

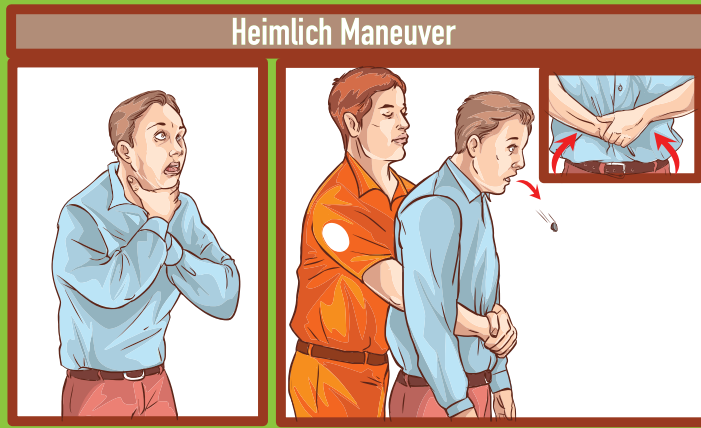


THEME: Scientific Method

Safety Measures in the Laboratory

Safety first

No matter where we are, safety is always important. This is true especially during scientific investigations. Safety is very important in the laboratory because if one is not careful, it could be very dangerous not only to that person, but to everybody around them. The first safety rule that everyone needs to remember and follow is to follow the instructions. Everyone also needs to be aware of the location of all safety equipment and wear the proper attire while in the laboratory. It is also prohibited to eat and drink in the lab as we might get poisoned if we do. Tasting and sniffing chemicals is also dangerous. Wastes are to be disposed of properly. When accidents do happen, one should know the steps to take. Lastly, we should not do any experiments without supervision.



FORM 4

CHAPTER

2



THEME: Scientific Method

Emergency Help

Emergency preparedness

Emergency help is very important to prevent fatalities, injuries, and to reduce damage to the bodies of both humans and non-humans. Since emergencies can occur at anytime and anywhere, preparedness is very important.

An individual can be prepared by taking training courses. During an emergency, the individual can then make decisions correctly and calmly. Have you attended any emergency preparedness courses?

Can you carry out CPR and the Heimlich manoeuvre?



FORM 4

CHAPTER

3

THEME: Scientific Method

Techniques of Measuring the Parameters of Health

How do I know if I am not healthy?

One of the ways we measure health is by measuring blood pressure. High blood pressure, if not monitored and controlled, may lead to more damaging consequences to the body.

Other than that, our waist circumference also depicts one's health. Its number may indicate the risk of stroke, sleep apnea and heart disease. Waist circumference shows the amount of visceral or belly fat that surrounds the internal organs. An increase in the amount of belly fat increases the risk of getting obesity-related disease.

The colour of urine can also show the state of hydration the body is in. Pale yellow or lighter-coloured urine is a good indicator that the body has consumed enough water.



FORM 4

CHAPTER

4

THEME: Maintenance and Continuity of Life

Green Technology for Environmental Sustainability

Love our Earth

In the past few decades, the developments in science and technology have grown very rapidly. The industrial sectors have expanded in turn to meet the demand of the world population. With the advancements in science, humans carry out various activities that harm Earth directly or indirectly.

If human activities are continued without proper management, all the harmful effects that we inflict on Earth will eventually get back to us. Therefore, Green Technology is developed to allow humans to carry out these activities with specific rules and restrictions to minimise, or not cause any more harm on Earth. For example, green vehicles are developed to reduce the emission of pollutants into the atmosphere, and awareness campaigns are carried out to educate the public of the importance of minimising the negative effects of human activities have on Earth.



FORM 4

CHAPTER

5

THEME: Maintenance and Continuity of Life

Genetics

Is my DNA the same as yours?

On the exterior, no two humans are 100% identical. However, on a genetic level, all humans are more than 99% identical! This means the diversity that we see is just less than 1% genetically. Scientists also believe that genes can disappear or break as a species evolve. It is believed that as a species evolve, some gene is lost because it is not needed anymore.

