Preventing 'Bird strikes'

By Elizabeth Heath

Birds colliding into planes, referred to as ‘bired strikes’, cost the aviation industry up to $3 billion every year. Even worse, they have contributed to a number of fatal plane crashes: 24 people were killed in Alaska in a bird strike crash in 1995, and at least 68 people have died in similar incidents in the United States and Europe since then, according to the International Bird Strike Committee.

At almost every major airport around the world the traditional method of reducing the risk of collision is to cull birds which pose a risk to planes.

But Professor Chris Dickman and his colleague Chin-Liang Beh from the University’s Institute of Wildlife are working with Sydney Airport on a system of ecological controls to minimise the danger.

“Generally there can be between two to a dozen collisions every month at Sydney Airport,” said Professor Dickman. “Most involve small species, but medium sized, heavy bodied birds – crows, magpies those sorts of birds – can be more problematic. The worst case scenario would be a pelican. That would be bad news.”

Unfortunately, the habitat around Sydney Airport is particularly attractive to birds. “It is right on the coast and you have lots of sea birds using those waters,” he said. “There is also a lot of pretty good bushland in the surrounding areas, and there are freshwater wetlands nearby.”

Professor Dickman’s project team is using a holistic approach to control bird numbers. Smaller birds that keep close to the ground are encouraged, food sources are controlled, and grass is grown to a length of 20 centimetres. “Even just netting the banks of the local wetlands stops a lot of species coming in,” he said.

And the approach is working. “Last November, for the first time ever, there were no bird strikes reported,” he said.

The project is now in its second year, and already projections are available to tell researchers when to expect certain species of birds and what to do about it.

“We have been doing predictive modelling and have identified which species come in and when. So then you could make sure the schools of fish are dispersed, garbage cans are locked down, and airport staff advised to be extra vigilant.

“The exciting thing is that we are using ecological principles to their best effect. You often hear about applied ecology, but this is a really good opportunity to show how it can be applied.”

Professor Dickman and his team hope to present their findings overseas.

“We have an international model that is working well. As far as we can tell, there is not much else going on like this in the southern hemisphere. Instead of sending airport workers out to check what birds are around and then shooting them, we are trying to make sure that we take a more considered and proactive approach.”

Photo courtesy of School of Biological Sciences
The 2007 University of Sydney Sleek Geeks Science Eureka Schools Prize saw not only an increase in entries but also an increase in the quality, making the judging that much more difficult. Entries came in from all grades with a range of styles on show. Many demonstrated their talents with animation for their videos whilst others focused on documenting an experiment. Not to mention the lyrical skills with many song entries and Oscar worthy performances.

The aim of this prize is to encourage secondary school students with a passion for science and for communicating ideas to tell a specific story via a short video piece. The story must be accurate and scientific: be it a discovery, invention or the student's own scientific hypothesis. Whilst the better editing looks nice and may make the video catchy, the judges were mainly looking at the science in the video and the student's ability to communicate this concept in a fun and entertaining way.

This year there were a number of stand out entries. After much deliberation the judges selected the four finalists, all from interstate schools!

The winners were two year 11 students, Tyler Stewart and Billy McNiece, from Melbourne High School and St Michael's Grammar School in St Kilda, Victoria, for their documentary ‘Alchemy: the Golden Age’.

Nicholas Dyer, a year 9 student from Shenton College, WA won second place for his amazing animated film ‘Zac’s Motion Picture’. Nicholas’ video explained Newton’s Law of Motion featuring a lego man and a huge rubber band ball.

‘Meiosis: the Chromosomal Wonderdance’ won Genevieve Martin and Annie Zheng from Kilvington Girls’ Grammar, Victoria, third place. This entry was popular with Dr Adam Spencer who aired the song the next day on his ABC radio show.

Fourth place went to a dynamic group from Becchus Marsh Grammar School, Victoria, consisting of Megan Betz, Jessica Gay, Jane Hawkey, Caitlin Henderson, Felicity Kelson and Jasmine Sunely. Their movie ‘The Periodic Playground’ was an entertaining look at the school yard whilst explaining atomic bonding.

