A PERSONAL TOUR THROUGH UCL SCIENCE

Cellular Hacking, Motion Camouflage, and Life on Mars.

I am currently a PhD research student at UCL, I came here after completing my Biology degree elsewhere. I joined the exciting new group called CoMPLEX, a fitting acronym for the full name "Centre for Mathematics & Physics in the Life Sciences and EXperimental Biology". As the name implies, the research covered by this department is extremely broad. It does not offer undergraduate degrees, but studying here has allowed me a very good insight into the great range of science that goes on at UCL. For my first year with CoMPLEX, a Masters degree, I undertook research projects into three completely different fields.

My first study was with the **Biochemical Engineering** department, looking into how genetic engineering could be used to artificially tweak the network of metabolic reactions within bacteria used by industry. The hope is to increase the yield of the commercially-valuable product at the expense of other irrelevant chemicals, but without effecting the health of the cell. For example, some ingredients for the food industry as well as drugs like insulin are harvested from bacteria grown in enormous vats.

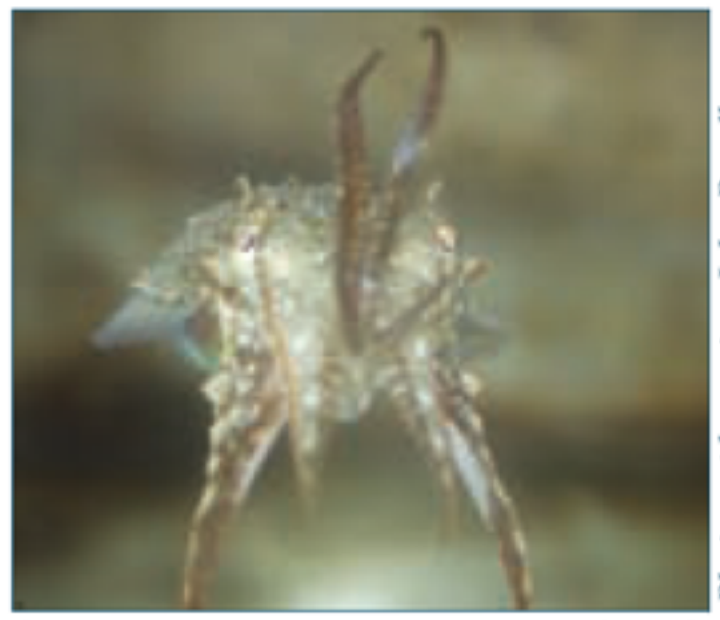
For my second project I worked with scientists in **Chemical Engineering**. I analysed the network of interacting proteins within each of our cells that works to stop them turning cancerous. It turns out that this vital biological network has a structure much like the Internet, and certain viruses exploit this by effectively 'hacking' particular target proteins to trigger tumour growth.

Thirdly, I moved into the **Psychology Department** for some research into optical illusions. Illusions are created when our brain makes a mistake or uses the wrong assumption, and so the kinds of pictures you find in books tell us a lot about how the human mind works to process visual information. I wrote a computer programme to make illusions that disrupt our ability to judge the speed or position of a moving object. The idea was that this could be used as a form of 'motion camouflage' to disguise something's true movement. I discovered that cuttlefish, creatures related to octopus and squid, might actually be using a kind of motion illusion when they hunt.

Cuttlefish can control the exact colour and pattern of their skin much better than any chameleon. They use this to perfectly camouflage themselves against the sea floor, enabling them to avoid predators or approach their own prey undetected. But sometimes when the cuttlefish has snuck right up to a prawn, say, it suddenly switches from invisible camouflage to a very conspicuous dynamic pattern of thick black stripes racing forwards over bright white skin. Why on Earth would a cuttlefish do something so noticeable just before it lunges on its prey? The theory is that the cuttlefish is generating a specific kind of motion illusion, effectively jamming the visual system of its prey to thwart its escape.

Photograph courtesy John Rundle

Another very conspicuous cuttlefish pattern. This is for mating/attracting mates.



Photograph courtesy John Rundle

Shrimp's eye view of a cuttlefish attacking.

Acknowledgement: cuttlefish pictures courtesy of John Rundle, Marine Biological Association, Plymouth (Email: jru@MBA.ac.uk, www.mba.ac.uk) whose work involves a breeding programme for these creatures.

