

Keywords

- ◆ Nuclear energy
- ◆ Nuclear fission
- ◆ Nuclear fusion
- ◆ Nuclear reactor
- ◆ Electricity generation
- ◆ Impact of nuclear test

Why is the number of countries using nuclear energy increasing?

How is nuclear energy produced?

Is nuclear energy safe to use?

Can nuclear power stations be built in Malaysia?



Science Digest

Thorium to Replace Uranium

Similar to uranium, thorium can also undergo nuclear reaction that can generate electricity. The Malaysian Nuclear Agency is responsible for conducting research projects on thorium in cooperation with several foreign agency. The project aims to study the availability of thorium as an alternative nuclear fuel to replace uranium in research reactors in the future.

Source: www.nuclearmalaysia.gov.my
(Access on 19 August 2019)

You will learn about:

- the use of nuclear energy
- the production of nuclear energy
- impact of using nuclear energy
- nuclear energy in Malaysia

12.1 The Use of Nuclear Energy

Nuclear energy brings a lot of benefits to mankind if it is generated and controlled properly. The number of countries using nuclear energy to generate energy in various fields has been increasing every year.

Now, there are more than 30 countries in the world using nuclear energy as their energy source. Among them are the United States of America, Russia, France, Slovakia and Japan. Why do these countries use nuclear energy rather than other energy sources?



Countries in the World that Use Nuclear Energy
<http://bukutekskssm.my/Science/F4/Pg256>

Nuclear energy is an alternative energy that can be used to generate electricity in order to replace or reduce the use of petroleum and coal. This energy is produced in greater quantity and is more efficient compared to other energy sources.



Nuclear energy produces ionising radiation that is used in various fields such as medicine, agriculture and industry. The use of nuclear energy can improve the standard of health and living of man.

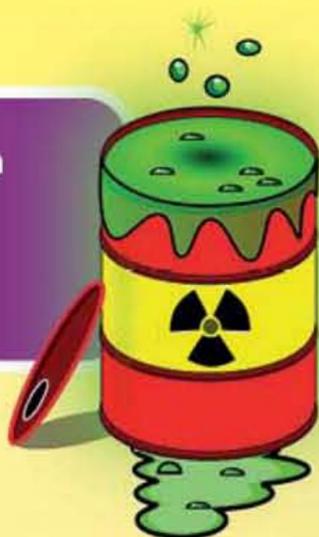
Nuclear energy releases very little greenhouse gases compared to other energy sources.



Figure 12.1 Uses of nuclear energy

What are the adverse effects of nuclear energy sources compared to other energy sources?

Radioactive waste can affect the health and threaten lives of all living things.



The huge amount of energy produced can cause severe harm to mankind if it is misused.



Figure 12.2 Adverse effects of nuclear energy sources



Activity 12.1

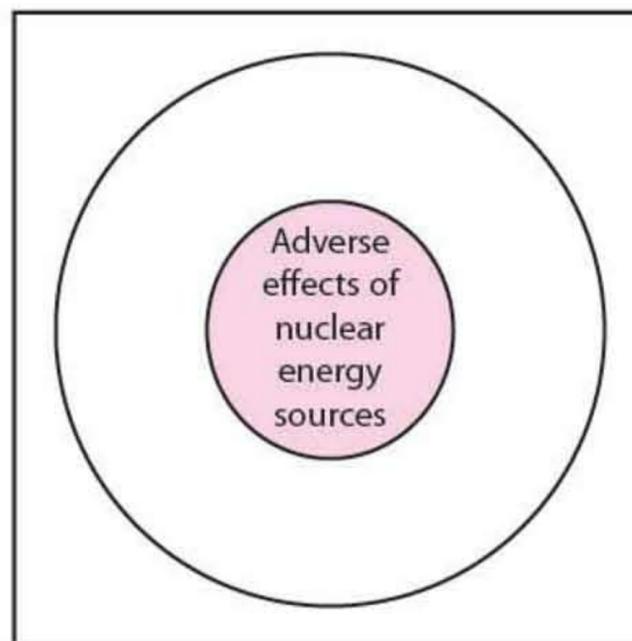
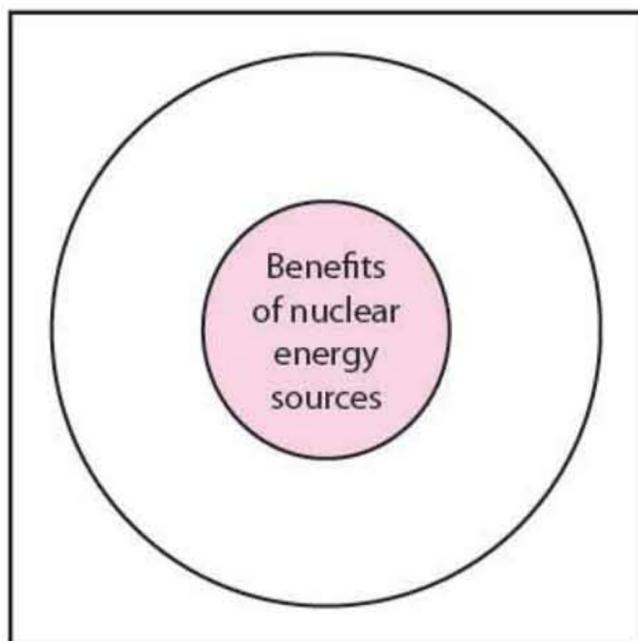
Mind Map

Aim: To construct a mind map to show the benefits and adverse effects of nuclear energy sources compared to other energy sources.

21st Century Skills

Instructions:

1. Do active reading and gather information regarding the benefits and the adverse effects of nuclear energy sources compared to other energy sources.
2. Construct the mind map as shown below and fill it with the information you have gathered.
3. Put up the mind map on the notice board at the back of the classroom.



FORMATIVE PRACTICE 12.1

1. State three major countries in the world that use nuclear energy sources.
2. What are the benefits of using nuclear energy sources compared to other energy sources?

Nuclear energy means energy resulting from reactions in the nucleus of atoms.



Teacher, how is nuclear energy produced?



Nuclear energy is produced through **nuclear fission** and **nuclear fusion**.

Nuclear Fission

Nuclear fission is the **process of splitting** a heavy radioactive nucleus into two or more nuclei, which are lighter and more stable together with the release of energy.

- Nuclear fission occurs when a heavy radioactive nucleus such as uranium-235 is bombarded by a slow neutron.
- Bombardment by the neutron causes the nucleus to split into two or more lighter and stable nuclei.
- This process releases a lot of energy.

