

Environmental Education Module
Modul Pendidikan Alam Sekitar

Climate Change Aspect

Aspek Perubahan Iklim



Jabatan Perlindungan Alam Sekitar Sabah
Kementerian Pelancongan, Kebudayaan dan Alam Sekitar Sabah

Climate Change Aspect

Aspek Perubahan Iklim



Jabatan Perlindungan Alam Sekitar Sabah
Kementerian Pelancongan, Kebudayaan dan Alam Sekitar Sabah



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PREFACE

The environment is among our most precious assets and a collective heritage that must be protected for the well-being of future generations. Sabah is world renowned for its rich natural heritage, diverse ecosystems, and extraordinary biodiversity, therefore environmental education is essential in promoting sustainable development and safeguarding the long-term integrity of our natural resources.

This Environmental Education Module has been developed as part of Sabah's ongoing efforts to enhance environmental awareness, deepen understanding, and encourage proactive engagement across all levels of society. It provides essential knowledge on key environmental aspects and offers practical actions any stakeholders can undertake to promote environmental stewardship.

We hope this module will contribute in strengthening the environmental education in Sabah and increase collaboration among government agencies, educational institutions, private sector and the community. Through shared responsibility and increased capacity, we can cultivate a society that values and actively participates in the protection of the environment.

My sincere appreciation to the Environment Protection Department Sabah and all parties involved in the development of this module. Special thanks are extended to the government agencies in Sabah, private sector, non-governmental organisations, academic institutions, and members of the Sabah Environmental Education Network (SEEN) for their dedication and continued support.

It is my hope that this module will inspire meaningful action and serve as a catalyst for a more sustainable and resilient future for Sabah.

DATUK JOSIE LAI

Permanent Secretary,
Ministry of Tourism, Culture and Environment Sabah



FOREWORD

The Environment Protection Department is proud to present this environmental education module, developed to support the advancement of environmental awareness and stewardship across Sabah.

This module has been carefully designed to provide fundamental knowledge on a key environmental theme, complemented by practical actions that individuals and communities can implement to contribute meaningfully to environmental sustainability. It reflects our commitment to fostering a deeper understanding of environmental issues and empowering proactive engagement at all levels of society.

In line with Sabah's broader environmental goals, this module aims to nurture a sense of responsibility, support informed decision-making, and encourage collective action towards the preservation of our environment. By strengthening environmental education efforts, we take a vital step towards building a more resilient and sustainable future for the state.

The development of this module would not have been possible without the dedicated efforts and collaboration of various stakeholders. On behalf of the Environment Protection Department Sabah, I would like to express my sincere appreciation to all government agencies, non-governmental organisations, educational institutions, and members of the Sabah Environmental Education Network (SEEN) who contributed their expertise and support to this initiative.

It is our aspiration that this module will serve as a valuable tool in promoting a deeper understanding of environmental conservation and in cultivating a community that is committed to protecting and sustaining Sabah's rich natural environment for generations to come.

DAISY ALOYSIUS

Acting Director,
Environment Protection Department Sabah

Acknowledgement

Penghargaan

This publication is part of the Environment Protection Department Sabah's initiative to create a comprehensive environmental educational module.

This module is intended for educational purpose only. All content, including text, illustrations and examples, is based on credible sources. Users are encouraged to refer to additional references or subject matter experts to obtain information tailored to their specific needs.

We would like to express our sincere appreciation to all stakeholders involved, including government agencies, educational institutions, non-governmental organizations, the private sectors, local communities, and members of the Sabah Environmental Education Network (SEEN), who have contributed directly and indirectly to this initiative. Their expertise, insights and commitment have been instrumental in shaping the content and ensuring its value as an effective educational resource.

Penerbitan ini adalah sebahagian daripada inisiatif Jabatan Perlindungan Alam Sekitar Sabah untuk menghasilkan modul pendidikan alam sekitar yang komprehensif.

Modul ini disediakan khusus untuk tujuan pendidikan sahaja. Segala kandungan, termasuk teks, ilustrasi dan contoh, adalah berdasarkan sumber yang boleh dipercayai. Pengguna digalakkan untuk merujuk kepada bahan tambahan atau pakar dalam bidang berkaitan bagi mendapatkan maklumat yang sesuai dengan keperluan masing-masing.

Kami merakamkan setinggi-tinggi penghargaan kepada semua pihak berkepentingan yang terlibat, termasuk agensi Kerajaan, institusi pendidikan, pertubuhan bukan kerajaan, sektor swasta, komuniti setempat serta ahli Sabah Environmental Education Network (SEEN), yang telah menyumbang secara langsung atau tidak langsung kepada inisiatif ini. Kepakaran, pandangan dan komitmen mereka telah memainkan peranan penting dalam menghasilkan kandungan modul ini serta memastikan nilainya sebagai sumber pendidikan yang berkesan.

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Chapter 1

Introduction and Purpose

Bab 1

Pengenalan dan Tujuan



Chapter 1 | Bab 1

Knowledge | Pengetahuan

This module is designed to equip facilitators with essential knowledge and practical tools to effectively educate a diverse range of audiences—including primary and secondary school students as well as adults—on critical climate change topics. By fostering a deeper appreciation of the environment's vital role in our daily lives, this module aims to illuminate the unique challenges faced in Sabah while inspiring community-driven actions to combat climate change and promote long-term sustainability. Through this approach, facilitators will not only raise awareness but also empower communities to take meaningful steps toward reducing their carbon footprint and protecting our planet.

Modul ini direka untuk melengkapkan fasilitator dengan pengetahuan asas dan alat yang praktikal untuk mendidik pelbagai jenis audiens—termasuk pelajar sekolah rendah dan menengah serta orang dewasa—tentang topik kritikal perubahan iklim. Dengan memupuk penghargaan yang lebih mendalam terhadap peranan penting alam sekitar dalam kehidupan seharian kita, modul ini bertujuan untuk menerangkan cabaran unik yang dihadapi di Sabah sambil menginspirasi tindakan yang didorong oleh komuniti untuk mengatasi perubahan iklim dan mempromosikan amalan lestari untuk jangka masa yang panjang. Melalui pendekatan ini, fasilitator bukan sahaja mampu meningkatkan kesedaran tetapi juga memperkasakan komuniti untuk mengambil tindakan yang bermakna ke arah mengurangkan jejak karbon dan melindungi planet kita ini.

1.1 | Purpose of the Module *Tujuan Modul*

The purpose of the module includes:
Tujuan modul ini meliputi:

- **Knowledge Sharing:**

Provide facilitators with a well-structured, easy-to-use framework that highlights essential concepts about climate change, its significance, the challenges impacting Sabah's environment, and practical strategies for mitigation and adaptation. This framework enables facilitators to deliver engaging, impactful sessions that are tailored to the diverse needs and comprehension levels of their audience, ensuring the content resonates effectively.

