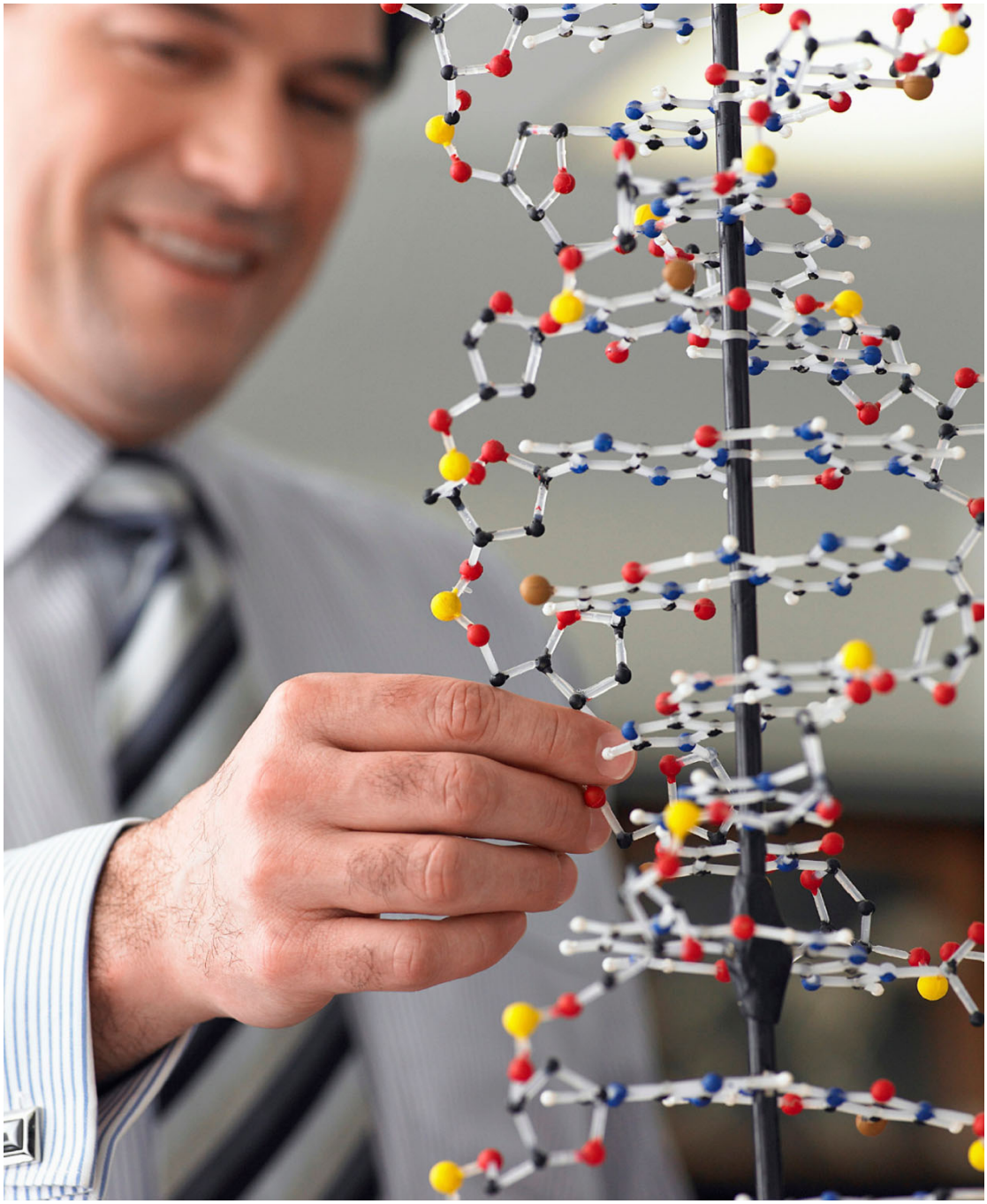
THE UNIVERSITY OF SYDNEY

Kickstart Biology

Year 11 and Year 12



Year 11 workshops

From 2019, we will be offering Kickstart Biology for Year 11 syllabus content. Building a strong foundation for students at this stage can encourage them to continue with their Biology studies.

These hands-on workshops will allow students to learn about photosynthesis and enzyme activity in a new and exciting way. With access to a wide range of instruments and resources from our modern teaching laboratories, Kickstart allows students to have a real university experience in biology.

1. Cell specialisation in plants: photosynthesis

This workshop investigates the structure and function of chloroplast and how plants convert light energy into chemical energy. Students will get the opportunity to extract chloroplasts from spinach leaves and examine these organelles under the light microscope. They will then determine whether their chloroplasts are functional using a spectrophotometer.

Students will perform the following hands-on activities:

- Extract chloroplasts from spinach leaves
- Examine chloroplasts under a light microscope
- Perform a functional assay to show that chloroplasts photosynthesis

Assumed Knowledge for this workshop: Module 1 – Cell Function

The syllabus points addressed in this workshop:

Module 1: Cells as the basis of life

CELL STRUCTURE

- Investigate different cellular structures, including but not limited to:
  - Examining a variety of prokaryotic and eukaryotic cells
  - Describe a range of technologies that are used to determine a cell's structure and function
- Investigate a variety of prokaryotic and eukaryotic cell structures, included by not limited to:
  - drawing scaled diagrams of a variety of cells

CELL FUNCTION

- investigate cell requirements, including but not limited to:
  - suitable forms of energy, including light energy and chemical energy in complex molecules
- investigate the biochemical process of photosynthesis

Module 2: Organisation of living things

ORGANISATION OF CELLS

- compare the differences between unicellular, colonial and multicellular organisms by:
  - relating structure of cells and cell specialisation to function

NUTRIENT AND GAS REQUIREMENTS

- investigate the function of structures in a plant, including but not limited to:
  - tracing the development and movement of the products of photosynthesis

2. Modeling the action of enzymes

This workshop investigates the role of enzymes in chemical digestion and how nutrients are liberated from foods – namely carbohydrates. Students will learn about the role of amylase in the breakdown of starch and how different environmental conditions will affect the activity of amylase using a spectrophotometer.

