ENVIRONMENTAL EDUCATION FOR THE YOUNG

Fostering Environmental Citizenship

TEACHER'S HANDBOOK

Environmental Education Project

FOR A BETTER FUTURE

BAN KI-MOON FOUNDATION

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Environmental Education For The Young:
Fostering Environmental Citizenship

Environmental Education for the Young:

Fostering Environmental Citizenship

Course Description

To realize the engagement of young people as deliberate environmental citizens, this course provides a comprehensive overview of the environment as a subject area and of its related themes such as biodiversity, water, energy, health, and climate change for beginner level students. In addition to continuously encouraging students to take practical action to contribute to combating climate change and its impacts, the course also aims to provoke interest in good health and well-being throughout our lives. Not only does the course intend to foster awareness of the various issues, but it ultimately aims to transfer the knowledge that the students gain throughout this course into action. These actions become internalized and eventually instill sustainable habits that ensure sustainable consumption and production patterns into the future. Instead of teaching students in a unilateral way, this course seeks to support each learner's ability to tackle environmental problems and to cultivate the habits and life attitude of an Earth citizen. This course is an environmental educational material designed for the young, with more content and ideas from Asian countries as it focuses more on students from Asian countries than on students from around the world.

The course is composed of 1 introduction section, 6 modules and 1 final exam to assist in achieving the overall learning objectives within the 20-week curriculum. There are two different types of formats: 1) **PPT** is for instructors to use in the classroom to lead and provide students with improved comprehension of the material, and for students to follow the class while actively making notes on the PPT slides with teacher's explanation; 2) **Teacher's handbook** is essentially for supplementing the contents covered in class with more detailed explanations, glossary, and various examples, through which the instructor can prepare and guide the classes more competently. Using discussions, debates, creativity, research, as well as quizzes and games, this course contains 55 activities overall whereby the students will grasp the basic concepts of each module and are exposed to a range of current critical issues related to climate change and unsustainable human behavior. In the last week, the final exam will take place to assess student´s achievement of the overall learning objectives of the course.

Course Schedule

Each module is designed for 2 hours of study with an instructor in a school environment. Considering that 1 class in China (elementary and middle school) is 40 minutes long, it is expected

to take 3 weeks to finish each module. The course is estimated to take 20 weeks to complete, which is equivalent to the number of weeks in a semester of public schools in China.

Week	Learning Contents
Week 1 (40 min)	Introduction
Week 2~4 (120 min)	Module 1
Week 5~7 (120 min)	Module 2
Week 8~10 (120 min)	Module 3
Week 11~13 (120 min)	Module 4
Week 14~16 (120 min)	Module 5
Week 17~19 (120 min)	Module 6
Week 20 (40 min)	Final Exam

Target Audience

This is an introductory course with no prerequisites and background knowledge required. This course is originally intended for students between the ages of 11 and 15. It is also suitable for whoever wants to learn the very basics of climate change action and living sustainably. This course is environmental educational material designed for the young, particularly students from Asian countries as it contains more content and ideas related to Asian culture.

Learning Outcomes

Upon completion of this course, students will be able to:

1. Explain climate change related topics and sustainable lifestyle with enhanced awareness
2. Change environmentally unsustainable behaviors and apply new adaptive behaviors
3. Analyze climate-induced impacts on environmental, biological, and social systems
4. Present the international disputes and key issues on climate change under negotiation
5. Provide a rationale for climate change mitigation and propose actions in key sectors
6. Make informed and responsible decisions with regard to the climate system as global citizens
7. Communicate globally relevant climate change solutions to non-scientist/specialist audiences
8. Reinforce their proactive aspects in critical thinking and active problem-solving
9. Strengthen collaboration, communication, rapport-building, and conflict resolution skills through activities with peers

Module Description

Module	Title	Theme	Objectives
Introduction	Why Environment?	Environment, SDGs, Harmony with Nature	1. understand the accurate definition of the SDGs and know why they are important. 2. understand the relationship between humans and nature. 3. understand some basic knowledge of current environmental issues. 4. realize the serious consequences caused by environmental damage. 5. become willing to choose a low-carbon or a sustainable lifestyle.
Module 1	There Is No Planet B	Climate Change	1. understand what weather and climate are 2. understand what are greenhouse gases (GHGs) and the atmosphere 3. know about the effects of a warmer earth and the vicious cycle of negative consequences 4. understand the concepts of climate change mitigation and adaptation 5. recognize relevant challenges and solutions at local/community levels
Module 2	We Are All In This Together	Biodiversity	1. understand terrestrial and marine ecosystems 2. understand the concept of biodiversity 3. know about different kinds of wildlife and endangered species 4. argue for the sustainable use of marine and terrestrial resources / living resources 5. recognize relevant activities at local/community levels

Module 3	Light Up The World!	Energy	1. understand where and when we use specific kinds of energy 2. realize the shortcomings of contemporary energy resources 3. understand how different sorts of energy are being utilized, according to countries' technical/economic status 4. know about alternative energy resources 5. understand local/national levels' different strategies of utilizing renewable energy sources
Module 4	70% Of Our Earth!	Water	1. understand the importance of water for energy, drinking and sanitation 2. know how water circulates and which processes are required to use water in daily life 3. recognize unequal accessibility to clean water and its negative impacts 4. understand the concept of virtual water and real-life examples 5. pursue more effective and sustainable ways to consume water
Module 5	If We Make Earth Sick, Earth Makes Us Sick Too?	Health	1. know about contemporary global health issues 2. understand how health issues are related to climate change 3. recognize the correlation between individual and public health 4. understand about human exposure to regional weather changes 5. understand the importance of not only physical health but also mental health and well-being
Module 6	The Journey Of My T-Shirt	Sustainable Consumption and Production	1. understand the basic concepts of sustainable consumption and production 2. understand why responsible consumption

			and production are important for achieving sustainable development 3. understand the general structure of a supply chain 4. consider the life cycle of products they use in their everyday lives 5. know about and be accustomed to specific ways to contribute to responsible consumption

Introduction. Why Environment?

Introduction Description

The introduction aims to provide a general understanding of sustainable development and environmental issues. From this module, students will know the importance of having an environmental education and have a positive attitude on changing our lifestyle.

The overall 17 SDGs will be briefly mentioned, especially goals 3, 12 and 13. The key concepts of sustainable development are the interdependence of society, economy, and the natural environment, all living things depend upon each other and are interconnected through natural cycles and ecological systems. Traditional Chinese philosophy also points out 'harmony with nature', 'The Earth is alive', etc. While currently, our nature is being destroyed by human activity, human beings also suffer from many natural disasters. With the development of economy and technology, our daily lives heavily rely on energy, which results in climate change and pollution.

Learning Objectives

After completing Introduction, participants will be able to:

- understand the accurate definition of the SDGs and know why they are important
- understand the relationship between humans and nature
- understand some basic knowledge of current environmental issues
- realize the serious consequences caused by environmental damage
- become willing to choose a low-carbon or a sustainable lifestyle

Topics

1. Friendship Dare: Test Your Bond with Earth!
2. What is the environment?
3. Why is the environment important?
4. Environmental Crisis
5. SDGs to heal Earth
6. A brief overview- What are we going to learn?

Module 1. There Is No Planet B

Module Description

Starting with **climate change**, the participants are expected to understand what climate is in general and why it is such an urgent matter that needs to be addressed. Through explaining what GHGs are, where they originate from and what they do in the atmosphere, the important role of plants, and anthropogenic activities on the planet will be examined. In model 1 basic concepts of climate change and global warming are being discussed and therefore laying the foundation to understand the relationship between climate change and the following issues presented in the next modules.

Learning Objectives

By finishing this module, participants are expected to:

- understand what weather and climate are
- understand what are greenhouse gases (GHGs) and the atmosphere
- know about the effects of a warmer earth and the vicious cycle of negative consequences
- understand the concepts of climate change mitigation and adaptation
- recognize relevant challenges and solutions at local/community levels

Topics

1. What is weather, what is climate?
2. Why are climate and atmosphere important?
3. What are Greenhouse Gases (GHGs)?
4. What is wrong with a warmer Earth?
5. A vicious cycle: Can it be even worse than now?
6. What is climate mitigation and adaptation?
7. What we are doing now

Module 2. We Are All In This Together

Module Description

Participants are expected to understand the broad concept of **biodiversity** through learning about terrestrial and marine ecosystems. By not only recognizing how living creatures on the earth are deeply interrelated to each other, module 2 provides participants an opportunity to ponder upon which anthropogenic factors are harming the biodiversity and overall ecosystem, to learn about the relevant issues that are being discussed contemporarily, and to argue for the sustainable use of marine and terrestrial living sources or resources. For the final part, participants are expected to search activities that are currently undergoing on local or national level.

Learning Objectives

By finishing this module, participants are expected to:

- understand terrestrial and marine ecosystems
- understand the concept of biodiversity
- know about different kinds of wildlife and endangered species
- argue for the sustainable use of marine and terrestrial resources / living resources
- recognize relevant activities at local/community levels

Topics

1. Meet the terrestrial ecosystem
2. Meet the aquatic ecosystem
3. Biodiversity and its importance
4. What is deforestation?
5. The changing environment
6. Climate change and biodiversity
7. How are we all linked together?
8. Which species are in danger?

9. What we've been doing

10. You'd better protect us or will never see us again

Module 3. Light Up The World!

Module Description

This module covers the issue of **energy** in terms of its originating sources and daily consumption. The participants are expected to learn where energy comes from, what are different sources and how energy has developed throughout history. This module anticipates teaching the impact of different energy sources on the environment and how energy can be consumed in a responsible way. Not all energy sources are abundant and therefore the issue of renewable and non-renewable energy sources will be dealt with in this section. Furthermore, it will be discussed what every individual can do to save energy and how energy can be used in an efficient way.

Learning Objectives

By finishing this module, participants are expected to:

- understand where and when we use specific kinds of energy
- realize the shortcomings of contemporary energy resources
- understand how different sorts of energy are being utilized, according to countries' technical/economic status
- know about alternative energy resources
- understand local/national levels' different strategies of utilizing renewable energy sources

Topics

1. Where do we meet energy?
2. Where does our energy come from?
3. What is the history of human energy?
4. Energy in different areas!
5. How are energy and environment linked?
6. Why do we need to be careful when selecting our energy source?
7. What can I do save energy?

8. Why is recycling important?
9. What are renewable energy resources we can use?
10. Real life examples of renewable energy!

Module 4. 70% Of Our Earth!

Module Description

Module 4 introduces the different usages of **water** in our lives. Even though water makes up more than 70% of the earth, people cannot use all of it and we need certain processes to make it available. Participants are expected to understand that procedure, following the circulation of water. Then the module explains the importance of 'clean' water for health and sanitation, touching on the issue of unequal accessibility to clean water and its problems. In a similar vein, participants will learn about pollutants of water and possible preventive measures for them. By learning a concept of 'virtual' water, they will be able to understand that water is literally utilized everywhere and every day. Finally, participants will explore the local community's water supply and usage cycle and the ways to improve its efficiency and responsibilities.

Learning Objectives

By finishing this module, participants are expected to:

- understand the importance of water for energy, drinking and sanitation
- know how water circulates and which processes are required to use water in daily life
- recognize unequal accessibility to clean water and its negative impacts
- understand the concept of virtual water and real-life examples
- pursue more effective and sustainable ways to consume water

Topics

1. Where is water?
2. Which water do we use?
3. What is water cycle?
4. Why is water important?
5. Can everyone use clean water?
6. What is polluting our water?
7. Where do we meet water?
8. How is my village using water?
9. How can we use water efficiently?

10. What is my village doing for water?

Module 5. If We Make Earth Sick, Earth Makes Us Sick Too?

Module Description

Module 5 anticipates providing broad information about the **human health**. Participants are expected to learn about what humans need to live a healthy lifestyle which includes various factors like weather and climate conditions, water quality, good air, healthy food, and so on. Furthermore, the understanding of how our environment is directly and indirectly linked to our health is explained and participants will learn about regional differences and what are important issues in their local environment. Also, health should not be known as a physical condition only, but in a mental and psychological way as well, helping participants to seek healthier ways to maintain personally and publicly healthy life.

Learning Objectives

By finishing this module, participants are expected to:

- know about contemporary global health issues
- understand how health issues are related to climate change
- recognize the correlation between individual and public health
- understand about human exposure to regional weather changes
- understand the importance of not only physical health but also mental health and well-being

Topics

1. What do we need to live a healthy life?
2. What are health impacts related to climate conditions?
3. How can we maintain a healthy lifestyle in our region?
4. What makes us sick and how can we protect ourselves?
5. Healthy food and sustainable consumption
6. How should we organize healthy daily routines?
7. Different kinds of diseases
8. Can we live a healthy life everywhere?
9. How can we think and live in a ‘healthier’ way?

10. How can we communicate and live with others healthier?

Module 6. The Journey Of My T-Shirt

Module Description

Module 6 is the final module, which is the most detailed and practical scheme for the participants. It firstly provides brief information on the concept of **sustainable consumption and production (SDG 12)**, as well as its importance to be achieved globally. Participants will then be introduced to current situations of the globalized supply chain and its possible adverse effects on the environment, especially the food and fashion industry. As the module itself follows the 'life cycle' of a certain product that can be directly related to everyday life, participants will be introduced from the process of production to its after treatment as waste. By following this timeline, participants will understand how production and consumption procedures are complicated and can be 'unsustainable' to the environment and the ecosystem. This will lead to increased curiosity of participants on actual behaviors they can adopt to be more responsible consumers.

Learning Objectives

By finishing this module, participants are expected to:

- understand the basic concepts of sustainable consumption and production
- understand why responsible consumption and production are important for achieving sustainable development
- understand the general structure of a supply chain
- consider the life cycle of products they use in their everyday lives
- know about and be accustomed to specific ways to contribute to responsible consumption

Topics

1. Meet sustainable consumption and production, and the 4Rs
2. What are causes and effects of material and food consumption?
3. What is the importance of responsible consumption and production in achieving sustainable development?
4. What is the basic structure of current industrialized supply chain?
5. What is life cycle analysis?
6. What are the concepts of ecological and carbon footprints, and what are examples?
7. What people have been trying for sustainable production: real examples

8. How to choose a “better” product?

Introduction: Why Environment?

By finishing the introduction section, students are expected to:

- understand the accurate definition of the **SDGs** and know why they are important.
- understand the relationship between **humans and nature**.
- understand some basic knowledge of **current environmental issues**.
- realize the **serious consequences** caused by environmental damage.
- become willing to choose a **low-carbon** or a **sustainable lifestyle**.

The introduction aims to provide a general understanding of sustainable development and environmental issues. From this module, students will know the importance of having an environmental education and having a positive attitude to changing our lifestyles.

Overview


Part 1
Friendship Dare: Test Your Bond with Earth!
How much are you familiar with the Earth?
Let's test your bond with Earth!
Part 2
What is the environment?
What is the environment, biosphere, and atmosphere
that constitute our Earth's system?
Let's explore them.
Part 3
Why is the environment important?
What is the environment, biosphere, and atmosphere
that constitute our Earth's system and
how are they important?
Part 4
Environmental Crisis
Which environmental crisis are happening on our planet?
Let's take a brief overview.
Part 5
SDGs to heal Earth
Have you ever heard of SDGs?
We will learn what SDGs are, their brief history, and aims.
Part 6
A brief overview - What are we going to learn?
We are going to learn together throughout the following
six modules. Let's explore what are we going to learn?

Introduction of Contents for Each Topic

Topic 1. Friendship Dare: Test your Bond with Earth!

Objective	Students learn that humans and Earth are closely bound together and the importance of getting to know our earth.
Part 1	Learn about how we interact with the planet.
Part 2	Have a general understanding of environmental related concepts.

Topic 2. What is the environment?

Objective	Students learn about what the environment is as well as the biosphere and the atmosphere.
Part 1	Learn about what environment is and why a healthy environment is crucial for us.
Part 2	Learn about the biosphere and the atmosphere, and their importance.

Topic 3. Why is the environment important?

Objective	Students learn about why our environment is important and why we need to protect it.
Part 1	Think about how we treat our environment and what should we do in the future.
Part 2	Learn about the relationship between humans and nature.
Part 3	Learn about Chinese Philosophy regarding the environment.

Topic 4. Environmental Crisis

Objective	Students will learn an overview of various kinds of environmental crisis and discuss their thoughts on their causes.
Part 1	Learn about different types of environmental crisis and how a crisis can be local, regional, or global in its scope.
Part 2	Students will discuss their own ideas about what they think the causes of environmental crisis are.

Topic 5. SDGs to heal Earth

Objective	Students gain an understanding of the Sustainable Development Goals (SDGs) in relation with the following modules.
Part 1	Learn about the backgrounds and basic contents of the SDGs.
Part 2	Understand especially SDG 3, 12, 13 in relation with the overall course and modules.

Glossary for Introduction

Vocabulary	Definitions
Friendship	A state of mutual trust and support between people. Possible with other subjects; for example, the environment.
Environment	Complex of physical, chemical and biotic factors which consists circumstances surrounding people.
Greenhouse effect	A natural process which warms the Earth's surface by trapping heat from the sun.
Biodiversity	Refers to the variety of life that can be found on Earth as well as communities and habitats they form and live in.
Pandemic	An outbreak of a disease; normally a status of a disease widely spread over a whole country or the world.
Energy Transformation	Process of changing energy from one form to another.
Kinetic energy	Energy of an object which is possessed due to its motion.
Natural Gas	Mixture of gases which are rich in hydrocarbons; general examples are methane, nitrogen and carbon dioxide. It is used by humans as a source of energy.
Climate change	Change in the average conditions in a region over a long period of time. Human activities contribute to the proliferation of this phenomenon.
Waterborne Disease	Illnesses caused by viruses and bacteria – the microscopic organisms which are in water contaminated by human or animals.
Vector	An organism which transmits a disease or parasite from one animal or plant to another.
Recycle	The process of converting waste into reusable material.
Responsibility	A state of having duties for something within one's power, control or management.
Biosphere	A layer of the planet Earth where life exists. It is the ecological system which integrates all living beings.
Atmosphere	The whole mass of air that surrounds Earth.
Self-cultivation	A development of one's mind or capacities done by one's own efforts.

Environmental Crisis	Dramatic worsening of the environment leading to significant loss of welfare and brings great influence over natural resources and ecosystems.
Sustainable Development Goals (SDGs)	Goals adopted by all United Nations (UN) Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030.
Millennium Development Goals	Eight goals to be achieved by 2015 with measurable targets and clear deadlines for improving the lives of the world's population with poverty. The leaders of 189 countries signed the historic millennium declaration at the United Nations Millennium Summit in 2000.

Topic 1. Friendship Dare: Test Your Bond with Earth!

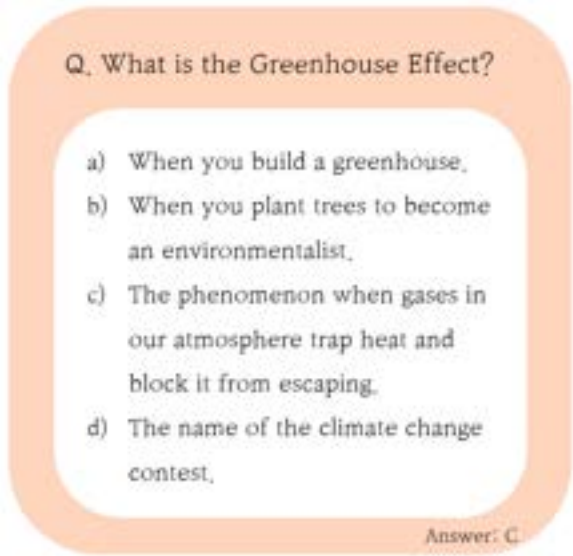
Why study Earth?

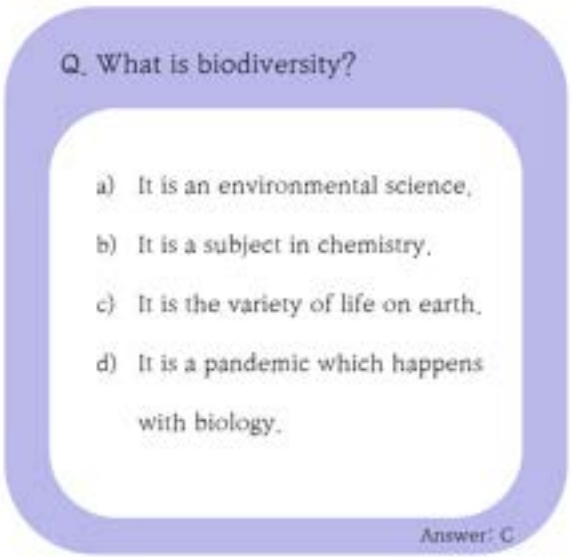
The simple response to this question is that Earth is our home, our one and only home. It is **the one place in the entire solar system where humans can live.** We need to learn how it functions to ensure that it continues to be a place where we can live well. Our relationship with Earth is closer than you can imagine:

- We depend on Earth for important resources, such as water, food, soil, metals, industrial minerals, and energy, and we need to know how to find or create and utilize these resources sustainably.
- Rocks and fossils are studied because we can understand the evolution of our environment and the life within it.
- We can learn how to mitigate our risks from earthquakes, volcanoes, slope failures and destructive storms.
- We learn how and why the atmosphere of the world has changed in the past and use this knowledge to unde rstand climate change, both natural and caused by humans.
- We can see how our actions have changed the atmosphere and climate more and more seriously in many wa ys and how we can prevent more serious future changes.

[Topic 1_Activity]

You have learned about the bond between humans and Earth. Here is a quick quiz testing your understanding about the concepts of the environment. Choose the best answer below.





Q. Which is an example of energy transformation?

a) Natural gas staying in the ground.
b) The sun making the crops grow.
c) Mining and burning coal.
d) Kinetic energy of water changed into electrical energy.

Answer: D

Q. Which is not a source of fresh water?

a) Glaciers and ice sheets.
b) Groundwater.
c) Oceans.
d) Lakes and rivers.

Answer: C

Q. Which issue is related to climate change?

a) Increase of food and waterborne disease.
b) Mental health and stress-related disorders.
c) Diseases carried by vectors.
d) All of the above.

Answer: D

Q. Which of these can you recycle?

a) Takeaway coffee cups.
b) Bubble Wrap.
c) Aluminum cans.
d) Electronic cords.

Answer: C

Topic 2. What is the environment?

What is the environment?

The environment is basically **everything that is around us**. All our surroundings make up the environment including the air, soil, water, plants, and animals.

A **healthy environment** is crucial. We need a healthy environment for our health, happiness and human development. It is **everyone´s responsibility** to help protect the environment since we all are living in the same environment on earth.

Figure 2. Pollution and effects on your water.

Figure 1. Social Responsibility.

What is the biosphere?

There are different layers which all work interdependent. From the largest scope there is the **biosphere**. The biosphere includes all the parts of the earth where life exists. Then, there is an **ecosystem**. An ecosystem consists of all the living and nonliving things on one specific area. At the next layer is a **community**. A community is a group of living things that interact with each other within an area. And then there is the **individual** level. Each of us are just one individual, but our actions effect our ecosystem.

Figure 3. Ecology.

What is the atmosphere?

The atmosphere is like a blanket that surrounds our planet. It is a **blanket made of gases** which surrounds the earth and plays a significant role to human life.

Figure 4. Atmosphere.

The importance of the atmosphere

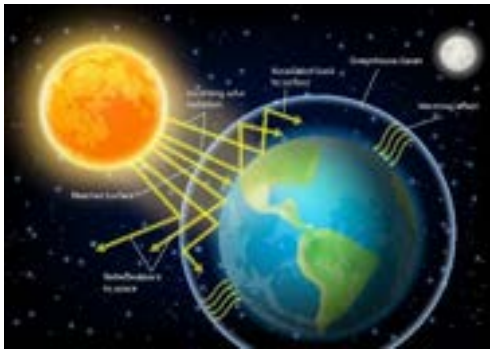


Figure 5. The Greenhouse Effect.

The atmosphere plays a crucial role to our life on earth. The atmosphere provides us with **oxygen** and keeps the **temperatures on earth warm** enough for us to survive. Without the atmosphere it would be different temperature conditions on Earth and human life would not be possible. Gases in the atmosphere trap some of the heat that comes from the sun and keep the earth warm.

The atmosphere also **protects us from the harmful ultraviolet rays** that are coming to the earth from the sun. Even though rays come through the atmosphere, most of them are safer than some rays that are very dangerous. The atmosphere therefore protects us from such dangerous sunrays.

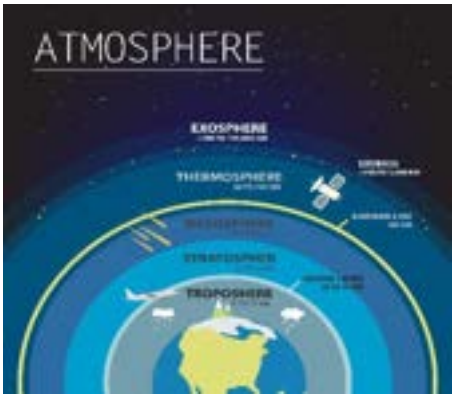


Figure 6. Atmosphere Layers.

Topic 3. Why is the environment important?

Why is the environment important?

> We need ants to survive, but they don't need us at all — Prof. E. O Wilson

With the rapid development of our economies and technology, people have more comfortable lives. However, this can also make us forget or ignore the contribution made by nature to our quality of life. Everywhere on the planet, species live together and depend on one another. Humans are also part of nature, it's time for us to take more action to protect nature and our environment. Let's start with some critical thinking questions, to open up our minds and consider more deeply the value of nature.

Critical Thinking

Question 1: Do we need to change the way we treat nature ?

Hint: Some of us may experience impacts from nature, use them as examples. Consider if we do not change our way, what consequence we will face. Which is a proper way we should act?

Question 2: 'Human beings will perish if we do not constrain our actions towards nature'. Is this correct?

Hint: Consider the impacts of natural disasters on human beings. Are natural disasters caused by human beings? How can we constrain our actions?

Humans and nature

Nature provides us with natural services and all the other species are essential to our health, quality of life and survival. A healthy ecosystem can purify our air, clean our water, maintain our soil, regulate the climate and provide food for humans. For example, forests store carbon dioxide and other pollutants from the air and emit fresh oxygen, they not only cool our air temperature, but also clean our air. Worse air quality will cause heart and lung problems for humans and animals. The wetlands can collect storm water and filter the pollutants in water, and the filtered water can be used for recharging our aquifers. In addition, many raw materials used in production come from nature, like our textbooks, which are made of paper created from trees.

What do we need to do for our environment?

What are we doing to nature?

Overexploitation

Illegal hunting

Deforestation

What should we do now?

It is critical to protect the environment to reduce the destruction of ecosystems caused by human activities. It is a moral obligation of humans to protect the environment from pollution and other activities that lead to environmental degradation. Environmental degradation is detrimental because it impacts the long-term health of humans, animals and plants.

Global warming, air and water pollution, deforestation, acid rain and wildfires are just few of the environmental issues that we are facing now. It is everyone's responsibility to protect our environment and make our planet remain a wonderful place to live. We don't necessarily need to spend a lot of money to achieve this goal, simply changing our daily lifestyles can reduce the damage we cause.

Chinese Philosophy and Nature – Harmony with Nature

'Tien-rén-hé-yi' (天人合一, '***the harmony between humanity and nature***') is a core idea in Chinese traditional culture. About 2,300 years ago, Chinese philosopher Mencius noted the impact of human activity on the natural system around him. He wrote that the Ox Mountain was beautiful, but it had been attacked by axes and hatchets, so how could it remain beautiful? In modern cities, it is almost impossible to see "the true nature" in almost any part of the urban area.

Smog (air pollution) hides the distant scenery and rivers have been canalized. So how could we rediscover the true value of nature? Confucian thought contains ethics promoting both development AND conservation. For our nations' development, we need nature and natural resources, but we also have responsibility to protect them. Mencius pointed out that a wise resource management was essential to people's subsistence and encouraged limiting harvests was necessary to ensure that resources would continue to be available in the future. This is very similar to the concept of sustainable development we talk about today. Our ancestors did not abuse natural resources, thus they ensured we could live better lives today. Similarly, for our future generations, we should change our way of life and re-learn the wisdom of our ancestors so that nature and natural resources can be preserved forever.

Topic 4. Environmental Crisis

What kind of environmental crisis are there?

Environmental Crisis can be defined as a dramatic, unexpected, and irreversible worsening of the environment leading to significant welfare losses, which are usually difficult or impossible to reverse. There are different types of environmental crisis. Let's look at some examples.

Figure 7. Desertification.

Desertification: a type of land degradation in drylands in which biological productivity is lost due to natural processes or induced by human activities whereby fertile areas become increasingly arid.

Figure 8. Air pollution.

Air pollution: the presence of substances in the air which are harmful to the health of humans and other living things.

Figure 9. Polar Melting.

Polar melting: the melting of the polar ice caps which causes the global sea levels to rise, threatening regions near sea level.

Figure 10. Water Scarcity.

Fresh water scarcity: the lack of availability of a clean, safe, and reliable drinking water source.

Figure 11. Global warming.

Global warming: the gradual increase in the overall temperature of the earth's atmosphere primarily caused by greenhouse gases emitted by human activities.

Figure 12. Improper waste disposal.

Improper waste disposal: when trash is thrown away improperly and thus has a negative impact on wildlife and the natural environment.

Figure 13. Deforestation.

Deforestation: the removal of trees and forests from land which is then used for another purpose such as farming, ranches or urban development.

Figure 14. Overpopulation.

Overpopulation: when there are too many people for the environment to sustain.

Environmental crisis can be categorized into 3 types

Global

- Global Warming
- Polar Melting
- Ocean acidification
- Ozone Depletion
- Biodiversity Loss

Regional

- Deforestation
- Acid Rain
- Water Pollution
- Desertification

Local

- Waste Disposal
- Fresh water scarcity
- Desertification
- Over Population

Causes and Effects of Environmental Crisis

What do you think the causes of environmental crisis are?
Let's think about it together.

Topic 5. SDG to heal Earth

SDGs to Heal the Earth

Have you ever heard about the **Sustainable Development Goals**, also known as the **SDGs**? They are goals to make the world a better place by 2030, which were created at the Rio de Janeiro Conference of the United Nations (UN). There are 17 goals in total and each goal has own targets and indicators to be met and to be monitored.

The history of the SDGs

The UN made the SDGs as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The SDGs succeeded the Millennium Development Goals (MDGs), which were announced in 2000 and expired in 2015. The MDGs aimed to establish measurable and universal objectives for the issues among global development priorities.

Some of the key MDG achievements are that since 1990 more than 1 billion people have been lifted out of extreme poverty, and that child mortality and the number of out-of-school children has dropped by more than half.

Sustainable Development Goals 3, 12 and 13

While going through the following modules, we will focus on **SDG 3 "Good health and well-being", SDG 12 "Responsible consumption and production", and SDG 13 "Climate action"**.

Goal 3 is for ensuring healthy lives and promoting the well-being for all at all ages.

Goal 12 is about doing more and better with less. It is also to have economic growth without damage to the environment.

Goal 13 is to take effective action to stop climate change.

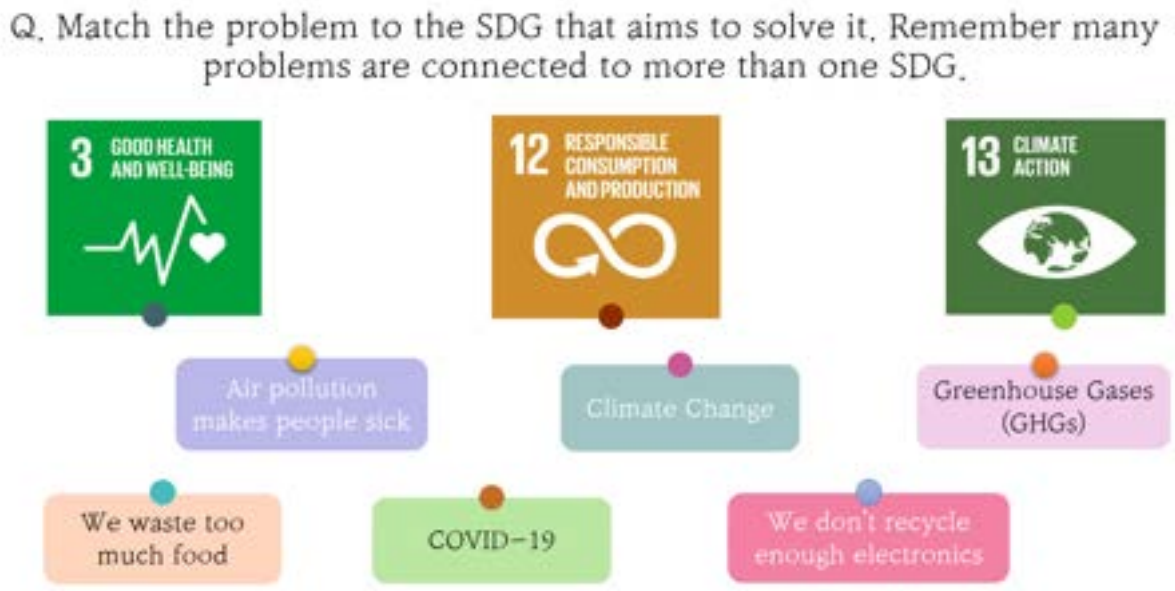
As with other SDGs, these three SDGs are also interlinked in many ways.

For example, by being more responsible in our consumption and production (Goal 12), we can also help stop climate change (Goal 13) by ensuring sustainability in our daily actions. This also can cause more people to be healthier (Goal 3) because of not being negatively affected by climate change.

[Topic 5_Activity]

1) This is a brief activity to help review what you have learned. First draw lines to connect each SDG to their correct number.

2) Next draw lines to connect each SDG to the problems they aim to solve.



Topic 6. A brief overview: What are we going to learn?

Module 1

Climate Change

· Weather and Climate
· Greenhouse Gases
· The role of Plants
· Permafrost
· Effort of the community

Module 2

Biodiversity

· Wildlife and extinction of species
· Terrestrial and marine ecosystem
· Climate change and biodiversity
· The nexus of ecosystem

Module 3

Energy

· Need and Usage of Energy
· Renewable energy
· History of energy
· Ways to save energy
· How to recycle

Module 4

Water

· Supply and usage of water
· Circulation of water
· Water pollution
· Clean water and sanitation
· Accessibility to water

Module 5

Health

· Importance of healthy life
· Health impacts from climate change
· Different kinds of diseases
· Communication and health

Module 6

Sustainable Consumption and Production

· Concept and the 4Rs
· Life cycle analysis
· Ecological/carbon footprint
· Basic structure of supply chain
· How to choose a better product

Module 1: There Is No Planet B

By finishing this module, students are expected to:

- understand what **weather** and **climate** are
- understand what are **greenhouse gases** (GHGs) and the **atmosphere**
- know about the effects of a **warmer earth** and the **vicious cycle** of negative consequences
- understand the concepts of climate change **mitigation** and **adaptation**
- recognize relevant **challenges** and **solutions** at local/community levels

By module 1, students are expected to understand **what climate is** in general and **why it is such an urgent matter** that needs to be addressed now. The basic concepts of climate change and global warming are discussed, therefore laying the foundation to understand **the relationship between climate change and other issues**.

Overview

Part 1

What is weather, what is climate?

Do you know the differences between weather and climate?
What constitute our planet's atmosphere?

Part 2

Why are climate and atmosphere important?

What is the atmosphere's role?
Why climate is important?

Part 3

What are Green House Gases?

Have you heard about Greenhouse effect?
What are Green House Gases, where do they come from,
and how do they affect the earth?

Part 4

What is wrong with the warmer Earth?

Our house on fire.
What exactly is wrong with that?

Part 5

A vicious cycle:
Can it be even worse than now?

The worse a situation becomes, the harder it gets to be solved.
And it's going to be even worse if we do not act now.

Part 6

What is climate mitigation and adaptation?

Climate mitigation and adaptation are endeavors to tackle
climate change. Let's see the concepts and details.

Part 7

What we are doing now

Facing the threats caused by climate change, there are
people who are making efforts to make changes.
Take a look their actions and think about what YOU can do.

Introduction of Contents for Each Topic

Topic 1. What is weather, what is climate?

Objective	Students can understand the basic concept of weather and climate and are introduced to their differences.
Part 1	Learn what constitutes weather.
Part 2	Understand the differences between weather and climate.
Part 3	The composition of our atmosphere and climate system of the earth are explained.

Topic 2. Why are climate and atmosphere important?

Objective	Students learn about the importance of climate and atmosphere in the overall system of our planet.
Part 1	Understand the basic structure of the earth's climate system and anthropogenic factors.
Part 2	Students are introduced to the negative changes happening to the earth and its climate.

Topic 3. What are Greenhouse Gases (GHGs)?

Objective	Students understand the basic concepts related to the Greenhouse Gases (GHGs), as well as their causes.
Part 1	Learn about greenhouse effect and the main GHGs.
Part 2	Understand where GHGs come from.

Topic 4. What is wrong with a warmer Earth?

Objective	Students understand the impacts of global warming on our planet by some examples.
Part 1	Understand the relation between increasing GHGs and the earth getting warmer.
Part 2	Students are introduced to representative examples of global warming impacts and their projected effects.

Topic 5. A vicious cycle: can it be even worse than now?

Objective	In a similar vein with Topic 4, students gain an understanding of the dynamics of climate change and its structure as a vicious cycle.
Part 1	Understand how the changing conditions of the earth are rapidly deteriorating.
Part 2	Understand what can make a vicious cycle in regard to climate change.

Topic 6. What is climate change mitigation and adaptation?

Objective	Students learn about what climate change mitigation and adaptation are and are introduced to some examples.
Part 1	Learn about the basic concept of climate change mitigation and adaptation.
Part 2	Students are introduced to Chinese examples of climate mitigation/adaptation strategies.
Part 3	Understand the mainstreaming of climate change action and significant factors in its implementation.

Topic 7. What we are doing now

Objective	Students are introduced to international and national examples of climate action.
Part 1	Learn about the international cooperation to tackle climate change, especially in relation to **SDG 13.**
Part 2	Learn about the recent national-level efforts to tackle climate change.

Glossary

Vocabulary	Definitions
Climate change	Climate change is a change in the pattern of weather, such as temperature and rainfall occurring over time scales of decades or longer.
Weather	The state of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.
Climate	The weather conditions prevailing in an area in general or over a long period.
Atmosphere	The mixture of gases around the earth.
Thermosphere	The layer in the Earth's atmosphere directly above the mesosphere and below the exosphere. The thermosphere is characterized throughout by an increase in temperature with height.
Ozone layer	A thin part of the Earth's atmosphere that absorbs almost all of the sun's harmful ultraviolet light.
Mesosphere	The mesosphere is the third layer of the atmosphere, directly above the stratosphere and directly below the thermosphere. In the mesosphere, temperature decreases as altitude increases.
Stratosphere	Stratosphere is the next higher layer, above the stratosphere is the mesosphere. Ozone is relatively abundant in the stratosphere, heats this layer as it absorbs energy from incoming ultraviolet radiation from the Sun.
Troposphere	The lowest densest part of the earth's atmosphere in which most weather changes occur, and temperature generally decreases rapidly with altitude and which extends from the earth's surface to the bottom of the stratosphere at about 11km high.
Hydrosphere	A hydrosphere is the total amount of water on a planet. The hydrosphere includes water that is on the surface of the planet, underground, and in the air. A planet's hydrosphere can be liquid, vapor, or ice.
Cryosphere	Places on Earth that are so cold that water is frozen solid.
Biosphere	The worldwide sum of all ecosystems.
Thermal conductivity	The thermal conductivity of a material is a measure of its ability to conduct heat.

Thermal inertia	The degree of slowness with which the temperature of a body approaches that of its surroundings and which is dependent upon its absorptivity, its specific heat, its thermal conductivity, its dimensions, and other factors.
Anthropogenic	(Chiefly of environmental pollution and pollutants) originating from human activity.
Global warming	The increase of the average global temperature.
Degraded soil	The decline in soil condition caused by its improper use or poor management, usually for agricultural, industrial or urban purposes.
Greenhouse gas	A gas that absorbs and emits radiant energy within the thermal infrared range. Increased greenhouse gases in the atmosphere cause the Earth to become warmer.
Permafrost	Permafrost is ground that continuously remains frozen for two or more years, located on land or under the ocean.
Deforestation	Clearance, clearcutting or clearing is the removal of trees or forests from land which is then converted to a non-forest use.
Desertification	Desertification is a type of land degradation in drylands in which biological productivity is lost due to natural processes or induced by human activities whereby fertile areas become increasingly more arid.
Vulnerability	Vulnerability refers to the inability (of a system or a unit) to withstand the effects of a hostile environment.

Which SDG is most related to this module?

Module 1 discusses the environment, climate change and its related issues. The according SDG that covers these subjects is **SDG 13.**

"Take urgent action to combat climate change and its impacts."

Topic 1: What is weather, what is climate?

How is the weather today?

How is the weather today? Take a look outside the window, how strong is the sunlight today? Is it sunny, cloudy, or raining? What about the temperature? Hot or cold? Weather is temporary which **changes daily and hourly.** It is a **short-term condition,** in any moment you can check the weather by just looking outside.

There are six main parts of weather: **temperature, atmospheric pressure, wind, humidity, precipitation, and cloudiness**. These components together characterize the weather at any given time.

°C (Celsius degree)
°F (Fahrenheit)

Are weather and climate different?

Weather refers to **short-term shifts** in the atmosphere, climate defines what the weather is like in a particular region for **a long period of time**. In other words, climate is the "average weather". Different areas can have different climates. For example, the Amazon Rainforest is hot and rainy nearly every day because it is a tropical wet climate.

What does our atmosphere consist of?

The Earth's atmosphere is categorized into **five main layers**: the exosphere, the thermosphere, the mesosphere, the stratosphere, and the troposphere. Now let's see the details of each layer.

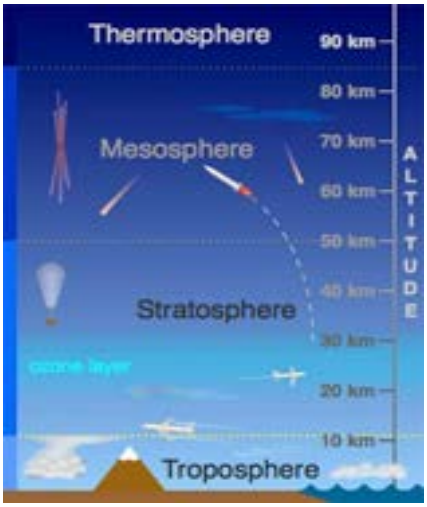


Figure 15. Atmosphere layers.

The **troposphere** is the layer nearest to the surface of the Earth. It is 7 to 20 km thick and contains half of Earth's atmosphere. The higher it is, the colder the air gets. Almost all of the water vapor and dust are in this layer, which is why clouds are located here.

The **stratosphere** is the second layer. It begins above the troposphere and ends approximately 50 km above land. Here, ozone is plentiful, and it heats the atmosphere while also absorbing harmful sunlight. This is where jet aircraft and weather balloons fly.

The **mesosphere** starts at 50 km and extends to 85 km high. This is the coldest part of Earth's atmosphere, with temperatures averaging about -90℃. This is the layer that meteors burn up.

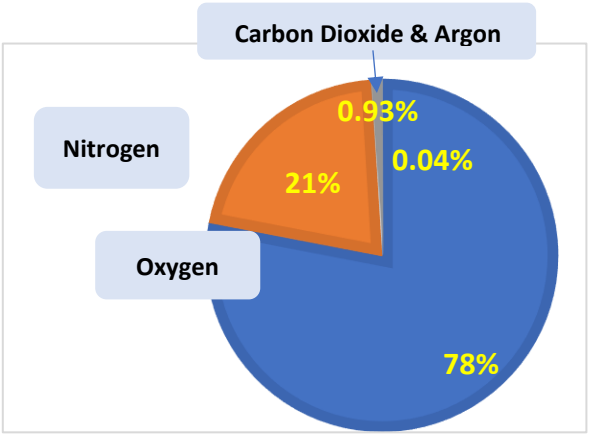
The **thermosphere** ranges from approximately 90 km to between 500 and 1,000 km. Temperatures can reach up to 1,500℃ at this altitude. This layer is where rockets flew and the International Space Station orbited Earth. This is also the layer where the aurora occurs.

The **exosphere** is the highest layer and the atmosphere blends into outer space. It is incredibly thin. It consists of hydrogen and helium particles that are very widely distributed.

Composition of air

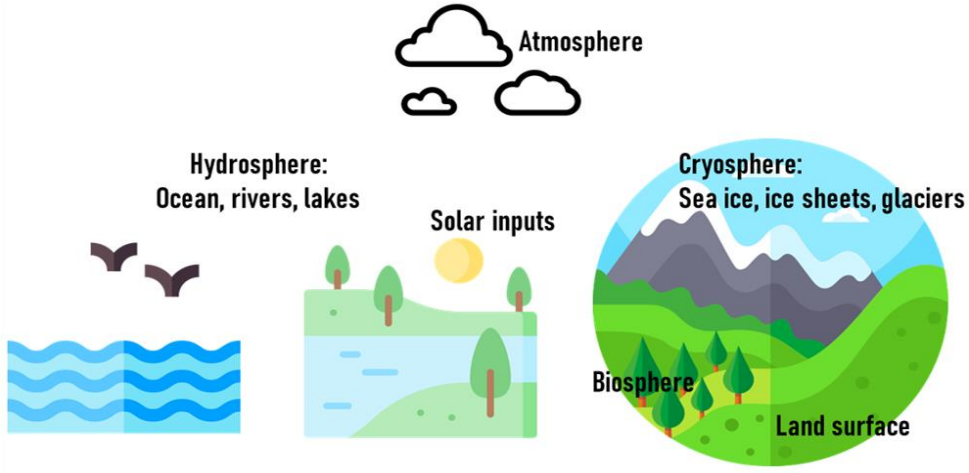
According to NASA, the gases in Earth's atmosphere include:

- Nitrogen: 78%
- Oxygen: 21%
- Argon: 0.93%
- Carbon dioxide: 0.04%



What does our global climate system look like?

