

DNA Lab Programmes 2020



Best Enrichment Experience
DNA Learning Lab Programmes

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Our Parent Ministry



Ministry of Education
SINGAPORE



About the DNA Lab

Students and public can now engage in unravelling the secrets of life at the DNA Learning Lab at Science Centre Singapore. With a strong focus on STEM education, our workshops provide real world applications on various Science concepts. Students get to experience authentic learning by using the equipment and techniques used by Scientists in research labs. Many workshops are interdisciplinary, combining both social and ethical issues with science and technology.

Read what other teachers say about the programmes on page 23 and 24.

THE OBJECTIVES OF THE DNA LEARNING LAB ARE TO:

- Give our students a deeper understanding of life sciences topics and issues.
- Stimulate students' interest in taking up careers in the life sciences.
- Educate students to be more scientifically literate and later, as adults have more considered views about life science issues and concerns.

The DNA Learning Lab is one of the centres set up in 2003 as part of a collaboration between the Ministry of Education and Cold Spring Harbor Laboratory's Dolan DNA Learning Center in New York. It now operates independently.

Public programmes are updated on our Facebook page
- [DNA Learning Lab - Science Centre Singapore](#).



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These classes are only available through school bookings

PRIMARY SCHOOL PROGRAMMES (PRI 5 - PRI 6)

Primary school curriculum links

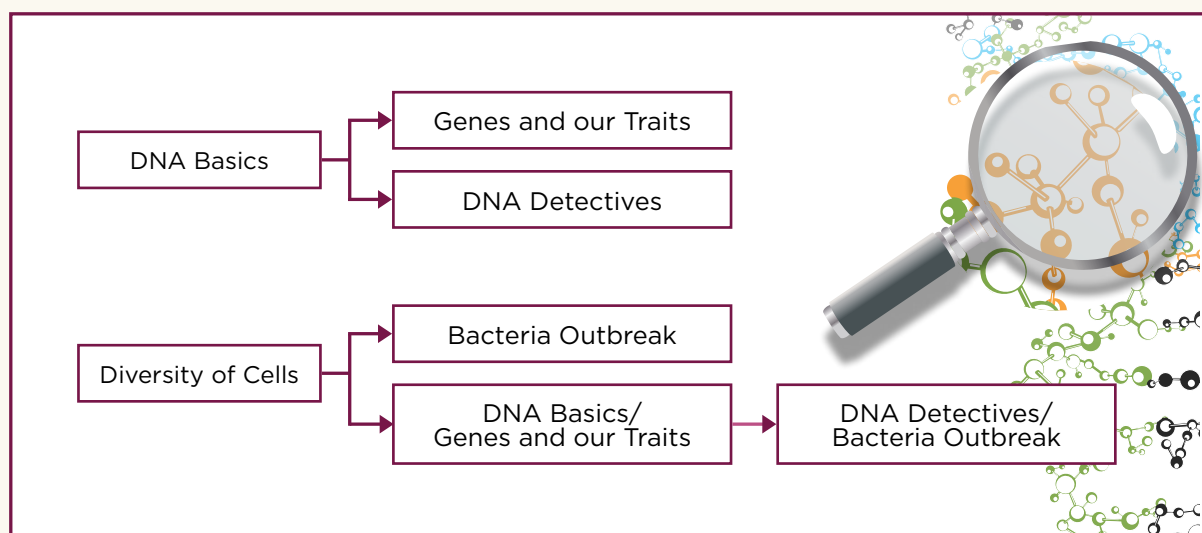
SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
Cycles	Classify living things into broad groups based on similarities and differences of common observable characteristics	Diversity of Cells
Energy	Understand how plants obtain energy to make food during photosynthesis	
Systems	Understand that a cell is a basic unit of life Compare plant and animal cells Identify animal and plant cell parts and relate to their function	
	Application of electrical circuits and current flow in DNA electrophoresis	DNA Detectives
Cycles	Understand inheritance - many characteristics of an organism are passed on from parents to offspring.	DNA Basics Genes and Our Traits
Interactions	Interaction of bacteria with the environment - growth conditions	Bacteria Outbreak
	Effect on organism when environment becomes unfavourable	Genes and Our Traits

Time : 9.30am (Session I) or 2.30pm (Session II)
Venue : Science Centre Singapore
Capacity : Minimum number - 20 students
(Unless otherwise stated) Maximum number - 40 students

*(Admission fee to Science Centre applies to non-member International school based in Singapore)

For a complete learning experience, we recommend your students to attend a series of workshops.

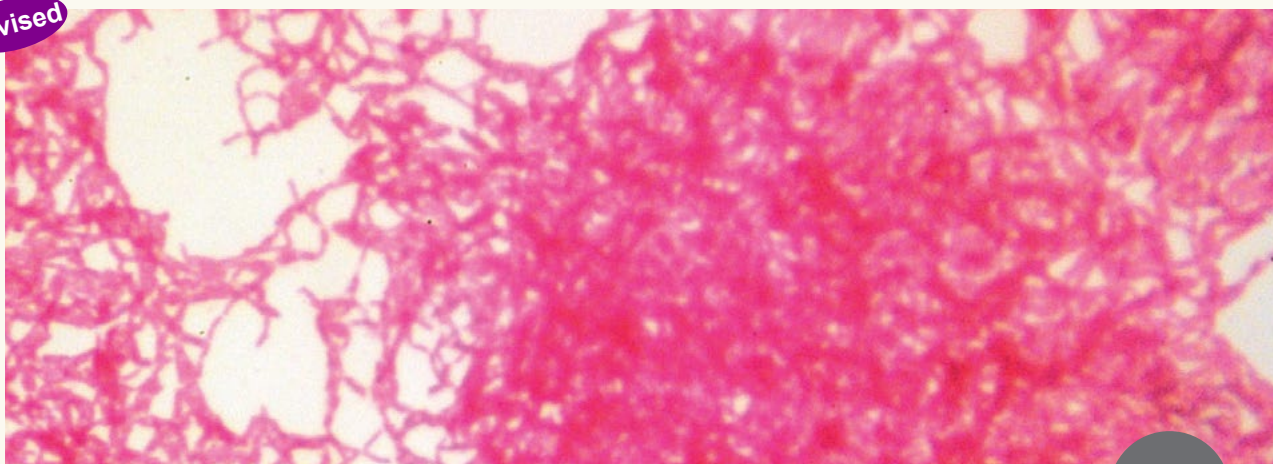
Here are suggested lessons that complement each other:



*(Admission fee to Science Centre Singapore applies to non-member International school based in Singapore)

Practical Lab Sessions

Revised



Diversity of Cells

***\$8.00** **2hrs**
(Inclusive of GST)

Earth is an amazing place with a whole variety of life forms and cells are the building blocks of these living things. Do you know that while a bacterium is made up of only one cell, a human being is made up of trillions of cells! Cells are so tiny that about 5000 of them can fit onto the head of a pin and each cell cannot be seen with the naked eye. However, in this lesson we will explore and observe these amazing cells through a microscope and appreciate their significance.

OBJECTIVES:

1. Understand what cells are and that there is a diversity of cells on earth.
2. Learn about classification of living things.
3. Compare a typical plant and animal cell.
4. Identify the different parts of a cell and relate the parts to the function.
5. Identify different parts of the compound microscope and know their functions.
6. Prepare sample slides using simple staining methods and view them under the microscope.
7. Understand the application of using microscope to identify microorganisms or cells.

This lesson comes with a pre-visit component. Please email dnalab@science.edu.sg once you have made your booking to access the pre-visit resources.



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DNA Basics

***\$7.00** **2hrs**
(Inclusive of GST)

Ever seen how DNA looks like? Why is DNA so important? Be a DNA scientist for the day and join us in this introductory lesson to learn the basics of DNA. See what DNA looks like in real life and make a 3D DNA model to bring home!

OBJECTIVES:

1. Understand the role of DNA in our lives.
2. Learn about the DNA structure and make a DNA model.
3. Conduct a simple DNA extraction from bacteria cells independently.

Revised



Genes and Our Traits

***\$8.00** **2hrs**
(Inclusive of GST)

Have you ever wondered why you look like your parents? Eye colour, gender and free or attached earlobes are examples of physical traits that are determined by our genes. How is it possible that one sibling has brown eyes, while the other sibling has blue eyes? To find out about this and more, join us as we observe our physical traits and learn how we inherit them from our parents!

OBJECTIVES:

1. Understand what physical traits are and how to identify them.
2. Understand the diversity of genetic traits and that every individual has a different genetic makeup.
3. Conduct a simple DNA extraction from wheat germ independently.
4. Learn about sex chromosomes and how they determine gender.
5. Understand that some traits are determined by the combination of genes from the father and mother.
6. Learn how DNA can give rise to traits that affect an individual's survival.



DNA Detectives

***\$8.00** **2hrs**
(Inclusive of GST)

A man has been convicted of brutally murdering his wife and children. However, he claims that he found them dead when he returned home. Which is the truth? Is he a cold-hearted murderer or an innocent man who lost his entire family? Could the police have arrested the wrong person? Take on the role of forensic investigators and join us to solve this real life case using various forensic tools!

OBJECTIVES:

1. Learn different types of forensic techniques.
2. Learn about the structure of DNA and its importance.
3. Learn micropipetting techniques.
4. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.
5. Learn how to interpret DNA analysis results and identify the possible criminal.



Bacteria Outbreak!

***\$7.00** **2hrs**
(Inclusive of GST)

A food poisoning outbreak has occurred and patients have been sent to the hospital with common symptoms and diarrhoea. Join us as we take on the role of an epidemiologist to identify the cause of the outbreak and the source. Can we stop the spread of the outbreak?

OBJECTIVES:

1. Understand what outbreaks are.
2. Learn the basic steps taken to investigate a case of food poisoning outbreak.
3. Understand the possible causes of food poisoning outbreaks and how to prevent them through proper hygiene.
4. Learn micropipetting techniques.
5. Learn the basic technique of growing bacteria.
6. Identify the basic shapes of bacteria.

These classes are only available through school bookings

SECONDARY PROGRAMMES (SEC 1 - SEC 2)

Lower secondary school curriculum links

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
The Scientific Endeavour	Use scientific inquiry skills such as posing questions, planning and carrying out investigations, evaluating experimental results and communicating findings	ABE: Developing Scientist's Mind
Models	<u>Model of Cells – the Basic Units of Life</u> Understand the function of the nucleus in the cell which contains genetic material that determines heredity	DNA and Life
Food Management	<u>Food and Kitchen Safety</u> - Food contamination due to improper handling - Awareness of hygienic practices when handling food	Bacteria and Health
Diversity	<u>Understanding Diversity of Living Things</u> Awareness that bacteria could have beneficial or harmful effects	
	<u>Exploring Diversity of Matter Using Separation Techniques</u> - Understand how constituents of a mixture can be separated based on their properties, using protein purification - Application of separation techniques in protein purification	AMGEN Biotech Experience
Systems	<u>Human Digestive System</u> - Application of enzymes in genetic engineering - Role of enzymes in digestion	DNA and life DNA in Forensic Science
	<u>Human Sexual Reproductive System</u> - Understand heredity - transfer of genetic information from one generation to another - Understand the union of the nuclei of an egg and a sperm forms a new individual - Understand a new individual formed through sexual reproduction receives a unique combination of genetic information from its mother and its father, resulting in variation between individuals.	
	<u>Electrical Systems</u> Application of electrical circuits and current flow in DNA electrophoresis	
Interactions	<u>Chemical changes</u> - Identify formation of new product as a result of chemical change - Awareness of different types of chemical reactions	

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SECONDARY PROGRAMMES (SEC 3 - SEC 5)