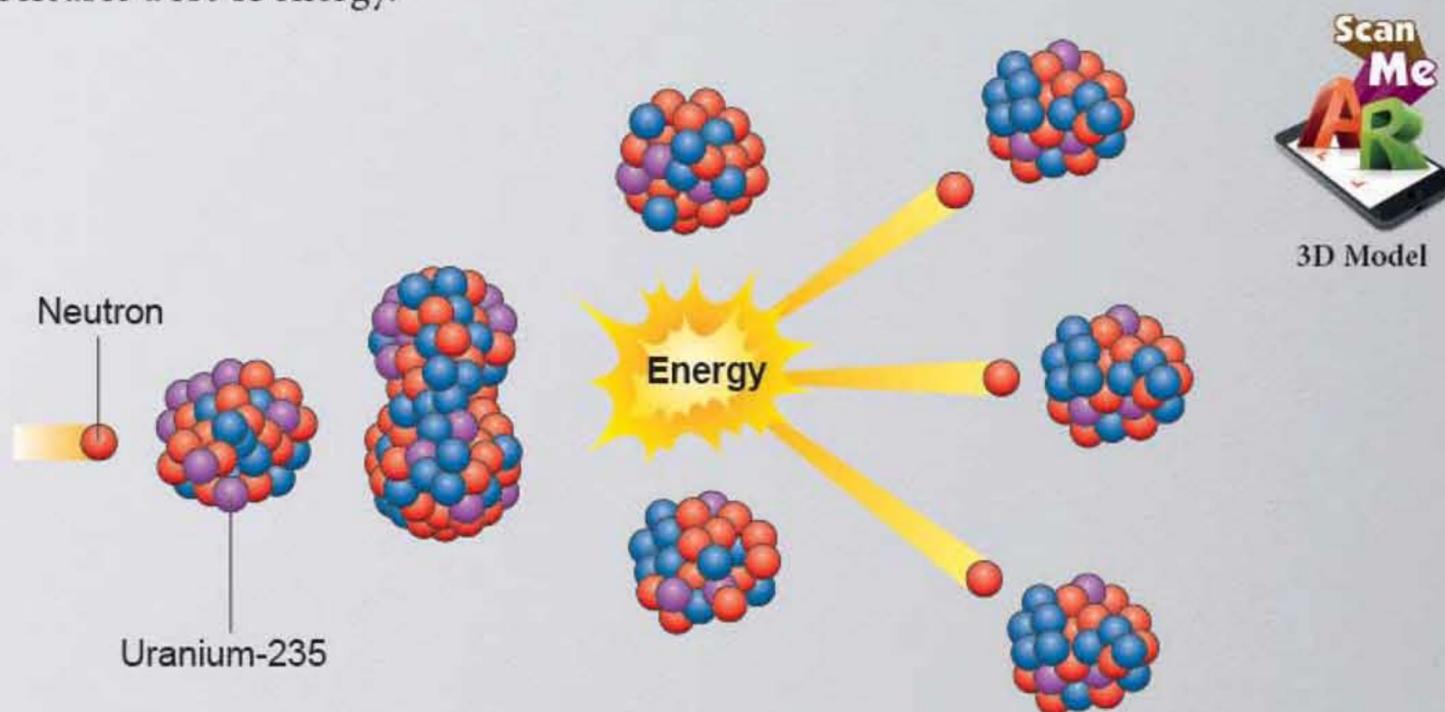


Figure 12.3 Nuclear fission of uranium-235

- The nuclear fission will occur continuously when a neutron bombards and splits a new nucleus of large mass. This reaction is called a **chain reaction**.

History Corner

Arco, Idaho in the United States of America is the first town in the world to use electricity generated by a nuclear power station. This occurred on 17 July 1955 with power generated by the BORAX-III reactor built at the Argonne National Laboratory.

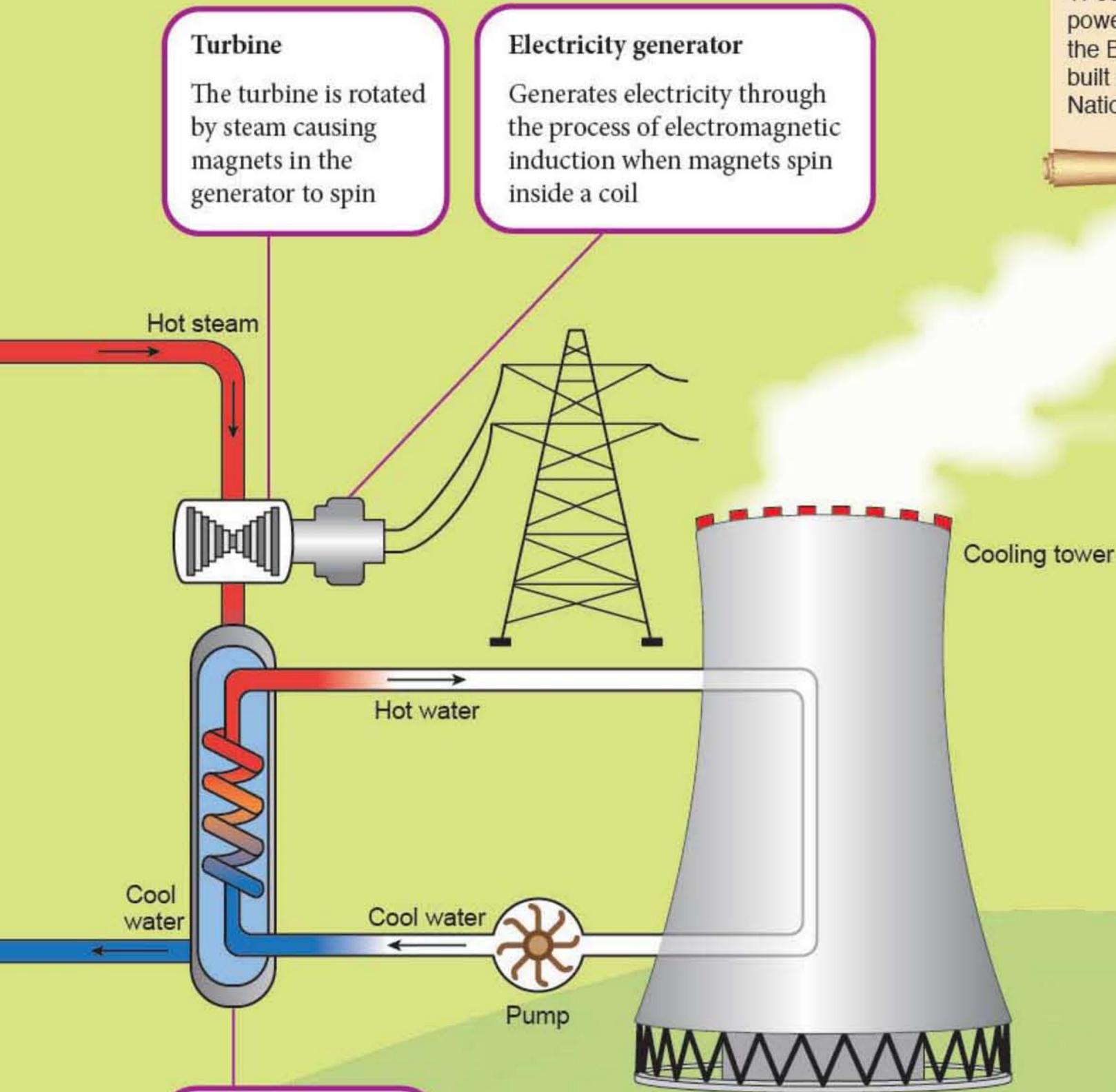


Turbine

The turbine is rotated by steam causing magnets in the generator to spin

Electricity generator

Generates electricity through the process of electromagnetic induction when magnets spin inside a coil



Condenser

Cools and condenses steam into water

Nuclear Fusion

Nuclear fusion is the **process of fusing** or **combining** two light radioactive nuclei to form a heavier nucleus with the release of energy.

- For example, two light and small nuclei such as deuterium and tritium (hydrogen isotopes) combine to form a bigger and heavier nucleus.
- This process occurs at a very high temperature.
- This process releases more nuclear energy than nuclear fission.

