DNA Learning Lab

By Science Centre Singapore

DNA Lab Programmes 2025



RECIPIENT
SINGAPORE EXPERIENCE AWARDS 2012

Best Enrichment Experience
DNA Learning Lab Programmes

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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 science, technology, engineering and mathematics (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 scientist 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 28 and 29.

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.



Content Page

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SECONDARY SCHOOL PROGRAMMES
(Sec 1 - Sec 4/5) P11

PRE-UNIVERSITY SCHOOL PROGRAMMES)
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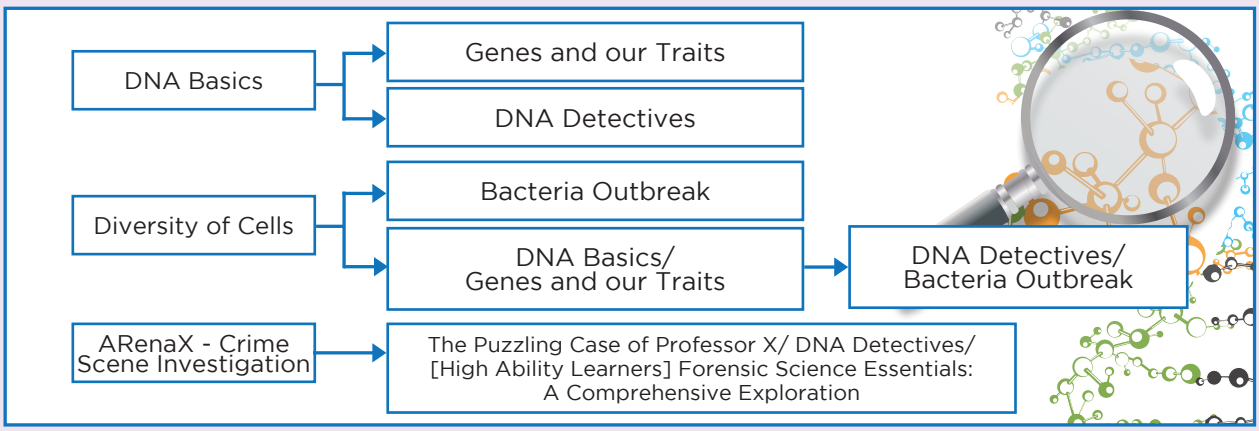
PRIMARY SCHOOL PROGRAMMES (PRI 5 - PRI 6)

Primary school curriculum links

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
Inquire like Scientists	• Evaluate claims and ideas critically based on logical scientific evidence and arguments	The Puzzling Case of Professor X ARenaX – Crime Scene Investigation DNA Detectives
Cycles	• Understand inheritance – many traits of an organism are passed on from parents to offspring	DNA Basics Genes and our Traits
	• Recognise that a cell is the basic unit of life	Diversity of Cells
Diversity	• Classify living things into broad groups based on similarities and differences of common observable characteristics	
Energy	• Understand how plants obtain energy to make food during photosynthesis	
System	• Application of electrical circuits and current flow in DNA electrophoresis	DNA Detectives [High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration
Interaction	• Understand the effect on organisms when the environment becomes unfavourable • Understand that adaptations serve to enhance survival and can be structural or behavioural	Genes and Our Traits
	• Interaction of bacteria with the environment – growth conditions	Bacteria Outbreak

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

For a complete learning experience, we recommend your students to attend a series of workshops. Here are suggested lessons that complement each other:



**Prices shown are for MOE Schools only. Different price applies to International or private schools based in Singapore. Contact us at schools@science.edu.sg for pricing.*

Outreach Programmes

The Puzzling Case of Professor X

****$15.00** *(Inclusive of GST)*

1.5hrs

Professor X has been found dead! A suicide, an accident, possibly foul play? As the detective working on the case, something tells you things are not as simple as they seem. Will the clues reveal something even more sinister...? It is up to you to uncover the truth!

OBJECTIVES:

1. Understand different forensic techniques
2. Identify types of fingerprints.
3. Learn about blood patterns and blood pattern analysis.
4. Roleplay interrogation techniques.

Delivery Mode: In-Person at School
Our educators will conduct this programme at your school, in individual classrooms / Science laboratories.

This outreach workshop is only available for booking as **2 consecutive classes**. Each class is **1.5 hours** long, with a 0.5-hour break between classes. Timings are as follows:

- 9.30am - 11.00am, 11.30am - 1.00pm
- 1.00pm - 2.30pm, 3.00pm - 4.30pm

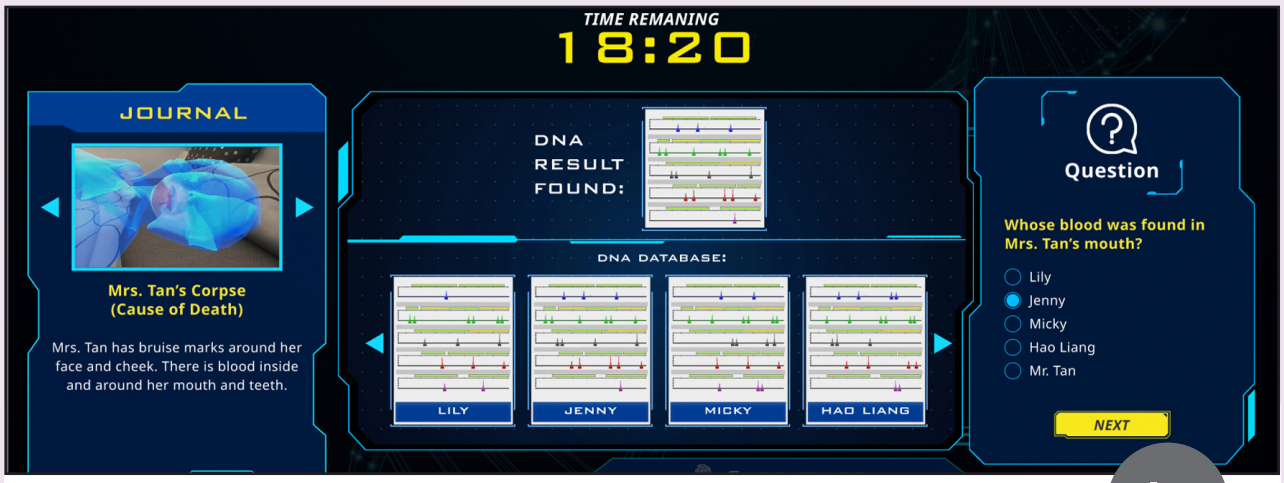
Total capacity for the 2 consecutive classes: 60 students (minimum)**, 80 students** (maximum)



