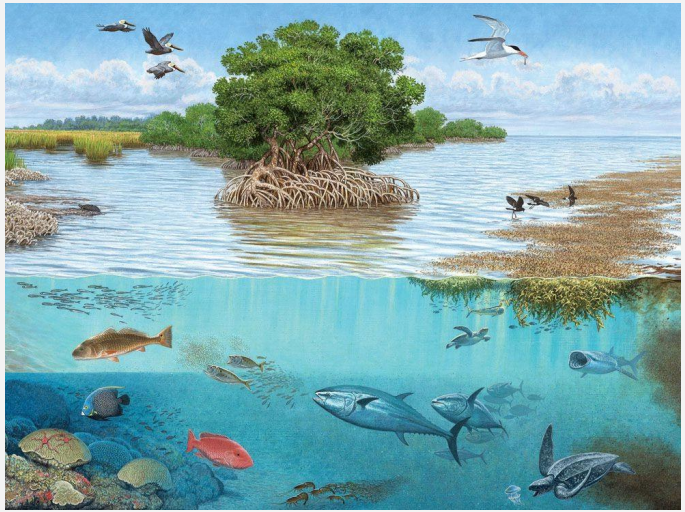
Organisms and the environment

(a) Describe the non-cyclical nature of energy flow

(b) Explain how energy losses occur along food chains, and discuss the efficiency of energy transfer between trophic levels

Ecology
Environment
Ecosystem



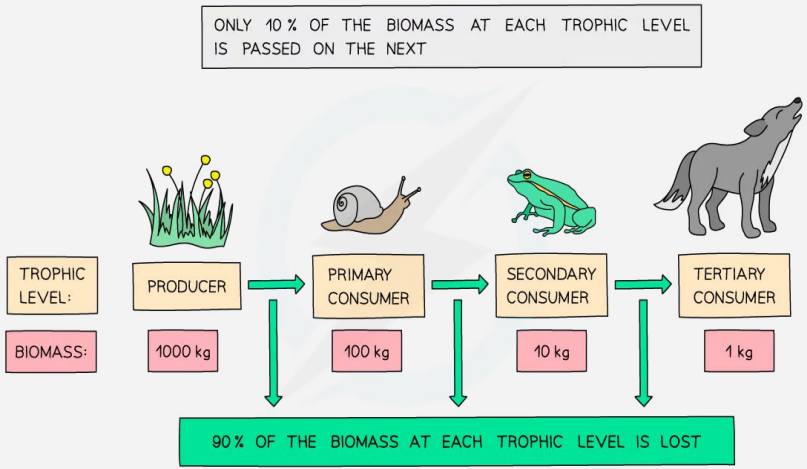
Ecology: study of interactions between organisms and environment

Ecosystem: consists of all organisms; biotic factors and abiotic factors

Biotic factors: refers to all living organisms (e.g. plants, bacteria) within an ecosystem and the interactions between them (e.g. predation, competition for resources)

Abiotic factors: non-living, chemical and physical factors in the environment that the community interacts with (e.g. air composition like oxygen content, light intensity, temperature)

Non-cyclic energy flow



Non-cyclic/ linear/ one-directional energy flow:

- In any ecosystem, the ultimate source of energy is the Sun. Light energy from the sun is absorbed by chlorophyll in producers and converted into chemical energy during photosynthesis
- Plants make its own food via photosynthesis and contain carbon in the form glucose, sucrose, starch
- Energy is passed from one trophic level to another when primary consumer feed on the producers and so on

Efficiency of energy transfer:

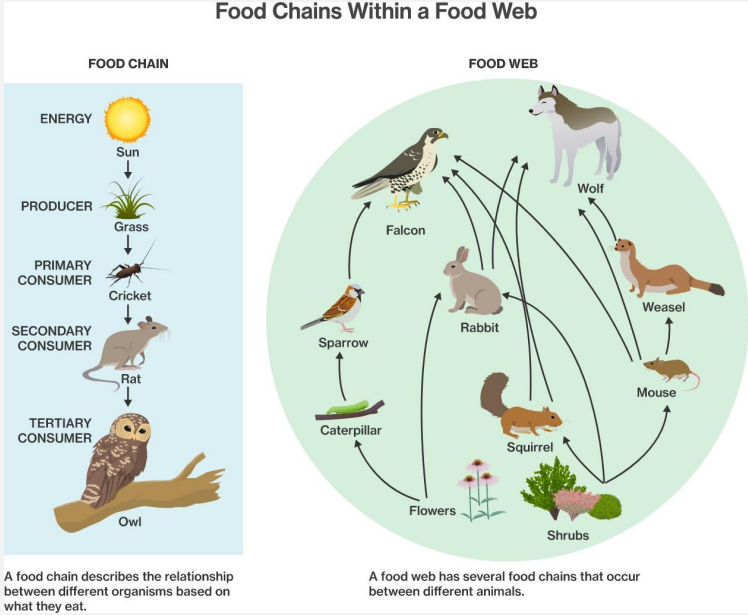
- Organisms at each trophic level pass on about 10% energy to the next trophic level compared to what they receive
- Hence organisms in the lower trophic level have more energy available to them compared to those in higher trophic levels

Energy losses:

- Energy is lost at every trophic level as heat in respiration, uneaten organism parts and through excreted and egested waste material.
- This lost energy cannot be recycled.
- Faeces, excretory products and dead organisms contain trapped chemical energy. This energy is released through the activity of decomposers. Decomposers use some of this trapped chemical energy for their needs, releasing CO2. The rest of the energy is lost as heat.