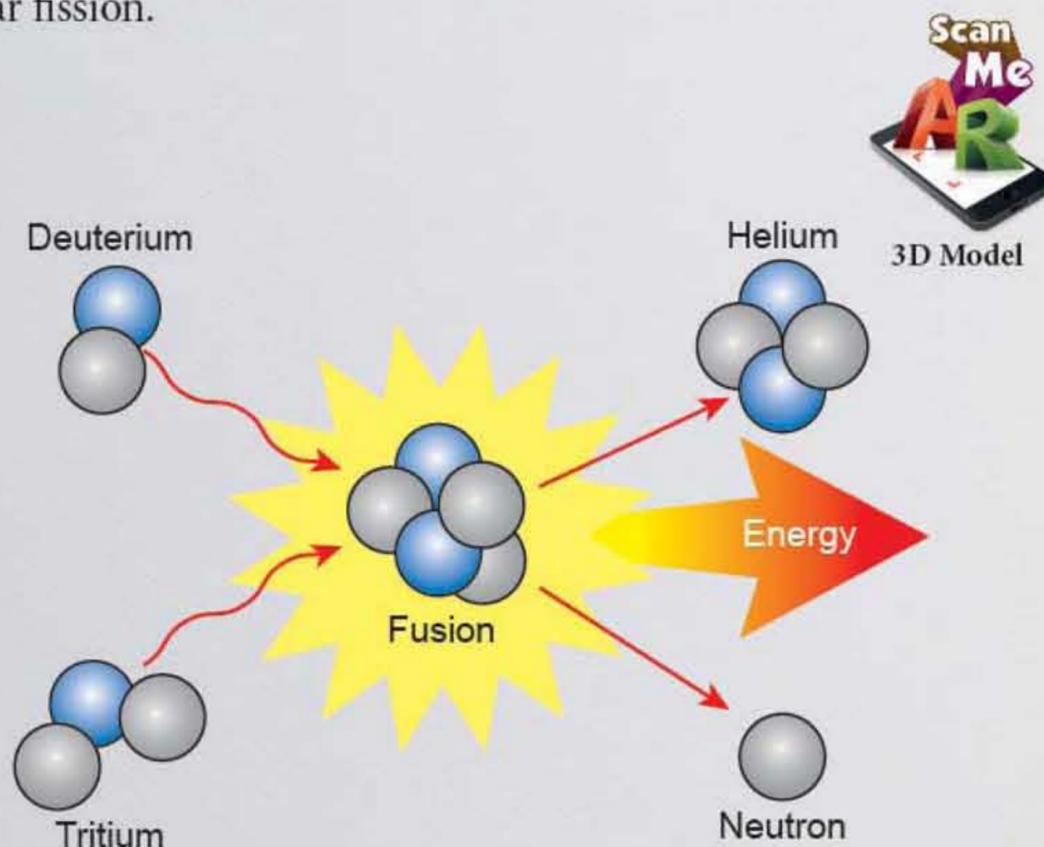
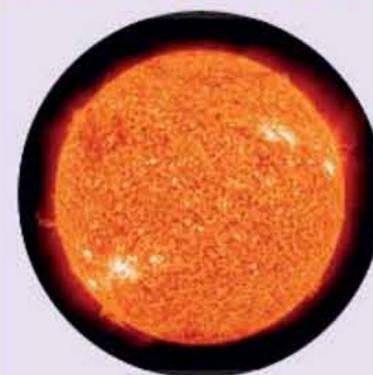


Figure 12.4 The fusion of two hydrogen isotopes

Science Gallery



Nuclear fusion occurs continuously in the Sun. This is because the Sun has hydrogen isotopes and high temperature. The energy released from this process is the main source of energy for life on Earth.

Brain Teaser



Why does nuclear fusion require a high temperature?



Activity 12.2

Result Showcase

Aim: To create a multimedia presentation to explain the production of nuclear energy.

Instructions:

1. Carry out this activity in groups.
2. Gather information about the production of nuclear energy through nuclear fission and nuclear fusion.
3. Discuss the information gathered and prepare a multimedia presentation to explain nuclear fission and nuclear fusion.
4. Present the findings obtained by your group to the class.

21st Century Skills

Generating Electricity from Nuclear Energy

You learned about electricity generation in Form 3. The main use of nuclear energy is to generate electricity. The generation of electricity from nuclear energy is done in the **nuclear power station**. A nuclear power station consists of a **nuclear reactor** and a **generator**. The nuclear reactor produces a huge amount of energy. Let us take a look at the process of generating electricity that occurs in a nuclear power station.

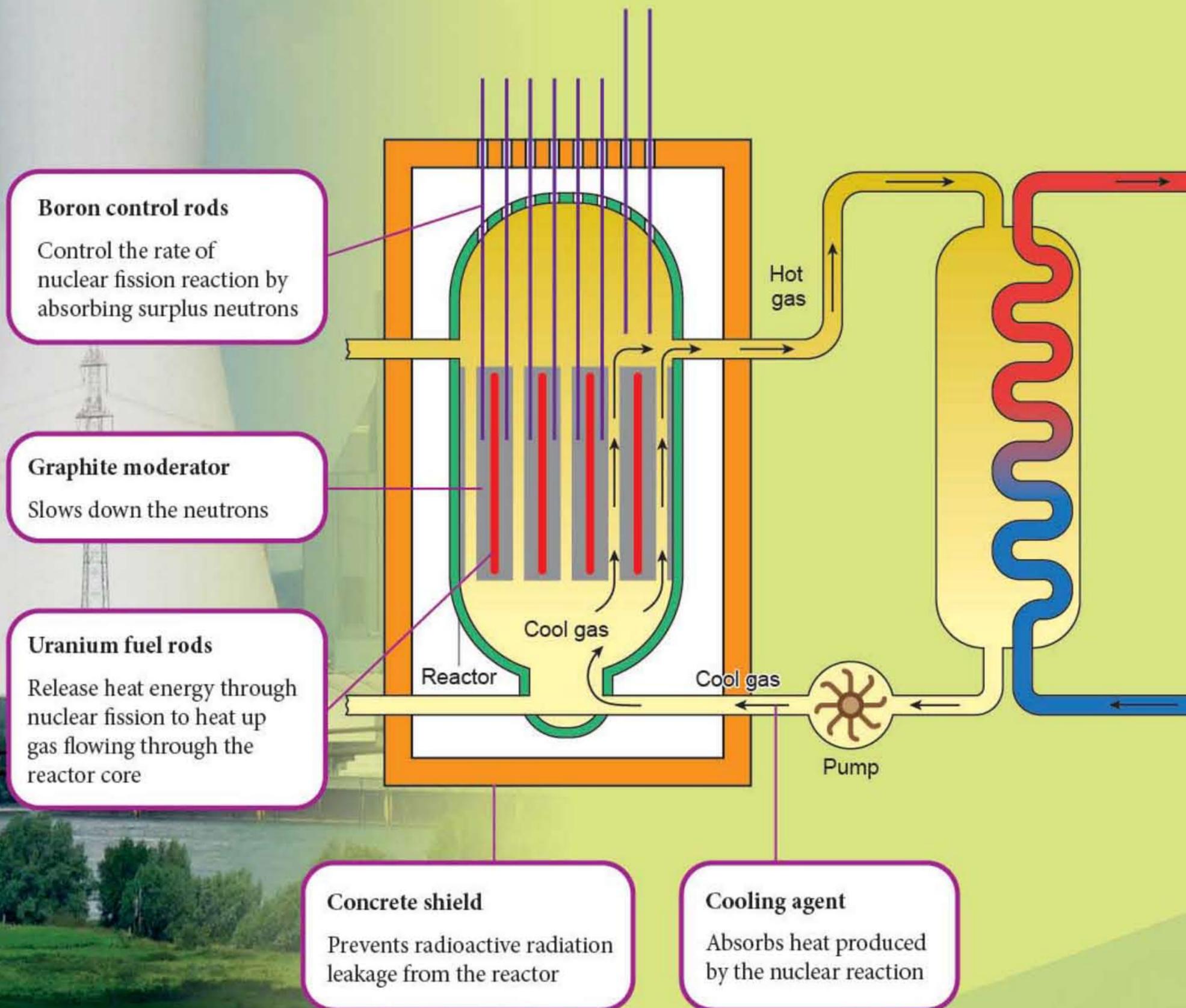


Figure 12.5 A nuclear power station

Malaysia has a nuclear reactor of 1 megawatt power belonging to the Malaysian Nuclear Agency. The TRIGA PUSPATI Reactor (RTP) started operation on 28 June 1982. RTP is a pool-type reactor permitting experiments to be conducted in the reactor core. However, this reactor is only for the purpose of training, doing researches and producing radioisotopes. Malaysia must build a nuclear reactor capable of generating 1000 megawatts of power if it wants to generate electricity using nuclear energy.



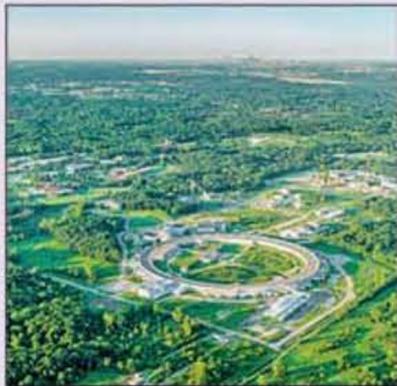
Triga Puspati Reactor

<http://bukutekskssm/Science/F4/Pg262.mp4>

VIDEO

(Source: Official Website Agensi Nuklear Malaysia)

Science Gallery



Argonne National Laboratory

The Argonne National Laboratory is a laboratory specifically built for the development of nuclear physics. This laboratory is on the outskirts of Chicago, United States of America. This laboratory which started operation in the 1940s has made many contributions to the field of nuclear physics. Almost all nuclear reactors built nowadays are the result of in-depth researches conducted at Argonne National Laboratory.