There is a difference between 'climate' and ‘atmosphere’. In the global climate system, the environment is created by a combination of 5 major processes: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them.



[Topic 1_Activity]

You have learned about the difference between weather and climate! Now let's introduce the climate and weather of your hometown and then compare it to the climate of another area! It is a great opportunity to learn about the climate patterns of different areas! There are some words provided which you can use for your introduction. So, let's start!

Describe the climate of your hometown

Example)

My hometown is in Beijing, where winters are freezing and dry, summers are hot and dry. The whole year temperature range is from −10 ºC to 38 ºC. The rainfall is unfrequently and irregular, summer is the rainiest season. Sometimes in summer, extreme weather occurs, like heavy rainfall which can hurt people .

Vocabulary box

Thunderstorm – Flood – Snow – Heat wave
Chilly – Humid – Wet – Hailstone – Mild

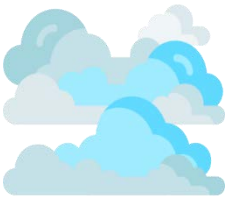
- **How to work on this activity**

1) The climate of a place may be defined as the long-term prevailing weather in a specific area. For example, whether the area is humid or dry, and on the average temperature in the whole year.
2) Consider the area where you live and its different seasons. For each season briefly describe the weather that occurs in each season.
3) Lastly compare your area to a different area where the climate is totally different. Like in Beijing, the winter is so cold that all the leaves fall down and in summer it is hot, but Hainan is a city with year-round heat and little distinguishable seasonal variation.

Topic 2: Why are climate and atmosphere important?

How does the climate system work?

The atmosphere is not an independent system. It interacts with other Earth system components. It is in contact with the cryosphere (ice and snow), the biosphere (animals and plants), the hydrosphere (water) and the land surface (rocks). All of these elements together make up the climate system, the components and processes of which are interconnected and influence each other in a variety of ways.



Atmosphere

The atmosphere is **a thin layer of mixed gas** that protects the earth and prevents it from being too hot or cold. It insulates the planet by trapping heat and transmitting heat and water vapor. The atmosphere is most dynamic and changeable among other spheres of climate system.

Cryosphere

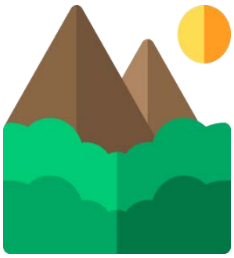
The cryosphere is basically the **ice** on the earth's surface. It includes ice sheets, glaciers, permafrost, sea ice and snow cover. The ice of the cryosphere reflects light radiation back to space, as well as it contains massive quantities of water.

Biosphere

All **living plants and animals** on earth make up the biosphere, including marine and terrestrial organisms. Life forms have enormous influence on greenhouse gas (GHG) absorption and release.

Hydrosphere

The Earth's **fresh and salt waters** make up the hydrosphere, including lakes, rivers, subterranean waters and oceans. It stores and transports energy, breaks down minerals, stores carbon dioxide and retains huge amounts of heat. The **oceans** are the main part of the global climate system and affect the atmosphere by absorbing and releasing heat, which accounts for about 70% of the planet's surface**.** The oceans act as climate regulators for the world.



Land surface

The land surface includes **soils, plains, mountains** and anything geologically connected to them. Land and soil influence how radiation from the sun is either absorbed or reflected into the atmosphere. The texture of the lithosphere (the solid, outer part of the Earth) affects the impact of the wind as it travels over the surface of the Earth.

How is the atmosphere now?

The greenhouse gas (GHG) emissions that we produce are the leading cause of the rapidly changing atmosphere of the earth. Concentrations of carbon dioxide are rising mainly because of the fossil fuels that people are burning for energy.

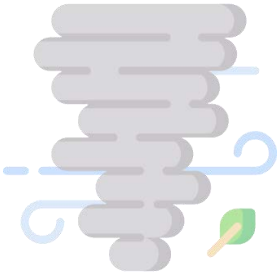
Greenhouse gases (GHGs) are responsible for the warming of the earth. The volume of these gases in our atmosphere has increased dramatically in recent decades which affects everything from the places we live to the air we breathe.

Bad Air Quality

Climate change and air pollution are related inextricably, one worsening the other. Not only does our air gets polluted as temperatures on Earth increase with more smog and soot, but also more allergic air contaminants like mold and pollen production occur.

Imperiled ecosystem

The pressure on wild animals to adapt to changing environments increases with climate change. It forced many to species search for cooler temperatures and higher altitudes, changes seasons and adjusts traditional migration patterns. These changes can radically transform whole ecosystems and the complex networks of life on which they depend.



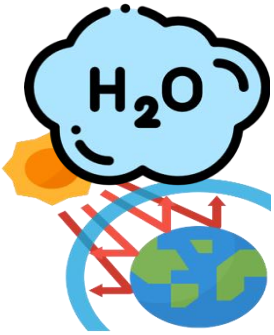
Extreme weather

As the world 's climate heats up, more water is stored, retained and falls as rain, changing weather patterns and making wet areas wetter and dry areas drier. Higher temperatures cause many types of disasters to worsen and appear more severe, including hurricanes, floods, heat waves, and droughts. These events can bring devastating and costly consequences.

Example: China climate events

During the 2020 summer, continuous unusual heavy rainfalls caused a series of devastating floods across parts of central and southwestern China. Tens of thousands of people were affected, some lost their homes, some even lost their lives.

[Topic 2_Activity]



We learned the importance of our climate atmosphere. Nobody wants to live in a dirty and unhealthy environment. So, we need make more effort to reduce climate change. Scientists are working on advanced technology to mitigate climate change but technology is not the only thing that needs to improve. We also need to improve our habits and lifestyles. As the young generation, what can we do as students to slow down climate change?

What can we do to mitigate climate change?

- Can you go to school by public transport instead of by private car?
- Can you bring reusable bags and don't use plastic bags?
- Will you consider purchasing a hybrid or electric vehicle?
- Will you persuade your parents to install a roof solar PV for your home?
- What should you do with your used textbooks? Why not donate them?

- **How to work on this activity**

1) Read each question carefully and write your answer.
2) Try to think of other ways we can mitigate climate change. Write your ideas in response to the first question 'What can we do to mitigate climate change?'

Topic 3: What are greenhouse gases (GHGs)?

Greenhouse gases are **gases that trap heat in Earth's atmosphere**. They let sunlight pass through the atmosphere, but they prevent the heat from leaving the atmosphere that the sunlight is carrying. They get their name from greenhouses, as the effect of absorbing and maintaining heat is similar to that of greenhouses.

Meet the main GHGs

There are **six main greenhouse gases**: Water vapor, Carbon dioxide, Methane, Ozone, Nitrous oxide and Chlorofluorocarbons.

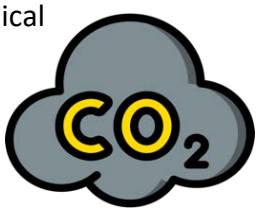
Water vapor

- Water vapor is created as a result of climate system which influences the system's continuous activity

- Evaporates from Earth's surface (rivers, oceans, soil)
- Increased evaporation results in a higher concentration of water vapor in the lower atmosphere, capable of absorbing and releasing infrared radiation back to the earth
- Causes a heating effect

Carbon dioxide (CO2)

- Made of carbon and oxygen
- Released into the atmosphere by the burning of fossil fuels (coal, natural gas and oil), solid waste, trees and other biological materials, and also by some chemical reactions
- A heat-trapping greenhouse gas



Methane (CH4)

- Made of carbon and hydrogen
- Released during coal, natural gas, and oil production and transportation
- Methane emissions are also caused by livestock and other farming activities and the waste degradation in urban solid waste landfills
- Extremely effective absorber of radiation which traps lots of heat

Ozone(O3)

- Ozone blocks the sun rays, which in the stratosphere is a positive effect as it blocks ultraviolet (UV) light which harms humans and animals
- However, in the troposphere (lower level atmosphere), ozone is harmful to human health and is a type of air pollution
- Man-made source is photochemical reactions involving the atmospheric pollutant carbon monoxide (CO)
- Burning gas in cars and factories is one of the example
  s, as well as burning vegetation
  can also release ozone

Nitrous Oxide (N2O)

- Emitted during agricultural and manufacturing operations, fossil fuel combustion and solid waste, as well as wastewater treatment

- Nitrous Oxide also damages the ozone layer, making humans and animals more vulnerable to UV light

Chlorofluorocarbons (CFCs)

- 100% man-made
- Fully synthesized for such application in areas such as refrigerants, aerosol propellants and solvent purification
- CFCs destroy stratospheric ozone, making humans more vulnerable to UV light
- Some concentrations of the CFCs will remain in the atmosphere for over 100 years

Many greenhouse gases, such as carbon dioxide, methane, water vapor, and nitrous oxide, exist naturally in the atmosphere while others are synthetic. However, without any doubt, human activities are responsible for almost all the increases in atmospheric greenhouse gases over the past 150 years. A huge portion of greenhouse gas emitted by human activity is from burning fossil fuels for electricity, heat, and transportation.

[Topic 3_Activity]

There are many types of greenhouse gases (GHGs) which come from various sources. In order to reduce GHG emissions it is important to know how they are produced, so we can reduce the environmentally harmful activities which release GHGs. Let's review our knowledge of GHG origins by matching each GHG to its primary sources.

Ozone (O3)	- Evaporates from Earth's surface (rivers, oceans, soil)
Methane (CH4)	- leaking coolants: refrigerators, air conditioners - producing computer chips.
Chlorofluorocarbons (CFCs)	- burning gas in cars and factories - small parts of ozone layer falls to Earth
Nitrous Oxide (N2O)	- applying fertilizer + fossil fuel–fired power plants - nylon production + vehicle emissions
Water Vapor (H2O)	- swamplands + raising livestock + landfills - producing and transporting natural gas + mining coal
Carbon Dioxide (CO2)	- living organisms + volcanos - burning fossil fuels vegetation

- **How to work on this activity**

1) Try to match each GHG (the green boxes) to their main sources (the pink boxes), preferable using a pencil.
2) Each box should only be matched to one other box.
3) After you finish check the answers together as a class.

Topic 4. What is wrong with a warmer Earth?

GHGs are increasing!

The concentration of natural and man-made **greenhouse gases (GHGs)** in the atmosphere has been **rising over the past few centuries**. One cause is the beginning of the **industrial revolution** that increased general production and consumption and from then on gases have been emitted in larger amounts. Another factor is the **increase of the global population**. With more and more people on the planet the reliance on fossil fuels such as coal, oil, and natural gas has been solidified as a major source for energy. Therefore, emissions have increased immensely.

What are the effects of climate change?

As more GHGs are emitted in the atmosphere, **temperatures will rise** and our climate will change and **global warming** will occur. The earth gets warmer which causes **land and water** to **expand** as a reaction to the increased heat. With warmer temperature **ice sheets will melt** and cause **rising water levels**. The melted water goes into streams, rivers, lakes and seas which causes floods. Furthermore, our **weather will become more extreme** which implies more droughts, more storms and heavy rain.

Changing climate is **very negative** not only for humans, but also for plants and animals. For example, polar bears and penguins live in icy conditions and when these ice sheets melt due to global warming, they will have nowhere to live.

We already can see the impacts of climate change:

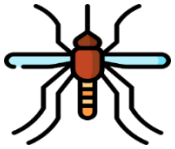
The effects of large GHG emissions have **far-ranging effects** on our environment and on our health. There are impacts of climate change that we **already can see** and which are **dangerous** for human, animals, and plants. Among those impacts are the following:

Worldwide **ice is melting**, especially at the earth´s poles. Mountain glaciers and ice sheets that cover the Antarctica and Greenland, and the Arctic sea are also melting. The number of glaciers has declined compared to the number in 1910. The ice melted contributes to a rise in sea-levels and globally the rise is occurring faster in recent years.

Temperatures are rising which affects wildlife and their habitats. Since the ice is melting and vanishing, species like penguins are being challenged and are threatened with extinction. Some populations have collapsed by 90% or even more. Many other species are on the move due to changing temperatures in their natural habitats. They migrate farther north to find cooler areas.

The **average rain and snowfall worldwide has increased**. However, some areas experience more severe droughts and increasing risk of wildfires which also leads to crop loss and drinking water shortages.

Some species are thriving due to the changing climate. Species like mosquitos, ticks and crop pests experience a booming population and destroy for example crops and posing threats to human health.

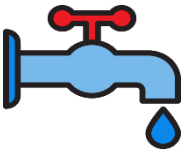


And what about our future?

If the global warming continues, **more effects** will take place later this century.

Water levels will continue to rise. By the end of this century sea levels are expected to rise by 26 to 82 centimeters, or even higher.

Natural disasters like hurricanes and other storms are likely to become much stronger. Also floods and droughts will become more common and some areas might face higher risks of experiencing “mega droughts”.



Glaciers store about three-quarters of global freshwater. Since our glaciers are melting there will be less freshwater available for us. We will experience huge **shortages of freshwater**.

Due to the fact that some species boom with rising temperatures, **diseases** that are brought by these animals will spread and cause human health problems and challenges. For example, the disease malaria is such a disease as it is spread by mosquitoes.

In general, **ecosystems will continue to change** over the next years. This will lead some species to move further away from their original habitats, and some species will not be able to adapt to changing environment and will become extinct.

[Topic 4_Activity]

Climate change has many negative effects on humans and ecosystems. We learned about how GHG emissions have increased and the various ways in which climate change will damage people's lives. For this activity, look at each statement and write down next to them if they are true or false.

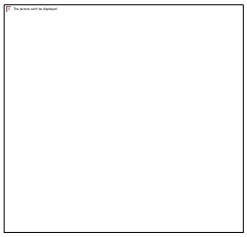
Statement	True or False
1. The amount of GHGs (greenhouse gases) in our atmosphere has decreased during the last few centuries.	
2. Climate change is mostly caused by human activity.	
3. Water levels will fall because of climate change.	
4. There will be more extreme weather, such as droughts, storms and heavy rain, due to climate change.	
5. Climate change will not affect ecosystems.	
6. Diseases such as malaria will spread more because of climate change.	
7. Various species may become extinct due to climate change.	

- **How to work on this activity**

1) You should complete this activity individually.
2) Read each statement carefully and write down whether the statement is true or false.
3) After all students have written down their answers, check your answer together as a class.

Topic 5. A vicious cycle: Can it be even worse than now?

The serious consequences of increasing GHG emissions



Increasing GHG emissions have **serious consequences** for all of us. Our earth as we know it will change more and more. If the emissions of GHGs keep increasing, then many people, animals and plants will suffer the consequences. The situation will become worse and worse and it will be even more difficult to tackle global warming.

Protecting Permafrost

In order to tackle global warming, we **need to protect the permafrost** that exists on our earth. The word comes from permanently and frost. It basically means **frozen ground.** Permafrost is called any ground that is completely frozen for at least two years in a row. It is made of a combination of soil, rocks and sand that are stuck together by ice. These permanently frozen grounds – permafrost – cover large regions of our earth´s surface and are most common in areas with high mountains and especially near the North and South Poles. In the Northern Hemisphere almost one quarter of the land has permafrost underneath. Permafrost is not always covered by snow.

With rising temperatures, the ice is melting, and permafrost is slowly shrinking.

But why is melting permafrost so dangerous?

The soil near the surface in permafrost contains **large amounts of organic carbon**. This comes from the material that is left over from dead plants which could not decompose due to the cold. In the deeper layers of the permafrost the soil is mostly made from minerals. Now, due to the warmer climate permafrost is thawing and the ice is melting. This leaves behind water and soil and the carbon that was frozen inside is being released. Melting permafrost has huge and dramatic impacts on our planet.

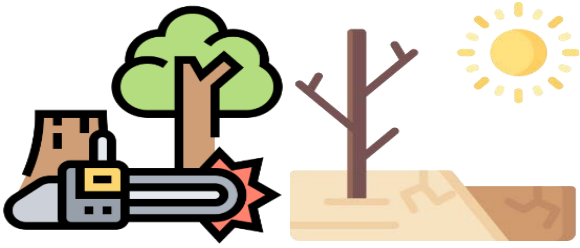
For example:

- In northern regions many villages are built on permafrost and it is home to many people. As the ground is frozen it is harder than concrete and supports the buildings constructed on top of it. If the permafrost melts, it will destroy houses, roads and other infrastructure that is built upon it. Therefore, it will **destroy the habitats** of many people.

- Melting permafrost sets organic carbon free and the frozen microbes begin to decompose this material. Hereby GHGs are released, especially **carbon dioxide and methane**.

- Not only greenhouse gases are being released with melting permafrost, but also **ancient bacteria and viruses** that are trapped in the soil and ice. These new and undiscovered bacteria and viruses could make humans and animals very sick.

The Role of Plants

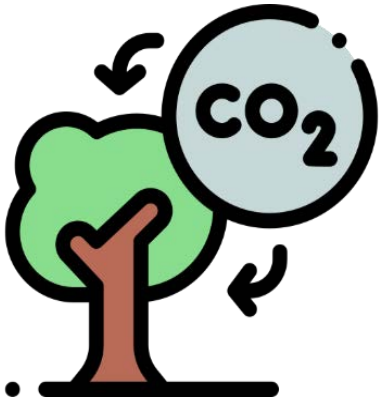


Why are there less plants on our planet now? Some factors cause the reduction in the numbers of trees and plants on our planet. These include the human activity of **deforestation** and the process of **desertification**.

Deforestation is the active removal of trees. Forests are severely affected by this. Trees from forests are being removed in order to make space for other things such as the construction of buildings and infrastructure. Sometimes crop fields are established on the previously forested areas in order to grow crops or raise livestock.

Desertification is the degradation of land. Regions that are affected by desertification are experiencing the loss of vegetation due to decreased biological productivity of the soil, which means that certain plants are no longer able to grow. Often this is because the soil is degraded, and plants cannot get enough minerals to survive.

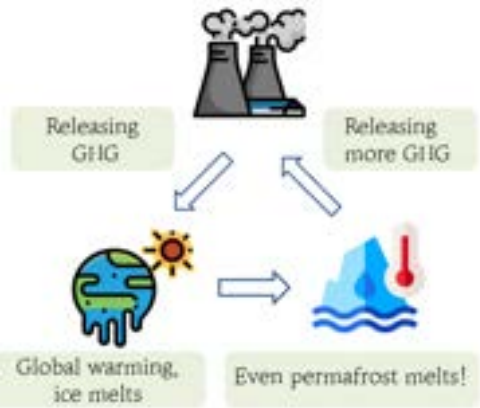
Why are plants so important for our planet?



Plants in general play a crucial role for every living thing on our planet. Plants have the ability to **absorb carbon dioxide and transform it into oxygen,** which creates air for us to breathe. Therefore, plants, and especially trees, remove harmful GHGs from the air and transform them into something that is crucial for us to live, i.e. oxygen. For example, rainforests, which have large amounts of tall trees and many diverse plants, absorb huge amounts of CO2 and produce huge amounts of oxygen. Thanks to this process rainforests are often called 'the lungs of the Earth', because they breathe in gases that we produce, and breathe out oxygen that we need to survive.

What is a vicious cycle?

In a cycle, all the steps are connected as one step causes the next, then the next and so on. For example, we as humans produce large amounts of GHGs which are released into the atmosphere. The built up of GHGs in the atmosphere leads to global warming which causes the ice sheets to melt. With melting ice sheets, the frozen carbon and minerals that is contained in these ice sheets (permafrost) is being released. This causes more GHGs to be released into the atmosphere which triggers a rise in global temperatures causing more climate change and global warming.

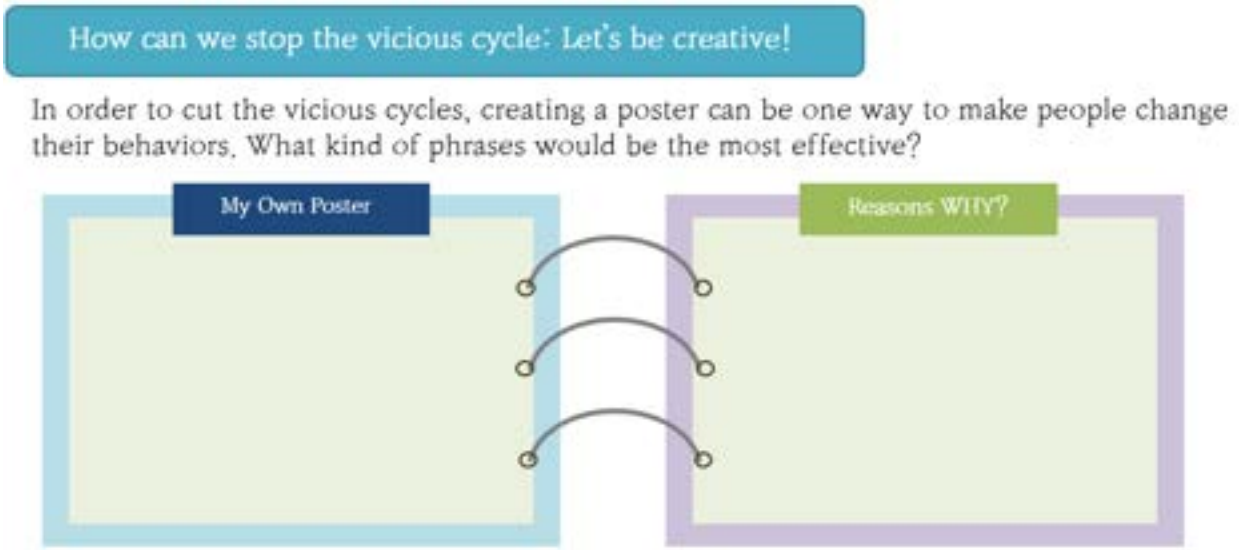


Eventually we may reach a point at which it will be very difficult or even impossible for us to reverse and tackle global warming.

This can be called a vicious cycle. It builds on a series of **negative events** that build on and **reinforce each other**. It is therefore more important than ever, to stop this vicious cycle and **break through it by stopping the emission of large amounts of GHGs into the atmosphere**, so that permafrost will not melt.

[Topic 5_Activity]

If we continue to emit greenhouse gases to the same degree, our Earth – people, animals and plants will all suffer together. In order to break the vicious cycles, creating a poster can be one way to make people change their behaviors. Let's come up with our own phrases and pictures to create a poster! After finishing, please explain why you chose that phrase.



- **How to work on this activity**

1) Choose one habit, or an area in which people should change the most.
   Ex) Recycling, wasting water, relying too much on personal vehicles
2) Create a nice phrase to convince people to change their habits in the field you chose. Be short, creative, and fun! Ex) "Please have a BMW – Bus, Metro and Walk."
3) After finishing creating your own poster, please also describe why you chose the habit or area, and why you selected the phrase. Share it with your partner or your class!

Topic 6. What is climate change mitigation and adaptation?

What is climate change mitigation?

As global warming is occurring at such an alarmingly fast rate, we have to take action in order to mitigate climate change. Mitigation means that we try to **minimize the emission of the greenhouse gases** which cause climate change. One of the most important actions to mitigate climate change is changing our source of energy to sources which release less GHGs. **Renewable energy** will play a central role in doing this as renewable energy sources do not release as much GHGs as other energy sources.

We can also mitigate climate change by increasing the **efficiency** of the energy that we are using so that nothing goes to waste. Efficient and **sustainable implementation of transportation** is another way to mitigate climate change. Additionally, **carbon taxes** and establishing **carbon trading markets** is an option to induce climate mitigation.

What is climate change adaptation?

Climate adaptation is our response to global warming, which is as equally important as mitigation. When we talk about climate adaptation it implies the actions taken to **reduce the vulnerability** that we have to climate change. For example, in many areas extreme weather events and natural disasters will occur more frequently. Therefore, the people living in those areas will need more **secure facilities and infrastructure** in order to survive and to be better prepared for these events. Also, the restoration of landscapes and **reforestation** is an important action that we can do to practice climate adaptation. Planting more trees will help to absorb GHGs in the air and enhance our quality of life.

Furthermore, we can reduce our vulnerability to climate change by developing **crops that are drought-tolerant** so that more extreme weather will not result in total crop losses. In order to adapt to global warming and to reduce vulnerability it is crucial to enhance ourselves in **disaster management and business continuity** so that we can be prepared as best as possible for future climate events.

Examples

1. Three Gorges Dam: Pros and Cons

One example that can be critically discussed regarding climate adaptation is the **"Three Gorges Dam".** This project has some positive and some negative aspects.

Figure 16. Three Georges Dam.

A **positive** aspect is that the dam creates a lot of electricity, creating the same amount of power as 18 nuclear power plants. The energy that is gained is sustainable and renewable. Also, the dam helps control floods and serves as an income-generating project.

On the other hand, the dam also has some **negative** aspects and impacts. Local people who lived in the area were forced to relocate and leave their homes. The dam also creates some negative environmental impacts like land erosion and water pollution and created a dreary looking landscape. Furthermore, for some species the dam destroyed their ecological environment.

2. China 2017-2021 winter clean heating plan

Another example of climate change mitigation and adaptation is the Chinese winter plan for clean heating in the period of 2017 to 2021. This plan was made in order to **increase the clean heating** rate during the winter season, especially in the northern areas of China. The aim is to increase the clean heating rate to 50% by 2019 and to 70% by 2021. As the heating in winter in the northern towns and rural areas mainly relies on coal as energy source, the environmental impacts were quite serious and caused severe hazing and polluted the air. In order to contribute to more clean heating this project called for large-scale deployment of renewable energy in heating, improved building **energy efficiency** and engaging more **renewable energy sources**.

Mainstreaming climate change adaptation

Mainstreaming climate change adaptation is on the agenda and implies the following aspects:

Climate change adaptation objectives need to be incorporated into sectoral policies and plans.

The awareness and understanding of climate adaptation is a crucial objective to increase especially among decision-makers and managers.

The resilience of development outcomes should be improved and contribute to the more efficient use of resources.

Climate policy has to be integrated into sectoral and development policies.

Five gears for the implementation gap

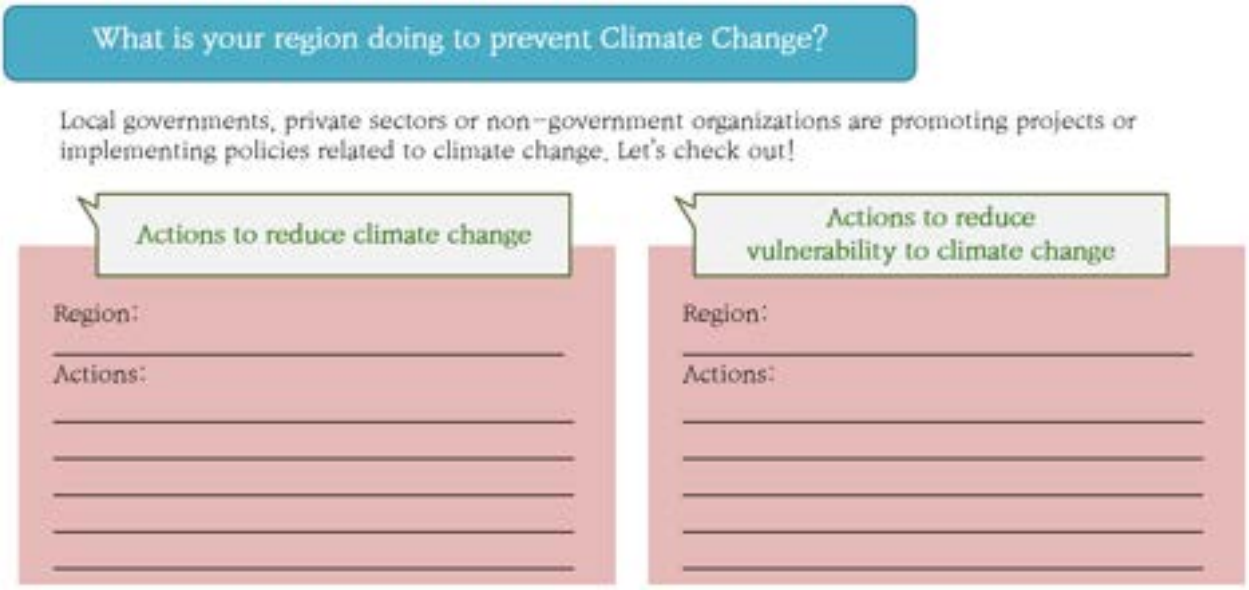
In order to close the gap of implementation, five gears play an important role and need to be addressed. The five gears are:

1. Policy frameworks
2. Financial processes
3. Information and tools
4. Leadership
5. Coordination mechanisms

These gears are influencing one another and therefore need to be addressed holistically. They all play an equally important role and only work well together when every single gear is working without problems.

[Topic 6_Activity]

Many different organizations are trying to fight climate change at a local level. Around us, local governments, private sector and non-government organizations are examples of organizations which are promoting projects or implementing policies related to climate issues. This activity is a good opportunity to discover what kind of actions are being taken by organizations in your area.



- **How to work on this activity**

1) Choose one sector that you want to focus your research on.
   Ex) Your region, another local government, a specific company, a NGO, etc.
2) Go through their webpage and search what kind of projects, policymaking, or even events are being promoted. Summarize them and fill out the form.
   Ex) '000 city's Climate Change Plan' 'A Recycling day' 'Legislation on punishment of fly tipping'
3) The subject you have chosen can be an action to reduce climate change (mitigation), or an action to reduce vulnerability to climate change (adaptation). Choose the sheet which is appropriate for your chosen topic.

Topic 7. What we are doing now

SDG 13: Climate Action

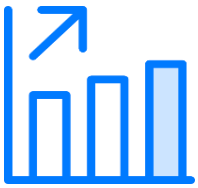
Why Climate Action?

Climate change caused by humans threatens the way we live and the very future of our planet.

The impacts of global warming lead to long-lasting changes that are almost irreversible, hence urgent action is required now.

Simple conclusion:
Addressing climate change will make a sustainable world for everyone.

Why is this problem so serious?



SDG 13. Take urgent action to combat climate change and its impacts

GHG emissions are now 50% higher than they were in 1990, recording an unprecedented increase.

Climate-related geophysical disasters are happening more frequently, including increased breakouts of new viruses, floods, wildfires, etc.

2019 was the second WARMEST year on record: it is now undeniable that our earth is in crisis

Strengthen resilience and adaptive capacity to climate related-disasters and natural disasters in all countries.

Integrate climate change measures into national policies, strategies and planning.

Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

Implement the commitment undertaken by developed country parties to the United Nations Framework Convention on Climate Change (UNFCCC) to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible

Promote mechanisms for raising capacity for effective climate change related planning and management in least developed countries and small island developing States, including focusing on women, young and local and marginalized communities

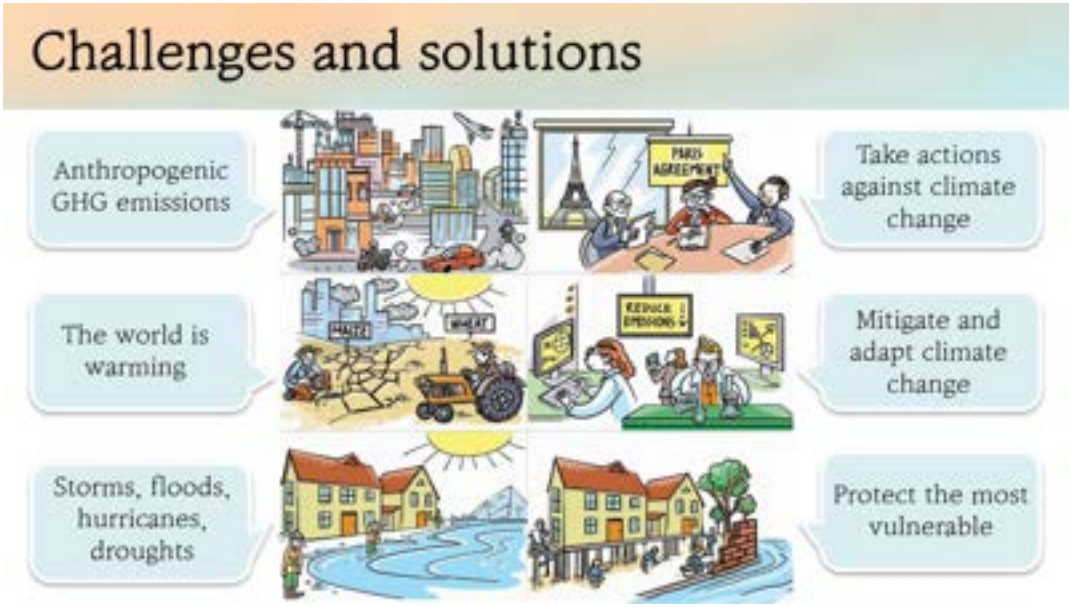


Figure 167. Why Sustainable Development Goals.

International level-effort: Global agreement

Do you think the existing international framework to tackle climate change is enough?

or should we seek more compulsory agreements for climate adaptation?

The Paris Agreement (2015)

Adopted at the 21st UNFCCC COP21 in 2015, the Paris Climate Change Accord – the Paris Agreement – came into operation from 2016. Its **objectives** are to 1) keep a global temperature rise below 2°C above pre-industrial levels, 2) strengthen ability by appropriate financial flow, new technology framework, and capacity building framework.

National-level efforts: Making the country 'greener'

Target 2 of **SDG 13** states: "Integrate climate change measures into national policies, strategies and planning". Here are some examples of national-level efforts to tackle climate change and its impacts.

Example I: Green Economy

'Green economy' aims to achieve growth in employment and income, while tackling environmental degradation. It includes public and private investment into the following:

- reduced carbon emissions and pollution.
- enhanced energy and resource efficiency.
- prevention of the loss of biodiversity and ecosystem services

An example could be observed in **the case of China**. China has had Five-Year Plans for their economic development and especially the 11th and the 12th Five-Year Plan incorporated strategies and goals that are relevant to green economy.

The 11th Five-Year Plan (2006-2010)

The Chinese government aims to increase consumption of renewable energy sources. With this plan, total investment in treating environmental pollution increased 15% annually and environmental investment reached 1.33% of its GDP by 2009.

The 12th Five-Year Plan (2011-2015)

The next Five-Year Plan addressed relevant issues such as renewable energy, climate change, resource efficiency, circular economy, and pollution control. Its goals included reducing carbon emissions per unit of GDP by 17% and energy consumption per unit of GDP by 16%, as well as increasing forest coverage to 21.66%.

Example II: Green New Deal

From 2019, the term 'Green New Deal' or 'Green Deal' has been mainstreamed in many countries and been recognized for its potential to promote economic recovery in response to the COVID-19 pandemic, and creating sustainable economy post-COVID-19. Green Deals include **1)** making a major contribution to reviving the world economy, saving and creating jobs, and protecting vulnerable groups, **2)** promoting sustainable and inclusive growth, **3)** reducing carbon dependency and ecosystem degradation.

New infrastructure construction in China

China aims to stimulate job creation and prepare for new changes in the global economy and revive its economy after the COVID-19 pandemic, particularly in the fields of technology and sustainable development. It is a long-term national economic strategy which includes the following as key areas:

① 5G networks

② Industrial Internet

③ Inter-city transportation and rail system

④ Data centers

⑤ Artificial Intelligence (AI)

⑥ Ultra-high voltage power transmission

⑦ New-energy vehicle charging stations

Climate Neutrality

'Climate neutrality' is achieving net zero carbon dioxide emissions. That means you are offsetting emissions of CO2 or its effects by various means, such as using energy resources other than fossil fuels or planting more trees to absorb emitted CO2.

'Carbon neutrality' and 'net-zero emissions' have similar meanings.

WHAT IS NEW DEAL?

The term 'New Deal' was coined under the economic recovery strategies led by the Roosevelt administration of the United States during the Great Depression. It highlighted the role of the state in creating jobs and stimulating economy.

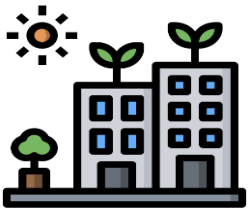
Now, the concept of a 'Green New Deal', literally, is a combination of 'Green' and 'New Deal', aiming for a green recovery of the economy and solidification of environmental sustainability as well.

What do you think of the roles of the national government in green recovery of the economy? What is the difference between the original 'New Deal' and the modern 'Green New Deals'?

Example III: Urban Green Growth

In addition to the local-level, national governments should also promote green growth in urban areas by giving financial, political, and technical support, cooperating with local governments and other relevant bodies.

Management of cities is important since they are where more than half of the world population live, account for 67% of global energy use, and produce 71% of global-energy related CO_2 emissions.



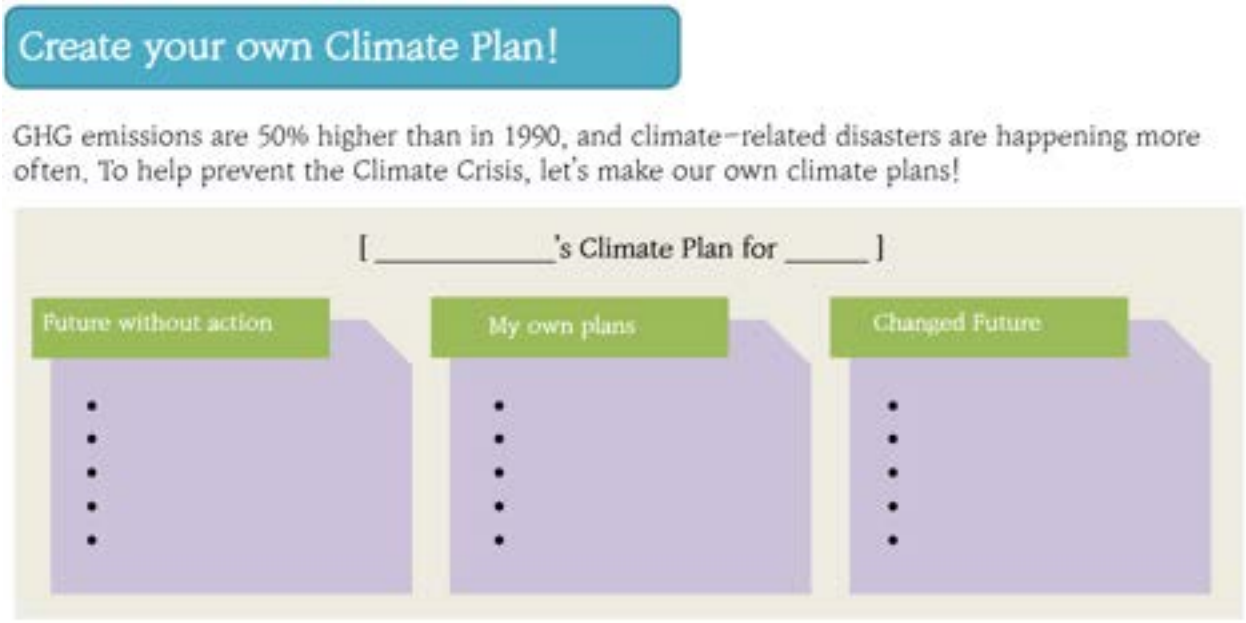
For example, Berlin in Germany has launched the "**Berlin Energy and Climate Protection Program 2030**" as a city/local-level effort to tackle climate change. It aims to make Berlin climate neutral by 2030, in accordance with the European Union's efforts to be climate neutral until 2050.

This program includes strategies such as the following:

- Promoting the use of solar energy;
- Increasing the use of 'green roofs' on buildings so that they can absorb radiation and mitigate urban heat island effects, contributing to the control of overheating within the city.

[Topic 7_Activity]

GHG emissions are now 50% higher than in 1990, and climate-related disasters are happening more often. To prevent ourselves suffering from the Climate Crisis, let's make our own climate plans! Your climate plan will consist of three parts – How the future will be if we continue living as the way we live now, your own climate plans to make a change, and the other, more positive potential future if your climate plans are successfully achieved. We can start saving our Earth with this little step.



• How to work on this activity

1) Predict what you think our future will be like if we do not take action to address climate change. Based on your own prediction, fill in the bullet points for the 'Future without action' section.
   Ex) 'Most of the glaciers will melt and there will be a huge flooding worldwide'
2) Then, think about the fundamental solutions to that problem. Make plans starting from that basic point. Please write them down in the 'My own plans' section.
   Ex) '(If you think the causes of melting glaciers are huge CO2 emissions) I will bring reusable water bottles to school every day, rather than buying new plastic bottles.'
3) Think about how the future will change due to your efforts. The future changed will be more positive than before. Put the predicted results in the 'Changed Future' section.
   Ex) 'The ice will melt slower; there will be no flooding, and polar bears won't lose their habitats.

Module 2: We Are All In This Together

By finishing this module, students are expected to:

- understand **terrestrial and marine ecosystems**
- understand the concept of **biodiversity**
- know about different kinds of **wildlife** and **endangered species**
- argue for **the sustainable use** of marine and terrestrial resources / living resources
- recognize relevant **activities** at local/community levels

By module 2, students will understand the concept of biodiversity through learning about terrestrial and marine ecosystems. Module 2 provides students an opportunity to reflect upon which anthropogenic factors are harming biodiversity and overall ecosystem, to learn about the relevant issues that are being discussed contemporarily, and to argue for the importance of sustainability for our planet's ecosystem.

Overview

We also stand on the terrestrial ecosystem, but do you exactly know what ecosystem means? What is terrestrial ecosystem anyway? Let's explore the world of land ecosystem.

Of course, there are definitely other life living under the water. Marine ecosystem is also another important part of our planet and we are going to see that in this topic.

What exactly "biodiversity" means? Why is it that important? Are we observing any threat to the biodiversity?

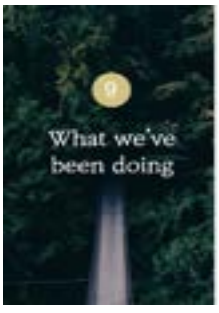
Forest might be one of the familiar natural landscapes we can meet in our daily live. However, it can be hard for us to enjoy forest as before if deforestation continues. Let's see deforestation's causes and effects.

It is obvious that our environment is changing. But these changes are more than natural nowadays - let's learn about its impacts on living things and examples of human factors.

Climate change is probably the most serious challenge we face. How will it affect biodiversity of our planet? Does weakened biodiversity affect us in only indirect way or is it naive idea?

The whole ecosystem consists of smaller chains and networks of life. Let's learn how those networks are organized and what will happen when the chains are broken.

More and more species are becoming endangered - why and how? Which species are in danger?



Of course, many people and organizations are trying to protect the ecosystem and endangered species. Let's see what we've doing as efforts for protection and conservation of life on earth.

Yes, we might not see some species in the near future if we do not put more efforts. However, there are some cases where the endangered life were brought back to the planet safely— Please do not lose hope!

Introduction of Contents for Each Topic

Topic 1. Meet the terrestrial ecosystem

Objective	Students can understand the basic concept of what an ecosystem is and get to know the terrestrial ecosystem
Part 1	Learn about the concept of an ecosystem.
Part 2	Learn about terrestrial ecosystems with the rainforest as example.
Part 3	Gain an understanding of the human factors that affect ecosystems.

Topic 2. Meet the aquatic ecosystem

Objective	Students can understand the concept and types of aquatic ecosystems and examples.
Part 1	Learn the two kinds of aquatic ecosystems.
Part 2	Look in detail at the marine ecosystem with the coral reef as example.
Part 3	Get to know the human factors that affect and pollute marine ecosystems.

Topic 3. Biodiversity and its importance

Objective	Students can understand the basic concept of biodiversity and why we have to pay attention to maintaining it.
Part 1	Learn about the meaning of biodiversity and why it is so important.
Part 2	Understand the main threats to biodiversity.

Topic 4. What is deforestation?

Objective	Students learn about the issue of deforestation and can understand why it is problematic.
Part 1	Learn what deforestation is and what are reasons for deforestation.
Part 2	Learn and understand the effects deforestation has on our environment and on us.

Topic 5. The changing environment

Objective	Students engage with the idea that a changing environment means changing our lives as well
Part 1	Learn about how changes in the environment have impacts on living things.
Part 2	Understand how the two human factors of reclamation and over-logging are changing our environment.

Topic 6. Climate change and biodiversity

Objective	Students understand impacts of climate change on biodiversity.
Part 1	Learn about the consequences of climate change, especially melting permafrost and sea level rise.
Part 2	Be introduced to examples of food insecurity that are caused by ecosystem loss.

Topic 7. How are we all linked together?

Objective	Students understand the linkages within ecosystems by learning about food chains and food webs.
Part 1	Learn about food chains in terrestrial and aquatic ecosystems.
Part 2	Understand that a change within one food chain or one part of the ecosystem can consequentially affect the others.

Topic 8. Which species are in danger?

Objective	Students understand that factors they have learned throughout previous topics can eventually lead to the danger or even extinction of specific species.
Part 1	Learn about what endangered species are and about different conservation statuses.
Part 2	Be introduced to exemplary species for each conservation status.

