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SPECIFIC DESIGN OF MOLECULAR BIOLOGY MINI-PROJECTS: EXPERIENCE OF AL-FARABI UNIVERSITY

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Summary

Mini-projects are being used in current biology and biotechnology as exam tools, accounts on modern or past research programmes as well as with research popularizing aims. Our experience of 2015 may demonstrate how to get students attention focused on molecular biology by inviting them to study the course through the scope of trialing a genome or individual gene databases. Such opportunity may assist the audience in acquiring knowledge together with basic skills of the small-scale project management. Maximal scoring reaches 30 per student. Such maximal grade is therefore achievable only in case of personal mini-project accomplishment or in case of team leadership. Exclusions may happen if, for instance, one of the projects would be devoted to a specific topic to be completed by two students. One of such pairs has proposed the topic entitled: "From Dinosaurs to Birds". That mini-project has especially impressed the instructor by a number of hypotheses and new viewpoints on evolutionary issues of inter-relationships between ancient dinosaurs and modern birds to be subsequently used for lecturing on paleobiology, molecular biology, and developmental genetics. Then contributions of both of the students were assessed equally high.

Implication of mini-project approach to molecular biology and other biological courses is regarded as being perspective for in-depth teaching, enhancing students independent and team works as their ability to get and handle required databases, undertake small-scale comparative studies as put forward working hypotheses and original conclusions.

Introduction

Molecular biology is essential course demanding a range of off-class activities. Each topic or process including DNA structure and replication, following transcription and RNA exit to cytoplasm, gene and genome stability, organization of protein synthesis, protein decay or translocation of the newly synthesized product to intracellular organelles is supposed to be highlighted by a number of special websites, PC software sources, research communities and scientific journals. Half-an-year education process based on mini-projects on individual genes and whole genomes for specific organisms has been experienced in 2015. This has facilitated the students in getting extensive self-education on nucleic acids design and functions, genome properties and gene clustering, gene control and related protein producing machinery issues.

Generally, biological mini-projects are nowadays used as examination tools [1], accounts on ongoing or accomplished research programmes [2], and with research popularization goals [3]. Our aim was to attract students to the course of molecular biology by inviting them to study the subject of special interest according to the state-of-art of its genome or individual gene investigations worldwide. Such attitude has assisted in successful acquiring the subject besides getting primary skills of project management.

Results and discussion

14 students of the 2-nd year of education in Biotechnology (Bachelor Studies) from Kazakh- and Russian-speaking groups which have been then transformed by the fusion into a joint English-speaking group have attended the class in 2015. The instructor posted by using Intranet the following guidelines to developing mini-projects which would be primarily concentrated on a range of relevant publications offered by the instructor:

Miniproject guidelines

The list of the sources:

Terence A Brown. Genomes. 2nd edition. Chapter 15. How Genomes Evolve

Oxford: Wiley-Liss; 2002.

ISBN-10: 0-471-25046-5

<http://www.ncbi.nlm.nih.gov/books/NBK21112/>

E. coli genome:

1) Microb Ecol (2010) 60:708–720

DOI 10.1007/s00248-010-9717-3

2) Proc. Nat. Acad. Sci. USA

Vol. 72, No. 6, pp. 2242-2246, June 1975

Fish genome:

1 Current Genomics, 2006, 7, 43-57

2 Jiang et al. BMC Genomics 2013, 14:780

<http://www.biomedcentral.com/1471-2164/14/780>

3 Genome Research 10:1890–1902 ©2000 by Cold Spring Harbor Laboratory Press ISSN 1088-9051/00

4 ARTICLE in BMC GENOMICS · NOVEMBER 2013

Impact Factor: 3.99 · DOI: 10.1186/1471-2164-14-780 ·

Bean genome:

1 Kalavacharla et al. BMC Plant Biology 2011, 11:135

<http://www.biomedcentral.com/1471-2229/11/135>

2 <http://www.beangenomics.ca/research/projects/view/draft-genome-sequence-for-common-bean-i-p-vulgaris-i>

3 <http://hudsonalpha.org/common-bean-genome-sequence-provides-powerful-tools-to-improve-critical-food-crop>

4 doi:10.1038/ng.3008

5 Phaseolus Genes

<http://phaseolusgenes.bioinformatics.ucdavis.edu/>

Primate genome:

1 Comparative genomics of higher primates, including humans and Neandertals (Svante Pääbo)

2 <http://www.genome.org/cgi/doi/10.1101/gr.3737405>.

