With the advent of regenerative medicine and tissue engineering as important segments of the future healthcare of ageing societies, regeneration has become one of the central problems in current biology. Interest in regeneration is, however, centuries old as the possibility to repair or regrow body parts easily captures imagination, especially that the phenomenon of regeneration is widespread in the animal world. So why is regeneration so limited in humans?

The essential processes that occur in living cells are driven by small biomolecules – proteins and ribonucleic acids (RNAs). The knowledge about which molecules participate in which process is required to better understand and even modulate the way the cells behave (for example by medicines). Recently, the researchers' attention has been particularly focused on stem cells – the ones that give rise to multiple cell types in a process called differentiation. For example, bone marrow harbors stem cells that differentiate into white and red blood cells. Stem cells are also very important for regeneration.

Despite many scientific discoveries, our knowledge about the molecular background of regeneration is very limited. That is why we still cannot efficiently stimulate regeneration or cure the diseases that result from aberrant behavior of stem cells.

In this project we will use fascinating model organisms, planarians, to look for RNAs involved in regeneration. Planarians are tiny free living flatworms and the real masters of regeneration. A 5 mm long planarian can be cut into over 200 pieces and each of them will regenerate a complete animal, including the nervous system! This is possible because stem cells make up about 30% of their body. We will apply the most advanced technology to track the regenerating planarians cell by cell to see which RNA molecules are responsible for regeneration. Because many molecular processes are similar across species, lessons learned from planarians can be applied to better understand the functioning of human cells. In addition, we will study how a deficiency of a protein involved in RNA processing impacts stem cell differentiation in planarians. Deficiency of a similar protein, resulting from genetic disease, occurs also in humans and causes serious health problems. Thus, we believe the results of our studies will both shed a new light on the regeneration and provide new insight into human disease.