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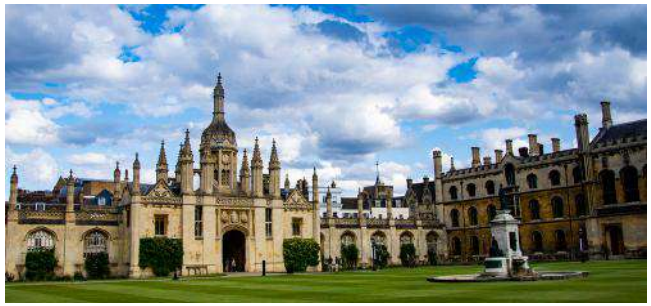

Biology

SYLLABUS OVERVIEW
16-18 YEARS OLDS

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About Immerse

Immerse Education is an award-winning academic summer school provider offering programmes for 16-18 year olds in centres of academic prestige.

The aim of these programmes is to provide participants with academically challenging content that develops their understanding of and passion for their chosen discipline. Through 40 hours of academic sessions, the programmes also offer young students unique and valuable insights into what it would be like to study their chosen subject at university.

This Syllabus Overview provides a summary of the topics and subject areas that participants can encounter during their studies with Immerse. It has been carefully created by our expert tutors who are current members of world-leading universities, and who have experience in teaching undergraduate students.

Academic Sessions

The academic sessions at Immerse are arranged into modules to enable participants to explore a broad range of topics over the course of two weeks. The modules included in this syllabus overview are indicative but not prescriptive.

Tutors are encouraged to include their own specialisms and also focus on any particular areas of interest expressed by participants within the class. They may choose to provide further detail on a specific topic, or they may include new material and information that builds on the knowledge already developed during the programme.

Personal Project

Each programme includes an element of individual work, generally termed the 'Personal Project'. This can take many forms but is commonly an essay or presentation delivered on the final day of the programme. Participants will receive feedback on this work which may also be mentioned in the participant evaluation which is provided in writing by the tutor once the programmes have ended.

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Preparatory work

Some tutors may ask participants to complete some preparatory work, such as reading or a series of exercises in advance of the programme. Participants are strongly encouraged to complete this work since it will be included in the opening sessions of the programme. Any preparatory tasks will be provided in advance of the programme directly to the participant.

Academic Difficulty

As all of our programmes are designed to provide a unique introduction to advanced material, the syllabus will be academically challenging at times.

This is something to be excited about and all of our tutors will encourage and support participants throughout the programme. Immerse Education aims to develop every participant regardless of ability, and our tutors will adapt their teaching to individual needs.

Aim of the Biology Programme

The Immerse Education Biology programme is designed to build upon the foundation of knowledge that participants have already gained in a traditional classroom environment and highlight how this can be used to inspire further study at university. Participants are encouraged to explore new material in-depth and to form independent and considered opinions and ideas based on sound academic knowledge and research. By the end of the programme, participants will have a good understanding, not only of university-level content, but also the variety of degree programmes available in subjects related to biological sciences. Beyond this, participants will also explore the career opportunities available to graduates in this field.

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What is Life?

This introductory session begins with a discussion about what constitutes life and how biologists have attempted to define life. Participants consider some of the ideas of how life is thought to have originated and briefly examine the RNA world hypothesis and its problems. After considering the variety of life, participants will explore how it is classified into a hierarchy of taxa, ending with a brief discussion of the two basic types of cells. By the end of this session participants are able to discuss the essential differences between prokaryotic and eukaryotic cells.

Macromolecules of Life

This session explores some key biological macromolecules and examines their role in living systems. Participants learn about the structure of biological membranes by consideration of lipid molecules (phospholipids and cholesterol) and introduce the idea of the membrane being a dynamic structure rather than a passive boundary between intracellular and extracellular compartments. This necessarily requires the introduction of concepts of membrane transport, cell signalling and cell-cell recognition. Participants explore the importance of proteins, carbohydrates and nucleic acids in biology and briefly discuss how these polymeric structures are constructed from simpler components.