- **Fostering Awareness and Action:**

This module extends beyond mere information sharing—they are designed to drive behavioural change and inspire collective community action. Through practical activities and interactive learning sessions, participants will not only gain a deeper understanding of climate change issues but also feel motivated and empowered to take meaningful steps toward reducing their carbon footprint and protecting the environment.

- **Perkongsian Pengetahuan:**

Membekalkan fasilitator dengan rangka kerja yang tersusun dan mudah digunakan dengan menekankan konsep penting tentang perubahan iklim, kepentingannya, cabaran yang mempengaruhi alam sekitar Sabah, dan strategi yang praktikal untuk mitigasi dan adaptasi perubahan iklim. Rangka kerja ini membolehkan fasilitator menyampaikan sesi yang menarik dan berkesan yang bersesuaian dengan keperluan dan tahap pemahaman audiens yang pelbagai, dan memastikan kandungan sesi yang efektif.

- **Meningkatkan Kesedaran dan Tindakan:**

Modul ini melangkaui perkongsian maklumat—ia direka untuk mendorong perubahan tingkah laku dan menginspirasi tindakan kolektif oleh komuniti. Melalui aktiviti praktikal dan sesi pembelajaran interaktif, peserta bukan sahaja akan memperoleh pemahaman yang lebih mendalam tentang isu-isu perubahan iklim tetapi juga mempunyai motivasi dan berdaya untuk mengambil langkah bermakna ke arah mengurangkan jejak karbon mereka dan melindungi alam sekitar.

1.2 | How Facilitators Can Use the Module

Bagaimana Fasilitator Boleh Menggunakan Modul Ini

The module is adaptable, making them suitable for diverse settings, including schools, community halls, and public events. They include:

- **Foundational Knowledge:**

Clear and concise explanations of climate change concepts, designed to be accessible for audiences of all ages.

- **Interactive Discussions:**

Facilitators can use the modules to initiate conversations about local climate change challenges and solutions.

- **Practical Activities:**

Each chapter contains hands-on activities that align with the educational goals for each target group, fostering experiential learning and personal connection to the topics.

Modul ini boleh diubah suai, menjadikannya sesuai untuk pelbagai persekitaran, termasuk sekolah, dewan komuniti, dan acara awam. Ia merangkumi:

- **Pengetahuan Asas:**

Penjelasan yang jelas dan ringkas tentang konsep perubahan iklim, direka untuk mudah difahami oleh audiens daripada semua peringkat umur.

- **Perbincangan Interaktif:**

Fasilitator boleh menggunakan modul ini untuk memulakan perbincangan tentang cabaran dan penyelesaian perubahan iklim setempat.

- **Aktiviti-aktiviti Praktikal:**

Setiap bab mengandungi aktiviti praktikal yang selaras dengan matlamat pendidikan untuk setiap kumpulan sasaran, memupuk pengalaman pembelajaran dan membina hubungan peribadi dengan topik-topik.

1.3 | Why This Module is Critical for Sabah *Mengapakah Modul Ini Kritikal Bagi Sabah*

Sabah, like many regions, faces unique challenges related to climate change, including pollution, deforestation, and environmental impacts. Educating the public—especially younger generations—on these issues is vital to ensuring the sustainable use of natural resources. This module provides facilitators with the tools to:

Sabah, seperti banyak kawasan lain, menghadapi cabaran unik berkaitan perubahan iklim, termasuk pencemaran, penebangan hutan, dan kesan alam sekitar. Pendidikan untuk orang ramai—terutamanya generasi muda—tentang isu-isu ini adalah penting untuk memastikan penggunaan sumber alam semula jadi secara lestari. Modul ini menyediakan fasilitator dengan alat untuk:

- Highlight the importance of climate action.
- Raise awareness about the environmental and socio-economic impacts
- Encourage community-driven initiatives
- *Menekankan kepentingan tindakan iklim*
- *Meningkatkan kesedaran tentang kesan alam sekitar dan sosio-ekonomi*
- *Menggalakkan inisiatif yang didorong oleh komuniti*

By equipping facilitators with this structured and practical guide, the aim is to empower individuals and communities to understand their roles in combating climate change and to instil a sense of responsibility that will benefit future generations.

Dengan melengkapkan fasilitator dengan panduan yang terstruktur dan praktikal ini, matlamatnya adalah untuk memperkasakan individu dan komuniti untuk memahami peranan mereka dalam memerangi perubahan iklim dan menanamkan rasa tanggungjawab yang akan memberi manfaat kepada generasi akan datang.



Chapter 2

Understanding Climate Change

Bab 2

Memahami Perubahan Iklim



Chapter 2 | Bab 2

Understanding Climate Change | Memahami Perubahan Iklim

2.1 | What is Climate Change? Apakah Perubahan Iklim?

Climate change refers to long-term alteration in temperatures and weather patterns over extended periods. Climate is sometimes mistaken for weather. But climate is different from weather because it is measured over a long period of time, while weather can change from day to day, or from year to year. The climate of an area includes average seasonal temperatures, rainfall and wind patterns.

Climate change may cause weather patterns to be less predictable. These unexpected weather patterns can make it difficult to maintain and grow crops in regions that rely on farming because expected temperature and rainfall levels can no longer be relied on. Climate change has also been connected with other damaging weather events such as more frequent and more intense floods, downpours and storms.

Perubahan iklim merujuk kepada perubahan suhu dan corak cuaca dalam jangka masa panjang. Iklim kadangkala disalahertikan sebagai cuaca. Namun, iklim berbeza daripada cuaca kerana ia diukur dalam tempoh masa yang panjang, manakala cuaca boleh berubah dari hari ke hari atau dari tahun ke tahun. Iklim sesuatu kawasan merangkumi purata suhu bermusim, purata hujan, dan corak angin.

Perubahan iklim menyebabkan corak cuaca sukar diramal. Corak cuaca yang tidak dijangka ini boleh menyukarkan pertumbuhan dan penjagaan tanaman di kawasan yang bergantung kepada pertanian, kerana tahap suhu dan hujan yang dijangkakan tidak lagi boleh diandalkan. Perubahan iklim juga telah dikaitkan dengan kejadian cuaca ekstrem lain seperti banjir, hujan lebat, dan ribut yang lebih kerap dan lebih teruk.



Phenomena due to unexpected weather patterns
Fenomena disebabkan oleh cuaca yang tidak dijangkakan | Canva

2.2 | What are Greenhouse Gasses? Apakah Gas Rumah Hijau?

Greenhouse gases (GHGs) are atmospheric gases that trap heat, creating a warming effect on Earth. These gases allow sunlight to penetrate the atmosphere but retain the heat radiating from the Earth's surface, forming a "blanket" that warms the planet. This warming effect contributes to climate-related impacts, such as rising sea levels, extreme weather events, and disrupted ecosystem.

Gas rumah hijau (GHG) adalah gas atmosfera yang memerangkap haba, mewujudkan kesan pemanasan di Bumi. Gas-gas ini membenarkan cahaya matahari memasuki atmosfera tetapi memerangkap haba yang terpancar dari permukaan Bumi, membentuk kesan "selimut" yang memanaskan planet ini. Kesan pemanasan ini membawa impak terhadap iklim, seperti kenaikan paras laut, kejadian cuaca ekstrem, dan ekosistem yang terganggu.