**You will be charged based on the booked number as materials will be prepared beforehand.*

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Interactive Online Sessions



ARenaX – Crime Scene Investigation

***$12.00**
(Inclusive of GST)

2hrs

Gear up (virtually) as a forensic scientist as you take on the latest edition of ARenaX – Crime Scene Investigation! Through this interactive, educator-facilitated online experience, students will investigate a triple murder through crime scene processing and evidence collection, as well as explore a variety of scientific analysis techniques with real-life relevance. This workshop was created by Science Centre Singapore and Digimagic Communications, in collaboration with Health Science Authority. A thrilling experience awaits for budding detectives! View the trailer here: https://for.edu.sg/axcsi

OBJECTIVES:

1. Understand the method and importance of proper crime scene processing.
2. Learn how to document observations and collect forensic evidence.
3. Learn and virtually experience real-life forensic/scientific techniques including fingerprint, blood spatter pattern and DNA analysis.
4. Explore witness testimonies and suspect interrogation as forms of evidence.
5. Practise observational, inferential and critical-thinking skills, learn to draw evidence-based conclusions and work together as a team.

Delivery Mode: Live Online at School
This programme will be conducted via live video conference and the ARenaX platform by an educator. Each student will need a laptop/computer and earphones with internet access and sound.

System Requirements:
Please note that the experience is optimised for PC or Mac Desktop or laptop viewing only. Surface computers running on Windows will work. The ARenaX platform is not optimised for mobile devices and tablets running both iOS and Android systems. Recommended browser: Google Chrome

To test your computer's compatibility with the platform, try accessing the demo site:
https://multiclass-arenax.ddns.net/Demo/

Minimum System Requirements for PC and Laptop:
- CPU: 5th Generation Intel Core i5 2 GHz or faster
- RAM: 8 GB
- Graphic Card: NVIDIA Geforce GTX 750 1.5G VRAM / Intel Iris Plus Graphics

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Workshops in Science Centre



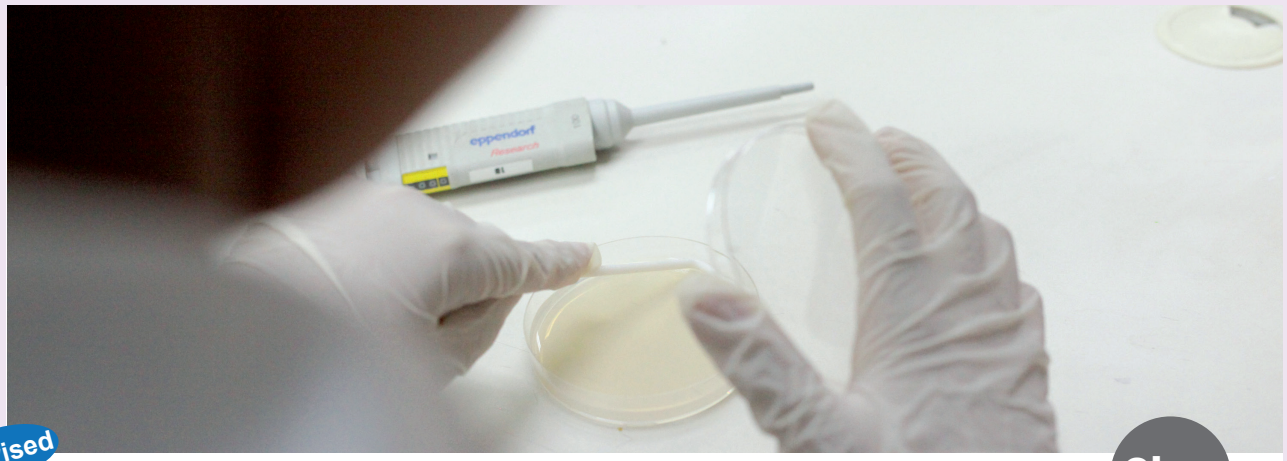
DNA Basics

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

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

Bacteria Outbreak!