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Cells: Structures

This session begins with the consideration of some early pioneers of microscopy, namely Hooke and Leeuwenhoek, and the subsequent development of the Cell Theory. Participants are reminded of the two fundamental cell types (prokaryotic and eukaryotic) and then review some of their key differences. Participants also examine the role and functions of various cell organelles in a eukaryotic cell. But how does one look inside a cell? Participants explore microscopy techniques which are currently available to allow us to see cells in more detail, covering the basics of light microscopy all the way to electron microscopy.

Is there Life in the Universe?

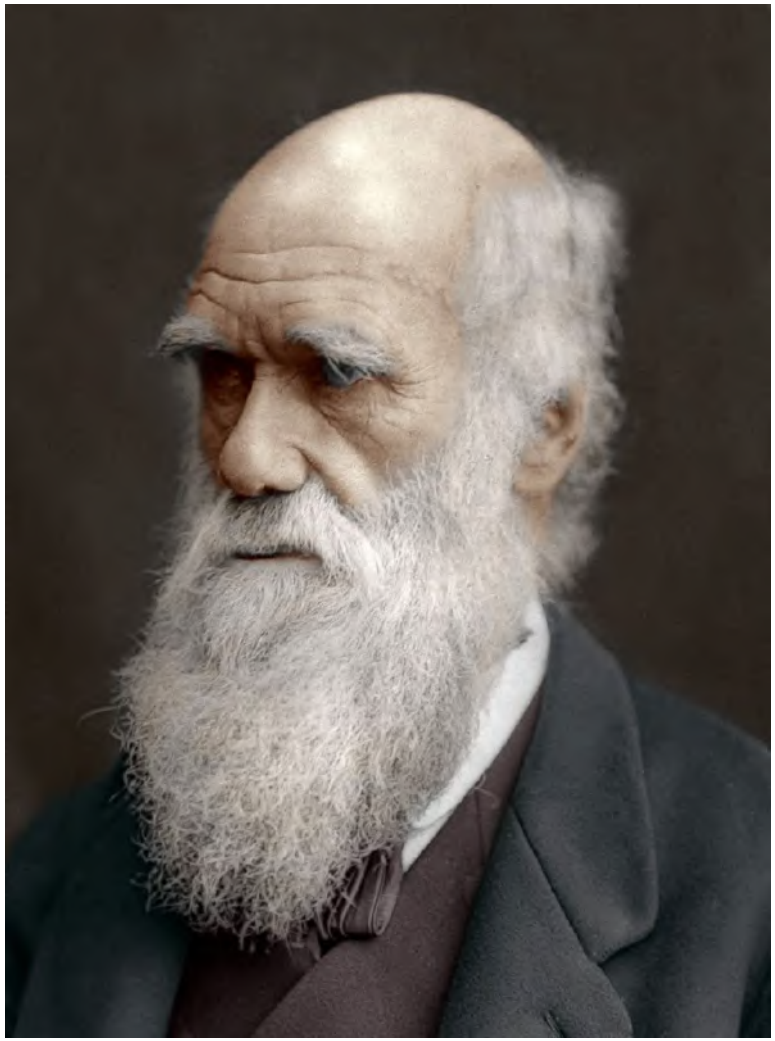
This session will be an examination of the probability of life elsewhere in the universe, making the distinction between intelligent life and life as molecular complexes able to replicate and make use of energy either of stellar origin or other available molecules. We will discuss how difficult the origin of life on earth would have been and look at some experimental evidence (Miller-Urey experiment) suggesting how it could have arisen. The significance of the Drake equation will be mentioned and the contributions of Carl Sagan and his designs to communicate with potential extraterrestrial intelligence.

DNA & RNA

This session begins by looking into the experimental evidence that established DNA as genetic material and goes on to explore some of the key structural features of DNA. Participants then discuss the double helical structure of DNA and the importance of complementary base-pairing. Students learn about the universality of semiconservative replication. The class is then introduced to the concepts of DNA replication and learns about some of the proteins involved in DNA replication. The central dogma of biology is explained and participants must collaborate to describe how information encoded in DNA is transcribed and translated.