Topic 9. What we've been doing

Objective	Students are introduced to some international and national efforts for conserving the environment.
Part 1	Learn about international level efforts for conservation of life and the environment: Greenpeace, CITES, CBD.
Part 2	Learn about national level efforts for conservation of life the environment: WWF China, NPCA (the US)

Topic 10. "You better protect us or will never see us again"

Objective	Students will recognize that despite the current dangers for certain species, efforts have been made with significant outcomes and there are things that students can do to help.
Part 1	Understand the roles of national parks in conservation of life.
Part 2	Learn about a successful case of panda protection and be introduced to some practical ways they can actually assist in protecting animals.

Glossary

Vocabulary	Definitions
Ecosystem	Geographic area where plants, animals and other organisms, as well as weather and landscape interact with each other in a specific environment.
Terrestrial Ecosystem	Land-based community of organisms and the interactions of biotic and abiotic components in given areas including tundra, taigas, rainforests, grasslands and deserts.
Tropical rainforest	A place where rains all year long, consisting of evergreen trees and high amount of rainfall.
Supply chain	A hub which has a hierarchical control among the network of ecological resources.
Aquatic Ecosystem	An interacting community of organisms in a body of water, including oceans, lakes, rivers, streams, estuaries and wetlands.
Coral reef	A ridge of rock in the sea formed by the growth and deposit of corals.
Pollution	The introduction of harmful materials into the environment.
Biodiversity	Community formed in habitats by variety of life which can be found on Earth.
Over-exploitation	Harvesting a renewable resource to the point of diminishing returns leading to the destruction of the resource.
Invasive species	Organisms which cause ecological harm in a new environment in which they are not native, causing extinctions of native organisms through competing for limited resources.
Deforestation	The loss of trees which causes climate change, desertification, soil erosion and increased greenhouse gases in the atmosphere.
Permanent	Lasting or intended to remain unchanged indefinitely.
Grazing	To feed on growing grass and pasturage.
Reclamation	The cultivation of waste land or land formerly under water.
Over-logging	Cutting and moving trees in an exceeding amount which leads to unsustainable deforestation and permanent habitat destruction for forest wildlife.
Permafrost	A thick subsurface layer of soil which remains frozen throughout the year

Symbiotic relationship	A type of biological interaction between two species in which at least one species benefit; the other species may be positive, negative or neutral.
Terrestrial vertebrate	Organism which possesses a spinal column or vertebra and lives predominantly on land.
Amphibian	Any cold-blooded vertebrate of the class Amphibia, typically living on land but breeding in water.
Food chain	A hierarchical series of organism dependent on the next as a source of food.
Endangered species	Species or animal or plant which is seriously at risk of extinction.
Conservation	A careful protection of wildlife; supervision of wildlife through prudent management.

Which SDGs are most related to this module?

Module 2 discusses biodiversity and related issues on land and water. The according SDGs that cover these subjects are **SDG 14** and **SDG 15.**

"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"

Topic 1. Meet the terrestrial ecosystem

What is an ecosystem?

An ecosystem is like a **bubble of life** that exists in a **geographic area**. In this geographic area plants and animals, as well as weather and landscapes, **live and work together**. In an ecosystem there are biotic and abiotic parts.

Biotic: *living parts*, such as plants, animals, and other organisms

Abiotic *nonliving parts*, such as rocks, temperature, and humidity

In ecosystems, **everything depends on each other**, directly or indirectly. For example, the temperature and humidity of an ecosystem has an effect on the plants that grow there. Animals that eat the plants depend on their ecosystem for food and shelter, and changes would severely affect them. Our whole Earth contains of a series of connected ecosystems.

The terrestrial ecosystem

Ecosystems that are **on land** are called terrestrial ecosystems. For example, land-based ecosystem includes tundra, taigas, forests, tropical rainforests, grassland, and deserts.

Example: Rainforests

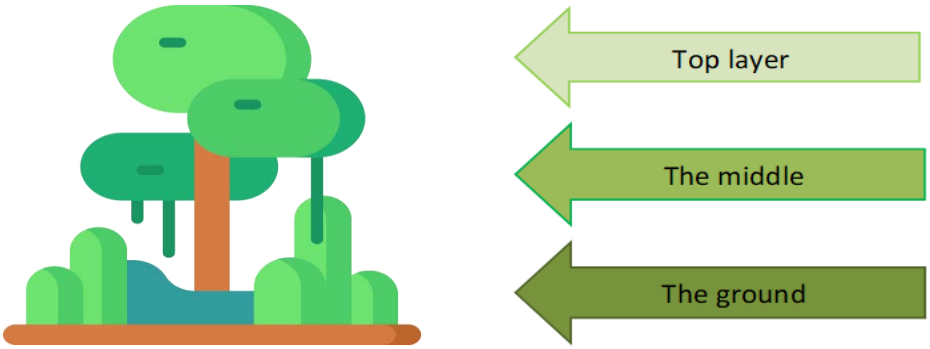
One example of a terrestrial ecosystem is a rainforest. This ecosystem is **characterized by tall trees and a high amount of rainfall**. As for the terrestrial ecosystems, rainforests are considered the **oldest living ecosystems** on earth and **cover around 6%** of its surface. Also, rainforests are home to more than half of the world´s plant and animal species and are therefore **very diverse and complex**. The two largest rainforests are in South America surrounding the Amazon River and in Africa surrounding the Congo River. Rainforests play a crucial role for humans, they provide us with many products that we use daily and they help to regulate our climate.

Today, **human activity is threatening** many ecosystems. Land from the rainforest is being cleared for the **purpose of farmland, housing, and industry**. Many trees are being cut down to make space for more farmland especially in countries like Brazil, Venezuela and Ecuador. Cutting such large numbers of trees results in ecosystem change and therefore worsens the **struggle to survive**

for species that live in the rainforest. Furthermore, the **soil** beneath the rainforest is **not appropriate** for intensive farmland because it has few nutrients for crops. Many crops can only grow a few seasons leaving a devastated soil behind that cannot be used any longer. The farmers then move to another patch of land. Cutting down trees from the rainforest not only delivers poor farmland but **leaves behind an empty and destroyed ecosystem.**

Rainforest Structure

Rainforests include various small ecosystems of their own. For instance, there are different layers in the structure of a rainforest.



Rainforests have **different layers** that can be summed up into three major layers. Each of the layers has **unique characteristics** based on the different levels of water, sunlight, air circulation and so on. All of the layers exist in interdependence and the plant and animal species in one layer influence the species living in another layer.

Top layer

The **trees** in the top layer of the rainforests are usually **very high** and can reach a height up to 60 meters. Leaves and branches of the trees are often scattered on tree trunks and spread wide. Animals that live here are for example different kinds of birds, bats, gliders, and butterflies.

The middle

Several meters below the top layer is the middle layer that gets **darker towards the ground**. **Trees** here are **shorter** and have larger leaves which catch minimal sunlight that comes through, forming a roof of leaves and branches. Plants here are often large and this environment of camouflage is advantageous for many animals. Most of the animals of the rainforest live in this layer, for example, snakes, insects, frogs etc.

The ground

The floor of the rainforest is the **darkest layer** of all. It is therefore difficult for plants to grow here. Leaves that fall to the floor decompose fast. Animals that live and thrive here are termites, scorpions, worms, and slugs.

Human factors:

Humans have always interacted with ecosystems and many cultures have developed nearby many different ecosystems. However, **some human factors are posing threats** to ecosystems.

The human **population** has grown constantly over time. People have demanded more and more space and therefore overtaken many ecosystems around them. New land is continually cleared in order to make more farmland, housing, or industry related facilities. However, **transforming and modifying some ecosystems** can change them completely from their original foundation. This has caused **ecosystems to shrink or even die**.

[Topic 1_Activity]

We have learned about the basic definition of an ecosystem and the types of terrestrial ecosystems. The rainforest was outlined as an example which included its functions, structure, and current status. We will apply this format to the other remaining types of terrestrial ecosystems and learn their details. After figuring out the climate, types of animals or plants which live there, as well as the issues affecting those terrestrial ecosystems, we will select one which we personally want to protect the most.

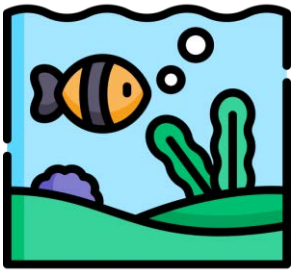
Types	Climate	Types of animals / plants	Problematic Issue	Where to protect and why?
Tundra				
Taigas				
Deserts				
Grasslands				
Forests				

- **How to work on this activity**

1) This activity requires research through use of books or the internet.
2) Find out what kind of climate each type has, what kind of animals or plants inhabit it and the environmental issues happening there. Each part can have more than one answer.
3) After you fill out the chart, choose the type of ecosystem which you want to protect the most. You should include the reasons why in the 'Where to protect and why?' section.
4) Share your thoughts with peers.

Topic 2. Meet the aquatic ecosystem

The Aquatic ecosystem



An aquatic ecosystem is any **water-based** ecosystem. In general, there are two different types of aquatic ecosystems.
One is the **marine** ecosystem which includes oceans, intertidal zones, reefs, and seabed, and the other is the **freshwater** ecosystem which includes lakes, ponds, rivers, and wetlands.

The Marine ecosystem

The **largest** water-based ecosystem is the marine ecosystem. It **covers over 70%** of the earth´s surface and has a high salt content. There are various examples of marine ecosystems. Some are offshore, like the deep sea or the seafloor, and some are nearshore, like coral reefs and seagrass meadows. Biotic components of these ecosystems can be different plants and animal species and organisms. Abiotic components are for example the concentration of nutrients, the temperature, sunlight, and salinity.

Example : Coral reef

An example for one of the marine ecosystems is the coral reef. Even though they look like rocks, they are in fact **animals** which have a calcium skeleton like clams. They are a very important ecosystem, because they **form a base to live for many other water organisms**. For example, crabs, sea stars, clams, sponges, jellies, sea turtles and lots of fish live in this ecosystem. Coral reefs are a **very fragile ecosystem**. Factors like rising ocean temperatures and decreasing salinity causing coral reefs to bleach and die. Due to these factors coral reefs are at risk today. When the coral reef ecosystem collapses many organisms and animals will disappear. Coral reefs are also referred to as the **“rainforest of the sea”.** Coral reefs are easily affected by any sort of marine pollution.

Human factors:

Human activity has a major influence in causing **marine pollution** which is a growing problem in today´s world. There are two main types of pollution: chemical and trash.

Chemical contamination occurs due to **human activities** like the use of fertilizers on farms. The chemicals from the fertilizer are washed into the waterways and finally flow into the ocean. The concentration of chemicals such as nitrogen and phosphorus, which are contained in fertilizers, has increased in coastal oceans.

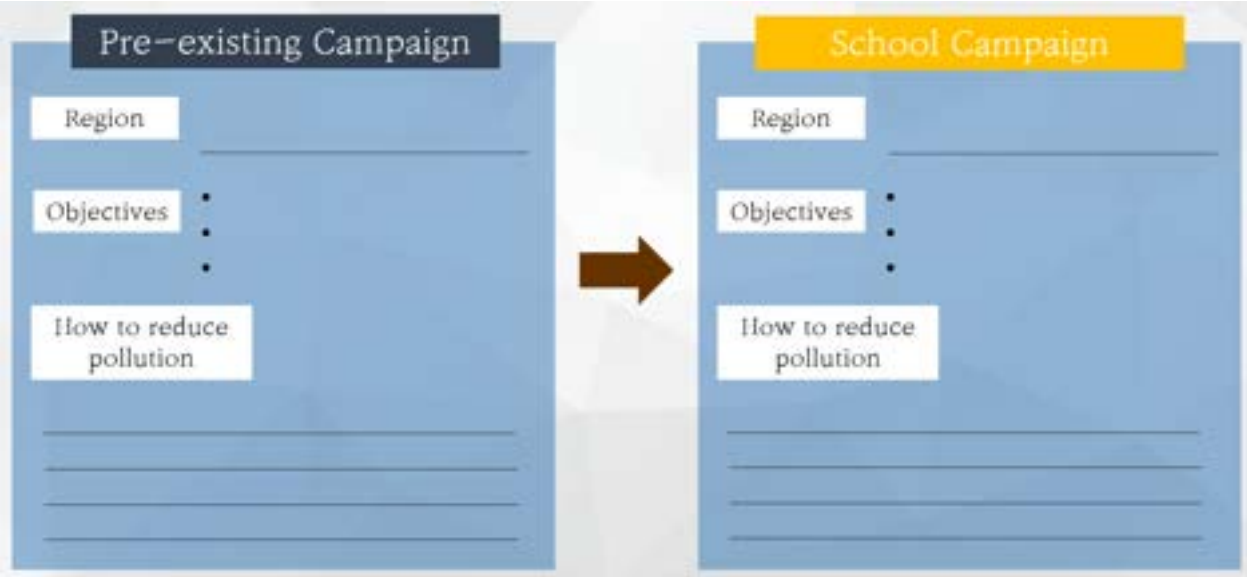
This increase in the concentration of chemicals causes and promotes the growth of algal blooms which can result in dead zones in the ocean where other living organisms cannot survive. These can be toxic to wildlife and affect people too, such as fishermen, who suffer huge losses. Chemical contamination can also be referred to as **nutrient pollution**.

Marine trash includes all **manufactured products** that end up in the ocean and mostly consists of plastic. Items such as plastic shopping bags, beverage bottles, cigarette butts, bottle caps, food wrappers, and fishing gear are common types of marine trash pollution.

Plastic waste is particularly problematic and **harmful** as a pollutant due to its long-lasting existence which can take hundreds of years to decompose. Trash poses dangers to the animals in the ocean and to humans as well. Animals become tangled and injured and some animals eat the trash because they mistake it for food. Microplastics are absorbed by different marine species and move up the food chain, eventually being consumed by humans.

[Topic 2_Activity]

Through this topic, we have learned about the aquatic ecosystem – which is also called marine ecosystem. Coral Reefs are a typical example of fragile sea life which is affected by human activity. As humans recognize that marine pollution is primarily caused by our actions, a lot of projects and campaigns are being held around the world to reduce the number of pollutants we release into the ocean. Look for a pre-existing campaign and develop a smaller school campaign using the information as a reference.



- **How to work on this activity**

1) Research projects or campaigns being held (or held in the past) on reducing marine pollution.
2) Fill out the form, 'Region, objectives, and ways to reduce pollution.'
3) Using the 'Pre-existing Campaign' as a reference, create your own campaign which can be done on school level in the 'School Campaign' section. You may develop your ideas with your peers.

Topic 3. Biodiversity and its importance

What is biodiversity?

Biodiversity contains the word "**bio**" which stands for "**life**", and the word "**diversity**" which means "**variety**". Put together biodiversity means the variety of different life forms that are living on our planet. Genes, species and ecosystems are included in this variety and biodiversity also implies the connection that exists between them.

Why is it important?

Scientific

Knowledge about biodiversity represents systematic ecological data which is crucial for science. Many medicines that are used today have been extracted from many different plants. This would not be possible without biodiversity.

Economic

Thanks to biodiversity different kinds of materials are provided that can be manufactured and made into products that human can interact with either for consumption or production.

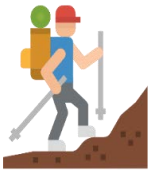
Ecological life support

Biodiversity has a huge influence on ecosystems and makes them function by providing factors that have an impact on regulating the climate, supplying enough oxygen etc.

Cultural

Culture and identity can be closely connected with biodiversity. In some cultures, biodiversity plays an important role in expressing identity.

Recreation



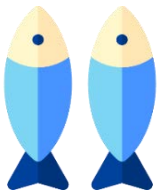
Biodiversity gives opportunities for enjoyment that humans and animals can experience in nature. Appreciation of and recreational activity in beautiful nature support a healthy and happy life.

Biodiversity plays a **crucial role for humans in sustaining their livelihoods** since everything relies on each other in order to survive. This includes the following five factors:

What are the main threats to biodiversity?

Various factors are threatening biodiversity. It is important to be aware of these factors and why they pose such a huge threat.

Over-exploitation:



One of the major threats to biodiversity is the over-exploitation of certain species. Overharvesting animals and exploiting natural resources at an excessively fast pace can challenge the survival of these species since they cannot recover at a fast rate.

Climate Change:

Climate change affects many ecosystems around the globe. Effects of climate change, such as rising temperatures, destroy the ecological balance by altering the distribution of many species.

Pollution:

All kinds of pollution, such as air, water and soil, are threatening all life forms on the planet in all kinds of ecosystems.

Invasive Species:

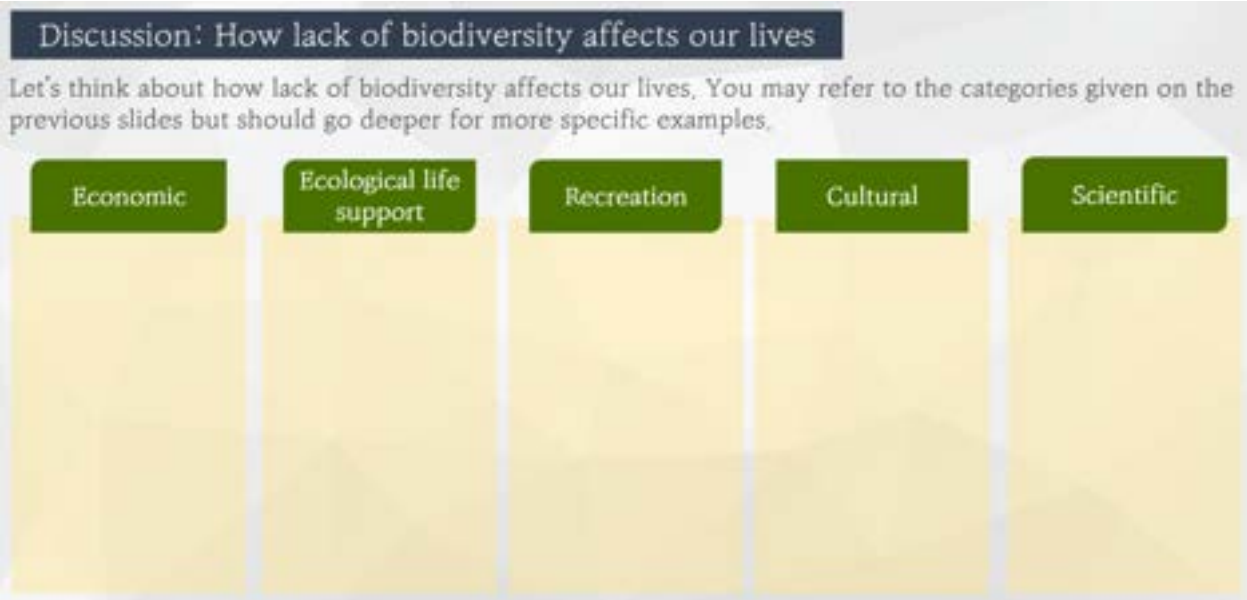
When invasive alien species spread to or are introduced to new locations, they can be harmful for native species and cause a large decrease in the numbers, or even the extinction, of native species.

Habitat Change:

Due to human activities and sometimes natural factors, habitats might change which can lead to habitat loss for some species and eventually threaten their survival.

[Topic 3_Activity]

Topic 3 discussed the importance of biodiversity. We learned about the many areas in which biodiversity and our lives are interrelated. This shows how humans and ecosystems rely on each other to survive. We should consider more deeply how ecosystems play a crucial role in sustaining human lives. For each area, try to come up with 2-3 specific examples which can show how a lack of biodiversity affects our lives.



- **How to work on this activity**

1) For each area consider the importance of ecosystems for humans' lives.
2) Think about 2-3 examples which can show how a lack of biodiversity affects our daily lives and write them under each section.
3) After you have finished, discuss with your classmates their examples or alternatively present your examples to your class.

Topic 4. What is deforestation?

Deforestation refers to the **permanent removal** of **trees** on a large scale in order to gain other resources. According to the World Wildlife Fund (WWF), the Amazon has lost around 17% of its forested area in only the last 50 years. Forested areas provide food, medicine and fuel for more than a billion people worldwide.

Figure 18. Madagascar Deforestation.

The reasons forests are destroyed

There are many different reasons why the forests on our earth are being destroyed.

Agriculture: Vast forests are being cut down in order to make space for agricultural activities such as planting crop fields.

Grazing: One of the major reasons why rainforests are being cut and burnt down, is to make way for cattle farming. The cattle are used to supply beef for the growing number of global consumers.

Human Infrastructure: Another reason is to build infrastructure that humans use, such as transportation, transformation and energy generation.

Logging: Companies that make money with timber, cut down huge amounts of trees in order to acquire wood to sell it.

Fires: Natural fires occur and burn down large areas of forests, especially during hot summer seasons when some areas are dangerously exposed to natural fires. However, another cause is human-lit fires which are commonly used to clear land for agricultural and other uses.

The effects of deforestation

Deforestation can cause the following effects that threaten not only trees and plants, but also animals and humans.

Loss of habitat:

80% of our planet's land animals and plants live in forests. Deforestation is therefore a major threat to them and can lead to the loss of their habitat and the loss of biodiversity.

Increased GHGs:

Since trees serve as major providers of oxygen and absorbers of GHGs such as carbon dioxide, decreasing the number of trees and plants causes more GHGs to stay in the atmosphere.

Soil erosion & flooding:

Trees help the land to retain water and topsoil. Without them the soil becomes fragile and in general becomes more vulnerable to natural disasters.

Destruction of homelands:

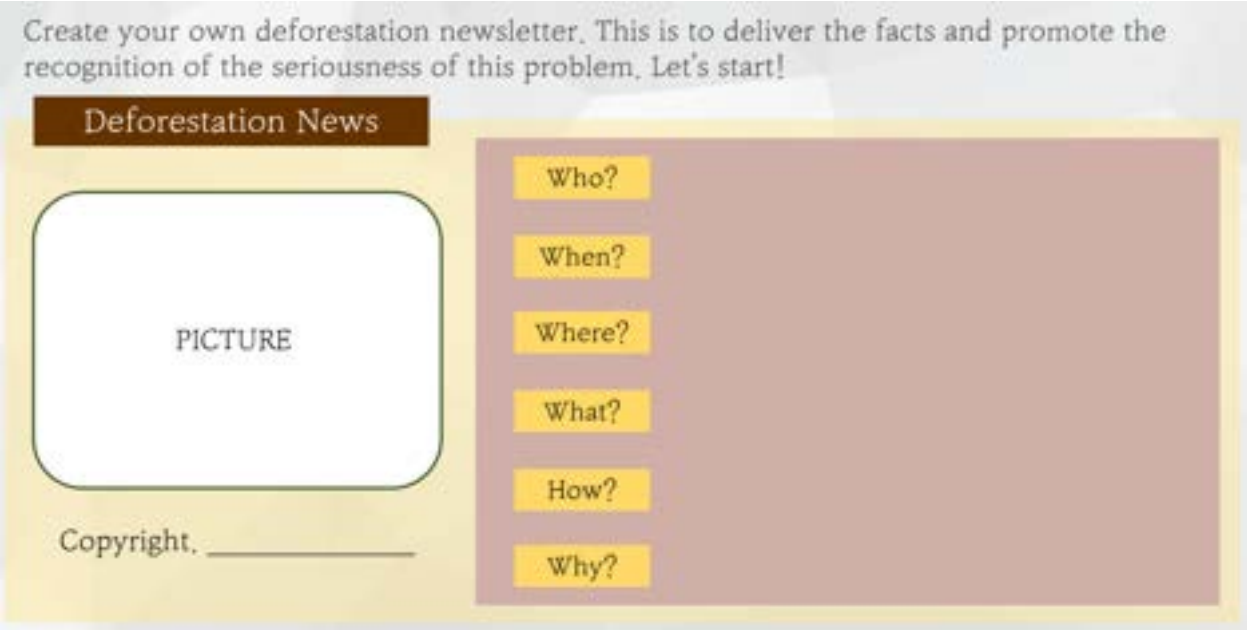
In some areas indigenous communities live and depend on the forest to survive. They are forced to move due to deforestation.

Disruption of water cycles:

Forests serve as an enormous reservoir of water. Deforestation breaks this balance of the natural water cycle.

[Topic 4_Activity]

Deforestation is mentioned as the main topic in this section. We learned the definition of deforestation and information on how forests are destroyed but have not learned about more concrete cases which are happening around the world. Newsletters, often published online, are a method which are used more frequently to update people on the current status of our forests. Now we will have the chance to create our own newsletters to help promote recognition of the seriousness of deforestation!



• **How to work on this activity**

1) Search for a recent deforestation connected issue happening around the world. As long as it is related to forest, the region where it occurred does not matter.
2) Accumulate the information that you have gained from your research.
3) Allocate the information into 6 sections – 'Who, When, Where, What, How and Why.' A picture is also needed on the left side. Don't forget to cite the copyright!
4) After filling out the form, expand the information into full sentences and complete your own newsletter.

Topic 5. The changing environment

Can the natural environment change dramatically?

Usually changes take time. However, we can see **more and more drastic changes** in our environment have happened and are continuing to happen **in a relatively short amount of time**. It is now said that ten years can be considered an epoch. Since the speed of changes has increased, we can say that our environment is exposed to **drastic changes even within 10 years!**

Changing environment, changing lives

Do our lives change when our environment is changing? Let's look at the changes that our environment is experiencing today. We can see that **weather patterns and climates** are changing. Also, some **geographic characteristics** seem to alter which **directly affects all living things** on earth. Certain ecosystems in different areas of the planet are changing. These changes have an impact on living things such as plants, animals, and humans. They can experience loss and changes in food, habitats, and the overall environment surrounding them.

Therefore, the most important point is:

When our environment changes, our lives change as well.

How humans are changing the environment

Human factors and activities are deeply **transforming and changing our environment**. Here we will talk about two different human activities that have caused the environment to change: Reclamation and Over-logging.

1) Reclamation:

Reclamation is a term that describes the cultivation of waste land or land which was previously covered in water. New land is being claimed from oceans for example. This process can deform ocean ecosystems and pollute the water by displacing the marine sediments and developing mud-waves beneath the reclamation fill.

2) Over-logging:

This term describes the process of excessive logging. Logging is a human activity where businesses are felling trees and cutting and preparing the timber for sale. This can cause loss of habitat for many animal and plant species that are living in the forests. Furthermore, when the trees of a forest are cut down, then they cannot absorb GHGs any longer. Over-logging can lead to massive deforestation.

Figure 19. Logging and its effect on the ecosystem.

[Topic 5_Activity]

A lot of videos or documentary programs are now provided online to enhance people's awareness of the changing of environment. Some of them have a huge impact on our recognition of the environmental crisis. Look for videos which contain deep meaning or insights and fill out the review sheet. After organizing the contents and your own thoughts on the paper, you are free to share it with your classmates and see which video they have seen and what they thought of it.

With your group, please find a video online which shows the change of the environment. It can be an advertising clip, or a short documentary. Then fill out the review paper for sharing thoughts with your peers.

Video Review Sheet

Link	
Region	
Main Environmental Issue	
Comments after watching the video	

• **How to work on this activity**

1) Choose a video which you think is creative or embeds meaningful insights on environmental issues. It can be a short clip.
2) Organize the contents of the video on the review sheet.
3) Share your contents and thoughts with classmates. If they have watched a different video, you may watch it also if you are interested.

Topic 6. Climate change and biodiversity

What would happen if permafrost melts?

There would be mainly two impacts:

First, and most directly, houses, roads and other infrastructure which is built on permafrost will be destroyed.

Second, permafrost does not only capture water in its ice – it also has ancient bacteria and viruses which can be unfrozen as permafrost melts. Thus, as permafrost melts there is more and more possibility of a breakout of unknown diseases which can threaten both humans and animals.

A rise in sea levels and its effects on us

Low-lying coastal areas will be flooded, which results in a possibility for many people to be insecure and eventually forcing them to migrate to somewhere else. Sea level rise has devastating effects on **coastal habitats farther inland** as well. Fish, birds, and plants will lose their habitat, threatening wildlife populations.

The rising sea level can also cause more dangerous hurricanes and typhoons: more powerful storm surges that cause more disasters. Furthermore, risen sea can seep into freshwater sources underground that many coastal areas rely on for daily use and farming use, directly threatening the community's food security.

Loss of coral reefs

Coral reefs help seed the ocean and provide shelter and food to a complex web of organisms. They are connected to over one million plant and animal species, hosting more than 25% of all species of marine life. **Without coral reefs, the ocean will also not be able to absorb as much carbon dioxide**. As you can see, the roles of coral reefs are critical in not only tackling carbon

dioxide emission but also in overall marine ecosystem. The loss of coral reefs, thus, will have costly impacts on our planet.

Figure 20. Coral reef scene, Fiji.

It is particularly significant to note the reciprocal relationship between fish and coral reefs in this sense. Fish can excrete ammonium, which is an essential nutrient for coral growth. Fish urine also contains phosphorous, another key nutrient that helps coral grow. In return, coral reefs can provide microbes as food for some fish and function as a breeding place for many marine life.

Clown fish, for instance, is a representative species that maintains a symbiotic relationship with coral reefs: coral reefs protect clown fish from predators and clown fish clean up the area in return.

Ecosystem loss and food security

Ecosystem loss led by environmental changes also has serious effects on food security issues. Increased temperature can lead to increased pest insect populations, including harmful insects that harm harvests. As more extreme weather and natural disasters appear, they also affect crop growth and harvests directly as well.

Case: Desert locusts in Africa

At the beginning of 2020, desert locusts hit East Africa. Although the main habitat of the species is North Africa, the number of populations had surged and they even moved to East African countries like Tanzania or Sudan.

Desert locusts are famous migratory pests – they can migrate up to 150km per day for maximum and gulp the crops. They not only eat away the crops but also devastate pastures and farmlands, threatening the community's food security from the ground up.

This phenomenon was mainly due to climate change – increased cyclones had facilitated reproduction and mobility of the species which ended up endangering livings of many African countries.

(Source: Oxfam Korea)

Figure 21. FAO/Sven Torfinn.

Examples: Planet losing its ecosystem

Terrestrial vertebrates in China

During 1970~2010, terrestrial vertebrates in China have declined by 50% - almost half of them vanished in the last 40 years! This was mainly because of habitat loss and nature degradation by human activity. Amphibian and reptile populations, in particular, declined by 97% and mammal populations dropped by 50%, putting 233 vertebrate animal species in facing extinction.

Groundfish

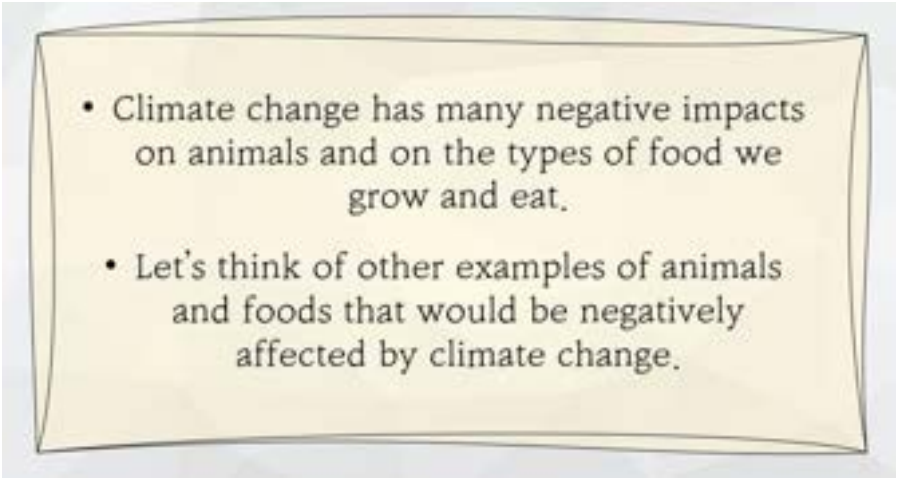
Groundfish resources have declined as well. Catches are of younger ages now, and they are becoming smaller in size and having lower values. This is related to river's fishery resources being badly degraded, resulting in loss of species and food security problem.

Rice

Local rice varieties planted by farmers declined from 46,000 in the 1950s to slightly over 1,000 in 2006. Again, it is not only a danger to the species, but also threatful to food security of people producing and consuming it.

[Topic 6_Activity]

In this section you have learned about and seen various examples of the ways in which climate change negatively affects animals and the types of food we grow and eat. Rising sea levels, more extreme weather events and overall increased global temperatures all influence diversity, meaning there will be a decreased variety of plants and animals. For this activity we will try to think of specific animals and foods that will be adversely impacted by climate change.



• **How to work on this activity**

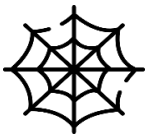
1) Think about the foods you eat every day and how they are grown. Also think of some animals which need a stable climate to survive.
2) Consider how these foods and animals would be affected by the effects of climate change.
3) Discuss what would be the results for humans if our supply of these foods or the number of these animals was greatly reduced.

Topic 7. How are we all linked together?

As you have seen in the previous topics, we are all linked together in the whole ecosystem. Now let's take a more detailed look into one of the examples of the nexus of our ecosystem.

Food chain and food web!

Food chain is basically about what eats what, showing the relationship between species where each one feeds on the other – predators and preys. **Food web** can be understood on the extension of food chains as it consists of all the food chains in an ecosystem, making up a web of food chains.



Both food chain and food web clearly show us that all living beings are linked together within the ecosystem. Now, let's look at how food chains in terrestrial and aquatic ecosystems work and are constituted.

Grassland ecosystem

Food chain in the grassland ecosystem, also known as terrestrial ecosystem, has mainly four actors. The lowest part consists of **producers** who make their own food using photosynthesis or chemosynthesis. Trees and plants that we can see everyday can be included as producers.

And now come consumers – the primary, secondary and tertiary consumers. **Primary consumers** are mostly herbivores who eat plants and other producers, like giraffes. **Secondary consumers** eat primary consumers and tertiary consumers eat secondary consumers. Easy logical flow right?

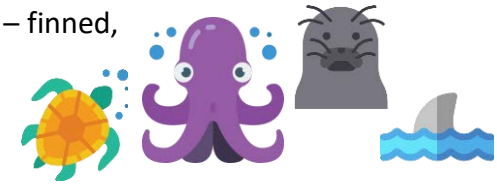
On the top of the food chain there are **apex predators** – they eat other consumers and have no predators other than humans. Lions or tigers, for instances, are top predators who do not have to worry about other predators when they do not face humans.

Ocean ecosystem

Food chain in the ocean ecosystem is basically similar to the hierarchical structure of the food chain in grassland ecosystem. The lowest part of the pyramid consists of **photoautographs** like

phytoplankton, tiny plants and bacteria who function as the primary producers. And **herbivores,** such as turtles or jelly fish consume these ocean vegetations, while **carnivores** like octopuses eat either herbivores or other small carnivores. It's a 'fish-eat-fish' world.

And again, **apex predators** sit atop the marine food chain – finned, feathered, or flippered animals are here, for instance Penguins, sea lions and sharks are here.



Break of the chain: What is the impact?

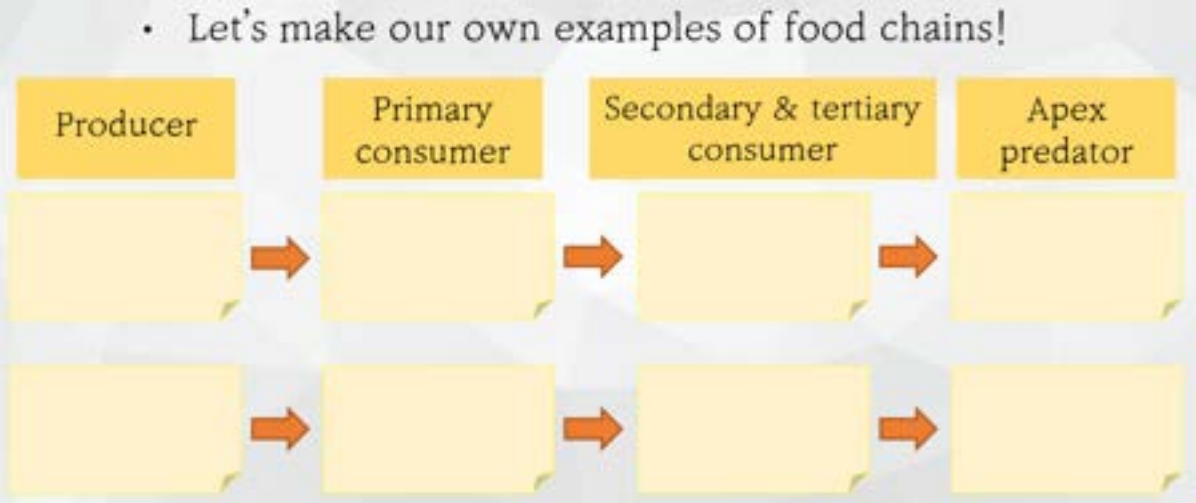
As you could see from how the food chain is structured, it is not difficult for you to imagine the impacts when the chain breaks. Since consumers live upon multiple sources of prey, other species including humans are affected when one species becomes endangered or even extinct. It is like a **domino effect**.

One strong examples is **COVID19**.

Wildlife trade, deforestation, urbanization and other human activities that destroy the ecosystem bring people closer to animals, putting the animal world and human world too close together. More human and wildlife interaction is inevitable – diseases or viruses thus, also have more opportunities to jump from animals to humans. Not only COVID19, but also Ebola, SARS, MERS, HIV originally came from inside an animal as a host. We should be cautious since the next pandemic might come this way as well.

[Topic 7_Activity]

We have learned about food chains and food webs in this topic and how all forms of life are linked together. We learned how animal species endangerment and even extinction can occur if foods chains are interrupted or broken, as well as how destroying ecosystems can negatively affect humans. In this activity we make our own examples of two food chains to help us think more deeply about how interconnected animals are.



• **How to work on this activity**

1) Think about animals that live in nature and what they eat to survive.
2) As you can see above there are 2 rows. In each row make a different example of a food chain.
3) Remember that each food chain should start with a plant (a producer) and end with an animal which has no predators other than humans (an apex predator).

Topic 8. Which species are in danger?

Endangered species?

What are 'endangered species'? You might have guessed from its name: they are species in danger, to be short and simple. It refers to **the species that are close to extinction**, that is, there are not many animals left of that type in the world. The causes for endangerment of certain species can be diverse: human activities such as logging, farming, construction or overhunting, and extreme climate change can put species in danger.

Different conservation status

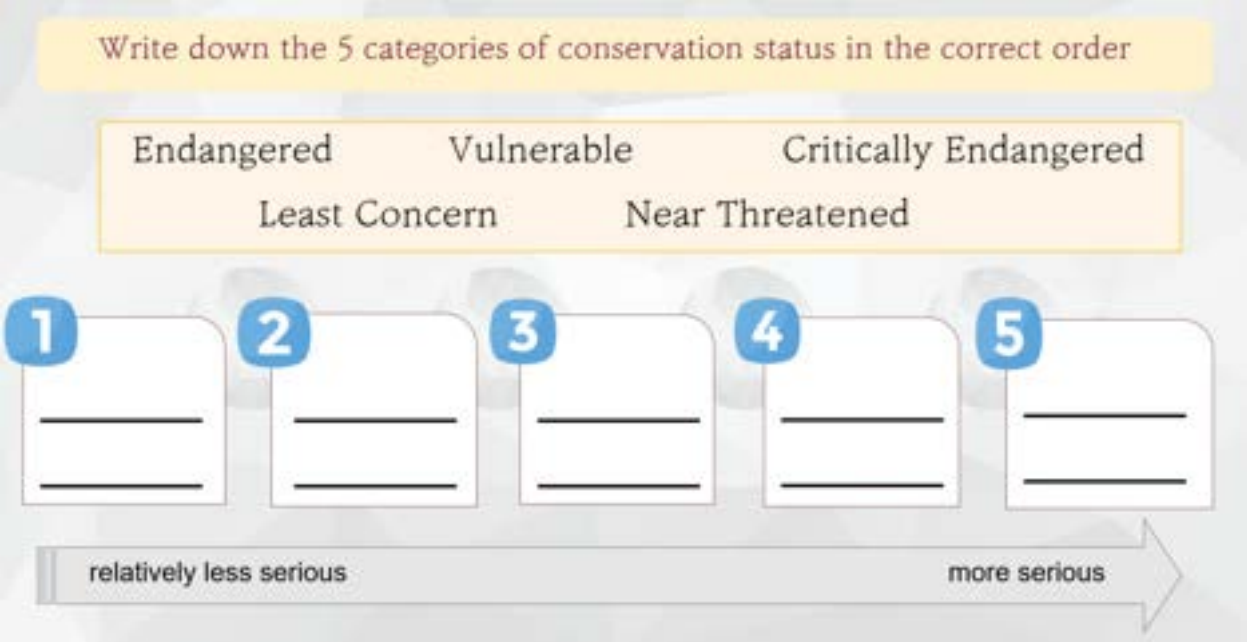
There are different conservation statuses based on the degree of danger. The IUCN Red List is the most famous listing for the conservation status of species. It originally has a grouping of total seven, but we will just look at five, excluding extinct (EX) and extinct in the wild (EW). Please refer to the following table.

Least concern (LC)	Near threatened (NT)	Vulnerable (VU)	Endangered (EN)	Critically endangered (CR)
Lowest risk e.g. Artic fox	Possibility of becoming endangered in the near future e.g. Beluga	High risk of endangerment in the wild e.g. Hippos	High risk of extinction in the wild e.g. Tiger	Extremely high risk of extinction in the wild e.g. Orangutan

Figure 2217. Species Directory.

[Topic 8_Activity]

In this topic we gained understanding of what endangered species means and looked at examples of species which are endangered. We learned there are five different conservation statuses based on the degree of danger. For this activity we will review the order of severity of the five categories by writing them in the correct order.



• **How to work on this activity**

1) In the first box you can see the names of the five categories of conservation statuses.
2) In the numbered boxes try to write the names of the categories in the correct order, without looking at the previous pages.
3) After completing the activity, check your answer as a class to see if you were correct.

Topic 9. What we've been doing

What we've been doing for conservation

Of course, there have been efforts for conservation. Now we will look at activities at international and national level that have been taking place.

GREENPEACE

Figure 23. Our Three Year Strategic Plan.

Greenpeace is an international organization that is famous for **non-violent activism to make the world greener**. It has started as an anti-nuclear NGO from 1971 and now is working with 27 organizations worldwide.

What they have been doing: 1) phase-out from nuclear plants and fossil fuels, 2) saving whales, 3) fighting climate change.

WWF CHINA

World Wildlife Fund works for the preservation of endangered species. Ongoing projects in China, in particular, are like the following:

1) **Tiger Network Initiative** – This initiative aims to restore 20% of tiger population and to eliminate tiger parts trade.

2) **The Green Heart of China** – This project aims for viable giant panda population in upper area of Yangtze River of China by 2030.

3) **Lesser-known Endangered Species** – aims for protection of reptiles and amphibians in particular.

National Parks Conservation

National Parks Conservation Association of the US 1) fought for commonsense hunting regulations, 2) planned for restoring the ecosystem's wolves, and 3) fought for protection of the endangered plants and animals.

Warning: National parks are completely different from commercial zoos. They provide more natural settings for wildlife and are not simply for sightseeing and entertainment of people.

CITES

CITES – **Convention on International Trade in Endangered Species of Wild Fauna and Flora** – is an international agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Having started from 1975, CITES now has 183 Parties.

Figure 24. What is CITES?

CBD

CBD – **Convention on Biological Diversity** – was signed by 150 governments at the 1992 Rio Earth Summit. It was underscored that biological diversity is also about people and our needs for food security, medicines, fresh air and water, shelter, and a clean and healthy environment. The convention has set 20 Biodiversity targets. Target 11, for instance, aims for conservation of at least 17% terrestrial water and 10% coastal and marine areas by 2020.

Convention on Biological Diversity

Figure 25. Convention on Biological Diversity.

[Topic 9_Activity]

We have learned about examples of the numerous ways people have been working for conservation. People, organizations, and governments from all around the world have taken action to help conserve nature and ecosystems. For this activity let's try to think of our own ideas of ways we can be a part of the solution in assisting environmental conservation.

- **How to work on this activity**

1) For this activity, you can discuss as a class or in groups.
2) Try to think of your own ideas of how we can help conservation and discuss them.

Topic 10. “You better protect us or will never see us”

What’s up with endangered species?

The situation is quite serious. Current rate of species extinction is at least 100 – 1000 times higher than the natural rate. Over 40 years, the population size of mammals, birds, fish, reptiles and amphibians experienced a decline of 60%, which definitely is not a natural phenomena.

What can we do to protect them? What can we do then? We already have seen the case of national parks working for conservation and protection of wildlife. They offer suitable habitats for animal and plant species, being home to creatures that exist nowhere else in the world. For example, Sanjiangyuan National Park in China was established in 2020 and is a home to: wild yaks, snow leopards, Tibetan antelopes, and Tibetan gazelles.

The Story of the Giant Panda

Figure 26. Giant Panda.

We should not lose positivity in saving biodiversity – here is a successful story of Giant Panda. Giant Panda’s Red List status was ‘Endangered’ but it became ‘Vulnerable’ in 2016! Although they are STILL vulnerable in the wild as forest loss is reducing their access to bamboo, which is their main prey, we can say that our endeavors can contribute to lessening the rate of extinction of certain species.