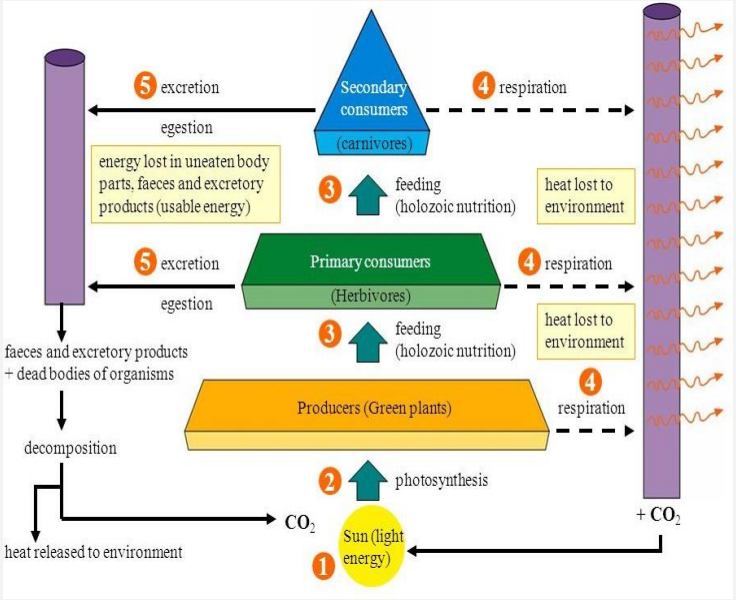
(c) Describe the roles of producers, consumers and decomposers in food chains and food webs

Food chain



Food chain	• A linear sequence of energy transferred in the form of food, between organisms in an ecosystem • Each level of the food chain is known as trophic level • In an ecosystem, food chain do not exist alone. They are interconnected to form a food web
Food web	• Consist of 2 or more food chains linked together • Shows feeding relationship in an ecosystem

Food chain

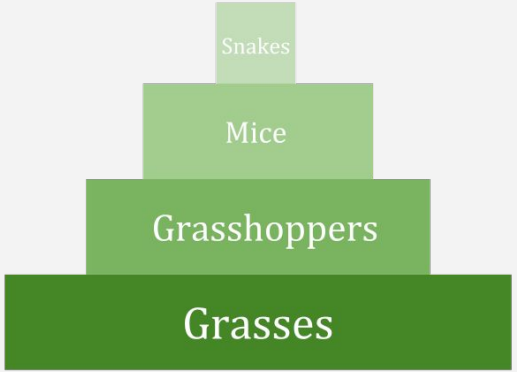


Producers (plants)	• First organism in the food chain **(1st trophic level)** • Organism that contain chlorophyll → photosynthesis → synthesis food through converting light energy from the sun to chemical energy • Make energy available to other organisms in the food chain / community
Consumers (animals)	• Organisms that are not able to make their own food and obtain energy by feeding on other organisms • Primary consumers: herbivores, feed on primary producers directly **(2nd trophic level)** • Secondary consumers: carnivores, feed on primary consumers **(3rd trophic level)** • Tertiary consumers: carnivores, feed on secondary consumers **(4th trophic level)**
Decomposers (eg. bacteria, fungi)	• Not shown in food chain • Obtains energy by breaking down dead organic matter ---> recycle nutrients back into the environment, releasing nutrients into soil and making energy available to other organism indirectly

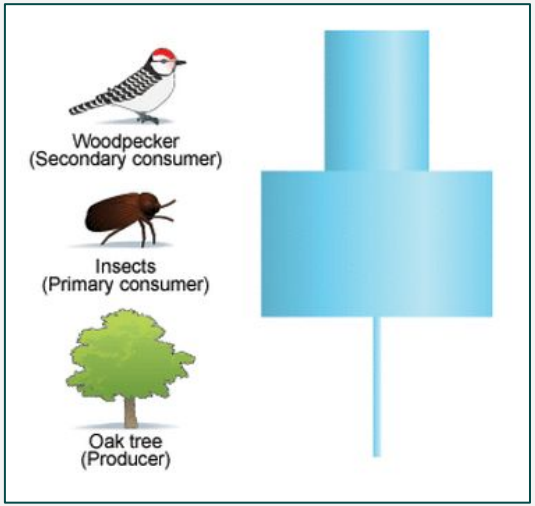
(d) Describe and interpret pyramids of numbers and biomass