3 ILAR Journal, Volume 54, Number 2, doi: 10.1093/ilar/ilt042

4 Nat Rev Genet. 2014 May ; 15(5): 347–359. doi:10.1038/nrg3707.

Dinosaurs genome:

<http://rspb.royalsocietypublishing.org/content/276/1677/4303>

<http://people.eku.edu/ritchisong/554notes1.html>

<http://news.ucsc.edu/2014/12/crocodile-genomes.html>

<http://www.icr.org/article/dinosaur-protein-sequences-dino-bird/>

http://jurassicpark.wikia.com/wiki/Dinosaur_DNA

<http://scienceblogs.com/notrocketscience/2009/06/21/dinosaurs-provide-clues-about-the-shrunken-genomes-of-birds/>

<http://www.reasons.org/articles/dinosaur-genome-size-estimates-lagerstatten-of-design>

<http://news.harvard.edu/gazette/story/2007/03/despite-their-heft-many-dinosaurs-had-surprisingly-tiny-genomes/>

http://www.world-science.net/othernews/070307_dinosaur.htm

<http://www.ucmp.berkeley.edu/diapsids/saurischia/theropoda.html>

<http://www.ucmp.berkeley.edu/diapsids/avians.html>

<http://10e.devbio.com/article.php?ch=16&id=161>

<http://www.enchantedlearning.com/subjects/dinosaurs/Dinobirds.html>

<http://www.enchantedlearning.com/subjects/dinosaurs/allabout/Evolution.shtml>

<http://www.enchantedlearning.com/subjects/dinosaurs/Dinobirds.html>

<http://www.membrana.ru/particle/11216>

<http://elementy.ru/news/430477>

<http://naked-science.ru/article/nakedscience/mozhno-li-vernut-dinozavrov>

<https://brodude.ru/mozhno-li-voskresit-dinozavrov/>

<http://www.ufolog.ru/publication/3480/>

Compiled by Z.G. Aytasheva

Then 5-6 weeks were termed for setting up proper partnerships, teaming or independent exploration of chosen topics. That work has been proceeded by midterm discussion on the state of mini-projects and related presentations.

On 14-th week the instructor received final presentations which have been defended by teams or a single student in consent with the topics.

The list of presentations has looked as follows:

1 A. Tamshibay. *E. coli* Genome.

2 A. Baibulatova, Yu. Genievskaya. *Aspergillus niger* as a Model Organism for Molecular and Genetic Investigations.

3 A. Bertleuova, S. Mukhanbetzhanova, A. Sharipbay, G. Bekbaeva. Bean Genome.

4 R. Kozhakhmet, S. Tolesh, D. Salimzhanova. The Primates.

5 Yu. Pak, Abisheva A. From Dinosaurs to Birds.

Below is an itinerary content of mini-project:

1 Introduction

2 Genome characteristics

3 Application in biotechnology

4 Conclusion

5 References

However, some of the projects have included comparative studies. For instance, Ms. Aidana Tamshibay's *E. coli* mini-project contained comparative analysis of *E. coli* and *Shigella spp.* genomes.

Evaluation of mini-projects and related maximal scoring have been made up of the items as follows:

- 1 Slide number in the presentation (1)
- 2 Slide quality (3)
- 3 Quoting accuracy (2)
- 4 Number and quality of intermediate accounting. Number of versions (presentations editions) demonstrated to the instructor (5)
- 5 Quality of final defence (10)
- 6 Team work. Individual impact (5)
- 7 Leadership skills in running a mini-project (4)

Maximal scoring was 30 per student. It meant, the maximum would be reachable by mini-project's single holders or the leaders of teams. However, there might be exclusions. For instance, one of the last projects out of those submitted was mini-project # 5 titled : "From Dinosaurs to Birds". It was presented by Ms. Aigerim Abisheva and Mr. Yuri Pak. It has impressed the instructor by the series of hypotheses and original viewpoints on evolution within ancient dinosaurs and up to modern birds. This project may be used in future graduates lecturing on paleobiology, molecular biology, and developmental genetics. That is why both students were assessed equally high. Based on all foretold, implication of mini-project approach in case of molecular biology and other biological courses would lead to profound teaching, "catalysing" student's independent and team work as the ability to search and retrieve updated resources, undertake small-scale comparative studies and put forward challenging hypotheses and conclusions.

References

- 1 Mini-project examination
http://www.stats.ox.ac.uk/__data/assets/pdf_file/0003/5691/Data_IG_and_GF_12_10_9_.pdf
- 2 Mechanistic Insights into P53-CYPD Interactions. Mini Project Report by V. R. Yanamala, A. Mathew, Ch. Cherian, M. James. 25 March 2013. Natl. Inst. Tech., Calicut.
<http://www.slideshare.net/vijayrajnazzi/btech-mini-project-computational-biology-nitc>
- 3 Split RNA extraction
<http://www.sciencefairadventure.com/ProjectDetail.aspx?ProjectID=123>