopy

Nuclear and Subnuclear Physics

Plasma Physics

Astronomy and Astrophysics

Geophysics

Meteorology and Climatology

Chemical Physics

Biophysics

Theory of Physics Education

Faculty of Science

P. J. Šafárik University in Košice

- **PhD degree in Physics**

Biophysics

Nuclear and Subnuclear Physics

General Physics and Mathematical Physics

Physics of Condensed Matter

How to achieve a career in physics

Pre-service teacher training

- Bachelor degree

Training of teachers with academic subject specialisation (combination of two subjects)
Interdisciplinary studies of two subjects

- Master degree

Teaching primary and secondary subjects (combination of two subjects)
Teaching of Academic Subjects (combination of two subjects)

- PhD degree

Theory of Physics Education

Physics as a teaching subject

Physics as a teaching subject

- International Standard Classification of Education

ISCED 0 Pre-primary education

ISCED 1 Primary education - first stage of basic education
physical content as a part of subject „Natural science“

ISCED 2 Lower secondary education – second stage of basic education
Physics, Biology, Chemistry = thematic field: Human and nature

ISCED 3A Upper secondary education (Gymnasium)
Physics, Biology, Chemistry = thematic field: Human and nature

Lessons per week 6th 7th 8th 9th

Elementary school **1** **1** **2** **1**

1st 2nd 3rd 4th

Gymnasium **2** **2** **1** in total **30 weeks**
per school year

Physics as a teaching subject

National physics curriculum

(upper secondary level)

Subject (Physics) characteristics

- searching and identification of relationships between the observed properties of objects around us,
- the conceptual understanding of phenomena,
- developing positive attitude towards science the scientific knowledge is interpreted as a part of a human culture,
- active cognition and systematic inquiry,

In education, the dominant attention should be paid to **students independent work** – so called activities, i.e. assignments that lead to new **knowledge construction**.

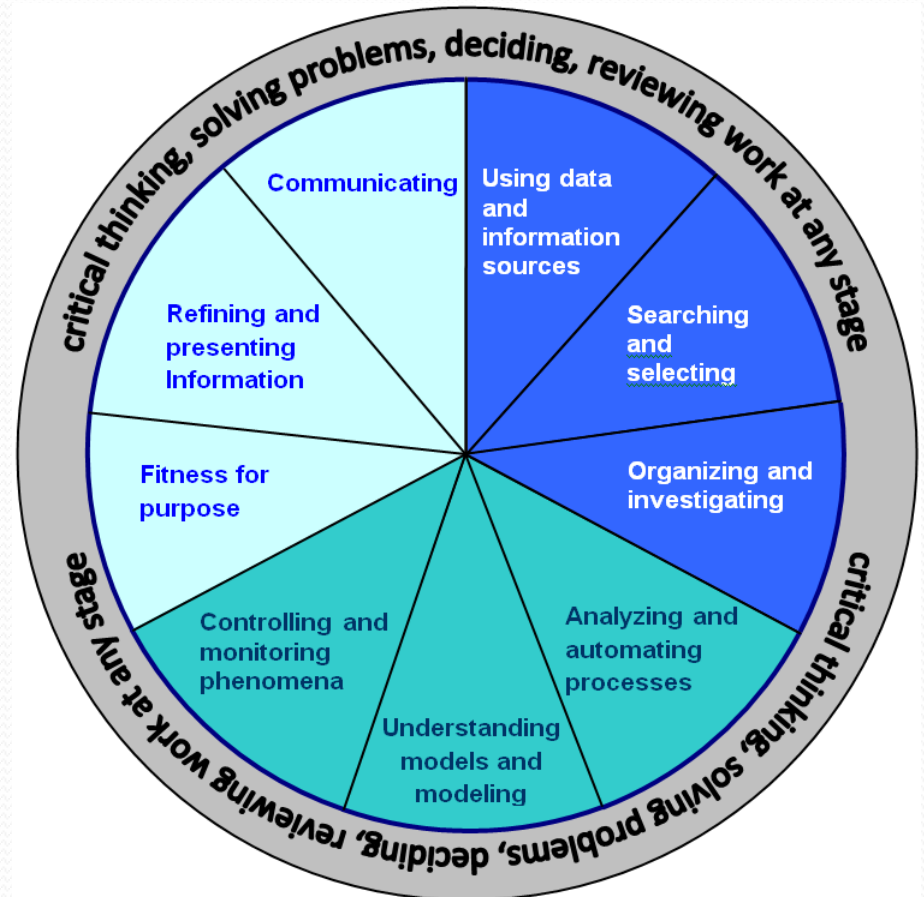
The stress is put on such forms like discussion, brainstorming, construction of logical patterns, and concept maps and working with information.