pyramid of food chain

pyramid of numbers

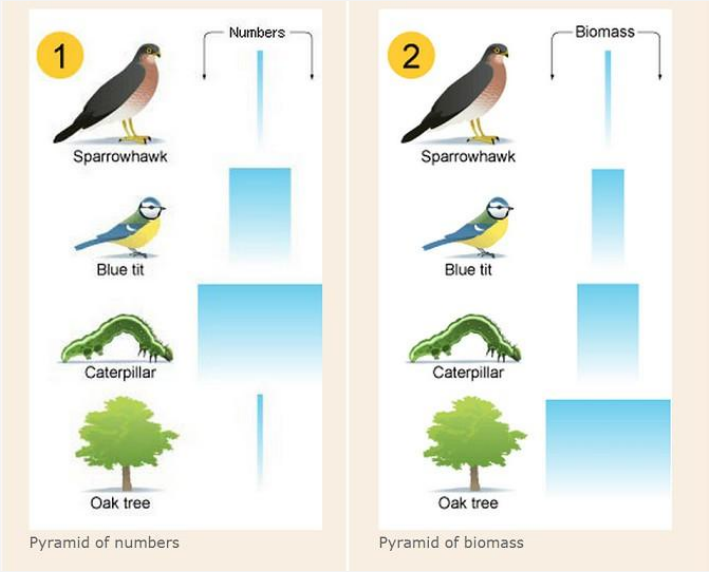


- A pyramid of numbers shows the **relative population size/ number** of each trophic level in a food chain at a particular time
- **Pattern:** Usually, the number of producers at the base is the largest , as they are needed to feed the next level. The number of consumers gradually decreases towards the top
- **Disadvantage:** It is not an accurate estimate of the amount of energy at each trophic level because the population number does not always correspond to the amount of energy it can transfer to the next trophic level, e.g. a single tree can support a large population of caterpillars



pyramid of food chain

pyramid of biomass



- A pyramid of biomass shows the dry mass of organisms at each trophic level in a food chain.
- Dry mass: mass of an organism after moisture is removed

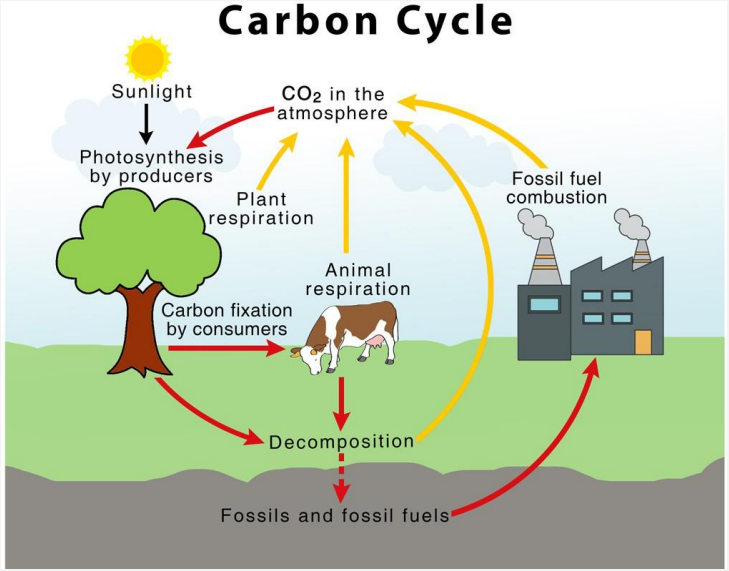
- **Pattern:** The biomass of the producer is the largest as it supplies all the energy for the resumers. Biomass is lost along the food chain due to loss of energy (to respiration, heat, waste etc.)

- -**Disadvantages:** Dry mass cannot be easily obtained from every animal e.g. human beings, large animals like tigers. It is also destructive as it involves drying the organism at 100 °C, which will affect the food chain/ food web.

One single tree has larger biomass than a large number of caterpillars.

(e) Describe how carbon is cycled within an ecosystem and outline the role of forests and oceans as carbon sinks