Upper secondary school curriculum links

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
Principles of Biology	<u>Exploring Diversity of Matter Using Separation Techniques</u> 'Lock and key' hypothesis and mode of action of enzymes - Effects of temperature and pH on the rate of enzyme - catalysed reactions	Amazing Enzymes
Maintenance and Regulation of Life Processes	<u>Nutrition in Humans</u> Functions of enzymes in digestion	
	<u>Transport in Humans</u> Role of red blood cells in oxygen transport and diseases (thalassemia and sickle cell anaemia)	Genetic Diseases
Continuity of Life	<u>Molecular Genetics</u> - Transfer of genes between bacteria cells - Understand how a gene that controls the production of human insulin can be inserted into bacterial DNA to produce human insulin in medical biotechnology - Social and ethical implications of genetic engineering	Bacteria Transformation AMGEN Biotech Experience
	<u>Molecular Genetics</u> - Relationship between DNA, genes and chromosomes - Structure of DNA and rule of complementary base pairing - Understand that DNA carries the genetic code used to synthesise proteins	Cracking the Code of Life Finding the Lost Princess Genetic Diseases
	<u>Inheritance</u> - Understand that a unit of inheritance is a gene and distinguish between gene and allele - Understand mutation as a change in the structure of a gene (sickle cell anaemia, Down syndrome)	DNA and Life
	<u>Inheritance</u> - Understand the terms dominant, recessive, codominant, homozygous, heterozygous, phenotype and genotype - Predict the results of simple crosses using genetic diagrams involving monohybrid inheritance - Inheritance of the ABO blood group phenotypes and the gene alleles - Determination of gender in humans - XX and XY chromosomes	Finding the Lost Princess Genetic Diseases DNA and Life

These classes are only available through school bookings

Time : 9.30am (Session I) or 2.30pm (Session II)
Venue : Science Centre Singapore
Capacity : Minimum number - 20 students
(Unless otherwise stated) Maximum number - 40 students

**(Admission fee to Science Centre applies to non-member International school based in Singapore)*

For a complete learning experience, we recommend your students to attend a series of workshops.

Here are suggested lessons that complement each other:

DNA and its application (in forensic science)

DNA and Life

DNA in Forensic Science / Finding the Lost Princess

DNA and its application (in diseases)

DNA and Life

Genetic Diseases / Finding the Lost Princess

DNA code

DNA and Life

Cracking the Code of Life

Body and health

Bacteria and Health

Genetic Diseases



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Interactive Lecture Demo

DNA: Cracking the Code of Life

Lecture Demo (Sec 3 to Sec 4/5 - Intermediate⁺)

***\$2.00**
(Inclusive of GST)

2hrs

Our DNA is a very long molecule which contains important information for all living things. How is this information decoded to give rise to our various traits? How does a seemingly tiny change in DNA results in significant life-changing impacts? Mysterious isn't it? Join us for this fun-filled lecture demo with games and activities to unravel the DNA code!

OBJECTIVES:

1. Understand the relationship between cells, chromosomes, DNA, genes and proteins.
2. Learn about the structure of DNA and its importance.
3. Learn how information in DNA is decoded to give rise to various traits through the process of transcription and translation.
4. Understand more about mutations and how they can affect life.

Capacity: **40** Students (minimum), **80** Students (maximum)



Practical Lab Sessions

DNA & Life

(Sec 1 to Sec 2 - Beginner⁺)

***\$7.00**
(Inclusive of GST)

2hrs

DNA is often described as the most important molecule of life which determines how living things look like and how they function. Ever wanted to see this extraordinary molecule? Join us in this lesson to view DNA without a microscope. At the same time, come and help us in an interesting case study to determine the baby's biological parents and solve a major family confusion!

OBJECTIVES:

1. Learn the structure of DNA and its importance.
2. Conduct a simple DNA extraction from bacteria and plant cells.
3. Learn the basics of blood typing and how DNA determines blood type of individuals.
4. Perform simple karyotyping, blood typing and DNA analysis to solve a case study.

DNA in Forensic Science

(Sec 1 to Sec 2 - Beginner*)

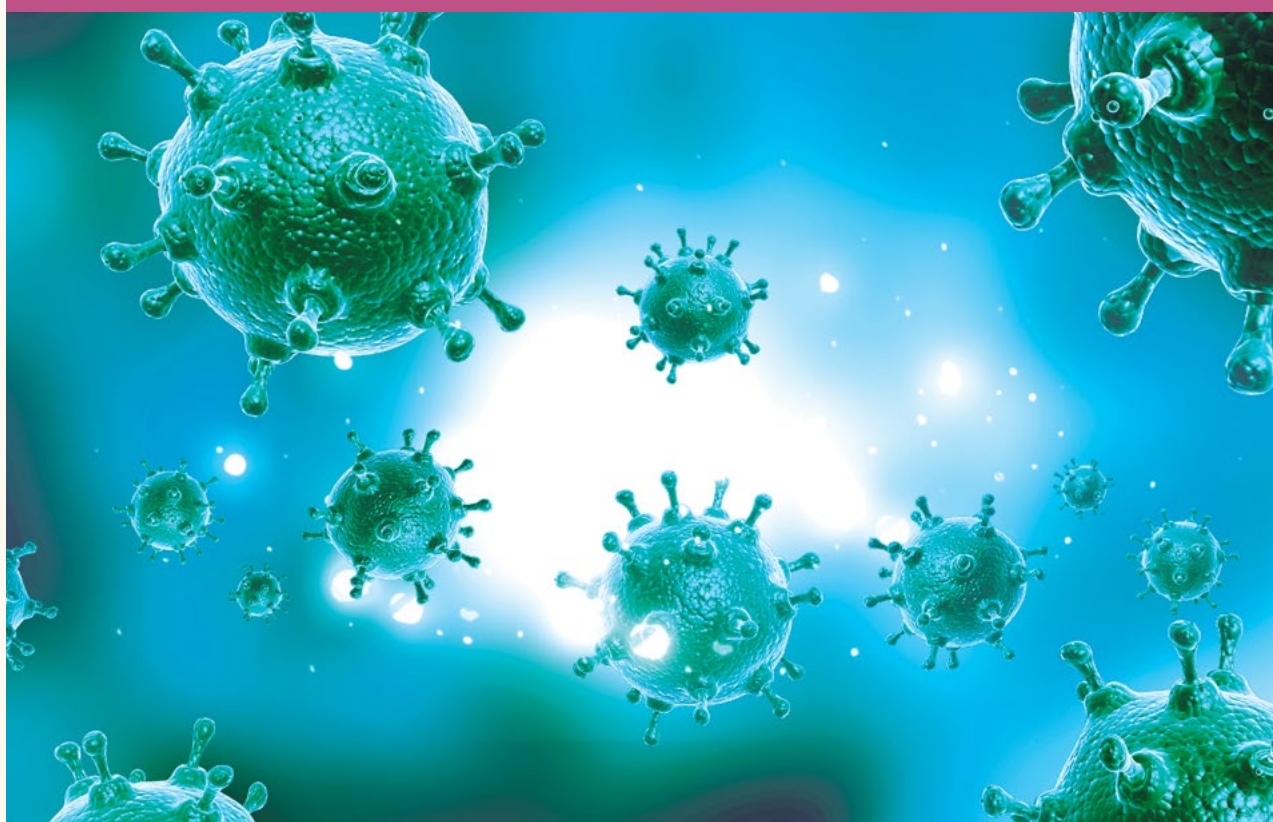
***\$8.00**
(Inclusive of GST)

