



THE STUDENT SCIENTIFIC CONFERENCE ON BRNO DAM

*The interdisciplinary approach
to cyanobacteria problems*

Dam it!

2013

17th May 2013, Brno, Czech Republic

Conference book

*Masaryk University
Brno 2013*



Inovace, metodika a kvalita jazykového vzdělávání a odborného vzdělávání v cizích jazycích v terciární sféře v ČR

Operační program Vzdělávání pro konkurenceschopnost



THE STUDENT SCIENTIFIC CONFERENCE ON BRNO DAM

***The interdisciplinary approach
to cyanobacteria problems***

Dam it!

2013

17th May 2013, Brno, Czech Republic

Conference book

Editors:

Nikol Zelíková

Tomáš Černák

Pavel Kohl

Front cover: Brno dam, Ignis Brunensis 2012

Table of contents

1. Preface	/7
2. Committees	/9
3. Biosketches	/11
4. Programme	/17
5. Abstracts	/19
5.1. List of abstracts	/19
5.2. Abstracts	/21
5.3. Posters	/30
6. List of participants	/33

1/ Preface

A group of science students at Masaryk University have been meeting every Friday to deal with an authentic problem. Their cooperation is based on an interdisciplinary approach. The results of the course will be presented at a conference organized by the students themselves.

2/ Committee

Scientific committee

Mgr. Jarmila Burianová, Ph.D.

Mgr. Dominik Heger, Ph.D.

Mgr. Tomáš Kuchovský, Ph.D.

Mgr. Ondřej Příbyla

Mgr. Pavla Řezníčková, Ph.D.

Language committee

Mgr. Eva Čoupková, Ph.D.

Mgr. Robert Helán, Ph.D.

Mgr. Věra Hranáčová

Mgr. Jana Kollárová

Mgr. Markéta Kovaříková

Mgr. Jana Kubrická

PhDr. Hana Němcová

James Edward Thomas, M.A.

Organizing committee

Nikol Zelíková

Tomáš Černák

Bc. Pavel Kohl

Bc. Katarina Palatinusová

Zeťo Xia

Mgr. Veronika Košařová

Mgr. Gita Jančaříková

Mgr. Eliška Čechová

Barbara Vonková

Ondřej Kovanda

Bc. Jana Faltýnková

Martin Blažek

3/ Biosketches

Blažek Martin

Martin Blažek is a student in the second year of the bachelor's degree programme, combined form. His field of study is Astrophysics and he has just started choosing the topic of and planning his bachelor thesis. He loves nature, especially that in the northern part of Europe.

Čechová Eliška

Eliška Čechová was born in 1988 in Slovakia and studied Analytical Chemistry at Masaryk University in Brno. Currently she is doing her PhD degree in the Research Centre for Toxic Compounds in the Environment. To her research interests belong the determination of estrogenic substances in environmental matrices, esp. wastewaters, fullerenes in the air, and analysis of brominated flame retardants and also organochlorine pesticides in human samples using modern instrumental techniques LC-MS and GC-HRMS.

Černák Tomáš

Tomáš Černák is a 22 years old student of the second year of his bachelor studies. His field of study is Applied Geography – Regional Development. He lives in the Tatra Mountains in Slovakia and loves mountains and nature. Apart from English, he can also speak French.

Guricová Karolína

Karolína Guricová is a bachelor student of Pure Mathematics, Biomedical Technology and Bioinformatics. She is in her second year and her thesis that deals with Signal Processing will connect both of the fields of her studies. She enjoys travelling; therefore she will spend the following semester in Finland, attending Tampere University of Technology.

Faltýnková Jana

Jana Faltýnková is a student of the first year of her master's degree studies. Her field of study is Financial Mathematics.

Ivanecký Martin

Martin Ivanecký is a bachelor student. Now he is in his third year of study in the field of Molecular Biology and Genetics.

Jančaříková Gita

Gita Jančaříková is a Ph.D student. Now she is in her third year of study in the field of Biomolecular Chemistry in the National Centre for Biomolecular Research (NCBR). Her doctoral thesis is called *Study of Saccharide-Recognising Proteins and Their Role in pathogenesis*.

Kohl Pavel

Pavel Kohl is a student of the master's degree programme. He is currently in his first year of study in the field of Biophysics.

