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Twinning

MiCoBion

Microbial Communities in Biomedical and Environmental Areas, and Systems Biology

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Report on organized courses Methods of Functional Genomics

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RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Executive Summary

This document provides a summary of a completed task within Work Package WP1 *Training*, namely: T1.3 *Course Methods of Functional Genomics* led by the European Molecular Biology Laboratory (EMBL). It contains description of the content of the organized courses, presents details about the event's participants and provides details about the course outcomes and benefits brought to CUNI.

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1. Introduction

Deliverable D1.3 *Report on organized courses Methods of Functional Genomics* provides a summary of activities carried out under task *T1.3 Course Methods of Functional Genomics,* under Work Package WP1 *Training.* The objective of this task is for CUNI to learn modern methods and approaches in genomics, transcriptomics and proteomics including other associated scientific fields and big data integration. The task was implemented through three events lasting from 5 days to 10 days which included lectures, tutorials and consultations. The first course was organized on April 1 – 5, 2019 through personal participation, the second and third courses adopted an on-line format due to covid-19 pandemic situation and were held on May 20 - 28, 2020 and April 13 - 23, 2021, respectively.

2. Course Participants

Attendees of the courses were mostly students and young scientists from BIOCEV and the Faculty of Science, Charles University (CUNI). However, the courses attracted also some senior scientists and academics. Interestingly, virtual versions of the course, which started as an alternative during the covid-19 pandemic, were attended by a lot more participants than the regular course. The first course, which was held in person in BIOCEV was attended by 36 participants. The 2019 course was intense and comprised morning and afternoon lectures and practical tutorials both in a wet-lab and on bioinformatics.

Covid-19 pandemic affected all travelling and teaching in the Czech Republic. Teaching through the personal participation was not allowed at universities both in 2020 and 2021 in months when the course was planned to take place. The EMBL tutors flexibly and rapidly responded the situation in 2020 and the course Methods of functional genomics was one of the few courses offered in the on-line version at CUNI in that time. This positively influenced the attendance and the course received record-breaking 86 attendees from CUNI and BIOCEV. Because the overall situation in the country and with teaching at universities hadn't changed until Spring 2021, we used our experience with on-line teaching and having more time to prepare it, we offered a more comprehensive course, which finally attracted 54 participants from CUNI and BIOCEV. Although we still prefer teaching in person on site, which allows better contact with participants and also allows offering of various practical tutorials, the unanticipated difficulties caused by the covid-19 pandemic situation showed us that virtual teaching could lead to higher attendance and thus to higher dissemination of the knowledge within the target cohort.

3. Course Content

3.1. Methods of Functional Genomics course held on April 1 – 5, 2019

The course was held in the newly established institute BIOCEV in Vestec, which is located near the Prague. The course content is clear from the attached flyer, so we can summarize it only briefly. The course started with the Kiran Patil (EMBL) talk entitled "From genomes to metabolic networks" which thematically fitted very well to the field covered by the MiCoBion project. The course comprised lectures and practical tutorials on various aspects of proteomics, protein expression and purification, technologies to study gene function by siRNA and CRISPR/Cas9, flow cytometry and its usage in genomics and life cell imaging. Besides that, a substantial part of the course was dedicated to all aspects of genome and transcriptome sequencing and analysis. Lectures from this part covered the whole topic from instrumentation used for DNA and RNA high-throughput sequencing to analysis of obtained big data by means of bioinformatics including hot topics on cancer genomics and single-cell genomics and transcriptomics. This part was thoroughly complemented with practical tutorials starting with basic introduction to programming in R and ending with analysis of sequencing data in cancer genomics and differential gene expression using RNAseq. We even succeeded to prepare a practical tutorial on protein expression and purification for smaller subgroup of interested participants.

We also organized a session in which all the participants could freely discuss their scientific projects with tutors. However besides this, there was a plenty of other possibilities including joint lunches to meet tutors and discuss with them the taught topics, hot scientific questions and/or own scientific projects of the participants.

3.2. Methods of Functional Genomics course held on May 20 - 28, 2020

As it was already mentioned, this course was taught in a virtual way due to the pandemic situation. EMBL tutors had to change their teaching materials rapidly and had to adopt the course to the new situation. Nevertheless, we succeeded to organize it. We used a CUNI licence for Google Classroom and Meet tools and prepared a complete classroom environment where students could find all the presentations, recommended literature, links to the lectures associated with a Google calendar and so on. Some presentations were offered to students only off-line however many of them were held virtually and offered a possibility to discuss the topic directly with the tutors. Talks directly presented and discussed during the course were on proteomics, protein expression and purification, DNA and RNA sequencing and cancer genomics. We also added a whole virtual block dedicated to bioinformatics analysis of genomics and transcriptomics data. The classroom remains opened for the participants until now, contains all the presentations, some talks recorded by tutors and many other study materials and is still frequently visited by the participants.