The 2007 finalist entries can be viewed on the ABC Science website at www.abc.net.au/science/sleekgeeks/eureka/2007/

At the Eureka Prizes Dinner, Professor David Day, Dean of the Faculty of Science, announced that our Sleek Geeks Prize will be expanding in 2008 to include $16,000 worth of prizes. There will be three categories – university students, secondary school students and primary school students.

The university students prize has a first and second place winning $3,000 and $2,000 respectively. The high school student category has three prizes. First place is $4,000 plus a $500 book voucher for Abbey’s Bookshop, Sydney. Second and third place win $3,000 and $2,000 respectively.

The winner of the primary school prize receives $1,000 plus a $500 book voucher for Abbey’s Bookshop, Sydney. Cash prizes are divided equally between members of the winning teams and their schools. All finalists also receive a copy of Microsoft Student 2007, with the school also receiving a copy of Microsoft Expression Web Designer.

Why not get a head start on next year’s competition? Former Sleek Geek finalist and current Faculty of Science student, Matthew Wardrop, has some tips for high school students entering the competition next year. Read his advice here: www.science.usyd.edu.au/school/eureka/sleek_qa.shtml
2007 is an exciting year for the Science in the City executive partners, The Australian Museum and the University of Sydney. Science in the City is a very successful program, and this year the Department of Education, Science and Training (DEST) signed a three year funding agreement worth $300,000 lending further support for the program’s outreach activities. These activities are held in areas around the state including Coffs Harbour, Orange, Tocal and Armidale, as well as areas around the Sydney region such as Sydney Olympic Park, Hawkesbury, Cronulla, Londonderry and Westmead.

This year Science in the City attracted around 6,000 primary and high school students. These students were able to immerse themselves in science through a range of activities.

The Science in the City Expo is a great opportunity for students to walk around and experience a range of different scientific areas. Displays were as wide ranging as understanding native bees, to solving mathematical puzzles, or seeing how smart you were with a science quiz. The University was heavily featured in the expo with activities from CUDOS, Geosciences, Mathematics and Statistics, Microscopes on the Move, Plant Energy Biology, Psychology, Science Faculty and Engineering and Information Technologies. This year students were also entertained by the top 20 entries in the University of Sydney Sleek Geeks Science Eureka Schools Prize, which proved very popular.

Students were able to book into a range of our workshops from Biology, Chemistry and Physics. Biology workshops involved searching through leaf litter for invertebrates and other interesting objects under the microscope. Chemistry allowed students to see a range of various chemical reactions with liquid nitrogen, acids, bases and fluorescence (photo below). Physics looked at electricity, magnetism and electromagnetism where students made their own lightning and charged themselves up to 10,000 volts!

Lectures and shows were also on offer from Associate Professor Tony Masters on ‘Great Chemical Disasters’, Dr Karl Kruszelnicki’s ‘Great Moments in Science’ and Physics’s very popular show, the ‘Physics Air Show’.

Science in the Suburbs at Hawkesbury ran for the first time this year. Science and Plant Energy Biology were at the expo helping students discover the DNA of strawberries, creating instant snow and having fun with tornado tubes. In addition, a microecology workshop, physics show and Dr Karl Kruszelnicki’s ‘Great Moments in Science’ lecture were part of the line up.

For more information about Science in the City, and the outreach programs visit: www.scienceinthecity.net
Revealing the molecules underlying Autism

Autism spectrum disorders are amongst the most devastating disorders of early childhood in terms of prevalence, family impact and cost to society. It is estimated that 120,000 people in Australia have autism spectrum disorders – lifelong disabilities that affect the way a person communicates and relates to other people and the world around them.

People with autism typically display major impairments in three areas: social interaction, communication and behaviour (which includes having restricted interests and demonstrating repetitive behaviours).

Scientists at the University of Sydney are working on the molecules that underlie autism spectrum disorders. There is no single known cause for autism, but recent research has identified strong evidence of a genetic factor for many sufferers.