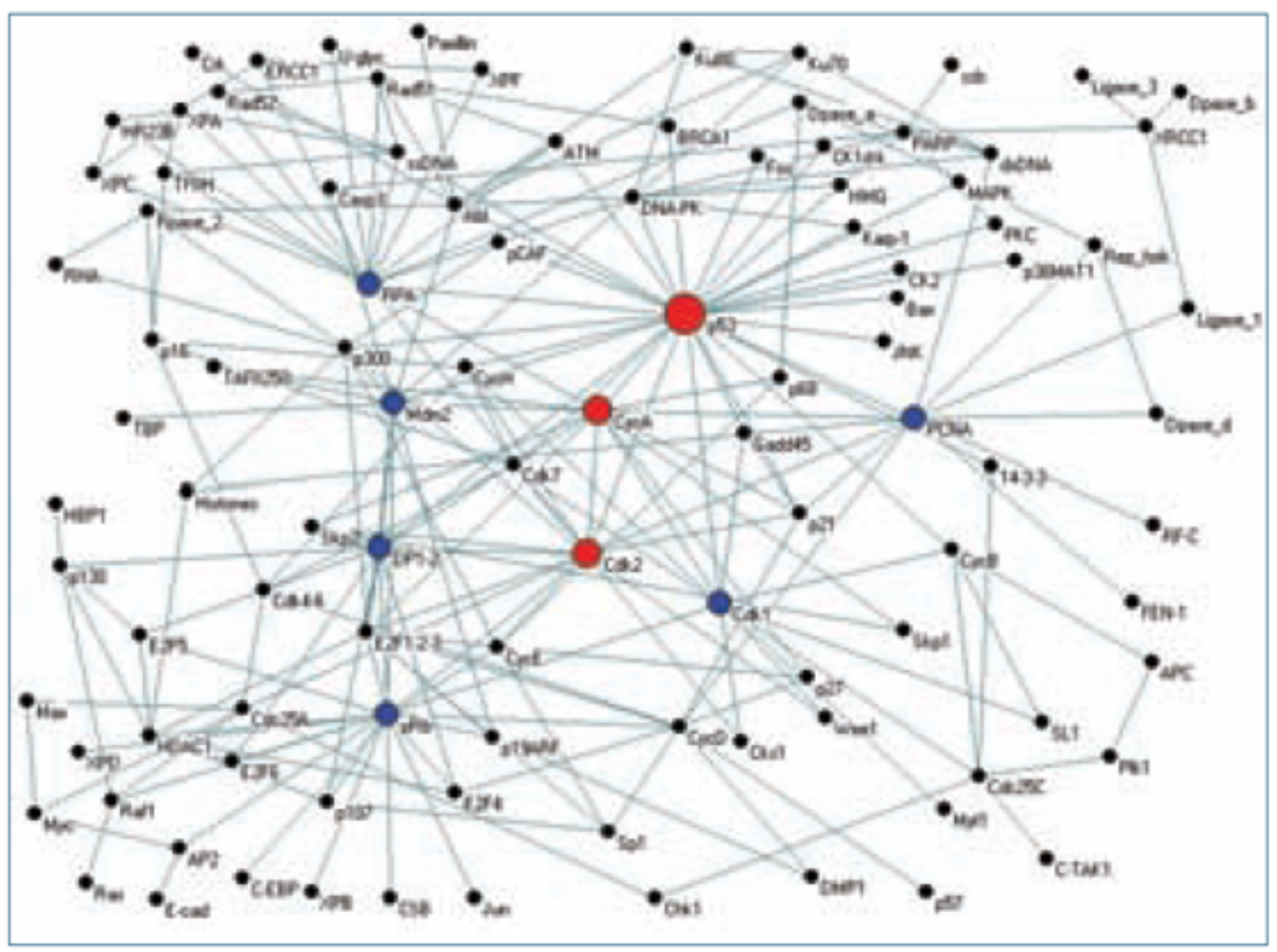


Figure 2: The large network of interacting proteins that protect our cells from turning cancerous. The most highly connected nodes (red and blue) are the hubs of the network, much like servers on the internet.

These are just a few snapshots of the full range of fascinating science being performed at UCL, and you could take up many similar projects as an undergraduate during the research dissertation in your course.

After my first year at UCL I moved on to PhD research and was lucky to have the opportunity to research into something I've found absolutely intriguing since I first started school. **'Astrobiology'** is a new field of science, interested in the possibility of life emerging on worlds other than our own Earth. It is very 'interdisciplinary' and involves biochemists, microbiologists, astrophysicists, and geologists all working together. Astrobiology incorporates all we know about what 'life' actually is, bizarre organisms that can survive in boiling acid or solid polar ice, the history of Earth and how life arose here, whether Mars or even some of the moons in the solar system might be suitable, and discovering other Earth-like planets orbiting distant stars. UCL is one of the few universities in the country with a developing centre for astrobiological research.

My particular work over the past year has been on our planetary neighbour, Mars. We know that the surface of Mars today is almost certainly too harsh for life, it's bone dry, freezing cold, devoid of organic molecules and bathed in lethal radiation from space. At least that's the story now, but when the planet was much younger (and life was only just emerging on Earth) the conditions were very different. The hope is that bacteria-like life became established on Mars as well, and is now sheltering from the inhospitable surface environment underground. I am looking into just this possibility.