2hrs

A trace is left in every crime scene but do they always lead to the right criminal? A double murder has been committed and a prime suspect has been identified. However, was he the one who committed the murders? Join us in this exciting roller coaster journey to uncover the truth of a real life story and learn how contradicting evidence can complicate a crime.

OBJECTIVES:

1. Learn different types of forensic techniques.
2. Learn about the structure of DNA and its importance.
3. Learn micropipetting techniques.
4. Learn the importance of preventing evidence cross-contamination.
5. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.
6. Learn how to interpret DNA analysis results and identify the possible criminal.



Bacteria and Health

(Sec 1 to Sec 2 - Beginner*)

***\$8.00**
(Inclusive of GST)

2hrs

Abdominal pain, nausea, diarrhoea and vomiting... more patients are turning up at the hospital with similar symptoms. Some patients have even lapsed into a coma upon infection. What is causing this outbreak? Based on a real life case study, follow in the footsteps of the investigators of a food poisoning outbreak that took social media by storm in 2015. Help us in this race against time to solve the outbreak before more people are infected!

OBJECTIVES:

1. Understand how bacteria can affect our lives in both positive and negative ways.
2. Identification of bacteria through its shapes and arrangements.
3. Learn micropipetting techniques.
4. Learn how to grow bacteria via plating.
5. Learn about antibiotics, how they came about and how antibiotic resistance affects our lives.

Revised

Genetic Diseases

(Sec 3 to Sec 4/5 - Intermediate⁺)

***\$8.00**
(Inclusive of GST)

2hrs

Thalassaemia is the most common inherited single-gene disorder in the world and is prevalent in Southeast Asia. Klinefelter syndrome affects males while Turner syndrome affects females. Both syndromes are due to chromosome mutations. What is the difference between a gene disorder and a chromosomal disorder? How can we predict the probability that an unborn child would have a genetic disorder? To know these answers and more, join us in this activity-filled lesson.

OBJECTIVES:

1. Understand about genetic diseases such as chromosomal disorders and single gene disorders.
2. Define genes, alleles and genotype.
3. Learn how to predict results of simple crosses using a genetic diagram.
4. Learn micropipetting techniques.
5. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.
6. Learn about genetic testing and its associated implications.



Finding the Lost Princess - A Forensic Approach

(Sec 3 to Sec 4/5 - Intermediate⁺)

***\$9.00**
(Inclusive of GST)

2.5hrs

Princess Anastasia was the youngest daughter of the last imperial family of Russia. When her family was killed by the Red Army firing squad, many thought that she had escaped and became the last surviving member of the Romanov family. The appearance of Anna Anderson, a woman with an uncanny resemblance to Anastasia, strengthened the belief that she had survived. Was Anna Anderson telling the truth when she claimed to be Princess Anastasia? How is it that a genetic disease could have indirectly contributed to the downfall of the Romanov legacy? In a captivating class that combines modern world history and forensic analysis, join us to learn the fate of Princess Anastasia and how the haemophilia gene became prominent in the European royal family.

OBJECTIVES:

1. Learn that haemophilia is a sex-linked recessive genetic disorder and how it is inherited in a family.
2. Learn that DNA is inherited from parents and how it can be used to trace a person's lineage.
3. Understand how science is interconnected to other disciplines of study.
4. Identify the difference between subjective and objective evidence.
5. Learn micropipetting techniques.
6. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.

Bacteria Transformation

(Sec 3 to Sec 4/5 - Intermediate⁺)

***\$9.00**
(Inclusive of GST)

2.5hrs

To help diabetic patients, human insulin has been mass produced by genetically engineered bacteria for many years. Genetic engineering may be controversial, yet it has its benefits. The thought of being able to genetically transform an organism is exciting yet intriguing at the same time. What exactly is genetic engineering? Come and immerse yourself in the magnificent world of genetic engineering and genetically transform bacteria to glow green (fluoresce)!

OBJECTIVES:

1. Learn the general structure of bacteria and the importance of plasmids.
2. Learn micropipetting techniques.
3. Conduct a bacteria transformation experiment using the heat shock method.
4. Understand more about GFP protein and its uses.
5. Understand applications of genetic transformation.
6. Grow bacteria via plating and observe the results.
7. Learn the sterile techniques required when working with bacteria.

Amazing Enzymes - The Important Catalysts of Life

(Sec 3 to Sec 4/5 - Intermediate⁺)

***\$13.00**
(Inclusive of GST)

2.5hrs

Enzymes are life's work horses. They help the human body in food digestion, speed up biochemical reactions and many other important processes. A new enzyme has just arrived in the lab and we need your help to determine its optimum working conditions. Through the use of a simple game and real time experiments, come and learn how certain factors can affect the rate of enzyme reaction.