The Use of Nuclear Energy in Some Countries

Many countries in the world continue to choose nuclear energy as an alternative source of energy to generate electricity. There are several reasons why the countries choose nuclear energy as their energy source.

Lack of other energy sources

- Most of these countries using nuclear energy lack other energy sources such as coal and petroleum. Importing these energy sources from other countries will incur high cost. Therefore, they have to use alternative energy sources such as nuclear energy.

Vast country and high population density

- China for example is vast and has a high population density. The amount of power produced using nuclear energy is enough to generate electricity for the whole country.

Source of national income

- The nuclear reactor in Slovakia, for example, can produce electricity more than needed by the country. Therefore, they can supply electricity to neighbouring countries and earn lucrative income.

Sophisticated technology

- Countries using nuclear energy are always conducting research and development. As a result, they now have more sophisticated technologies and are able to reduce the risks associated with nuclear reactors. One such example is the Argonne National Laboratory in the United States of America.



Activity 12.3

Think-Pair-Share

21st Century Skills

Aim: To search and share information on the use of nuclear energy in certain countries.

Instructions:

1. Carry out this activity in pairs.
2. Take a card written with the name of a country which uses nuclear energy from your teacher.
3. Gather information on the use of nuclear energy in that country.
4. Present the findings obtained in front of the class.



FORMATIVE PRACTICE 12.2

1. Fill in the blanks with the correct answers.
 - (a) The process of _____ occurs when a _____ bombards a nucleus of large mass which then _____ into two new nuclei of smaller mass that are nearly the same and more stable together with the release of energy.
 - (b) The process of nuclear fusion only occurs at high _____.

12.3 Impact of Using Nuclear Energy

The use of nuclear energy should be regulated properly so as to bring benefits to mankind and the environment. Since nuclear energy is increasingly being used around the world, we should know the impact of using this energy on life and the environment.

Impact of Using Nuclear Weapons

Early research on nuclear energy was conducted in the 1940s to produce the atomic bomb. Plutonium, the byproduct from nuclear fission in the nuclear reactor was used to make the atomic bomb. The world saw the devastation when nuclear energy was used to make nuclear weapons. Nuclear weapons were used by the United States of America on the cities of Hiroshima and Nagasaki during World War II.

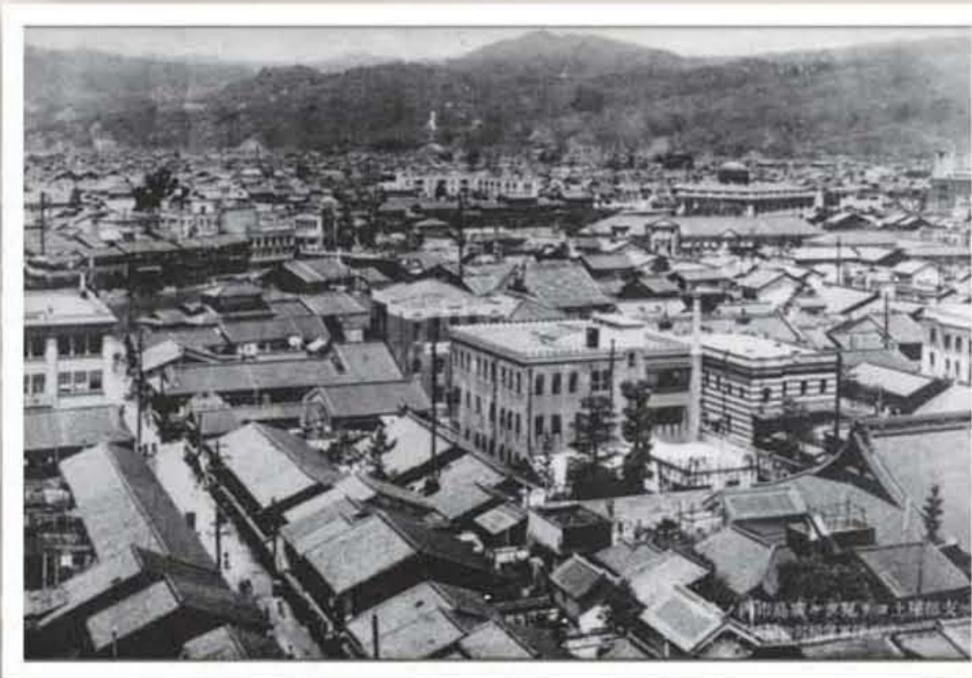
History Corner

J. Robert Oppenheimer is the first person in the world to invent the atomic bomb. He is called 'Father of the Atomic Bomb'. The bomb he invented was used by the American military during World War II. He, however, expressed regret after personally seeing the devastation caused by the explosion of the atomic bomb.

The bombing of Hiroshima and Nagasaki with atomic bombs during World War II

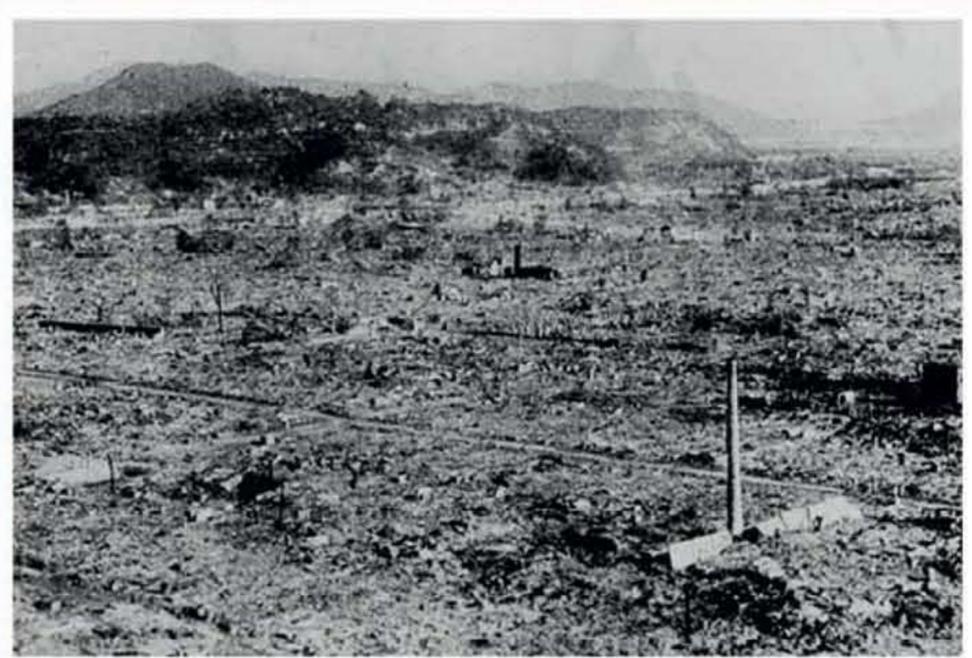
- The atomic bomb “Little Boy” was dropped on Hiroshima on 6 August 1945, followed by another atomic bomb “Fat Man” on Nagasaki on 9 August 1945.
- The nuclear explosion caused a powerful shock wave that immediately killed about 70,000 civilians.
- The blast caused the whole city to heat up to the extent that steel structures began to melt.
- The blast also affected the environment due to shock wave and radioactive fallout.
- At that moment, all communication systems in the city were cut off.

Before



(Photo source: *The City of Hiroshima*)

After



(Photo source: *ICRC Archives*)

Photograph 12.1 *Effect of bombing on Hiroshima*

Many countries have now started to invent and produce their own nuclear weapons. However, they are still bound by the **Nuclear Nonproliferation Treaty (NPT)** which controls and prohibits any country from using nuclear weapons arbitrarily.



The Effects of Nuclear Weapons
[http://bukutekskssm.my/Science/
F4/Pg264](http://bukutekskssm.my/Science/F4/Pg264)

INFORMATION

Impact of Nuclear Test

Before nuclear weapons are used, nuclear tests have to be conducted to determine whether the weapons can function. Nuclear tests are conducted in the open atmosphere, on land or underwater. These nuclear tests have adverse impact on living things and the environment.