Professor Jill Trewhella, who is an Australian Federation Fellow working jointly as Professor of Molecular and Microbial Biosciences at the University of Sydney, and at the Australian Nuclear Science and Technology Organisation, is leading the team investigating specific molecules associated with autism.

“Genetic screens of people with autism have shown that there are often several mutations in the sections of DNA that code for proteins called neuroligins and neurexins,” Jill explained. “These proteins are involved in allowing one neuron in the brain to pass its message onto the next neuron – absolutely key in normal brain function.”

“The gap between one neuron and the next is called a synapse, and it is here that neuroligin and neurexin proteins sit, allowing signals to be transmitted from one nerve cell to the next,” said Jill.

Many neurodevelopmental disorders involve abnormal synaptic function, as the synapse provides the essential connections between nerve cells that enable signals to pass through the brain.

“We are using X-ray and neutron scattering tools to uncover the physical structure of these neuroligins and neurexins,” said Jill. “Firing X-rays and neutrons at our samples allows us to build up a picture of where individual atoms in the neuroligin and neurexin proteins are located, so we can ‘see’ their complex structure.

“We have learned how these two proteins interact with each other to form a complex in the synapse by observing patterns of scattered X-rays and neutrons,” explained Jill. “The X-ray scattering patterns gave us the shape of the whole complex. Then, using neutron scattering and labelling the neurexins with deuterium – a form of hydrogen with an extra neutron in its nucleus – we were able to determine the positions and orientations of the neurexin molecules bound to the neuroligin.

Using this information, we were able to build the first three-dimensional model of the complex.”

Part of each neurexin molecule is embedded in the cell membrane of the neuron on the transmitting side of the synapse, with a thin stalk-like section of the molecule projecting into the synapse. At the end of the elongated stalk, the globular end of the neurexin molecule sits in the synapse, near the largest part of a neuroligin molecule. The neuroligin molecule has a similar elongated stalk and a section that is embedded in the cell membrane of the neuron on the message-receiving side of the synapse.

“The model shows the two proteins tethered to each side of the synapse and facing in towards each other in the synaptic space,” explained Jill. “Our model provides an important foundation for further research into mutated neurexins and neuroligins in neurodevelopmental disorders.”

The exciting findings have been published in the scientific journal Structure and are featured on its cover. Understanding the structure of neurexins and neuroligins in the synapse will allow for linking of genetic information on mutations in these two proteins with the autism disorders. Such knowledge offers hope for the development of therapies that can improve the quality of life for those who suffer from autism spectrum disorders.
Dr Karl Kruszelnicki's Great Moments in Science

Ice Age Myth

Weather is the stuff that happens in the atmosphere over a short period of time. It includes changes in how much energy the Sun throws at us, the humidity, the temperature, the wind, the air pressure and the precipitation (rain, snow or hail – how often and how powerful).

Climate is like weather, but over a long period of time. Even with all the information given to us about climate change, most of us don’t realise that the average climate on our planet while the human race has been evolving, is the ice age.

So here’s some stuff for you to think about.

Firstly, we humans have been here for a few million years – evolving from Homo habilis (beginning about 2.5 million years ago) to Homo erectus (about 2 million years ago) and then to us Homo sapiens (a few hundred thousand years ago). Between 300,000-400,000 years ago, the human brain began expanding rapidly, and seems to have stabilised at its present size of around 1,200 mL about 50,000 years ago.

Secondly, what is an ice age? It’s any long period of time during which thick sheets of ice cover huge areas of land. Ice ages seem to come in bursts about 150 million years apart – beginning about 570 million years ago. During an ice age the ice is about one kilometre thick over land masses like North America and Europe, with massive glaciers over other areas. The water to make this ice has to come from somewhere – and that source is the ocean. So during an ice age, the ocean level drops some 100-120 metres. As a result, during the last ice age, it was possible to walk from Tasmania across to mainland Australia and on to New Guinea. Of course, with these lower ocean levels, the size of the continents was much greater.