The main greenhouse gases include :
Gas-gas rumah hijau utama termasuk :

Greenhouse Gases Gas-gas Rumah Hijau	Properties Ciri-ciri
Carbon Dioxide (CO ₂) Karbon Dioksida (CO ₂)	Produced mainly by burning fossil fuels and deforestation, CO ₂ is one of the leading contributors to global warming. Terhasil daripada pembakaran bahan api fosil dan penebangan hutan, karbon dioksida adalah salah satu penyumbang utama kepada pemanasan global.
Methane (CH ₄) Metana (CH ₄)	Released from livestock farming, rice paddies, and landfills, methane traps more heat than CO ₂ , making it highly impactful. Terhasil daripada aktiviti ternakan, sawah padi, dan tapak pelupusan, metana memerangkap lebih banyak haba berbanding karbon dioksida, menjadikannya lebih berimpak.
Nitrous Oxide (N ₂ O) Nitrus Oksida (N ₂ O)	Emitted from agricultural activities and industrial processes, it traps heat even more effectively than CO ₂ and methane. Terhasil daripada aktiviti pertanian dan proses industri, ia memerangkap haba dengan lebih berkesan berbanding karbon dioksida dan metana.

Greenhouse Gases <i>Gas-gas Rumah Hijau</i>	Properties <i>Ciri-ciri</i>	
Water Vapor (H ₂ O) <i>Wap Air (H₂O)</i>	The most abundant greenhouse gas, water vapor increases as the Earth warms and amplifies the greenhouse effect.	<i>Gas rumah hijau yang paling banyak, wap air meningkat seiring dengan pemanasan Bumi dan memperkuat kesan rumah hijau.</i>
Ozone (O ₃) <i>Ozon (O₃)</i>	While ozone in the stratosphere (ozone layer) protects us from harmful UV radiation, ozone in the lower atmosphere (ground-level ozone) is a powerful greenhouse gas and pollutant. It contributes to warming and can harm human health and ecosystems.	<i>Walaupun ozon di stratosfera (lapisan ozon) melindungi kita daripada sinaran UV yang berbahaya, ozon di atmosfera rendah (ozon paras tanah) adalah gas rumah hijau dan pencemar yang berbahaya. Ia menyumbang kepada pemanasan dan boleh membahayakan kesihatan manusia serta ekosistem.</i>
Chlorofluorocarbons (CFCs) <i>Klorofluorokarbon (CFCs)</i>	Man-made chemicals once used in products like refrigerators and aerosol sprays. CFCs are extremely potent greenhouse gases that can damage the protective ozone layer.	<i>Bahan kimia buatan manusia yang sebelum ini digunakan dalam produk-produk seperti peti sejuk dan semburan aerosol. Klorofluorokarbon adalah gas rumah hijau yang sangat kuat dan boleh merosakkan lapisan ozon pelindung.</i>

2.3 | Causes of Climate Change

Punca Perubahan Iklim

Climate change can be natural, but since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas, which significantly contributes to the release of greenhouse gases.

Perubahan iklim boleh berlaku secara semula jadi, tetapi sejak abad ke-19, aktiviti manusia telah menjadi pendorong utama perubahan iklim, terutamanya disebabkan oleh pembakaran bahan api fosil seperti arang batu, minyak, dan gas yang menyumbang secara signifikan kepada pelepasan gas rumah hijau.

Generating Power Penghasilan Tenaga



Burning fossil fuels for electricity and heat is a major contributor to global emissions, primarily carbon dioxide and nitrous oxide. Most electricity is still generated by burning coal, oil, or gas, releasing these potent greenhouse gases into the atmosphere. These gases create a blanket around the Earth, trapping heat from the sun and intensifying global warming.

Pembakaran bahan bakar fosil untuk elektrik dan haba menyumbang secara signifikan kepada pelepasan global, terutamanya karbon dioksida dan nitrus oksida. Kebanyakan tenaga elektrik masih dihasilkan dengan membakar arang batu, minyak, atau gas, yang membebaskan gas rumah hijau yang kuat ke atmosfera. Gas-gas ini membentuk selimut di sekeliling bumi, dan memerangkap haba matahari serta meningkatkan pemanasan global.

Manufacturing Goods Pengeluaran Barangan

The manufacturing sector is a major source of emissions, primarily from fossil fuel combustion to power production processes for materials like cement, steel, and plastics. Industrial activities, including mining and construction, also release greenhouse gases, making manufacturing one of the largest contributors to global emissions.

Sektor pembuatan merupakan sumber utama pelepasan, terutama dari pembakaran bahan bakar fosil untuk proses pengeluaran bahan seperti simen, keluli, dan plastik. Aktiviti industri, termasuk perlombongan dan pembinaan, juga melepaskan gas rumah hijau, menjadikan industri pembuatan salah satu penyumbang terbesar kepada pelepasan global.



Deforestation Penebangan Hutan



Deforestation and land-use changes for agriculture and other purposes leads to substantial emissions as trees release stored carbon when cut down. Globally, about 12 million hectares of forest are lost annually, limiting nature's ability to absorb carbon dioxide and accounting for roughly a quarter of global greenhouse gas emissions.

Penebangan hutan dan perubahan guna tanah untuk pertanian dan tujuan lain menyebabkan pelepasan yang besar kerana pokok-pokok melepaskan karbon yang disimpan apabila ditebang. Pada peringkat global, sekitar 12 juta hektar hutan ditebang setiap tahun, mengehadkan kemampuan alam semula jadi untuk menyerap karbon dioksida dan menyumbang kepada sekitar satu perempat daripada pelepasan gas rumah hijau global.

Using Transportation *Penggunaan Pengangkutan*

Transportation is a significant source of greenhouse gases, especially from vehicles that rely on fossil fuels. Road vehicles contribute the largest share due to petroleum combustion, while emissions from ships and planes are also rising. Transport accounts for nearly one-quarter of global emissions, and this is expected to increase as demand for transportation grows.

Pengangkutan adalah sumber utama pelepasan gas rumah hijau, terutamanya daripada kenderaan yang bergantung pada bahan bakar fosil. Kenderaan jalan raya menyumbang bahagian terbesar disebabkan oleh pembakaran petroleum, manakala pelepasan daripada kapal dan pesawat juga semakin meningkat. Pengangkutan menyumbang hampir satu perempat daripada pelepasan global, dan ini dijangka akan meningkat dengan permintaan penggunaan pengangkutan.



Producing Food *Pengeluaran Makanan*



The food production industry generates emissions through various processes, including deforestation and land-use changes for agriculture, methane released from livestock digestion, and fossil fuel use for farming equipment. Additionally, the food production, packaging, and distribution all contribute to climate change, making agriculture a major emission source.

