The simplest definition of an essential gene is its indispensability to organismal survival. Yet, survival without the reproduction is a dead end for an organism, so more accurately we can define essential gene as the one which is necessary for an organism to survive and reproduce. The definition is quite straightforward and it would look that with the development of modern molecular methods allowing for the knockout of any single gene from the genome it will be easy to establish the set of genes essential for an organism. The question about the basic set of genes required for an organism to survive and reproduce is of great interest to geneticists, synthetic biologists, evolutionary biologist, and even medical researchers. Such genes should be sufficient to create fully functional artificial life, which is one of the goals of synthetic biology. They should be responsible for the functions which are most important for the organism fitness pointing out to the most fundamental biological processes. They should play a significant role in evolution, as their loss should lead to the organism death.

Nevertheless, in recent years it was shown that this simple definition of essential genes is not sufficient. As it transpired, gene essentiality will depend on genetic and environmental context. Genes essential in one population or even individual might not be essential in another, and vice versa, non-essential genes in one genetic background might become essential in another (as every individual and population will have slightly different genetic makeup than any other). That is why some mutations might be lethal or lead to the severe disease in some individuals but not in others.

The same is true for environmental context, genes essential in one environment might become dispensable in another, e.g. genes which are needed for synthesis of specific molecules, might be dispensable if those molecules are directly available in the environment. On the other hand, genes nonessential in one environment might become essential in another, e.g. when the food source will change and genes responsible for metabolism of that specific new food will become crucial for survival. This dependence of gene essentiality on genetic and environmental context have very important practical consequences as well. For example, for antimicrobial therapy we would like to target genes essential for the microorganism in most genetic and environmental backgrounds.

It is expected that essential genes will be more evolutionary conserved as purifying selection should act on them more strongly than on nonessential genes, which are more “dispensable” for fitness. Nevertheless, in many studies on evolutionary conservation of genes there was not clear differences between essential and nonessential genes in their conservation. The reason for that might be the context dependence of gene essentiality. Many studies on gene essentiality were done in one laboratory condition and one genetic background. That means that many genes essential in other contexts were probably unidentified. And although the number of studies analyzing gene essentiality in different genetic and environmental contexts is increasing, they are mainly done on unicellular organisms or cell lines. There is noticeable lack of such studies in multicellular, whole organisms.

In this project we aim to uncover context dependence of gene essentiality in model multicellular organism, *Caenorhabditis elegans*. We will study how essentiality of genes is changing depending on genetic context by using different wild type isolates of that nematode. Additionally, we will check how conserved is gene essentiality between species, by checking essentiality of *C. elegans* orthologs in another nematode, *C. briggsae*. The essentiality of *C. elegans* and *C. briggsae* genes will be checked as well in five different environments. The evolutionary conservation of essential and nonessential genes will be compared between genes with different degree of essentiality, e.g. conserved in both species, and all environments; conserved only in some genetic and environmental contexts, and those nonessential in any context.