Students will perform the following hands-on activities:

- Learn how to use a micropipette
- Determine the optimal pH for amylase activity on starch using a spectrophotometer
- Calculate the rate of activity for amylase

Assumed Knowledge for this workshop: Module 1 – Cell Function

The syllabus points addressed in this workshop:

Module 1: Cells as the basis of life

CELL FUNCTION

- Conduct a practical investigation to model the action of enzymes in cells
- Investigate the effects of the environment on enzyme activity through the collection of primary or secondary data

Module 2: Organisation of living things

NUTRIENT AND GAS REQUIREMENTS

- Trace the digestion of foods in a mammalian digestive system, including
  - Physical digestion
  - Chemical digestion

Year 12 workshops

We will also offer **three** Year 12 Biology Kickstart workshops focusing on Heredity, Genetic Change and Antibiotic resistance.

These hands-on workshops will allow students to learn about these complex areas in an engaging and digestible format. Students will have access to a wide range of instruments and resources from our modern teaching laboratories and knowledgeable demonstrators. Kickstart allows students to have a real university experience in biology as these techniques are currently used in the undergraduate science courses.

1. Heredity: a case study of sickle cell anaemia

The *Heredity: a case study of sickle cell anaemia* workshop will be available from Term 4, 2018.

Workshop description

In this workshop, students will learn about an inherited disease – Sickle cell anaemia and its genetic cause (single-nucleotide polymorphisms).
Aligning with inquiry-based learning, students will investigate the genetic cause of sickle cell anaemia with a case study. Their job is to determine whether a child has inherited the disease and to discuss in small groups the steps and experiments that would be needed to answer this question.

Students will perform the following hands-on activities:

- DNA extraction
- Lego-based Polymerase Chain Reaction activity
- paper-based restriction enzyme digest
- Gel electrophoresis.

Assumed Knowledge for this workshop: At least an introduction to DNA, polypeptide synthesis and inheritance patterns (dominant, recessive and co-dominant).

The syllabus points addressed in this workshop are:

Module 5: Heredity

DNA AND POLYPEPTIDE SYNTHESIS

- Model the process of polypeptide synthesis including:
- Analyzing the function and important of polypeptide synthesis
- Assessing how genes and environment affect phenotypic expression

GENETIC VARIATION

- Conduct practical investigations to predict variations in the genotype of offspring by modellings meiosis, including the crossing over of homologous chromosomes, fertilization and mutations
- Model the formation of new combinations of genotypes produced during meiosis, including but not limited to:
- Interpreting examples of autosomal
- Constructing and interpreting information and data from pedigrees and Punnett squares
- Collect, record and present data to represent frequencies of characteristics in a population, in order to identify tends, patterns, relationships and limitations in data, for examples:
- Analysing single nucleotide polymorphisms (SNP)

INHERITANCE PATTERNS IN A POPULATION

- Investigate the use of technologies to determine inheritance patterns in a population using, for example:
- DNA sequencing and profiling

2. Genetic change: biotechnology and transgenic organisms

The *Genetic change* workshop will be available from Term 1, 2019.

Workshop description

In this workshop, students will learn about the importance of biotechnology in several aspects of our society including medicine, agriculture and industry.
Students will be given a quick introductory tutorial on genetic modification, bacterial transformation and research performed at the University of Sydney. They will then be given a scenario where their task is to increase the production of a useful protein using bacteria and plasmids. They will do a paper activity to learn the key principles involved followed by a protein purification of a fluorescent protein from genetically modified *Escherichia coli (E. coli)*. This will be followed by a quality check of the protein using a spectrophotometer.

Students will perform the following hands-on activities:

- Paper activity exploring gene splicing and plasmids
- Protein purification from transgenic bacteria
- Confirming protein quality using spectrophotometer

Assumed Knowledge for this workshop: Module 5 – Heredity. If the module is not yet learned, then at least knowledge of DNA and polypeptide synthesis.

The syllabus points addressed in this workshop are:

Module 6: Genetic change

BIOTECHNOLOGY

- Investigate the use and applications of biotechnology including:
- Analysing the social implications and ethical uses of biotechnology, including plant and animals' examples
- Evaluating the potential benefits for society of research using genetic technologies

GENETIC TECHNOLOGIES

- Investigate and assess the effectiveness of cloning, including but not limited to:
- Gene cloning
- Describe techniques and applications used in recombinant DNA technology, for examples:
- The development of transgenic organisms in agricultural and medical applications
- Evaluate the benefits of using genetic technologies in agricultural, medicinal and industrial applications

Depth study support

We can offer suggestions on how you can incorporate the above Year 12 workshops into a Depth Study on request. If this is something you and your students are interested in please let us know by emailing science.kickstart@sydney.edu.au .