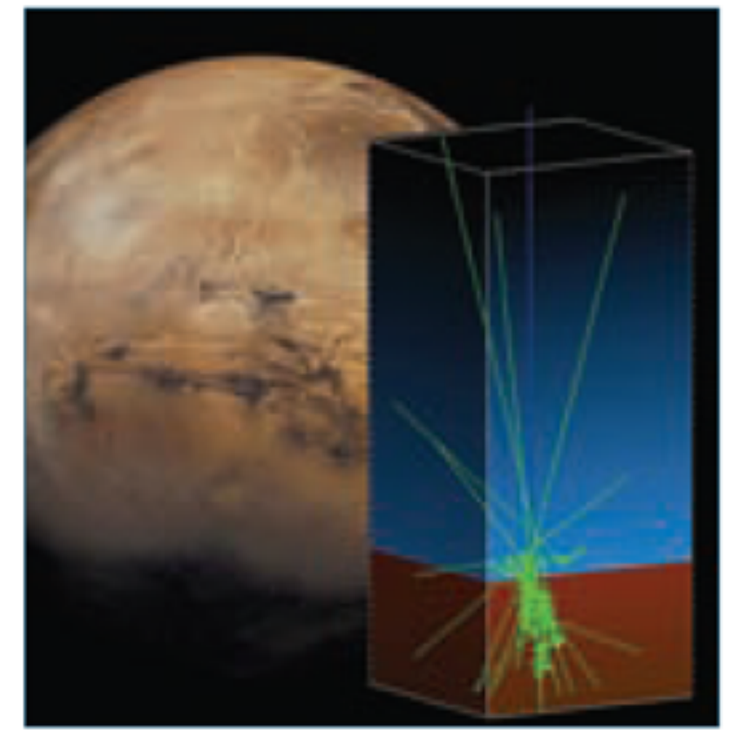


Figure 3: Lewis' simulation of an eneretic particle (blue line from above) generating a great underground cascade of secondary radiation (green and red) on Mars.

I have built a computer model that simulates how all the energetic radiation from space passes through the thin atmosphere and surface rock of the planet. The image above shows a subatomic particle (the blue line from above) moving at close to the speed of light, perhaps accelerated by an exploding star on the other-side of the galaxy, as it arrives at Mars. It punches straight through the thin atmosphere and generates a great cascade of secondary radiation underground (shown in red and green) that is eventually reabsorbed by the rock.

How deep would dormant life need to be for protection from this radiation? How long could a radiation-resistant bacterium survive if it were near the surface? Where are the best spots to send our robotic probes to look for signs of life? These are just a few of the crucial questions I will be looking into over the next year.

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Websites mentioned:
CoMPLEX - www.complex.ucl.ac.uk/
Biochemical Engineering - www.ucl.ac.uk/biochemeng/
Chemical Engineering - www.ucl.ac.uk/chemeng/
Psychology - www.psychol.ucl.ac.uk/
UCL Centre for Astrobiology - www.star.ucl.ac.uk/astrobiology/

PUNK ROCK & SCIENCE? OH YEAH!

PhD student Stephanie Thompson wears her shocking blonde hair in a 50's Elvis-style quiff, applies heavy black eyeliner, and makes her way from Camden Town to her office at the Institute of Cognitive Neuroscience in the esteemed scientific quadrangle that is Queen Square. She is a woman, a punk rocker, and a scientist. Yes, you really can be all of these things!!

After obtaining a degree in Psychology, Stephanie moved to London to study Cognitive Neuroscience at Masters Level. During this time, she met Dr Sarah-Jayne Blakemore, and felt a calling to study the mysterious world of adolescence. She wondered, why do teenagers act in such unique ways?

Having found that teenagers' sleeping and waking patterns change to a more adult like pattern at the onset of puberty, a postgraduate position at UCL (University College London) allowed further investigations into what makes teenagers tick. Days spent learning about adolescent development from research conducted by scientists across the world gradually turn into hypotheses about what might happen to the way children think about other people as they enter into puberty and adolescence.

Computer tasks are created to look at these hypotheses, using programming skills developed through attending one of the many courses offered by UCL. This is a handy way of collecting data, as the computer records the time taken for people to respond to certain questions and whether they get the questions right or wrong. Statistics can be used to find out if there are any differences between the responses of teenagers compared to children and adults; for example, an increased time taken to respond or decreased error rate during puberty. If any differences are found during this period, it could suggest that puberty is a special time for developing certain ways of thinking about the world, which is pretty exciting!

Also available to UCL postgraduates is the opportunity to help Psychology undergraduates understand how to conduct good scientific research by acting as demonstrators and seminar