The -Omics Era

In 2001, the whole human genome was sequenced. Since then, the cost of DNA sequencing has dropped dramatically. Today, researchers not only sequence genomes, but they look at expressed genes sequencing RNA molecules and they can now look at single cell RNA content, if they wish to. Various techniques have been developed and they provide different and complementary information that help us understand how nucleic acid molecules and their products are able to define different cell functions or appearances. We will study some of the more broadly used techniques and understand how they work and what information they give us.



Cell Respiration

In this session students learn how cells transform food substrates into useful energy in the form of ATP. The class considers the body's fuel stores (carbohydrates, fats and proteins) and de novo cellular respiration. With specific reference to glucose, participants learn about the three stages of cellular respiration. The class is then presented with an overview of glycolysis, Krebs cycle and learns how electrons transport across protein complexes in the inner mitochondrial membrane, which results in ATP production. By the end of the session, participants are able to identify the difference between aerobic and anaerobic respiration and understand the importance of electron carriers (NAD+ and FAD) in this process.

Charles Darwin and the Theory of Evolution

In this session participants will explore in broad terms the theory of evolution as expounded by Charles Darwin and aim to understand the terms variation, competition, fitness (adaptations and exaptations) and selection. We will look at the sources of genetic variation with reference to mutations, genetic drift, gene flow and natural selection. We will discuss the emerging science of epigenetics – the study of heritable changes in the absence of changes in DNA sequence. We will also briefly discuss some works and views of Richard Dawkins, a leading evolutionary biologist.

Superbugs

Infectious diseases are caused by bacteria, viruses or parasites. In this session, participants look at three different examples and learn how three different kinds of pathogens spread and make us ill. Students will be able to understand why it is so important to watch out for meningitis symptoms, why Ebola is so difficult to fight and how some genetic conditions make us immune to malaria. Our knowledge on disease has widened, and we try to protect or treat ourselves with medications, one of those being antibiotics. Participants will consider why bacteria are becoming stronger to the point that they can survive antibiotic treatments.

Lab Visit

A visit to a laboratory is planned where participants will be shown around a typical laboratory and will be given the opportunity to talk to research workers and ask any questions about higher education or careers in the biomedical sciences. This is a key opportunity to consider biology outside of the classroom environment and as more than just a subject of academic study. Exploring the practicalities of a researcher in biological sciences further encourages participants to consider the field of biology at large and to reflect on the broad range of career opportunities that it affords.

Personal Project

Throughout the fortnight, participants will be working on their own personal project. Having been provided with a brief, participants should research and prepare a presentation for their peers. This will build upon an aspect of the theory that they have learnt over the course of the programme and is also an opportunity to showcase the academic research skills they have developed. The presentation is followed by questions from the audience and wider class discussion of particular points of interest. The tutor may also include feedback about the presentation in the written evaluation which is sent to participants after the programme has ended.

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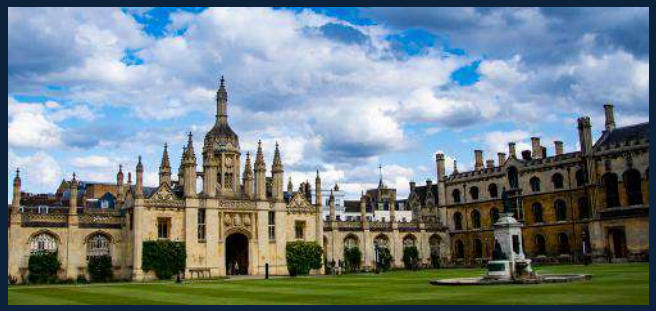

OUR AWARDS AND ACCREDITATIONS

THE QUEEN'S AWARDS FOR ENTERPRISE 2018

BAC ACCREDITED

COBIS SUPPORTING MEMBER | COUNCIL OF BRITISH INTERNATIONAL SCHOOLS

RoSPA Member

BETA British Educational Travel Association