What is genetic and why is it important? Genetics is a branch of biology. It is the study of genes, gene variations and heredity in organisms. The study of genetics has been around since the 19th century. Through the study of genetics, we now better understand the way our body works and why it works in such manners. In addition, the advancement in biology techniques and broader knowledge in genetics made diagnosing individuals at risk of inheriting genetic disorders easier.





SCIENCE
inCONTEXT

FORM 4

CHAPTER

6

THEME: Maintenance and Continuity of Life

Support, Movement and Growth

Human beings have muscles covering their skeleton. This might seem normal to us, but 90% of organisms in the world actually have their bones outside of their bodies. These organisms are called invertebrates. Humans are called vertebrates.

There are two types of bones inside our body. The first is the cortical bone, which is a hard and dense bone. The second is the trabecular bone, which is usually inside larger bones, is less dense but still hard, and provides protection. Other than protecting the internal organs, bones also house bone marrows. Bone marrows have stem cells which are responsible in the production of blood, brain, heart and bone cells.



FORM 4

CHAPTER

8

THEME: Exploration of Elements in Nature

Elements and Substances

The Power of the Sun

As we all know, the Sun is the source energy for everything on Earth. Without the power of the Sun, there will be no waves, no wind and all living things on Earth will cease to exist. But where does the energy of the Sun come from?

The Sun is composed of mostly hydrogen and helium gas. With an extremely high temperature in its core, reaching millions of degree Celsius, the isotopes of hydrogen, hydrogen-1 and hydrogen-2 combines with one another in a nuclear fusion reaction to produce a helium-3 isotope.



A nuclear fusion reaction is a self-sustaining reaction that generates a tremendous amount of energy, mostly in the form of light energy and heat energy. The reaction will only stop when the hydrogen supply in the Sun runs out. The hydrogen supply has been estimated to run out in another few billion years.

*Penicillium* sp.

THEME: Exploration of Elements in Nature

Chemicals in Medicine and Health

A 'Lucky' Discovery

One sometimes finds what one is not looking for. When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionize all medicine by discovering the world's first antibiotic, or bacteria killer. But I suppose that was exactly what I did. — Alexander Fleming

Sir Alexander Fleming (6 August 1881 – 11 March 1955), a Scottish physician and microbiologist, discovered the world's first effective antibiotic, named by Fleming himself as Penicillin on March 7, 1929. Fleming's discovery of penicillin is described as the 'single greatest victory ever achieved over disease' and he was awarded the Nobel Prize in Medicine in 1945.

Fleming was already a brilliant researcher and was investigating the properties of Staphylococci. Fleming inoculated staphylococci on culture plates and left them in a corner of his laboratory before leaving for a holiday with his family. When he returned, he noticed that the lid of one of his culture plates was left open and the culture was contaminated with a blue-green mould. Fleming noticed that the bacteria around the mould did not grow, but those farther from the mould grew normally. This suggested that the mould had killed the bacteria. Fleming then identified the mould as being from the genus *Penicillium*. After further experiments and many tests, the antibiotic was finally mass produced.



FORM 4

CHAPTER

11



THEME: Energy and Sustainability of Life

Force and Motion

Supersonic aircrafts are aircrafts that can travel at a speed greater than the speed of sound. In air, sound travels at an average speed of 330 m s^{-1} , which is equivalent to 1188 km hr^{-1} . The first aircraft to fly at supersonic speed is the American Bell X-1, built in 1945.

Mach number is a simplified term used to represent the speed of sound. Mach 1 is equal to the speed of sound. Mach 0.75 refers to 75% of the speed of sound while Mach 1.5 means 1.5 times faster than the speed of sound.

Supersonic aircrafts are capable of travelling at speeds greater than Mach 1. Aircrafts that can fly at a speed greater than Mach 5 are often referred as hypersonic aircrafts.

Here is the Super Hornet aircraft with visible shock waves caused by a sonic boom.