OBJECTIVES:

1. Learn about enzymes and their roles in everyday life.
2. Understand the different conditions that affect enzymatic reactions.
3. Learn micropipetting techniques.
4. Use the spectrophotometer to perform a quantitative enzyme assay analysis.

Beginner⁺ - This is suitable for students without prior knowledge of the subject

Intermediate⁺ - Some prior knowledge of the subject is required to better appreciate the content of the lesson.



^{*}(Admission fee to Science Centre Singapore applies to non-member International school based in Singapore)

ABE

AMGEN® Biotech Experience

Scientific Discovery for the Classroom

Singapore

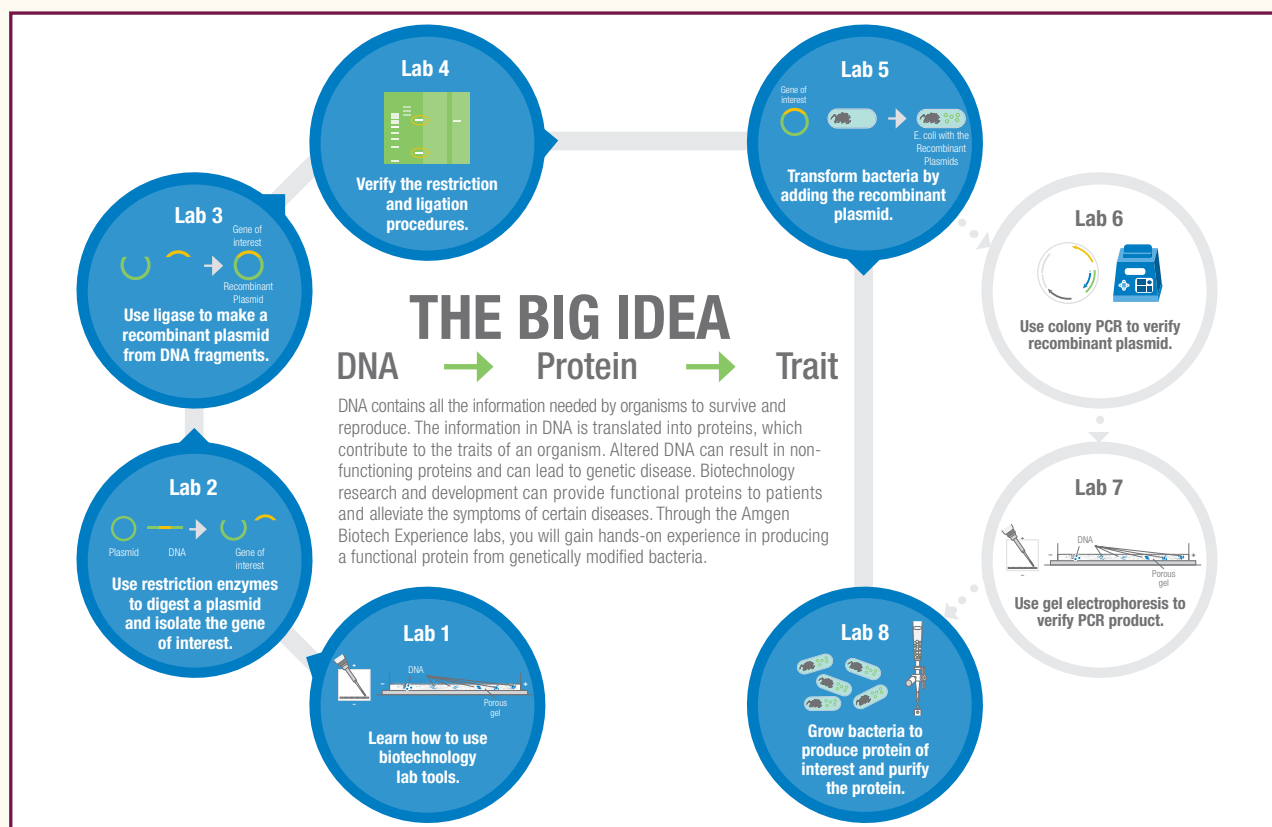
ABE is an innovative science education programme which provides teachers with the loan of research-grade equipment, supplies, curriculum and professional development for teachers to conduct the labs with their students. There are 8 labs involved for students to appreciate the genetic engineering process and its use in biotechnology and drug discovery (as shown in diagram below). Alternatively, Science Centre has put together a series of workshops comprising some of the labs that will be conducted by our Science Educators.

Possible ways to implement this programme:

1. Teachers borrow kit and conduct any of the 8 labs on their own (Cost: Free)
2. Science Centre educator conducts any of the 8 labs in your school (Cost: \$9/lab/pax)
3. Science Centre educator conducts any of the 8 labs in Science Centre Singapore (Cost: \$5/lab/pax)
4. Science Centre educator conducts ABE workshops listed on page 16 and 17

For more information on the labs and how to implement, please visit

www.science.edu.sg/for-schools/dna-learning-lab/amgen-biotech-experience



ABE Labs 1-8

ABE Express: Genetic Engineering Beginner

(Sec 1 to Sec 2)

***\$20.00**
(Inclusive of GST)

DAY 1
9.30am - 4pm

(Includes lunch break, food not provided)

Have you wondered how human insulin is produced in the lab? This is done by genetically engineering bacteria to produce insulin. Since its innovation in 1973, genetic engineering has been applied in many fields such as producing genetically modified food, genetic treatments and medicines. Come and learn the basics of Genetic Engineering.

OBJECTIVES:

1. Learn how genetic engineering can be used to treat genetic diseases such as diabetes.
2. Learn micropipetting techniques.
3. Understand what happens during restriction digest and ligation through a paper activity.
4. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.
5. Conduct bacteria transformation using the heat shock method.
6. Learn more about the applications of genetic engineering.

