„There are two sides to the coin" – a well-known proverb says. It turns out that the two sides play an important role in... a replication cycle of some viruses. The "coin" is a molecule, a viral protein, named a fusion protein. Fusing, in other words, joining. It is a fusion of two membrane fragments: viral envelope and a cell membrane of an infected cell, which is a responsible process in replication of enveloped viruses. One of the protein sides (termini) is called a fusion peptide (FPR) which embeds in cellular membrane, while the other side, transmembrane domain (TMD) is anchored in the viral envelope. Membrane fusion allows for a release of the genetic material into the cellular interior. The aim of this project is studying the "sides" of proteins from viruses such as: influenza, parainfluenza and respiratory syncytial virus (RSV). These viruses are especially severe when they infect respiratory tracks in children. We want to study the protein fragments responsible for membrane fusion, their structures, their behavior in lipid bilayer and potential mutual interactions. The reason for taking a decision regarding the research topic is an incomplete knowledge on the molecular mechanisms standing behind membrane fusion induced by viral proteins and- what is related to it- unsatisfactory methods of healing and prevention of these infections.

In this project we intend to apply the so-called virus-like particles (VLP). It turns out that current biochemical methods allow for viral membrane protein purification and placing them in artificial membranes of liposomes. Such an approach has a benefit of a better control of membrane composition and protein (peptide) ratio. These features are not possible when working with cellular material. In our research we are planning to apply various fluorescence microscopy techniques and apply microfluidic methods to visualize and quantify membrane fusion. Potentially such a method may be applied in screening of antiviral drug candidates in the future. Additionally, to complement the experiments, we are planning to perform computer molecular dynamics simulation to better understand all the processes in atomic scale.

In summary, we are planning to study the fragments of selected enveloped viruses which cause severe infection of respiratory tract, especially in children. We want to characterize the molecular mechanisms of membrane fusion, which is a key element in the replication cycle of viruses. In the future, such knowledge may contribute to creating new antiviral drugs.