



## CHEMISTRY AS PART OF PRIMARY SCIENCE EDUCATION AT TIME OF THE NEW CURRICULAR REFORM IN THE CZECH REPUBLIC

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### Abstract

In the article we are presenting present state and new possibilities for chemistry in primary science curriculum development in the Czech republic with orientation towards ecological and environmental aspects. The new curricular reform is the most important field of the education reform in Czech Republic.

**Keywords:** science education, curricular reform

### Introduction

In the Czech republic new approaches to the formation of educational programmes appear at present. Actually it is preparation of so-called “two-level curriculum”, which includes the “general curriculum” developed by Pedagogical Research Institute (Prague) of Czech Ministry of Education and the “school curriculum” constructed by particular school. In this short description we would like to describe some aspects of starting points, i.e. of the possibilities of curriculum formation for primary and secondary schools in the area of science education (especially chemistry) with ecological and environmental orientation (Bílek et al., 2001, Gajdoš, 1992).

„Former Curricular Situation“ in Area of Primary Science Education

At present are being created three variants of primary curriculum (for children of 6–15 years old) – “Základní škola”, “Obecná a občanská škola” and “Národní škola”. Parts of primary science education are presented in tables 1–3.

Table 1.

#### Science in Subjects – Primary School Curriculum “Základní škola“

Grade	Subjects (classes weekly)
1	Primary Science (2)
2	Primary Science (2)
3	Primary Science (3)
4	Natural Science – Homeland Study (3)
5	Natural Science – Homeland Study (4)
6	Physics – Biology – Geography (*)
7	Physics – Biology – Geography (*)
8	Physics – Chemistry – Biology – Geography (*)
9	Physics – Chemistry – Biology – Geography (*)

(\*) At grades 6. – 9. altogether: Phy 6, Che 4, Bio 6, Geo 6

Table 2.

#### Science in Subjects – Primary School Curriculum “Obecná a občanská škola“

Grade	Subjects (% of week appropriation)
1	Primary Sciences (9-13)
2	Primary Sciences (9-13)
3	Primary Sciences (16-20)
4	Natural Science – Homeland Study (15-19)
5	Natural Science – Homeland Study (14-18)
6	Physics (1)–Biology (2)–Geography (1)*
7	Physics (1) – Biology (1) – Geography (2) *
8	Physics (2) – Chemistry (1) – Biology (1) – Geography (1) *
9	Physics (1) – Chemistry (2) – Biology (1) – Geography (1) *

- classes weekly

Table 3.

## Science in Subjects – Primary School Curriculum “Národní škola“

Grade	Subjects (classes weekly)
1	Primary Science (2)
2	Primary Science (2)
3	Primary Science (3)
4	Natural Science (2)–Homeland Study (1)
5	Natural Science (2) – Homeland Study (2)
6	The Cognition of Nature (Phy-Bio) (3) –Geography and History (3)
7	The Cognition of Nature (Phy-Bio)(4)–Geography, History (3)
8.	The Cognition of Nature (Phy-Bio-Che)*- Geography and History **
9	The Cognition of Nature (Phy-Bio- Che) * - Geography and History **

\* 4 classes in 8. - 9., \*\* 2 classes in 8. - 9. + facultative subjects

From the above mentioned survey it is apparent, that chemistry has a privileged position among all science subject. If we compare all the modelled curricula we can draw the fact that chemistry is the only obligatory subject in 6<sup>th</sup> to 9<sup>th</sup> class, which is not included in all years curricula. It is apparent mainly in the most liberal program „Narodní škola“ in which chemistry is missing in 6<sup>th</sup> and 7<sup>th</sup> grade curricula. The question is if the chemistry education is or must be so exceptional. The positive answers are based on difficulties of education for students (chemical symbolism, abstraction of chemical notions etc.). We think that the real reason is rather manifestation of the focus on subjects and domination of the content and disrespect for educational value of the qualitative attitude to the notions and links among the science subjects at the 1<sup>st</sup> to 5<sup>th</sup> grade of the primary school.

## „New Curricular Situation“ in Area of Primary Science Education

New situation in the Czech republic (new curricular reform) is characterized by preparation of so-called “two-level curriculum”, which includes the “general curriculum” developed by Pedagogical Research Institute of Czech Ministry of Education and “school curriculum” constructed by a school (Bílek and Semrádová, 2003). The “general curriculum” - in this example “Core Curriculum for Primary Education (RVP ZV – Rámcový Vzdělávací Program pro Základní Vzdělávání)” – does not mention learning subjects but learning areas. Teams of scientists, educationists, teachers etc. have defined nine basic areas:

- Language and Communication,
- Mathematics and its Application,
- Information and Communication Technology,
- Man and His World,
- Man and Society,
- Man and Nature,
- Arts and Culture,
- Man and Health,
- Man and World of Work.