Nuclear tests done underground, for example, will cause radiation effects to soil and water sources. Similarly at sea, destruction of living things and pollution will occur. For humans and living things on land, the spread of radiation from nuclear tests will cause somatic and genetic effects.

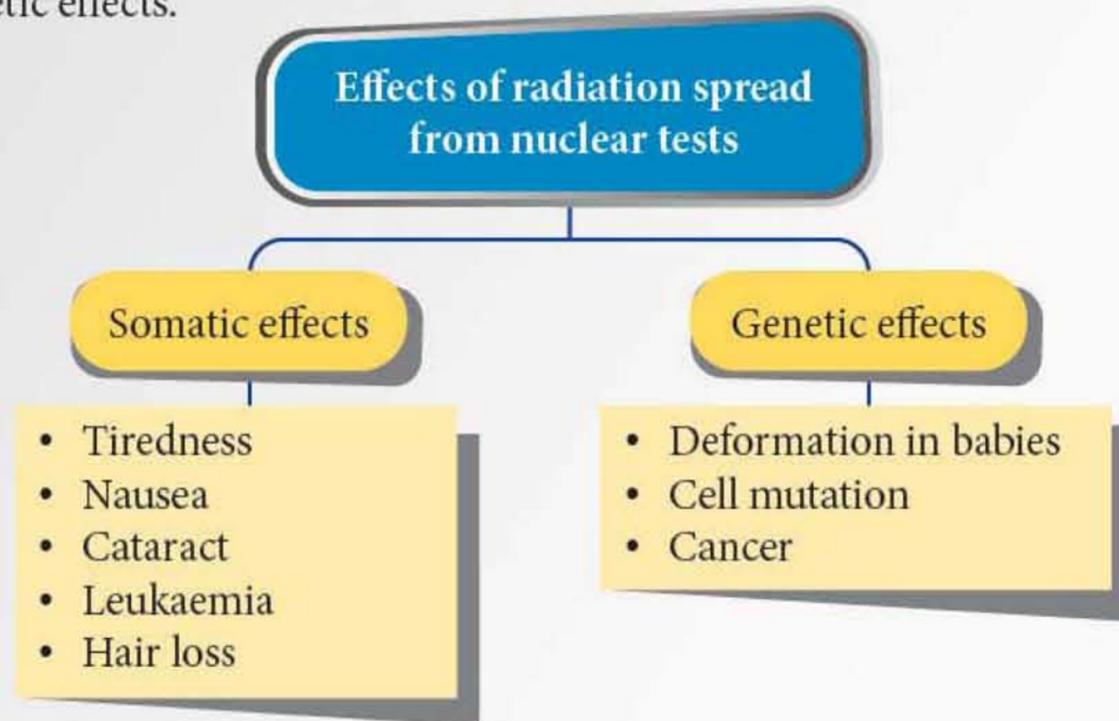


Figure 12.6 *Effects of radiation spread from nuclear tests*

Are there countries still doing nuclear tests?



Photograph 12.2 *Nuclear test at sea*



Activity 12.4

Think-Pair-Share

Aim: To gather information regarding history of the atomic bomb attack on Hiroshima and Nagasaki, and also nuclear tests.

21st Century Skills

Instructions:

1. Carry out this activity in pairs.
2. Gather information regarding history of the atomic bomb attack on Hiroshima and Nagasaki, and also nuclear tests by visiting the relevant websites.
3. Present the information gathered to the class.



FORMATIVE PRACTICE

12.3

1. State three adverse effects that may occur if nuclear weapons continue to be used.
2. What is the purpose of conducting nuclear tests?

12.4 Nuclear Energy in Malaysia

Justify the Construction of Nuclear Power Station in Malaysia

In subtopic 12.1, we learned the benefits and adverse effects of using nuclear energy. In Malaysia, 70% of the energy used is generated by natural gas. Petroleum, natural gas and coal are fossil fuels that are non-renewable.

Some students were asked about the justification for building a nuclear power station in Malaysia. The following are some of their opinions.



In my opinion, Malaysia needs to build a nuclear power station to meet the increasing consumer demand for electricity.

I do not agree because nuclear reactors produce radioactive waste that is dangerous to humans and the environment if not handled carefully.



As a Malaysian citizen, what is your opinion? Carry out Activity 12.5 with your classmates.



Activity 12.5

Debate

Aim: To debate the justifications for a nuclear power station in Malaysia.



Instructions:

1. Carry out this activity in groups.
2. The topic of the debate is "The justifications for a nuclear power station in Malaysia".
3. Divide into two groups, the proposing team and the opposing team.
4. As the proposing and opposing teams, each team has to present their arguments.

Several factors have to be considered in operating a nuclear power station:

- fossil fuels such as coal, natural gas and petroleum will deplete and its cost will increase
- effects of pollution due to nuclear energy is less compared to fossil fuels
- the location to build nuclear power station must be strategic. It must be near water sources to facilitate the cooling process
- the rate of energy production by nuclear power is much greater than that of fossil fuels

My Nation



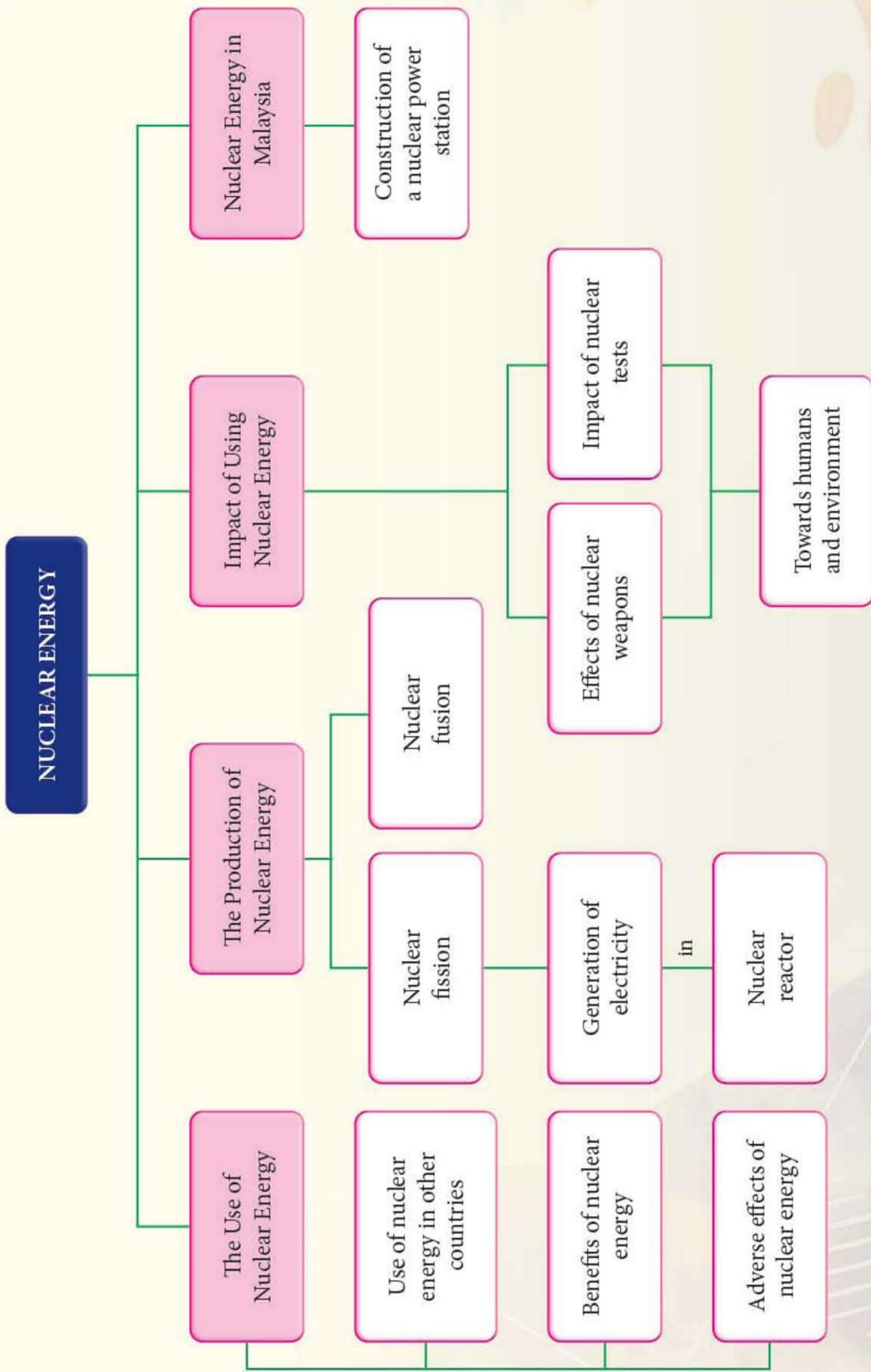
Malaysian Nuclear Agency

The Malaysian Nuclear Agency, formerly known as Malaysian Institute for Nuclear Technology Research (MINT), is located in Bangi, Selangor. This agency was formed to coordinate science and technological activities and other related technologies. Its main activity is international collaboration in the research and development of nuclear technology for national development.



