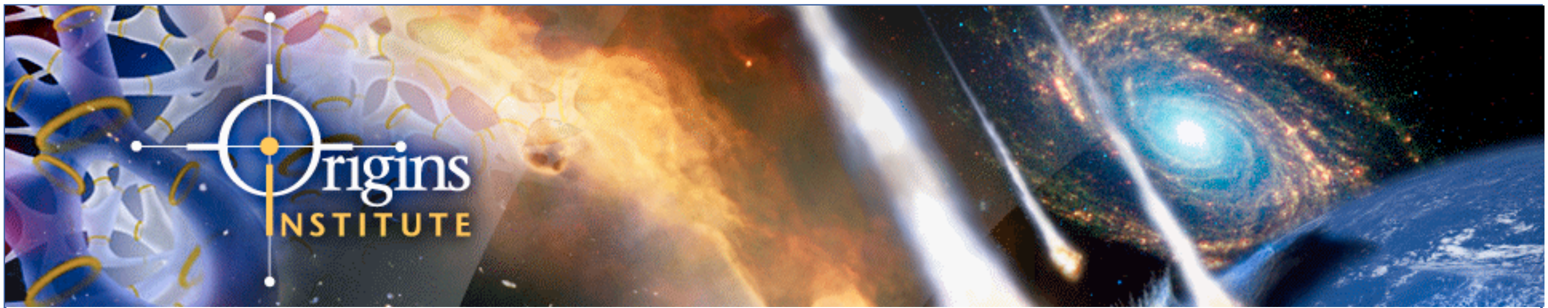

A word from our director, Ralph Pudritz

Welcome everyone in our Origins Institute "family" to our first Newsletter – prepared by our Astrophysics postdoc Elizabeth Tasker. This has been an eventful year in the life of the institute with the growth of our research programs in Astrobiology, the success of our public lecture series and the large audiences that it attracts, our many visiting scientists and our exciting colloquium series, the contributions of our newly formed Origins Institute Undergraduate Society, the work of our two postdocs – the list goes on! The New Year will see a number of new initiatives such as the launch of the McMaster 3D Theatre for regular shows, as well as the approval of a new collaborative graduate program in Astrobiology. We value and look forward to your continued participation in our various programs. Best wishes for a wonderful Holiday / Christmas, and a fruitful and enjoyable New Year.

From the public lecture series:

ON COMPLETING THE COPERNICAN REVOLUTION

Dimitar Sasselov, from the Havard-Smithsonian Center for Astrophysics, described the current search for habitable worlds outside our solar system and the problems with identifying alien life.

Where in the galaxy might there be life and what will it look like? These are the questions tackled by Astrobiologists as they explore the Universe for evidence that we are not alone. Based on the current 500 planets already discovered, there might be as many as 100 million habitable planets in our galaxy. Do we expect them to be like the Earth? Professor Sasselov explained that this is not necessarily the case. It turns that when it comes to habitable worlds; size matters. Too small a planet, and it might not have enough gravity to retain its atmosphere or, like Mars, it could cool too quickly and become geochemically inactive, which might make life less likely. On the other hand, large planets can have too much hydrogen which dilutes the necessary surface chemistry. The Earth turns out to be at the smaller end for a habitable planet, leading scientists to search for so called 'super-Earths' which are larger than our own planet, but smaller than the giant planets such as Jupiter.

Currently searching the skies for these worlds is Kepler, a NASA space observatory that was launched last year. Kepler is monitoring 150,000 stars for Earth-like plants. If such a planet crosses in front of the star, it will cause a tiny dip in its brightness that Kepler can detect. From this, Kepler can estimate both the planet's mass and its radius, allowing scientists to calculate its density. The density of a planet tells us whether it is a rocky world like the Earth or a water-world where up to 75% of the planet's mass is water or ice.

Once a possibly habitable planet has been identified, Astrobiologists are faced with the next big question; how do we know if it has life? This comes down to the philosophical sounding query "what is life?" Biologists know a huge amount about it, but how can we define it so we could recognise its signatures on another world? Despite its incredible diversity, life on Earth is made up of a very limited set of molecules. Whether this biochemical root would be shared by an extra-terrestrial system or if it is possible to form life from an entirely different combination of elements is a subject of intense research (see also the 'World Perspective' section of this newsletter!).