ABE Express: Genetic Engineering Intermediate

(Sec 3 to Sec 5)

***\$30.00**
(Inclusive of GST)

DAY 1
9.30am - 4pm

DAY 2
9.30am -
12.30pm

(Includes lunch break, food not provided)

Have you wondered how human insulin is produced in the lab? This is done by genetically engineering bacteria to produce insulin. Since its innovation in 1973, genetic engineering has been applied in many fields such as producing genetically modified food, genetic treatments and medicines. Come and have a first-hand experience of conducting these authentic biotechnological experiments used by researchers around the world!

OBJECTIVES:

1. Learn how genetic engineering can be used to treat genetic diseases such as diabetes.
2. Learn micropipetting techniques.
3. Perform digestion of DNA with restriction enzymes and ligation of desired vectors.
4. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.#
5. Conduct a bacteria transformation experiment using the heat shock method.
6. Purify a protein product using column chromatography.#
7. Learn more about the applications of genetic engineering.

* Also available as a 1-day workshop upon request. Items with # will not be covered for 1-day workshop.



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ABE: Developing a Scientist's Mind

(Sec 1 to Sec 5)

***\$45.00**
(Inclusive of GST)

15hrs

Over the course of history, scientific research has enabled humans to investigate the world around us and solve problems. How do scientists conduct research? Join us as we apply the scientific method in this problem-based learning (PBL) workshop to design and conduct your very own genetic engineering experiment! This workshop can be conducted in Science Centre Singapore or in your school.

OBJECTIVES:

1. Engage problem-solving skills to investigate a case study.
2. Learn molecular biology techniques such as micropipetting*, agarose gel electrophoresis and bacteria transformation.
3. Learn and apply the scientific method to design an experiment.
4. Conduct a self-designed laboratory experiment.
5. Learn to review experimental methodology, analyse results and draw conclusions.
6. Explore different perspectives on the effect of genetic engineering.

**Prior micropipetting experience is encouraged but not necessary.*

Duration - 5 sessions of 3 hours each (Total 15 hours)

- A minimum 1-day gap is required between Sessions 4 and 5.
- An optional Session 6 is also available upon request to allow students to present their work.

Capacity - 16 students (minimum), 28 students (maximum)

Class size is kept small to allow closer interaction between instructor and students.

Before attending this workshop, students should have:

1. Prior understanding of the following:
 - The structure of DNA and its importance
 - The relationship between DNA, genes, proteins and traits, **or**;
2. Attended one of the following DNA Lab workshops at Science Centre Singapore:
 - DNA: Cracking the Code of Life
 - DNA & Life
 - Genetic Diseases
 - ABE Lab 1

**(Admission fee to Science Centre Singapore applies to non-member International school based in Singapore)*

PRE-UNIVERSITY SCHOOL PROGRAMMES

(GCE 'A' Level)

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
The Cell and Biomolecules of Life	Proteins - Effects of temperature and pH on protein structure - Mode of action of enzymes and enzyme specificity using the lock-and-key and induced-fit hypotheses - Effects of temperature, pH, enzyme concentration and substrate concentration of an enzyme-catalysed reaction by measuring rates of formation of products or rate of disappearance of substrate	Amazing Enzymes
	Separation of proteins by column chromatography based on protein properties	AMGEN Biotech Experience
Genetics and Inheritance	Structure of Nucleic Acids and Gene Expression - Structure and roles of DNA - DNA information is used to synthesise proteins	
	Control Gene Expression Understand how gene expression in prokaryotes can be regulated through lac operons	Advanced Bacteria Transformation
	Differential gene expression regulated by activators and promoters	AMGEN Biotech Experience
	Describe the principles and procedures of polymerase chain reaction and gel electrophoresis	AMGEN Biotech Experience Forensics Analysis DNA Profiling PTC
	Inheritance Explain how genotype is linked to phenotype	AMGEN Biotech Experience PTC Advanced Bacteria Transformation
Biological Evolution	Natural Selection & Adaption - Environmental factors act as natural selection forces and role of natural selection in evolution - Understand how genetic variation may be preserved in a population	PTC
Infectious Diseases	- Specific adaptive immune system and acquired immunity - Roles of B lymphocytes and memory cells in specific immune responses - Understand how vaccination can control disease and the benefits and risks of vaccination. - Understand the mode of transmission and infection of bacterial pathogens, using <i>Corynebacterium diphtheria</i>	Understanding our Immune System

Time : 9.30am (Session I) or 2.30pm (Session II)
Venue : Science Centre Singapore
Capacity : Minimum number - 20 students
(Unless otherwise stated) Maximum number - 40 students

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Practical Lab Sessions



Advanced Bacteria Transformation

***\$13.00**
(Inclusive of GST)

3hrs

Human insulin is the first known genetically engineered drug developed through the process of genetic engineering. Since then, numerous other genetically engineered drugs have been successfully produced and used for a variety of treatments. Come join us and learn advanced techniques of genetic engineering such as blue-white screening and the concept of lac operon, and be amazed at how scientists engineer such marvels to help mankind!

OBJECTIVES:

1. Learn the general structure of bacteria and importance of plasmid.
2. Define genetic engineering and recombinant DNA cloning.
3. Perform an experiment on recombinant DNA cloning which involves:
 - a. Bacteria transformation
 - b. Selection of transformed bacteria using blue/white screening
4. Understand the application of lac operon in scientific research.

** Biology background is required.*

Amazing Enzymes - The Important Catalysts of Life

***\$13.00**
(Inclusive of GST)

2.5hrs

Enzymes are life's work horses. They help the human body in food digestion, speed up biochemical reactions and many other important processes. A new enzyme has just arrived in the lab and we need your help to determine its optimum working conditions. Through the use of a simple game and real time experiments, come and learn how certain factors can affect the rate of enzyme reaction.