FORMATIVE PRACTICE 12.4

1. State two main energy sources which are currently used in Malaysia.
2. State three factors that must be considered in operating nuclear power stations.



Self-reflection

After studying this chapter, you are able to:

12.1 The Use of Nuclear Energy

Justify the use of nuclear energy for a country that has been identified.

12.2 The Production of Nuclear Energy

Describe the production of nuclear energy by nuclear fission and nuclear fusion.

Describe the generation of electricity from nuclear energy.

Justify the use of nuclear energy in countries using it.

12.3 Impact of Using Nuclear Energy

Tell a story about the impact of using nuclear weapons on life and the environment.

Conclude the impact of nuclear tests on the environment.

12.4 Nuclear Energy in Malaysia

Justify the construction of a nuclear power station in Malaysia.

Summative Practice 12



Objective Questions
<http://bukutekskssm.my/Science/F4/Q12>

1. Photograph 1 shows a nuclear power station in a certain country.



Photograph 1

- (a) Name two countries that are major users of nuclear energy.
 (b) Based on your answer in question 1(a), what is the use of nuclear energy in those countries?
 (c) State two advantages of nuclear energy sources. 
2. Figure 1 shows a nuclear reaction.

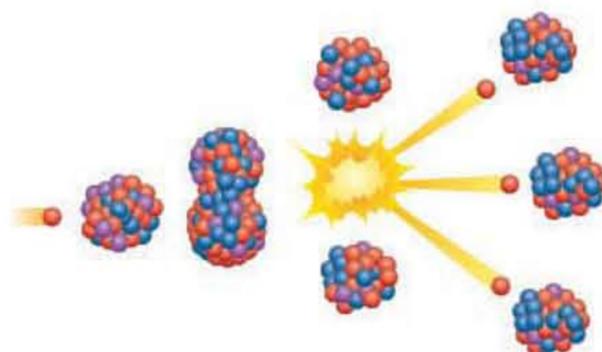


Figure 1

- (a) Name the nuclear reaction.
- (b) Based on Figure 1, explain the nuclear reaction. 🧠
- (c) What would happen if the reaction is not controlled properly? 🧠
- 3.** Reaction X always occurs in the Sun.
- (a) What is the reaction?
- (b) Explain why the reaction can occur on the surface of the Sun. 🧠
- (c) What would happen on Earth if the reaction you mentioned in question 3(a) suddenly stops? 🧠
- 4.** Figure 2 shows part of a nuclear power station.

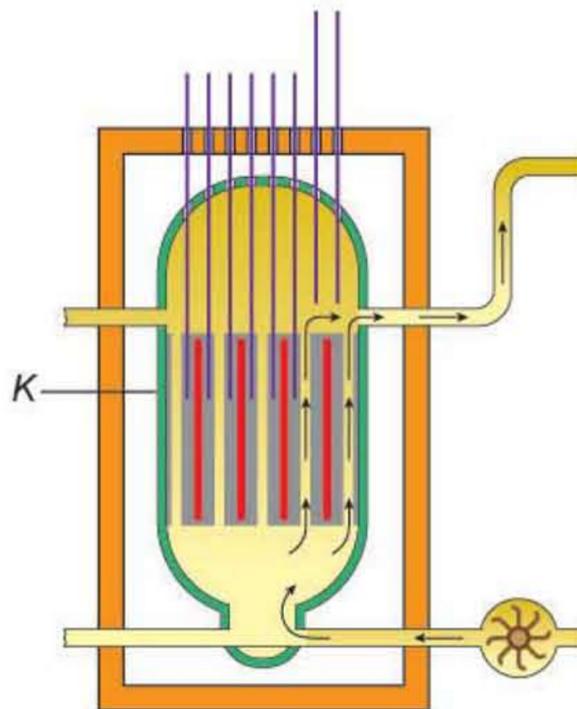


Figure 2

- (a) What is the process that occurs in *K*?
- (b) What is the purpose of the process you mentioned in question 4(a)? 🧠
- (c) *K* has various safety features. State two safety features in *K*.
- (d) Predict the impact if there is a leakage in the structure of *K*. 🧠

Mind Challenge

5.

A nuclear reactor can produce nuclear energy on a large scale to generate electricity.

Based on the statement above, explain the way nuclear energy is converted into electricity in a nuclear power station. 🧠

Answers

ONLY SELECTED ANSWERS ARE PROVIDED HERE

Chapter 1

Summative Practice 1

- (a) Laminar flow cabinet/fume chamber/safety shower/eyewash station (any three)
(b) There are dangerous substances in the laboratory that are flammable, corrosive, toxic and fragile.
(c) His action is correct because lemon juice contains a pH value of more than 5 and less than 7.
- (a) (i) Class B fire
(ii) Foam/dry powder/carbon dioxide
(b) • Ethanol is very close to the fire source and the conditions needed for combustion are present.
• Ethanol is a flammable and volatile substance.
(c) • Use the fire extinguisher
 - Pull the safety pin from the fire extinguisher.
 - Aim the nozzle at the base of the fire. He should be 2.0 – 2.5 metres away from the fire.
 - Squeeze the handle on top of the fire extinguisher.
 - Spray evenly on the entire fire source by sweeping the nozzle from side to side.• Use the fire blanket
(d) (i) Types of fire extinguishers
(ii) Expiry date of fire extinguishers
(iii) Pressure reading on fire extinguishers
(iv) Number of fire extinguishers based on types
(v) Location of the fire extinguishers in the school's emergency route plan

Chapter 2

Summative Practice 2

- (a) *P*: Cardiopulmonary resuscitation, CPR
Q: Heimlich Manoeuvre
(b) The victims will experience brain damage because they do not receive sufficient oxygen in their body and brain for a certain period.
- (a) CPR
(b) Position the victim's body on his side and wait for the ambulance to arrive.

- (a) The victim will choke.
(b) The Heimlich Manoeuvre will increase the pressure in the lungs causing the food to be ejected.
(c) Yes. To help a pregnant woman using this method, place your hands right at the bottom of the breastbone, a little bit higher than on a non-pregnant woman. Then, proceed with the usual Heimlich Manoeuvre.
- (a) The Heimlich Manoeuvre
(b) Firstly, one of Jia Hui's friends needs to stand behind Jia Hui and bend her body slightly forward. Then, place her hands around Jia Hui's waist and clench a fist her right hand. The right fist is put between Jia Hui's navel and ribs. Her left hand is placed on top of her right fist. Next, she needs to press and jerk upward with quick force until the food is ejected out of Jia Hui's mouth.

Chapter 3

Summative Practice 3

- (a) Infection, exposure to extreme heat, vigorous exercise
(b) 36.9°C
(c) Infrared thermometer/rectal thermometer
- (a) *P*: Infrared thermometer
Q: Rectal thermometer
(b) To measure body temperature
(c) Infrared thermometer
(d) Can cause death (accept any suitable answers)
- (a) 100 – 150
(b) Manipulated variable: the age
Responding variable: the pulse rate
(c) When the age increases, the pulse rate decreases.
(d) 60 – 65 beats per minute
- (a) The wrist
(b) 60 – 65 beats per minute
(c) 120/80 mmHg
(d) Fareeza must do health check-ups regularly at the clinic or hospital (accept any suitable answers)
- (a) 120/80 mmHg
(b) The reading of Siva's blood pressure is higher than a normal person because he may have high blood pressure.
(c) Siva needs to go to the hospital to get proper treatment.
(accept any suitable answers)

6. (a) Organ damage
- (b) Sphygmomanometer
- (c) Systolic pressure is the blood pressure when the heart muscles contract. Diastolic pressure is the blood pressure when the heart muscles are resting.

