Research interests: Eukaryotic genome evolution (Organellar DNA transfer to the nucleus)

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In the laboratory, we are interested in eukaryotic genome evolution. Eukaryotic cells arose more than a billion years ago through endosymbiotic engulfment of free-living alpha-proteobacteria and cyanobacteria that were gradually converted into mitochondria and chloroplasts. Since these endosymbiotic events, there has been a continuous deluge of organellar DNA entering the nuclear genome that has been a source of genetic diversity and significant in the creation of new genes. A good example that highlights the importance of this process is that up to 5,000 of the 25,000 *A. thaliana* nuclear genes derive from chloroplastic sequences. However, genes deriving from the chloroplast genome (prokaryotic) do not become functional immediately after being inserted within the nuclear genome (eukaryotic). To become functional in this new environment, they must acquire nuclear regulatory elements. While functional gene transfer has ceased in animals, it still occurs in plants where it is uniquely amenable to experimental and bioinformatic studies. We are interested in finding real recent functional gene transfers in plants and understanding how chloroplastic genes adapted to their new environment at the molecular level. **One possible Honours project will be to work on the molecular characterization and evolutionary fate of genes functionally transferred from the chloroplast to the nucleus.**

The deluge of organellar DNA transferred to the nucleus is potentially deleterious since it must result in an increase in nuclear genome size and may also insert into active nuclear genes, potentially resulting in deleterious mutations. For these reasons, the insertion and removal of organellar DNA integrated in the nucleus must be in equilibrium. **Another possible Honours project will be to characterize the molecular mechanisms involved in the insertion or in the genetic stability of chloroplastic DNA transferred to the nucleus.**

In each project, the Honours student will have the opportunity to enhance his/her intellectual and technical skills in genetics, molecular biology and evolution. He/she will have the opportunity to use different molecular techniques that includes many PCR-derived techniques, cloning, *in vitro* culture techniques, plant transformation or Southern Blotting. The Timmis laboratory has worked on eukaryotic genome evolution for about 30 years and has created many transgenic and transplastomic lines that are only available in the University of Adelaide and will facilitate the realisation of these projects.

For further details on possible Honours project, feel free to come to the laboratory and discuss possibilities with us.

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