There also are things that you can do to ensure a more promising future for the pandas:

1) Learn about endangered species in your area (Learn more about Giant Panda)

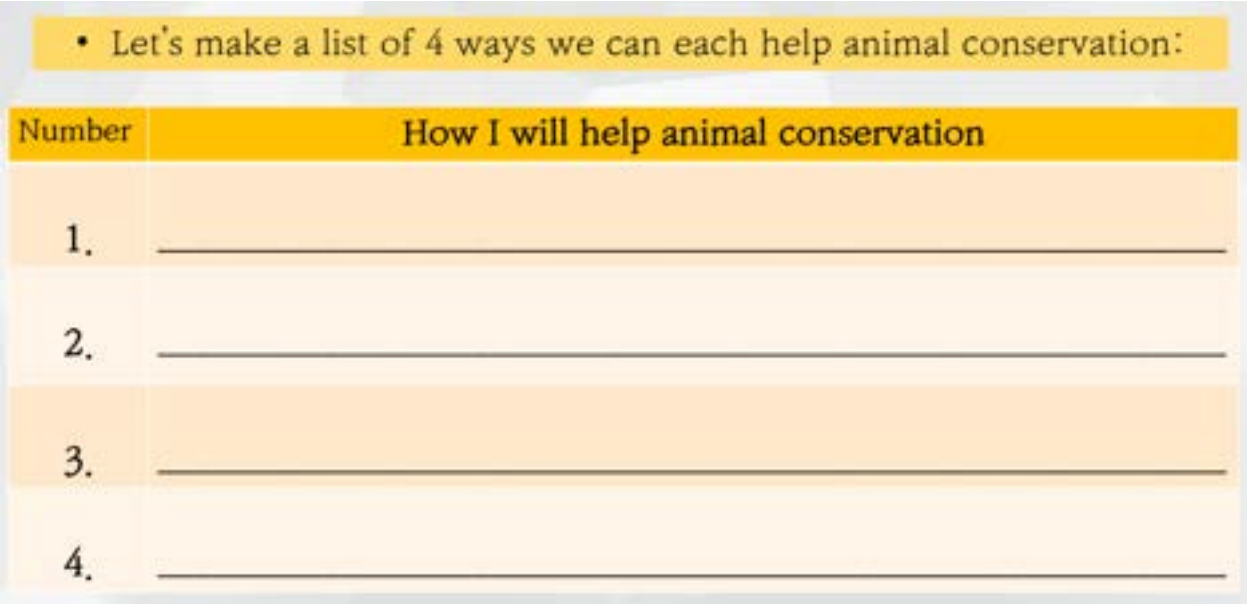
2) Visit a national wildlife park or research base (Cheng du Research Base of Giant Panda Breeding)

3) Find out more about funds and activities, like WWF and other conservation organizations.

Additionally, recycle and buy sustainable products. Never purchase products made from threatened or endangered species and grow native plants!

[Topic 10_Activity]

Continuing on from the previous topic, in this topic we learned more about endangered species and methods of protecting endangered animals. We can all do our part to be part of solving this problem. For this activity we will write four ways in which we personally commit to helping animal conversation.



• Let's make a list of 4 ways we can each help animal conservation:

Number	How I will help animal conservation
1.	_____
2.	_____
3.	_____
4.	_____

• How to work on this activity

1) This activity should be completed individually.
2) Try to recall the various ways of helping animal conservation you have learned about, as well as the ideas you and your classmates suggested in the previous activity.
3) Write four practical things that you can do to help animal conservation.

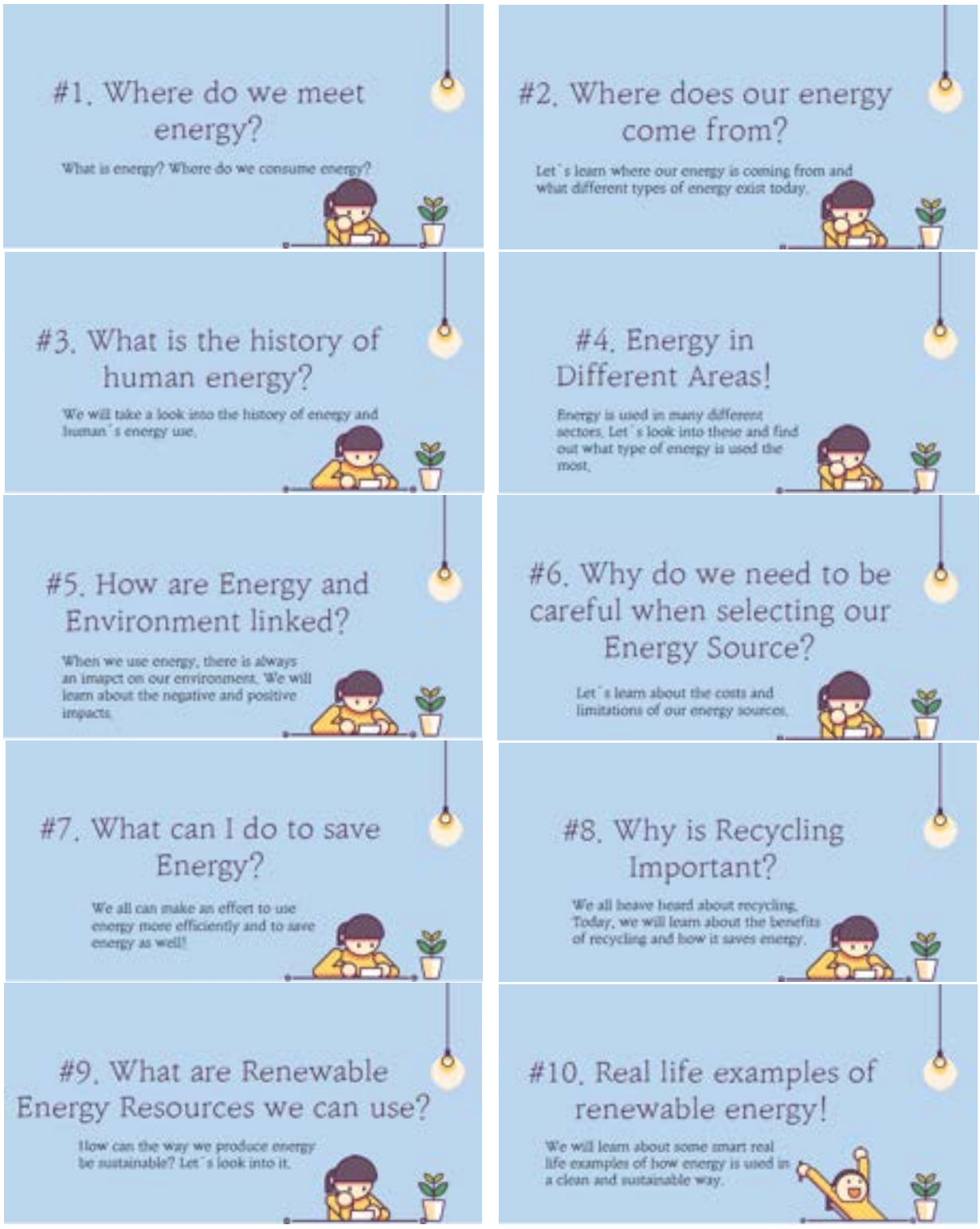
Module 3: Light Up The World!

By finishing this module, students are expected to:

- understand where and when we use specific **kinds of energy**
- realize the **shortcomings** of contemporary energy resources
- understand how different sorts of **energy are being utilized**, according to countries' technical/economic status
- know about **alternative energy** resources
- understand **local/national** levels' different strategies of utilizing renewable energy sources

By completing module 3, students will be aware of where the energy they use every day comes from and have a deeper understanding of the negative and positive impacts of humans' energy use, as well as the importance of renewable energy sources for our future. Students will be informed of how they can reduce their energy use and encouraged to think of new ways of lessening their energy use.

Overview


#1. Where do we meet energy?
What is energy? Where do we consume energy?
#2. Where does our energy come from?
Let´s learn where our energy is coming from and what different types of energy exist today.
#3. What is the history of human energy?
We will take a look into the history of energy and human´s energy use.
#4. Energy in Different Areas!
Energy is used in many different sectors. Let´s look into these and find out what type of energy is used the most.
#5. How are Energy and Environment linked?
When we use energy, there is always an imapct on our environment. We will learn about the negative and positive impacts.
#6. Why do we need to be careful when selecting our Energy Source?
Let´s learn about the costs and limitations of our energy sources.
#7. What can I do to save Energy?
We all can make an effort to use energy more efficiently and to save energy as well!
#8. Why is Recycling Important?
We all heave heard about recycling. Today, we will learn about the benefits of recycling and how it saves energy.
#9. What are Renewable Energy Resources we can use?
How can the way we produce energy be sustainable? Let´s look into it.
#10. Real life examples of renewable energy!
We will learn about some smart real life examples of how energy is used in a clean and sustainable way.

Introduction of Contents for Each Topic

Topic 1. Where do we meet and need energy?

Objective	Students will gain a basic understanding of what is energy and why energy is important.
Part 1	Learn about energy's definition and how energy resources are converted to final energy and how we can use it during our daily lives.
Part 2	Students can recognize the convenience electricity gives our lives, and try to imagine if there was no electricity in our world, how difficult it would be to survive.

Topic 2. Where does our energy come from?

Objective	Students learn about the various sources of the energy we use and how those energy sources are formed.
Part 1	Learn about nonrenewable energy and how currently most of our energy needs are provided by nonrenewable sources.
Part 2	Students gain an understanding of renewable energy sources, their current constraints, and how each renewable energy sources make electricity.
Part 3	Students briefly review which energy sources are nonrenewable and which are renewable.

Topic 3. What is the history of human energy?

Objective	Students learn how humans' use of energy has changed over time and gain insight about the top 12 energy consuming countries.
Part 1	Learn about how people's use of energy, mostly fossil fuels, has massively increased over the past century.
Part 2	Study which 12 countries consume the most energy and look at the case of China, its sources of energy and growth of its energy use.

Topic 4. Energy in Different Areas

Objective	Students will further understand energy consumption in different areas, especially in high energy demand sectors.
Part 1	Students will see an overview of world energy consumption in different sectors, especially in industry, transportation and building sectors.
Part 2	Student will learn how and why energy is consumed in these three sectors.

Topic 5. How are Energy and Environment linked?

Objective	Students will learn about the negative and positive impacts of energy and its relationship with humans.
Part 1	Students will see the negative impacts of energy depending on different kinds of materials.
Part 2	Students will learn the positive impacts of energy on the environment and humans. They will also look at the benefits of renewable energy.

Topic 6. Why do we need to be careful when selecting our Energy Source?

Objective	Students will accumulate knowledge on the limitation of energy sources. The topic will go through non-renewable energy and renewable energy, to lessen the prejudice that either one is inherently good or bad.
Part 1	Students will learn about how energy sources are subsidized and the importance of considering external and long-term costs of energy use.
Part 2	Students will learn by guessing and expressing their own opinions the limitations of existing energy sources.
Part 3	Different limitations depending on the materials will be introduced focusing on its impacts on the environment and human health.

Topic 7. What can I do to save Energy?

Objective	Students are introduced to the concepts of energy efficiency and energy conservation, and learn practical ways they can save energy.
Part 1	Learn about the difference between energy efficiency and energy conservation, and examples of each.
Part 2	Student realize practical methods of conserving energy directly, as well as indirectly, such as by using less water and paper.

Topic 8. Why is Recycling Important?

Objective	Students will recognize the importance of recycling and how it saves energy by learning about the real process of recycling. They will learn the importance of recycling properly and the consequences of incorrect recycling habits.
Part 1	The recycling of products is linked with energy. Explanations on how the recycling of certain products saves energy are given with some tips on how to recycle properly are provided.
Part 2	Students will learn how to recycle properly by looking at the negative results of circumstances of incorrectly recycling.

Topic 9. What are Renewable Energy Resources we can use?

Objective	Students will review renewable energy sources and learn how each energy type generates energy for us to use.
Part 1	Students will learn the detailed process of how solar energy, hydroelectric power and wind energy generate electricity.
Part 2	Learn about how renewable energy is sustainable as it produces no greenhouse gases and reduces the amount of air pollution, which negatively affect human health and wellbeing.

Topic 10. Let's see some Real Life Examples!

Objective	Students are introduced to some renewable energy applications in the real world, and learn how renewable energy, instead of fossil fuels, will be the energy source we will use in the future.
Part 1	Students will learn about different types of renewable energy applications in the real world in different countries. These countries use their abundant renewable resources to carry out renewable energy (zero-emission) projects and make great contributions to emission reduction and energy conservation in the building, transportation, and electricity sectors.
Part 2	Students will learn about how small renewable energy applications like roof top solar PV show that renewable energy can be used by every family.

Glossary

Vocabulary	Definitions
Energy	The capacity of doing work which exists in potential, kinetic, thermal, electrical, chemical, nuclear or other various forms.
Nonrenewable energy	Energy which is derived from sources that will eventually run out.
Renewable energy	A clean energy which comes from natural sources or processes that are constantly replenished.
Biomass	Renewable organic material that comes from plants and animals. It is used as an important fuel.
Geothermal	Of or relating to the heat in the interior of the Earth.
Consumption	An act of process of using; for example, fuel.
Natural gas	A fossil energy source that formed deep beneath the Earth's surface.
Petroleum	A dark, thick oil obtained from under the ground, from which various substances, including petrol, are produced.
Commercial	Act related to business operations in the market.
Residential	A term which expresses relationships with homes, apartments, or other places people live.
Subsidy	Direct payment from the government to an entity which leads to the fall of the price of a targeted product.
Environmental cost	Expenditures that are incurred to prevent or remove the pollution of the environment.
External effect	An effect which is imposed on people not relative or involved in a certain circumstance.
Energy conservation	An act of prevention of energy; using less energy.
Solar panels	A device which transforms energy from the sun into electricity.

Which SDG is most related to this module?

Module 1 discusses the energy, sources of energy, and their impacts on the environment. The according SDG that covers these subjects is **SDG 7.**

"Ensure access to affordable, reliable, sustainable and modern energy for all."

Topic 1. Where do we meet and need energy?

What is energy?

In physics, energy is defined as the ability to do work. The development of our modern society relied on humans learning how to transfer energy from one form to another and then use it to do work.

Example: The stored chemical energy in coal or natural gas can be converted to electrical energy, which in turn can be converted to light and heat.

Where does energy come from?

Primary energy: The energy that is harvested directly from natural resources.

Secondary energy: The energy transformed from the primary sources.

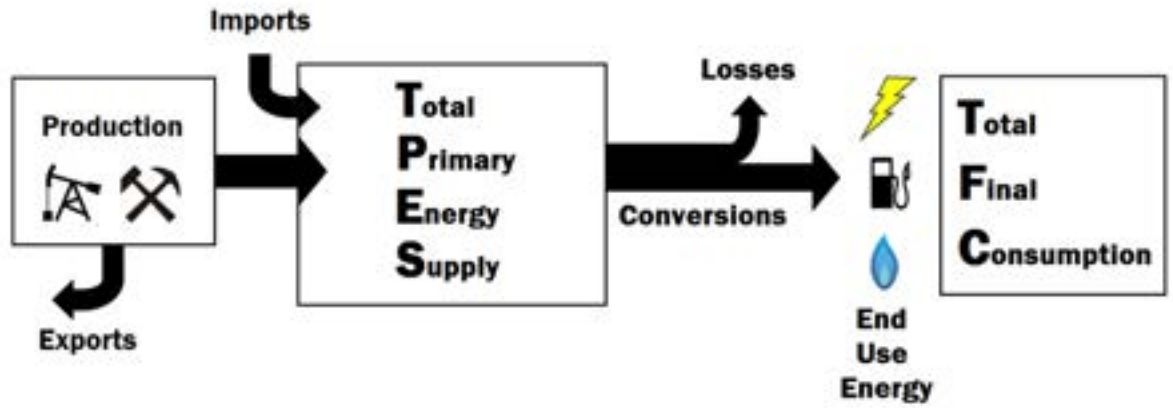


Figure 27. How Total Primary Energy Supply becomes Total Final Consumption.

Humans get primary energy sources from sources such as oil, coal, or natural gas which are extracted from the earth by mining activities. Next, these energy resources are converted through energy conversion technology to become secondary energy. Finally, the electricity is supplied for humans' consumption.

Where do we use energy?

Energy is very important in today's world. We use energy nearly everywhere and every moment in our lives! Let's think about where we use energy in our daily lives.

Every morning, the alarm clocks wake us up, the battery provides the energy for alarm clocks and makes sure we will not be late for school.

Then we have our breakfast! Natural gas provides the heat for cooking breakfast and helps us have meals more easily. And then it's time to go to school! For those students who live far away from school, cars, buses or subways are better choices, which are powered by fuels. In our classroom, teachers use computers and projectors during their classes and students use laptops or other electronic devices to make studying more convenient. The lights and air-conditioners provide us a more comfortable environment, which is all supported by electricity. If we do not have any electricity someday, what would happen?

[Topic 1_Activity]

Starting Module 3 we learned that energy is basically power that comes from different resources and provides us with light and heat in different forms. Let's take some time and think about what we might already know about energy.

What do you know about energy?

When you hear the word energy, what comes to mind? Let's think about it together! Take a look at the questions below and talk about them with your peers, friends and family.

- What does energy mean to you?
- Where do you meet energy?
- What are activities in your daily life where you need energy?
- Where does this energy come from?
- Do you know different sources of energy?

- **How to work on this activity**

1) This activity aims to make you think about energy in general by expressing your own thoughts about energy.
2) Read and discuss each question in groups or as a class.

Topic 2. Where does our energy come from?

Nonrenewable energy sources

Currently, most of our energy comes from nonrenewable sources. A nonrenewable energy source is a source of energy that can only be used once so will eventually run out. The four main nonrenewable energy sources are oil, coal, natural gas and nuclear power.

Most nonrenewable energy sources are fossil fuels. Fossils fuels are formed from the remains of plants and animals and take millions of years to form.

Figure 30. Nonrenewable Energy Sources.

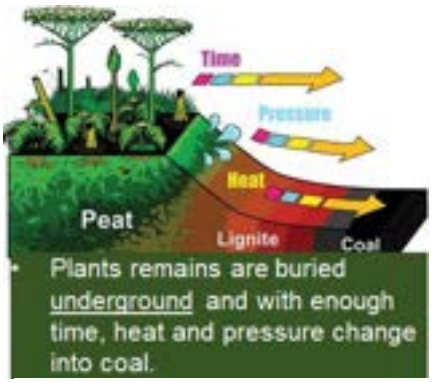


Figure 28. Petroleum and natural gas formation.

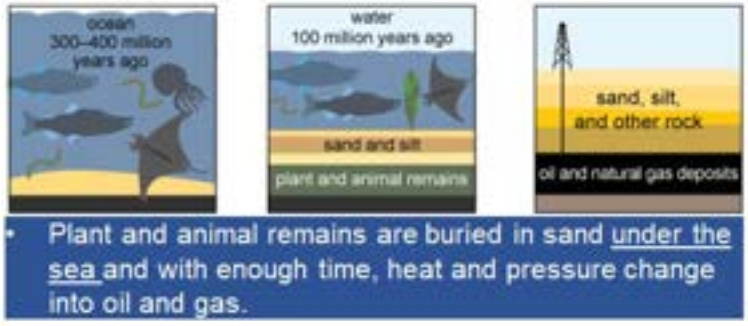


Figure 29. Coal Formation.

As you can see from above, time, heat and pressure are needed for the formation of fossil fuels. In the case of coal, the organic matter which eventually becomes coal primarily comes from forests, whereas in the case of oil and natural gas, the organic matter is from sea creatures. In both cases, the dead organisms are buried over time and the extreme heat and pressure converts the organic matter into coal, natural gas, or oil.

Renewable energy sources

Renewable energy sources are sources of energy which do not run out. Renewable energy comes from natural sources or processes that are constantly replenished. The main types of renewable energy sources are wind, hydro, tidal, solar, biomass and geothermal.

Figure 31. Renewable energy sources.

As they do not run out and have much fewer negative environmental impacts, we are gradually increasing our use of renewable energy sources. Increasing our use of renewables is beneficial but there are currently constraints on renewable energy sources as a source of energy, such as:

- **Technology**: Renewable energy technology has improved significantly but efficiency is still being improved. Due to the intermittency of some renewable energy sources energy storage technology plays an essential role. Energy storage capacity will need to continue growing and become cheaper to bring down the cost of electricity generation using renewable energy sources.

- **Stability:** Generating a stable supply of electricity can be an issue with renewable energy sources. For example, on non-windy days wind power cannot be made and on cloudy days less solar energy can be generated.
- **Scale:** There can be obstacles when using energy on a large scale to replace nonrenewable sources of energy. For example, solar panels require a large surface area, and wind farms require areas with enough regular wind currents.

- **Economy Activity:** Some economic activities require energy intensive heat levels that are difficult to achieve with renewables, for example steel production.

How does each type of renewable source make energy?

Wind, hydro and tidal energy sources make electricity in a similar way, the energy source turns a turbine which produces electricity. In the case of wind energy air turns the turbine and in the case of hydro and tidal energy, water turns the turbine to make electricity.

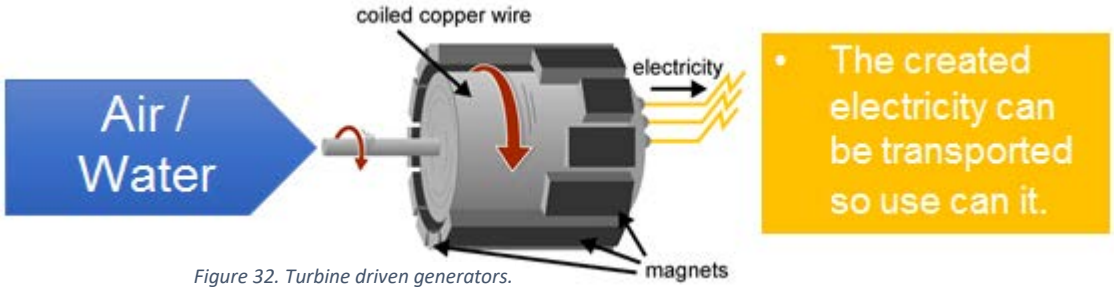


Figure 32. Turbine driven generators.

Geothermal energy also uses turbines. Hot water from underground which turns to steam turns turbines which make electricity. The water is then sent to a cooling tower and injected back underground.

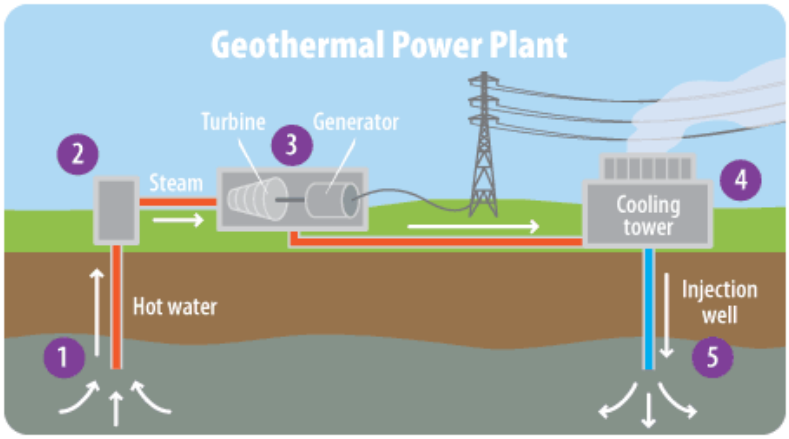


Figure 33. Geothermal Power Plant.

Biomass, like fossil fuel, releases energy when it is burnt. The important difference is that unlike fossil fuels biomass can be created by humans by growing trees, crops or other plants.

Solar panels absorb energy directly from the sun. Light from the sun hits photovoltaic or PV cells in the solar panel which convert the sun's energy into electricity.

[Topic 2_Activity]

The energy that we use comes from very different sources. Among those energy sources, there are nonrenewable sources and renewable sources. Since nonrenewable sources take an extremely long time to form, it is good to know that there are more options for obtaining energy from sources that are renewable.

- **How to work on this activity**

1) Working individually, match the picture of each energy source with one of the two categories: nonrenewable energy or renewable energy.
2) After you have finished, check your answers as a class.

Topic 3. What is the history of human energy?

Human's energy use

Most of our energy currently comes from fossil fuels. Fossil fuels release a lot of energy when burned, which makes them extremely useful for generating energy. However, fossil fuels have many negative aspects. Fossil fuels are nonrenewable sources of energy and release harmful emissions, which cause air population and climate change. Using fossil fuels for most energy needs is unsustainable in the long run.

Human's energy use and sources of energy from 1965-2018

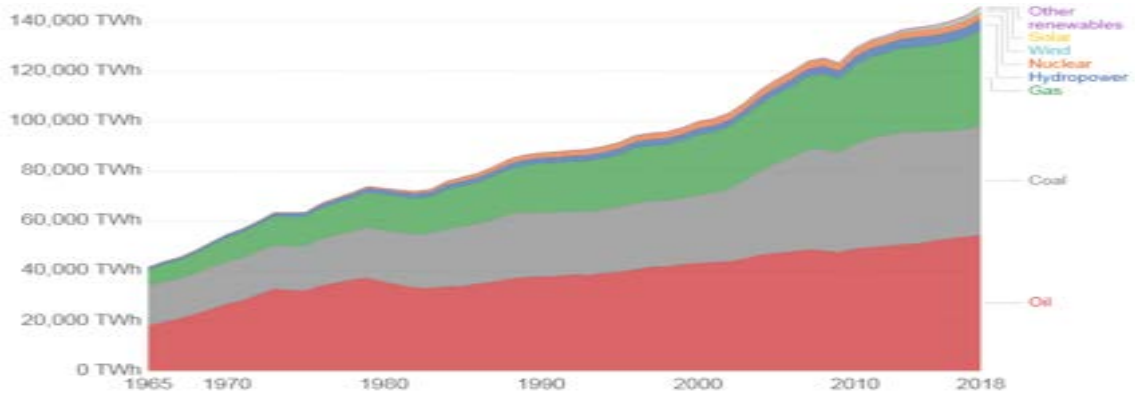
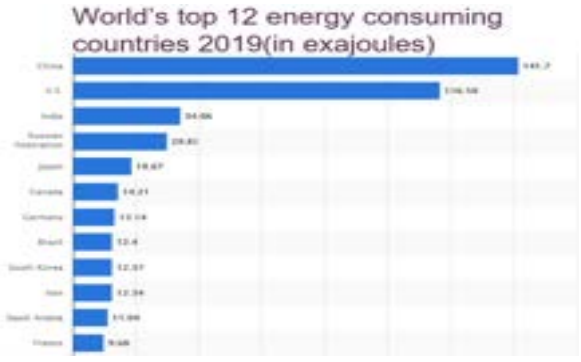


Figure 34. Global direct primary energy consumption.

As you can see from the above chart, human energy use has more than tripled over the last 50 years. Most of our energy currently comes from oil, coal and gas. Renewable energy sources are currently a small fraction of our total energy sources. We will need to increase our use of renewable energy sources to live more sustainably.

China's energy use



China is the number one consumer of energy in the world. The US is second highest, and India is the third. All countries have a responsibility to reduce their energy use and use more renewable energy sources to protect the environment.

Figure 35. Leading countries in primary energy consumption worldwide.

China's energy use and sources of energy from 1965-2015

Most of China's energy currently comes from coal, which causes pollution and greenhouse gas (GHG) emissions. China will need to drastically reduce its use of coal to be more sustainable and cause less damage to the environment. Over the past 10 years, China has greatly increased its use of renewable energy sources, which is a positive development. Renewable energy as a percentage of China's total energy use will need to continue to rapidly grow to meet China's energy needs in a long-term sustainable way.

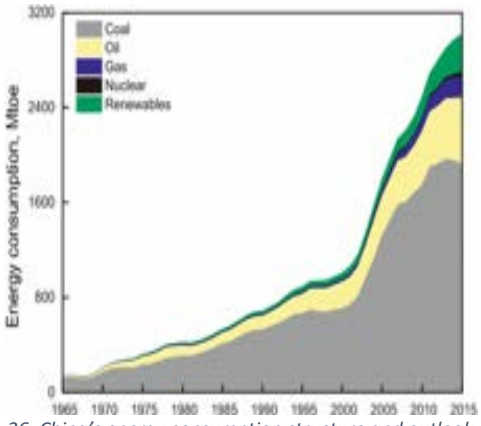


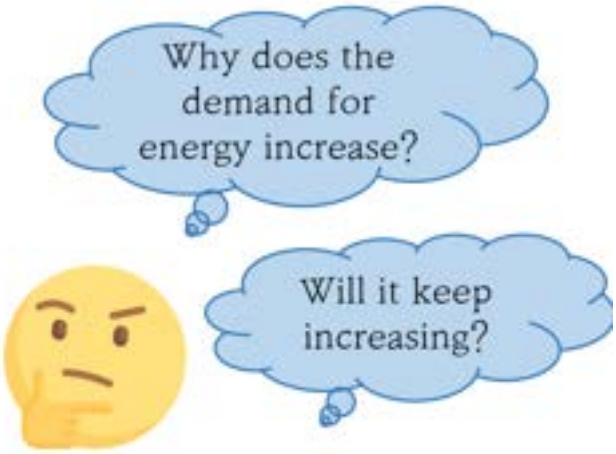
Figure 36. China's energy consumption structure and outlook

[Topic 3_Activity]

The history of energy shows us that energy is being increasingly demanded and many countries use more and more energy now then a few decades ago. The energy that is being used is mostly coming from nonrenewable sources, which is not sustainable especially with an increasing demand for energy.

Looking at the history of energy we see that over time more and more energy was being produced and consumed. But why is that?

Let's take some time and think about it together!



- **How to work on this activity**

1) Try to think to critically think about the reasons why human population is using more and more energy. Reasons can be various, such as a growing global population, industrialization, usage of various technologies, the aim to develop convenient devices, and so on.
2) Discuss with your classmates in groups or as a class.

Topic 4. Energy in Different Areas

Energy consumption in different sectors

1. Industry Sector

The industrial sector consumed most (45%) of global energy in 2018, followed by residential and commercial buildings (29%) and transport (21%).

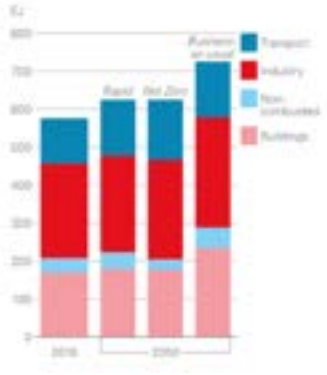


Figure 37. Industry Sector.

Different types of industry

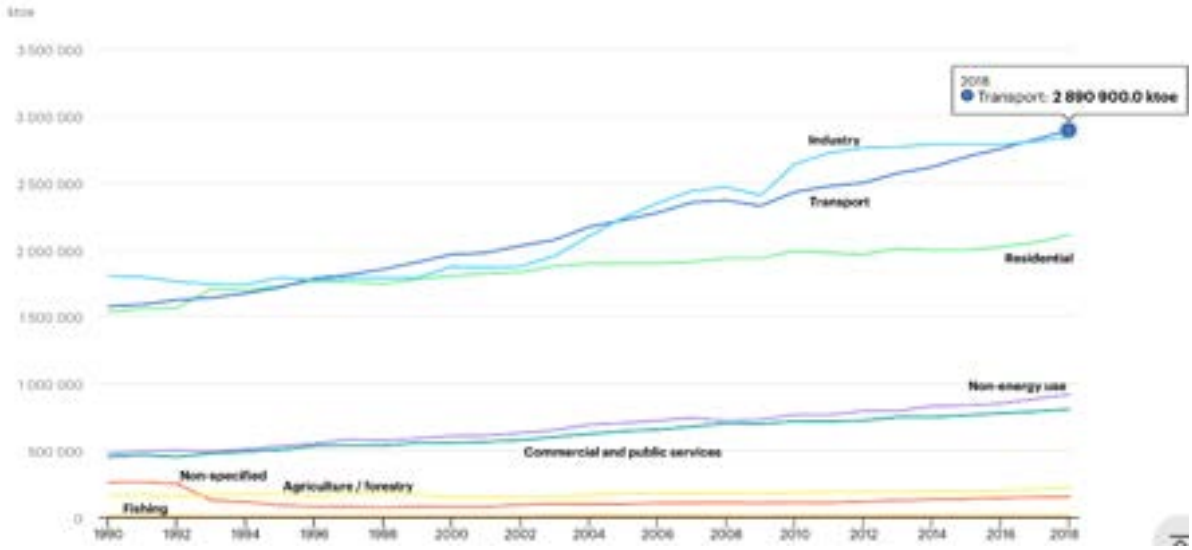


Figure 38. Different types of industry.

The industrial sector consumes energy for a wide range of purposes, such as steam and cogeneration, process and assembly, process heating and cooling etc. The industrial sector can be categorized by three different types: energy intensive manufacturing, non-energy intensive manufacturing, and non-manufacturing.

- **Energy intensive manufacturing:** heavily relies on energy. Examples are food, iron and steel, pulp and paper, refining, and basic chemical.

- **Non-energy intensive manufacturing:** consumes less energy. Examples are paint and coatings, pharmaceuticals and other miscellaneous chemical products.

- **Non-manufacturing:** Mainly includes mining utilities, business services and construction, finance, and banking.

How is energy consumed in industries?

Industry uses many energy sources, including fossil fuels (natural gas, petroleum, coal), electricity and renewable energy sources. Some energy resources are also used as the basic chemical feedstocks in this industry.

Fossil fuels and renewable energy sources are usually used for heating processes in factories, space heating in buildings, feedstocks for some industries and generating electricity.

Electricity is used for operating industrial motors and machinery, lights, heating, cooling, and ventilation for facilities.

For example, petroleum products (like naphtha) and natural gas liquids can be used for the manufacturing of organic chemicals and plastics. And electricity is a significant energy resource to support the operation of machines on the production lines.

Now let's have a look how a food factory works and think why it is energy intensive manufacturing.

Figure 39. Foodfactory.

Food like instant coffee, milk powder, crisps, bread and French fries are among the most energy intensive food products. It is mainly due to the thermal processes which consume large amounts of the total processing energy. To produce meat and dairy products a lot of water and energy are consumed due to the high hygienic standards and cleaning requirements. And instant food being over-processed results in increased energy usage. For transportation, local food is transported by trucks, some food is also transported by sea, and some is transported by air. The vehicles used in transportation consume a lot of fuel.

2. Transportation Sector

Energy consumption in the transportation sector has kept increasing in recent years, especially in passenger and commercial transportation.

Passenger transportation

The private car is the dominant mode of passenger transportation. Rising incomes result in increased automobile ownership. More cars means more consumption of energy, and most of the energy resources used for transportation are fossil fuels.

Land transportation:

Land transportation accounts for the major share of energy consumption in transportation.

Air transportation:

The aviation industry accounts for 8% of total energy consumption in transportation. The high energy consumed level is linked to high speeds, which require more fuel. Development of technologies can increase the efficiency of engines and saves energy.

Maritime transportation:

Maritime transportation is important for cross-border world trade. The energy consumption is mainly provided by fossil fuels (used for dockyard equipment) and electricity (about 30% is used for portainers).

Transportation Fuel:

Transportation is almost totally reliant on petroleum products (95%), with the exception of railways using electricity. This is the reason for the high GHG emissions in the transportation sector. 90% of the trucks rely on diesel and 85% of the automobiles relying on gasoline. Maritime transportation requires petroleum with some specialized additives. The rapid development of electric vehicles can be a great alternative to traditional petroleum vehicles.

3. Buildings

CO2 emissions from buildings have risen in recent years. Direct and indirect emissions from electricity and commercial heat used in buildings increased to 10 Gt CO2 in 2019 which is the highest level ever recorded. Several factors have impacted to this rise, including the increase of energy demand for heating and cooling caused by more air-conditioner ownership and extreme weather events.

Electricity and natural gas are the main energy resources for the building sector. For residential buildings, more natural gas is used due to cooking and heating processes, especially in the Northern part of China. And the electricity consumed by families is mainly used for electronic devices, like refrigerators, air conditioners, TVs etc.

In commercial buildings, more electricity is consumed. Electricity is primarily used for refrigeration, powering equipment, lighting, cooling/heating systems and ventilation.

Topic 5. How are energy and environment linked?

Negative impacts of energy

Energy, which is a necessary element of our lives, ironically has many negative impacts on our environment and health. It is obvious that we cannot avoid using at least some energy in order to maintain our quality of life. However, it is also important to learn the kinds of energy and each of its impacts to prevent the climate crisis from becoming even more serious. Let's begin with fossil fuels and greenhouse gas emissions – the main cause of climate change.

Greenhouse gas (GHG) Emissions

Figure 40. GHG Emissions.

Burning fossil fuels releases greenhouse gases (GHGs). Greenhouse gases include carbon dioxide, methane and other gasses. Diverse types of fuels are the causes of greenhouse gases, but coal produces the largest amount among them. These gases create a warmer atmosphere for humans, animals and plants. Eventually when the planet continues to become warmer, the climate is affected – furthermore, animal ecosystems, biodiver sity, also production of goods can be damaged.

Degrading Air Quality

In line with the impacts of greenhouse gases mentioned above, let's go deeper to the degradation of air quality. It is obvious that a large amount of fuel is needed to use energy as we learned before. However, did you know that truckloads of fuel are needed in order to keep power stations working? When the fuels burn, they release pollutants which make it much more difficult for people to breathe. Some poisonous materials such as mercury, sulfur dioxide and nitrogen oxides can cause breathing problems, leading humans living shorter, less healthy lives.

Figure 41. Degrading Air Quality.

Impacts on Soil

Figure 42. African soil crisis threatens food security.

Not only air, but also land is exposed to the threat of greenhouse gas emissions. When the non-renewable energy sources are being extracted from the land, they have negative impacts on rock and soil. For accessing coal beneath the earth, surface mining is required and this ruins the habitats of animals – consequently interrupting the ecosystem and forcing animals to relocate to another place. In addition, mining damages the quality of the soil with chemicals used for the process. Plants which used to live in the area can be poisoned and soil can become inadequate for food production. This may eventually cause food shortages throughout the world.

Water Contamination and Overuse

Figure 43. Aspects of water pollution.

Similar to biomass and geothermal powerplants, coal and natural gas-fired powerplants require water for their cooling processes. In addition, some accidents happen when mining, extracting and transporting fuels. Oil spills have the most devastating impact. Food sources and habitats for species which live in the ocean can decrease considerably. Not only the ecosystem and ocean life, but also the coastal economies which depend on tourism connected to the marine life will suffer severe impacts. Other possible accidents include pipeline leaks and nuclear meltdowns. When these events happen, part of the environment is permanently damaged, and requires a large amount of money and time to recover.

Positive impacts of energy

Regardless of the negative impacts of energy, positive aspects of energy also exist. The type of energy which brings primarily positive impacts is 'Renewable Energy.' This clean energy, - which originates from sources which are not depleted when used - improves public health as well. It benefits animals, humans and the Earth to be sustainable.

Reducing CO2 Emissions

Figure 44. Reducing CO2 Emissions.

Renewable energies have abundant supplies which are unlikely to run out. Therefore, the maintenance requirements are much lower than the energy sources which we are primarily using currently. Renewable energy also allows countries to save money by lowering their reliance on energy which is imported from foreign countries. The most important

thing is that renewable energy sources emit a much smaller carbon footprint and reduce negative impacts on the environment.

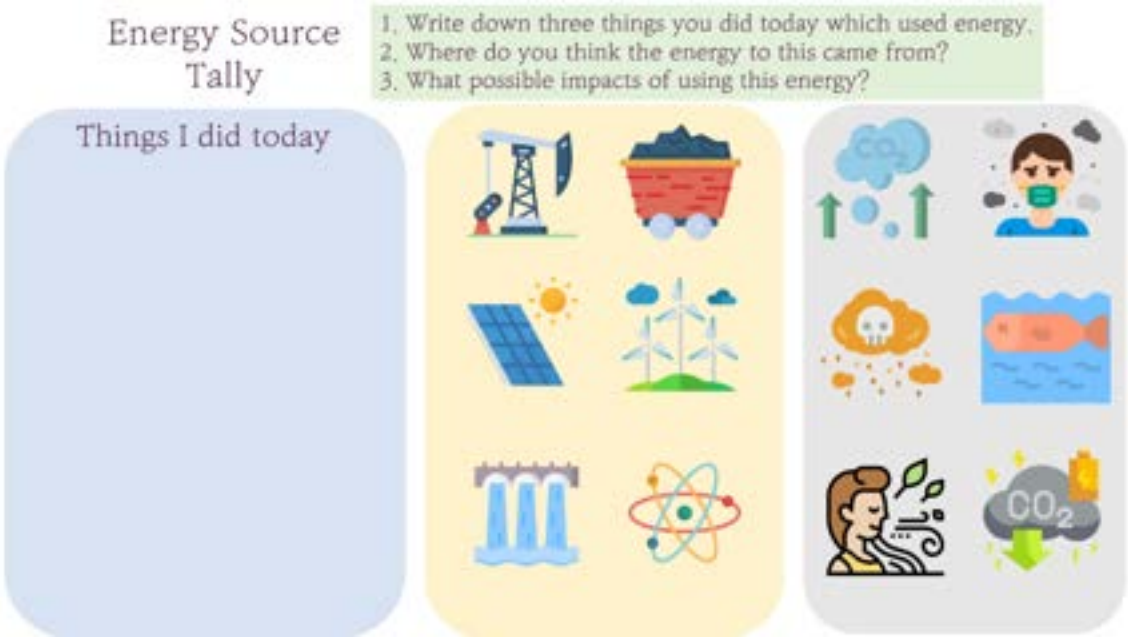
Improving Public Health

Figure 45. Group Meeting.

Although renewable energy requires higher upfront costs, it allows us to have an Earth with less pollutants and healthier lives. Wind, solar and hydroelectric systems are examples of renewable energy. They generate electricity with no chemicals which pollutes the air. In addition, wind and solar energy do not require water to operate their processes, which naturally leads to preserving water resources and supplies. Geothermal and biomass systems still emit some air pollutants, although, the amount is much less than coal fired powerplants. Cleaner energy technologies reduce the negative health impacts such as respiratory problems, neurological damage and heart attacks.

[Topic 5_Activity]

It is important be aware that their daily lives depend on energy and how much we are currently reliant on non-renewable energy. This activity aims for us think about our current energy structure and how our daily activities impact our environment.



- **How to work on this activity**

1) Write down 3 activities which you have done today.
2) Discuss what are the energy sources which support that activity.
3) List and discuss some of the energy-related impacts of using that source of energy.

Topic 6. Why do we need to be careful when selecting our Energy Source?

The Cost of Energy Sources

Cost is an important factor to consider when choosing an energy source. Choosing the energy source with the lowest cost seems like the obvious choice to make. However, it is important to think carefully about what is the **true of cost** of the energy sources we use.

There are **subsidies for renewable energy** generation to help them compete with nonrenewable energy providers. They need these subsides because renewable energy technology is still developing and our energy infrastructure was primarily built for non-renewable energy sources. Our energy systems and infrastructure need to be improved to better incorporate renewable energy.

In many countries the market price of electricity produced by non-renewable energy sources is lower than renewable energy sources. This can lead to the misunderstanding that fossil fuel energy is always cheaper than renewable energy. However, it is important to remember that fossil fuels are and have been **subsidized for a long time**. Subsidies for fossil fuels **distort their prices** causing fossils fuels to be cheaper than they should be.

The long-term Negative Impacts of Non-Renewable Energy Sources

We should take into account **environmental and social costs**, not just market prices based on supply and demand. Market prices do not reflect the true value or costs of many important things. Fossil fuels have **negative external effects** on people, animals and the environment, such as air pollution and global warming. These negative impacts are not included in the market price.

Investing in and using renewable energy now **will be cheaper in the long run** as it will reduce future generations suffering from problems such pollution, fine dust and global warming. We need to **change our perception** of cost to consider long-term environmental and health impacts as well the quality of life of future generations.

Downsides of Renewable Energy Sources

When we choose and use energy, there are costs and downsides of each energy source. As we learned from the previous topic, it is true that renewable energies benefit humans and the environment much more than coal and natural gas fuels. However, they are still in the process of development and there are limitations existing which we should overcome. Non-renewables should not be considered only as 'bad,' and renewables should not be considered as only 'good.' Limitations exist for both kinds of energy sources.

Limitations of Solar Photovoltaic panels

Solar photovoltaic panels (solar PVs) can be installed on individual buildings or housings but can also be created as community solar PVs. In the case of community solar PVs, large land areas are required in order to install this renewable energy power source. Also called solar farms, approximately 100 square feet of land is required for every 1kW of solar panels for a typical installation.

Figure 46. Why China's Renewable Energy Transition is Losing Momentum.

Limitations of Wind Energy

Migratory birds often get affected by wind energy. When the wind turbines make strong pressure with a fast speedup to 180mph, this changes the flow of air in the nearby area. Birds which fly nearby may be engulfed inside the blades. This is a huge problem since a lot of wind turbines are installed in birds' migratory routes.

Figure 47. Wind Turbines: "Environment Saver" or "Birds' Killer"?

Limitations of Bioenergy

Bioenergy has effects on air quality, vegetation degradation, and deforestation. This means that it not only impacts the air, but also the soil. Energy companies use forests for fuel and cut mature trees in order to produce fuel sources. However, these trees could have reduced the total amount of greenhouse gas in the atmosphere if they had not been cut down. This removal of trees causes deforestation which causes loss of habitats, destruction of ecosystems and consequently soil erosion.

Figure 48. Is Biomass Really Renewable?

Limitations of Geothermal Energy

In the closed-loop process of producing geothermal energy, gases are injected back into the ground after producing heat. Therefore, there are minimal emissions of pollutants into the air. However, in the open-loop systems, harmful materials such as hydrogen sulfide, carbon dioxide, ammonia and methane are emitted into the air. Hydrogen sulfide is especially harmful as it transforms into sulfur dioxide (SO2) which causes heart and lung disease.