Student through physics education gains knowledge **to understand scientific ideas** and procedures needed for personal decisions and to participate in civil and cultural matters.

Physics as a teaching subject

Main objectives (upper secondary level)

- A. World around us
- B. Communication
- C. Science knowledge and ideas
- D. Scientific inquiry
- E. Data processing
- F. Experimentation



Physics as a teaching subject

Main objectives (upper secondary level)

A. World around us

at the end of the course student should be able:

- to describe the ways how science works
- to evaluate profits and drawbacks of science applications
- to discuss ethical and moral questions arising from science
- to discuss how science study is affected by cultural influence
- to understand how different sciences are connected and how they are connected with other disciplines
- to consider science as a collaboration activity

Physics as a teaching subject

Main objectives (upper secondary level)

B. Communication

at the end of the course student should be able to communicate ideas, observations, arguments, practical experience:

- using appropriate language and vocabulary
- using tables and diagrams
- using appropriate form of laboratory report
- using appropriate software, e.g. wordprocessor, spreadsheet

Physics as a teaching subject

Main objectives (upper secondary level)

C. Science knowledge and ideas

at the end of the course student should be able to demonstrate his knowledge and understanding of:

- the nature and methodology of science
- scientific facts, definitions, laws, models
- appropriate vocabulary and terminology, including symbols
- how laws, models and opinion have changed in time
- SI system of units

Physics as a teaching subject

Main objectives (upper secondary level)

D. Scientific inquiry

at the end of the course student should be able:

- to formulate a problem, research question, that can be answered by experiment
- to formulate a prediction,
- to test a prediction,
- to plan an appropriate experiment ,
- to formulate a conclusion according to observation and experimentation, to comment on measurement errors,
- to formulate the validity of conclusions based upon a series of measurements,
- to evaluate the overall experiment including the procedures used in it.

Physics as a teaching subject

Main objectives (upper secondary level)

E. Data processing

at the end of the course student should be able:

- to organize, present and evaluate data in different ways
- to transform data presented in a form into another form (including calculs, tables, diagrams)
- to identify possible trends in data
- to create predictions based upon data
- to suggest conclusions based upon data
- to use knowledge to explain conclusions

Physics as a teaching subject

Main objectives (upper secondary level)

F. Experimentation

at the end of the course student should be able:

- to follow written or oral instructions,
- to select and use safely the experimental setup, materials, technology appropriate for measurement
- to carry out the experiment safely, to record data gained by observation and measurement
- to use appropriate tools and technology to collect data,
- to work and cooperate in groups

Physics as a teaching subject

Suggested topics of Physics (upper secondary level)

Observation, measurement, experiment	(4+40 lessons)
Force and motion	(18 lessons)
Energy around us	(18 lessons)
Electricity and magnetism	(20 lessons)
Periodic phenomena	(15 lessons)
Electromagnetic waves and particles of microworld	(20 lessons)

Pre-service teacher training

Pre-service teacher training

5 years study planes oriented on:

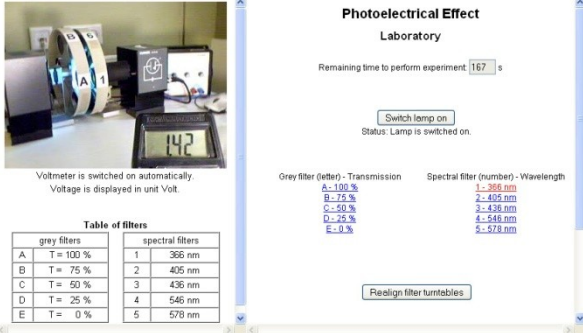
- conceptual understanding of basic physics problems,
- experimental skills for school physic experiments,
- problem solving through the various methods and approaches,
- modern teaching methods (PEER Instruction, Interactive lecture demonstrations, Just in Time Teaching...),

Remotely Controlled Laboratories - RCLs
experimenting from a distance

Home RCL Project RCLs Technical Notes Contact

Photoelectrical Effect

Introduction
Setup
Theory
Tasks
Laboratory
Analysis
Discussion
Material
Support



Voltmeter is switched on automatically.
Voltage is displayed in unit Volt.

