

Why Study Astronomy?

It is a dark night, just like every other. The outside lights have gone out and just as you like to do, you've turned out your room lights so you can peer at the total darkness outside through the Perspex dome of your living quarters. There's not a glimpse of the shapes and colours of the day-time clouds. You love to let your imagination wander as you drift off to sleep in the dark. Anyone living on a permanently cloud covered world, such a Venus or Titan, would not in a million years conceive that if those clouds parted at night they would see points of light in the sky, or moons and planets within their own solar system. If by chance you were a sentient lifeform living in an ocean tens of kilometres below the surface of your world – such oceans certainly exist - you would have no clue about the universe at large. We are extraordinarily lucky to be able to see the stars.

It is easy to imagine a technological civilisation on Earth, even, where mankind would all be living in artificial quarters that gave no view of the stars. The stars may be pin-pricks of light but we would be missing a lot. We now know that what we are made of comes from the stars. Not just us and all living organisms but the very Earth itself, the moons and planets of the solar system and the Sun itself. Most of the elements we are made of were created in distant space, inside earlier stars long-since exploded and dead. Studying stars is indeed studying other suns but it's also studying what we are part of and how we fit into the Universe as a whole.

This little piece is mostly extracted from the course introductory notes but may be of interest to others not on our course. Astronomy has a special place in science and you can read below a score reasons why this is so. You may think of others. They are not in order of importance, which is for your own judgement.

- The world we live in is stunning in its beauty, its variety and its depth of organisation. Most of us are **eager to learn about the whole world** we live in. Our interest does not stop at our local ecology or the events of our current decade. Astronomy sets all other science (and much of our culture) in a universal context. I suspect that many people go to their grave without ever pondering what the great universe beyond the Earth is like and others may ponder but not trouble to find out what we really know. Hopefully if you've started to read this you won't be amongst them.
- **Modern astronomy is an exhilarating science.** It is truly international, with global collaboration the everyday mode of working; billions of dollars spent on it annually; technology representing the frontiers of modern development; fresh results materialising by the week; a tradition of rapid, world-wide distribution of results; tremendous effort placed on making new findings intelligible to the non specialist. As an advertisement for science, it is hard to beat. In the first year astronomy course you will probably hear and see more modern scientific results than most final Honours courses deliver.
- Astronomy is an **excellent subject to learn how science works**. Data is hard to come by and the skill of deduction has to be honed to the highest. Astronomy is old enough to illustrate how science matures and is self-correcting. Astronomy teaches valuable lessons to any aspiring scientist. Even more widely, the international Office of Astronomy for Development (OAD) established in 2011 has offices in several continents. It is dedicated to promoting projects that relate society and local culture to the working of science, though the example of astronomy.
- **The science in Astronomy is truly universal** and not special to a small discipline. The results introduced and the skills required to appreciate the deductions are common to much of physical science. Good, transferable, scientific ideas and methods are learnt in an astronomy course, almost painlessly.

- **Astronomy has shaped mankind's view of the Universe.** If the Earth had been enveloped in permanent cloud, our view of the Universe would have been extremely parochial. From the earliest times, the pageant of the heavens has aroused our curiosity and stimulated our interest, our sense of awe and our desire for discovery. Do you want to study science as if the Earth were enveloped in clouds?
- Many people do not appreciate **the seminal influence of astronomy on society.** Heavenly bodies have directly affected our agricultural life, our tidal shorelines, our time-keeping and calendars, our seafaring and navigation, our current climate and long-term climate change, our scientific and technical life, our religious and philosophical life.
- **All of humanity shares the same sky;** understanding what's in it is a quest we share with everyone on Earth. There is, and has been in times past, a huge range of cultures on Earth, with widely different environmental surroundings, social customs, political systems and religious beliefs yet everyone on Earth who looks up at the starlit sky is looking at the same sky. You can truly say to anyone that my astronomy is your astronomy.
- **Astronomy is the science that has been most intimately connected with civilisation and culture** since records began. It is therefore the science that is accessible to the widest of all audiences.
- The picture of the Universe revealed by modern astronomy should be **an essential ingredient in a modern education.** The colossal size of the Universe, its immense age, the uniform nature of its constituents and processes all provide a context for the place of mankind in the scheme of things. On a more local scale, our knowledge of the solar system has increased phenomenally in the past half century, providing a valid context for environmental science that previous generations have never had.
- Astronomy more than almost any other discipline **opens one's mind** to think the unthinkable and experience the limits of nature. It was the great biologist Thomas Huxley who said that astronomy is the science "*which of all sciences has filled mans' minds with general ideas of a character most foreign to their daily experience*", and that was when astronomical knowledge covered a fraction of its present scope.
- Life has established itself on Earth in virtually every accessible place, in an enormous range of environments. Modern science indicates that life began on Earth comparatively soon after the Earth was formed. Life is composed almost entirely of the four most common chemically active atomic species in the universe, H, C, N and O, along with phosphorus, P and sulphur, S. CHNOPS are the 6 atomic species associated with life. Yet biological science still seems to be taught as if it is concerned only with what happens on Earth. Modern astronomy is slowly strengthening the view that biology is likely to be a common phenomenon in the Universe. **It is time for the next generation of biologists to have some knowledge of astronomy.**
- If the previous paragraph sounds like a 'head in the clouds' biology, then I'd go further and say that it's time the biologists put their heads above the clouds and looked at the rest of the solar system, at the very least. **Can life that is radically different from life on Earth develop in alien environments,** not fantasies dreamt up by science fiction writers but environments that really exist? Think of the cold, oxygen free, atmosphere of Saturn's moon Titan, or the sulphuric acid laden clouds of Venus. No use looking for the biology we know about in these places but what about something radically different? What can the subject of astrobiology tell us? In truth, not a huge amount at the moment because people are just beginning to realise that there are serious questions here needing serious, complex and fascinating answers.
- To re-enforce the previous conclusion, it is worth realising that life began on Earth when the Earth was quite unlike its present state. In fact life on Earth as we now recognise most of it could not have existed on the early Earth. Hence, **it is already completely established that**

life can exist in environments that are quite unlike those found over most of the Earth today.

