Student Research Opportunities in the Steinauer Lab 2011/2012

There are several opportunities for research in the Steinauer lab for motivated students with an interest in parasitology, infectious disease, and host defense against pathogens. Students will learn how to write an effective research proposal, be trained in laboratory techniques, plan experiments, collect and analyze data, and contribute to a research publication. A commitment of a full summer is expected and continued involvement in preparation of the project into a manuscript. Below are a few established projects or projects of interest to me that students may work on, but any project ideas that fit into our research program will be considered.

1. **Determining different types of host defense strategies against pathogens**. Offense is not necessarily the best defense. Hosts can use offensive strategies to combat pathogens (i.e. resistance), but may also use defensive strategies, namely tolerance. Tolerance is the ability to maintain health despite infection. Although the principle of tolerance is generally accepted, it has rarely been quantified and there are no known mechanisms in animals. We are investigating tolerance mechanisms in a host-pathogen system in the lab and in the field in Kenya to 1). Characterize tolerance, 2) Determine the underlying mechanisms, 3) Determine the relationship between tolerance and resistance, 4) Determine how these mechanisms evolve in populations. Students could be involved hands-on in several aspects of this project including performing the infections of hosts with pathogens and determining the outcome of the disease.
2. **Developing a PCR-based diagnostic to identify *Giardia* strains.** It has become clear that what we call *Giardia lamblia* comprises multiple distinct "strains". In diagnostic settings, there has been a lot of interest in determining *Giardia* identity in infections of companion animals. One primary reason is to determine whether a companion animal contains a harmless symbiont or if it contains a zoonotic pathogen. We are interested in developing and validating a test for the VDL. A student would play the primary role in the collection of specimens, PCR amplification, DNA sequencing, and sequence analysis in order to validate these tests.
3. **Profiling a natural product for anti-parasitic activity.** We have discovered that rotifers (freshwater micro-organisms) emit a compound that has a negative effect on schistosome parasites (trematode parasites of great human health concern and of Veterinary importance in Africa and Asia). The compound paralyzes free living stages of the parasite and prevents infectivity to the next host. We are interested in determining the identity of the compound and how it may be used to disrupt transmission and prevent infection. Students may get involved in the chemical analysis of the compound or in determining how the compound affects schistosomes at all of its life stages, and also effects on other parasites and organisms.
4. **The effect of coinfection on disease dynamics.** Parasitic helminths are master manipulators of their hosts' immune systems. Immunomodulation serves to keep the parasite alive and reproducing in the host in a chronic infection. Helminths can cause general immunosuppression, which makes hosts more susceptible to other parasites. They can also skew the immune response to be more TH2-biased. This manipulation is predicted to influence different helminth species in various ways by influencing host susceptibility, immunopathology, parasite mortality, and parasite fecundity. These effects are important because most hosts are exposed to numerous parasite species and they should have important health consequences at the individual level. Furthermore, at a population or herd level, these effects may "scale up" to influence the disease dynamics of the system. These effects may be particularly important when considering a drug treatment program, as it may have unintended consequences on other pathogens in the system. We will perform experimental coinfections of helminths in a rodent system to determine how each helminth influences the recruitment rate, fecundity, pathological

consequences and mortality of the other. These data will be used to parameterize a model aimed at predicting the effects of coinfection and parasite removal on a population.

5. **Determine the role of coinfection on the development of parasite resistance.** Schistosomes are important blood flukes of humans, cattle, and wildlife. It has been shown that many humans that are repeatedly treated for schistosomes become immune to reinfection. However, not all individuals respond by becoming resistant. Why? Recently it has been shown that production of IL10 after treatment for schistosomes impedes the development of resistance in a rodent model. In areas where humans are commonly infected with schistosomes, they are also commonly infected with other helminths, especially nematodes. Nematodes are notorious for manipulating the immune systems of their hosts, and many species do so by inducing the production of IL10. This project would determine the role that co-infection plays on the development of resistance to schistosomiasis using a rodent model. These data will be relevant to drug treatment programs that are aimed at inducing resistance to these parasites.