Chapter 4

Summative Practice 4

1. (a) The development and application of products, equipment and systems used to conserve the environment and nature, as well as minimising and reducing the negative effects of human activities.
- (b) Energy, environment, economy, social
2. (a) Saves energy, avoids wastage, strengthens the country's economy
- (b) Switch off the electrical appliances when they are not in use. This can save energy consumption at home.
3. (a) Energy sector, transportation sector, waste and wastewater management sector
- (b) Energy sector – focuses on the use of a cleaner and carbon-free alternative energy that can replace the use of fossil fuels.
Transportation sector – focuses on the improvement of a cleaner transportation infrastructure, vehicle fuel and public transportation.
Waste and wastewater management sector – focuses on minimising waste disposal and wastewater into the environment by converting waste or wastewater into something new such as compost.
4. (a)
 - Global warming
 - Increase in greenhouse gases
 - Acid rain
- (b)
 - Use renewable energy
 - Practise energy efficiency
- (c) Prevents global warming/reduces carbon dioxide production in the air/prevents acid rain
- (d) I agree, because the practice of Green Technology can reduce the dependence on fossil fuel energy sources, thus can reduce air pollution due to the release of carbon dioxide from the burning of fossil fuels.
5. (a) Transportation sector – focuses on the improvement of a cleaner transportation infrastructure, vehicle fuel and public transportation
- (b) Using solar-powered vehicles, carpooling, cycling

Chapter 5

Summative Practice 5

1. (a) (i) DNA (deoxyribonucleic acid)

- (ii) Deoxyribose sugar, phosphate group, nitrogenous base

- (b) 46
- (c) Autosomes carry genes that control the characteristics of organisms such as the colour of pupil, ability to roll the tongue and types of hair, while sex chromosomes carry genes that determine the gender of an organism whether male or female.
2. (a) Prophase I
- (b) Chromosomes shorten and thicken, and become clearly visible. Homologous chromosomes pair together. Crossing over occurs.
- (c) The process that occurs is crossing over. Crossing over produces a new genetic combination. If crossing over does not happen, no variation is formed.
- (d) Reproductive cells
3. (a) Prophase
- (b) Chromosomes are arranged in an equatorial plane. The spindle fibres are attached to the centromere.
- (c) Humans: skin, Plants: shoot/root

Chapter 6

Summative Practice 6

1. (a) (i) Tendon
- (ii) Tendons connect muscles to bones.
- (iii) Tendons consist of a combination of tough and inelastic fibres.
- (b) The individual cannot move the bone because the force generated by muscle contraction cannot be transferred to the bone.
- (c) Tendon is a structure that connects muscles to the bone while ligament is a structure that connects bone to bone.
2. (a) Hydrostatic skeleton
- (b) Longitudinal muscle and circular muscle
- (c) Movement in the earthworm occurs when the longitudinal muscles contract and the circular muscles relax in opposition. This opposite movement creates movement from the front to the rear of the earthworm's body. The earthworm also has chaetae (bristle-like hairs) on its body to grip the ground during movement.
3. (a) (i) The giraffe will spread its legs.
- (ii) This will increase the base area of the giraffe and lower its centre of gravity
- (b) (i) X
- (ii) Animal X has a lower centre of gravity.
- (iii) When sitting down.
4. Woody plants have big and tall stems. To increase the stability of woody plants, the plants need to increase their base area. Therefore, woody plants have additional support such as buttress roots, prop roots and stilt roots to increase their base area.

Chapter 7

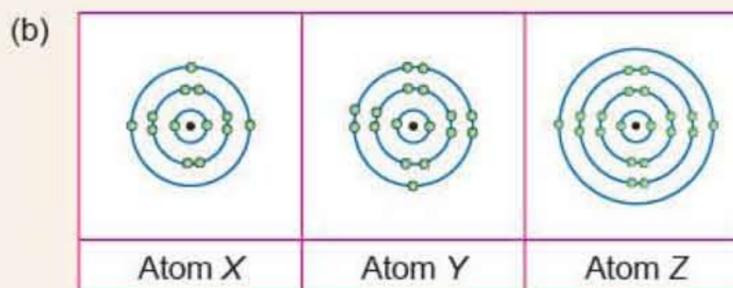
Summative Practice 7

- Pituitary gland
 - Thyroxine
 - Low metabolic rate
 - Stunted mental and physical development in children (cretinism)
 - Lack of energy in adults (myxedema)
 - Tend to be obese
 - Have goitre
 - Pancreas
 - Insulin
 - Less insulin hormone is secreted
 - Blood glucose is not able to be converted to glycogen.
 - This causes the blood glucose level to rise.
 - Testosterone hormone
 - Oestrogen, progesterone
 - Promotes the development of female secondary sexual characteristics
 - Prepares the uterus for implantation of embryo
 - After puberty
 - Testis
 - Controls the development of male secondary sexual characteristics such as enlargement of the voice box and hair growth on their face.

Chapter 8

Summative Practice 8

- Salt: ions
 - Sugar: molecules
 - Ions: marbles/limewater/acid/alkali
Molecules: carbon dioxide/oxygen/nitrogen/naphthalene/alcohol
 - Molecules: oxygen gas/carbon dioxide gas/sulphur dioxide gas
Ions: zinc oxide/iron oxide
- The elements are arranged from left to right and top to bottom, in the order of their increasing proton numbers.
 - P and U
 - Element R.
Element R has achieved a stable octet electron arrangement.
 - Group 16, Period 3
 - P: 2.1
 - Q: 2.7
 - T: 2.8.3
- X: 14
Y: 18
Z: 20



- X: Group 13, Period 3
Y: Group 17, Period 3
Z: Group 2, Period 4
 - Atom X will donate three electrons to the atom of another element to form a positive ion.
 - Atom Y will accept one electron from the atom of another element to form a negative ion.
- Q and R, because atom Q and R have the same proton number but different nucleon number.
 - Industry: is used to detect leakage in underground pipes
Medical: detect clogged blood vessels
 - Phosphorus-32: is used to detect the rate of absorption of phosphorus fertiliser in plants
 - Carbon-14
Agriculture: to detect the rate of photosynthesis in plants
Archaeology: to determine the age of fossils and artifacts

Chapter 9

Summative Practice 9

- Object P: brass
Object Q: bronze
 - Alloy P: to make door knobs/to make decorative items/to make food containers
Alloy Q: to build sculptures/to build monuments/to make knives
 - A bronze block is stronger compared to a copper block due to the presence of foreign atoms in the bronze block. This will disrupt the orderly arrangement of the atom in the bronze block. When force is applied onto the bronze block, the layers of atoms have difficulty sliding over one another thus making it stronger.
 - Yes, it can.
Because alloy P is hard and resistant to corrosion making it suitable to be used. Besides that, alloy P will also make the body of the ship look better because alloy P is gold in colour.
- Borosilicate glass
 - Borosilicate glass has high resistance to heat and chemical substances.