Košařová Veronika

Veronika Košařová is a Ph.D student of Analytical Chemistry at the Faculty of Science. She has devoted the last few years to material research of colours and foundation layers of work of fine arts by using instrumental analytical methods. She has dealt with application of analytical methods for the identification of artwork in her bachelor thesis, as well as, much more profoundly, in her diploma thesis.

Kovanda Ondřej

Ondřej Kovanda was born in 1993. He is a bachelor student of the degree programme Geology. Cosmopolite Eco – friendly pacifist, interested in making the world a better place.

Lukeš Václav

Václav Lukeš is a student of Applied Geography and next year he will finish his bachelor course. He specializes in combining natural and social issues in a geographical point of view which he finds very useful. Understanding the principles of connections between nature and society is the key issue in this age. The main impulse that led to his enrolment in this course was the increasing need of English in the scientific world.

Palatinusová Katarína

Katarína Palatinusová is a first year student of the master's programme of Financial Mathematics. In her bachelor's degree programme she studied Applied Mathematics.

Polsterová (Župková) Svatava

Svatava Polsterová is a master student. Her field of study since 2011 has been Physical Chemistry and she characterizes metal nanoparticles in her master's thesis. From 2008 to 2011 she was studying the bachelor's degree programme: Chemistry. In her bachelor's thesis she studied carbon nanoparticles in plasma environment.

Seifertová Marta

Marta Seifertová is a Ph.D. student at the Research Centre for Toxic Compounds in the Environment (RECETOX). Her major interest is the development and

optimization of analytical methods (especially liquid chromatography coupled with mass spectrometry) and extraction techniques. For some time now she has been working on methods for the determination of alkylphenols in environmental matrices (e.g. sampling of alkylphenols in indoor air). Currently, she is a team member (researcher) of an international project DENAMIC (Developmental Neurotoxicity Assessment of Mixtures in Children). Her main task is the development of methods for the determination of pyrethroids in human matrices (i.e. children's urine, umbilical cord blood and breast milk samples) and subsequent data analysis.

Vasířová Janka

Janka Vasířová is a student of the master's degree programme. She is currently in her first year of study in the field of Financial Mathematics.

Vířková Aneřka

Aneřka Vířková attended Episcopal grammar school in Brno and currently she is 21 year-old student in the second year of her bachelor's degree programme in the field of Geology. One of her hobbies is ballroom dancing.

Vonková Barbara

Barbara Vonková is interested in biology and chemistry and that is why she is currently studying Medical Genetics in her first year of bachelor degree. In her free time she works in CEITEC, in the department of molecular medicine in Hemato-Oncological Clinic in the hospital.

Xia Caiyun

Caiyun Xia [Zeťo Xia] is in his first year of bachelor's degree programme in the field of Astrophysics. He lives in Prievidza in Slovakia and he attends this course to improve his English so that he could travel all over the world.

Zelíková Nikol

Nikol Zelíková was born in 1991 in Vsetín. She studies Physical Geography in the second year of her bachelor's degree programme. She is interested in connections between urban areas and nature aspects, renovation of abandoned areas (industrial, urban), and planning and construction of permaculture.

4/ Programme

Friday, 17 May, Assembly Hall, Faculty of Science, Kotlářská 2, Brno

8:30 – 9:00 Registration, check-in

9:00 Opening

Session 1 - Has the Ecosystem Changed after Algal Blooms?

Chair: Martin Ivanecký

Presenters: Lenka Sedlačková (BCH)

Karolína Guricová (M)

Martin Blažek (FY)

Veronika Košařová (CH)

9:30 Session 2 - Removal of Cyanobacteria – Aeration Towers

Chair: Martin Ivanecký

Presenters: Gita Jančaříková (BCH)

Jana Faltýnková (M)

Caiyun Xia (FY)

Ondřej Kovanda (GE)

10:00 **Coffee Break, Refreshments, and Poster Display**

10:30 **Session 3 – Human Impact on Brno Reservoir**

Chair: Lenka Sedlačková

Presenters: Katarína Palatinusová (M)

Svatava Župková (CHE)

Martin Ivanecký (EXB)

Anežka Víšková (GE)

Janka Vasiřová (M)