Figure 49. What is geothermal energy?

[Topic 6_Activity]

It is important to understand that energy has both positive and negative attributes. In this activity we will design, present, and defend a proposal that states why a certain energy resource is better for generating electricity than the alternatives. By doing this we can gain a deeper understanding of the basic facts, advantages and disadvantages of each energy resource.

- **How to work on this activity**

1) Students should be separated into groups based on the size of the class.
2) There are two main tasks, Gathering and organizing information about an energy resource and Designing and conducting a presentation.
3) Certain group members can be made responsible for each task. The following is a summary of responsibilities of each group member:

Organizer
The Organizer should work with the Researchers to assess what additional information needs to be obtained and meet with the Presenters to establish the proposal and the presentation.

Researchers
The Researchers are responsible for finding and collecting the information required. Their aim is to provide valuable information to the presenters that they can use to help the proposal.

Presenters
The Presenters should prepare speaker-support materials such as charts, graphs, and photographs, and should work with the Organizer and Researchers to design the presentation.

Panel Members
The Panel Members should listen carefully to presentations from the groups and determine which energy resource to generate electricity should be used.

4) Each member should work together to objectively examine the benefits and disadvantages of different energy resources and use solid arguments to present and defend the energy resource. As a team create your Proposal form and Recording Sheet containing the following information:

Requirements for Proposal Form

Proposal Statement

Overview of Presentation

Description of Charts, and Graphs Supporting the Energy Resource

Prepared Questions about Other Resources

Anticipated Questions Posed by Other Groups, and Answers to Those Questions

Requirements for Proposal Recording Sheet

Group Name

Energy Resource Represented

Summary of Proposal

Facts about the Resource

Advantages of the Resource

Disadvantages of the Resource

Other Comments

5) Using the following as a guide, conduct your presentation and debate:

Proposal and presentation/debate consists of 4 stages

1. **The Presentation** (8–10 mins)
The proposal team announce their proposal then clarify the position of their team. The presentation's key focus should be on why the selected resource of the team is the best resource to use.

2. **Clarifying Questions** (3–5 mins)
The panel will bring clarifying questions at the end of the presentation stage. The proposal team can answer those questions with the aid of other group members. Clarifying questions are frequently expressed as "What do you mean by…" Questions that challenge or argue a point should be reserved for the next stage.

3. **Discussion/Debate** (5–10mins)
The groups challenge each other during this stage, searching for strengt hs and flaws in each other's arguments and pointing out the drawbacks of the resources selected by the other groups. At least 1–2 questions should be asked in this stage.

Topic 7. What can I do to save Energy?

What is the difference between energy efficiency and energy conservation?

Energy efficiency is using less energy to do the same task. For example, new LED light bulbs light rooms in the same way as old light bulbs but use much less energy. As you can see in the chart, newer LED energy efficiency lightbulbs typical lifespan is 3 times as much as CFLs and 20 times as much as incandescent lightbulbs!

	LEDs 10W/800 LUMENS	CFLs 10W/450 LUMENS	INCANDESCENT 10W/81 LUMENS
ENERGY EFFICIENCY	Best	Good	Average
TYPICAL LIFESPAN	25,000 hrs	8,000 hrs	1,200 hrs
YEARLY COST	$1.34/yr	$1.73/yr	$3.05/yr

Figure 50. Energy efficiency.

Energy efficiency improvements enable us to reduce the amount of energy required to provide products and services. Energy efficiency has many benefits, it reduces our energy needs and saves money for household businesses.

Energy conservation is the decision and effort to use less energy. It is the reduction of energy consumption by choice. For example, instead of driving to work, some people cycle which saves energy. Everyone can conserve energy in their daily lives by making small changes to their routines.

How can we conserve energy?

There are many ways to reduce your energy use by conserving energy. Simple changes to our behaviors and developing and keeping good habits allow us to save a lot of energy in the long run. Using less water and paper enables us to reduce our energy use indirectly. By conserving energy, we can save money on electricity bills and help protect the environment.

Save electricity:

- Don’t leave your phone charging overnight.
- Don’t leave electronic items on standby.
- Unplug or switch off the power outlet when not in use.
- Try to use natural light when reading.
- When possible, try to use a fan instead of air-conditioning.

- Turn off fans/lights when not in room.
- Keep the room doors closed to maintain the temperature in winter/ summer when using heating/air-conditioner.
- Don’t leave refrigerator open for too long.

Save Water:

- Turn off tap when brushing your teeth.
- Shower instead of taking a bath.
- Shower for a shorter time.

Save paper

- Try to print using both sides of paper.
- If not possible, keep single side printed paper as scrap paper.

[Topic 7_Activity]

You have learned about how we can contribute to energy saving in our daily lives. Let's make a commitment and think about what you can do in the following week to save energy.

List at least 4 ways that you can do to reduce your energy use in the coming week.

	How will you reduce your energy use?
1.	
2.	
3.	
4.	

• How to work on this activity

1) You have learned about realistic energy saving strategies, now list four ways that you plan to reduce your energy consumption in the coming week.
2) The task should be completely individually.
3) Remember to choose practical things that you can do in your daily life.

Topic 8. Why is Recycling Important?

Why should we Recycle?

You must have heard of recycling at home, from teachers, or even from TV shows and advertisements. Also, you must have learned that it should be done for saving the environment. But have you ever learned about its relationship with energy? Or the actual process of recycling? Let's learn some other aspects of energy through this topic.

How does Recycling save Energy?

Recycling reduces the total energy used by allowing materials to be reused instead of having to extract and process new raw materials to be used in production. To reiterate, using recycled materials reduces the cost of the manufacturing process and allows us to consume less energy

when producing a product. By using less energy, less raw materials and less fossil fuels, greenhouse emissions are reduced. Recycling saves energy and also helps to save the environment.

Figure 51. Save Energy. Figure 52. Mining.

How does each product save Energy when it's Recycled?

Aluminum

Figure 53. The benefits of Aluminum Recycling.

There is no limit on the amount of times aluminum can be recycled. Therefore, aluminum is one of the most beneficiary materials for the environment. Even though it is recycled multiple of times, there is no loss of material. Therefore, 90 to 95 percent of the energy which is needed to produce one new aluminum can be saved when recycling one used can. In addition, recycling one pound of cans can save 7kWh of electricity; with the amount of energy needed to produce one new aluminum can, 20 recycled aluminum cans can be manufactured.

Plastic

If people recycle a ton of plastic, it saves approximately up to 5.774 kWh of electricity which is almost the same amount of energy consumed by two people in a year. In addition, we can free up land of 30 cubic yards from being used for storing trash. Plastics are another material which we use a lot in our daily lives. Make sure to remove all the labels and wash it well before you put it into the recycling bin!

Figure 54. 22 Facts About Plastic Pollution.

Paper

Figure 55. Recycling Paper.

Paper is another material which benefits energy saving when recycled. Producing recycled paper consumes only 60 percent of the energy needed to make new paper from fresh pulp. From a more statistical point of view, recycling one ton of office paper saves 17 trees, 7,000 gallons of water, 463 gallons of oil and landfill space of 3 cubic yards. Naturally, this saves resources and the environment as well.

If we don't recycle properly, what will be the consequences?

Figure 56. 6 Things You're Recycling Wrong.

Unwashed boxes or jars which still have traces of food in them can contaminate other recyclable materials by attracting pests and forming unsanitary conditions. Therefore, putting materials for recycling in the correct recycling bin is not the 'everything' of recycling. When you recycle something, you should wash it, dry it, check again that all traces of food are removed, and then put it in the recycling bin.

When containers with food still in them are sent to recycling facilities and get included in the loads, it decreases the salability of the recyclable materials which are already processed. If the entire load reaches the buyer and it is found that a small portion of it is contaminated, the entire shipment will be turned away.

Figure 57. Waste Connections dumped it in landfill.

Figure 58. Many Pittsburgh-area plastics end up in landfills or the environment.

This causes harm to the environment since those materials which are not recycled properly have to be transferred from the recycling facility to a landfill. This is a huge waste of resources and causes environmental pollution.

[Topic 8_Activity]

We have learned about the importance of recycling and analyzed ways to reduce the amount of waste generated. It is also important to consider things we throw away on a typical day or over a period of a week, as the things we throw away can affect the environment.

Things Typically Thrown Away: Composition of material

Types of Material	Paper	Plastic	Aluminum	Steel	Glass	Organic Materials	Others
Durable goods (products used for 3 years or more)							
Nondurable goods (products used for 3 years or less)							

Identify which approach(es) might work as alternatives to disposing of products. Evaluate each alternative you identified.

Alternatives	Convenient	Saves Energy	Protects the Environment	Sanitary	Inexpensive	Air pollution	Land pollution
Reduce							
Reuse							
Recycle							
Incinerate							
Landfill							

- **How to work on this activity**

1) For this activity you should work in groups and selecting one product that is typically thrown away. (examples: old clothes, old books, take-away boxes etc.)
2) As a group you should make a short report on the product that includes the following:
   ⓐ Materials used during production
   ⓑ Production steps and energy resources required to make the product
   ⓒ Energy-related problems associated with throwing away the product

Topic 9. What are renewable energy resources we can use?

In previous topics, non-renewable energy and renewable energy were both outlined. Here, we are going to review what renewable energy means and what kind of renewable energies are being developed worldwide. Furthermore, we will also learn how each energy type is generated, consequently leading to sustainability.

The definition of Renewable Energy

Renewable energy is a clean energy source which is derived from natural sources which are replenished constantly. The innovative and cost-efficient technology to utilize this power source is being expanded for us to live in a better environment.

How we make Energy

Solar Energy

The photovoltaic cells collect energy which is radiated from the sun. Then, it is converted into electricity through an inverter from the photovoltaic array into a format which can be used as a real-life energy within devices. The power is distributed to the electrical grid, businesses, or homes.

Figure 59. How to get a solar tax credit in 2020.

Hydroelectric Power

Large dams are normally involved in producing hydro power. Tidal or run-of-river projects are also included in generating renewable electricity. For example, dams convert the stored energy in water reservoirs into a mechanical energy. When water flows through a dam, this energy turns turbines and the generator changes the turbine's energy into electricity.

Figure 60. AfDB finances construction of two hydroelectric power plants.

Wind energy

Wind energy is generated by using wind turbines. Wind energy is converted into electricity when wind turbines capture the force of the wind which makes the rotor spin. When the rotor spins, the moving blades create energy through driving a generator. It is possible to install wind turbines on properties – any place where wind resources are available.

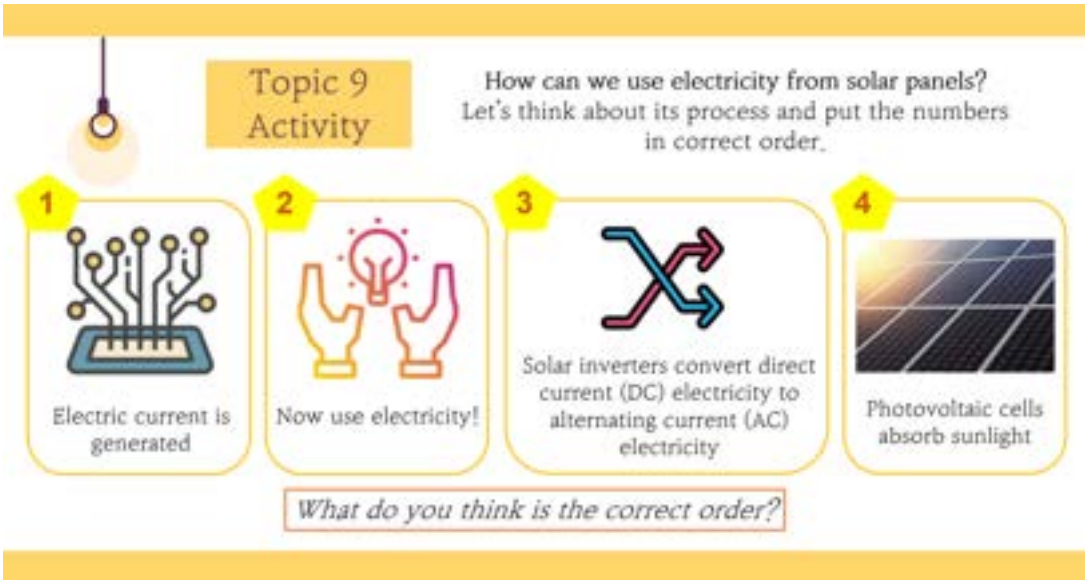
Figure 61. Wind power supplied 43.6% of Denmark's energy in 2017.

How it is sustainable

Most renewable energy produces no greenhouse gases and reduces the amount of air pollution. By utilizing renewable energy, we can lessen global warming which is a critical problem causing climate change. In addition, it reduces water pollution since it is a clean energy source and requires less amount of water when being produced. This can also be related to the improvement of human health. The most important thing is that renewables are inexhaustible. They can provide an infinite supply of energy. Therefore, the technologies used to develop renewables lower the cost of energy in the future.

[Topic 9_Activity]

You have learned about renewable energy resources that we can use. Among them, we will look at a more detailed procedure to generate energy from solar power – imagine that you have your own solar panels at home or school. How can you use electricity from those panels? Let's think about its process and put the numbers in correct order.



My answer:

Step 1	Step 2	Step 3	Step 4

- **How to work on this activity**

1) Write the steps of the process (numbers) in the correct order in the above table This activity should be completed individually.
2) After all students have finished, check your answers as a class.

Topic 10. Let's see the real-life examples!

We have gained some knowledge of renewable energy, so let's see some renewable energy applications in real life!

The world's smartest building: Pearl River Tower, China

With rapid population growth and ground space becoming even more precious in urban areas, we are faced with the question: how can we create skyscrapers that are environmentally friendly? The Pearl River Tower in China gives us the answer that we can build a totally zero emission skyscraper.

Many 'green buildings' rely on sustainable energy, such as solar panels on the roof, or photovoltaic windows. Here is where Pearl River Tower differs: its structure was built to generate energy.

Figure 62. SOM Architect's Pearl River Tower, Guangzhou.

There are 4 wind turbines built into the middle of the tower and the sleek shape of the building can drive air through to the turbines, which can generate 1 million kilowatt hours of electricity a year. The angle, shape and direction of the tower is optimized to the sun's path in order to produce electricity via photovoltaic cells within its east and west façades. Radiant ceiling technology uses piped water to keep the internal space's temperature at a comfortable level instead of costly and energy-intensive air conditioners.

Figure 63. Agence France-Presse in the Hague.

The sustainable engineering elements like a double skin façade, chilled ceiling system and daylight harvesting all contribute to this building's energy generation.

Dutch Electric trains become 100% powered by wind energy

The Netherlands has abundant wind resources. Across Europe wind energy is the cheapest when compared with other renewables. So the Dutch railway company NS decided to apply wind energy in their railway business. They built wind farms with 19 turbines across the country and off the coast to meet the electricity required to operate the railway. NS operates about 5,500 train trips and can transport 600,000 passengers per day. And one windmill running for an hour can power a train for 200km. This project has largely decreased GHG emissions in the transportation sector.

Figure 64. Korea Sihwa Tidal Powerplant.

Korea Sihwa Tidal Powerplant

The west coast of South Korea has a rich repository of tidal energy resources and the world's largest operating tidal power station is located there. The electricity generated by tidal power is 100% clean. The 552.7 GWh of electricity generated from here is equivalent to 862,000 barrels of oil, which means it can reduce 315,000 tons of CO2. At the same time, the local ecosystems have recovered.

Small scale solar PV

The previous examples show renewable energy projects supported by national government or on a relatively large scale. As an individual citizen in your nation, is it possible for you to apply some renewable energy during your daily life?

Here are some examples of small-scale solar PV installation. It is not difficult to find small solar panels which are installed on streetlamps and traffic lights in our cities. Compared with many large solar panels, these small ones only occupy a much smaller area, which makes them more suitable for urban areas. Some families also install solar panels on their roofs to provide electricity or hot water for their daily consumption. This not only saves energy, but also allows them to spend less on energy bills in the long-term. As solar energy is totally free, the electricity generated by solar energy is also free! These small-scale solar PVs are becoming more and more popular. Many local governments also provide subsidies for families to install solar PVs.

[Topic 10_Activity]

Designing a 'green' building might sound overwhelming, but let's try to think of some ways to improve the energy efficiency of your school. Not a total complete design, just imagine that you can make some changes. How would you do it? Which factors should you consider? This activity aims to give you an opportunity to think about possible options and factors to consider when designing a building in 'greener' ways. By following the questions provided, you will be able to take account of the building's space, labor force, energy-used place or appliances, and other diverse things that should be taken into consideration when designing an energy efficient building.

- **How to work on this activity**

1) For this activity you can work in groups or individually.
2) Consider the three questions and write your answers.
3) After you completed you may present your ideas to your classmates.

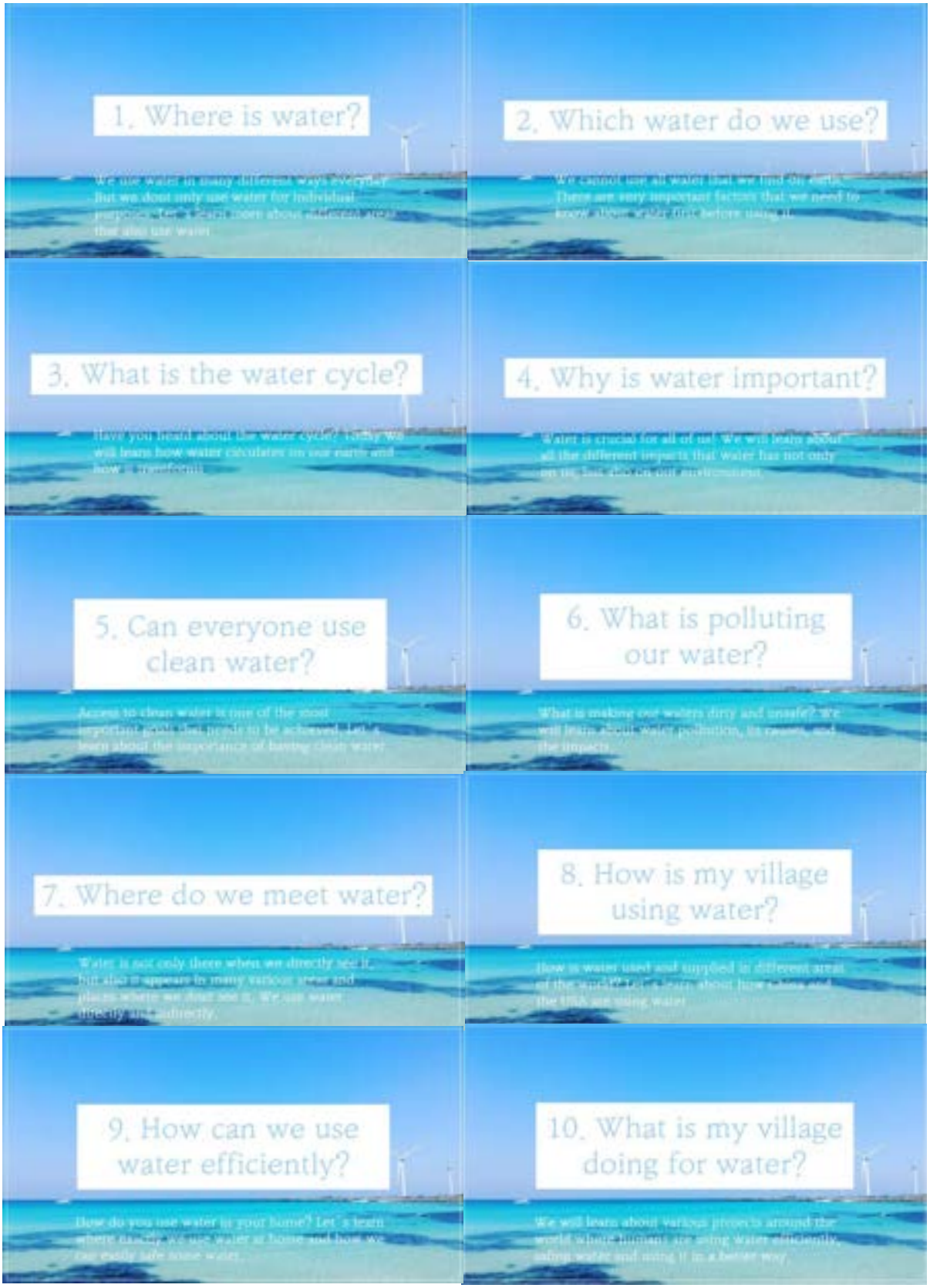
Module 4: 70% Of Our Earth!

By finishing this module, students are expected to:

- understand the **importance of water** for energy, drinking and sanitation
- know how **water circulates** and which processes are required to use water in daily life
- recognize **unequal accessibility** to clean water and its negative impacts
- understand the concept of **virtual water** and real-life examples
- pursue more effective and **sustainable** ways to consume water

By studying module 4, students will understand how water is crucial for us to survive and live healthily. They will learn why we have to engage more to save water and stop polluting. This will lead to the increased curiosity of participants about practical actions and attitudes they can adopt to become more responsible consumers, which are well outlined in the "**Life Attitude of an Earth Citizen**".

Overview


1. Where is water?
2. Which water do we use?
3. What is the water cycle?
4. Why is water important?
5. Can everyone use clean water?
6. What is polluting our water?
7. Where do we meet water?
8. How is my village using water?
9. How can we use water efficiently?
10. What is my village doing for water?

Introduction of Contents for Each Topic

Topic 1. Where is water?

Objective	Students will consider the many ways they use water in their daily lives and learn the importance of water in various processes.
Part 1	Learn about how water is essential for human health and discuss the many ways we use water every day.
Part 2	Students will learn how water is used in the process of generating electricity.
Part 3	Learn about the importance of water in manufacturing and food production.

Topic 2. Which water do we use?

Objective	Students learn about where the water we use actually comes from.
Part 1	Students gain an understanding of the fact that we literally cannot use all of the water that is on our planet.
Part 2	Learn about the three different water sources from where we can access water.
Part 3	Learn about important factors affecting the water that we use.

Topic 3. What is the water cycle?

Objective	Students can learn where the world's water is and how the water cycle moves water through its various states.
Part 1	Understand where water is stored and the proportion of water in each of the three states, i.e. liquid, solid and gas.
Part 2	Learn the different processes of the water cycle and how water is continuously transported from the ocean inland.

Topic 4. Why is water important?

Objective	Students learn about the importance of water and why it is a crucial component of our lives.
Part 1	Understand that everything in our world relies on water and that protecting it has many benefits.
Part 2	Learn how water impacts our health and well-being.
Part 3	Learn about the importance of water for biodiversity, climate change, and storing CO2.

Topic 5. Can everyone use clean water?

Objective	Students learn about how the Sustainable Development Goals (SDGs) are related to water and how water access improves lives.
Part 1	SDG 6 Clean Water and Sanitation and its connection to SDG 3 Good Health and Well-Being is outlined for students.
Part 2	Students learn how easier access to water can improve people's lives by reducing the need to travel great distances for clean water.

Topic 6. What is polluting our water?

Objective	Students learn about water pollution, its sources and its impacts.
Part 1	Understand what water pollution means and what it is caused by.
Part 2	Learn about the problem of water depletion, examining agriculture as an example of water degradation.
Part 3	Learn about the effects of water pollution and getting to know the terms of "Point" and "Non-point" Source Pollution.

Topic 7. Where do we meet water?

Objective	Students learn about direct and indirect water use and are introduced to the concept of virtual water with examples.
Part 1	Students gain an understanding of the difference between direct and indirect water use.

Part 2	Learn about the concept of virtual water and look at examples of how many liters of water are used to create different foods.

Topic 8. How is my village using water?

Objective	Students learn about different examples how water is being used in different places.
Part 1	Understand the chain of water supply and water usage in China.
Part 2	Learn about water conditions, water policies and water projects in China.
Part 3	Learn about water usage, water conditions and water supplies in the USA and compare it to China.

Topic 9. How can we use water efficiently?

Objective	Students learn about water use in the home and practical ways to reduce their water use.
Part 1	Learn about what percentage of total water usage is used for different functions in the average household.
Part 2	Students learn about practical methods of reducing water use which they can carry out in their daily lives.

Topic 10. What is my village doing for water?

Objective	Students learn about different projects that have been implemented around the world.
Part 1	Learn about water-saving in China through two different projects.
Part 2	Learn about water usage and water saving potential in Europe.
Part 3	Learn about a water efficiency program in Australia.

Glossary

Vocabulary	Definitions
Surface water	Any body of water above ground, including streams, rivers, lakes, wetlands, reservoirs, creeks, and the ocean.
Groundwater	Water that is below the surface of Earth. Also called 'subsurface water'.
Rainwater	Water that can be collected from precipitation.
Freshwater	Water that is not salty, such as water in lakes, streams, and rivers. Freshwater is different from ocean water as it has a low concentration of salts and other dissolved solids.
Evaporation	The process by which liquid water enters the atmosphere as water vapor.
Condensation	The process by which water vapor changes to liquid form.
Precipitation	All liquid and solid water particles that fall from clouds and reach the ground.
Water-borne disease	Disease that can be caused by contaminated water, via microorganisms.
Fertilizer	A natural or artificial substance containing chemical elements that improve the growth and productiveness of plants.
Algal bloom	Algal bloom is a dense accumulation of algae and harmful algal blooms (HABs) which have negative impacts on other organisms.
Point source pollution	Contamination that originates from a single source such as wastewater, oil refinery, etc.
Non-point source pollution	Contamination that originates from diffused sources, for example many different farmers using excess fertilizer.
Virtual water	Virtual water is the amount of water used in the production of a product. It also referred to as indirect water use.
Suspended particulate matters	Finely divided solids or liquids that may be dispersed through the air from human activities or natural sources.
Freshwater withdrawal	Also called water abstractions, freshwater withdrawal is basically freshwater taken from its sources to be used somewhere else.

Which SDG is most related to this module?

Module 4 discusses water, and its importance for human health and quality of life. The according SDG that covers these subjects is **SDG 6.**

"Ensure availability and sustainable management of water and sanitation for all."

Topic 1. Where is Water?

Water is essential to all life

Humans, plants, and animals **all need water to survive**. No form of life can survive without water. Regular consumption of **water is vital** for your health. People should drink about two liters of water a day to stay healthy. Lack of proper hydration can cause tiredness, inability to focus, bad mood, and in extreme cases even death.

We use water in many ways every day

We use water to clean ourselves:

- Washing our hands.
- Showering.
- Brushing our teeth.

We use water to clean the things we use:

- Washing dishes/utensils.
- Washing clothes.
- Cleaning our homes.

Some of the other ways we use water:

- We use water to cook.
- We use water in toilets.
- We use water to swim in.
- We use water to put out fires.

We also use water to make electricity

The **direct energy** of waves and rivers makes tidal and hydro energy. In the case of tidal energy generation, the force of tidal currents and waves turns turbines in the ocean to make electricity. For hydro energy generation, in a very similar process, the force of the water in the dam or the normal current of a river pushes and turns the turbines to make electricity.

Figure 65. Renewables Now.

Water is used in other forms of electricity also, again being used to turn turbines. Water is heated which turns into steam and turns turbines, making electricity. This method is used in thermal, biomass, coal, natural gas, oil, and nuclear energy production.

Figure 66. Renewables Now 2.

Water use in manufacturing

Most of our water use is in the industrial sector. As you can see from the chart the amount of water used in the industrial sector is more than the transportation, residential and commercial sectors combined. Water is needed in **every step** of the production process.

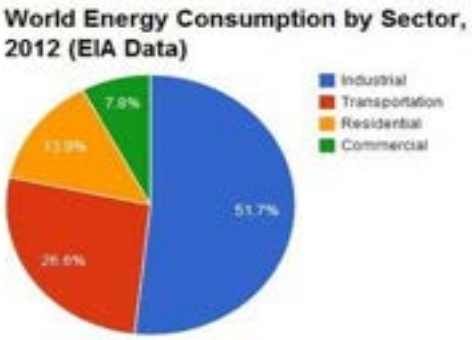


Figure 67. The shift to diesel fuel engines and how the emission scandal of diesel vehicles unfolded.

Figure 68. Water use by sectors.

Water is used for fabricating, processing, washing, diluting, cooling, or transporting a product. Water is also used by smelting facilities, petroleum refineries, and industries producing chemical products, food, and paper products. Without the use of water many products we use every day could not be manufactured.

Water use in food production

Water is an **essential part of food production**. Plants require food to grow and animals need to drink plenty of water. Water is also used to clean animals and their environments. All of the food we eat requires large amounts of water to be produced.

[Topic 1_Activity]

In this topic, you learned about how water use is important, particularly in our daily lives. By considering the number of daily activities which use water, we can realize more deeply the importance of water for sustaining our most basic needs and our lifestyles.

• How to work on this activity

1) Draw a blank circle so that you can draw your daily routine.
2) Fill in the circle with your daily activities.
3) For each activity, consider whether water is needed – do you use water while you are cooking, sleeping, or exercising? What else requires water in your daily life?
4) Share your routine and daily water usage with your peers.

Topic 2. Which water do we use?

Can we use all water?

When we look at our planet **two thirds of the earth´s surface** is covered with water. However, out of this two thirds only 2.5% is fresh water and the rest is salt water found mainly in the oceans. Furthermore, some of that fresh water is frozen in glaciers or permafrost. This means that the amount of water that is actually available for human use is only **1%** of all the Earth's water.

We cannot use all water!

Which water do we use?

So, where is the water that we can use coming from? The water we use comes from three main sources.

Surface water:

As the name implies, this water can be found **on the Earth´s surface** and is fresh water. Examples are rivers, streams, lakes, and ponds which provide such water. How much of these water sources are available depends on regular rainfall.

Groundwater:

Groundwater refers to layers of water that are **underground**. This water can be reached by building wells, or obtained through springs.

Rainwater:

When it rains, fresh water falls to the Earth's surface. This water can be **collected and stored** to use.

Important to know!

The **quality** of the water used is very important. Only water that has good quality and is clean is safe to drink and use for other purposes. Fresh water is a **valuable resource** that is very vulnerable and most importantly it is finite.

[Topic 2_Activity]

By studying Topic 2, students have learned that there are various sources of water we can use and their characteristics. As this topic contained a lot of important basic information about water sources, some simple true or false questions can be used to evaluate students' understanding of the topic's content.

Answer the following questions with True (T) or False (F):

1. The available amount of surface water heavily depends on regular rainfall. (T / F)
2. If you collect water from rainfall, you can directly use it for whichever purpose you want. (T / F)
3. Freshwater is abundant on our planet, so it is unnecessary to worry about its shortage. (T / F)
4. Groundwater is water from wells or springs. (T / F)

• How to work on this activity

1) Read each sentence carefully. If the sentence is true circle T, and if the sentence is false circle F.
2) After completing the activity, check the answers as a class.

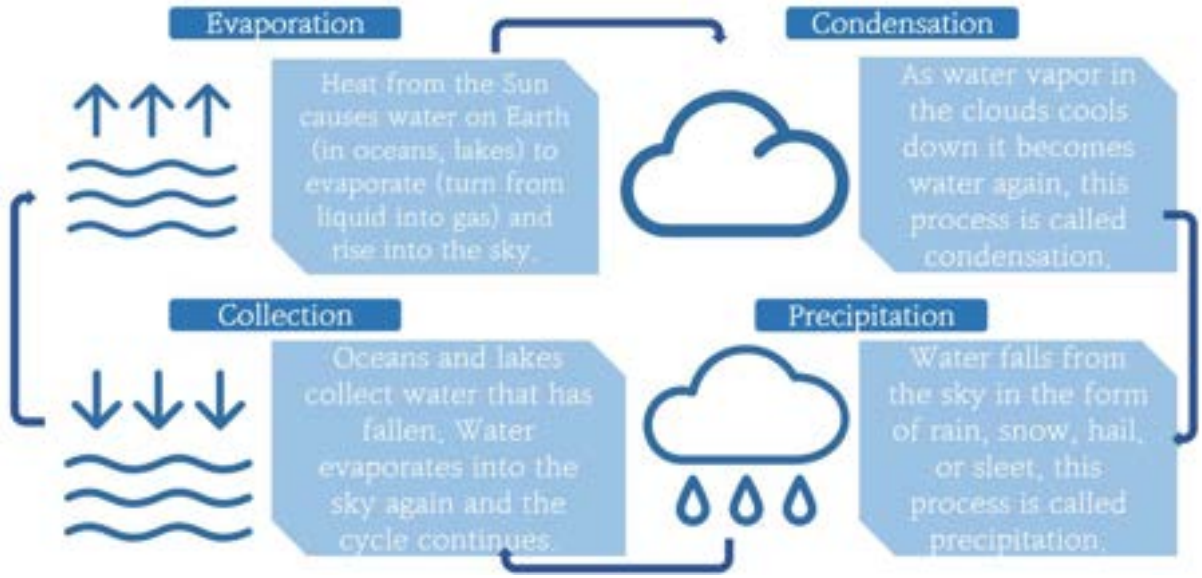
Topic 3. What is the water cycle?

Where is Earth's water?

The **vast majority** of our planet's water which is in liquid form is in the Earth's oceans. As ocean water contains high levels of salt it is not safe for human consumption and unsuitable for other purposes such as cleaning or industrial use. The rest of the water in liquid form is in lakes, rivers, streams, and soil. As this water is fresh water, these sources are the primary sources of humans' water supply. Water can also be found in solid forms such as ice and snow in polar ice caps, glaciers, and permanent snow. A tiny fraction of the total amount of water consists of water vapor in Earth's atmosphere.

Different Process of the Water Cycle

Water is constantly moving and changing form through the process of the water cycle. As you can see in the following chart, the process of evaporation, condensation, precipitation and collection keeps water moving through different states and generating clouds and rain.



What is the water cycle?

The water cycle is the continuous circulation of water within Earth and its atmosphere. Solar energy heats ocean water which then moves inland becoming clouds. The clouds then turn to rain and create rivers which flow back out to the ocean, where the cycle starts again.

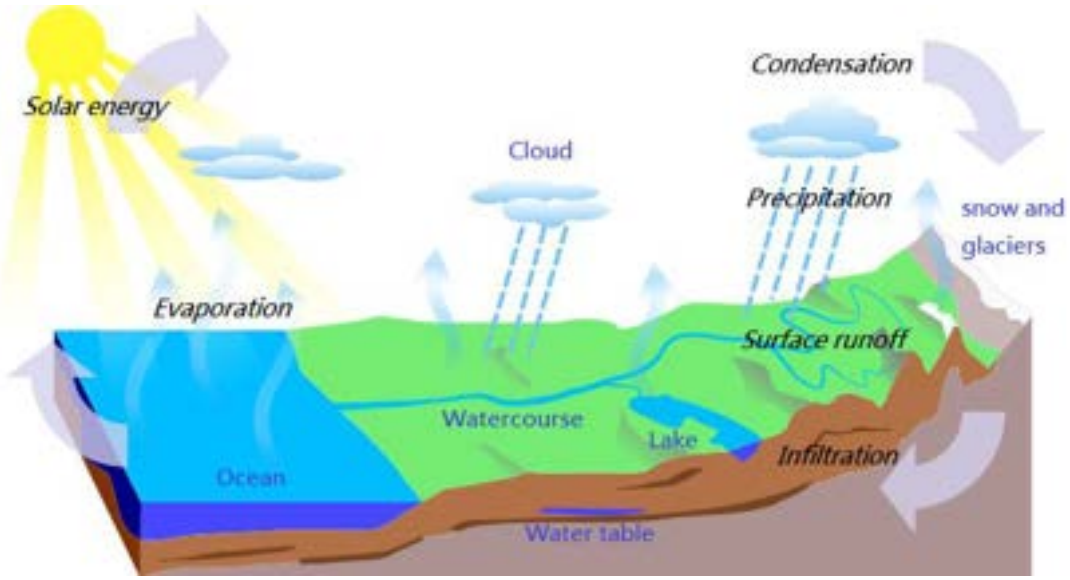
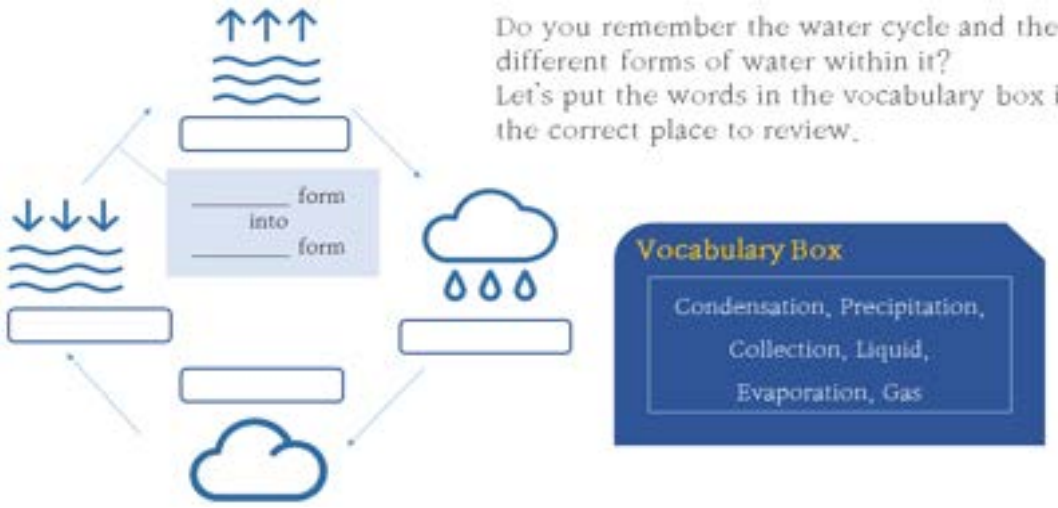


Figure 69. Water cycle.

[Topic 3_Activity]

Topic 3 mainly covered the Earth's water cycle and the diverse forms of water within the water cycle. It is important be able to understand the overall picture of that cycle. This activity will help you remember the cycle more easily.



• **How to work on this activity**

1) Fill in the blanks with the right words among those provided in the 'Vocabulary Box'.
2) Check as a group if your answers are correct.
3) **(Optional)** Discuss with peers what would happen if one of the causal links in the water cycle broke – what if there is not enough precipitation or too much of it? If something toxic is also condensed and then falls on the surface, how would that affect our ecosystem?

Topic 4. Why is water important?

Everything in our world relies heavily on water

Everything around us **depends** on water. Water flows across natural and developed areas. Water pipes move water to our faucets, to farms, and to various types of businesses. **Watersheds** are vital natural infrastructure for human daily consumption and use in nearly all cities around the world.

Benefits from protecting our water sources

We can generate the following benefits if we protect our water sources:

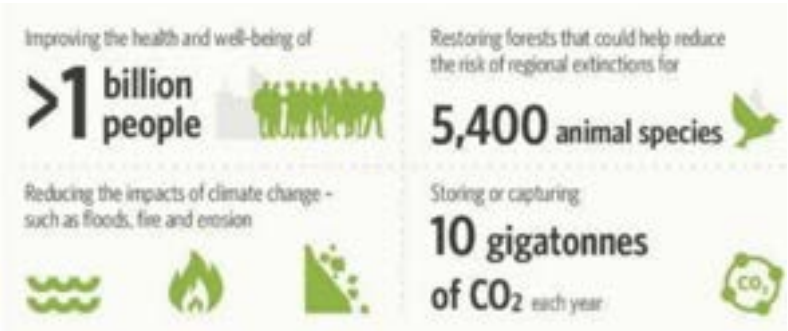
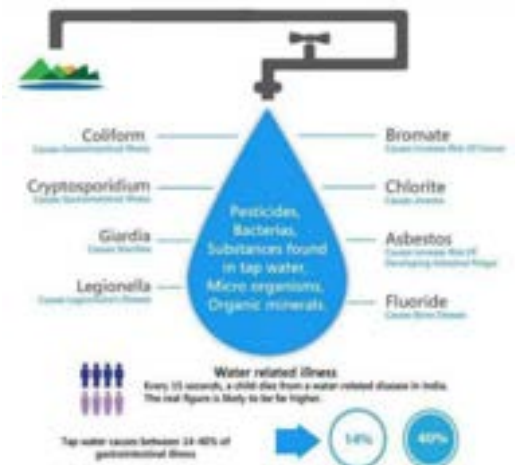


Figure 70. Benefits from protecting our water sources.

How water impacts health and the well-being of humans



Water has a crucial impact on our health and on our well-being. Having clean water and sanitation means that we are able to **avoid exposure** to countless diseases. Millions of people are dying from diseases caused by inadequate water supply, sanitation, and hygiene. Different water pollutants cause such **harmful conditions**. For example, biological contaminants cause water-borne diseases, but also pollutants like heavy metals and synthetic chemicals, as well as fertilizers and different pesticides can be very harmful for humans and affect our health.

Figure 71. Tapping the benefits of clean water, sanitation, and hygiene.

Water is important for biodiversity

Water is directly connected to and plays a major role in the biodiversity of our planet. Over 75% of urban source **watersheds** are within regions of **high species diversity** and **endemism** which refers to a species that is restricted to a particular region. Nutrient pollution and chemical pollution pose significant threats to the aquatic and the terrestrial biodiversity. The loss of habitats damages the biodiversity as some species die out.

Figure 72. Water and Biodiversity.

Climate change and water: Impacts, mitigation and adaptation

Due to climate change extreme weather occurs more frequently. This leads to the phenomena that places that are dry become even drier and places that are wet become even wetter. That is why **proper water management** is needed. Through proper water management the impacts of floods and droughts are reduced, and the water supply can be secured. Furthermore, it improves the proper use of water in high emission sectors.

Figure 73. Flood.

Figure 74. Drought.

Storing or capturing CO2

Figure 75. Protecting our water sources brings a wealth of benefits.

One very important factor of water is that healthy water sources provide a great habitat for **forests**. Trees have the ability to store or capture CO2. Therefore, forests can store around 10 gigatons of CO2 per year. This is a characteristic that is crucial for tackling climate change.

[Topic 4_Activity]

We have learned about the importance of water for the health and well-being of humanity, biodiversity, and the climate system. This activity focuses on two problems which can occur with water usage: water shortage and the pollution of water. We should write down in words or simply draw pictures of the possible impacts of water shortage and pollution on animals and plants, human, and climate system.

	Animals and Plants	Humans	Climate system
Shortage			
Pollution			

• How to work on this activity

1) Write down in words or simply draw pictures of the possible impacts of water shortage and water pollution on animals and plants, humans, and the climate system.
2) Students discuss with their peers the potential impacts they wrote or drew. Alternatively, students can present their work to the class.
3) Students can also discuss some examples of water shortages or pollution that they have experienced or heard about.

Topic 5: Can Everyone Use Clean Water?

Water and the Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are the blueprint to achieve a better and more sustainable future for all. Access to clean water is one of the SDGs. **SDG6: Clean Water and Sanitation**. This SDG aims to ensure availability and sustainable management of water and sanitation for all.

People need clean water and sanitation to have good health and well-being. Therefore, achieving SDG 6 is a **vital step** towards achieving SDG 3: Good Health and Well-being.

Access to clean water and health consequences

Many people in the world do not have access to a safe, clean, reliable water supply. Unclean water makes people sick and causes **serious health problems**. Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid, and polio.

Think of all the ways you use water in your daily life. Our lives are much more convenient due to our clean, reliable supply of water. When people have access to clean water, they can live healthier, happier lives.

Access to clean water and gender equality

Figure 76. Water Bucket Woman.

A lot of people have to travel a great distance to access clean water. Traveling back and forth from the clean water supply can be **very time consuming and tiring**. All the time and effort used to do this, means people have less time to do other things. The burden of bringing clean water is mostly **carried by women and girls**. Without easy access to clean water many cannot live up to their full potential.

Having a clean, reliable water source nearby allows people to save a lot of time and effort. When water comes from improved and more accessible sources, people spend less time and effort physically collecting it, meaning they can be productive in other ways. Easier access to clean water will also allow many people, particularly women and girls, to have more time to pursue **opportunities** such as education and employment.

[Topic 5_Activity]

Water sanitation has been especially emphasized for prevention of COVID-19. However, there has been an issue with providing clean water to make people wash their hands as the accessibility and availability of clean water is limited to a certain extent, making it harder to be addressed. In this activity, we are offered an opportunity to consider real-time examples of the impact of lack of clean water on our health and daily lives. It also asks a question on the disproportionate effects of clean water shortages and how people find solutions at village or community level.

Water sanitation has been highlighted globally due to the COVID-19 pandemic, as washing hands with clean water is crucial for prevention of infection.
However, this issue has been difficult to solve since accessibility and availability of clean water is uneven across different regions.
How can you ensure the supply of clean water to more people and promote washing hands under these circumstances? Discuss with your peers, using the questions below:

1. If there is a communal water source that a community uses together, how can you assure clean management? Think of potential options that people can adopt to maintain proper distribution and management of water.
2. Is there a way to easily purify unclean water so that people don't have to use contaminated water?
3. What are other options? Hand sanitizers? Wet tissues?
4. When there is a very limited amount of clean water, what is the most efficient way to use it for both for sanitation, food preparation and other uses?

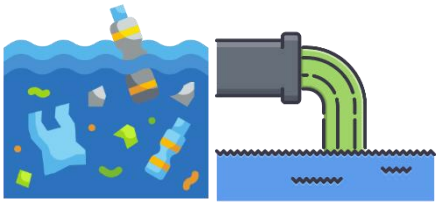
- **How to work on this activity**

1) This activity can be completed as a class or in groups.
2) Discuss each of the four questions above, which relate to issues of water accessilibty and clean water supply.