For specific goals so-called “cross-curricular topics” were prepared: Education to Democratic Civics, Education to Personality and Social Adaptation, **Environmental Education**, Medial Education, Education to Thinking on European and Global Connection and Multicultural Education.

The learning area “**Man and Nature**” is characterized by the following aspects that possibly introduce ecological and environmental approaches:

- Subject matter of physics, chemistry, biology and geography,

- 22 classes weekly (minimum for 6<sup>th</sup> – 9<sup>th</sup> Grades),
- Possibilities for integration, for traditional or new subjects,
- School curriculum as a school product by RVP ZV or modification of so called pattern curriculum,
- The beginning at 1. 1. 2006 as a maximum (now there are 2 years for preparation of school curricula – New School Law).

Chemistry in Time of „New Curricular Situation“ (VÚP, 2004)

As it has been said the Chemistry curriculum in the new situation part of **Man and Nature** curriculum, which includes problems connected with nature researching (Bílek and Hruška, 2002, 2004). It offers pupils means and methods for deeper understanding nature facts and principles. It provides them with necessary basis for comprehension and use current technologies and facilitates better orientation in life.

In this educational field pupils are given opportunity to learn nature as a system, parts of which are connected and influence each other. This is the principle on which the importance of understanding and keeping the balance in the nature is essential for living system, including the man. The educational area also helps create open thinking (accessible to alternative opinion), critical and logical thinking.

Educational disciplines in the area of **Man and Nature** aim at enabling pupils deeper understanding principles of processes in nature via active and inquiring way of learning, and thus realize how useful the processes are and how they can be applied in real life. Using the special ways of learning mentioned above pupils master important skills at the same time, especially observe in a systematic, objective and reliable way, make experiments, measurements, formulate and verify hypotheses on phenomena observed, analyse results received and deduce conclusions. Pupils learn how to research causes of processes in the nature, causality and relations, ask questions (How? Why? What happens if?), discover solutions, explain observed principles, solve problems and apply their knowledge to predict and influence the processes.

General objectives in Man and Nature area aim at key competences and to learn pupils how to:

- Use empirical methods of cognition (observation, measurement, experiment, rational thinking) in researching facts and connections in nature,
- Ask questions on causes and development of processes in nature and find correct answers to them think to verify hypotheses in several independent ways,
- Evaluate importance reliability correctness of data to verify hypotheses or not,
- Join activities aiming at being friendly to nature systems, their own and other people's health, understand relations between man and nature,
- Act and prefer effective use of energy and its renewable sources, especially sunshine, water and biomass,
- Behave in life, property and nature threatening situations.

The Chemistry curriculum includes following topics (final competences are presented in brackets):

- **Observation, Experiment, Safety of Work** (pupil is able to define identical and different features of substances, work safely with common substances, evaluate their danger, judge the safety rate, explain the most effective behaviour in danger situation leak),
- **Mixtures** (pupil is able to differ mixtures and chemical substances, calculate the concentration of solutions, prepare solutions; explain basic factors influencing to solubility of solid substances; suggest and demonstrate technologies of mixtures separation (components of mixtures defined content); present practical examples of separation of components, differ various types of water and gives examples of their

- appearance and use, show ways of polluting water and air in working process and households, suggest optimal preventive precautions and ways of recycling),
- **Microelement Structure of Substances and Chemical Elements** (pupil is able to use expressions atom and molecule in correct context, differ chemical elements and chemical compounds and uses the expressions in correct context, have good knowledge in periodical table of chemical elements, distinguish selected metallic and non-metallic elements and evaluate their features),
  - **Chemical Reactions** (pupil is able to differ incipient substances and products of chemical reactions, give their practical examples, classify them and evaluate their use, read chemical reactions and calculate used the mass conservation law of reactants or products; apply knowledge of factors which practically influence to course of chemical reaction),
  - **Inorganic Compounds** (pupil is able to compare features and use of important oxides, acids, bases and salts and consider the influence on the environment, explain origin of acid rains and their influence on the environment, present preventive precautions; prove orientation in pH scale, measure reaction of solution by universal indicator paper and give practical examples of neutralisation),
  - **Organic Compounds** (pupil is able to differ simple hydrocarbons, present their sources, features and use, evaluate the use of fossil fuels and man-made fuels as sources of energy and give examples of oil treatment, differ some derivatives of hydrocarbons, present their sources, features and use, be oriented in photosynthesis reactants and products and end-products of biochemical processes, especially proteins, fats, saccharides; determine sufficient conditions for active photosynthesis, give examples of proteins, fats, saccharides and vitamin sources),
  - **Chemistry and Society** (pupil is able to evaluate the use of primary and secondary raw materials from the sustainable development point of view on the Earth, apply rules of distinguishing fires on model situations, be oriented in preparation and practical use of various substances and their influence on man's health).