11:00 **Session 4 – Phosphorus Cycle in Brno Reservoir**

Chair: Lenka Sedlačková

Presenters: Václav Lukeš (AG)

Barbara Vonková (BI)

Eliška Čechová (CH)

Pavel Kohl (FY)

11:30 **Awards and Farewells**

5/ Abstracts

5.1 List of Abstracts

- 1/ **Aeration Towers in Brno Reservoir**
Gita Jančaříková
- 2/ **Widespread Use of Brno Reservoir**
Katarína Palatinusová
- 3/ **Structure of Aeration Towers and their Efficiency in the Brno Reservoir**
Jana Faltýnková
- 4/ **Change in Ecosystem of the Brno Reservoir**
Guricová Karolína
- 5/ **The Effects of Phosphorus Decrease**
Barbara Vonková
- 6/ **Aeration and Aeration Tower**
Caiyun Xia
- 7/ **The Mud Story**
Ondřej Kovanda
- 8/ **Phosphorus Cycle in the Brno Reservoir**
Pavel Kohl

- 9/ Human Impact on Brno Reservoir**
Svatava Župková
- 10/ Human Impact on the Brno Reservoir**
Janka Vasilová
- 11/ Human Impact on Biodiversity**
Martin Ivanecký
- 12/ Deposition Rate of Brno Dam Lake Sediments and its Effect on Cyanobacteria**
Anežka Víšková
- 13/ Has the Ecosystem Changed in the Brno Reservoir?**
Lenka Sedlačková
- 14/ Has the Ecosystem Changed after Algal Blooms?**
Veronika Košařová
- 15/ Changes in the Ecosystem of the Brno Reservoir – the Influence of Weather**
Martin Blažek

Posters

- 16/ How Do Fireworks Affect Phosphorus Equilibrium in the Brno Dam?**
Eliška Čechová, Marta Seifertová, Dominik Heger
- 17/ Land-Use and the Phosphorus Impact on Chlorophyll**
Václav Lukeš, Tomáš Černák, Nikol Zelíková

5.2 Abstracts

Aeration Towers in Brno Reservoir

Gita Jančaříková

Cyanobacteria, also known as blue-green algae, are gramnegative bacteria. The majority of this phylum is aerobic photoautotrophs, and their life processes require only water, carbon dioxide, inorganic substances, and light. Cyanobacteria can produce cyanotoxins in such concentrations that they poison and even kill animals and humans. Cyanotoxins can also accumulate in other animals such as fish and shellfish, and cause poisonings, namely, shellfish poisoning. For these reasons it is important to eradicate these bacteria. One approach is aeration, which can be facilitated using aeration towers. In Brno dam 20 aeration towers were built that use aeration and destratification technologies. It enables the removal of the anoxic layer from the hypolimnion layer. The major advantage of this process is that chemical compounds are not used and the environment is not overburdened. The aeration towers – along with phosphorus precipitation at the influent to the Brno Dam – have dramatically improved the swimming conditions, and have freed the dam of the feared cyanobacteria for two seasons now.

Widespread Use of Brno Reservoir

Katarína Palatinusová

The Brno Reservoir is a dam on the Svatka River right outside the city of Brno. It is used as a place for recreation, a source of electric power and as a place for

many events. The purpose of this study is to present all opportunities for spending free time near the Brno Reservoir. This paper provides some interesting facts and statistics about the visitors of the Brno Reservoir and introduces the most interesting activities people can do there. This study is based on information that is available on the internet. The findings of this paper could make this place more attractive for locals and visitors.

Structure of Aeration Towers and their Efficiency in the Brno Reservoir

Jana Faltýnková

The region surrounding the Brno Reservoir on the Svatka river is an important recreational area outside Brno. In recent decades, high concentrations of biogenic elements have disturbed the ecosystem. This paper focuses on the proposed solution to the problem, namely, aeration. It describes the structure of the aeration towers that were installed in the reservoir in 2009. These towers helped to solve the problem with cyanobacteria. Since 2011 values of cyanobacteria cells per 1 ml of water have met the hygienic limit. This study is based on information that is available on the internet. The findings in the study could clarify the structure of the aeration towers and their effect on cyanobacteria.