carbon cycle



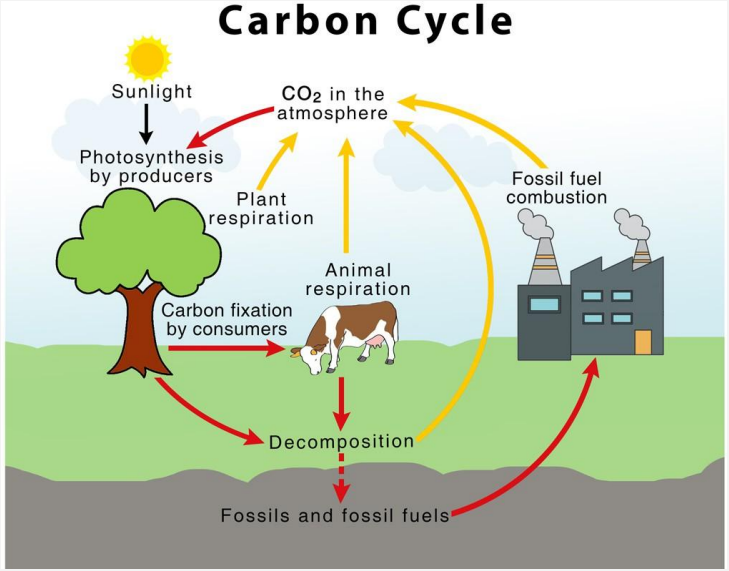
Removal of carbon dioxide

1. Plants convert atmospheric carbon dioxide into glucose during photosynthesis. Glucose can be converted to other carbohydrates, proteins and fats within the plants

Return/ contributors of carbon dioxide

2. When cellular respiration takes place in living organisms.
3. When the plants and animals die, decomposers such as bacteria and fungi break down the organic matter into carbon dioxide, which is released back to the atmosphere.
4. When fossil fuels and wood (carbon-based compounds) are burnt

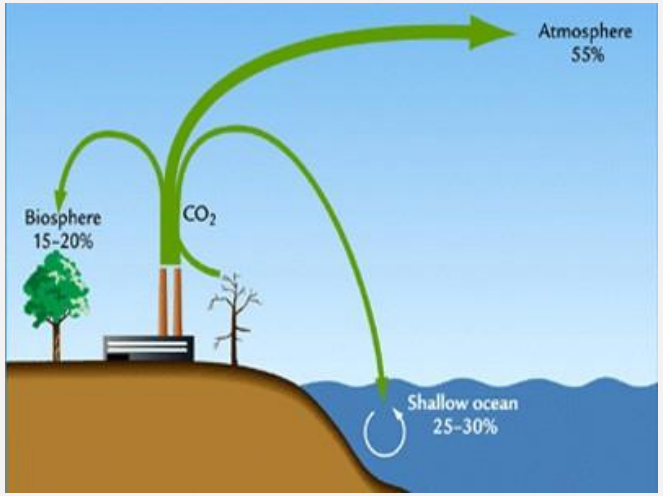
carbon cycle



Importance of carbon cycle

- Ensures there is a continuous supply of carbon dioxide for plants to carry out photosynthesis.
- Allows photosynthesis to convert light energy from the Sun into chemical energy in food, which non-photosynthetic organisms can feed on to stay alive.
- Enables energy to flow through the ecosystem. Carbon compounds carry the stored energy from organism to organism in the food chains of an ecosystem.
- Maintains the correct concentration of carbon dioxide in the atmosphere.

Role of oceans and forests as carbon sinks



Carbon sinks

An area that absorbs more carbon than it releases as carbon dioxide

Oceans

- Atmospheric carbon dioxide is absorbed by the ocean as carbon dioxide dissolves in the ocean's water
- Dissolved CO2 is used by phytoplankton and algae in photosynthesis.
- Iron compounds increases the photosynthetic activity of phytoplankton.
- The organisms in the oceans store carbon compound. When they die, they may sink and be buried deep in the seabed and may form fossil fuels.

Forests

- The plants in forests absorb atmospheric carbon dioxide for photosynthesis
- A large amount of carbon compound is stored in trees. When trees die, they are buried deep in the ground and form coal, a kind of fossil fuels.

(f) Describe how human activities, such as deforestation and use of fossil fuels, cause an increase in atmospheric carbon dioxide concentration, leading to global warming

Human activities as carbon sources, leading to global warming

Fossil fuels are burnt to release energy so as to generate electricity for human uses.
Combustion of fossil fuels release large amount of carbon dioxide, increasing level of atmospheric carbon dioxide