Industri pengeluaran makanan menghasilkan pelepasan melalui pelbagai proses, termasuk penebangan hutan dan aktiviti perubahan tanah untuk pertanian, metana dari pencernaan ternakan, dan penggunaan bahan bakar fosil untuk peralatan pertanian. Selain itu, pengeluaran, pembungkusan, dan pengedaran makanan semua menyumbang kepada perubahan iklim, menjadikan pertanian sebagai salah satu sumber pelepasan utama.

Over Consumption Penggunaan Berlebihan

Household activities including energy consumption, transportation, diet, and waste significantly contribute to greenhouse gas emissions. A large chunk of global greenhouse gas emissions is linked to private households highlighting how lifestyles can have a profound impact on the environment.

Aktiviti isi rumah seperti penggunaan tenaga, pengangkutan, diet, dan sisa turut menyumbang kepada pelepasan gas rumah hijau. Sebahagian besar pelepasan gas rumah hijau global dikaitkan dengan isi rumah persendirian. Gaya hidup individu boleh memberi kesan yang mendalam kepada alam sekitar.



2.4 | Impact of Climate Change Impak Perubahan Iklim

Climate change affects society in various ways, including drought, which harms food production and health, and flooding, which can spread disease, cause fatalities, and damage ecosystems and infrastructure. These health issues increase mortality rates, alter food availability, and reduce worker productivity, ultimately impacting economic performance.

Perubahan iklim memberi kesan kepada masyarakat dalam pelbagai cara, termasuk kemarau, yang mengancam pengeluaran makanan dan kesihatan, serta banjir, yang boleh menyebarkan penyakit, menyebabkan kematian, dan merosakkan ekosistem serta infrastruktur. Isu kesihatan meningkatkan kadar kematian, mengubah ketersediaan makanan, dan mengurangkan produktiviti pekerja, yang akhirnya memberi impak kepada prestasi ekonomi.

1

Increased Flooding *Banjir yang Meningkat*

Sabah is experiencing more frequent and severe flooding due to heavier rainfall and rising sea levels. This impacts infrastructure, homes, and agriculture.

Sabah mengalami banjir yang lebih kerap dan teruk akibat hujan lebat dan kenaikan paras laut. Perkara ini akan memberi kesan buruk kepada infrastruktur, kediaman, dan aktiviti pertanian.



2

Sea Level Rise *Kenaikan Paras Laut*

Coastal areas in Sabah, including Kota Kinabalu, Kudat, Tawau, Sandakan, and Lahad Datu, are at risk of inundation due to rising sea levels.

Kawasan pesisir di Sabah, termasuk Kota Kinabalu, Kudat, Tawau, Sandakan, dan Lahad Datu, berisiko ditenggelami akibat kenaikan paras laut.



3

Forest Fires *Kebakaran Hutan*

Higher temperatures and prolonged dry seasons increase the risk of forest fires, which can devastate large areas of Sabah's rich biodiversity.

Suhu yang tinggi dan musim kering yang berpanjangan akan meningkatkan risiko kebakaran hutan yang boleh memusnahkan kawasan yang besar dan mengancam kepelbagaian biodiversiti di Sabah.



4

Biodiversity Loss *Kehilangan Biodiversiti*

Climate change threatens Sabah's unique ecosystems, including its forests and marine life, leading to potential loss of species.

Perubahan iklim mengancam ekosistem unik Sabah, termasuk hutan dan hidupan marin, yang membawa kepada risiko pengurangan dan kepupusan spesies.



5

Health Impacts *Impak Kesihatan*

Changes in climate can lead to health issues such as heat stress, respiratory problems from haze, and the spread of vector-borne diseases.

Perubahan iklim boleh menyebabkan isu kesihatan seperti tekanan haba, masalah pernafasan akibat jerebu, dan penyebaran penyakit bawaan vektor.



6

Agricultural Challenges *Cabaran Pertanian*

Altered weather patterns affect crop yields and livestock, impacting food security and the livelihoods of farmers.

Pola cuaca yang berubah mempengaruhi hasil tanaman dan ternakan, memberi kesan kepada keselamatan makanan dan mata pencarian petani.



7

Economic Impact *Impak Ekonomi*

The combined effects of climate change on infrastructure, health, and agriculture can lead to significant economic losses for the state. Livelihood of groups such as coastal communities, farmers, and ecotourism are vulnerable from reduced yield and change of surrounding environment.

Kesan-kesan perubahan iklim terhadap infrastruktur, kesihatan, dan pertanian boleh menyebabkan kerugian ekonomi yang ketara di Sabah. Mata pencarian kumpulan seperti komuniti pesisir pantai, petani, dan ekopelancongan akan terancam oleh pengurangan hasil dan perubahan persekitaran sekitar.



2.5 | Climate Vulnerability & Resilience *Kerentanan & Daya Tahan Iklim*

2.5.1 | What is Climate Vulnerability? *Apakah Kerentanan Iklim?*

Climate vulnerability refers to the susceptibility of communities, ecosystems, and individuals to the adverse effects of climate change. While climate change impacts everyone, its effects are uneven across regions and populations. Even within the same community, one neighbourhood or individual may be more affected than another. Vulnerability is shaped by various factors, including socioeconomic conditions, health and the quality of infrastructure.

Certain individuals and groups in Sabah are more vulnerable to climate change due to personal characteristics and societal inequalities. Children, the elderly, and people with certain health conditions are at higher risk, as are outdoor workers such as farmers and fishermen who are exposed to extreme weather conditions. Coastal communities are particularly vulnerable due to their proximity to rising sea levels and increased flooding. Economically disadvantaged or low-income communities often live in areas that are less resilient to climate impacts. These communities frequently lack access to healthcare or resources to secure safe housing if their homes are damaged or become uninhabitable.

Kerentanan iklim merujuk kepada tahap pendedahan komuniti, ekosistem, dan individu terhadap kesan buruk perubahan iklim. Perubahan iklim memberi kesan kepada semua individu, tetapi impaknya kepada setiap kawasan dan populasi adalah tidak sama. Malah, dalam satu komuniti, perubahan iklim boleh memberi kesan yang lebih besar kepada sesetengah kejiwaan atau individu berbanding yang lain. Kerentanan ini dipengaruhi oleh pelbagai faktor, termasuk keadaan sosioekonomi, kesihatan, dan kualiti infrastruktur.

Individu dan kumpulan tertentu di Sabah lebih terdedah kepada perubahan iklim disebabkan oleh ciri-ciri peribadi dan ketidakadilan sosial. Kanak-kanak, warga emas, dan mereka yang mempunyai masalah kesihatan berisiko lebih tinggi, begitu juga pekerja luar seperti petani dan nelayan yang terdedah kepada keadaan cuaca ekstrem. Komuniti pesisir pantai amat berisiko kerana penempatan mereka yang terdedah dengan kenaikan paras laut dan peningkatan kejadian banjir. Komuniti yang kurang berkemampuan atau berpendapatan rendah sering tinggal di kawasan yang kurang berdaya tahan terhadap impak iklim. Komuniti ini kebiasaanya menghadapi kekurangan akses untuk penjagaan kesihatan atau sumber untuk mendapatkan tempat tinggal yang selamat jika kediaman mereka rosak atau menjadi tidak boleh didiami.