Change in Ecosystem of the Brno Reservoir

Guricová Karolína

The project Clean Basin of the Svatka River has brought about considerable changes in the Brno Reservoir over the last five years. The main aim is to

decrease the amount of cyanobacteria in the dam and to increase the level of oxygen in the water. In 2013 this project should be coming to an end, therefore it is very important to monitor its impact on the Brno Reservoir during and after the project to be able to estimate its efficiency. First steps were made to improve water conditions, for instance, by draining the dam in 2009. However, it is essential for the future that smaller adjustments which will help the ecosystem maintain homeostasis are implied as well.

The Effects of Phosphorus Decrease

Barbara Vonková

The high abundance of cyanobacteria in water is caused by many factors. One of the most important factors is the overproduction of phosphorus bonded in phosphates released by human activity. Phosphorus is used by cyanobacteria as a source of nutrition. There are numerous options available for phosphorus reduction, of which some are effective and others are not. However, it has not been thought necessary to consider the impact of phosphorus decrease on the whole ecosystem. What will then happen if we eliminate phosphorus completely? This is a question we are trying to answer. Our hypothesis is based on the knowledge of the relationships in an ecosystem from various points of view. We deal with two cases which depend on blocking both the inflow and the outflow but stopping only the inflow. Our results have so far confirmed the balance of nature and the spontaneous increase of phosphorus by itself.

Aeration and Aeration Tower

Caiyun Xia

Cyanobacteria make a toxic layer on the water surface, causing problems for the water ecosystem and all human activities. With the increase of water pollution, there have been attempts to find ways of improving the quality of water. One of the methods available for removing unwanted cyanobacteria is using aeration towers. Aeration is the process by which the air is circulated through, mixed with or dissolved in a liquid or substance. Aeration tower is a device which is intended for use in water treatment stations for aeration and degassing of water for industrial and domestic use. It can be made of plain stainless steel.

The Mud Story

Ondřej Kovanda

This presentation is concerned with the problem of dealing with cyanobacteria in the Brno reservoir. After several attempts to remove cyanobacteria using various chemicals and hydro-engineering, authorities decided to excavate the sediment from the bottom of the reservoir. The sediment was rich in nutrients, providing support for the growth of cyanobacteria. The source of the nutrients could have been found along the upper stream of the Svatka River. When excavated, the sediment was limed, mixed with the topsoil and spread around fields using agricultural machinery. Once the environment of the reservoir contained much less nutrients, the numbers of cyanobacteria decreased rapidly.

Phosphorus Cycle in the Brno Reservoir

Pavel Kohl

Phosphorus is a limiting factor for the growth of cyanobacteria (CB). It is necessary for living organisms – it is included in cells membranes, nucleic acid or bones. Current projects of removing CB colonies are reliable and cut down phosphorus entry into dams. If we stop the phosphorus entry into the Brno dam, the concentration of nutrients will decrease. However, other organisms will need them. In this study we show the possible effects of reducing some nutrients, phosphorus in particular. The process of converting inorganic phosphorus to organic and their biodegradation are included. The life cycles of CB are analyzed in many studies. When CB die, they produce dangerous toxins, being deposited in the sediment. The dirty water creates a different environment for other species and it also changes the biodiversity. The effect of disrupting the phosphorus cycle can cause damage to the ecosystem equilibrium. The implications are that nutrient concentration must be reduced carefully in the future if the ecosystem is to be saved.

Human Impact on Brno Reservoir

Svatava Župková

This study shows chemical effects of human activity on the quality of water in the Brno Reservoir. This review focuses on the ferric ions used in phosphorus precipitation. Ferric sulphate, polyaluminium chloride, and calcium hydroxide are used. Iron reacts with oxygen in water, and it is toxic for many organisms. Polyaluminium chloride is toxic for organisms living in water. This research provides information on the negative effect of removing cyanobacteria from the reservoir.

Human Impact on the Brno Reservoir

Janka Vasilfová

The purpose of this study is to identify the economic aspects of the Brno reservoir. We focus on the progress of the Brno dam over the several years. We summarize certain running endowments and their later effective use, and focus on the importance of environmental projects. In trying to find the equilibrium between the ecological issues and their price, we compare the profits and expenditures, and analyze the return on investment. Based on the results, we could evaluate that taking action has significantly improved the water quality. This has led to the development of tourism which increases the overall economic value of the dam. However, these environmental projects should continuously work to maintain this state.