Topic 6. What is polluting our water?

What is water pollution?

Water pollution is when **harmful substances**, such as chemicals, contaminate water and degrade its quality making it toxic for humans, animals and the environment. An example of this is when wastewater is dumped back into the environment without being treated. This causes pollution in rivers, lakes and oceans.



What causes water pollution?

Water is very **vulnerable** to pollution, because harmful substances **dissolve easily** in water and the water itself absorbs it quickly. Toxic substances therefore dissolve and mix with water which makes it highly difficult to reverse this process. What causes the pollution of our three main water sources?

Groundwater:

The pollution of our groundwater is caused mainly by **pesticides**, **fertilizer** and waste from **landfills**. These pollutants sink into the ground and make groundwater unsafe to use. Once groundwater is polluted the water can be **unusable** for decades or even hundreds of years.

Contaminated groundwater can spread far from the original polluting source carrying the pollution to other places as well.

Surface water:

The water on Earth´s surface gets polluted by the **discharge** of municipal and industrial **waste** and through **nutrient pollution**. Nutrient pollution occurs when fertilizers, animal manure, discharge from sewage treatment centers and detergent get washed into the water.

Ocean water:

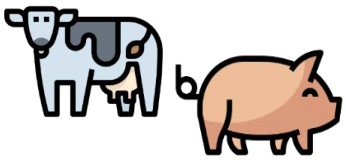
Our oceans are contaminated by harmful substances such as **chemicals**, **nutrients**, **heavy metals**, but also from sources like **oil spills** and leaks from oil tanks as well as absorbed **carbon**. All these pollutants can be carried into the oceans from farms, factories and cities by streams and rivers.

Water depletion

Another factor that is threatening our water is water depletion. Water depletion refers to the **excessive extraction** of water. This excessive extraction leads to water depletion. This means that **we use water up faster than it can replenish**. This causes wells to dry up which leads to humans digging deeper and deeper to reach water.

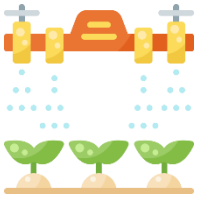
Another water depletion is directly linked to the reduction of forests. As trees are being cut down the areas without trees are **not able to capture rainwater**. The water runs straight off the surface without going into the ground to replenish the groundwater.

Agriculture

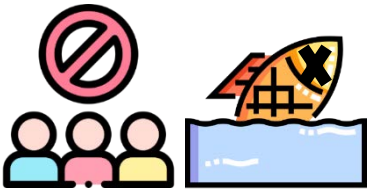


Agriculture poses another threat to our water sources. It is the **biggest consumer of global freshwater resources** and the global leading **cause** of **water degradation**. This is mainly caused by fertilizers, pesticides and animal waste that is washed into the water.

The problem with **fertilizer** is that it is rich in nutrients (nitrogen and phosphorus). Excessive use of fertilizer leads to **nutrient pollution** which is a threat to water quality worldwide. Nutrient pollution can cause **algal blooms** which are a toxic soup of blue-green algae that is harmful to people and wildlife. Algal blooms create so called **dead zones** in the water which are an oxygen-poor area in which no animal is able to live. It is therefore an uninhabitable area.



Effects of water pollution



Water pollution has major effects on **human health** and on the **environment**. When our water sources are polluted, bacteria and viruses occur and can make us sick and eventually may lead to death. Polluted water can cause whole ecosystems to die and therefore affect the environment immensely.

Types of pollution

Point Source Pollution refers to contamination that originates from a single source. Examples are wastewater, oil refinery, and wastewater treatment facilities that pollute through pipes.

Non-point Source Pollution refers to contamination coming from diffuse sources, for example, from agriculture or debris. It is difficult to regulate, because there is no single identifiable culprit.

[Topic 6_Activity]

You have learned about multiple sources of water pollution throughout this module. Water pollution has many negative effects on animals and plants, as well as humans. We should consider all of the negative impacts on animals and plants. In this activity, let's consider from their perspectives and write a journal imagining how the pollution will be experienced from their point of view.

Many animal and plants are suffering negative impacts due to water pollution. Choose an animal, plant, or any creature in the environment and write a journal from their perspective.

_____'s water pollution journal

- **How to work on the activity**
  1) Choose an animal or plant which you want to be the writer of the journal.
  2) Think of the negative effects that the animal/plant would perceive when water pollution impacts their environment.
  3) On the left side of the sheet, draw a picture which can show one of the main consequences of water pollution on the animal/plant. On the right side, write a journal in narrative form.

Topic 7. Where do we meet water?

What is virtual water?

We use water for **direct** and **indirect** purposes. Direct purposes include washing your hands, brushing your teeth, bathing, drinking and cooking. Indirect water use refers to the water used to produce the goods and services others need and enjoy. Indirect water use is also called "**virtual water**".

For example, think about the water needed to make a box of cereal. When you buy the cereal, it is crispy and dry but all the processes of growing, manufacturing and packaging the cereal require a huge amount of water. The crops grown to make the cereal needed water to be grown, and the factory that manufactures the cereal used water in almost every step of the process, from cleaning the crop before the manufacturing process started to rinsing away what was left behind. Even the paper box and plastic packaging that the cereal is sold in required large quantities of water to produce.

Another example is a cup of coffee. How much water do you think is used to make a cup of coffee? 125ml of water is used for making a cup of coffee directly, but what about the amount of virtual water needed to create the coffee beans which are used? The virtual water used to produce a cup of coffee, from irrigating coffee plants and processing the beans, is more than 1,000 times 125ml at 132 liters!

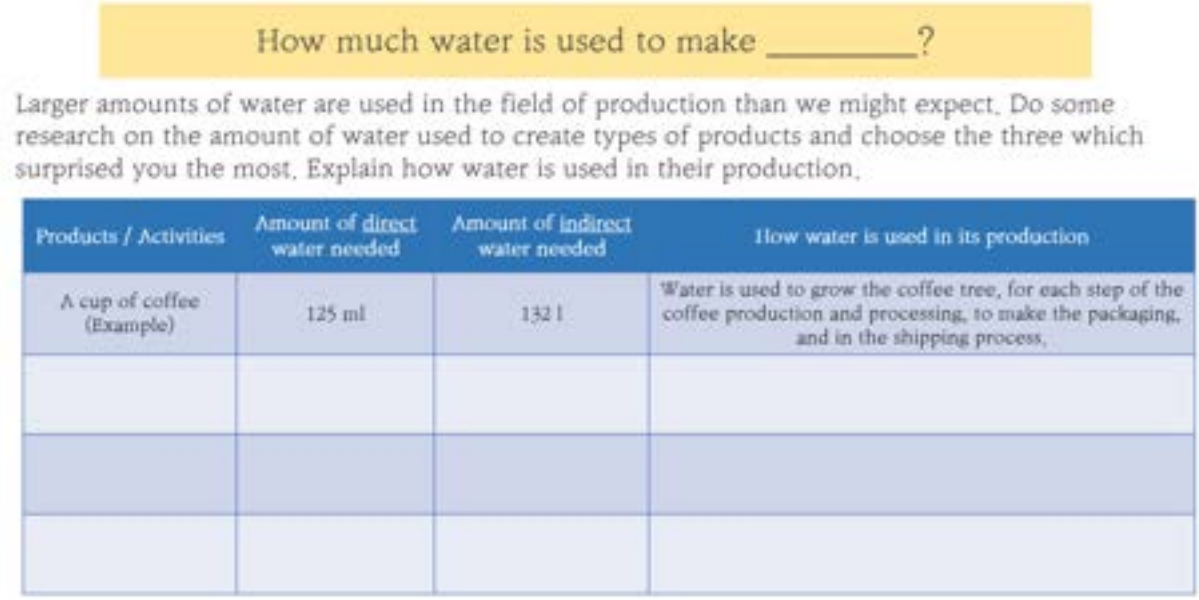
The amount of virtual water used to produce various foods and drinks

Below is a chart which shows how much virtual water is needed to produce the amount of different food and drinks. As you can see the amount of virtual water necessary to produce different items varies widely. Barley and wheat only require 650 liters of water per pound, but sorghum needs 1400 liters per pound, and millet 2500 liters per pound. Food products made from animals require a lot of water. Producing just one liter of milk requires 1000 liters. 2500 liters of water is required produce one 150g burger and 4650 liters is needed to make just one 300g beef steak!

Figure 77. Amount of water used to produce a product.

[Topic 7_Activity]

We use water for direct and indirect purposes. Direct purposes include water usage for daily life activities such as bathing, drinking and cooking. On the other hand, indirect water usage normally includes production of goods and services. In this activity we will focus on the latter. Larger amount of water is used in the field of production than we might expect. Research the usage of water in the production process of different types of products and choose the three which surprised you the most. After filling out the form with your research results, explain how so much water is used in the production of the three products you chose.



How much water is used to make _____?

Larger amounts of water are used in the field of production than we might expect. Do some research on the amount of water used to create types of products and choose the three which surprised you the most. Explain how water is used in their production.

Products / Activities	Amount of direct water needed	Amount of indirect water needed	How water is used in its production
A cup of coffee (Example)	125 ml	132 l	Water is used to grow the coffee tree, for each step of the coffee production and processing, to make the packaging, and in the shipping process.

- **How to work on the activity**
  1) By using the internet, research how much water is needed for the production of different products.
  2) Select the three products which surprised you the most about how much water is needed to produce them.
  3) Fill in the information in the chart.
  4) In the 'How water is used in its production' section, describe briefly how water is used in the production process of each of the three products.

Topic 8. How is my village using water?

How water is supplied for our daily usage

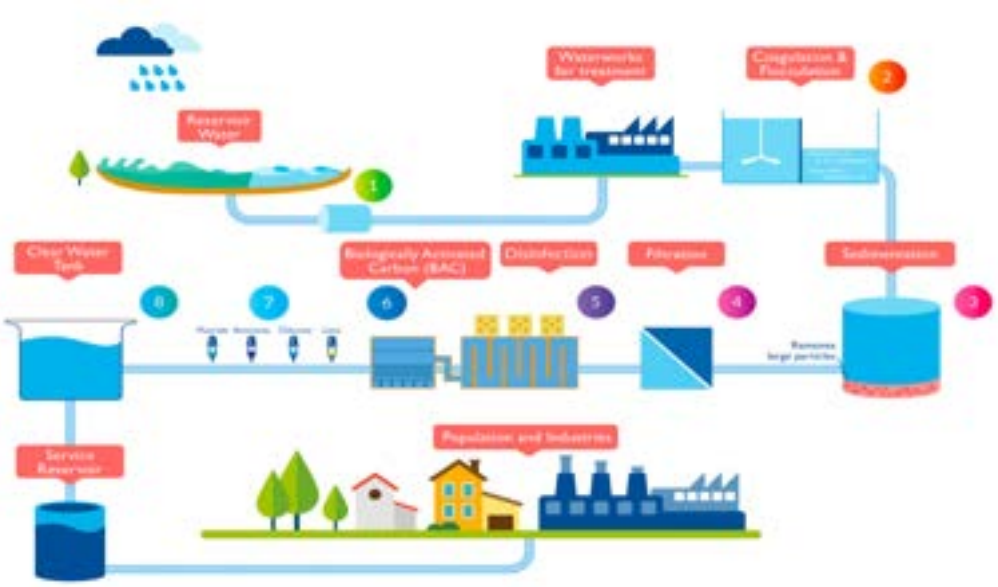


Figure 78. China's water situation; the supply of water and the pattern of its usage.

- to remove suspended particulate matter from the water.
- the water is disinfected with chlorine to get rid of harmful bacteria and viruses.
- the water goes through a series of water quality tests before it is piped to customers.

Water usage in China

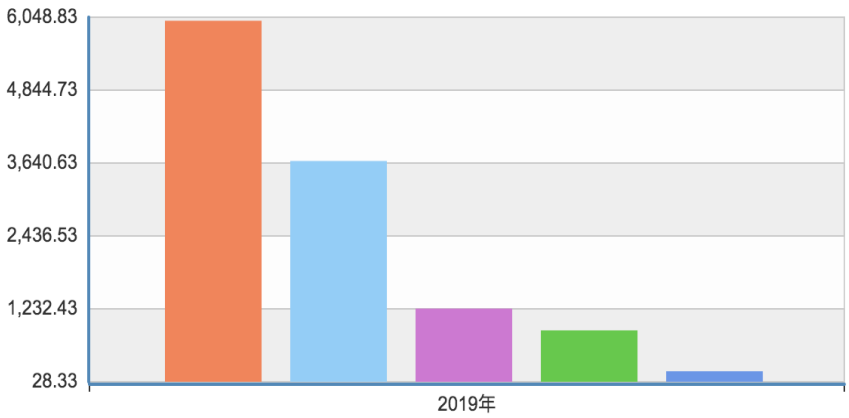


Figure 79. China faces serious water supply problems.

70% of water usage in China is for **agricultural** purposes and 20% of all water use is for mining, processing or consumption of coal.

Water conditions in China

In China, about 60% of the 669 largest cities are facing **water shortages** at a rate of about six billion m^3 per year, affecting over 40 million urban residents' daily lives. China's per capita freshwater resources are only 2,220m^3, which is about one-fourth of the world average. About **one-third** of lakes and rivers in China are **polluted** to the level that their use for human consumption is not possible.

There is an **uneven distribution** of water sources. 80% of China's water supply lies in southern China, but this water cannot be used by the population of 12 Chinese provinces representing 41% of its total population, 38% of Chinese agriculture, 46% of its industry, and 50% of its power generation.

Water policies in China

National regulations have been established to protect and manage China´s water resources, including drinking water standards, soil and water conservation, agriculture irrigation, wastewater discharge, and environmental protection. The State Council of China set the goals of China's water resources management to develop a system that can optimize distribution and efficiency of the nation's water resources. The Central Document No.1 "The Decision on Accelerating the Reform and Development of Water Conservancy" sets three targets:

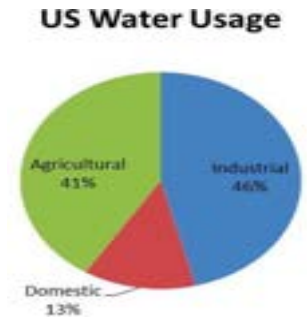
1. In 2030, the maximum annual water consumption shall not be over 700 billion m^3.
2. Water use efficiency will approach the leading level globally.
3. The total discharge of main pollutants to the rivers and lakes shall be limited to the assimilation capacity of those waterbodies, meeting water quality standards 95% of the time by 2030.

Water projects in China

China relies on large water works and built **some of the world´s largest water projects** to meet its increasing water demands. For example: the Three Gorges Dam, the South-to-North Water Transfer Projects, and over 97,988 reservoirs which account for 32% of Chinas surface water resources.

Figure 80. Water use in China.

Water usage in the USA



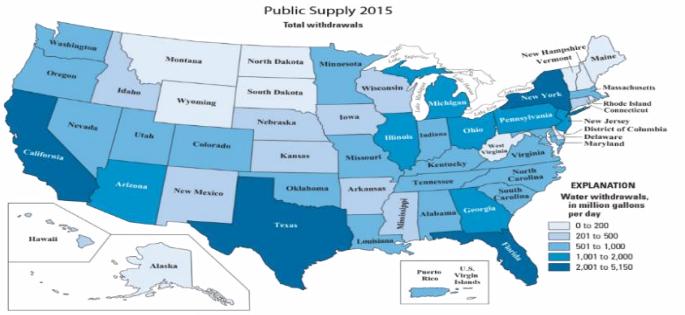


Figure 81. Water use in USA.

The average U.S. water consumption is 2,930 km³/year/person. Freshwater resources in the U.S. are about 11,500 m³ per capita.

Water condition in the USA

Water pollution in the U.S. shows **high concentration of contaminants** from industrial manufacturers which have contaminated drinking water supplies and endangered thousands of human lives across the whole country. In the U.S. this is estimated to cost over one trillion dollars over the next 25 years. From 2012 to 2016, the state California encountered a record-breaking five-year consecutive drought.

Figure 82. Water use in USA.

USA water supply

The federal government governs the nation´s freshwater through **laws and regulations**. The state and local governments regulate the **allocation** of water. The primary federal laws include **'the Federal Water Pollution Control Act'**, and **'the Safe Drinking Water Act'**. Water works, including water transfer schemes have been an essential component of supply management to meet the needs of water scarce regions.

- Hoover Dam—used for flood control, irrigation water supply and hydropower generation for the western states.

- The California State Water Project: transfers 400 million m³ of water from the northern to the southern part of the State each year

Comparison of water in China and USA

China's total withdrawal of freshwater in 2007 was greater than that of the U.S., with agriculture, the largest water user, accounting for 63% of the total freshwater use.

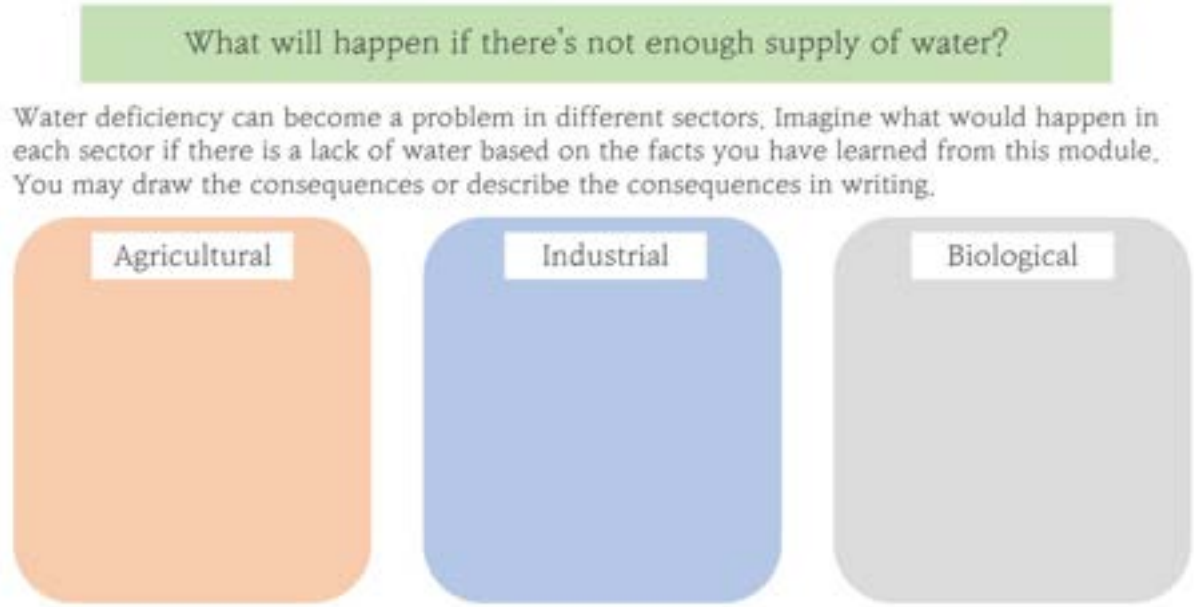
Country	Total freshwater Withdrawal (10^9 m^3/yr)	Per Capita Withdrawal (m^3/person)	Domestic Use (%)	Industrial Use (%)	Agricultural Use (%)	2010 Population (10^6)
China (2007)	578.90	425	12	23	63	1361.76
U.S. (2005)	482.20	1518	13	46	41	317.64

Figure 83. Comparison of water in China and USA.

The U.S. withdraws less freshwater than China, U.S. per capita freshwater withdrawal tripled the Chinese per capita withdrawal, with the industrial sector, the largest water user, accounting for 46% of total water withdrawal.

[Topic 8_Activity]

Water is supplied for our daily lives, even in situations which we might not realize. Have you ever thought of what would happen if there was a huge water deficiency? As water is a vital component in many different sectors, the impacts would be significant. Imagine what would happen in each sector based on the facts you have learned from this module. You may fill in the form with your own drawings or describe the consequences in writing.



- **How to work on the activity**
  1) Set the categories of which you want to imagine the situation of not enough water supply. 'Agricultural, Industrial and Biological' are samples provided to help you. You may come up with another sector where water acts as a necessary component.
  2) Imagine what will happen in each sector if it faced a water deficiency.
  3) Draw or write with words (or both) in each section. You may share your results with your peers and see what the other students have thought of.

Topic 9. How can we use water efficiently?

Water Use in the Home

A lot of infrastructure and energy is needed to supply our homes with fresh water. Yet a lot of water is wasted or used inefficiently. Let's take a look at the portion used for each purpose of an average household's total water use.

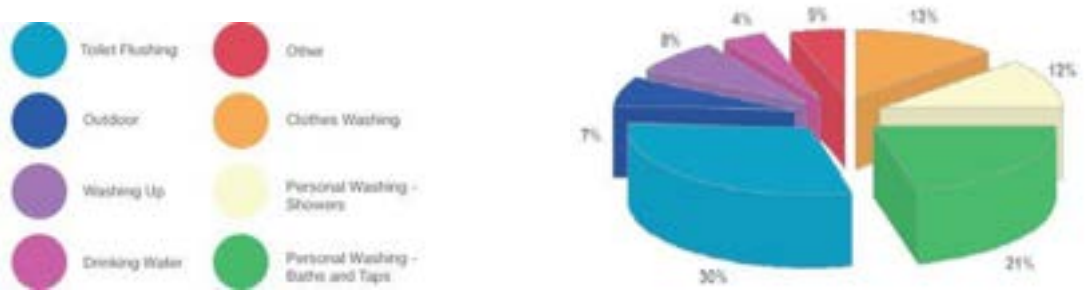


Figure 84. Residential end uses of water.

At 30% toilet flushing is the largest portion, followed by personal washing – baths and taps at 21%. Clothes washing and personal washing – showers are the next highest at 13% and 12% respectively.

How to save water at home?

To help protect the environment and save money it is important to save water. The following are some practical steps to reducing water use:

Turn off the tap while you are not using it.

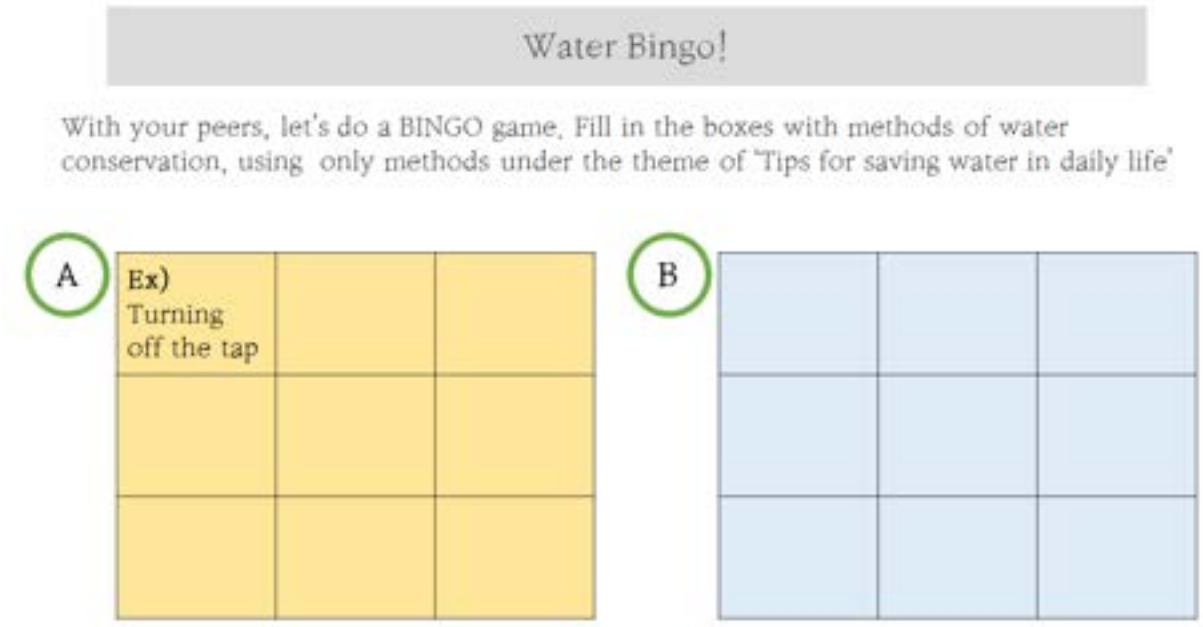
Choose energy-efficient appliances and save money on both your electric and wat er bills.

Shower instead of having a bath and try to shower for a shorter amount of time.

Collect rainwater in a water container and use it to water your garden.

[Topic 9_Activity]

You have learned about the water usage at home and how to use water efficiently. Saving water is one of the things that can be easily done when we try to change our daily-life habits. For promoting your awareness, let's do a bingo game. Water conservation will be a closer term as you finish this activity.



- How to work on the activity
  1) Make a team with your peers. It may be a pair, or a group up to 3-4 members.
  2) Each get an empty table of 3x3. If there is enough time, you may have 4x4 or 5x5.
  3) Do not show your sheets to the other team and fill out the table with 'Tips for saving water in daily life'.
  4) When every member has filled out the table, take turns and guess tips/methods. If the other team has that tip/method they should cross it out.
  5) The person/team who crosses out one horizontal / vertical / diagonal line first is the winner.

Topic 10. What is my village doing for water?

Water-Saving in China

In China, the smart irritation system helps water management in the agricultural sector. It simulates and predicts the movement of salt and water in different types of soil and reduces salinization. Farmers can plan their water use with unprecedented ease and accuracy. Irrigating more than 70 million hectares of cotton field in China and Central Asia alone could generate over US$7 billion in extra income for farmers every year. This system can help to cut water use by 25% and boost the output for crops by nearly 20%.

Figure 85. Chinese scientists recognized for water saving irrigation technology.

Water Cellar for mothers

This project is implemented by the CWDF, the China Women´s Development Foundation. It helps people in western China, especially women, to tackle poverty that is caused by water shortages. Through the School Safe Drinking Water Project, the foundation donated to a rural elementary school in order to install water purifying devices and enable sewage treatment facility and health education training for teachers and students. This was carried out in 24 provinces, building more than 130,000 water cellars and 1,500 water supply systems, benefiting more than 1.9 million people with a project implementation scale of more than US$ 96.5 million.

Better water usage in Europe

Figure 86. Save earth water.

The potential to save water in Europe was identified to be 90%. Key methods are implementing technical measures to make water use more efficient, changing behavior when using water, changing production patterns, and establishing an irrigation system in the agricultural sector. For the domestic sector, technical measures to save water are anticipated and for the industry sector, higher recycling rates and rain water collection shall be implemented.

Water efficiency program in Australia

In Australia, over $1,5 billion is available to improve the water efficiency and deliver 450 gigalitres of water for the environment. Urban water efficiency projects are aimed to reduce leakage and sewerage processing practices. An industrial water efficiency project is anticipated to upgrade plant processing and to redesign and implement products. Another project that is regarding on-farm efficiency implies a drip system which replaces open channels with pipes.

Figure 87. Lake Eildon.

[Topic 10_Activity]

Individual households are trying to save water, but also cities, regions and countries are making efforts for water conservation at a larger scale. As you have seen various examples, it is now time to learn about your own city's or area's improvement of water efficiency. If your city or area doesn't have a specific program, you may widen the range to your province, district or even country. Try to find something that is near you.

How did my city or area improve its water efficiency?	
City / Area	
Contents of the Program	
Results	

- **How to work on the activity**

1) Write down your city or area on the sheet.
2) Research what kind of programs or initiatives the city/area has promoted regarding water saving and improvement of water efficiency. If there are no specific programs, you may see other cities/areas of your own country.
3) Specifically describe the program. Furthermore, check out if the program has had positive or negative results. Describe them in the results section.

Module 5: If We Make Earth Sick, Earth Makes Us Sick Too?

By finishing this module, students are expected to:

- know about contemporary **global health issues**
- understand how health issues are **related to climate change**
- recognize the **correlation** between **individual** and **public health**
- understand about **human exposure** to regional weather changes
- understand the importance of not only physical health but also **mental health and well-being**

By studying module 5, students learn about what humans need to live healthy lifestyles which includes various factors such as weather and climate conditions, water quality, good air, health food, and so on. Furthermore, how our environment is directly and indirectly linked to our health is explained and participants will learn about regional differences and what are important issues in their local environments. Additionally, students will gain an awareness of how health should not only be thought of as a physical condition but also considered in terms of its mental and psychological aspects as well, helping participants to seek healthier ways to maintain healthy lives both personally and publicly.

Overview


1. What do we need to live a healthy life?
Let's learn why we need to live a healthy life through understanding its relationship with environment.


2. What are health impacts related to climate conditions?
We will see how climate change issue affects our health and learn different types of disasters.


3. How can we maintain a healthy lifestyle in our region?
We will learn that healthy climate is crucial to healthy lives and look at different types of climate and ecosystems.


4.What makes us sick and how can we protect us?
Let's see what kind of risks we may face in our daily lives and learn ways to protect ourselves.


5. Healthy food and Sustainable consumption
We will understand the life cycle of products we use and see how it is linked to healthy food and sustainable consumption.


6. How should we organize healthy daily routine?
Let's take a step for healthier lifestyle through figuring out good and bad habits. We will establish our own daily routine.


7. Different kinds of diseases
Let's learn about different kinds of diseases and its impacts on the regions.


8. Can we live a healthy life everywhere?
Let's understand what measures will help people in vulnerable places to avoid death.


9. How can we think and live in a 'healthier' way?
Let's learn the correlation between mental health and physical health.


10. How can we communicate and live with others healthier?
Let's learn the importance of public health and understand efforts required for its improvement.

Introduction of Contents for Each Topic

Topic 1. What do we need to live a healthy life?

Objective	Students understand that maintaining healthy lives requires a healthy environment.
Part 1	Understand that our environment satisfies our basic needs.
Part 2	Learn about the importance of biodiversity in health.

Topic 2. What are health impacts related to climate conditions?

Objective	Students learn about how climate change impacts our health.
Part 1	Understand what kind of disasters will be caused by climate change.
Part 2	Learn about the impacts from these disasters on humans.
Part 3	Realize the serious consequences caused by climate change.

Topic 3. How can we maintain a healthy lifestyle in our region?

Objective	Students learn that a healthy climate is crucial for healthy lives.
Part 1	Learn about diverse climate and ecosystems across the globe.
Part 2	Understand the importance of a healthy climate for maintaining healthy lives.

Topic 4. What makes us sick and how can we protect ourselves?

Objective	Students learn about what kind of risks we face in our daily lives and how we can protect ourselves.
Part 1	Understand what kind of risks affect people and what should we do to protect ourselves.
Part 2	Learn about basic information of COVID 19.

Topic 5. Healthy food and sustainable consumption

Objective	Students gain an understanding of the life cycle of products they use.
Part 1	Understand the importance of healthy eating with nutrient balance.
Part 2	Get practical tips for a healthy diet.
Part 3	Learn how to eat more sustainably.

Topic 6. How should we organize healthy daily routines?

Objective	Learn how to have a healthier lifestyle.
Part 1	Learn how to figure out what are good habits and what are bad habits.
Part 2	Set up your own healthy daily routine.

Topic 7. Different kinds of diseases

Objective	Students learn about the different kinds and effects of diseases and their impacts in different regions.
Part 1	Understand the definition of disease and its consequences.
Part 2	Learn about difference between communicable diseases and non-communicable diseases.
Part 3	Overview of regional impacts of diseases and the spread of viruses in different regions.

Topic 8. Can we live a healthy life everywhere?

Objective	Learn how people in vulnerable places can protect themselves.
Part 1	Understand what measures will help people in vulnerable places to avoid sickness and death.

Topic 9. How can we think and live in a 'healthier' way?

Objective	Students learn about the correlation between mental health and physical health.
Part 1	Understand how mental health and physical health are intertwined.
Part 2	Learn methods to maintain good mental health individually.
Part 3	Learn how to communicate with people and ways to maintain good mental health through interactions.

Topic 10. How can we communicate and live with others healthier?

Objective	Students learn about the importance of public health.
Part 1	Understand the definition of public health and its importance.
Part 2	Learn what kinds of efforts the public should make for the improvement of public health.
Part 3	Recognize the individual's role in enhancing public health.

Glossary

Vocabulary	Definition
Basic Needs	We have basic needs that need to be satisfied in order to live, like breathing fresh air, drinking clean water, having nutritious food to eat.
Biodiversity	The variety of life which includes the number of different species of plants and animals on Earth.
Flooding	Occurs due to heavy rainfall and is a temporary overflow of water which damages the affected area and the people living there.
Air Pollution	Bad air quality that is worsened by higher temperatures and shifting weather patterns and leads to respiratory health problems.
Global Warming	The gradual increase in the overall temperature of the earth's atmosphere primarily caused by greenhouse gases emitted by human activities. Higher temperature in many places exposes people to a heated environment.
Drought	Dry conditions that negatively affect air quality and risk wildfire and dust storms.
Food Impact	Effects that temperature changes or other changes can have on food, such as increased bacteria-related poisoning.
Vector-borne diseases	Illnesses transmitted by disease vectors, like ticks, mosquitoes, and fleas.
Grasslands	Areas where the vegetation is mostly grass.
Rainforests	Areas with lots of tall trees and continuous rainfall.
Tundra	A biome with climate conditions of low temperatures and short growing seasons.
Deserts	An arid area with lots of sand and little rainfall.
Coral Reefs	Animals which are part of the marine ecosystem and are the base for many other types of animals and plants.
Mountains	Large landforms that rise above the surrounding land which are formed due to the tectonic activities which raise the Earth’s surface.

COVID-19	The coronavirus which broke out at the end of 2019 and infected millions of people. Derived from "coronavirus disease 2019".
Balanced Diet	A good balance of nutritious food that keeps our bodies healthy and strong.
Sustainability	Meeting the needs of the present without compromising the ability of future generations to meet their needs.
Good and Bad Habits	Repeated actions that can have a positive or negative impact on our lives, the lives of others, and the environment.
Disease	A condition of a living person, animal, or plant body (or one of its parts) that impairs normal functioning and its typically manifested by distinguishing signs and symptoms.
Communicable Diseases	Infectious diseases that are caused by microorganisms such as bacteria, viruses, parasites and fungi which can spread from one person to another.
Noncommunicable Diseases	Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors.
Mental Health	A person's condition with regard to their psychological, emotional and social well-being. It is strongly linked to how we feel physically.
Physical Health	Physical health is related to the condition of our body. Important elements for maintaining physical health include exercise, a nutritious and balanced diet, and sufficient sleep.
Public Health	Public health is the science of protecting and improving the health of people and their communities.

Which SDG is most related to this module?

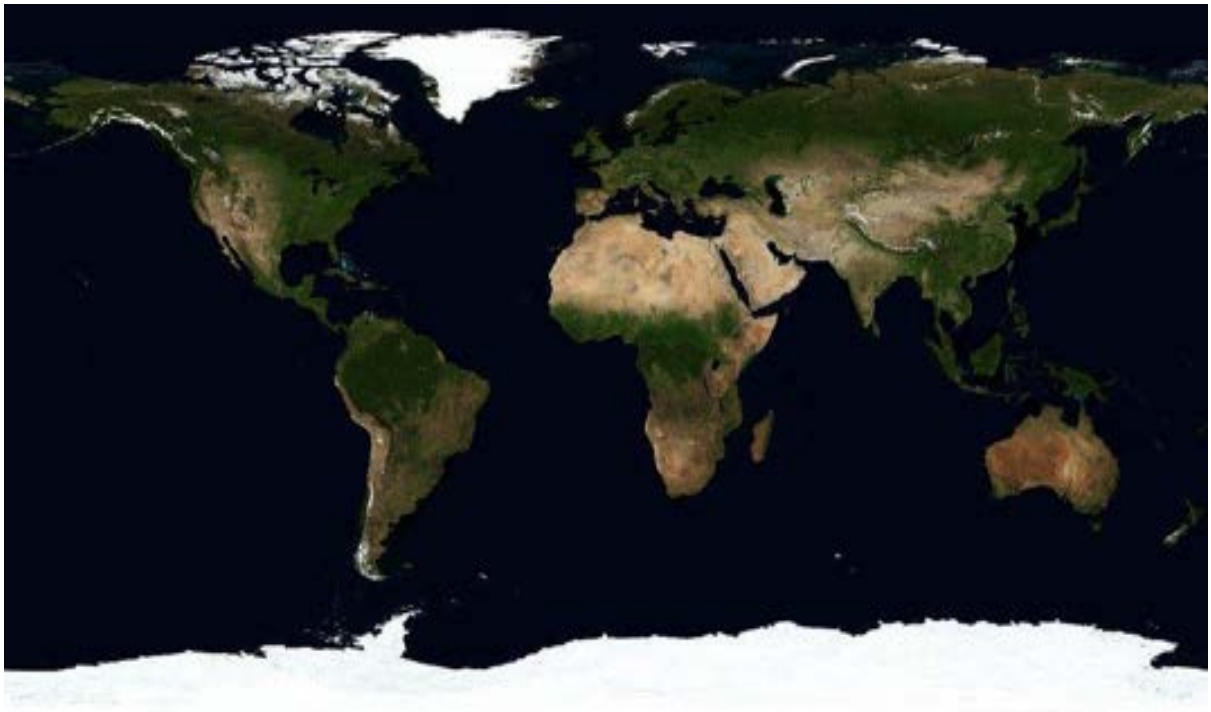
Module 5 discusses health, and various factors that are essential for living a healthy life. The according SDG that covers these subjects is **SDG 3.**

"Ensure healthy lives and promote well-being for all at all ages."

Topic 1. What do we need to live a healthy life?

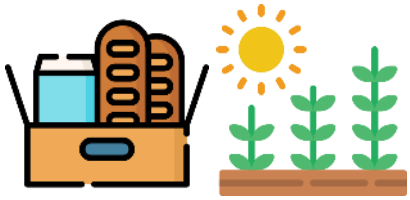
Healthy environment for healthy life

We should always keep in mind that we need a healthy environment to live healthy lives. Our environment is our life-support system, as it provides us with our most basic needs which should be satisfied such as fresh air to breathe, clean water to drink, and nutritious food to eat. So, if our climate conditions change, there will be many negative effects on human health as well.



We also have to note that each part of the world has a unique climate. People living in particular climates have acquired knowledge and methods to live and coexist with such climate conditions. If their climate rapidly changes it would be very difficult for people to adapt. However, regardless of regional differences, all people need stable and predictable climates to remain healthy.

Importance of biodiversity



As we already have seen in previous topics, **biodiversity** is the variety of life on Earth. It is the number of different species of plants and animals. Maintaining rich biodiversity has many benefits for our health.

First of all, rich biodiversity ensures a greater variety of nutritious crops we can eat. If there is a large variety of crops, there will be less food supply vulnerability. If one crop fails, there are more alternatives among crops when there is rich biodiversity. Ecosystem productivity will increase and ecosystems themselves can also recover faster from disasters when there is more biodiversity. Additionally, animal populations can be kept in better balance.

[Topic 1_Activity]

You have learned about the importance and the correlation between environment and living healthily. An increasing number of us are just beginning to recognize that the environment is vital to our health. Here are some statements related to what we have just learned, determine which of the following is true and which is false.

Statement	T/F
We need to protect our environment as it supports various sectors.	
Every part of the world shares the same climate.	
We don't need to protect certain species as reduction in their numbers won't affect other species.	
Biodiversity has nothing to do with our food supply.	
Maintaining rich biodiversity could have a positive impact on medical development	

- **How to work on this activity**

1) Read each sentence carefully.
2) If the sentence is true write T, and if the sentence is false write F.
3) After completing the activity, check the answers as a class.

Topic 2. What are health impacts related to climate conditions?

Climate change causes many different disasters, and these disasters can severely impact human health. The key point is that the effects on our health are varied, pervasive, and expected to become more severe as climate change impacts become even more acute. Here are some examples of how climate change impacts our health:

Flooding

Figure 88. Floods.

The frequency of heavy precipitation increases and results in flooding events occuring more frequently in some regions, which threatens the health of people during and after the event. During flooding, people may suffer from drowning, injuries, or being inflicted with permanent disabilities. After flooding, safe food and drinking water are usually in short supply, which will result in people not having enough nutrition and cause stomach and intestinal illnesses. Flooding can also interrupt communications, and damage roads and bridges, which disrupts access to hospitals. As a result, the wounded are often not able to be treated in time. Additionally, the incorrect usage of electric generators when power outages occur can result in carbon monoxide poisoning. Lastly, many of the people who have experienced these disasters can suffer from mental problems, such as PTSD, due to the trauma of the event.

Air pollution

Figure 89. Air Pollution.

Climate change affects the air we breathe. Higher temperatures and shifting weather patterns will worsen our air quality and lead to respiratory and cardiovascular health effects like asthma attacks or lung cancer. Climate change causes wildfires which create smoke, dust and other unhealthy air pollutants. Human activities can directly emit particulate matter (the term for a category of extremely small particles and liquid droplets suspended in the air). Inhaling particulate matter (PM) can lead to a broad range of serious health effects like chronic obstructive pulmonary disease and cardiovascular disease.

Global warming

Figure 90. Global Warming.

Higher temperatures in many places result in more frequent heatwaves. Exposure to a heated environment can lead to heatstroke and dehydration, and respiratory or cardiovascular diseases. Increased temperatures can have more severe impacts on populations in certain places (such as those living at northern latitudes or in less developed areas without cooling infrastructure) where local people are less prepared to cope with higher temperatures. As the temperature increases, air quality decreases, and at the same time more people choose to use air conditioners, which results in higher consumption of energy which leads to climate change. The end result is a vicious circle.

Drought

Figure 91. Drought.

The health impacts of droughts are numerous and far reaching. Serious drought conditions will negatively affect air quality. The risk of wildfires and dust storms will increase during the drought period and is bad for air quality. Water is the most important thing for humans and plants to survive. People living in drought affected areas do not have enough water to maintain their livelihoods, and the shortage of water supply reduces agricultural incomes and food supplies.

Food impacts

Higher temperatures can lead to increased levels of salmonella or other bacteria-related food poisoning due to the fact that bacteria become more active in warmer temperatures. Food poisoning can cause gastrointestinal distress and even death. Climate change is caused by higher concentrations of carbon dioxide in the atmosphere, which also affects food safety and nutrition. CO2 in the atmosphere can be a "fertilizer" for some plants, but lowers the levels of protein and essential minerals in important crops such as wheat, rice, and potatoes. If people can no longer consume enough nutrition from these crops, it will be detrimental to their health. Extreme weather events can also disrupt or slow the distribution of food resulting in a reduced food supply for people.

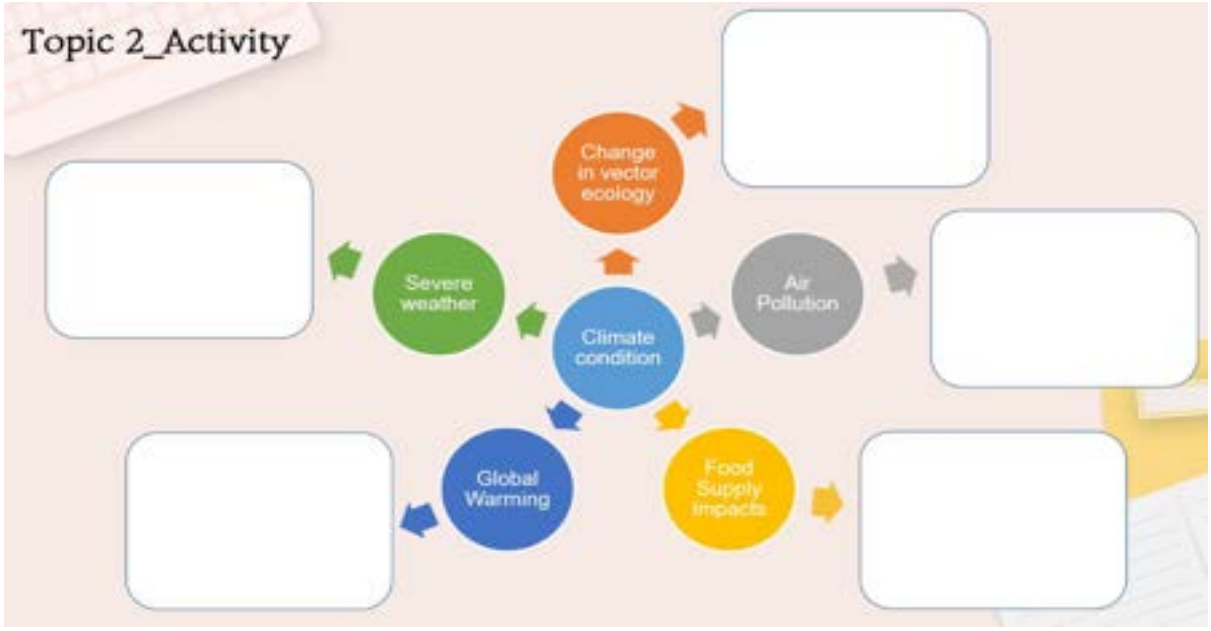
Vector-borne disease

Figure 92. Vector Borne Diseases.

Vector-borne diseases are illnesses transmitted by disease vectors, such as ticks, mosquitoes, and fleas. These vectors can carry infectious pathogens, like bacteria, viruses, and protozoa, from animals to humans. Higher temperatures and unclean water resources result in these pests become more active and increase the range of disease spread.

[Topic 2_Activity]

Climate conditions impact people in very direct and personal ways: our health, our food supply, our daily lives and so on. This is the reason why we need to take this issue seriously.



We have learned that climate change is having significant impacts on human health now and will have even more dramatic impacts on human health in the future. Those impacts either are direct or indirect. Please list out possible impacts in the white boxes.

