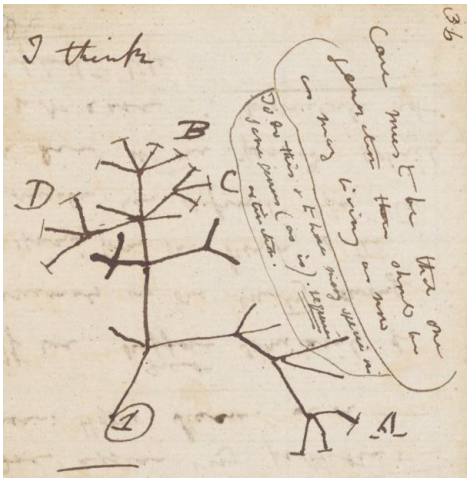
MRes in Evolution programme

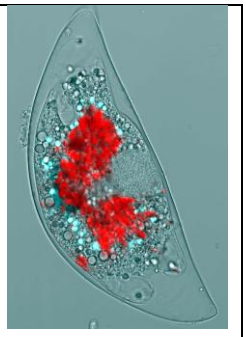
at the University of Southampton



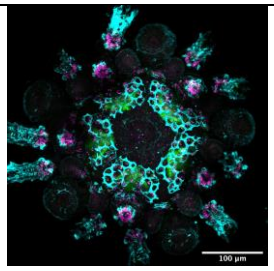
From Charles Darwin's visit to the Galapagos to modern advances in genetics and developmental biology, unravelling the process of evolution has had a profound impact on humanity's understanding of the biosphere. It offers explanations for the fascinating diversity of species on Earth but also their molecular make-up and behaviour. As aspects of evolutionary theory have changed since its inception, its power to act as integrative force across diverse fields of research is arguably stronger than ever. Together, we will explore the cutting-edge of evolutionary biology and discuss and experience how it has become an inclusive and interdisciplinary science spanning across biology, geology, data science, medicine, archeology, philosophy, engineering and more. You will gain a range of specific analytical skills representing the current state-of-the-art of evolutionary biology, while also honing more transferrable skills like presentation, scientific writing, and proposal preparation. Most importantly, you will become intimately involved in research itself, generating, analyzing, and interpreting data to ultimately produce a publishable body of work in an aspect of evolutionary biology.

Your lecturers:

Neil Gostling (programme lead): Origin of animals, Origin of birds and flight, Dinosaurs, Origin of mammals and placental evolution, Mesozoic marine reptiles and fish.



Jan Janouskovec (deputy lead): Origin of eukaryotes, Evolution of photosynthesis and bioluminescence. Protist diversity. Parasite origin and evolution.

Jorn Cheney: Evolution of locomotor modes, Bio-inspired technology. 	Veronica Zamora-Gutierrez: Evolutionary ecology in mammals. 
Jeff Thompson: Evolutionary developmental biology, Morphological evolution, Evolution of animal body plans. 	Mark Chapman: Speciation, hybridisation and domestication, mainly in plants, and from a genomic and transcriptomic point of view. 
Dan Stabler: Plant-Organism Interactions, Coevolution.	… and excellent invited speakers in evolutionary sciences.

Evolutionary skills you will learn. As part of the BIOL6087 and BIOL6089 modules you will have the opportunity to gain insights into the fundamental methods of evolutionary biology in lectures and hands-on activities such as the following:

- Light microscopy (w. Jan Janouskovec)
- 2D image analysis in Matlab (w. Jorn Cheney)
- Introduction into R (w. Jeff Thompson)
- Machine learning for acoustic analysis (w. Veronica Zamora)
- Sequence analysis using online tools (w. Jan Janouskovec)
- Molecular phylogeny inference (w. Jan Janouskovec)
- Morphological phylogeny inference (w. Jeff Thompson)
- CT scanning and data analysis (w. Neil Gostling)
- 3D reconstruction (w. Jorn Cheney)
- Big data sequence analysis (w. Mark Chapman):
- Taxonomic ID in plant-insect interactions (w. Dan Stabler)

Research project topics. The following topics provide *examples* for the kind of research project you will do during your MRes studies. Please email prospective supervisors for more information about research topics that interest you and note that your project can be supervised by *any* University of Southampton faculty member who has agreed to it.

- Molecular timing and evolution of phytoplankton (Jan Janouskovec)
- Bioluminescence in dinoflagellates (Jan Janouskovec)
- Parasite genomics and cell evolution (Jan Janouskovec)
- Convergent evolution in gliding flight in mammals (Jorn Cheney)
- Interactions between arboreal morphology and gliding evolution (Jorn Cheney)
- How animals stabilise their flight in turbulent conditions (Jorn Cheney)
- Trade-offs between immunity and bats life-history traits (Veronica Zamora)
- Anthropogenic noise and its impact on mammalian/avian communication (Veronica Zamora)
- Evolution of vocal complexity in social mammals (Veronica Zamora)
- Molecular evolution of developmental pathways (Jeffrey Thompson)
- Morphological evolution across macroevolutionary time scales (Jeffrey Thompson)
- Evolution of biomineralised skeletons (Jeffrey Thompson)
- Pollinator nutrient balancing and physiology (Daniel Stabler)
- Factors influencing pollen and nectar nutritional composition (Daniel Stabler)
- Mechanisms underpinning nutrient allocation to nectar and pollen (Daniel Stabler)
- The origins and evolution of avian flight (Neil Gostling)
- Evolution and adaptation of the mammalian placenta (Neil Gostling)
- Palaeobiology of dinosaurs and/or Jurassic marine reptiles (Neil Gostling)
- The effect of genome divergence on hybridisation (Mark Chapman)
- Population genetics and selection during domestication (Mark Chapman)
- Gene expression in species and their hybrids (Mark Chapman)

Examples of past MRes research projects:

- Virtual reconstruction of the skull of Koupiodontosuchus aprosdokiti and resolving the neosuchian-eusuchian transition.
- Impact of Parental Genetic Divergence on the Likelihood of Hybridisation and the Fertility of Hybrids.
- Medullary bone in 3D: The microstructure and distribution of female-specific bone tissue in Neornithes.
- The genetic and morphological diversity within and between two related underutilised legumes, in focus Macrotyloma axillare and Macrotyloma uniflorum.
- Correlative µCT Imaging and Histology of the Bovine Placental Structure.
- Investigating the Evolution of Transmissibility in Devil Facial Tumour Disease 2 through classical MHC class I Expression in an Endangered Marsupial, the Tasmanian Devil (*Sarcophilus harrisii*).

- Using Micro-Computed Tomography to Compare Cortical Bone Microstructure in the Forelimbs of Flying and Terrestrial Archosaurs.