2.5.2 | What is Climate Resilience? Apakah Daya Tahan Iklim?

Climate resilience refers to the ability of communities, ecosystems, and individuals to anticipate, prepare for, and recover from the impacts of climate change. Building climate resilience is essential for minimizing damage and adapting to changing conditions. Many communities are not adequately prepared to face threats related to climate change. Even within a single community, some groups are more vulnerable to these threats than others. Actions for individuals and communities to enhance resilience to climate change and enhancing climate resilience requires coordinated efforts at both individual and community levels.

Daya tahan iklim merujuk kepada keupayaan komuniti, ekosistem, dan individu untuk menjangka, bersiap sedia, dan pulih daripada kesan perubahan iklim. Membangunkan daya tahan iklim adalah penting untuk meminimumkan kerosakan dan menyesuaikan diri dengan keadaan yang berubah-ubah. Kebanyakan komuniti masih belum tersedia menghadapi ancaman yang berkaitan dengan perubahan iklim. Malah, dalam satu komuniti, ada kumpulan yang lebih terdedah kepada ancaman ini berbanding yang lain. Tindakan untuk individu dan komuniti dalam meningkatkan daya tahan terhadap perubahan iklim dan meningkatkan daya tahan iklim memerlukan usaha di peringkat individu dan komuniti.

Resilient daisy plant flowering on a sandy area with no water | AlessandroZocc
Bunga daisi yang berdaya tahan untuk kembang di kawasan berpasir tanpa kehadiran air

2.6 |

Actions Community Can Take to Build Climate Resilience *Tindakan yang Boleh Diambil Oleh Komuniti Untuk Membina Daya Tahan Iklim*

2.6.1 | Personal Health & Well-being *Kesihatan & Kesejahteraan Diri*



Prioritize staying hydrated to prevent heat-related illnesses, especially during heatwaves.

Utamakan pengambilan air yang mencukupi bagi mencegah penyakit berkaitan haba, terutamanya semasa gelombang haba.

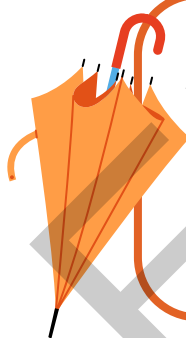
Stay Hydrated
Kekal Hidrasi



Apply sunscreen regularly to protect against harmful UV rays, especially when spending time outdoors.

Gunakan pelindung matahari secara berkala untuk melindungi diri daripada sinaran UV yang berbahaya.

Use Sunscreen
Gunakan Pelindung Matahari



Use umbrellas, hats, or stay under canopies during outdoor activities, especially during peak sunlight hours.

Gunakan payung, topi, atau berada dibawah kanopi semasa melakukan aktiviti luar, terutamanya pada waktu matahari terik.

Seek Shade
Cari Teduhan

Limit Outdoor Activities
Hadkan Aktiviti Luar

Reduce time spent outdoors during extreme heat by organizing events that promote indoor activities or shaded gatherings to reduce heat exposure.

Mengurangkan masa di luar semasa cuaca panas yang melampau dengan menganjurkan acara yang menggalakkan aktiviti atau perhimpunan didalam bangunan atau kawasan teduh untuk mengurangkan pendedahan kepada cuaca panas.



Monitor Weather Reports
Pantau Laporan Cuaca

Keep track of local weather forecasts to stay informed about extreme heat or heavy rainfall alerts, allowing better planning for outdoor activities. Example: portalbencana.nadma.gov.my, met.gov.my, aquams.my

Memantau ramalan cuaca tempatan untuk sentiasa mengetahui amaran cuaca panas melampau dan hujan lebat, membolehkan perancangan yang lebih baik untuk aktiviti luar. Contoh: portalbencana.nadma.gov.my, met.gov.my, aquams.my



2.6.2 | Sustainable Practices

Amalan Lestari

Plant Trees
Penanaman Pokok

Plant native plants or preserve trees around your home to cool indoor temperatures, provide shade, and enhance the community's appearance, while also mitigating urban heat.

Tanam atau pelihara pokok di sekitar rumah untuk menyejukkan suhu dalaman, menyediakan teduhan, dan memperindah komuniti sambil mengurangkan haba bandar.



Create Community Gardens
Wujudkan Kebun Komuniti

Establish community gardens to promote local food production and reduce reliance on external food sources.

Mewujudkan kebun komuniti untuk menggalakkan pengeluaran makanan tempatan dan mengurangkan kebergantungan kepada sumber luar.



2.6.3 | Community Engagement & Awareness *Penglibatan & Kesedaran Komuniti*



Implement community and school programs that educate residents and students about the impacts of climate change and the health risks associated with extreme heat.

Laksanakan program komuniti yang mendidik penduduk tentang kesan perubahan iklim serta risiko kesihatan berkaitan dengan cuaca panas yang melampau.

Education Campaigns
Kempen Pendidikan



Host workshops that focus on resilience strategies, such as proper hydration, heat safety, and first aid for heat-related illnesses, to empower community members with essential knowledge.

Anjurkan bengkel yang menumpukan kepada daya tahan perubahan iklim, seperti menjaga hidrasi, keselamatan semasa cuaca panas, dan pertolongan cemas untuk penyakit berkaitan haba, untuk memperkasakan komuniti dengan pengetahuan penting.

Community Workshops
Bengkel Komuniti



Establish support groups to check on vulnerable individuals, such as the elderly and children, during extreme weather events, ensuring those in need receive assistance. Join SEEN and collaborate with other government agencies, educational institutions, NGOs, and private sector.

Membentuk kumpulan sokongan untuk memantau individu yang terdedah, seperti warga emas dan kanak-kanak, semasa kejadian cuaca ekstrem, bagi memastikan mereka yang memerlukan boleh mendapat bantuan. Sertai SEEN dan bekerjasama dengan agensi-agensi kerajaan, institusi pendidikan, NGO, dan sektor swasta.

Community Support Networks
Rangkaian Sokongan Komuniti

2.6.4 | Disaster Preparedness *Persiapan Menghadapi Bencana*



Develop and regularly update disaster response plans for extreme weather events including conducting community drills for floods, heatwaves and other climate-related disasters. This is to ensure that residents know what to do in the event of an emergency.

Merangka dan mengemas kini pelan tindak balas bencana secara berkala bagi menghadapi kejadian cuaca ekstrem, termasuk menjalankan latihan kecemasan untuk menghadapi banjir, gelombang haba, dan bencana berkaitan iklim yang lain. Ini adalah bagi memastikan penduduk tahu apa yang perlu dilakukan sekiranya berlaku kecemasan.

**Disaster
Response Plans**
*Pelan Tindak
Balas Bencana*



Set up local emergency shelters particularly for vulnerable communities.