**Cross-curricular topics** are another way how to apply curriculum in any situation. They represent current problems of contemporary world in RVP-ZV and become important and inseparable part of basic education. They are also a formative part; they create an opportunity for individual use by pupils, their mutual cooperation and help to develop any pupil personality in the field of attitudes and values.

The Chemistry curriculum as part of **Man and Nature** area should be applied in another cross-curricular topic – **Environmental Education**. The topic is divided into several parts, which enable undivided understanding of relations between man and the environment. It leads pupils to realize the basic life conditions and responsibility the current generation for life in the future. The basic areas are as follows:

- **Ecosystems** – forest; field; water sources; sea and tropical rain forest; men's settlements – town - village; cultural countryside,
- **Basic Life Conditions** – water, soil, air, ecosystems – biodiversity; energy; natural sources,
- **Men's Activities and Environmental Problems** – agriculture and environment, ecological agriculture; transport and environment, industry and environment; waste and waste disposal, protection of nature and culture, changes in countryside, long-term programmes aimed at public ecological awareness, The Environmental Day, The Earth Day etc.,
- **Relation between Man and the Environment** – our place, our lifestyle, local ecological problems, environment and health, non-uniform life on the Earth.

## Conclusion

The fate of the chemistry education or as it is mentioned in RVP ZV the chemical nature education has been so far very uncertain. Will chemistry remain the only subject, which is not taught in all grades? Will there remain various nature science subjects at the secondary school or will prevail the model of one integrated nature science in the upper grades of the primary and the secondary school? These are some of our expectations or questions the answers to which we have not got but we are trying to find.

More pieces of information and experience are presented and offered from abroad (e.g. Lamanauskas, Gedrovics and Raipulis, 2004, Pfeifer, Häusler and Lutz, 2002, Kluz and Poźniczek, 2003, Kmeťová, 2003), which might improve the situation if being presented.

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## Santrauka

### CHEMIJA KAIP PRADINIO GAMTAMOKSLINIO UGDYMO DALIS UGDYMO TURINIO REFORMOS LAIKOTARPIU ČEKIJOS RESPUBLIKOJE

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Čekijoje, kaip ir kitose šalyse, vyksta intensyvus mokymo programų atnaujinimas. Prahos pedagoginių tyrimų institutas parengė Bendrąsias programas. Mokyklos konstruoja savo lygmens programas. 6–15 metų vaikams parengti trys programų variantai – „Základní škola“, „Obecná a občanská škola“ ir „Národní škola“. Įdomu tai, kad chemija turi privilegijuotas pozicijas visoje programoje. „Národní škola“ yra liberaliausia programa, kurioje chemija išbraukta iš 6 ir 7 klasės kurso. Autoriai konstatuoja, kad moksleiviams chemija yra sunkus dalykas. Taip pat daroma išvada, kad tai lemia ir menkas dėmesys chemijos žinioms pradinės mokyklos kurse. Naujojoje programoje nenurodomi atskiri dalykai, bet sritis. Išskirtos devynios pagrindinės sritys:

- kalbos ir komunikacija;
- matematika ir jos taikymas;
- informacijos ir komunikacijos technologijos;
- žmogus ir jo pasaulis;

- žmogus ir visuomenė;
- žmogus ir gamta;
- menas ir kultūra;
- žmogus ir sveikata;
- žmogus ir darbo pasaulis.

Taip pat buvo parengta nemažai tarpdisciplininių sričių, tokių kaip „Aplinkosauginis ugdymas“, „Pilietinės visuomenės ugdymas“ ir t. t.

Chemija yra sudėtinė kurso „Žmogus ir gamta“ dalis. Šiame kurse moksleiviai turi galimybes pažinti gamtą kaip sudėtingą sistemą, kuri sąveikauja su kitomis įvairiomis sistemomis. Pagrindinis kurso tikslas – supažindinti su gamtoje vykstančiais procesais, giliau juos suprasti per įvairius tyrinėjimus ir kitą praktinę veiklą. Moksleiviai turi išmokti stebėti, matuoti, atlikti nesudėtingus eksperimentus, kritiškai mąstyti.

Lieka atviras klausimas, koks turi būti gamtamokslinis ugdymas bendrojo lavinimo mokykloje. Ar turi būti atskiri gamtos dalykai plėtojami, ar reikalingas integruoto gamtamokslinio kurso modelis, kuris būtų realizuojamas tiek žemesnėse, tiek aukštesnėse vidurinės mokyklos klasėse? Tai pagrindinis klausimas, į kurį ieškoma atsakymų Čekijos autorių darbuose.

**Raktiniai žodžiai:** gamtamokslinis ugdymas, programų reforma.

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