Human Impact on Biodiversity

Martin Ivanecký

The amount and composition of organisms in the environment is termed biodiversity. Changes in biodiversity often indicate the effect of human activity on nature and/or particular environment. It is therefore very important to monitor biodiversity in environments most likely to be affected by human activities. Biodiversity in the Brno reservoir is influenced by two main factors. High concentrations of nutrients in the water cause eutrophication, which in turn demands human counter-attack in the form of proper water treatment. Both phenomena have been reasonably addressed in recent years, but the role of biodiversity in the Brno reservoir has been somewhat underrated.

Deposition Rate of Brno Dam Lake Sediments and its Effect on Cyanobacteria

Anežka Višková

This study focuses on sedimentation as an important piece of data while evaluating data about cyanobacteria in water reservoirs. The sedimentary succession can be subdivided into two main units. The lower part is formed predominantly by medium to coarse-grained silty sands and is interpreted as a fluvial succession deposited before the Svatka River was dammed. The upper unit consists of brownish planar laminated slits, rarely of clayey or sandy slits, and is interpreted as a product of the reservoir deposition. This analysis is based on a radionuclide method where the concentration of ^{137}Cs was used, showing two marked peaks. The upper one is attributed to the Chernobyl reactor accident in 1986, and the lower marks atomic weapons testing in 1963. The results of the measurements provide us with data to calculate depositional rates for three periods from 1939 to 2007. In 1986-2007 it was 3.2 cm/year, 1963-1986 it was 3.4 cm/year, and in 1939-1963 it was 3.1 cm/year. In conclusion, the most important factors influencing the sedimentation are the lake depth, area, hydrogeology and human management in the lakes' drainage basins.

Has the Ecosystem Changed in the Brno Reservoir?

Lenka Sedlačková

The Brno reservoir was finished in 1940 as a protection against floods appearing throughout centuries. Another of its function is to support the city of Brno with drinking water. Therefore, it has to fulfil strict health criteria including e.g. the maximum allowed number of cells. There are various species of cellular organisms living in the dam and the goal of our research was to find a relation between weather conditions, chemical properties of water and ratio of

phytoplankton species. We focused mainly on cyanobacteria, but we also mention fish and benthic species. Using data provided by state institutions and applying statistical tools, we show dependence of the ratio within 5 years. Our conclusion is that the expansion of cyanobacteria has not influenced biodiversity in the Brno reservoir to such an extent as the public assumes.

Has the Ecosystem Changed after Algal Blooms?

Veronika Košařová

The development of cyanobacterial blooms in lakes and reservoirs has a major impact on the provision of services, particularly limiting their use for recreation and water supply for drinking and spray irrigation. Compounds of nitrogen and phosphorus are major cellular components of organisms. Since the availability of these elements may be lower than the biological demand, environmental resources can regulate or limit the productivity of organisms in aquatic ecosystems (“nutrient limitation”). Dramatic increases in the global rates of production of nitrogenous fertilizers and the mining of phosphate rock since about 1960 coincide with our recent concerns over the Brno dam. The reason is that over 85% of the commercially fixed nitrogen and 80% of the mined phosphorus go into the production of fertilizers. In this paper we explore the rationale for dual–nutrient reduction strategies for aquatic ecosystems, especially in the Brno dam. The question of whether one or both nutrients should be controlled to reverse the detrimental effects of eutrophication of the Brno dam was thought to be solved in the autumn of 2007. The Brno dam was drained and planes dropped a special solution against cyanobacteria. This decision led to widespread reductions in phosphorus loading to the Brno dam and consequent improvements in water quality. Nutrient enrichment is thought to be the most important pressure responsible for the widespread increase in

cyanobacterial blooms in recent decades. Quantifying how nutrients limit cyanobacterial abundance in lakes is, therefore, a key need for setting robust targets for the management of freshwaters.