3.3. Methods of Functional Genomics course held on April 13 - 23, 2021

The pandemic situation hasn't changed over the year in the country and universities are still not allowed to teach students through their personal participation. We used our skills obtained from the last course and other virtual teaching during the last year and prepared even more comprehensive virtual course than in 2020. We prepared a new virtual classroom and designed it as previously. As it is clear from the attached flyer, we succeeded to cover a broad range of topics associated with the contemporary genomics and transcriptomics oriented research. We included flexibly a talk dealing with single-cell genomics and transcriptomics in deeper details on request of the participants. This talk took place on April 23 and is not listed in the programme attached.

4. Course outcomes

The participants benefited from the courses which is clear from high attendance which significantly exceeded the expected and planned number of participants. In all courses the participants had a chance to listen lectures given

by top-notch scientists who used to work in one of the best European molecular biology institute (EMBL). There was enough time always provided to discuss the topics with tutors as well as to discuss possible scientific projects held by participants. All the participants received contacts to the tutors and were encouraged to contact the tutors in cases they will encounter significant problems with their own research projects which fall to the range of the respective tutor's expertise. Regarding the first course, participants also benefited from the practical training in bioinformatics and protein expression and purification. Last but not least, participant benefited from informal discussions with tutors and other participants on their projects and science, including career in science, in general. The courses were also offered as an official subject to Msc and Ph.D. students at CUNI through the CUNI Student Information System (SIS). Students could enrol into the courses, complete an on-line exam which was also prepared by EMBL tutors and receive credits. In total, 42 students officially enrolled into the Methods of functional genomics during these three years (11 in 2019, 10 in 2020 and 21 in 2021)

5. Conclusions

T1.3 *Course Methods of Functional Genomics* was successfully completed. Depending on the year, from 6 to 10 experts from EMBL delivered lectures, tutorials and consultations about modern methods and approaches in genomics, transcriptomics, proteomics and big data analysis and integration. The courses were attended by a total of 176 participants from CUNI and BIOCEV. Most of them were students and young scientists.

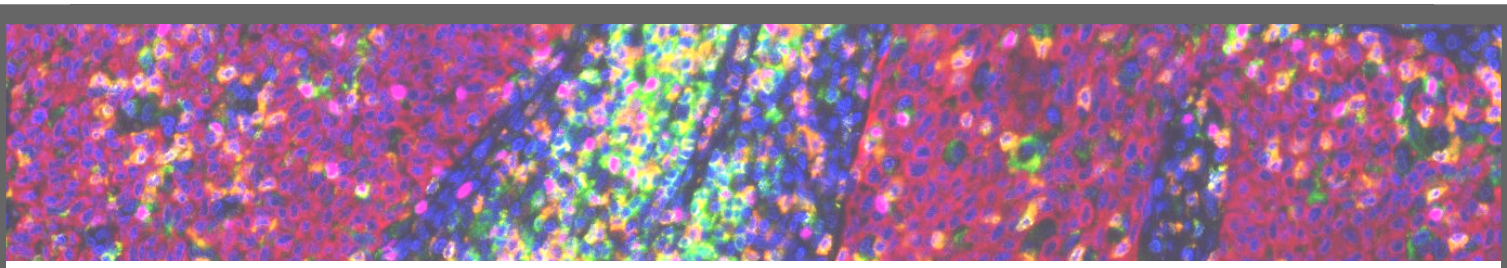
6. Degree of Progress

The deliverable is 100% fulfilled.

7. Dissemination Level

The Deliverable D1.3 *Report on organized courses Methods of Functional Genomics* document is public.

8. Annex I: Course Agendas



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METHODS OF FUNCTIONAL GENOMICS

April 1-5, 2019

BIOCEV, Průmyslová 595,
Vestec, Czech Republic

Tutors comes from The European Molecular Biology Laboratory (EMBL, Heidelberg, Germany), German Cancer Research Center (DKFZ), BIOCEV and Faculty of Science, Charles University

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1

MONDAY LECTURES

Morning: **Kiran Patil (EMBL):** From genomes to metabolic networks
Afternoon: **Dominic Helm (EMBL):** Lessons from proteomics and mass spectrometry: Proteomics as a versatile tool