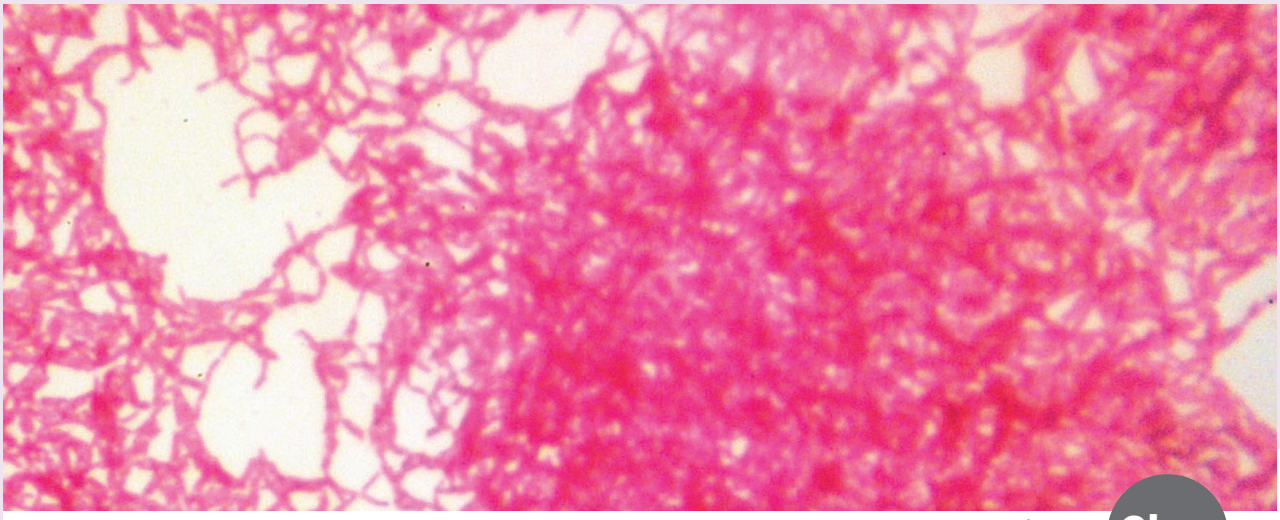
***$8.00** *(Inclusive of GST)* **2hrs**

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? The case study will be based on a food poisoning outbreak but will draw links to show how the COVID-19 outbreak was handled.

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. Understand the differences between bacteria and virus and identify the basic shapes of bacteria.

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Diversity of Cells

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

2hrs

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.

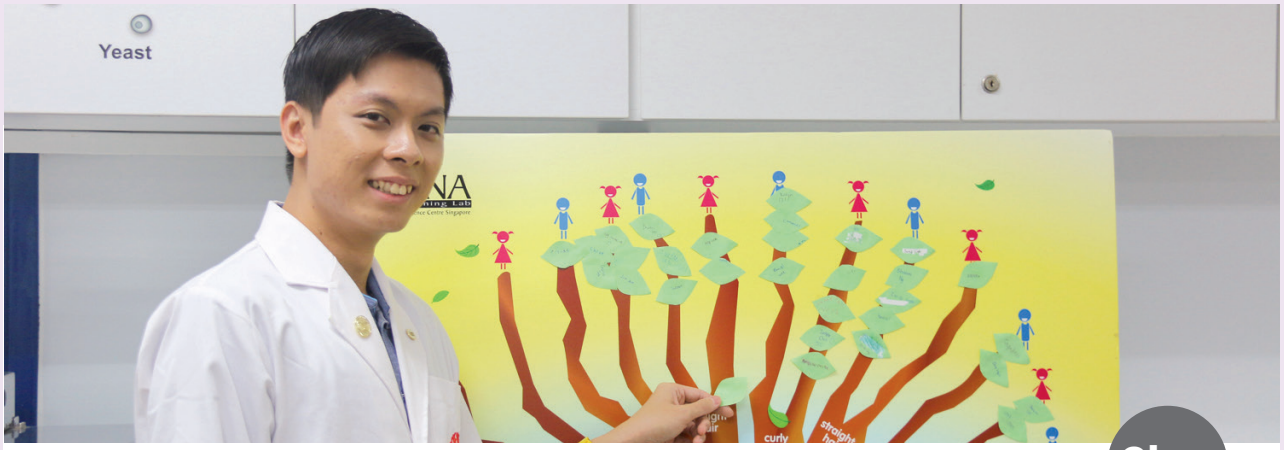
OBJECTIVES:

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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Genes and Our Traits

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

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** *(Inclusive of GST)* **2hrs**

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.

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ARenaX – Crime Scene Investigation

***$15.00**
(Inclusive of GST)

2hrs

Gear up (virtually) as a forensic scientist as you take on the latest edition of ARenaX – Crime Scene Investigation! Through this interactive, educator-facilitated online experience, students will investigate a triple murder through crime scene processing and evidence collection, as well as explore a variety of scientific analysis techniques with real-life relevance. This workshop was created by Science Centre Singapore and Digimagic Communications, in collaboration with Health Science Authority. A thrilling experience awaits for budding detectives! View the trailer here: https://for.edu.sg/axcsi

OBJECTIVES:

1. Understand the method and importance of proper crime scene processing.
2. Learn how to document observations and collect forensic evidence.
3. Learn and virtually experience real-life forensic/scientific techniques including fingerprint, blood spatter pattern and DNA analysis.
4. Explore witness testimonies and suspect interrogation as forms of evidence.
5. Practise observational, inferential and critical-thinking skills, learn to draw evidence-based conclusions and work together as a team.

This workshop is conducted in a computer lab. Students are required to bring their own earphones (3.5mm jack or USB port).

NEW

[High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration

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

DAY 1 & 2
9.30am - 2.30pm

DAY 3
2hrs

Immerse yourself in the intriguing world of forensic science, where every clue counts! Through hands-on activities, participants will explore key forensic techniques, including fingerprint analysis and DNA profiling. Utilising inquiry-based learning and collaborative investigations, students will develop critical thinking skills and apply their newfound knowledge to solve a crime.

