Responding to a parasitic invasion

Research Chair in Bioinformatics and Public Health Genomics, **Dr Alan Christoffels,** shares some of the details of his laboratory's work on genomics and the role that he plays as an educator of future scientists

You lead the South African National Bioinformatics Institute (SANBI) lab's research on host-pathogen interaction. Could you provide a brief overview of your work in the field?

Different host immune responses are invoked during parasitic invasion. These immune responses can represent evolutionary adaptations specific to certain organisms, and they are clearly illustrated in the three model systems that are used in my laboratory. The three relationships we focus on are between *Anopheles* and *Plasmodium*, humans and *Mycobacterium*, and *Glossina* and *Trypanosoma*. My lab uses a combination of computational and experimental approaches to unravel the molecular interactions at the host-pathogen interface. We also aim to develop high throughput genomics methods, including next generation sequencing data analysis approaches, in order to study communicable diseases such as tuberculosis, malaria and sleeping sickness. As part of an international tsetse genome consortium, my group has been analysing the tsetse genome with a view to understanding the evolution of the immune system and its response to invading parasites.

Why did you decide to pursue a career in computational biology research and, specifically, its application to communicable diseases?

My career started out in the medical sciences, and as time went on, I found myself having to engage with data more and more. A natural affinity for computers made the transition to formal computational biology training an easy career shift for me. The first bioinformatics institute was established at the time when I was considering my PhD options. My choice of research topic is linked to the prevailing disease burden on the African continent and specifically in South Africa.

By what means is SANBI developing throughput genomics methods such as next generation sequencing data analysis for the study of diseases like tuberculosis, malaria and sleeping sickness?

Across all these disease model systems, the issue of data integration is key. We have access to large sequencing datasets and we often find ourselves having to either alter existing computational approaches such as genome annotation pipelines or detect genetic variation. On the other hand, we are using machine-learning techniques to identify protein interaction networks between humans and mycobacteria.

How is the biomedical research conducted at SANBI relevant in both African and international contexts?

The research portfolio at SANBI spans both communicable and non-communicable diseases. Each project focuses on a disease that is pertinent to South Africa, the wider African continent and the international community; for example, our work on developing a cost effective assay for HIV drug resistance testing has a global impact. Tuberculosis multidrug resistance and extreme drug resistance is also a global problem. We are using a combination of metabolic networks and drug design to look at new drug targets.

Alongside pioneering biomedical research, SANBI aims to foster the highest levels of excellence in education. Could you outline the undergraduate and postgraduate programmes and training courses offered by the Institute?

Currently, we do not offer any complete undergraduate programmes, although we do teach a term module to third year BSc students as part of the biotechnology degree at the University of the Western Cape. At SANBI, we offer MSc and PhD degree programmes. These postgraduate degrees are research-based and supplemented with short courses, including a compulsory seven-week course hosted at SANBI for all South African universities.

What can students expect from SANBI with regard to mentoring, research opportunities and teaching environments?

We have five research laboratories and their research themes cover HIV dynamics, non-communicable diseases, plant viruses, clinical biomarker discovery and host-pathogen interactions. Each of these labs is embedded in multinational collaborative projects, and students will have an opportunity to engage with an international network of researchers. Participation in these global projects will also allow students to enjoy overseas visits as part of their graduate experience.

On a personal level, what do you believe to be SANBI's greatest accomplishment to date?

I will not single out any specific research project, but the institute as a whole has achieved a number of important accomplishments. We have delivered on our mandate to develop computational biology in South Africa and the African region, for example, and our graduate students have taken up prominent academic positions at local universities – or have gone abroad, and are contributing significantly on an international stage.