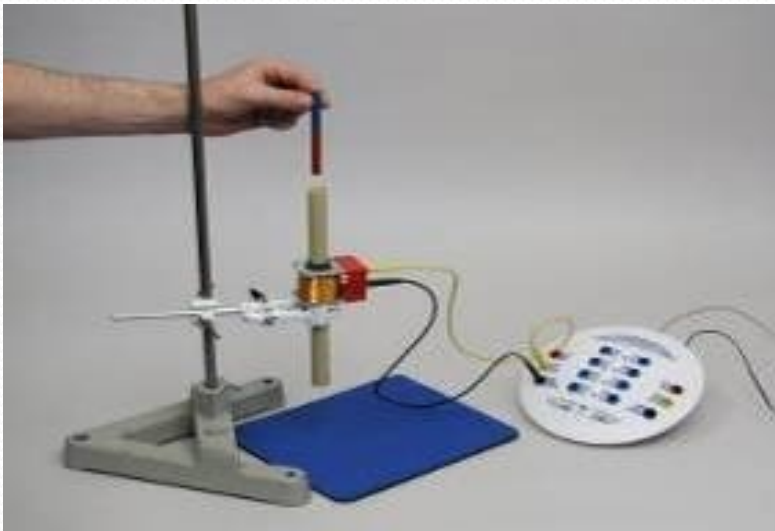
Remaining time to perform experiment: 167 s

Switch lamp on
Status: Lamp is switched on.

Grey filter (letter) - Transmission Spectral filter (number) - Wavelength

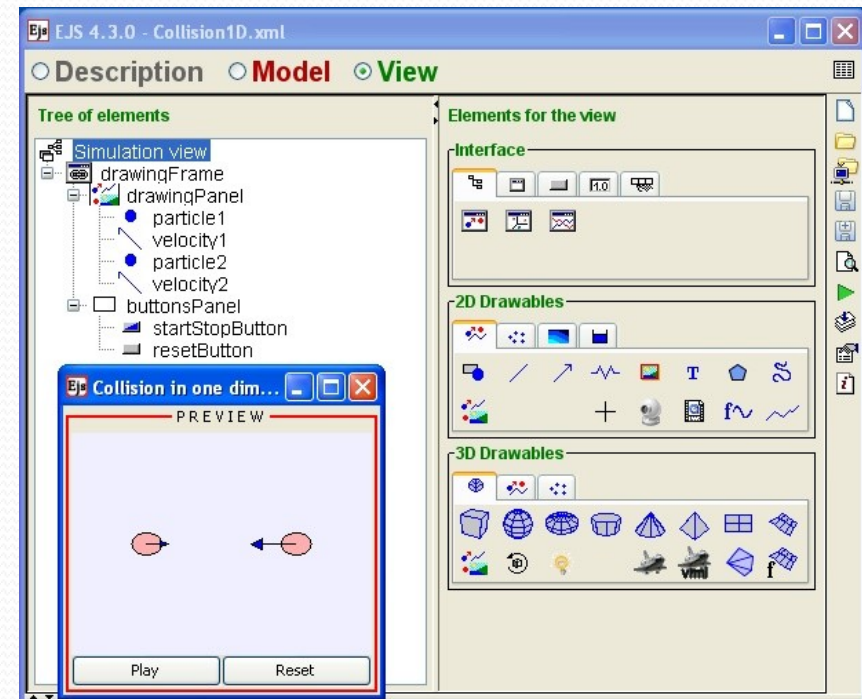
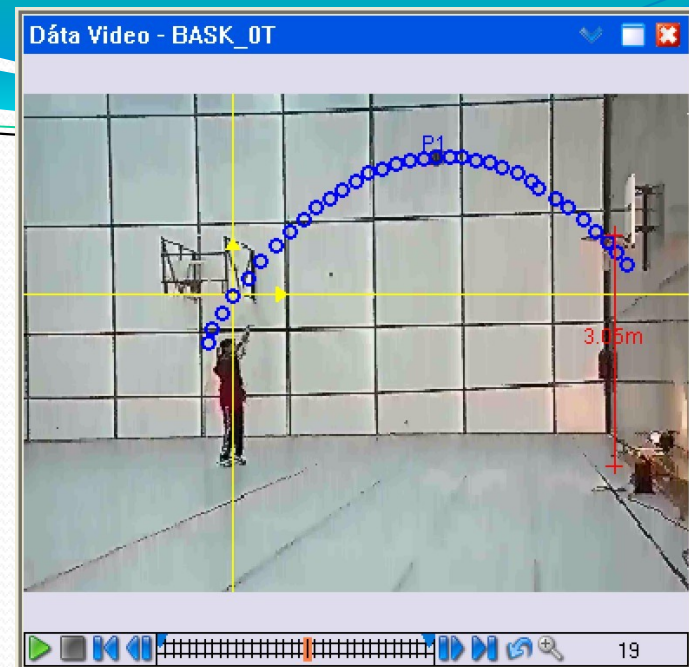
Grey filter (letter) - Transmission	Spectral filter (number) - Wavelength
A - 100 %	1 - 366 nm
B - 75 %	2 - 405 nm
C - 50 %	3 - 436 nm
D - 25 %	4 - 546 nm
E - 0 %	5 - 578 nm