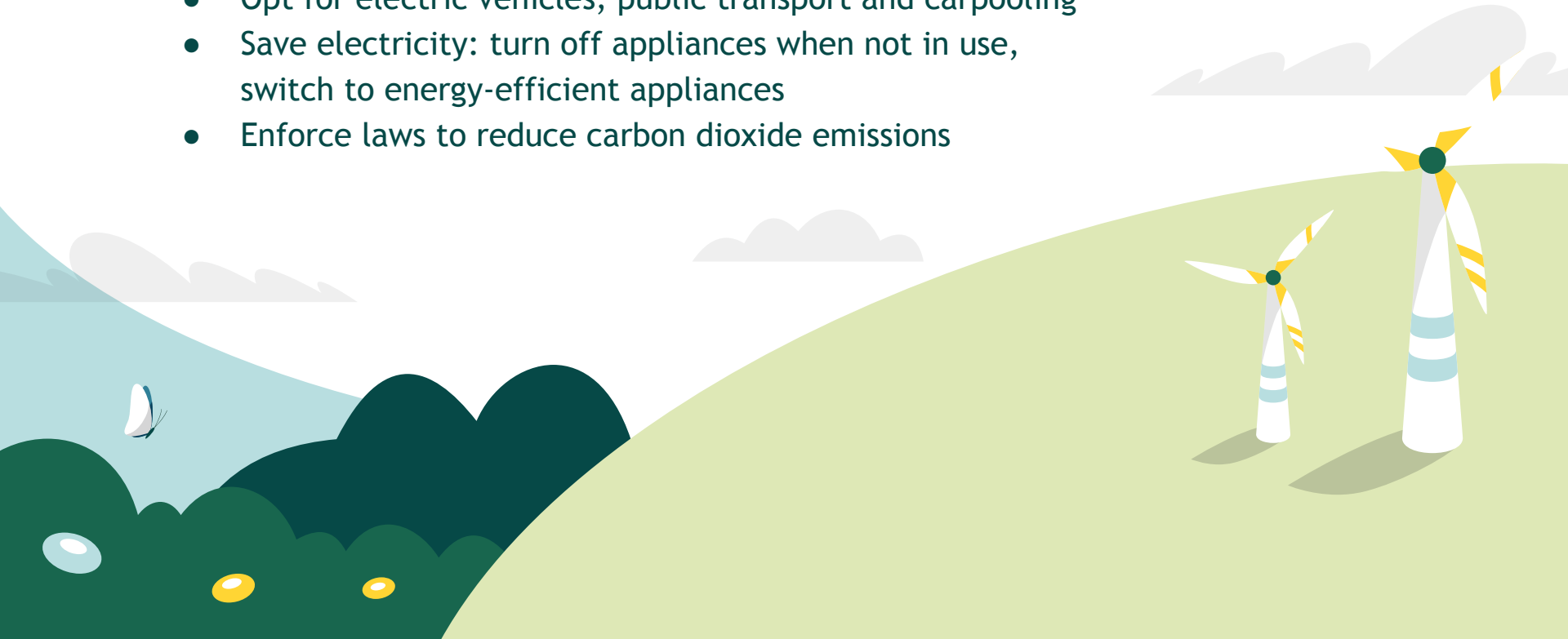
Deforestation, purposeful clearance of forest, is done for reasons such as urbanisation or agriculture.
When trees are “slash and burnt” / cut down, they release stored carbon as atmospheric carbon dioxide and there are lesser trees to photosynthesis, increasing level of atmospheric carbon dioxide

Carbon dioxide causes more heat to be absorbed and reflected back to earth, increasing greenhouse effect,
leading to **global warming**-- **the rise in earth’s temperature**

(g) Discuss how human actions can reduce the effects of global warming

Ways to reduce global warming:

- Utilise renewable energy sources like solar or wind energy
- Opt for electric vehicles, public transport and carpooling
- Save electricity: turn off appliances when not in use, switch to energy-efficient appliances
- Enforce laws to reduce carbon dioxide emissions



Address deforestation:

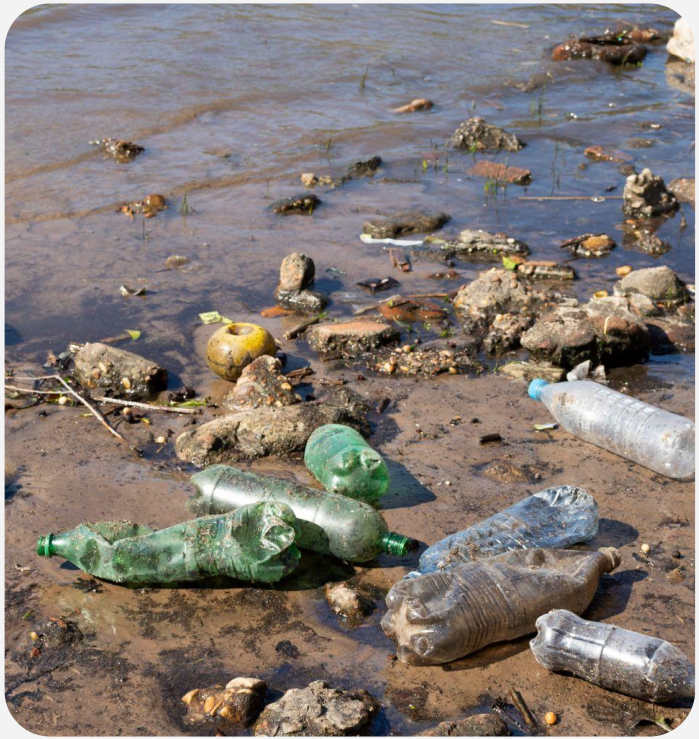
- Regulate rate of logging
- Selective logging: do not cut down young trees
- Designating land as forest reserves
- Reforestation

(h) Describe the effects of pollution caused by:

- sewage in water
- plastic wastes in the marine environment
- insecticides and their biomagnification up food chains, impacting on top carnivores

Effects of pollution caused by sewage in water

- Untreated sewage contains high concentrations of nitrates and phosphates
- If released into water, this results in **eutrophication: entry of nitrates and phosphates in into waters**
- Minerals would cause population explosion of native bacterial and algal species, leading to **algal bloom: excessive algae growth, forming thick opaque layer on water surface**
- Algal bloom would block entry of sunlight into the waters
- Submerged plants, or aquatic plants living beneath the water surface cannot photosynthesize and will die
- Decomposers will consume oxygen to break down dead algae and aquatic plants
- This deprives fishes and other aquatic organism of oxygen to respire, who will subsequently die.
- Loss of marine life overall leads to loss in biodiversity and habitat

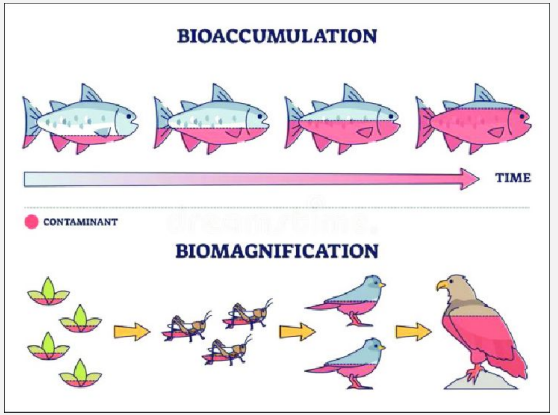


Effects of pollution caused by Plastic wastes in the marine environment

- Most plastics are non-biodegradable. They will remain in the environment for a prolonged period, posing risks to marine life when discarded into waters.
- **Ingestion:** Pieces of plastic may be mistakenly eaten by marine organisms, which can cause internal injuries and kill them.
- **Entanglement:** Marine animals become tangled in plastic debris and live fishing lines. This may cause injuries and even suffocation.
- **Habitat degradation:** Plastic can damage certain ecosystems' habitats such as coral reefs

Effects of pollution caused by insecticides

- Environmental contamination: Insecticides may accumulate in soil, waters and vegetation, contaminating the environment and aquatic ecosystems
- Unintended harm: Insecticides may destroy non-target organism as well, killing other insects, birds and animals. This disrupts ecosystems and reduces biodiversity
- **Bioaccumulation and biomagnification**
- Insecticides contain inorganic and non-biodegradable chemicals that are toxic at high concentrations
- When organisms consume producers laced with insecticides, toxic insecticides is transferred to the organism
- Organisms are unable to digest these insecticides
- Instead, insecticides are stored in the tissues of organisms
- This results in **bioaccumulation: a buildup of inorganic compounds in organism body overtime**
- Organisms at higher trophic levels would need to consume multiple organisms at lower trophic levels due to inefficient energy transfer
- This results in **biomagnification: an increase in concentration of inorganic compounds in organism at higher trophic level as larger amounts of insecticides are being transferred to organisms at higher trophic level**



(I) Discuss how the conservation of species and sustainable use of natural resources contribute to the maintenance of biodiversity and a balanced ecosystem (e.g. coral reef, tropical rainforest, mangrove)

Conservation

Conservation is the protection and perseveration of species, their habitats and entire ecosystems from extinction.

Conservation is important

1. Maintenance of biodiversity
   - Maintaining a large gene pool is important as many wild plants and animals possess favourable genes.
   - By cross-breeding the different varieties of wild plants and animals, we can improve agricultural produce such as improving yield and quality of organisms
2. Scientific research
   - Many tropical plants are of great importance as they are sources of medicinal drugs.
3. Conservation preserves the existence of rich variety of species for us and future generations to appreciate and enjoy
4. Economical value
   - Tropical rainforests provide raw materials such as timber, cotton and rubber for industries
   - Ecotourism is a source of income for several countries such as Costa Rica, Madagascar, and Kenya.
   - Marine life, tropical rainforests provide food sources such as seafood and maize
5. Stable and balances ecosystem
   - This prevents disruption of natural cycles such as carbon cycles
   - Prevents global warming

Conservation

Conservation is the protection and perseveration of species, their habitats and entire ecosystems from extinction.