"[High Ability Learners] Forensic Science Essentials" features advanced content designed to intellectually challenge and stretch participants beyond our standard offerings.

This programme is 2.5 days long. Please contact dnalab@science.edu.sg with your preferred dates to book the programme.

OBJECTIVES:

1. Develop an understanding of key forensic science concepts and methodologies.
2. Learn various lab techniques such as micropipetting and agarose gel electrophoresis, and their applications in forensic science.
3. Enhance collaboration, critical thinking and presentation skills by designing their own investigation to solve a case study.
4. Apply scientific knowledge to real-world scenarios in forensic investigations.

**Prices shown are for MOE Schools only. Different price applies to International or private schools based in Singapore. Contact us at schools@science.edu.sg for pricing.*

SECONDARY PROGRAMMES (SEC 1 - SEC 2)

Lower secondary school curriculum links

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
Inquire like Scientists	• Evaluate claims and ideas critically based on logical scientific evidence and arguments	The Puzzling Case of Professor X ARenaX – Crime Scene Investigation DNA in Forensic Science [High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration
Model of Cells	• Understand the function of the nucleus in the cell which contains genetic material that can be passed down to the next generation	DNA and Life
Exploring Diversity of Matter Using Separation Techniques	• 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
Human Digestive System	• Application of enzymes in genetic engineering • Appreciation of the importance of sensible food and lifestyle choices in the fight against diabetes	
	• Awareness that bacteria could have beneficial or harmful effects	Bacteria and Health
Human Sexual Reproductive System	• Understand heredity – passing down of genetic material from one generation to the next • Recognise that the union of the nuclei of an egg and a sperm forms a fertilised egg which develops into a new individual • Recognise that a new individual formed through sexual reproduction receives a unique combination of genetic information from the mother and the father, resulting in variation between individuals	DNA and Life
Electrical Systems	• Application of electrical circuits and current flow in DNA electrophoresis	DNA in Forensic Science [High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration
Chemical Changes	• Identify a change that leads to the formation of new substances as a chemical change • Awareness of different types of chemical changes	
Food and Consumer Education	• Causes of food contamination • Awareness of hygienic practices when handling food	Bacteria and Health

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These classes are only available through school bookings

SECONDARY PROGRAMMES (SEC 3 - SEC 5)

Upper secondary school curriculum links

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
Inquire like Scientists	• Evaluate claims and ideas critically based on logical scientific evidence and arguments	ARenaX – Crime Scene Investigation Finding the lost princess
Infectious Diseases in Humans	• Infectious diseases are caused by pathogens such as bacteria and viruses and can be spread from person to person through body fluids, food and water • Misuse and overuse of antibiotics may accelerate the emergence of antibiotic-resistant bacteria	Bacteria and Health
Biological Molecules	• Large molecules (polypeptides and proteins) are synthesised from smaller basic units (amino acids)	AMGEN Biotech Experience Bacteria Transformation
Homeostasis, Coordination and Response in Humans	• Describe diabetes in terms of a persistently higher than normal blood glucose concentration due to the body's resistance to insulin or insufficient production of insulin	
Molecular Genetics	• Genes may be transferred from the cells of one organism to the cells of another to form transgenic organisms • 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 • Relationship between DNA, genes and chromosomes • Structure of DNA and rule of complementary base pairing • Genes as units of inheritance • Understand that DNA carries the genetic code used to synthesise specific polypeptides	Finding the Lost Princess Genetic Diseases DNA and Life
Inheritance	• Understand that a unit of inheritance is a gene and distinguish between a gene and an allele • Understand the terms dominant, recessive, homozygous, heterozygous, phenotype and genotype • Predict the results of simple crosses using genetic diagrams involving monohybrid inheritance • Determination of sex in humans – XX and XY chromosomes • Understand mutation as a change in the sequence of a gene (sickle cell anaemia) or in the chromosome number (Down syndrome)	
Transport in Humans	• Role of red blood cells in oxygen transport and diseases (thalassaemia and sickle cell anaemia) • List the different ABO blood groups	Genetic Diseases DNA and Life

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These classes are only available through school bookings

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

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/ [High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration

DNA and its application (in diseases)

DNA and Life → Genetic Diseases / Finding the Lost Princess

Forensic techniques

ARenaX - Crime Scene Investigation → The Puzzling Case of Professor X

ARenaX - Crime Scene Investigation → DNA in Forensic Science/ [High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration

Body and health

Bacteria and Health → Genetic Diseases

Bacteria and its impact on humans

Bacteria and Health → Bacteria Transformation



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These classes are only available through school bookings

Outreach Programmes

The Puzzling Case of Professor X

****$15.00** *(Inclusive of GST)* **1.5hrs**

Professor X has been found dead! A suicide, an accident, possibly foul play? As the detective working on the case, something tells you things are not as simple as they seem. Will the clues reveal something even more sinister...? It is up to you to uncover the truth!

OBJECTIVES:

1. Understand different forensic techniques
2. Identify types of fingerprints.
3. Learn about blood patterns and blood pattern analysis.
4. Roleplay interrogation techniques.

Delivery Mode: In-Person at School
Our educators will conduct this programme at your school, in individual classrooms / Science laboratories.

This outreach workshop is only available for booking as **2 consecutive classes**. Each class is **1.5 hours** long, with a 0.5-hour break between classes. Timings are as follows:

- 9.30am - 11.00am, 11.30am - 1.00pm
- 1.00pm - 2.30pm, 3.00pm - 4.30pm

Total capacity for the 2 consecutive classes: 60 students (minimum)**, 80 students** (maximum)

Pre-Recorded Home-Based Learning Programmes

DNA and Life

(Sec 1 to Sec 2 - Beginner)

****$8.00** *(Inclusive of GST)* **1.5hrs**

DNA is often described as the most important molecule of life which determines how livings 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 solve a case of baby mix-ups at the hospital and reunite the children with their parents!