Menyediakan pusat perlindungan kecemasan tempatan terutamanya untuk komuniti yang terdedah kepada risiko.

**Community
Hubs**
Pusat Komuniti





Flood in Sabah
Banjir di Sabah | fotoBERNAMA

Chapter 3

Practical Activities

Bab 3 *Aktiviti Praktikal*



3.1 | Activities for Primary School Children *Aktiviti Untuk Pelajar Sekolah Rendah*

3.1.1 | Green House Effect Experiment *Eksperimen Kesan Rumah Hijau*

Without the greenhouse effect, life on Earth as we know it would not be possible. The greenhouse effect is a very natural and essential process. It has been around for millions of years.

During the day, the sun shines on planet Earth. But only some of the sun's energy reaches the Earth are absorbed by the atmosphere/cloud.

At night, most of the sun's energy escapes back into space. Most but not all. Thanks to the greenhouse effect, some of the heat is trapped in the atmosphere, and it protects us from the chill of space. The greenhouse effect is what keeps the Earth's temperature stable.

Tanpa kesan rumah hijau, kehidupan di Bumi sebagaimana yang kita kenali tidak akan terjadi. Kesan rumah hijau adalah proses yang sangat semulajadi dan penting. Ia telah wujud selama berjuta-juta tahun.

Pada siang hari, matahari bersinar di planet Bumi. Tetapi hanya sebahagian daripada tenaga matahari yang sampai ke Bumi yang diserap oleh atmosfera/awan.

Pada malam hari, sebahagian besar tenaga matahari kembali ke angkasa. Kebanyakan, tetapi tidak semuanya. Berkat kesan rumah hijau, sebahagian daripada haba terperangkap di atmosfera, dan ia melindungi kita daripada kesejukan angkasa. Kesan rumah hijau adalah yang apa yang memastikan suhu Bumi stabil.

Objective / Objektif:

To observe the greenhouse effect.

Untuk memerhatikan kesan rumah hijau.

Materials needed / Bahan yang diperlukan:

- Thermometer (2)
- Food container with cover

- Termometer (2)
- Bekas makanan dengan penutup



Preparation Work:

- Start the activity in the morning so you can observe the experiment over the course of the day. The activity works best on a sunny day.

Kerja Persediaan:

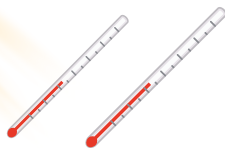
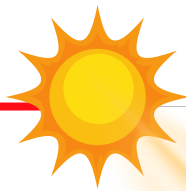
- Mulakan aktiviti pada pagi hari supaya anda dapat mengamati eksperimen sepanjang hari. Aktiviti ini berfungsi dengan baik pada hari yang cerah.

Steps / Langkah-langkah:

1

Lay both thermometers for a few minutes outside in a sunny area.

Letakkan kedua-dua termometer selama beberapa minit di luar di kawasan yang cerah.



2

Record down the time and the temperatures of both thermometers

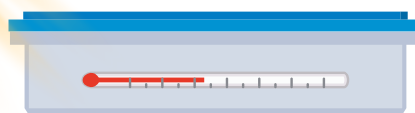
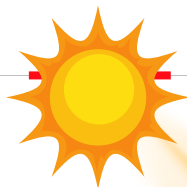
Catat masa dan suhu kedua-dua termometer.



3

Place a covered container in the sun with a thermometer in it. If the container has no cover, use a plastic wrap or a dark t-shirt to cover it.

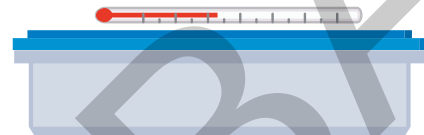
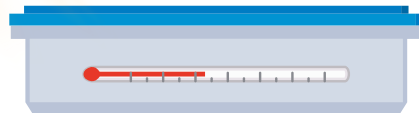
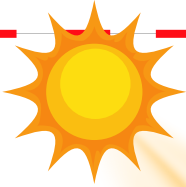
Letakkan bekas bertutup di bawah sinar matahari dengan termometer di dalamnya. Jika bekas itu tiada penutup, tutup bekas dengan bungkus plastik atau baju gelap.



4

Place the second thermometer on top of the container (outside of the covered container).

Letakkan termometer kedua di atas bekas (di luar bekas bertutup).



5

Record the temperatures on both thermometers every 5-10 minutes for one hour.

Catat suhu pada kedua-dua termometer setiap 5-10 minit selama satu jam.

6

Discuss your results. Example of questions that can be discussed are:

Bincangkan hasil anda. Contoh soalan yang boleh dibincangkan ialah:

- What causes the temperature difference?
- Which thermometer recorded the highest temperature at in the end?
- How do the results differ between the thermometer in the container and outside?

- Apakah yang menyebabkan perbezaan suhu?
- Bagaimana hasilnya berbeza antara termometer di dalam bekas dan di luar?
- Thermometer manakah yang mencatat suhu tertinggi pada akhirnya?

3.1.2 | Air Pollution Particulate Capture *Penangkapan Partikel Pencemaran Udara*

Particulates in the air is another cause of climate change. This experiment uses Vaseline or transparent petroleum jelly and index cards to capture visible particulates from indoor and outdoor spaces, so students can compare them.

Zarah di udara adalah satu lagi punca perubahan iklim. Eksperimen ini menggunakan Vaseline atau jeli petroleum lutsinar dan kad indeks untuk menangkap zarah yang boleh dilihat dari ruang dalaman dan luaran, supaya pelajar boleh membandingkannya.

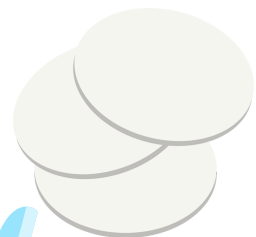
Objective / Objektif:

To observe impurities suspended in the air.

Untuk mengamati kekotoran yang terapung di udara.

Materials needed / Bahan yang diperlukan:

- Vaseline or clear petroleum jelly
- White paper or cards
- String
- Scissor
- Cotton pad
- Vaseline atau jeli petroleum jernih
- Kertas putih atau kad
- Rentetan tali
- Gunting
- Pad kapas



Steps / Langkah-langkah:

1

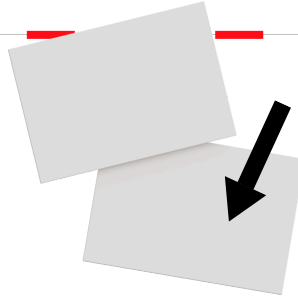
Cut up white paper or cards into name card sizes to prepare index cards. Prepare one set of 2 index cards.

Potong kertas putih atau kad menjadi saiz kad nama untuk menyediakan kad indeks. Sediakan satu set 2 kad indeks.

2

Spread Vaseline on the index cards using cotton pad.