Importance of conservation:

Maintenance of biodiversity 	• Maintaining a large gene pool is important as many wild plants and animals possess favourable genes. • By cross-breeding the different varieties of wild plants and animals, we can improve agricultural produce such as improving yield and quality of organisms • Preserves the existence of rich variety of species for us and future generations to appreciate and enjoy
Scientific research 	• Many tropical plants are of great importance as they are sources of medicinal drugs.
Economical value 	• Tropical rainforests provide raw materials such as timber, cotton and rubber for industries • Ecotourism is a source of income for several countries such as Costa Rica, Madagascar, and Kenya. • Marine life, tropical rainforests provide food sources such as seafood and maize
Stable and balances ecosystem 	• This prevents disruption of natural cycles such as carbon cycles • Prevents global warming

Importance of conserving tropical rainforests, coral reefs and mangroves in maintenance of biodiversity and a balanced ecosystem:

Tropical Rainforests

- Host a diversity of plant and animals
- “Lungs of the earth” that maintain balance of atmospheric carbon dioxide and oxygen
- Regulate rainfall patterns and prevent soil erosions
- Sources of ecotourism, medicinal drugs, sustainable resources

Coral Reefs

- “Rainforest of the sea”: an important habitat and breeding grounds for a multitude of marine species

Mangroves

- Serve as important habitats, breeding grounds for a wide variety of plants and animal species (eg. fish, crustaceans, birds)
- Their dense roots serve as natural buffers against coastal erosions
- Effective carbon sinks

MEET THE OVERMUGGED TEAM

MEET OUR ALL-STAR TUTORS

All our tutors have between **7-13 years of teaching experience** and have guided countless batches of students to excel at 'O' Levels & 'A' Levels.

UNLOCK YOUR FULL POTENTIAL.

SOME STATS

07

LOCATIONS

We have classes across 7 locations in Singapore, with **3 main branches**.

20+

TUTORS

We have a team of 20+ tutors, each specialising in their respective subjects.

70%

RESULTS

About **70%** of OVERMUGGED students score an A1/A2 at 'O' Levels/ 'A' Levels.

700+

STUDENT UNDER OUR CARE

We have about 700+ students under our care which we work closely with on a week-on-week basis!

SG FASTEST GROWING TUITION BRAND

We believe in uplifting the student community!

OVERMUGGED, 'O' Levels Channel
6,214 subscribers

OVERMUGGED, 'A' Levels Channel
2,778 subscribers

One of SG largest Telegram student community

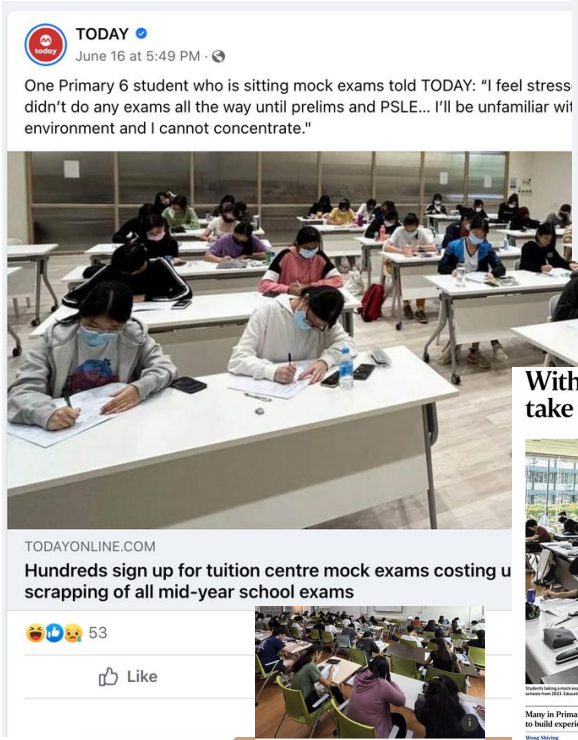
LEADERS IN THE CHANGING EDUCATION LANDSCAPE

FEATURED ON STRAITS TIMES

Our efforts to go out of our way to support our students were captured by local new publications.

OVERMUGGED was SG first tuition center to host **large scale mock exam**!

Our **student's needs comes first**!



OUR LOCATIONS

BUKIT TIMAH

Tan Kah Kee

2 min walk from Tan Kah Kee MRT.

Kovan

Upper Serangoon Road

5min walk from Kovan MRT.

MARINE PARADE

PARKWAY CENTER

Upcoming TE line in 2024.

TOA PAYOH

CLASSROOM

Conveniently located near Toa Payoh MRT

JURONG EAST

CLASSROOM

Right beside Jurong East MRT

WOODLANDS

CLASSROOM

Right beside Woodlands MRT

TAMPINES

READY IN 2024

Right beside Tampines MRT

OUR SECRET TO PRODUCE TOP RESULTS?

CONSISTENT HARD WORK,

OVER A LONG PERIOD OF TIME.

We work hard consistently alongside you, week in, week out.

We grind hard when no one is watching because we know that when it comes time for exams, we will be one cut above the rest.