Realign filter turntables



Pre-service teacher training

- using of modern technologies in education (tablet, electronic whiteboard, voting system,)
- computer based measurement,
- Computer modelling and simulation,
- e-learning, LMS for distance education,
- gifted student competitions,
- informal education,
- ...



Pre-service teacher training

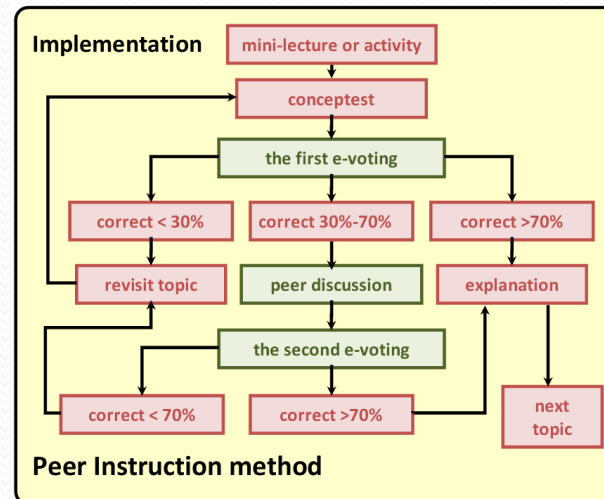
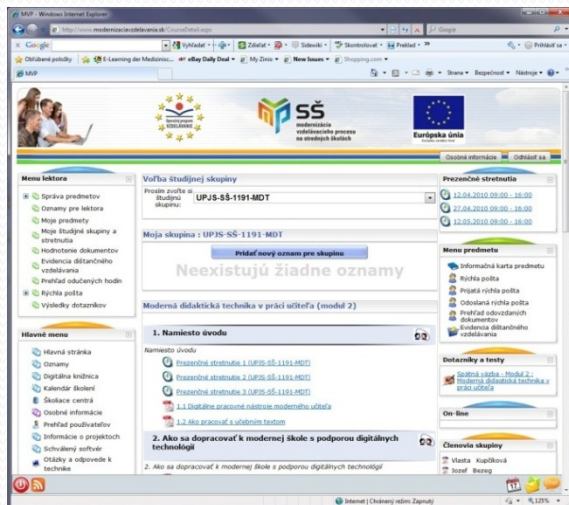
Actual problems:

- weak interest in teaching profession,
- decreasing quality of students,
- too high average age of school teachers,
- lack of job vacancies for young teachers,
- high requirements on the teacher's work,

In-service teacher training

In-service teacher training

- National system for teacher personal development,
- Credit system for further teacher education
- Accreditation commission Ministry of Education for further education
- F2F and distance courses with help of e-learning,
- National project:
 - Modernization of the education at primary and secondary schools



Popularization
of science (physics)
in society

Popularization of science (physics) in society

- Science week
- Open door University
- Science seminars, science cafe, discussion forums,
- Research lab open for public
- Science show,
- Science toy,
- ...



What we are doing
for gifted children

What we are doing for gifted children

- Physics Olympiad (52nd year of the competition)
- Young Scientists Tournament
- Secondary school professional activity
- Distance courses for gifted students in problem solving
- Summer camps and schools,



International cooperation

International cooperation

- FP 7 projects oriented on Inquiry based science education (IBSE methods, pre- service and in- service teacher training):
 - **ESTABLISH: European Science And Technology in Action Building Links with Industry, Schools and Home**
 - **PRIMAS: Promoting Inquiry in Mathematics and Science education across Europe**
 - **ASPIRE: Assessment Strategy Programmes In Renovating Education**



Thank you for your attention

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