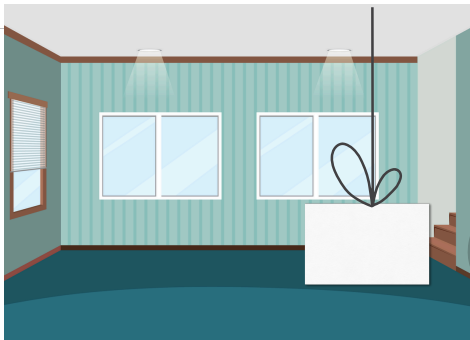
Sapukan Vaseline pada kad indeks menggunakan kapas.



3

Tie each index card with a string. Hang each card in 2 different locations indoor and outdoor.

Ikat setiap kad indeks dengan tali. Gantung setiap kad di 2 lokasi berbeza di dalam dan luaran.



4

After 1 week, observe the particles that have stuck to the index cards. This helps visualize air pollution. Example of questions that can be discussed are:

Selepas 1 minggu, perhatikan zarah-zarah yang telah melekat pada kad indeks. Ini membantu menggambarkan pencemaran udara. Contoh soalan yang boleh dibincangkan ialah:

- What can be observed on each index card?
- What causes the appearance of the index card?
- Does the location of each index card influence your observations?

- *Apa yang dapat diperhatikan pada setiap kad indeks?*
- *Apakah yang menyebabkan penampilan kad indeks?*
- *Adakah lokasi setiap kad indeks mempengaruhi pemerhatian anda?*

3.2 | Activities for Secondary School Children *Aktiviti Untuk Pelajar Sekolah Menengah*

3.2.1 | Acid Rain Experiment *Eksperimen Hujan Asid*

Higher carbon dioxide concentrations in the atmosphere increases the occurrences of acid rain. Rainwater that are slightly acidic will affect plants life which human relies for many things including as food source. This experiment simulates the effects of acid rain on plant life.

Kepekatan karbon dioksida yang lebih tinggi di atmosfera meningkatkan kejadian hujan asid. Air hujan yang berasid akan memberi kesan kepada kehidupan tumbuhan yang menjadi kebergantungan manusia untuk pelbagai perkara termasuk sebagai sumber makanan. Eksperimen ini mensimulasikan kesan hujan asid terhadap kehidupan tumbuhan.

Objective / Objektif:

To observe how plant life is affected by acid rain.

Untuk mengamati bagaimana kehidupan tumbuhan dipengaruhi oleh hujan asid.

Materials needed / Bahan yang diperlukan:

- 2 potted plants
- 2 1L water containers
- Lime or lemon juice
- 2 pokok pasu
- 2 bekas air 1L
- Jus limau nipis atau lemon



Steps / Langkah-langkah:

1

Put 2 potted plants in the same location indoor and exposed to sunlight. Label each pot to distinguish one to be watered with tap water and lime juice solution.

Letakkan 2 pokok dalam pasu di lokasi yang sama di dalam rumah dan terdedah kepada cahaya matahari. Beri label pada setiap pasu untuk membezakan satu yang akan disiram dengan air paip dan larutan jus limau.

2

Mix 1 tablespoons of lime or lemon juice into 1 on the water container.

Campurkan 1 sudu besar limau nipis atau jus lemon ke dalam bekas air.

3

Water each plant following the label once a day. Record your observations.

Siram setiap tumbuhan mengikut label sekali sehari. Catat pemerhatian anda.

4

Take final observations after 2 weeks.

Ambil pemerhatian akhir selepas 2 minggu.



Pot A / Pasu A



Pot B / Pasu B

3.2.2 | Investigate Urban Heat Island Effect *Mengkaji kesan Pulau Haba Bandaraya.*

Climate change also bring about rising temperatures that worsens urban heat island effect. As urban environments are built using different materials, some area will experience urban heat island differently.

Perubahan iklim juga membawa peningkatan suhu yang memburukkan lagi kesan pulau haba bandar. Oleh kerana persekitaran bandar dibina menggunakan bahan yang berbeza, sesetengah kawasan akan mengalami pulau haba bandar secara berbeza.

Objective / Objektif:

To investigate how different surfaces differs in heat absorption.

Untuk menyiasat bagaimana permukaan yang berbeza-beza dalam penyerapan haba.

Materials needed / Bahan yang diperlukan:

- 4 1L containers
- Sand, soil, water, gravel
- 4 digital thermometers
- Stopwatch

- 4 bekas 1L
- Pasir, tanah, air, kerikil
- 4 termometer digital
- Jam randik



Steps / Langkah-langkah:

1

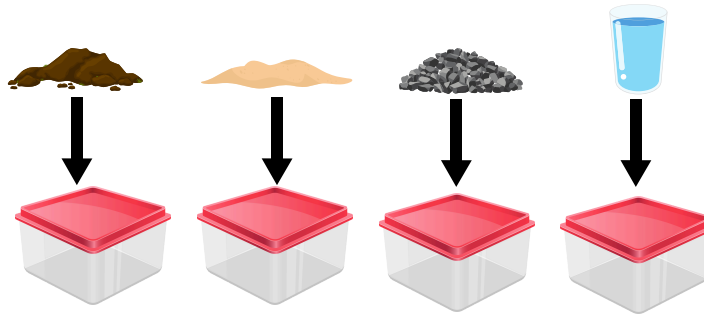
Before the trip, conduct a short briefing about catchment is an area of land where water collects and flows into a river, stream, or lake.

Sebelum perjalanan, jalankan taklimat ringkas tentang tadahan adalah kawasan di mana air terkumpul dan mengalir ke sungai, sungai atau tasik.

2

Fill each container with different materials.

Isi setiap bekas dengan bahan yang berbeza.



3

Put thermometers at the centre of the container, about 1 inch deep. Record initial temperature reading.

Letakkan termometer di tengah-tengah bekas, kira-kira 1 inci dalam. Catat bacaan suhu awal.

4

Put the containers outside, exposed to the sun. Leave the containers outside for 15 minutes. Record the temperature reading.

Letakkan bekas di luar, terdedah kepada matahari. Biarkan bekas di luar selama 15 minit. Catat bacaan suhu.

5

Put the containers indoor, in shade. Record the temperature reading after 15 minutes. Make your observation on:

Letakkan bekas di dalam rumah, di tempat teduh. Catat bacaan suhu selepas 15 minit. Buat pemerhatian anda tentang:

- Material that recorded the highest temperature after 15 minutes being outdoor.
- Material that recorded the lowest temperature after 15 minutes being indoor.

- *Bahan yang mencatatkan suhu paling tinggi selepas 15 minit berada di luar rumah.*
- *Bahan yang mencatatkan suhu paling rendah selepas 15 minit berada di dalam rumah.*

3.3 | Activities for Adults Aktiviti Untuk Dewasa

3.3.1 | Sea Level Rise Demonstration Tunjukkan Kenaikan Paras Laut

As ice from north & south pole and glaciers are melting, sea level rise is affecting the whole world. Its impact is happening gradually over time, with coastal communities are at risk.

