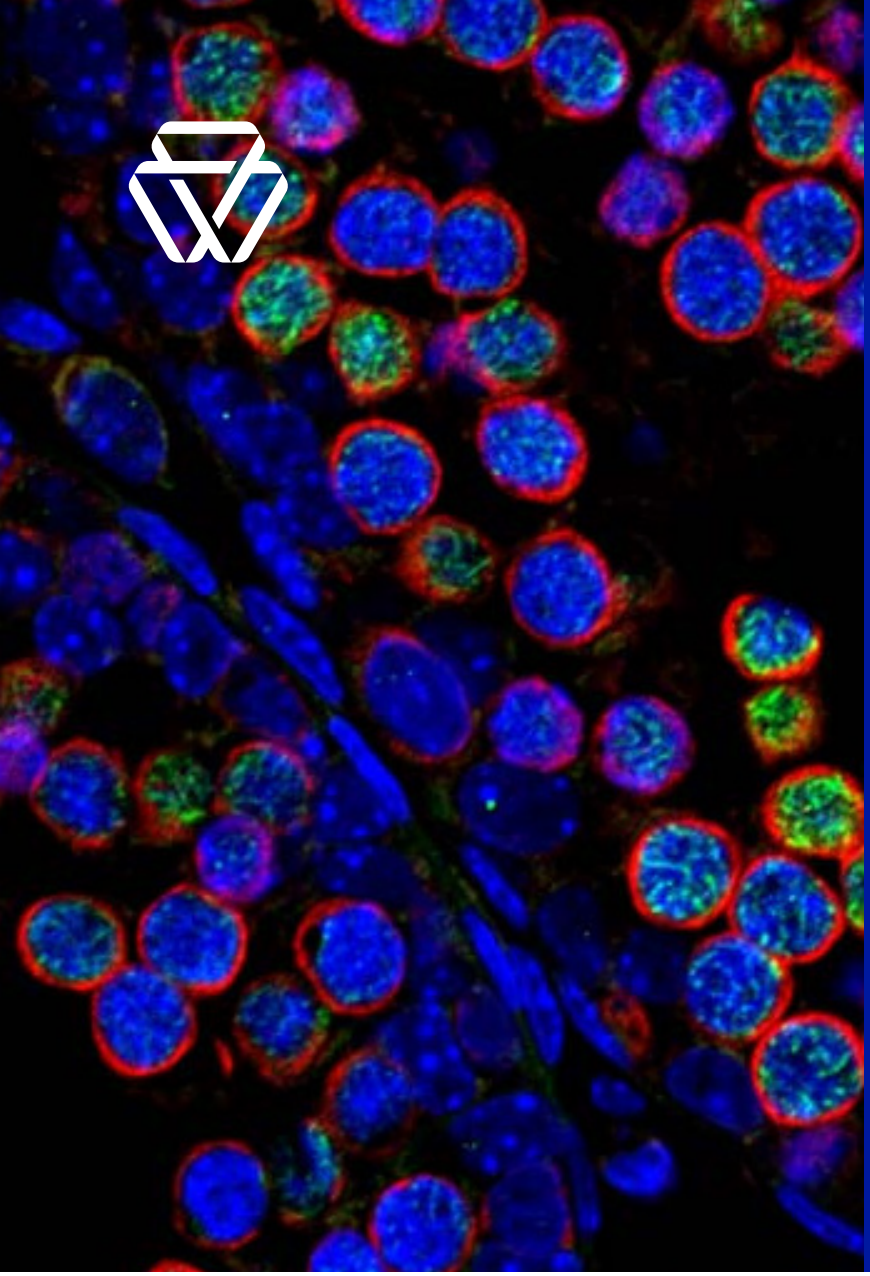

Behind the biology driving infectious disease

Infectious diseases are caused by pathogens including bacteria, viruses, fungi, and parasites, that invade our cells. Unlike genetic diseases, infectious diseases can spread from person to person. As we saw with the global toll of HIV/AIDS, and more recently with the Covid-19 pandemic, caused by the virus SARS CoV-2, they can impact not only individuals but whole societies. The pathogens that cause infectious diseases survive by being easy to spread and hard to eliminate. Whitehead Institute researchers are working to understand the pathogens' underlying biology, including how they invade human cells, how they persist, and how they evade treatments. This work is building an important foundation that can lead to new strategies for the prevention and treatment of infectious diseases, and creating a robust toolset with which researchers can more rapidly investigate new pathogens when they appear.

Valhalla Fellow **Lindsey Backman** studies how disease-associated bacteria outcompete beneficial bacteria and overcome environmental challenges to thrive in our bodies. For example, the human immune response to infection subjects pathogens to high levels of reactive byproducts from which invading bacteria must develop strategies to protect or repair themselves. Backman's work may reveal weak points in the bacteria's defenses that researchers can leverage to create antibiotic drugs, and perhaps provide knowledge that could be used to bolster the beneficial bacteria in our bodies.

“Backman’s work may reveal weak points in the bacteria’s defenses that researchers can leverage to create antibiotic drugs.”

Founding Member **Rudolf Jaenisch** is creating models of disease, using induced pluripotent stem cells (adult cells that have been reverted into stem cells, then turned into other cell types) and organoids (small 3D assemblies of cells), to get a more accurate, close-up look at how infectious diseases affect human cells. Jaenisch has studied the mosquito-borne Zika virus, and is collaborating on projects related to Lyme disease and other tick and mosquito borne diseases. Jaenisch lab researchers are also studying SARS-CoV-2. They have found that parts of the virus’ genome can be copied into the human genome. They also found that the virus can infect sensory neurons, which may help to explain Covid-19’s symptoms in the peripheral nervous system. Jaenisch’s work reveals how viruses infect cells and cause symptoms, which can help researchers determine how to prevent or treat viral diseases.

Member **Sebastian Lourido** studies Apicomplexans, a group of single-celled parasites including the species that spread malaria and toxoplasmosis—a potentially severe disease estimated to affect 25% of the world’s population—to discover how they have adapted to become such successful human pathogens. The parasite responsible for toxoplasmosis switches between an acute stage, responsible for symptoms and spread of disease, and a chronic stage, an inert form that can evade the immune system and current treatments, making the disease impossible to cure. Lourido lab researchers recently identified two genes, BFD1 and BFD2, that create a positive feedback loop to commit the parasite to entering its chronic stage. If the genes are turned off, the parasite remains in its acute stage, which can be cleared from our cells. This finding may lead to strategies for curing toxoplasmosis.

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