- (c) Fused silica glass
It has high resistance to heat and is inert to chemicals.
- (d) Yes, it is suitable
It will not break easily when cold or hot water is placed in it.
3. (a) • Superconductor alloys are used in the construction of railway tracks for Maglev train service.
• Magnets are placed at the bottom of the Maglev train.
• Superconductor alloys are cooled to a very low temperature and electric current flows through it to produce antimagnetic property.
• Maglev train will float a little and the bottom part of the train will not be in contact with the railway track.
• This will prevent friction between the railway track and the Maglev train.
• Thus, the Maglev train is able to move at high speed.
- (b) MRI machine/Electrical cable/Microchip
- (c) Yes, it can.
- A track needs to be prepared
 - Place magnets at the bottom of the car
 - When electricity flows on the track, the antimagnetic force will be formed allowing the car to move without touching the track
 - The bottom structure of the car is specially created to make sure the car does not derail from the track
- No, it cannot
- Cars move without track
 - Difficult to place superconductor alloy on the road to allow electricity to flow
 - The car can crash because there is no tool to allow the car to be attached to the runway

Chapter 10

Summative Practice 10

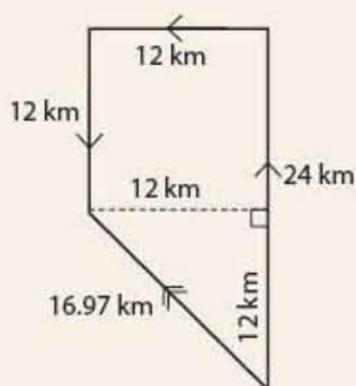
1. (a) Method *M*: Complementary medicine
Method *N*: Modern medicine
- (b) Follow-up treatment after the cancer treatment/
Weak muscle condition/Poor blood circulation/
Reduce pressure and stress (any one)
- (c) • Analgesic: used to reduce headaches, migraine and fever
• Antibiotics: used to treat diseases due to pathogen infections such as tuberculosis (TB) and syphilis
• Psychotherapeutic: used to treat mental illness such as depression and anxiety
- (d) Method *M* can reduce the side effects of medicine use in method *N*. Radiotherapy for example is a treatment for cancer.

2. (a) Free radicals are formed from oxidation process that happens in the body due to internal and external factors.
- (b) External factors such as sunlight, smoke from factories, cigarette smoke while internal factors are metabolism and inflammation
- (c) For most individuals, the free radicals formed naturally due to internal factors usually are stabilised by antioxidant substances from the food intake. For individuals who are exposed to external factors in excess such as cigarette smoke, factories smoke and radiation, many free radicals will be formed and cannot be stabilised by the antioxidant substances from food. This can cause health problems due to the presence of additional free radicals in the body.
3. (a) Antioxidants are chemical compounds that can be obtained from chemical synthesis or natural plants. When antioxidants react with free radicals, more stable compounds will be produced, stopping the oxidation process.
- (b) This substance protects body cells from free radical damage and is regarded as a defensive line against diseases.
- (c) • Beta carotene is an antioxidant substance which is commonly found in most red, yellow or orange coloured food such as apricots, carrots, pumpkins, mangoes, sweet potatoes and peaches.
• Lutein is an antioxidant substance which is commonly found in large quantities in green leafy vegetables such as spinach, cabbage and broccoli.
• Lycopene is an antioxidant substance which is commonly found in papaya, guava, watermelon, tomato, apricots, grapefruit and oranges.
• Vitamin C which is also known as ascorbic acid, is a water-soluble vitamin. Vitamin C is an antioxidant substance which is found in citrus fruits, spinach, broccoli, kiwi, strawberries, cranberry, cabbage and green pepper.
4. Massage is a method of manipulating soft tissues in the body using hands, fingers and fist. Massage soothes anxiety, pain, fatigue, muscle tension and nerve problems.

Chapter 11

Summative Practice 11

1. (a) $24 \text{ km} + 12 \text{ km} + 12 \text{ km} = 48 \text{ km}$
(b) $\sqrt{(12 \text{ km})^2 + (12 \text{ km})^2}$
 $= 16.97 \text{ km to the northwest}$



- (c) $48 \text{ km} \div 2 \text{ hours} = 24 \text{ km h}^{-1}$
 (d) $16.97 \text{ km} \div 2 \text{ hours} = 8.485 \text{ km h}^{-1}$
2. (a) $8 \text{ m} + 8 \text{ m} = 16 \text{ m}$
 (b) $\sqrt{(8 \text{ m})^2 + (8 \text{ m})^2} = 11.31 \text{ m}$ to the northeast
 (c) $11.31 \text{ m} \div (5 \times 60 \text{ s}) = 0.038 \text{ m s}^{-1}$
3. (a) Gradient of graph
 (b) $20 \text{ m s}^{-1} \div 5 \text{ s} = 4 \text{ m s}^{-2}$
 (c) $\frac{1}{2} \times (30 \text{ s} + 15 \text{ s}) \times 20 \text{ m s}^{-1} = 450 \text{ m}$
4. (a) Graph *P* because its gradient is greater compared to *Q*. Value of gradient represents the value of acceleration.
 (b) $20 \text{ m s}^{-1} \div 8 \text{ s} = 2.5 \text{ m s}^{-2}$
5. (a) $16 \text{ cm} \div 0.2 \text{ s} = 80 \text{ cm s}^{-1}$
 (b) 0 cm s^{-2} /zero. This is because the velocity of the ticker tape strip is constant.
6. (a) Inertia is the natural tendency of an object to resist any change in its original state, whether being at rest or in motion.
 (b) Both wooden blocks have the same inertia because their masses are the same.
 (c) Newton's First Law of Motion states that an object tends to remain in its original state, either being at rest or in motion with uniform velocity if no external forces acts on it.
7. (a) The motion of an object that is affected only by gravitational force.
 (b) The time taken for the coin to fall is shorter than the feather in cylinder tube *R*, whereas for cylinder tube *S*, the time taken for both the coin and the feather to fall is the same. This is because cylinder tube *R* has air, whereas cylinder tube *S* is a vacuum. Cylinder tube *R* has air resistance.

- (c) An object will free fall if no air resistance acts on it.

Chapter 12

Summative Practice 12

1. (a) France, Slovakia
 (b) • France uses nuclear energy to generate electricity to a large part of the country.
 • Slovakia generates income by supplying electricity generated from power stations to neighbouring countries.
 (c) • Can produce huge amounts of energy compared to other energy sources
 • Release very little greenhouse gases compared to other energy sources
 • Low maintenance cost indirectly strengthens national economy
 (any two)
2. (a) Nuclear fission
 (b) Nuclear fission occurs when a low-velocity neutron bombards a heavy radioactive nucleus and causes the nucleus to split into two lighter and more stable nuclei together with the release of a lot of energy.
 (c) The rate of nuclear reaction would be too high and can cause explosion.
3. (a) Nuclear fusion
 (b) The Sun has very high temperature/Rich in hydrogen
 (c) Earth would not receive sunlight and heat anymore. All living things cannot survive.
4. (a) Nuclear fission
 (b) To produce a lot of heat
 (c) • It has 2 m-thick walls that are made of concrete and lead
 • Has boron control rods that absorb excess neutrons so that reaction is under control
 (d) Leakage of radioactive radiation occurs.



Full answers for teacher, please scan QR code.



Laboratory Rules and Safety Measures

In this Science KSSM Form 4 Textbook, there are some experiments that need to be carried out in the laboratory. Therefore, all students must comply with the rules and safety measures in the laboratory to avoid accidents.

Before you enter the laboratory

1. Make sure that you enter the laboratory with the teacher's permission.
2. Do not bring in bags or other items to the laboratory.

In the laboratory

1. Do not run or play in the laboratory.
2. Do not eat or drink in the laboratory.
3. Do not taste or inhale any chemicals.
4. Read all instructions and warning symbols on the labels on chemical bottles before using them.
5. Do not point the mouth of the test tube at yourself or your friends when heating a chemical substance in a test tube.
6. Keep all flammable materials away from fire sources.

Emergencies

1. Know the location of the fire extinguishers, fire blanket and first aid kit and the ways to use them.
2. If any chemical substance gets onto your skin, wash it off immediately with plenty of running tap water.
3. If any chemical substance gets into your eyes, wash it off immediately with plenty of running tap water.
4. If you accidentally swallow any chemical substance, spit it out immediately and rinse your mouth with plenty of water. Inform the incident to your teacher quickly for treatment.
5. Do not panic if your clothes are on fire, roll your body on the floor. Your teacher will put the fire blanket on your body to extinguish the fire.
6. Inform all accidents to your teacher immediately.

Before you leave the laboratory

1. Turn off or switch off all water, gas and electricity supplies.
2. Clean and tidy all apparatus used.
3. Return all apparatus and chemical substances to their original place.
4. Dispose all experimental waste according to their category.
5. Wash your hands.