By describing searches for a life form so fundamentally different from us that it does not even share the elements we are formed from, on a world across the galaxy that is completely different from Earth, Professor Sasselov gave us a whole new perspective on the term 'alien'.

DID YOU MISS US?
Check our website:
http://origins.mcmaster.ca
for our next public lecture
or visit our facebook page!

LOVE, SEX & BRAIN EVOLUTION

David Linden, from John Hopkins University School of Medicine, Neuroscience explains why humans tend to be monogamous and why your cat is appalled by human intercourse.

Your cat, Professor Linden told the packed auditorium, is completely disgusted by even the most conventional human sex. For a start, it mainly occurs outside the female's fertility cycle. It also tends to be monogamous, private and the male stays around to assist with the upbringing of any resulting off-spring. None of this appears to make sense for the purposes of gene propagation, so why do humans -- independent of their culture or country -- do it?

The answer, Professor Linden explained, is because your brain is designed like an ice cream cone and that neurones are actually terrible information processors. The first is a product of evolution. Over time, the human brain has adapted by adding systems onto existing ones like scoops on an ice cream cone. This has left us with a much bigger brain than would be necessary if you designed it from scratch for the modern human, with multiple systems acting in parallel. A fascinating experiment was performed with people who were blind due to damage to their visual cortex, caused by an event such as an injury to the head. They were asked to insert a letter into a slot at a particular angle. Despite being unable to see the slot, a statistically significant percentage of patients were able to correctly orientate the letter to insert it. This was due to the presence of an ancient sight system that we share with animals all the way down to lizards. It is this that makes you duck if you are about to be hit and produces other reflexes that act faster than your conscious mind can respond. To add to the problems of this bulky system, the neurons that transmit information throughout your body are surprisingly inefficient, being slow, not consistently responsive and leaking information to neighbouring transmitters. To compensate for this, we have a massively interconnected system, with 200 billion neurons. The combination of this with our ice cream cone designed brain gives humans huge heads.

To lay down a wiring diagram for such a massive brain turns out not to be possible. Instead, the brain has only a rough map of connections at birth and gains the rest through experience. This results in incredibly long childhoods, since the brain does not finish the process until we are 20 years old! It is therefore a great advantage to have a two parents home, leading to monogamous relationships and romantic love.

In short, Professor Linden concluded, we love because of the body we live in.

Spotlight on research:

Origins postdoc, Eric Collins, tells us about his research into life in some of the most extreme environments on Earth.

I am very interested in how microbes adapt to survive in extreme environments, such as those found within Arctic sea ice or rocks from the Atacama desert. Thanks to complete genome sequencing , which tells you the exact order of every component in the microbe's DNA, we know that many of these microbes can acquire genetic material from their neighbour or environment, rather than just through inheritance from an ancestor. This is known as "horizontal gene transfer" and is like getting your brown hair from your mother, but your green eyes from the girl living down the street. The microbes can gain and lose these genes very quickly as they evolve and reproduce, allowing them to 'choose' the best genes to suit their habitat. With Professor Paul Higgs, I am working on creating a mathematical model of the gene evolution in these microbes to study the processes that take place in horizontal gene transfer.

World perspective:

IT'S LIFE JIM, BUT 5/6TH HOW WE KNOW IT

Lake Mono in California might be considered one of the most inhospitable places on the Earth's surface. More alkaline that baking soda, with a salt content twice that of sea water and a high concentration of the deadly poison, arsenic, this is not the place you might think to search for life. But this extreme environment is home to a bacterium that could revolutionise what we know about life, both here and on other planets.

All known forms of life, from humans to the bacteria in your kitchen sink, are composed of six major elements; carbon, hydrogen, nitrogen, oxygen, sulphur and phosphorus, with trace other ingredients as icing to the biological cake. Until a press release from NASA last month, there was no evidence that life didn't require these elements to exist. This meant that searches for life on other worlds has focussed on detecting these six elements. Yet, this microbe discovered in Lake Mono seems to use not phosphorus, but arsenic in its DNA. Should this prove to be true, Astrobiologists are going to have rethink what they need to detect as a blue-print for life or if maybe life is so adaptable, that no such blue-print exists at all.

Lake Mono, Photo by Richard E. Ellis http://yosemitephotos.net/

HAVE SOMETHING TO SAY?
Email us at origins@mcmaster.ca or write to us at the address below!