How to work on this activity

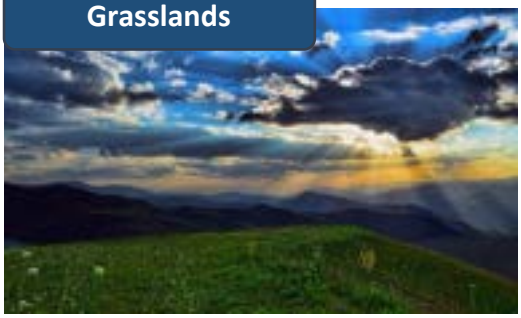
1) Consider each aspect of climate conditions and their effects.
2) For each of the aspects write the possible impacts in the white boxes. These impacts can be direct or indirect.
3) After completing the activity, share your work with your peers or present your work to your class.

Topic 3. How can we maintain a healthy lifestyle in our region?

Earth's different ecosystems

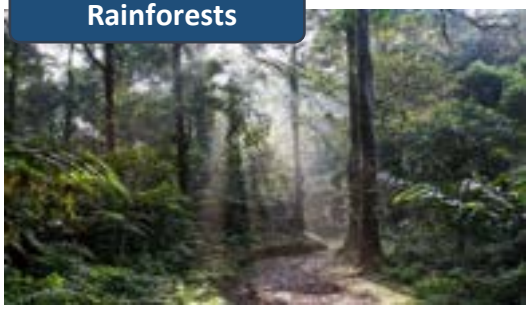
Earth has many vastly different ecosystems.

Grasslands



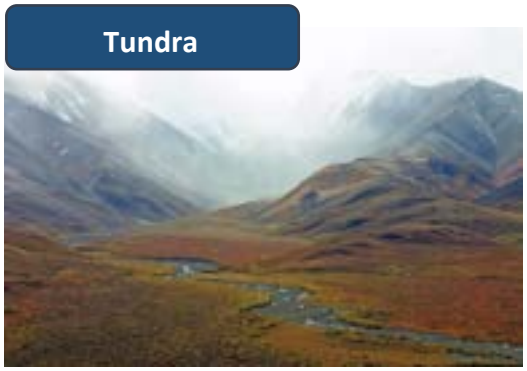
Grasslands are where the vegetation is mostly covered by grasses. The specific climate and plant life of grasslands depends on the specific regions, but usually it is hot and dry during the summer.

Rainforests



As we have seen from module 2, **rainforests** consist of tall trees and lots of rainfall. They are Earth's oldest living ecosystems and home to more than half of the world's plant and animal species.

Tundra



Tundra is a biome with the climate conditions of low temperatures and short growing seasons. Generally, the vegetation in tundra regions consist of short grasses, mosses and so on, with scattered trees.

Desert

Deserts are arid areas with lots of sands and little precipitation. Deserts are formed due to weathering processes and the daily temperature difference can be huge.

Coral reefs

Coral reefs are parts of the marine ecosystem. Surprisingly they are animals, and they are the base for many creatures to live in. Coral reefs are very significant ecosystems and are sometimes called “the rainforests of the sea”!

Mountains

Mountains are large landforms that rise above the surrounding land which are formed due to the tectonic activities which raise the Earth’s surface. Depending on the height of the mountains there are different types of plants, animals and ecosystems.

Healthy climate, healthy lives

We need a stable climate and healthy local ecosystems to maintain healthy lifestyles. Our lifestyles and infrastructure are adapted according to the region we live in. For example, buildings are heat insulated according to local temperatures.

Thus, if our local ecosystems are damaged or our regional climate changes, it will negatively impact our ability to live healthy lifestyles.

So, we should bear in mind that protecting our local ecosystems is vital for human health and happiness. It is also essential to exercise regularly and eat healthily whatever type of climate region we live in.

[Topic 3_Activity]

We have learned a lot of different vocabulary and concepts in this module. Let's do a simple review of the important vocabulary and concepts we have learned.

Sustainability	Biodiversity	Imbalance
Negative	Impact	Environment
Natural	Choices	
Community	Positive	

	The existence of many different kinds of plants and animals in an environment
	Taking what we need to live now, without risking the potential for people in the future to meet their needs
	The area in which something exists or lives
	Something that is produced without help from humans
	Something that is not good and can make things worse
	Having too much or too little of something
	A group of people living in the same place or having a particular characteristic in common
	Choosing between 2 or more possibilities
	Something that is good and helps to improve or make things better
	Having an effect on someone or something

How to work on this activity

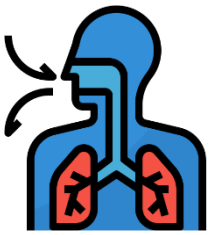
1) Read each sentence carefully.
2) Next to each sentence write the correct word from the vocabulary box.
3) After completing the activity, you can check your answers together as a class.

Topic 4. What makes us sick and how can we protect ourselves?

What are the main causes of human death?

There are a lot of causes of human injuries and deaths. The World Health Organization (WTO) lists the top 10 causes, which result in more than half of deaths all over the world. Ischaemic heart disease and stroke are the world's biggest killers, causing 15 million deaths each year. Chronic obstructive pulmonary disease can take 3 million lives, while lung cancer causes 1.7 million deaths per year. From 2000 to 2016, the number of deaths due to diabetes increased from 1 million to 1.6 million per year and death caused by dementia more than doubled. Lower respiratory infections are the most deadly communicable disease, which caused 3 million deaths in 2016. The death

rate of diarrhoeal diseases decreased by about 1 million from 2000 to 2016, and caused 1.4 million deaths in 2016. The number of deaths caused by tuberculosis decreased during the same period, but it still is a leading cause of death. Road accidents have killed millions of people every year, over 74% of whom were men and boys.



How can we protect ourselves?

We should learn how to protect ourselves. From the WHO, we know most people die from disease and accidents. So, what should we do to improve our health and prevent death? In order to reduce the probability of getting sick, we can have a healthier lifestyle. We should eat more healthy food (such as vegetables, fruit, milk) instead of junk food (such as sugary drinks, burgers, fried chicken). Also, we should avoid bad habits, such as smoking and drinking too much alcohol, to protect our heart and lungs. Additionally, we need to sanitize our surroundings. A lot of bacteria and viruses can spread in the air and our hands can easily come into contact with some bacteria or a virus. If we do not clean our hands carefully, we can be infected with diseases. Trying to mitigate climate change is another useful way to protect ourselves. Recall the health impacts of climate change we learned in previous modules. If we effectively mitigate climate change we can avoid these negative health impacts and thus be able to live more healthily.

What health issues have we been facing recently?

COVID-19

At the end of 2019, a new type of coronavirus broke out and caused over 50 million people to become infected and over one million deaths. Most people infected with the virus experience mild to severe respiratory illness. Vulnerable people like older people and people who have some health problems, like chronic respiratory disease, are more likely to develop serious illness.

Coronaviruses can spread through the air. Close contact of about 2 meters can cause the spread of the virus. Do not cough, sneeze, or talk with people without a mask in close contact. You can also be infected if some parts of your body, like your hands, come into contact with the virus and then touch your nose, eyes, or mouth. Therefore, it is essential to clean your hands well before touching your face or eating. The most common symptoms of COVID-19 are fever, dry cough and tiredness.

What can we do to prevent infection and to slow transmission of COVID-19?

First, we need to wash our hands regularly with soap or alcohol-based hand rub. Always remember that if you have not cleaned your hands yet, you should avoid touching your face and mask. Next, you should try to keep at least one-meter distance between you and other people in public areas. If

possible, avoid crowded areas and enclosed spaces. Also, if you need to cough or sneeze, cover your face with your arm. If you feel unwell and have COVID 19 symptoms, please self-isolate at once and seek medical advice. Finally, try to live healthy to keep your immune system strong. Having a healthier lifestyle, makes your body stronger and have a better resistance to the disease.

[Topic 4_Activity]

As the pandemic continues, we need to pay more attention to our daily hygiene practice. This is a simple exercise to remind us to maintain healthy habits in order to protect our health.

How to work on this activity

1) Look carefully at each of the two options, for example ‘Wash your hands’ ‘Wash your feet’.
2) Of the two options select the one that we should do to reduce our chances of being infected.
3) After completing the activity, you can check your answers together as a class.

Topic 5. Healthy food and Sustainable consumption

Healthy eating and its importance

To keep our bodies healthy and strong, we should have a balanced diet of nutritious foods.

Eating healthily is essentially important for children and teenagers, as it is in this time of humans' lives that we grow the most. Particularly, not eating a healthy balanced diet during childhood and adolescence means your body will have less energy to grow.

The correct balance of nutrients is essential in order to stay healthy and grow. For instance, energy intake – which we also call calories – should be in balance with energy expenditure. To avoid unhealthy weight gain, total fat should not exceed 30% of total energy intake and sugars should be less than 10% of total energy intake. Also, keeping salt intake to less than 5g per day greatly reduces your chances of developing heart disease later in life.

Practical tips for a healthy diet

① Always include vegetables in meals.

② Try limiting your consumption of sugary snacks, candies, and sugar-sweetened beverages.

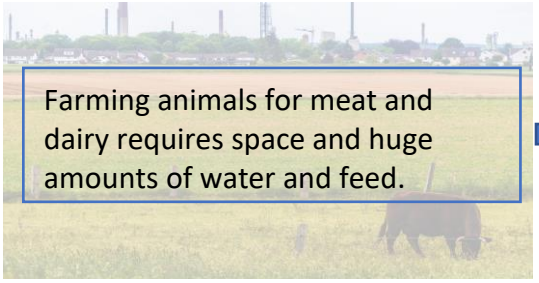
③ Try eating fresh fruit and vegetables as snacks, instead of unhealthy snacks.

④ Try to eat less red meat, eat alternatives like fish, chicken, nuts, and tofu instead.

Sustainability

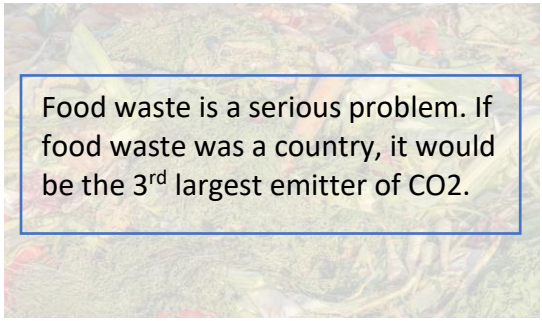
Meeting our own food needs is obviously important, but we must endure we do not undermine the ability of future generations to be able to eat healthily as well. This means we must grow and eat our food sustainably.

Now, let's see what you can do to eat more sustainably.



Transporting food from far away to eat is inefficient.

Eat fresh fruit and vegetables that are local and in season.



Food waste is a serious problem. If food waste was a country, it would be the 3rd largest emitter of CO2.

Eat fresh fruit and vegetables that are local and in season.

[Topic 5_Activity]

Fruits and Vegetables (per serving)	Calories	Grams of Protein	Grams of Fiber
banana	100	1	3
apple	80	0	3
orange juice	120	2	0.5
carrot	30	1	2.3
corn	70	2	3.5
mushrooms	20	2	2.2
lettuce	5	0	1
baked potato	145	4	3.8
beans	35	2	5
tomato	25	1	1.5
Cereals and Grains (per serving)			
whole wheat bread, one slice	65	3	2
flakes	95	2	<1
cupcake	130	2	0.5
spaghetti/meat sauce	330	19	5
white rice	204	1.83	1.1
Meat and nuts (per serving)			
tuna	170	24	0
roast beef	165	25	0
Eggs and Dairy (per serving)			
milk	150	8	0
yogurt	230	10	0
cheese	115	7	0
fried egg	85	5	0

- **How to work on this activity**

1. List the foods you ate for breakfast, lunch, and dinner on the previous day. Compare your list with your classmates and discuss as a class which foods are nutritious and which foods are not.
2. For each item on your list write the amount of calories, protein and fiber. You can use the list on the top of the previous page as a reference and search online for foods not included in the list.
3. Calculate the total amount of calories, protein and fiber you consumed in each meal and for the entire day.
4. Compare these totals to the recommended consumption of calories, protein and fiber.

Breakfast	Calories	Protein	Fiber
Breakfast Total			

Lunch	Calories	Protein	Fiber
Lunch Total			

Dinner	Calories	Protein	Fiber
Dinner Total			

Topic 6. How should we organize healthy daily routines?

We have learned many ways to help protect ourselves and keep ourselves healthy. Making and keeping good habits, while stopping bad habits is important for our health. Here are some examples of good and bad habits:

Good Habits 👍	Bad Habits 👎
Sleeping 8 hours/night	Sleeping 5 hours/night
Reading for 1 hour every evening	Spending all free time watching TV
Meal prepping every Sunday	Regularly getting takeout
Making time for friends and family	Isolating yourself
Setting boundaries between work and life	Overworking to the point of burnout

What are some of your good and bad habits? Write some in the lists below

Good Habits ：

_____

_____

_____

_____

_____

_____

_____

Bad Habits:

_____

_____

_____

_____

_____

_____

_____

Here are some hints:

- Spending all free time watching TV or playing online game.
- Eating more vegetables and fruit instead of junk food.
- Drinking more water.
- Isolating ourselves
- Being more active.
- Have more than 8-hour sleeping every day.

The importance of routine

Setting up and maintaining a good routine has many positive effects on our health. Predictable, daily schedules and regular routines help keep our body clock running smoothly. Try and do the following to make a healthy routine:

- Get up at the same time every day.
- Spend some time outdoors.
- Set times for regular activities.
- Exercise every day.
- Eat your meals at the same time every day.
- Stick to consistent sleep and wake times that fit your natural rhythm.

[Topic 6_Activity]

In this topic, you learned about the importance of daily routines and how routines affect physical and mental health. With the provided checklist you may question yourself about how you spent your day and therefore become more aware of how you spend your time. You may realize into which activities you are investing your time and energy. This activity aims to make you consider your daily habits and whether they are healthy.

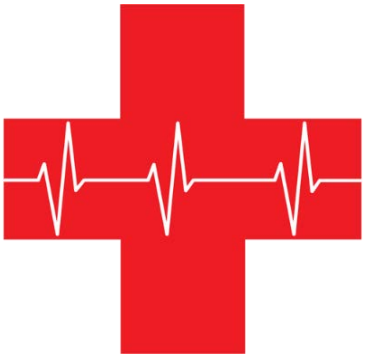
Question	Your Answer
How many hours did you sleep last night?	
What time did you go to bed and what time did you wake up?	
What did you have for breakfast/lunch/dinner yesterday?	
Did you have a good balance of school and freetime yesterday?	
What did you do in your free time yesterday?	
Did you watch TV? For how long and what did you watch?	
Did you read something? For how long and what did you read?	
Did you make some time for your family and friends yesterday?	
How did you feel yesterday?	
What was good and what was bad about yesterday?	

How to work on this activity

1. After reading each question carefully, write your answer in the answer section.
2. Think about which parts of your routine you would like to change.
3. Discuss together as class what you think a healthy daily routine should consist of.

Topic 7. Different kinds of diseases

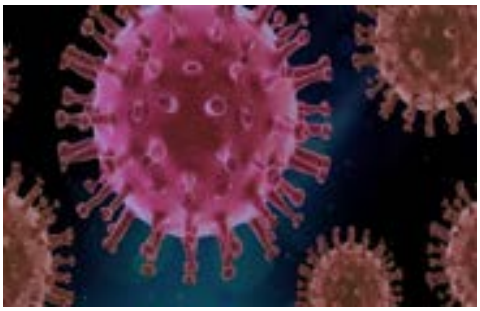
What is a disease?



'Disease'. You must have heard this word a lot in your daily lives. Why do you think this word appears so often, at school, or on world news? It is because it's directly related to our quality of life. From a fundamental perspective health is the most crucial thing which we should consider in every single activity we do. Disease, by definition, means a condition of a living person, animal or plant body (or one of its parts) that impairs normal functioning and its typically manifested by distinguishing signs and symptoms. Basically, it is a sickness that is not caused by being injured physically.

Communicable diseases and noncommunicable diseases

Diseases are categorized into communicable and non-communicable diseases in specific. First, communicable, or infectious diseases, are caused by microorganisms such as bacteria, viruses, parasites and fungi which can spread from one person to another. Examples of communicable diseases are measles, tuberculosis, HIV, malaria, viral hepatitis, and COVID-19.



COVID-19 has only recently been added to the list. It is a newly emerged virus which has caused a serious pandemic affecting the entire world. This pandemic has shown how different regions of the world can be especially vulnerable to a new, highly contagious communicable disease. COVID-19 spreads primarily through water droplets from the nose or mouth when someone coughs, sneezes, or speaks. There are vaccines and treatments under development for COVID-19, but large-scale vaccination will take time. For the meantime, the best thing we can do is practice social distancing.

Regional Impact of diseases

When regions are affected by a disease, or by a pandemic, each region and local government plays an important role in dealing with the disease. Well-funded public care systems and advanced medical infrastructure helps prevent widespread outbreaks of communicable diseases. However, as countries became more developed, the possibility for diseases to become prevalent has increased as well. When group infections happen, the first step to take is preventing further spread of the disease on a large scale in the region from its origin point. An organized management system and good governance of each region are important, but proper public investments as well as policies are other influential factors to be highlighted when trying to increase the resilience of a region.

Wealthy countries and noncommunicable diseases

Wealthy countries' populations are very vulnerable to noncommunicable diseases. Behaviours such as tobacco use, binge drinking, overeating, insufficient physical activity as well as problems like air pollution tend to increase as societies become wealthier. This is due the fact that higher economic status enables greater increased consumption. It is a global issue to reduce the danger by living healthier lifestyles along with a better quality of life.

Communicable and noncommunicable diseases in the 6 World Health Organization (WHO) Regions

Among the list of WHO regions, the African region is the only one where communicable and nutritional diseases are more prevalent than noncommunicable diseases. This represents the food security and health security issues taking place in the region. The European region is the most affected by noncommunicable diseases (NCDs). These diseases account for about 85% of deaths in the region: diabetes, cardiovascular diseases, cancer, chronic respiratory diseases and mental disorders. Noncommunicable diseases are becoming more of a problem in the Western Pacific, South East Asian, American and Eastern Mediterranean region as well.

[Topic 7_Activity]

You have learned what a disease is and what are different kinds of diseases. In order to review the recent learned content, we will answer some True or False questions.

Are the following statements True (T) or False (F)?

1. A disease is a condition that impairs normal functioning and is manifested by distinguishing signs and symptoms. (T/F)
2. Chronic diseases are also known as communicable diseases. (T/F)
3. In developed and wealthy countries, the population is vulnerable to noncommunicable diseases. (T/F)
4. Living a healthy lifestyle cannot reduce the danger of catching diseases. (T/F)

- **How to work on this activity**

1. Read each of the four True or False statements.
2. Circle 'T' if the statement is true and 'F' if the statement is false.
3. After all students have finished, check your answers together as a class.

Topic 8. Can we live a healthy life everywhere?

The answer is NO! Many people live in vulnerable places and suffer a lot from natural disasters. These disasters not only damage local infrastructure, but also result in injuries and deaths. So, what can make people in vulnerable places be able to live more safely?

People in vulnerable places usually choose to migrate. Migration may be the result of an environmental catastrophe such as a hurricane or a tsunami, or be a more gradual process of migration due to the slow onset of an environmental issue, like the long-term effects of drought on agriculture.

Some vulnerable places have some adaptation options. For example, in the case of cities near the sea they can build some sea defences, such as the picture on the right. Sea defences can play an important role to protect local residents and infrastructure during storms or extreme

weather. The local building codes should be revised to ensure greater resilience to the natural disasters and thus reduce the infrastructures damage.

The local government also needs to prepare suitable measures of risk management. For example, the Caribbean Hazard Mitigation Capacity Building Programme is a three-year project funded by the Canadian International Development Agency, which aims to enhance regional capacity in order to reduce vulnerability to natural disasters. The national hazard mitigation policies are developed to promote the wider use of hazard information.

Figure 93. High Tides.

[Topic 8_Activity]

In this topic, you have engaged with the question of whether people can live a healthy life everywhere. You have learned about vulnerable places and the reasons why people have to migrate to other places to escape danger. In this activity, you will be asked to do some research of your own to find out specific cases and examples where the health and lives of people is threatened and why this is happening.

- **Be a detective!**

Find out where in the past years the health of many people was threatened and why.

Search online.

You can follow these questions as guidelines:

- Where in the world do people suffer from health-related issues?
- What are these health issues and why do they occur?
- Why are these health issues so dangerous?
- Do people migrate because of these health issues?
- Where do they migrate to?
- What do the people in these areas do to adapt?
- Are there any risk management programs to tackle these issues?

Find a case

Investigate

Can we solve it?

Keywords for online research might be:

Climate-related migration; Dry-season; Droughts; Hurricane-related migration; Air pollution; Flooding; Severe Climate Events; Uninhabitable land

How to work on this activity

1. Be a detective and choose one case where health related issues occur and people cannot live healthy lives. You can find a case through online research.
2. You should investigate in this case and find out more about the circumstances, reasons and issues about why people in the chosen case are suffering from health problems.
3. Next search for possible solutions, like adaptation options or risk management opportunities.
4. After finishing your research, you can either present your example in class and discuss about different cases and solutions or you write a short paper about what you learned.

Topic 9. How can we think and live in a 'healthier' way?

Why is mental health important?

Have you ever thought of the connection between mental health and physical health? You might think they are two separate issues but in fact mental and physical health are strongly intertwined. For instance, poor mental health can impact and degrade physical health. The activities we do in our daily lives directly affect our mental health, so it is important to take care and do things that are good for our mental health and try to think positively. And the other way around, poor physical health can lead to increased risk of mental health problems as well. The actions we take, the activities we do – the experiences can become the sources of how we think. Therefore, mental health plays a major role in people's ability to participate in healthy behaviours and maintain good physical health. Mental health problems often show up as physical problems as headaches, fatigue, stress, changes in sleeping patterns, appetite fluctuations, muscular tensions and so on.

How to look after your mental health

The ways to look after your mental health can be mainly divided into two parts: the things you can do for yourself individually, and the things you can do through communication with others.

The first thing you should do to improve your mental health is to go to bed on time. Sleep deprivation has a significant negative effect on your mood. Good habits to get better sleep can improve your mental health through reducing fatigue. Second, taking enough breaks is important. A change of pace is good for your mental health. A few minutes with pause can moderate your amount of stress, letting you enjoy leisure and explore something new. Third, eat a good meal. The food you eat nourishes your brain. Moderate amounts of carbohydrates, protein, and omega 3 improve your mood and promotes cognitive function. And last, exercise and keep active! Your body releases stress-relieving and mood-boosting endorphins after

work out, which makes you lessen your stress, anxiety, and depression. Just 30 minutes of daily exercise helps you to maintain your mental health.

The first thing you can do through communicating with other people is to talk about your feelings. When you have problems which are bothering you, you should definitely open up to someone. Being more trusting helps increasing your emotional wellbeing with finding positive aspects in other people, leading to better recognition of yourself. Furthermore, ask for help. Getting tired or overwhelmed with feelings means that you do not have enough energy to cope with the situation. You may ask your family or friends to offer you a listening ear. As you receive care from the others, care for the others too. It is important keeping up relationships with people close to you. This can bring you to feel good about yourself as well, leading to good self-esteem. Finally, do something you are good at. Think about what you love to do. Enjoying yourself, with other people for synergy if possible, can help you to beat stress. Let go of your stress and boost your confidence.

[Topic 9_Activity]

In this topic, you have learned about how we can think and live in a healthy way. We studied about mental health and learned why it is such an important issue that affects us not only mentally but also physically. This exercise is designed to encourage us to become more aware of healthy lifestyles. By actively reflecting on our activities of the previous week and considering if we did the mentioned actions we can think more deeply about health-related issues.

I slept around 8 hours last night	I took a break when I needed while studying	I made my own meal today	I exercised for 30 minutes everyday
I ate many vegetables and fruits this week	I went to sleep before midnight	I did something I love	Deeply inhale and exhale when stressed
I did someone a favor	I gave myself some compliments today	I talked about my feelings	I talked about what it is like feeling overwhelmed
I regularly stretched my body	When I felt tired and overwhelmed I talked to someone	I listened to someone who needed to talk	I knew how to calm myself when I was angry

- **How to work on this activity**
  1) Look at the above bingo sheet and consider if you did each action in the previous week.
  2) Check each of the boxes you have done in the previous week.
  3) As a class hold a panel discussion about which activities were easy to do and the reasons why some of the actions in the boxes were difficult to do.

Topic 10. How can we communicate and live with others healthier?

What is public health?

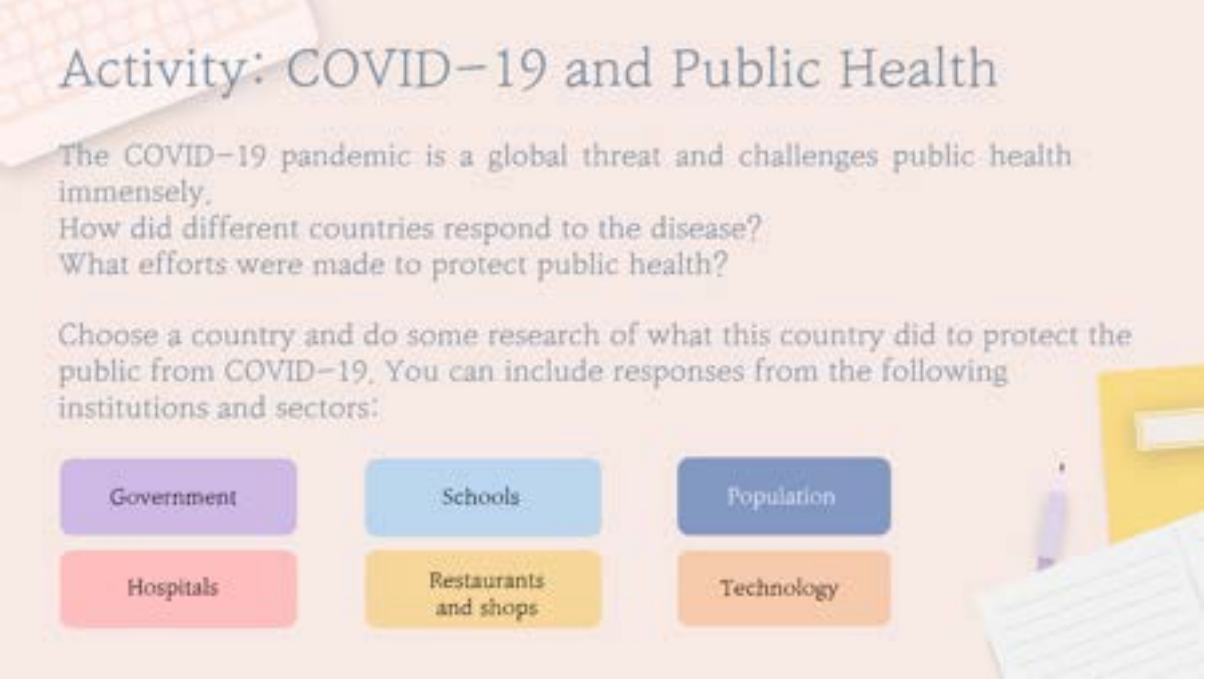
Figure 94. Public Health.

We have talked about individual health in categories divided into mental and physical health. Now, it is time to learn about public health. Public health is the science of protecting and improving the health of people and their communities. In fact, when you maintain good health at an individual level, you are also helping public health. The concept is achieved by promoting healthy lifestyles, researching disease and injury prevention, and detecting, preventing and responding to infectious disease. The main function of public health is to limit health disparities. A large part of public health is related to promoting healthcare equity, quality and accessibility. There are vulnerable groups of people whose ability to maintain good general health status is relatively limited.

There are many general efforts needed by the public for improving public health. First, we need an improvement in environmental hygiene. The environment is the place where humans maintain their lives but humans are imposing so many negative impacts on the environment through unsustainable development. However, we should be aware that the negative results of these actions consequently return to humans. Secondly, we should obviously prevent the spread of infectious diseases. One of the representative examples would be COVID-19. Not only individual sanitation, but also keeping adequate distance among the community is required until the virus is overcome. Effective organization of medical and nursing work for diagnosis and treatment should be improved in addition to preventive treatment. More investments in research should be made in the medical field for higher quality of medical care and medication. Lastly, community efforts are important. Our communities should aim for the development of social organizations in order to ensure all residents of the community have a sufficient living standard to maintain their health.

[Topic 10_Activity]

In this topic, we learned about the area of public health. We studied what public health is, why it is crucial to all of us and how we can take part in promoting public health ourselves. The following exercise is to emphasize the importance of public health especially in a situation like the global pandemic of COVID-19. We will conduct our own research on a chosen country to learn about varying responses different countries took in order to protect public health.



- **How to work on this activity**
  1) Choose a country of your choice and conduct your own research about how this country took action in order to protect public health.
  2) The six sectors mentioned above should be included. If you wish to add other further sectors you may.
  3) When you have completed your own research, you may answer the two questions posed and share the information you researched with the class

Module 6: The Journey Of My T-shirt

By finishing this module, students are expected to:

- understand the **basic concepts** of sustainable consumption and production
- understand **why** responsible consumption and production are **important** for achieving sustainable development
- understand the general structure of a **supply chain**
- consider the **life cycle of products** they use in their everyday lives
- know about and be accustomed to specific **ways to contribute to responsible consumption**

By studying module 6, students will understand the ways in which production and consumption processes are complicated and can be 'unsustainable' for the environment and the ecosystem. This will increase participants' curiosity of behaviors and habits which they can adopt to become more responsible consumers, which also are well introduced with "**Life Attitude of an Earth Citizen**" of the Broad Group.

Overview


1. Meet sustainable consumption and production, and the 4Rs
Have you heard about sustainable consumption, production, or the 4Rs? Let's meet some new concepts!
2. What are causes and effects of Material and food consumption?
We always consume something in our daily life. Why do we consume and how do we affect the environment by consumption?
3. What is the importance of responsible consumption and production in achieving sustainable development?
What do responsible consumption and production have to do with sustainable development? Let's see how they are important.
4. What is the basic structure of current industrialized supply chain?
Have you ever wondered where your things come from? Let's take a look at your t-shirt's journey.
5. What is life cycle analysis?
We all have life cycles. So do the products. Which stages they go through and how they affect our environment?
6. What is the concept of ecological/ carbon footprint and what are examples?
Like the footprints you leave on the road, you also leave so-called ecological or carbon footprint in your everyday life. What is it and where can we find it?
7. What people have been trying for sustainable production: real examples
It's harder for sole person cannot change the whole consumption patterns. How are companies and communities trying for sustainable production?
8. How to choose a 'better' product?
Last but not the least, we all can make small changes that would be stronger together. Do not forget these tips when you are shopping!

Introduction of Contents for Each Topic

Topic 1. Meet sustainable consumption and production, and the '4Rs'

Objective	Students can understand the basic concept of sustainable consumption and production, and the 4Rs.
Part 1	Learn about the meaning of sustainability, sustainable consumption and production.
Part 2	Understand what the 4Rs stand for.
Part 3	Know some specific ways to apply the 4Rs in daily life.

Topic 2. What are causes and effects of material and food consumption?

Objective	Students learn about the causes of consumption and problems with contemporary patterns of consumption.
Part 1	Learn why we eventually consume and be given a brief explanation about consumer culture.
Part 2	Know how contemporary fashion industry mainly depends on fast fashion and its problems especially to the environment, as an example of material consumption.
Part 3	Understand how food consumption affects our planet.
Part 4	Learn about the globalization of lifestyles and western influence.

Topic 3. What is the importance of responsible consumption and production in achieving sustainable development?

Objective	Students learn the meaning and kinds of responsible consumption and production, while understanding its importance in sustainable development.
Part 1	Understand the meaning of responsible consumption and production, which is SDG 12, and its importance.
Part 2	Learn which behaviors can be considered as responsible consumption and production.

Topic 4. What is the basic structure of current industrialized supply chain?

Objective	Students learn the basic structure of supply chain of contemporary industry, eventually to understand where the products they use come from.
Part 1	Understand what supply chains consist of and examples of supply chains.
Part 2	Understand the possible challenges of supply chains.

Topic 5. What is life cycle analysis?

Objective	In a similar vein with Topic 4, students can understand the life cycle of products they use.
Part 1	Learn about the basic concept of life cycle analysis and its process.
Part 2	Understand that recycling is also an important aspect of products' life cycles.

Topic 6. What are ecological/carbon footprints and what are examples?

Objective	Students learn about what ecological and carbon footprints are and are given the opportunity to consider their daily routines in relation to these concepts.
Part 1	Learn about the basic concepts of ecological and carbon footprints.
Part 2	Be asked some questions that help students to think how their daily activities affect the environment.

Topic 7. What people have been trying for sustainable production: real examples

Objective	Students are introduced to real life examples of private and public sector's endeavors for sustainable production and consumption.
Part 1	Learn about companies that incorporate sustainable production into their management philosophy and actual practices.
Part 2	Understand which international/state/local-level efforts are in progress working to achieve sustainable production and consumption.
Part 3	Realize that societal and institutional solutions, not only individual efforts, are required for bigger and effective change.

Topic 8. How to choose a 'better' product?

Objective	From what they have learned from the previous topics, students are introduced to specific methods that they can undertake as part of an individual endeavor to live more sustainably.
Part 1	Learn about exemplary behaviors they can actually practice in daily life.
Part 2	Be introduced to "Life Attitude of an Earth Citizen", provided by the Broad Group.

Glossary

Vocabulary	Definitions
Sustainable	Able to continue over a period of time.
Sustainable production	The production of goods or services using processes and systems that are socially beneficial, economically viable and environmental friendly in their whole life cycle.
Sustainable consumption	The usage of products and services in such a way that minimizes the impact on the environment, so that human needs can be met not only in the present but also for future generations.
Consumption patterns	The process by which people search, purchase and consume products in a way to meet all their needs or desires.
Supply chain	The whole process of making and selling products, including every stage from the supply of raw materials and the manufacturing of the goods to their distribution and sale.
Natural resources	Resources which come from the natural environment such as minerals, timber, water, and fertile land, which can be used for further production or consumption.
Carbon footprint	The amount of greenhouse gases—primarily carbon dioxide—released into the atmosphere by a particular human activity.
Life cycle analysis	Method to evaluate the environmental impact of a product through its life cycle, encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.
Raw material	The basic material that is used to produce goods and finish products or intermediate materials that are feedstock for future finished products.
Industrial process	The procedures including physical, chemical, electrical or mechanical steps for the manufacturing of an item or items.
Reduce	Make smaller or less in amount, degree, or size e.g., reduce waste generation, reduce over consumption.
Reuse	Use some goods again or multiple times. Before throwing goods away, trying to find someone or someplace else the goods can be further used.

Recycle	The process of converting waste materials into new materials and objects.
Recover	Convert waste into resources (such as electricity, heat, compost and fuel) through thermal and biological means.
Ecological footprint	A method promoted by the Global Footprint Network to measure human demand on natural capital.
Ethical shopping	The term given to the practice of purchasing products based on their minimal harmful impacts to society.
Anaerobic digestion	A sequence of processes by which microorganisms break down biodegradable material in the absence of oxygen. The process is used for industrial or domestic purposes to manage waste or to produce fuels like bio-methane.
Compost	The process of the organic matter that has been decomposed. This process recycles various organic materials otherwise regarded as waste products and produces a soil conditioner.
Bio-methane	A purified form of raw biogas from anaerobic digestion that can be used as a natural gas substitute.
Excessive consumption/ over-consumption	A situation where consumption has outpaced the sustainable capacity of the ecosystem.
Greenhouse gas	A gas that absorbs and emits radiant energy within the thermal infrared range. These gases cause climate change.
Soil fertility	The capacity of soil to sustain agricultural plant growth.
Monoculture	The agricultural practice of producing or growing a single crop, plant, or livestock species, or breed in a field or farming system at a time.
Groundwater	The water found underground, from the cracks and spaces in soil, sand and rock.
Responsible consumption and production	Promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all.

Which SDG is most related to this module?

Module 6 discusses sustainable consumption and production, and practical ways we can live more sustainably. The according SDG that covers these subjects is **SDG 12.**

"Ensure sustainable consumption and production patterns."

Topic 1. Meet Sustainable Consumption and Production, and the 4Rs

What does sustainability mean?

When something is "**sustainable**", it basically means that it is "**capable of being continued at a certain level**". In the context of our studies, something is considered to be sustainable if it doesn't hurt ecosystem services or it allows the society's quality of life not to decrease.

Economy Society Environment

Sustainability is, however, not only about the environment – it is made up of three pillars: economy, society, and environment.

What does sustainable consumption mean?

What is consumption? As you all know well, people continue to consume something whether it is goods or services, to satisfy their needs and wants. This activity, consumption, drives production as well.

So, we now know what is meant by 'sustainable' and 'consumption': then what does **'sustainable consumption'** mean? Literally that would be "the use of goods and services, but when it's kept capable of being continued at a certain level". Quite abstract, right? What do you think that "certain level" is?

'Level' means the level of impacts, especially negative impacts on the environment. Thus, when we say we are trying sustainable consumption, it basically means that we are trying to **minimize negative effects on the environment**, which can result from our consumption behaviors. From this, you can realize that sustainable consumption means that human needs can be met not only in the present but also for future generations.

What does sustainable production mean?

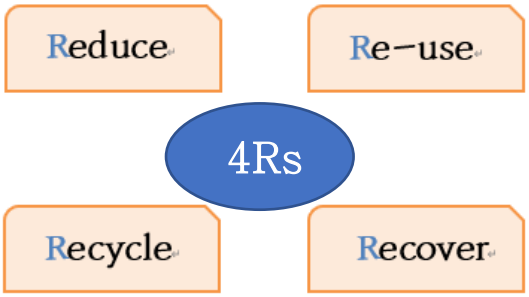
"In most of industrialized and developed nations, consumption patterns are not sustainable: products and services rely heavily on natural resources and are unsustainable."

Is consumption the only problem? No, we definitely have to look at the production side as well since **production uses raw material provided by the environment**, such as water, timber, and fossil fuels. So, to meet the desire of consumers for more goods and services, more industrial and manufacturing processes are required and those can deplete resources and increase pollution. And that is why we will discuss the importance of '**sustainable production'**.

Sustainable production basically means the creation of goods and services using processes and systems that have the following aspects. Firstly, **non-polluting** is considering the environment and thinking from an environmental perspective, also **conserving energy and natural resources**. And what were the other pillars of sustainability? Yes, from the economic pillar, sustainable production should be **economically viable**. Finally, from the society pillar, it means a production that is **safe and healthy** for workers, communities and consumers, and **socially and creatively rewarding**.

The concept of the 4Rs

When it comes to sustainable consumption and production, this is the very basic part for you to think of: the 4Rs! These 4Rs stand for four important concepts. They help to **minimize the impact of waste that we create**.



The first R is '**reduce**': you can reduce the amount of waste that is generated in the first place. The second R is '**re-use'**: you can give items to someone else who can use them, instead of simply throwing them away. The third R is '**recycle**': we all heard about recycling – if an item cannot be re-used any longer, it can be recycled, where it will be broken down into its original raw material state and produced into something else. Finally, '**recover**': recovering valuable resources from our waste also helps converting waste into new products.

Rethink

"We should rethink our daily consumption, our relationship with things and our relationship with Earth!"

There is also another R, though it is not included in the 4Rs: it's "**Rethink**". We should rethink our daily consumption, our relationship with things and our relationship with our planet – this is the basis for all of the 4Rs. Now, let's take a look at what we can actually do in our daily lives to practice the 4Rs.

Applying the 4Rs

Reduce	Reuse	Recycle	Recover

First of all, what we can do is to '**reduce**': this is basically about reducing our consumption or at least reducing the possible negative impacts on the environment from our consumption behaviors. So, you can either try to buy less, especially when it's not necessary, or choose 'ethical' products to consume when you have to buy something.

Cutting out the new: You can refrain from buying the newest version of a product if the current one is still working. Be an early-adapter for the environment. Also, you can try buying used or 'vintage' products – maybe you find something really cool and cheaper!

2. Choosing the ethical option: First learn more about products, including their carbon footprints. Then you can buy more environmental-friendly products like easily recyclable goods or choose products from companies with clear environmental and ethical policies.

3. Buying nothing: Please rethink before you buy something – ask yourself whether it is really necessary for you to purchase something. Do you really need it? How long are you going to use it?

Reduce	Reuse	Recycle	Recover

Reusing something can be practiced by easy and fun ways.
See the following!

1. Exchange, donate, or resell!

You can exchange old books, toys, or clothes that you don't use anymore, with your friends or family members. If you have things they don't want, you can either donate or resell them so that other people who need those things can reuse them.

2. Use your creativity

Try to think of other usages of your things. You can turn broken crayons into pretty candles as gifts or use old jars as pen holders, for instance.

3. Reuse the "disposable" things

Of course, you should refrain from using disposable items frequently. However, when you face a situation where you have to use disposable items, think about reusing them as well. Most disposable items can be reused after you clean them. Please do not throw them right away after a single use!

Reduce	Reuse	Recycle	Recover

Recycling, the third R, should be familiar to you. Though it may seem trivial, recycling in the 'right' way is very important, considering that lots of used-materials can be reused when they are properly recycled.

How to Separate Your Recyclables

Aluminum cans are highly valued recyclables, as they can be recycled again and again. Don't forget that aluminum foil and foil packaging can also be recycled, but make sure that you clean them well before throwing them away!

Plastics

Did you know that it is almost impossible for plastic items to decompose naturally once they are produced? That is why it is so important that you recycle plastics, not just throw them away. Check your local community's or country's regulations for recycling products made of plastic, as they can vary in different regions.

Paper

We have already learned how trees and forests should be valued. If there are staples in the paper you want to recycle, remember to remove them! Try to use clips or bulldog clips instead of staplers.

Glasses

Do not forget to rinse glass jars and bottles before throwing them away. Other things made out of glass like lightbulbs, mirrors, ceramics, sheet glass, etc. should be separated from glass jars and bottles when recycled.

Used electronics such as computers, monitors, keyboards should be properly recycled. Household batteries should never be simply dumped to the garbage – check your community's guidelines for recycling used batteries!

Recycling: from can to iPod

Recycling one aluminum can saves enough energy to listen to a full album on an iPod. In 2007, in an open letter to Apple, Steve Jobs encouraged the company to expand its own product recycling efforts. The company has set a goal of 70 percent recycling efficiency by 2015.

Reduce	Reuse	Recycle	Recover

The final R, recover, may sound a bit unfamiliar but it is also an important part that we should remember.

Even after we reduce, reuse, and recycle as much as we can, there can still be some waste left over. If so, we can use it to generate energy – and the place where we can do this is called an '**energy-from-waste** (EfW)' or '**waste-to-energy** (WtE)' facility.

For example, we can collect food leftovers or some agricultural waste and by utilizing composting or anaerobic digestion produce biomethane.

In China, landfills have been the main method of waste disposal. However, this tendency is changing – the amount of incineration is growing, following the government's policies to enhance waste incineration which include building municipal **incineration power plants**.

Figure 95. Tongxing City Household Garbage Incineration Power Plant.

Tongxing City Household Garbage Incineration Power Plant in Chongqing, for example, has a daily capacity of 1200 tons

[Topic 1_Activity]

You have learned about the 4Rs! Now let's link the 4Rs with our own daily lives, by reviewing the meanings of each of the 4Rs: Reduce, Reuse, Recycle and Recover. This is a simple reminder for you on the basic concepts of Sustainable Production and Consumption, to prepare you for the following topics.

Reduce	This week, I have reduced / I am planning to reduce _____. WHY? _____
Reuse	This week, I have reused / I am planning to reuse _____. WHY? _____
Recycle	This week, I have recycled / I am planning to recycle _____. WHY? _____
Recover	I think _____ can be recovered into _____. WHY? _____

- **How to work on this activity**

1) For 'Reduce, Reuse and Recycle,' fill in the blanks based on your experience.
   Ex) This week, I have reduced / I am planning to reduce _____.
   ➔ This week, I am planning to reduce the amount of plastic spoons I use / the amount of water I use when I take a shower.

2) For the first 3 Rs, think about 'why' I did / am planning to do those actions and fill in the following blanks too.
   Ex) This week, I am planning to reduce the amount of plastic spoons I use.
   ➔ WHY? Because by using less plastic, we can produce less plastic than before, and this will save energy.

3) For the last R – 'Recover,' imagine the transformation of old and used materials into a new, different product. Fill in the blanks with the reasons and share your opinions on this part with your classmates.
   Ex) I think used clothing can be recovered into a brand-new bag.
   ➔ WHY? Because throwing away new clothes creates too much waste, if clean parts of old clothes are collected, they may become fabric to make a new bag.

Topic 2. What are causes and effects of material and food consumption?

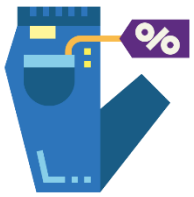
What are the reasons for humans to consume products and services?

We all need certain things to meet our **basic needs** and therefore consume or purchase such things as water, food, housing, clothing and so on. Another reason to buy items is that they might have value, meaning and a certain cost for us. We **associate social and personal experiences** with the consumption of some items. However, buying things to gain **personal happiness** by gaining some material possessions is a cause of consumption. Furthermore, some might consume certain items because of being encouraged by the **media which influences our consuming behaviors** in our daily lives. Influencing one´s social status can be another reason for consuming specific items and products.

In many developed countries, we can see a certain **consumer culture**, where people get used to consuming more and more, which leads to excessive consumption / over-consumption.