OBJECTIVES:

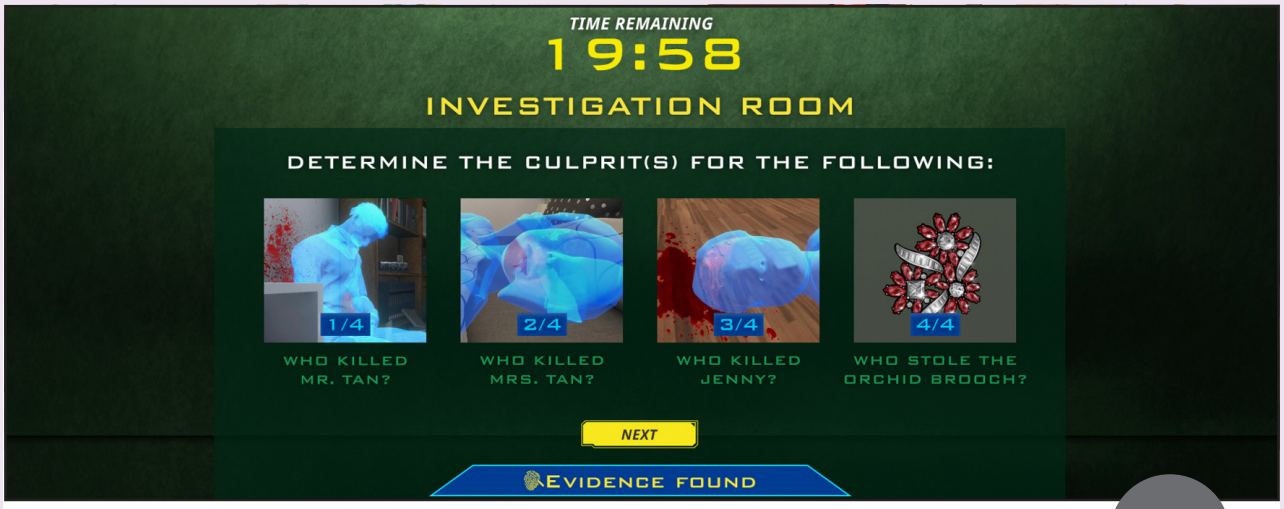
1. Learn the structure of DNA and its importance.
2. Observe a simple DNA extraction from plant cells.
3. Learn the basics of blood typing and how DNA determines blood type of individuals.
4. Perform simple karyotyping, blood typing and DNA analysis to solve a case study.

Delivery Mode: Pre-Recorded HBL
Pre-recorded instructions and demonstrations will be sent to school in advance, together with materials for hands-on activities. This programme can be completed asynchronously and does not need to be completed in one sitting.

**You will be charged based on the booked number as materials will be prepared beforehand.*

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Interactive Online Sessions



ARenaX – Crime Scene Investigation

(Sec 1 to Sec 4/5 - Beginner)

***$12.00**
(Inclusive of GST)

2hrs

Gear up (virtually) as a forensic scientist as you take on the latest edition of ARenaX – Crime Scene Investigation! Through this interactive, educator-facilitated online experience, students will investigate a triple murder through crime scene processing and evidence collection, as well as explore a variety of scientific analysis techniques with real-life relevance. This workshop was created by Science Centre Singapore and Digimagic Communications, in collaboration with Health Science Authority. A thrilling experience awaits for budding detectives! View the trailer here: https://for.edu.sg/axcsi

OBJECTIVES:

1. Understand the method and importance of proper crime scene processing.
2. Learn how to document observations and collect forensic evidence.
3. Learn and virtually experience real-life forensic/scientific techniques including fingerprint, blood spatter pattern and DNA analysis.
4. Explore witness testimonies and suspect interrogation as forms of evidence.
5. Practise observational, inferential and critical-thinking skills, learn to draw evidence-based conclusions and work together as a team.

Delivery Mode: Live Online at School
This programme will be conducted via live video conference and the ARenaX platform by an educator. Each student will need a laptop/computer and earphones with internet access and sound.

System Requirements:
Please note that the experience is optimised for PC or Mac Desktop or laptop viewing only. Surface computers running on Windows will work. The ARenaX platform is not optimised for mobile devices and tablets running both iOS and Android systems. Recommended browser: Google Chrome

To test your computer's compatibility with the platform, try accessing the demo site:
https://multiclass-arenax.ddns.net/Demo/

Minimum System Requirements for PC and Laptop:
- CPU: 5th Generation Intel Core i5 2 GHz or faster
- RAM: 8 GB
- Graphic Card: NVIDIA Geforce GTX 750 1.5G VRAM / Intel Iris Plus Graphics

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DNA and Life

(Sec 1 to Sec 2 - Beginner)

+$8.00 *(Inclusive of GST)* **1.5hrs**

DNA is often described as the most important molecule of life which determines how livings 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 solve a case of baby mix-ups at the hospital and reunite the children with their parents!

OBJECTIVES:

1. Learn the structure of DNA and its importance.
2. Conduct a simple DNA extraction from 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.

Delivery Mode: Live Online at School

This programme will be conducted via live video conference by an educator, with materials sent to school in advance. Students will be joining the video conference from school. Each student will require a device that can access internet (laptop/desktop/tablet) as there will be individual online activities as part of the workshop.