Seiring dengan peleburan ais dari kutub utara dan selatan serta glasier, kenaikan paras laut sedang mempengaruhi seluruh dunia. Kesan ini berlaku secara beransur-ansur sepanjang masa, dengan komuniti pesisir pantai berada dalam risiko.

Objective / Objektif:

To demonstrate the impact of sea level rise to coastal community.

Untuk menunjukkan kesan kenaikan paras laut kepada komuniti pesisir.

Materials needed / Bahan yang diperlukan:

- 1 2L or bigger container
- 1L tap water
- Ice cubes
- Ruler
- Stopwatch

- 1 bekas 2L atau lebih besar
- 1L air paip
- Ketulan ais
- Pembaris
- Jam randik



Steps / Langkah-langkah:

1

Fill the container with 1 litre tap water.

Isi bekas dengan 1 liter air paip.

2

Put ice cubes in the container.

Masukkan ketulan ais ke dalam bekas.

3

Measure water level in the container every 5 minutes 6 times. Discuss the followings:

- What is the difference in water level between the first and last measure?
- What factors are affecting the rate of ice melting?
- How does the observation applies in real world?

Ukur paras air dalam bekas setiap 5 minit 6 kali. Bincangkan yang berikut:

- Apa perbezaan paras air antara ukuran pertama dan terakhir?
- Faktor-faktor apa yang mempengaruhi kadar peleburan ais?
- Bagaimana pemerhatian ini berlaku dalam dunia sebenar?

?

Answer / Jawapan

- During the last measure, water level increases compared to the first measure.
- Heat.
- The melting of glaciers at the poles due to global warming. This lead to sea level rise.

- Semasa ukuran terakhir, paras air meningkat lebih daripada ukuran pertama.
- Haba.
- Pencairan ais di kutub kerana pemanasan global. Ini menyebabkan peningkatan paras air laut.

3.3.2 | Sea Level Rise Demonstration Tunjukkan Kenaikan Paras Laut

Everyone can play their part to mitigate climate change by reducing their carbon footprint. Calculate carbon footprint to find out what can you do to reduce your carbon emission.

Semua orang boleh berperanan dalam mengurangkan perubahan iklim dengan mengurangkan jejak karbon mereka. Kira jejak karbon untuk mengetahui apa yang boleh anda lakukan untuk mengurangkan pelepasan karbon anda.

Objective / Objektif:

To investigate ways to reduce carbon emissions from daily activities.

Menyiasat cara mengurangkan pelepasan karbon daripada aktiviti harian.

Materials needed / Bahan yang diperlukan:

- Internet Access
- Notes

- Akses kepada internet
- Nota



Steps / Langkah-langkah:

1

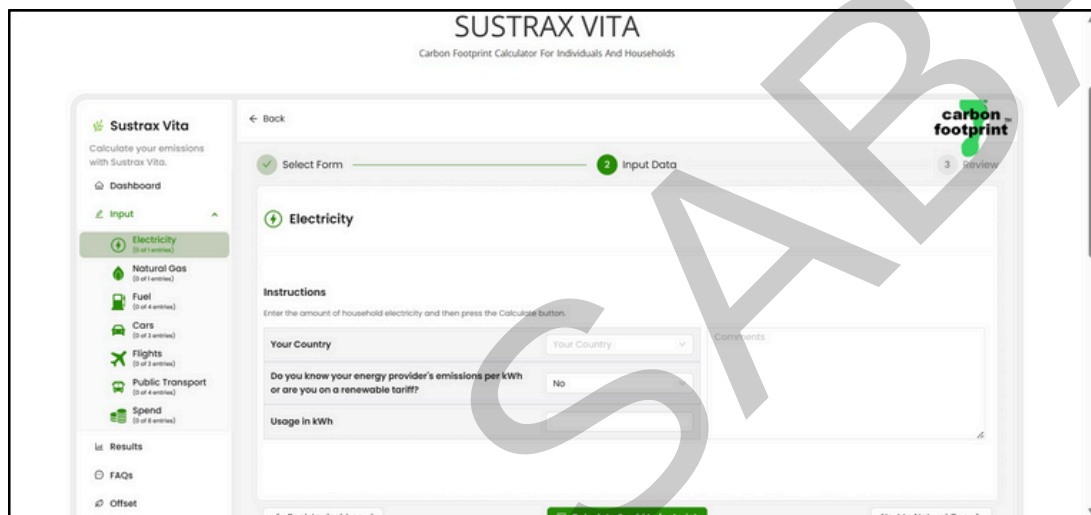
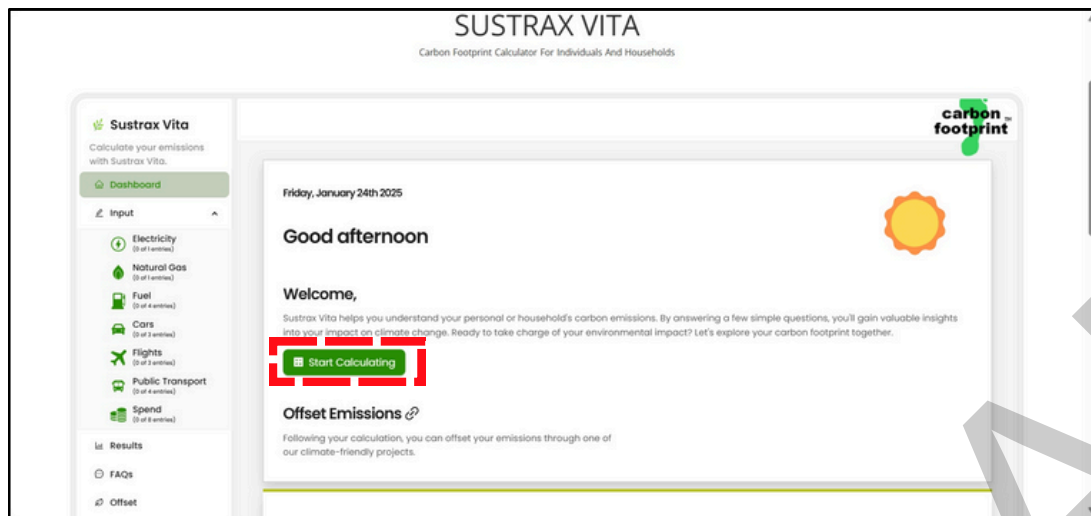
Split the participants into 3-4 persons per group.

Bahagikan peserta kepada 3-4 orang setiap kumpulan.

2

Visit <https://www.carbonfootprint.com/sustraxvita.html> and select applicable country and region.

Lawati <https://www.carbonfootprint.com/sustraxvita.html> dan pilih negara dan wilayah yang berkenaan.



Source / Sumber: Carbon Footprint website.

3

Record your or your household activity in the calculator.

Catat aktiviti anda atau isi rumah anda dalam kalkulator.

4

Discuss with your team what changes you can do to reduce you or your household's carbon emission.

Bincangkan dengan pasukan anda tentang perubahan yang boleh anda lakukan untuk mengurangkan pelepasan karbon anda atau isi rumah anda.

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