LEARNING RESOURCES

IF YOU THOUGHT THE FREE MATERIALS ARE GOOD,

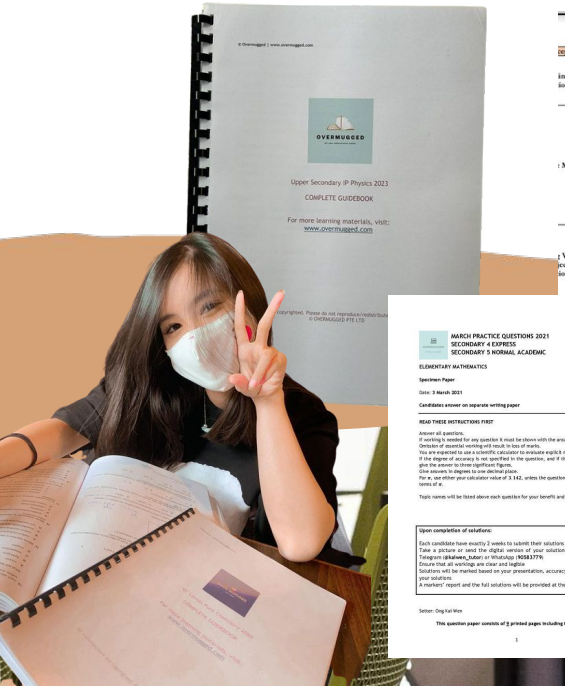
Wait till you see the resources our own students get!

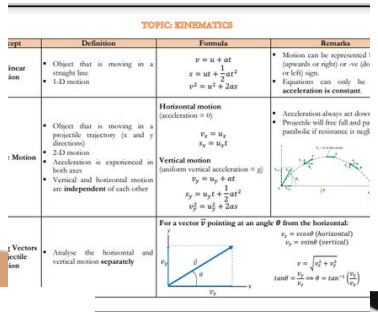
WEEKLY WORKSHEETS

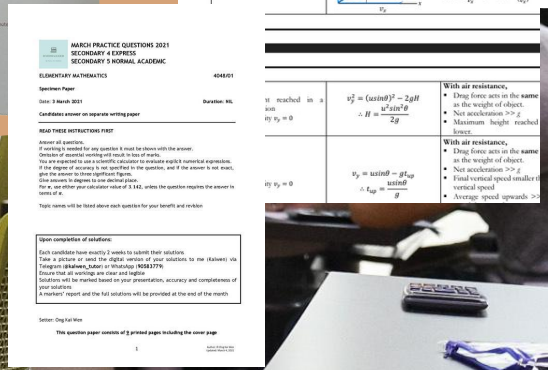
Topical, Thematic, Mock Test, Mock Exam, Prelim Prep, Practical Prep

EXCLUSIVE CHEATSHEETS

Revision booklets, extra cheatsheets, Practical Assessment booklet



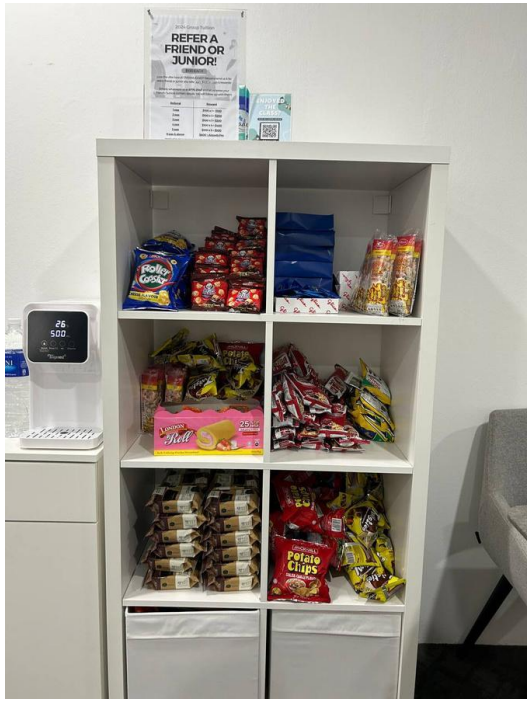




WELFARE, ALL DAY EVERYDAY

NEED FOOD TO THINK

Unlimited snack shelf



TUITION RATES

'O' LEVELS

$80/lesson

$85/lesson (weekend)

INTEGRATED PROGRAM

$90/lesson

$95/lesson (weekend)

'A' LEVELS

$100/lesson

$105/lesson (weekend)

10% if signing up for 2 'A' Levels subject & above

Fees are collected at the start of the term (every 3 months).

Our Policy

No deposit fee.

No extra material fee.

Unlimited access to study lounge.

Unlimited snacks.

Free consultations.

Special discounts for holiday program.

ACADEMIC YEAR

TERM 1: NOV – JAN

Topical Recaps

Key highlight: Christmas Party

TERM 2: FEB – APR

Topical Mastery

Key highlight: March Holiday Cohesion Program

TERM 3: MAY – JUL

Prelim/EOY Preparation

Key highlight: Mock Prelim/EOY

TERM 4: AUG – OCT

'O' Levels / 'A' Levels Preparation

Key highlight: Mock Exams, Science Practical Assessment

Sign up for a free trial lesson today!

Class Schedule:

SCAN ME

Whatsapp us:

SCAN ME

540
d@gmail.com
ermugged.com
mugged