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Workshops in Science Centre

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.



DNA and Life

(Sec 1 to Sec 2 - Beginner)

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

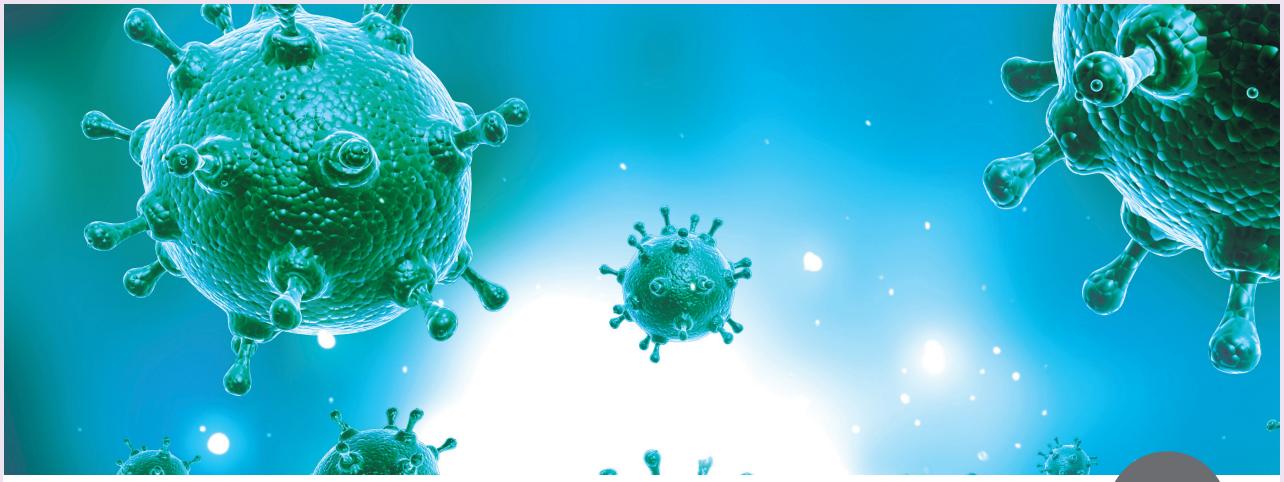
1.5hrs

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OBJECTIVES:

1. Learn the structure of DNA and its importance.
2. Conduct a simple DNA extraction from 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.

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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.

NEW

[High Ability Learners] Forensic Science Essentials: A Comprehensive Exploration

(Sec 1 to Sec 2 - High Ability Learners)

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

DAY 1 & 2
9.30am - 2.30pm

DAY 3
2hrs

Immerse yourself in the intriguing world of forensic science, where every clue counts! Through hands-on activities, participants will explore key forensic techniques, including fingerprint analysis and DNA profiling. Utilising inquiry-based learning and collaborative investigations, students will develop critical thinking skills and apply their newfound knowledge to solve a crime.

"[High Ability Learners] Forensic Science Essentials" features advanced content designed to intellectually challenge and stretch participants beyond our standard offerings.

This programme is 2.5 days long. Please contact dnalab@science.edu.sg with your preferred dates to book the programme.

OBJECTIVES:

1. Develop an understanding of key forensic science concepts and methodologies.
2. Learn various lab techniques such as micropipetting and agarose gel electrophoresis, and their applications in forensic science.
3. Enhance collaboration, critical thinking and presentation skills by designing their own investigation to solve a case study.
4. Apply scientific knowledge to real-world scenarios in forensic investigations.

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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.



Bacteria Transformation

(Sec 3 to Sec 4/5 - Intermediate)

***$12.00** *(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.

**Prices shown are for MOE Schools only. Different price applies to International or private schools based in Singapore. Contact us at schools@science.edu.sg for pricing.*



Finding the Lost Princess – A Forensic Approach

***$12.00** *(Inclusive of GST)* **2.5hrs**

(Sec 3 to Sec 4/5 - Intermediate)

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.

ARenaX – Crime Scene Investigation

***$15.00** *(Inclusive of GST)* **2hrs**

(Sec 1 to Sec 4/5 - Beginner)

Gear up (virtually) as a forensic scientist as you take on the latest edition of ARenaX – Crime Scene Investigation! Through this interactive, educator-facilitated online experience, students will investigate a triple murder through crime scene processing and evidence collection, as well as explore a variety of scientific analysis techniques with real-life relevance. This workshop was created by Science Centre Singapore and Digimagic Communications, in collaboration with Health Science Authority. A thrilling experience awaits for budding detectives! View the trailer here: https://for.edu.sg/axcsi

OBJECTIVES:

1. Understand the method and importance of proper crime scene processing.
2. Learn how to document observations and collect forensic evidence.
3. Learn and virtually experience real-life forensic/scientific techniques including fingerprint, blood spatter pattern and DNA analysis.
4. Explore witness testimonies and suspect interrogation as forms of evidence.
5. Practise observational, inferential and critical-thinking skills, learn to draw evidence-based conclusions and work together as a team.

This workshop is conducted in a computer lab. Students are required to bring their own earphones (3.5mm jack or USB port).