Changes in the Ecosystem of the Brno Reservoir – the Influence of Weather

Martin Blažek

It is clear that weather is a very important element influencing an ecosystem. It means that we still need to observe weather day by day and thanks to this we can forecast how the weather will influence the ecosystem. For our subject of interest, the Brno dam, we have collected some data related to the changes in weather from 2006 to 2012. We have found out the temperatures for particular months of these years. Certainly, the ecosystem reacts to the temperature changes. The growing temperature can displace some kinds of plants from their natural environment and then they may become extinct. It is a general problem of the whole Earth and the Brno dam is not an exception. That is why we focused on this influence as well as other factors causing changes in the ecosystem of the Brno reservoir.

5.3 Posters

How Do Fireworks Affect Phosphorus Equilibrium in the Brno Dam?

Eliška Čechová, Marta Seifertová, Dominik Heger

The Brno dam and its surroundings are highly sensitive to the presence of phosphorus compounds, causing the growth of cyanobacteria. Fireworks events held annually at the Brno dam interfere with the dam ecosystem. Therefore, we investigated which compounds are present in pyrotechnics and what consequences they may have on the formation of cyanobacterial blooms. The elemental phosphorus, which is a component of these explosives, burns spontaneously in the air ¹. During the analysis of the composition of the most frequently used fuels, we found that fireworks contain mostly charcoal and thermite (a mixture of iron oxide and aluminum)². Fireworks, therefore, do not directly affect the phosphorus equilibrium and their influence on the water bloom formation is minimal. However, they do contain heavy metals, which are water contaminants of great concern. In order to bridge the gaps in our understanding of phosphorus equilibrium, more research is needed.

1 <http://chemistry.about.com/od/fireworkspyrotechnics/a/phosphorusfire.htm>

2 <http://www.ch.ic.ac.uk/local/projects/gondhia/composition.html>

Land-Use and the Phosphorus Impact on Chlorophyll

Václav Lukeš, Tomáš Černák, Nikol Zelíková

The poster explores a variety of topics dealing with the Brno reservoir that can be analyzed from a geographical point of view. In land-use maps from different historical periods, it is possible to observe changes in the region such as the

growth of the urbanized area, the Svatka flow situation and the political impact on the agricultural area. The next part of the poster illustrates the phosphorus influence on the amount and depth distribution of chlorophyll in the Brno reservoir in different seasons. The aim of the last part is to discuss the work of the Čistá Svatka (Clean Svatka) Project run by the Department of Environment of the South Moravian region.

6/ List of Participants

Martin Blažek

393760@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Eliška Čechová

270599@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Tomáš Černák

394181@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Bc. Jana Faltýnková

358088@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Karolína Guricová

394139@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Martin Ivanecký

386962@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Gita Jančaříková

175742@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Bc. Pavel Kohl

357814@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Veronika Košařová

211233@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Ondřej Kovanda

409018@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Václav Lukeš

394401@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Bc. Katarína Palatinusová

357006@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Lenka Sedlačková

393280@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Marta Seifertová

270383@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Bc. Janka Vasiřová

356847@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Anežka Víšková

394198@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Barbara Vonková

408595@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Caiyun Xia

408944@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Nikol Zelíková

394449@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Bc. Svatava Župková

323502@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Jarmila Burianová, Ph.D.

burianova@mail.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Eva Čoupková, Ph.D.

coupkova@sci.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Dominik Heger, Ph.D.

hegerd@chemi.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Robert Helán, Ph.D.

18899@mail.muni.cz

Faculty of Medicine, Masaryk University, Brno, Czech Republic

Mgr. Věra Hranáčová

hranacov@rect.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Jana Kollárová

1194@mail.muni.cz

Faculty of Education, Masaryk University, Brno, Czech Republic

Mgr. Markéta Kovaříková

markikov@mail.muni.cz

Faculty of Medicine, Masaryk University, Brno, Czech Republic

Mgr. Jana Kubrická

kubricka@fsps.muni.cz

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Mgr. Tomáš Kuchovský, Ph.D.

tomas@sci.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

PhDr. Hana Němcová

nemcova@rect.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Ondřej Příbyla

pribyla@physics.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

Mgr. Pavla Řezníčková, Ph.D.

44247@mail.muni.cz

Language Centre, Masaryk University, Brno, Czech Republic

James Edward Thomas, M.A.

thomas@phil.muni.cz

Faculty of Arts, Masaryk University, Brno, Czech Republic

Lenka Pavlíková

l.pavlikova@rect.muni.cz

Faculty of Science, Masaryk University, Brno, Czech Republic