OBJECTIVES:

1. Learn about enzymes and their roles in everyday life.
2. Understand the different conditions that affect enzymatic reactions.
3. Learn micropipetting techniques.
4. Use the spectrophotometer to perform a quantitative enzyme assay analysis and understand enzyme kinetics.

Understanding our Immune System

***\$20.00**
(Inclusive of GST)

2.5hrs

Have you ever wondered how a disease is detected? Why are some diseases treatable while others are not? Ever been intrigued by how our immune systems miraculously work to keep foreign organism at bay? Join us in discovering the world of immunology and understanding vaccination through the use of a real-life diagnostic tool!

OBJECTIVES:

1. Learn micropipetting techniques.
2. Understand the role of memory B cells in secondary infection.
3. Understand antigen-antibody interaction and learn its application in disease detection.
4. Investigate and track whether a patient has been infected by bacteria through serum analysis.
5. Perform Enzyme-linked Immunosorbent Assay (ELISA) and explain the use of ELISA in disease diagnosis.
6. Understand and learn how ELISA can help in identifying vaccinated from unvaccinated patients.
7. Discuss how vaccination can control disease, as well as benefits and risks of vaccination.

Full-day workshops

9.30am-11.30am and 12.30pm-3pm
(includes lunch break- food not provided)

PTC- The 'Bitter' Life of Super-tasters

***\$22.00** 4.5hrs
(Inclusive of GST)

Are your friends frustrated with you for being a fussy eater? Maybe it is because you are a super-taster! Find out how a single gene in our DNA can affect the ability to taste phenylthiocarbamide (PTC), a harmless bitter tasting chemical and how it may also affect our sensitiveness to other bitter compounds! Join us in this ultimate self-discovery hands-on workshop to find out who among us have this PTC taste receptor gene!

OBJECTIVES:

1. Learn micropipetting techniques.
2. Perform DNA extraction from cheek cells[^] and polymerase chain reaction to amplify DNA.
3. Digest DNA with restriction enzyme.
4. Cast agarose gel and analyse DNA through a technique known as agarose gel electrophoresis.
5. Introduce Bioinformatics tools used in DNA analysis.

Forensic Analysis DNA Profiling

***\$22.00** 4.5hrs
(Inclusive of GST)

DNA profiling is currently considered the gold standard in forensic science and has been highly popularised by crime related programmes on the media. Although the current state of the art DNA profiling uses 13 to 16 short tandem repeat (STR) loci in a multiplex PCR format, this experiment pursues the amplification of a single variable number of tandem repeat (VNTR) locus, D1S80. Come and experience the work of a forensic scientist in analysing DNA profiles and learn techniques used in forensic science.

OBJECTIVES:

1. Understand the importance of DNA as evidence of a crime.
2. Learn the application of STR and VNTR in DNA profiling.
3. Learn micropipetting techniques.
4. Perform DNA extraction from cheek cells[^] and polymerase chain reaction to amplify DNA.
5. Cast agarose gel and analyse DNA through a technique known as agarose gel electrophoresis.
5. Learn how to collect fingerprint evidence using actual forensic fingerprint dusting tools.



[^]Participants will need to provide their own DNA sample from cheek cells.

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ABE

AMGEN® Biotech Experience

Scientific Discovery for the Classroom

Singapore

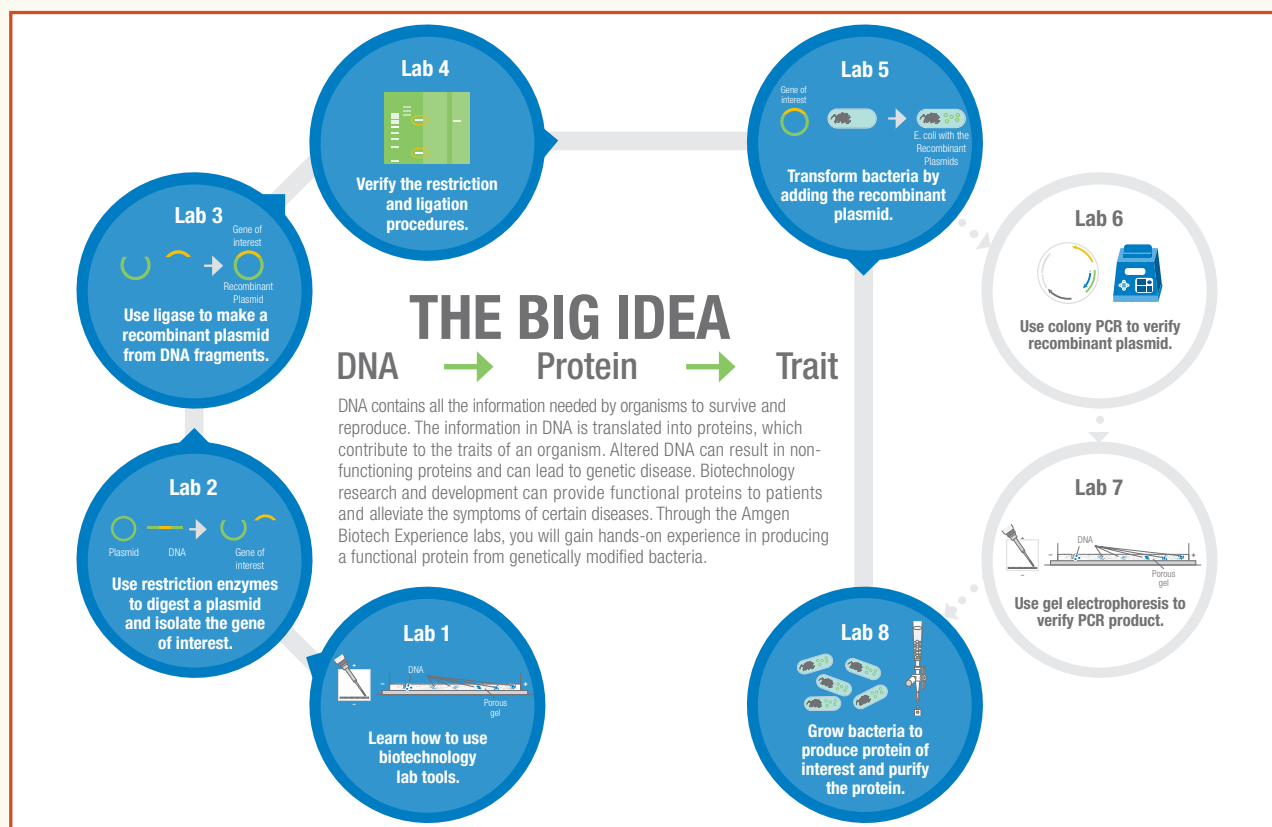
ABE is an innovative science education programme which provides teachers with the loan of research-grade equipment, supplies, curriculum and professional development for teachers to conduct the labs with their students. There are 8 labs involved for students to appreciate the genetic engineering process and its use in biotechnology and drug discovery (as shown in diagram below). Alternatively, Science Centre has put together a series of workshops comprising some of the labs that will be conducted by our Science Educators.