MONDAY TUTORIALS

Dominic Helm (EMBL), Barbara Helm (DKFZ): Afternoon tutorial on proteomics

2

TUESDAY LECTURES

Morning: **Aleš Benda (BIOCEV)**: Imaging Methods
Afternoon: **Beate Neumann (EMBL)**: RNA interference - A technology to study gene function / High-throughput phenotypic screens / Life cell imaging

TUESDAY EXCURSION

Aleš Benda (BIOCEV): Visit of Imaging Methods Core Facility

3

WEDNESDAY LECTURE

Kim Remans (EMBL): Protein expression & purification challenges

WEDNESDAY TUTORIALS

Kim Remans (EMBL): Afternoon practical tutorial on protein expression & purification
Beate Neumann (EMBL): Practical tutorial on siRNA design
All the tutors (EMBL, FS CUNI): Projects consultations, optional tutorials & practicals of all sorts
There will be the day of BIOCEV's Core Facilities with excursions in the afternoon and MFG participants may join.

4

THURSDAY LECTURES

Morning: **Vladimír Beneš (EMBL):** DNA sequencing technologies - For sequencing 'today', tomorrow never dies...
Afternoon: **Tobias Rausch (EMBL):** Genomics in cancer
Jonathan Landry (EMBL), Jan Provaznik (EMBL): RNAseq - Differential gene expression analysis using RNA-seq data - Assessment of the best practices

THURSDAY TUTORIALS

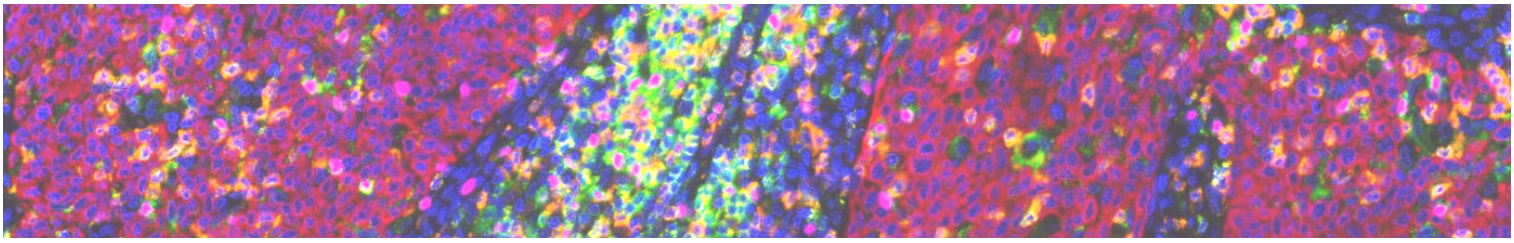
EMBL tutors: Morning and afternoon practical turorials on genomics, cancer genomics and RNAseq data analysis including essentials of "R"

5

FRIDAY LECTURES

Morning: **Malte Paulsen (EMBL):** Flow Cytometry & Cell Sorting
Afternoon: **Vladimír Beneš (EMBL), Jonathan Landry (EMBL), Jan Provaznik (EMBL):** Single-cell RNAseq

The program and time schedule is subject to further minor changes and clarification.



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METHODS OF FUNCTIONAL GENOMICS

13-22 April, 2021

VIRTUAL / GOOGLE CLASSROOM
Course code: fydagft

On-line webinars / lectures / consultations given by top-notch scientists from EMBL Heidelberg, German Cancer Research Centre and University of Copenhagen.

13/4 **09:00 - 12:00**	**Dr. Dominic Helm** German Cancer Research Center *Proteomics - a versatile tool*
14/4 **10:00 - 12:00**	**Dr. Malte Sören Paulsen** University of Copenhagen *Flow Cytometry and Cell Sorting in the Genomics World*
15/4 **10:00 - 12:00**	**Dr. Vladimír Beneš** EMBL *NGS Cool but is it that simple?* *Single-cell genomics:it's time to get serious..*
16/4 **10:00 - 12:00**	**Dr. Beate Neumann** EMBL *Microscopy based high-throughput screeing. siRNA technology & CRISPR/Cas9.*
21/4 **10:00 - 12:00**	**Dr. Kim Remans** EMBL *Methods in advanced protein expression and purification.*
21/4 **14:00 - 16:00**	**Dr. Yannick Schwab** EMBL *Linking gene expression atlas with volume electron microscopy to explore cell types in a multicellular model system*
22/4 **09:00 - 12:00**	**The NGS analysis block (EMBL)** Dr. Tobias Rausch, Dr. Jonathan Landry, Dr. Jan Provazník

The program and time schedule is subject to further minor changes and clarification.