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ABE

AMGEN® Biotech Experience

Scientific Discovery for the Classroom

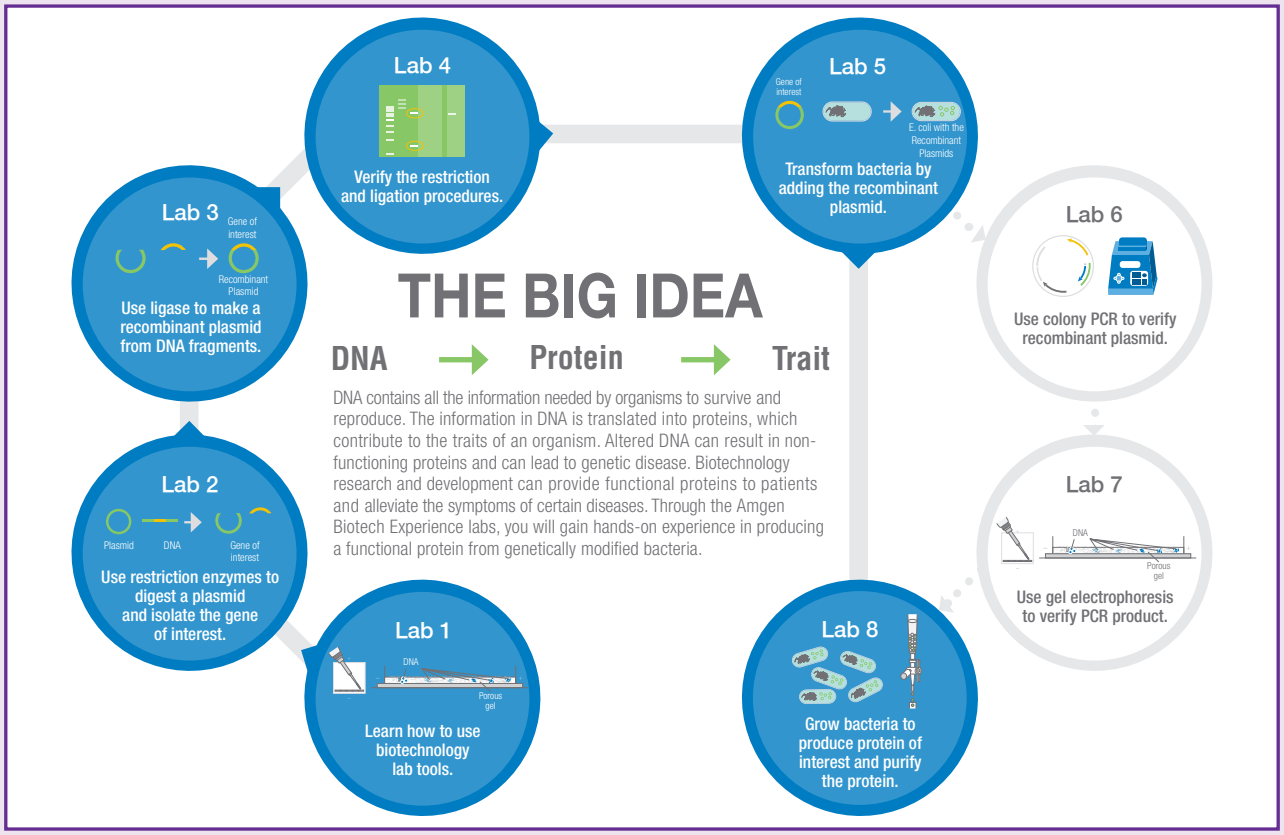
Singapore

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. The ABE programmes are subsidised by Amgen Foundation.

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 ABE workshops listed on page 21

For more information on the labs and how to implement, please visit
http://www.amgenbiotechexperience.net/sg/



ABE Labs 1-8

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These classes are only available through school bookings

ABE Express: Genetic Engineering Beginner

(Sec 1 to Sec 2)

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

DAY 1
9.30am - 4.30pm

(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 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 - 4.30pm

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 bacteria transformation using the heat shock method.
6. Purify a protein product using column chromatography.
7. Learn more about the applications of genetic engineering.



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These classes are only available through school bookings

PRE-UNIVERSITY SCHOOL PROGRAMMES

(GCE 'A' Level)

SCHOOL SYLLABUS LINKS	COMMON KEY LEARNING POINTS	DNA LAB PROGRAMMES
The Structure of Nucleic Acids and Gene Expression	• Structure and roles of DNA and RNA • DNA information is used to synthesise polypeptides	AMGEN Biotech Experience
Control of Gene Expression	• Understand how differential gene expression can be regulated by activators and promoters	
	• Understand the principles and procedures of polymerase chain reaction and gel electrophoresis	Forensic Analysis DNA Profiling ABE: Exploring Precision Medicine
Inheritance	• Explain how genotype is linked to phenotype	AMGEN Biotech Experience ABE: Exploring Precision Medicine
Organisation of Genomes	• Awareness of variation in viral genomes due to antigenic shift and antigenic drift	Understanding our Immune System
Natural Selection and Adaptation	• Environmental factors act as natural selection • Role of natural selection in evolution • Understand how genetic variation may be preserved in a population	ABE: Exploring Precision Medicine
Infectious Diseases	• Specific (adaptive) immune system and acquired immunity • Roles of B lymphocytes and memory cells in specific primary and secondary 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 *Corynebacterium diphtheria* as an example	Understanding our Immune System

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

**Prices shown are for MOE Schools only. Different price applies to International or private schools based in Singapore. Contact us at schools@science.edu.sg for pricing.*

Workshops in Science Centre



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 organisms 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.