Possible ways to implement this programme:

1. Teachers borrow kit and conduct any of the 8 labs on their own (Cost: Free)
2. Science Centre educator conducts any of the 8 labs in your school (Cost: \$9/lab/pax)
3. Science Centre educator conducts any of the 8 labs in Science Centre Singapore (Cost: \$5/lab/pax)
4. Science Centre educator conducts ABE Express: Genetic Engineering Advance

For more information on the labs and how to implement, please visit

www.science.edu.sg/for-schools/dna-learning-lab/amgen-biotech-experience



ABE Labs 1-8

ABE Express: Genetic Engineering Advance

***\$35.00**
(Inclusive of GST)

2 DAYS
9.30am - 4pm

(Includes lunch break, food not provided)

Have you wondered how human insulin is produced in the lab? This is done by genetically engineering bacteria to produce insulin. Since its innovation in 1973, genetic engineering has been applied in many fields such as producing genetically modified food, genetic treatments and medicines. Come and have a first-hand experience of conducting these authentic biotechnological experiments used by researchers around the world!

OBJECTIVES:

1. Learn how genetic engineering can be used to treat genetic diseases such as diabetes.
2. Learn micropipetting techniques.
3. Perform digestion of DNA with restriction enzymes and ligation of desired vectors.
4. Conduct bacteria transformation using the heat shock method.
5. Perform colony polymerase chain reaction to amplify DNA.#
6. Understand how DNA is analysed through a technique known as agarose gel electrophoresis.#
7. Purify a protein product using column chromatography.#
8. Learn more about the applications of genetic engineering.
9. Explore different perspectives on the effect of genetic engineering.

** Also available as a 1-day workshop upon request. Items with # will not be covered for 1-day workshop.*



**(Admission fee to Science Centre Singapore applies to non-member International school based in Singapore)*

ABE PROGRAMME

"The ABE programme supports and extends on the O-Level syllabus on "Molecular Genetics". The topic requires students to describe the relationship between DNA, genes, and chromosomes, state the composition and structure of DNA, explain and apply the rule of complementary base pairing, understand the function of DNA in genetic coding, explain the role of genes in the production of polypeptides, understand that genes can be transferred between cells, describe the application of genetic engineering in the production of human insulin and discuss the various issues arising from genetic engineering."

HERE'S WHAT TEACHERS SAY ABOUT OUR PROGRAMMES

DNA BASICS

"Interesting info shared with the pupils and the hands-on activities were engaging and appropriate for their age group."

"DNA model making helped them visualise the DNA structure better."

GENES AND OUR TRAITS

"Pupils are able to see DNA; they are able to see the relation between what they learn in school and how it affects in real life."

BACTERIA OUTBREAK

"Good exposure to students as real life scenarios were discussed."

DNA AND LIFE

"Provides learning beyond textbook."

GENETIC DISEASES

"Covered real life diseases which students can relate to."

FINDING THE LOST PRINCESS

"Interesting story that captivated the students' attention. Applicable to Sec 4 syllabus."

DNA IN FORENSIC SCIENCE

"Helpful in sparking students' interest in the science."

"Students enjoyed casting the gel and solving the crime. It was engaging for the students and created awareness among them about the different techniques involved in forensic science."

BACTERIA TRANSFORMATION

"The discussion on the use of GMO, its issues and implications were very interesting and helped to inject a real life application."

FORENSIC ANALYSIS DNA PROFILING

Many topics were covered and these could serve as introductory courses for the students who are in JC1, eg. micropipetting skills, VNTR vs STR, PCR.

PTC-THE "BITTER" LIFE OF SUPER-TASTERS

Fantastic facilities and equipment. Hard to do PCR in school!"

"Fit IB diploma syllabus for Biology."

BACTERIA AND HEALTH

"Simplified explanation for people who totally did not know about bacteria."

OUR EDUCATORS

“The instructor was EXCELLENT, very informative, patient and organised.”

“The instructor was knowledgeable and infused the lesson with many stories related to today’s lesson. This piqued the pupils’ interest in Science.”

“Instructions given were very clear, simple and direct. In-depth learning and clarity of explanation by instructor.”

“Very good instructor - very enthusiastic!”

“Engaging, organised, good classroom management, humorous yet firm.”

“The scaffolding questions and clear voice projection, together with timely comments on observations, helped the students learn better.”

For enquiries, please email
dnalab@science.edu.sg

or contact

Charissa Lin

(Senior Manager, DNA Learning Laboratory).

Tel: 6425 2789

email: **charissa_lin@science.edu.sg**

To book for ABE Workshops,
please email

dnalab@science.edu.sg.

For all other classes, please book online at
<https://obs.science.edu.sg/login>



The information is accurate at the time of printing and is subjected to changes.

For the latest updates, please log on to **www.science.edu.sg** (DNA Learning Laboratory) or scan the QR code.



Like our Facebook page “**DNA Learning Lab – Science Centre Singapore**” to receive latest updates and share your experiences in the DNA lab.