- **The public at large want to know about the origin of life.** Although microbiologists are spending increasing amounts of time on this question the answer is not going to come from a microbiology lab. The answer will come from the broad interdisciplinary subject of astrobiology, for the question of the origin of life involves astronomy and the universe at large.
- It is not just biologists of the future who should be taking an interest in astronomy. The Earth has an astronomical origin. It has existed for about a third of the life of the Universe as a whole and needs to be seen in a cosmological context. Geologists have been guilty of treating the evolution of the rocky Earth with scarcely a glance up to the sky. Where has all the water come from? Why are heavy elements found near the surface when one might have expected them to have sunk into the core? The rocky structure of the Earth is as an eggshell sitting on the fluid mantle beneath. Geologists are now realising that major historic incidents of volcanism may have been triggered by meteoric impact. **Geologists need to see the Earth as part of the solar system, and the universe at large.**
- The days are long past when astronomy was the preserve of those who liked to pass solitary nights wrapped in a warm cloak observing the Universe through a telescope. Planetary astronomy is now a cutting edge subject occupied by academic geologists, meteorologists, technologists and biologists. Space science is an international multi-billion commercial industry. **Astronomy is everyman's science in the 21st century.**
- Taking up the last point, **astronomy and space science drive innovation** at a pace matched by few other multi-national activities. Economists, Engineers and Technologists can't afford to treat astronomy as a luxury of minority interest. It is a key activity in developing high-technology manufacturing capability of national importance, expertise in professional data handling and managing large, tight, multi-national programs.
- The Earth was formed about four-and-a-half billion years ago, as astronomy and geology tell us, but it was not simply formed and left on its own to evolve. It is becoming increasingly clear that **the dynamics of the solar system**, from orbital sizes and shapes to meteorite impacts, **has shaped life on Earth**. Educated people should know the basic dynamics involved.
- The Earth has provided an environment that has been ‘just right’ for the evolution of life for a few billion years. Is the stability of this environment guaranteed whatever we do, or can it go horribly wrong? **The study of other planets is essential knowledge** for answering this question. As an example, James Lovelock’s insight that the Earth has many environmental feedback loops, the net result of which determine the environment that all life occupies on Earth, came from his reflections on how possible life on Mars would affect the Martian atmosphere.
- Nowadays many people measure the value of a university education by the training it gives for a future job. This is a rather narrow view. For most people life is much more than their job. For many in Western Europe their job occupies 35 out of the 168 hours in a week. By mid-century that is likely to seem a lot as various aspects of digital technology and robotics kick in. **University should be a training for life**, not just a job, and a life well-lived includes a wide variety of interests. An interest in Astronomy and the universe at large will enrich many future lives.
- As mankind exploits the Earth, there is perhaps a tendency to think that seven billion people on this globe can't be wrong. The perspective that our solar system is but ‘a speck of dust in the cathedral of the Universe’, to quote another astronomer, tends to make those with this knowledge **better world citizens**. We have to take responsibility for our own actions, and far from being the end of the Universe if we don't, it is worth realising that it won't make a jot of difference to the Universe.

- *Heaven/ Is as the book of God before thee set/ Wherein to read his wond'rous works*, as the poet Milton said a long time ago. You or I mightn't use the same religious imagery these days but the sentiment is still the same.
- Rachel Carson developed this point when she said *The more clearly we can focus our attention on the wonders and realities of the universe about us, the less taste we shall have for the destruction of our race*. She was campaigning for environmental responsibility at a time when few were and saw that 'environment' embraced all of nature.
- Finally, to return to the excitement that is modern astronomy, a good case can be made that **this is a golden age for astronomy**. This golden age has been achieved by the huge advances made by space probes visiting much of the solar system, by opening up the whole of the electromagnetic spectrum to observation now that measurements can be made outside the atmosphere, and by the application of modern technology to produce a generation of Earth-based telescopes with performances that are factors of ten better than their predecessors. As a result, we are witnessing a blossoming of knowledge, understanding and insight that is profoundly changing our perceptions of the Universe.

Enough? You could debate some of these points but my personal view is that for someone who has the skills and good fortune to have a healthy life, integrated into society, there is no knowledge more valuable than an appreciation of the Universe in which we find ourselves. If you go to your deathbed without such knowledge, then you have missed out on part of the human experience. It will be a life less fulfilled than it should be. The author T. H. White, perhaps depressed by the Second World War, wrote '*Man seldom looks above his own height after adolescence*'. He may have been speaking metaphorically but make sure this comment doesn't apply to you, literally or otherwise. In my list of '100 things to do before you die' then learning something about modern astronomy is right up there close to the top. It's a personal view but it's no bad thing that your lecturer on Astronomy feels strongly about the worth of the subject. I think that the student who takes the astronomy course will be a better scientist because of it, whatever their Honours Degree.

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