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Forensic Analysis DNA Profiling

***$25.00**
(Inclusive of GST)

1 Day
9.30am - 3pm

(Includes lunch break, food not provided)

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

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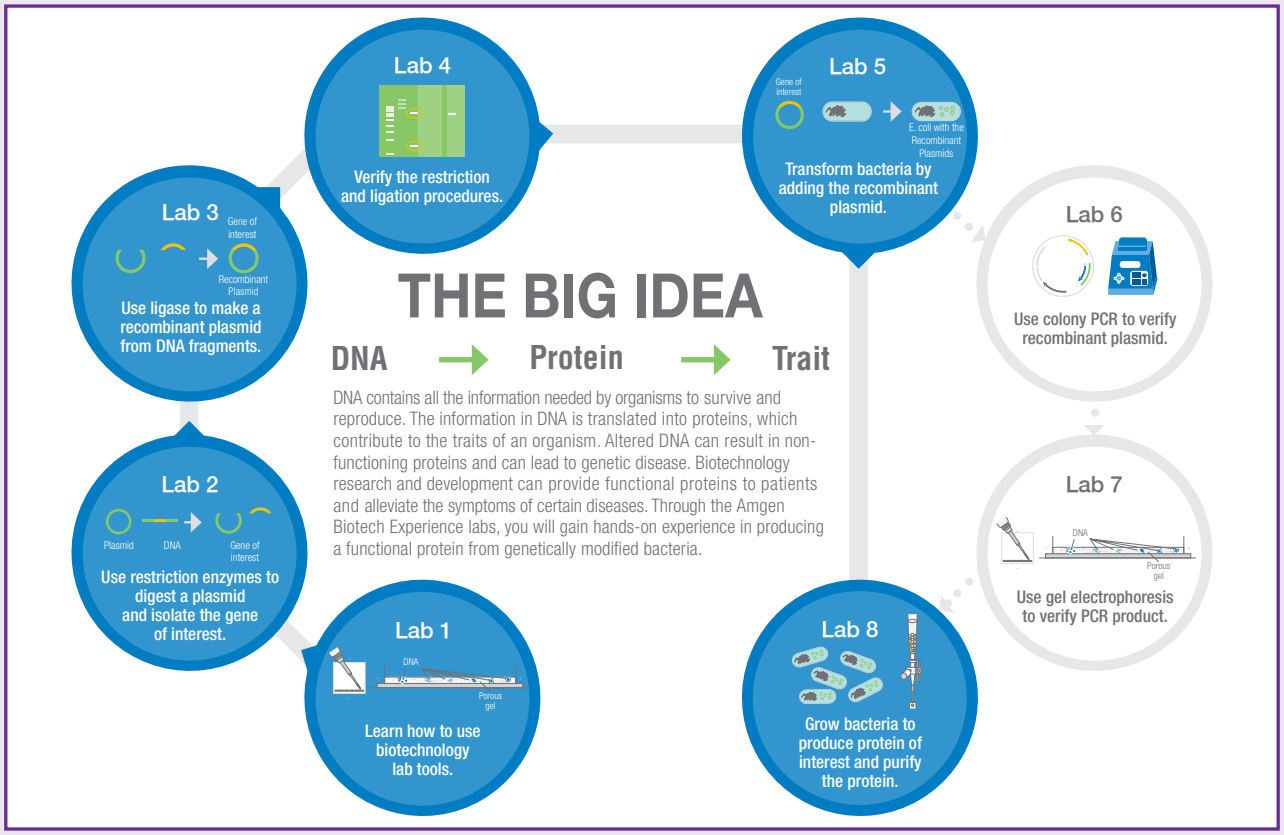
Singapore

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. The ABE programmes are subsidised by Amgen Foundation.

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 listen on page 27

For more information on the labs and how to implement, please visit
http://www.amgenbiotechexperience.net/sg/



ABE Labs 1-8

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ABE: Exploring Precision Medicine

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

1 Day
9.30am - 3pm

(Includes lunch break, food not provided)

In recent years, precision medicine has emerged as an important approach to health management. Doctors can now use their understanding of genetics to personalise the medical treatments that patients receive. How do our genes affect traits that cannot be seen, such as our ability to metabolise medicine or taste bitter compounds? Join us as we learn more about precision medicine through an investigation of how a single gene in our DNA can affect the ability to taste phenylthiocarbamide (PTC), a harmless bitter-tasting chemical!

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.
6. Explore the connection between genes and drug metabolism.



ABE Express: Genetic Engineering Advanced

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

2 DAYS
9.30am - 4.30pm

(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. 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.

^Participants will need to provide their own DNA sample from cheek cells.
**Prices shown are for MOE Schools only. Different price applies to International or private schools based in Singapore. Contact us at schools@science.edu.sg for pricing.*

HERE'S WHAT TEACHERS SAY ABOUT OUR PROGRAMMES

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."

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."

GENETIC DISEASES

"Interesting concept and students can learn practical skills that they would otherwise not have a chance to in secondary school."

DNA AND LIFE

"Provides learning beyond textbook."

BACTERIA OUTBREAK

"Engaging and relevant to real-life. Students were engaged."

FINDING THE LOST PRINCESS

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

DNA IN FORENSIC SCIENCE

"It is an interesting lesson that lets students take a look at how science is applicable in real life."

"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.

DNA DETECTIVES

"Engaging and excellent extension of learning beyond classroom. Also case study is based on true incident, help students see the relevance of forensic science application. Keep it up!"

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.

"Really appreciated the instructor's helpfulness in answering the students questions even after the session."

"Am impressed with the facilitator. She has excellent class management skills and she ensures that everyone is kept on the same page as her."

To book for ABE Workshops, please email
amgenbiotechexperience@science.edu.sg

To book for High Ability Learner's Workshops, please email **dnalab@science.edu.sg**

For all other classes, please book online at
https://bookings.science.edu.sg/obsinternetweb/

Please direct any other enquiries to
dnalab@science.edu.sg

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).

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

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SCIENCE CENTRE singapore

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