Thirdly, the last series of ice ages seem to have begun about 3 million years ago. From 3 million to 1 million years ago, the ice ages seemed to come and go every 41,000 years or so. But for the last million years, the pattern shifted to the ice age lasting for about 80,000-100,000 years, followed by a nonice age that lasted about 20,000 years, then another 80,000-100,000-year ice age, and so on. The non-ice age period is called an ‘interglacial’, meaning the time between the glaciers. So over the last million years, we've had about ten ice ages, and ten interglacials, or non-ice ages.

So for 80% of the time that we Homo sapiens have ranged across the globe, the normal state of climate on our planet has been the ice age.

Fourthly, what caused ice ages? We’re not really sure, but one theory says that the amount of sunlight energy that falls on the planet depends on various factors related to the spin of the Earth, and its orbit around the Sun. These include how the Earth’s orbit changes from almost circular to slightly egg-shaped (a 100,000 year cycle), the angle at which the North-South spin axis of the Earth varies from the vertical (a 41,000 year cycle) and finally, how the North-South spin axis of the Earth lurches around like a giant slow motion top (a 23,000 year cycle). The other theory relates to carbon dioxide levels in the atmosphere. Almost certainly, the two theories are both correct, and relate to each other in ways we don’t yet fully understand.

As an example of how complex the ice ages are, the interglacials (the short periods between the ice ages) over the last million years are not all identical. For example, the last interglacial was a lot warmer. About 126,000 years ago, the oceans were about three to four metres higher, and warmer. We know this because there were coral reefs south of Perth.

At the moment, we are roughly 18,000 years into the current warm interglacial. But for the 80,000 or so years before that, our ancestors lived in a much colder world, with vast areas covered by ice.

And for 80% of the time that we humans have been the big-brained Homo sapiens, the normal state of climate on our planet is the ice age – not the current warm interglacial that we are so used to, that we now mistakenly think of it as normal.

But all of this is no reason to be complacent about the more urgent effects of climate change caused by human-generated greenhouse gases. We’ll have to wait until hell freezes over, before we can take our climate for granted again.
Gifted & Talented Program opens up the possibilities of Science

The Gifted & Talented Discovery Program once again saw an increase in participation with over 1,300 exams ordered in 2006. The top 15% were invited to attend the workshops, of which 105 students took up the opportunity. 30 of these students attended both the April and July workshops.

The April workshop began with some interactive chemistry demonstrations with students freezing things in liquid nitrogen and looking at the activity of metals. Physics took a closer look at mechanics. Newton’s first law involved collisions with stacks of weight, whilst looking at conservation of energy required the use of the ‘Pendulum of Death’. Physics also went a little astro with an interesting talk by one of Physics’ Federation Fellows, Professor Bryan Gaensler, on Magnetars.

Biology took a turn with students walking into a practical where they designed a robot to catch ocean creatures underwater for their Exploring the Ocean with Robots practical. The students ended the day by riffling through leaf litter and finding all sorts of animals lurking around.

The July workshop started with a bang in Chemistry. Students made soap and esters, and performed thin layer chromatography of smarties amongst other things. Physics got heavily involved in chaos – Chaos theory, that is. Half the time was spent in computer simulations whilst the other half was spent playing with some very cool equipment, some of which was hair-raising, literally! Biology got down and dirty by starting with cuttlefish dissections. Once again, a number of girls found fish inside their cuttlefish!

One of the programs greatest achievements is that in 2007 alone, the workshop altered almost 50% of the student’s perceptions of science. In addition to this, 80.3% are considering studying at least one science subject in their HSC, with many of these students considering studying more than one science subject. One student said, “It showed me how interesting science really is and has opened my mind to the opportunities of studying science.”

The program is open to students up to year 10 in 2008. If you’re interested in being a part of the 2008 Gifted & Talented Discovery Program, exam registrations for schools open soon.

For more information and to register your school for the 2008 program visit: www.science.usyd.edu.au/school/gifted