FORM 5

CHAPTER

1

THEME: Maintenance and Continuity of Life

Microorganisms

The world of microbes

Microorganism or microbes are small organisms. Microbes include millions of species of fungi, bacteria, algae, protozoa and viruses. Scientists have determined that microorganisms are the oldest form of life on Earth. They have found a fossil dating back 3.5 million years that contains the remnants of the earliest microbes.

Having lived hundreds of millions of years before dinosaurs, microbes are everywhere. Most microbes cannot be seen by the naked eye, but some are visible, such as bread mould and mushrooms. Some microbes can be found in places with near boiling point temperatures, while others survive in freezing conditions. Most microbes live in moderate temperatures.



FORM 5

CHAPTER

5

THEME: Exploration of Elements in Nature

Carbon Compounds

Methane clathrate, the ice that burns

Ice and water cannot catch fire and burn like petrol and kerosene because they do not contain carbon. But it is a different case for methane clathrate. Methane clathrate, also known as methane hydrate, looks like ice (or snow) but it can catch fire easily due to its chemical composition. Discovered in Russia in 1960s, methane clathrate is a solid compound with a large amount of methane trapped in the crystal structure of water, forming a solid that appears almost like ice. Methane clathrate can be found in the sediments on the ocean floor. When lit, the crystal structure of water breaks down, releasing the methane, which catches fire and burn.

Methane + oxygen \rightarrow carbon dioxide + water vapour

It looks like the ice catches fire and is burning continuously!



VIDEO

Methane
clathrate

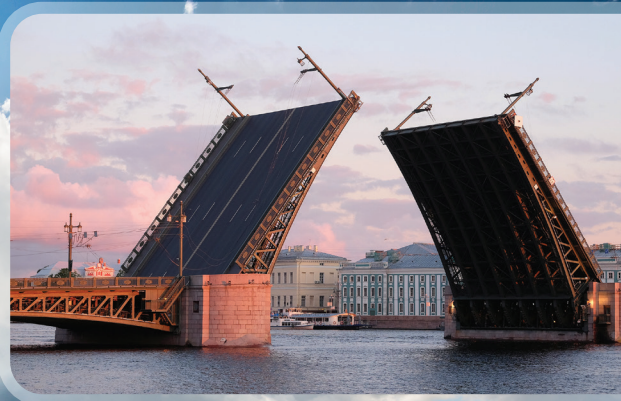


SCIENCE
inCONTEXT

FORM 5

CHAPTER

8



THEME: Energy and Sustainability of Life

Force and Pressure



The photographs above show four objects with one thing in common. All of them utilise the concept of pressure in a fluid. There are two important scientific principles involving the pressure in a fluid; the Pascal's principle and the Bernoulli's principle.

The Pascal's principle discusses how pressure is transferred in a liquid within a closed system. The idea from Pascal's principle is applied in an excavator and a lift bridge.

The Bernoulli's principle discusses how the pressure of a fluid changes with its speed. How a huge airplane takes off and how a bullet train can travel so fast can be explained by the Bernoulli's principle.



FORM 5

CHAPTER

9

THEME: Earth and Space Exploration

Space Technology

Gateway Space Station

The Lunar Gateway or Gateway in short, is a new space station set to be built in the orbit around the Moon. Gateway will be located at a distance of 410 000 km away from Earth, compared to the current International Space Station, ISS which is 400 km away from Earth. Gateway's location is very close to the Moon, which allows astronauts to explore the Moon in great detail, as well as the outer space. The Gateway Space Station can also serve as a service station for astronauts who are traveling to Mars and beyond. Compared to the International Space Station, the Gateway Space Station will be much smaller. The ISS is 109 m long and 73 m wide, which is slightly larger than an American football field. The Gateway will be about 30 to 35 m long and only 5 m wide. The ISS is occupied by at least 3 astronauts throughout the year, but the Gateway will only be occupied by 4 crew members for just 30 days in a year. For the rest of the time, Gateway will be empty.

As the Gateway is so far away from Earth, the signal transmission from Gateway takes a longer time to reach the control centre on Earth. To overcome this, the choice of laser communication over radio communication was proposed.