Buying products and consuming them in huge amounts has an effect on our environment too! Let's look into some examples.

Example 1: Today´s Fast Fashion



The term "Fast Fashion" means **trend driven, cheap, poorly made, and easy to purchase clothing**. Fashion changes very fast and therefore new clothes are being made faster and faster. Fast Fashion occurred due to the increased affordability, accessibility and rapid production of clothes.

But more importantly, it has become an issue because of us. It often happens to many people that after buying an item of clothing, for example a new shirt, that we barely even wear it, maybe just a few times or maybe even only once or twice. And then after a short time we don't like it anymore, as it is probably out of fashion after a few weeks. Then, we simply

throw it away and buy ourselves a new shirt. This process happens within a short amount of time and the shirt did not get many chances to be worn by us. What happened here is: **Fast Fashion**.

Fast Fashion is extremely bad not only for our planet, but also for the people who make our clothes. One major problem of Fast Fashion is that for many people it causes **overconsumption** of clothes by making them buy more and more, but rarely wear them before throwing it away, and then buying new clothes that are on the market. Another problem is **poverty and human rights abuses**. Many workers in the factories that produce our clothes are forced to work for low wages in unsafe conditions because they are very poor and have no other option to make any money.

Of course, the **environmental impacts** of Fast Fashion are immense as well. It is a major contributor to GHG emissions, and harmful chemicals from toxic dyes are washed into the water. Also, textile waste is created and causes damage to our environment.

Example 2: Food Consumption

What we eat has a huge impact on our planet as well. The way we produce and consume our food influences not only our environment, but also our personal health.

With an **increasing global population**, more and more people need to have food. However, the production of many food products that we eat every day, need lots of resources like water and energy. Therefore, the sustainability of the production of more food becomes an issue that we need to address.

Effects that our diet has on the environment

- Food production is a major contributor to **GHG emissions** worldwide.
- Agriculture consumes major **water resources**.
- Raising **large numbers of animals** in small areas leads to inhuman conditions in which many animals suffer. Lots of animals produce lots of manure waste that is harmful for our environment through gas emissions like methane. Additionally, the production of waste water also harms the environment.

- **Diversity gets lost** when more and more farmers cultivate crops that are the same type (monoculture). This is also dangerous, because the crops become more vulnerable to parasites or diseases as they are the same type, meaning there is a greater chance of a huge loss of crops at the same time, undermining food security.

- To grow more and more crops faster requires the increased use of **fertilizers and pesticides** that can turn the soil into poor farmland in the long run and pollute our groundwater.

Globalization of Lifestyle

In the process of industrialization global excessive consumption has increased and the western lifestyle was adapted in quite some areas. Let's look into some example and compare a traditional Chinese lifestyle with a modern globalized lifestyle.

Traditional Lifestyle

Some examples for a traditional Chinese lifestyle are presented by the following areas:

Buildings: most people lived in rural mud and straw houses.

Weddings: wedding ceremonies were traditionally hold in traditional clothes and the bride was wearing a red traditional wedding dress.

Hairstyle: most people had the same hairstyle; one example is the traditional Manchu (pigtail).

Diet: the Chinese diet was dominated by rice and local vegetables and fruits.

Basic needs were met through the traditional lifestyle. It was a satisfying life.

Western Influence / Globalization

Through globalization the influence coming mainly form the western culture was introduced and many things in a daily life changed. The average lifestyle became more focused on consumption of various western introduced products. Some examples are the following:

Buildings: American style skyscrapers and western modern architecture can be found in China today and the skyline of many big cities is dominated by such skyscrapers.

Weddings: the western form of wedding ceremony is implemented by many wedding couples and the traditional wedding dress is replaced (or added) by a white dress.

Hairstyle: western hairstyles with dying hair colors is common nowadays.

Fashion: various different clothes, designs and fashion styles of various brands can be found, as well as many with Chinese designs.

Diet: an increased consumption of wheat, high protein and energy dense foods has taken place. Also, more livestock and dairy products have been introduced to the Chinese population.

In many areas western influence can be found. The western lifestyle has changed the lifestyle of many people today.

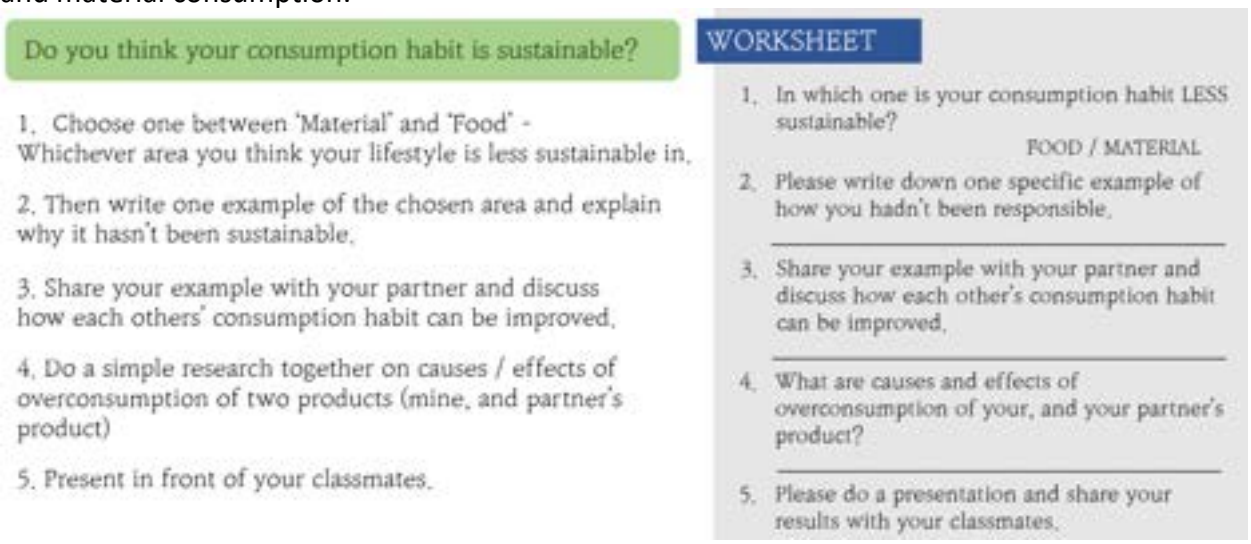
Now ask yourself:

- Where does the food I eat come from?
- How much water, energy and land does certain foods require to be produced?

- ✓ Which food or ingredients do you eat daily?
- ✓ Do you know where those foods and ingredients come from and how? Through which supply chain do you think your food traveled?
- ✓ Think of your favorite food and its main ingredient. How much water, energy and land does it require to produce?

[Topic 2_Activity]

We have learned about the causes and effects of material and food consumption. Each of us will have some aspects of our consumption which are not responsible. Let's examine our own habits and think about how we can improve. Also, let's look for more diverse causes and effects of food and material consumption.



Do you think your consumption habit is sustainable?

1. Choose one between 'Material' and 'Food' - Whichever area you think your lifestyle is less sustainable in.
2. Then write one example of the chosen area and explain why it hasn't been sustainable.
3. Share your example with your partner and discuss how each others' consumption habit can be improved.
4. Do a simple research together on causes / effects of overconsumption of two products (mine, and partner's product)
5. Present in front of your classmates.

WORKSHEET

1. In which one is your consumption habit LESS sustainable?
   FOOD / MATERIAL
2. Please write down one specific example of how you hadn't been responsible.
   _____
3. Share your example with your partner and discuss how each other's consumption habit can be improved.
   _____
4. What are causes and effects of overconsumption of your, and your partner's product?
   _____
5. Please do a presentation and share your results with your classmates.

- **How to work on this activity**

1) Think about your consumption habits in your daily life. Then circle the area (Food/Material) that you think you are less sustainable in (you may choose both).

2) Think of a specific case in which you haven't been acting sustainably. It may be simple or can be detailed with a certain product. Please fill in the blanks explaining your experience.
   Ex) I chose food because every time I order pizza, I don't finish all the slices and end up throwing half of them away since I am the only person who likes pizza among my family members.

3) Share each of your answers and discuss how you can improve those unsustainable habits.
   Ex) My partner told me that he always throws half of the pizza away, but still orders it every time he wants it. Rather than ordering a big sized pizza, I think it might be better for him to buy just a few pizza slices when he goes to the store. That way, he wouldn't have to overconsume food and can reduce the amount of food waste.

4) Think about why people overconsume the product you chose and the product your partner chose. And then guess the results from this overconsumption.
   Ex) I think for pizzas, it's because people think it doesn't harm humans directly. People don't think deeply about leftover foods' impacts. The overconsumption of pizza may make people use more water to produce more food, which is bad for the environment.

5) Make a presentation outlining what you and your partner wrote.

Topic 3. What is the importance of responsible consumption and production in sustainable development?

What is responsible consumption and production?

In short, it means using resources efficiently, reducing waste as much as possible **taking into account ecosystem services** that are key for people's lives, and reducing the impact of dangerous chemicals.

According to United Nations: "Sustainable consumption and production is about promoting **resource and energy efficiency**, **sustainable infrastructure**, and **providing access to basic services**, **green and decent jobs** and a **better quality of life for all**. Its implementation helps to **achieve overall development plans**, **reduce future economic, environmental and social costs**, **strengthen economic competitiveness** and **reduce poverty**."

Which means it is about to **do more and better with less**. It is not just about a personal living habit or a short-term goal, it is a kind of long-term living style which can contribute to various sectors.

What's the importance?

Responsible or sustainable consumption is **necessary to reduce the negative impact on the climate, the environment and people's health**. Our environment will be damaged if we don't do our part.

Lots of people are consuming far to more than their basic needs. If we keep overusing our resources to meet our excessive wants, there will come a day when the earth can no longer provide us with the resources necessary to fulfil our basic needs.

Think about the advertisements we see every day. We are being encouraged to spend more and buy more, there is no doubt that we are living in a consumerist society. We are influenced by the internet, social media, advertisements, and TV to use far more than necessary, or buy things we do not even need. An exaggerated amount of products are shown to us, the production of which is using up the earth's limited natural resources. It is important for us to break away from this "culture" created by business. Our challenge now is to rethink the way we do things.

Responsible

Consumption | Production

Responsible consumption means consumption which is more environmentally friendly, but also considers the social and economic impacts of consumption.

- **Buying better** – buying greener products
- **Consuming better** – wasting less and having more sustainable consumption behaviours
- **Throwing away better** – taking into account recycling in particular

Responsible

Consumption | Production

Responsible production involves the production of goods and services in an ethical way which involves the minimisation of waste and pollution.

- Minimising carbon emissions at all stages of the production process
- Cutting down on or seeking to eliminate waste
- Controlling and reducing any harmful emissions and pollution resulting from production activities
- Ensuring that all supplies are from sustainable sources
- Monitoring and minimising negative impacts on natural environments where production takes place
- Making environmental health and safety paramount

[Topic 3_Activity]

Think of the products around you. It can be things in school, or any stuff at home. Why did you buy it? Did you use the product properly and efficiently? If not, how can we reduce the waste created by using this item? Let's link this with how we can throw this away in a better way – in a more ecofriendly way. Fill in the chart with your own thoughts. You may share your opinions with your partner or ask family members if you have a hard time coming up with a certain product you have bought on your own.

Example) Name of the item: Electronic dictionary / Use of the item: I had to use it for English tests at school. / How can we reduce the waste created by using this item?: If we need it for only a short period, instead of buying it we can borrow it from someone else few days before the test. Or if we already bought an electronic dictionary, we could lend it to classmates. We could also use paper dictionaries too. / How can we throw away this item in a better way?: We should separate the batteries and the body of the electronic dictionary before throwing it away, and put it in the appropriate recycling bin.

Name of the item	Use of the item (Why did you buy this?)	How can we reduce the waste of this item?	How can we throw this item in a better way?

- **How to work on this activity**

1) Read the above example.
2) Fill in the chart with the list of products around you. It can be things in school, or stuff at home.
3) Think about why you bought it, how you can reduce the use of the item and how to throw it away in a better way.

Topic 4. What is the basic structure of our current industrialized supply chain?

What is a Supply Chain?

A supply chain describes the **process** that transforms raw materials into final products that we can use. It is a connected network of individuals, organizations, resources, activities, and technologies. There are many people and many steps involved in one supply chain. A good supply chain can be very efficient and optimized. A supply chain is very important for both, companies and customers. Before we can get a product or service, many steps are involved in producing and bringing this product to us.

Who is involved in an industrialized supply chain?

Producers, Vendors, Warehouses, Transportation, Companies, Distribution centers, Retailers

What are Functions of supply chains?

Product development, Marketing, Operations, Distribution, Finance, Customer service

Basic structure

The **raw materials** that are needed for a certain product are bought by a **supplier** and then brought to a **factory** where the raw materials are transformed into products. When the product is finished it will be brought to a **distributer**, who will then distribute them to different **retailers**. The retailers will sell the product to us, the **customers**. We use the product and after a certain amount of time we demand a new product, and the cycle starts again.

Examples of Supply Chain's Structure

Products for e-commerce

When you order products online, the products are delivered from warehouses to you via only a few stages of logistics and shipping.

Products made out of raw materials

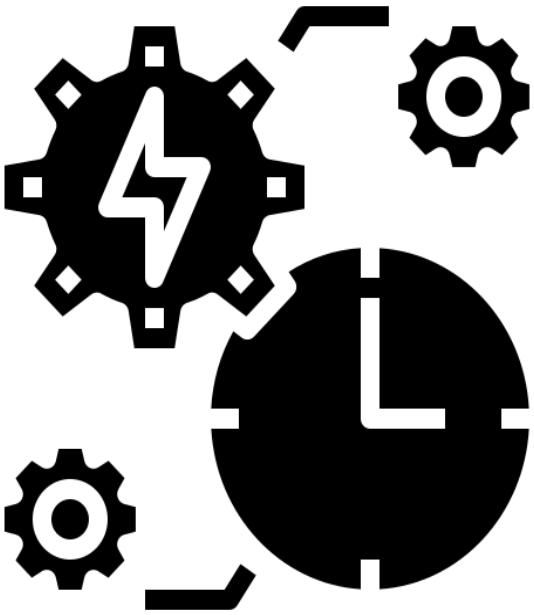
When there is demand from customers, raw materials are delivered to suppliers and then manufactured at factories. Final products are brought to retailers, usually through distributers, and then we can buy what we want at markets, etc.

Good or bad supply chain?

A supply chain needs to be managed well in order to be a good and sustainable supply chain that **minimizes any negative impacts on the environment and the people working in it**.

Challenges

Today, we have so many products from which we can choose to buy and consume. It is therefore challenging for some supply chains to be good and maintain its services. A growing global market makes it more and more competitive for companies to establish a safe market position with regular customers. Customers always seek to buy cheaper products and want to have their products delivered to them faster.



This challenges supply chains to work faster, harder and cheaper. This excessive focus on cost minimization can harm the people who are working in the supply chain. Workers get exploited, some supply chains make profits from child labor and in extreme cases human trafficking is involved.

It is important to know as much as possible about the supply chain of the products that we use. Only then we effectively minimize any harmful impacts.

[Topic 4_Activity]

Supply chains are an essential part of the world economy and bring us things from all around the world. It's important to think about the process of how things we use every day were made and transported to the stores where we bought them. For example, in this picture we can see how milk is made from the first step where cows are fed, to the final step where we consume the milk. Let's try to make some other examples of supply chains. We can do this activity as a class or in teams. Don't worry about being 100% correct; let's just try our best guess of the steps of the supply chains!

- **How to work on this activity**

1) This activity can be done as a class on the board or in groups who present the supply chains they made to the class afterwards.
2) Look at the above example of a supply chain.
3) With other students name some other products you use every day (fruit, toothbrush, smartphone, etc.).
4) Try to make a supply chain of those products. Don't worry about your supply chain being 100% accurate.

Topic 5. What is Life Cycle Analysis?

Life Cycle Analysis

Manufacturing a product can be very complex. We use lots of resources to produce a product, and obtaining each one of the materials involves a different series of inputs, outputs and processes.

Figure 96. Life Cycle Analysis.

Life cycle analysis (LCA) is a method used to **evaluate the environmental impact of a product through its life cycle** encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.

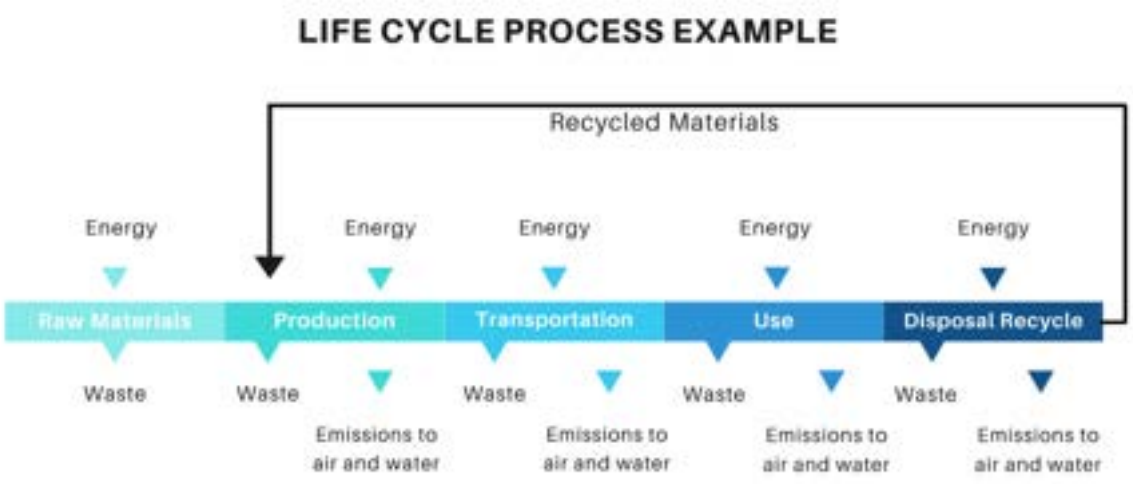


Figure 97. LCA Process.

Life cycle analysis covers all related inputs from the environment (e.g. crude oil, water, land use) as well as emissions into surroundings (e.g. carbon dioxide and nitrogen oxides). It includes the upstream (e.g. suppliers) and downstream (e.g. waste management) processes connected with the production (e.g. production of raw), transportation (e.g. fuel of vehicles), use (e.g. waste), and disposal (e.g. waste incineration).

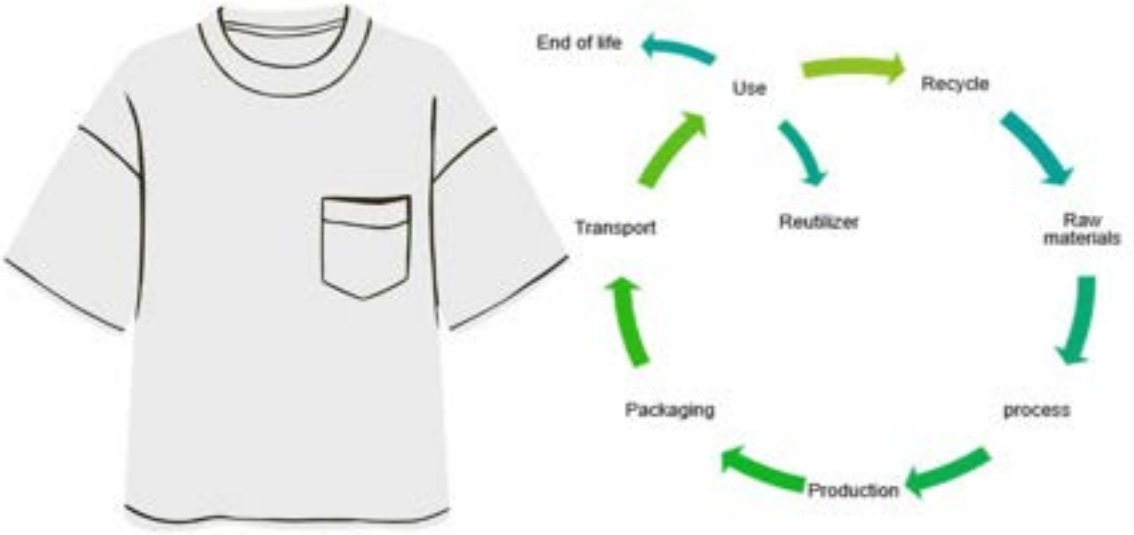


Figure 98. LCA of T-Shirt.

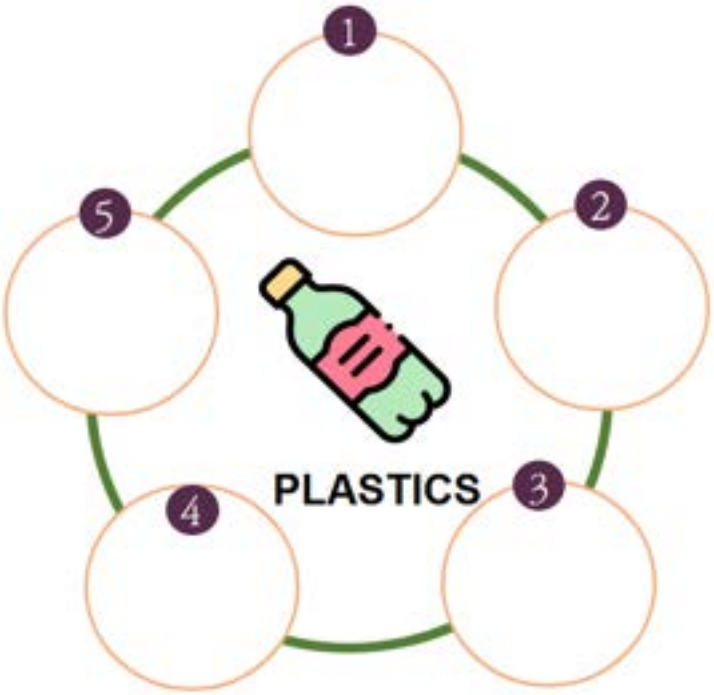
For example, think about the t-shirt you wear, how many processes are involved? How are energy, water, and other inputs used during each stage of the production process? Can energy be saved either by upgrading to more efficient techniques or by switching to more sustainable suppliers? What other methods of being more efficient can you think of?

[Topic 5_Activity]

Life cycles for every product are different. Recycling is a way in which we can make the life cycles of each product more efficient and environmental friendly. In order to become familiar with sustainability and find out how we can participate, it is important to know products' recycling cycle steps in the right order. Let's begin!

Recycling cycles, lets fill in the order!

The colored boxes are the steps of each product's recycling cycle, which are in random order. Match the colored boxes with the empty circles in the right order.



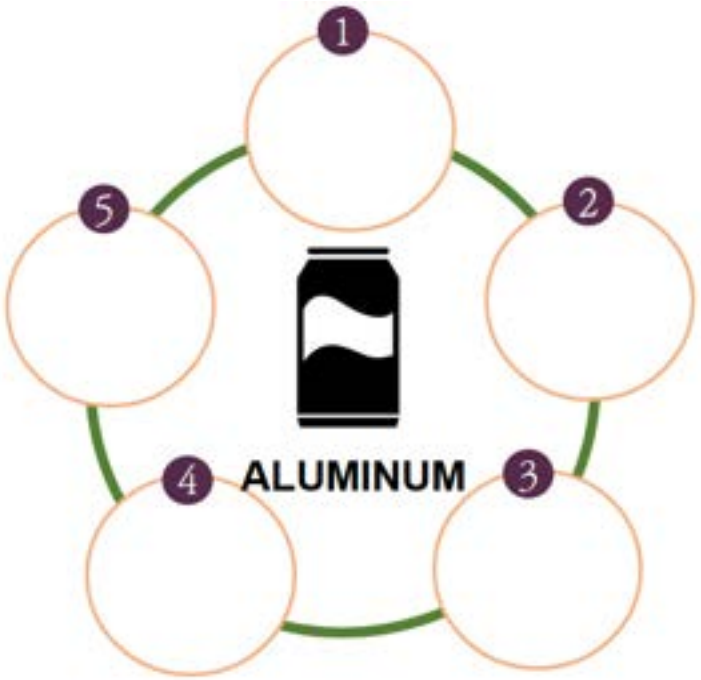
Sorted into different types and colors.

Picked up by drivers who transport the material to the nearest recycling center.

Filtered and sifted of contaminants.

From the pallets, new plastic is created to be taken back to a store.

Chopped and melted into pellets or made into fibers.



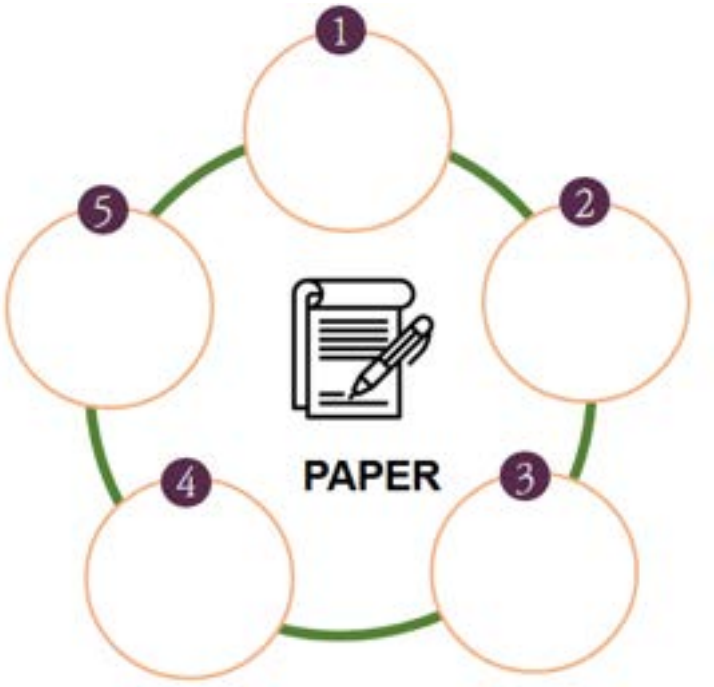
When collected as a waste, products are chopped up.

The molten product is poured into ingots.

They are heated for melting and get mixed .

Rolled into flat sheets and ready to be made into new products.

They are heated to remove the paint coating.



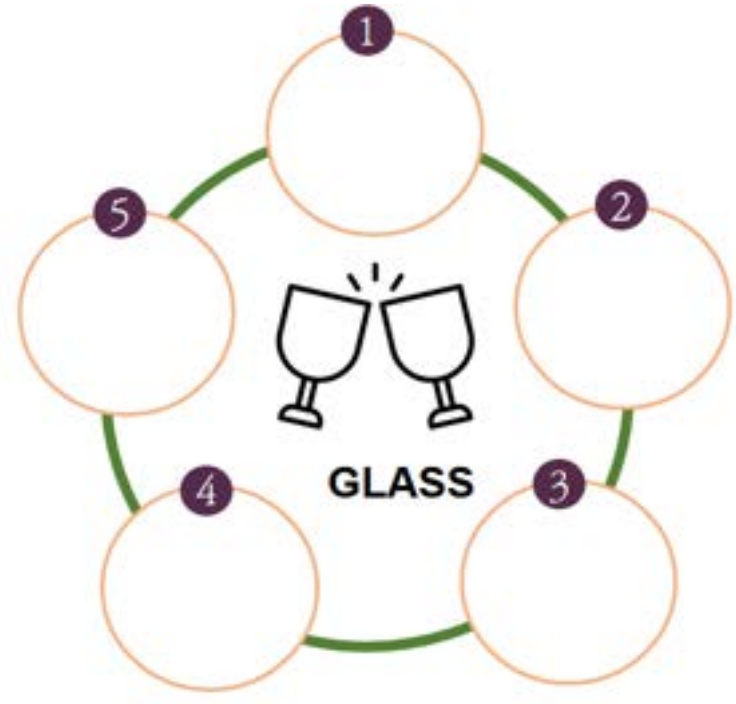
Different products such as cardboard, newsprint or office paper.

Mixed with water to create a slurry.

Different materials added to the slurry.

Separated into different types and grades.

Washed with soapy water to remove inks, plastic film, staples and glue.



Crushed and mixed with sand, soda ash and limestone

Collected and sorted by color.

The mixture is melted through heat.

Washed to remove any impurities.

Molded into new products such as bottles and jars.

• **How to work on this activity**

1) Each of the above charts are the recycling cycle steps for plastics, aluminum, paper and glass.
2) In the colored boxes, the steps of each product's recycling cycle are written. They are in a random order.
3) Each number represents the steps of the cycle. Therefore, the colored box with the first step should go to the vacant circle with number 1 on the top. Match the colored boxes with the numbered circles.
4) Guess, and match all the 5 steps – and check your answers with your partners!

Answers:

• Plastics: Picked up by drivers who transport the material to the nearest recycling center → Sorted into different types and colors → Filtered and sifted of contaminants → Chopped and melted into pellets or made into fibers → From the pellets, new plastic is created to be taken back into a store

• Aluminum: When collected as waste, products are chopped up → They are heated to remove the paint coating → They are heated for melting and get mixed → The molted product is poured into ingots → Rolled into flat sheets and ready to be made into new products

• Paper: Separated into different types and grades → Washed with soapy water to remove inks, plastic film, staples and glue → Mixed with water to create a slurry → Different materials added to the slurry → Different products such as cardboard, newsprint or office paper

• Glass: Collected and sorted by color → Washed to remove any impurities → Crushed and mixed with sand, soda ash and limestone → The mixture is melted through heat → Molded into new products such as bottles and jars

Topic 6. What are the concepts of ecological/carbon footprints and what are examples?

Our planet has many resources that help us to fulfill our basic human needs. Such needs include food, housing, and heating. We therefore can use the resources that our planet has to meet our needs.

However, we have to ask **how much** of the resources that our planet provides we can use. How much of the Earth's resources are we consuming? In order to answer that question, the concepts of our ecological and our carbon footprints can help us.

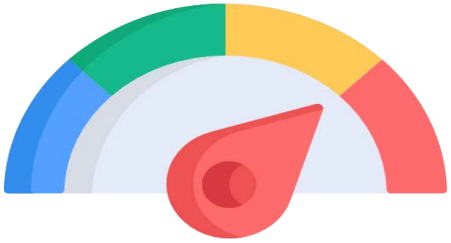
Our Ecological and Carbon Footprint

Both are concepts that help to measure human impact on the environment. With these measurements we can have a better impression of how much of our planet's resources we are using.

The Ecological Footprint

The ecological footprint is a metric that helps to measure **how much nature we have and how much nature we use.** It also tells us the speed of how fast we consume the planet´s resources and how fast we generate waste. Basically, it compares how fast we use resources and compares it to how fast nature can absorb our waste and how fast nature can generate new resources. This ecological footprint tells us the amount of environment that is necessary to produce the goods and services that we are using today to support the particular lifestyles that we are living.

Supply side
Biocapacity
= Ecological reserve



Demand side
Ecological Footprint
= Ecological deficit

The ecological footprint is measured in global hectares (gha). It is expressed by the **ecological footprint as the demand side**, which is measured by ecological assets that a population needs to produce goods and services it consumes. On the **supply side** is something called "**Biocapacity"**. The biocapacity represents the productivity of ecological assets, like forests, land, fishing waters, and croplands etc., so basically the capacity of a certain area that produces resources for us.

Measure of **demand vs. supply of nature**.

The ecological footprint can be calculated for a single individual, a city, a region, a country or even the entire planet. There can be an **ecological reserve** or an **ecological deficit** for the area

that is being calculated. For example, if the ecological footprint of specific country´s population exceeds the country´s biocapacity, then it has an **ecological deficit**. This means that this country´s demand for goods and services that its land and seas can provide exceeds what the country´s ecosystem can renew. Of course, some countries have more biocapacity than others and not every country can provide for itself sufficiently. Countries which have an ecological deficit meet their demands usually by importing resources and goods. But this also means, that they often emit more GHG than their own ecosystem can absorb. On the other hand, if a country´s biocapacity exceeds its ecological footprint, then it has an **ecological reserve**. This means that this country can produce its goods and services self-sufficiently and emissions can be absorbed by its own ecosystem.

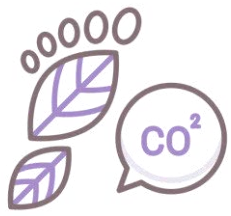
Calculating one´s ecological footprint can help to improve sustainability and to understand one´s impact on the planet. While calculating your ecological footprint you need to think about the following consumption categories:

- Food
- Shelter (Home)
- Mobility (Transportation)
- Goods that you buy
- Services

What is overshoot day?

Earth´s overshoot day is the day when humanity's ecological footprint is bigger than the earth´s biocapacity. This happens when the whole planet is then in an ecological deficit. It is the day when humanity´s demand for ecological resources in a year exceeds what our planet can regenerate in that year.

The Carbon Footprint



The carbon footprint is an important component of the ecological footprint. It measures **the total amount of GHG emissions** (measured in carbon dioxides equivalent in tonnes) that are being emitted by an individual, an organization, or an activity. It therefore is part of the ecological footprint but compared to the ecological footprint, the carbon footprint concentrates on GHG emissions rather than on an entire lifestyle. The carbon component of the ecological footprint measures the area of land, like forestland, that is required to absorb all the carbon emissions from human activity.

A carbon footprint can be used to determine the impact that burning fossil fuels or consuming electricity would have on the environment.

'Food mileage' is used to describe the carbon footprint of food that travels around the world – and that is why it is better to consume locally-produced food, as transportation of food also contributes a lot to the GHG emission.

Things to keep in mind when checking carbon footprints:

Carbon footprints are usually production-based. So even when the goods are not 100% consumed within a certain country and rather are produced for consumers of other countries, it can be included in that certain country's carbon footprints.

For instance, the carbon footprints based on consumption of China turns out to be relatively smaller when compared to those based on production as the graph below shows.

Thus, consider both perspectives when you check carbon footprints – production-based and consumption-based!

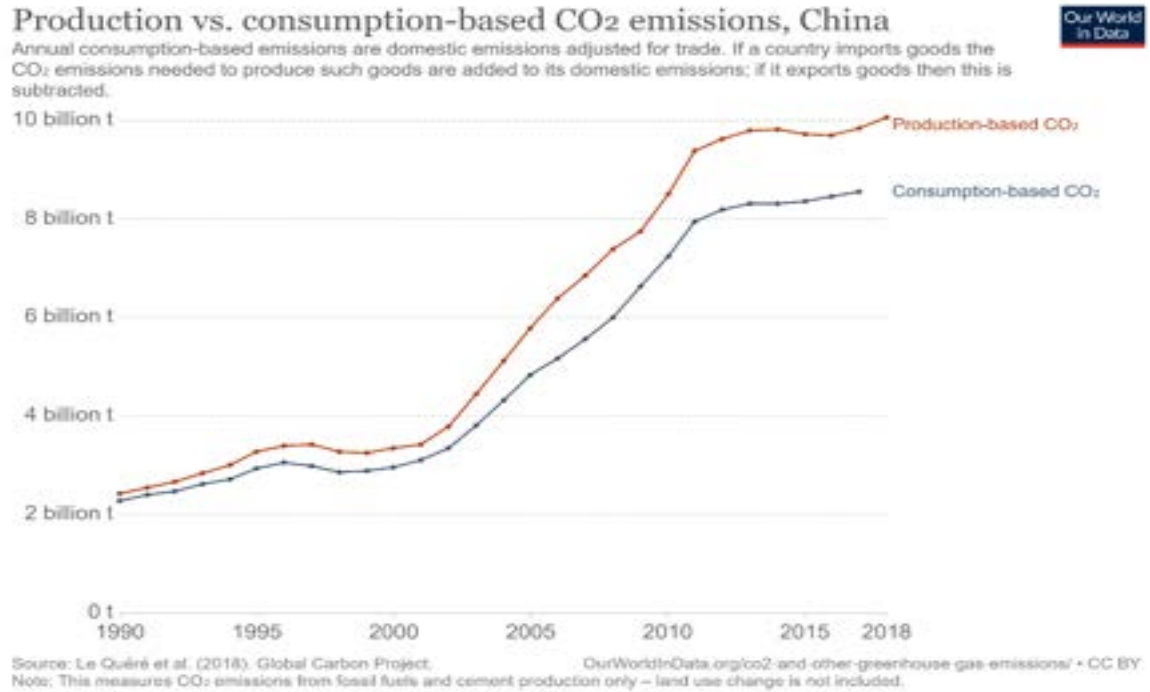


Figure 99. Production vs. consumption-based CO2 emissions, China.

[Topic 6_Activity]

Ecological and carbon footprints are useful ways of understanding how our lifestyles impact our environment. It's important to seek out information on how to live sustainably. But it's also important to think for yourself about ways we as individuals and as societies can reduce our ecological and carbon footprints. Let's discuss as a class or in teams our own ideas of how to reduce our negative impact on the environment.

• How to work on this activity

1) For this activity we should think about things we can do as individuals and things we can do as society do reduce our carbon footprints.
2) It is important to think independently about solutions to problems, rather than just passively being told solutions.
3) Be respectful when debating different methods of living more sustainably, and the benefits and costs of different approaches.

Topic 7. What People Have Been Trying for Sustainable Production: Real Examples

It is not just our individual efforts that are important for responsible production and consumption: many companies and communities – at local, nation/state, or international level – are moving forward for more sustainable production. Let's look at some examples to see how companies and organizations are being more sustainable.

Companies – Management philosophy & actual practice

Market Kurly

Figure 100. Market Kurly's green packing materials.

"Market Kurly" is one of the most famous online distributors in the Republic of Korea and aims for **sustainable distribution** based on its management philosophy. This includes the pursuit of sustainability of ▷ accompanied growth with producers, ▷ choice of products, ▷ development and improvement of packing materials and ▷ social responsibility and contribution.

One of their endeavors for sustainable production is **environmentally friendly packing materials**. All packing materials are made of paper instead of plastic, so that they can be recycled and thus be more sustainable in the long term.

IKEA

One of the most famous global furniture brands, IKEA, also promotes sustainability in their corporation. IKEA pursues sustainable furniture materials, environmental-friendly products, sustainable food production, and mainstreaming sustainable lifestyles at home.

Figure 101. Ikea logo.

These all go along with its vision: "**To create a better everyday life for the many people**."

Nantong Yiyi Interlining Company

Product innovation for better environmental performance

The company replaced its polluting product line with a less water-consuming and water-polluting fabric and improved its recycling system for processed water. It also increased water use efficiency by one third, significantly reduced its COD (chemical oxygen demand) discharges, and reduced energy consumption by 400 tons of coal. This not only improved their production process environmentally, but it also increased the company's profits.

Figure 102. Nantong Yiyi Interlining Company.

General Electric (China)

Green supply chain

GE China implemented the **green supply chain management system**. This includes most of the stages of their supply chain: production, logistics, and information platform construction. The company is also implementing green information disclosure and supplier for sustainable development.

Figure 103. Sustainable Priorities of GE.

Its effort is also helping China's green supply chain **innovation** project in general. GE's green supply chain is helping more supplier partners resolve excess capacity, promote transformation and upgrading, and achieve multi-win results. These include digital energy-saving management, intelligent production, and sewage treatment.

Green production, management, and suppliers

Baic Group

Baic Group of China focuses on green production, green management, and green suppliers as well

Figure 104. Baic Group.

The group uses the environmental protection and energy-saving materials and puts effort into improving the efficiency of resource utilization and reducing pollution.

Its green management includes the following: 1) shortening product development cycles; 2) improving product quality; 3) reducing resource consumption; 4) reducing environmental impacts.

All suppliers should meet the requirements of national green environmental protection laws and standards, including reducing the use of packaging materials.

Green management | Green product | Green suppliers

International cooperation – Strong criteria and regulations

Forest Stewardship Council

Established in 1993, the Forest Stewardship Council (FSC) is now working with 25 countries to implement **sustainable forest management** from social, economic, and environmental perspectives. The council also aims to protect forests from reckless development, illegal reclamation, and illegal logging. The council's values are not only for businesses, but also for people and forests, including encouragement of the SDGs. Its standards include forest management certification and chain of custody certification.

Figure 105. Forest Stewardship Council.

National/state-level efforts

China's Guideline of Green Production and Consumption

It aims to promote **cleaner production, resource recycling and management**

The country will develop a circular industrial economy, with a focus on electrical, electronic and automobile products, power storage batteries, lead-acid storage batteries and certain packaging materials. The guideline states amid efforts to strengthen the responsibility of producers for recycling waste products.

Fresh approaches for garbage treatment

1) State-level efforts

Spittelau incinerator

The Spittelau incinerator, a municipal incinerator plant of Vienna, Austria, became a famous landmark and photo spot thanks to its remarkable design.

Figure 106. Spittelau incinerator.

Amager Bakke

Also known as CopenHill, Amager Bakke is a waste-to-energy power plant in Copenhagen, Denmark, with hiking trails and ski slopes, attracting people for sightseeing as well.

Figure 107. Amager Bakke.

2) Local-level efforts

Curitiba, Brazil

Curitiba of Brazil had suffered from environmental problems by rapid industrialization. To solve those problems, city government's environmental policies were conducted and succeeded. Its policy included:

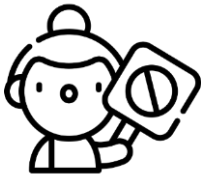
1) Strong protection of green areas
2) Improvement of the public bus system
3) Practical incentives for recycling

Muntinlupa, The Philippines

The village of Muntinlupa runs an innovative program for trash management. When people bring plastic trash, the local government pays them with rice.
Considering the serious ocean pollution in the Philippines, this policy is not only an effective garbage management strategy, but also is a subsidization program for the poor.

Why is the system important?

We have seen many examples of systemic efforts for sustainable consumption and production. Before looking at what we can do in our own daily lives, why do you think it is important for the society to develop and implement policies?



There have been many activists and NGOs who speak out and fight for the environment – such as Greta Thunberg, Paul Hawken, Greenpeace, World Wildlife Fund, and Friends of Nature. Solutions and sustainable habits at an individual level or activism are crucial, but **systems and policies need to be in accordance with other parts** of our economy, society, and policies in order to effectively and thoroughly fight climate change.

So, think about these questions:

* How can people be encouraged to use public transportation if there is none, or the transportation system itself is old and emits large amounts of GHGs? Can people still try to use public transportation or is it even environmental-friendly?

* How can people cook without combustion if no electricity is provided? What if there is not enough infrastructure to use electricity? Do they have any other options?

* How can we eat more vegetables instead of red meat if there are no fresh markets, or when we do not have enough money for better products?

We should bear in mind that not every single person lives in the same surroundings or circumstances in their daily life: **the very base line for responsible consumption and production should be encouraged by society and the system**.

[Topic 7_Activity]

We have learned many ways of how countries and companies have changed their behaviors to be more sustainable. By focusing on practical achievable goals many people have greatly reduced waste and inefficiency which harm the environment. Let's each make our own list of ways we will reduce our ecological and carbon footprints.

Make your own plan on how you will reduce your ecological and carbon footprints

How I will reduce my ecological and carbon footprints:

a. _____

b. _____

c. _____

d. _____

e. _____

- **How to work on this activity**

1) The activity should be completed individually.
2) Having learned about practical methods of reducing their ecological and carbon footprints, and also creating and discussing their own ideas in the previous activity, now you should list 5 ways you intend to reduce your ecological and carbon footprints.
3) You should take the your commitment seriously to contribute individually to protecting the environment.

Topic 8. How to choose a 'better' product

The choices we make every day as individual consumers collectively affect our world. It would be much better for everyone to know how to choose 'better' products and be responsible consumers. So, you should always ask yourself when consuming: how is my consumption affecting the environment and my community. Let us take a look at some suggestions for living a greener life.

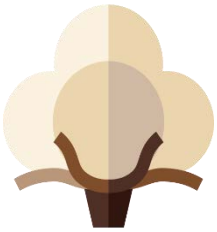
1. Clothing

✓ **Ethical shopping**

Ethical shopping aims to minimize harm to people, animals and the natural environment.

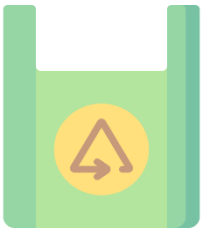
This includes products that are fair traded, organic, recycled, reused, produced locally, or cruelty-free (products which were created without animal experiments).

✓ **Better textiles and clothing**



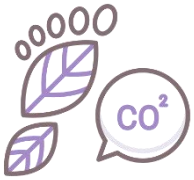
You can choose clothes made of natural fibres as they are produced with less use of fossil fuels, in comparison with glass and mineral fibres. Re-fashioned and second-hand clothes also extend the life of products. Remember that fast fashion can end up creating tons of trash.

✓ **Sustainable packaging**



Try to use less packaging, but if you have to use packaging, use as minimal as possible and try to find packaging made of recyclable or renewable materials that have the most potential to be reused or recycled and therefore have the least negative impact on the environment. Do not forget to bring your own bag when shopping!

2. Food



We should consider how the food we eat is produced, transported, and sold. To do this you can refer to **'food miles'**: how far a particular food has travelled to get to your plate.

To lessen the food miles of the food you eat consider the following:

- **Local and seasonal food** help reducing the use of fossil fuels as they require less use of resources to be transported. Also purchasing local food boosts local economies and thus helps your neighborhood.

- Food production GHG emissions directly from farm animals account for 30% of total GHG emissions. Therefore, **meat-free meals** definitely help our planet. If you find it difficult to have 100% meat-free meals, try to lessen the amount of red meat you consume. Compared to other types of meat production, red meat production is usually the worst for the environment. Reducing red meat consumption can also be good for your health. Alternatively, you can choose one day per week when you do not eat meat. The greener your plate becomes, the greener our planet will be.

3. Living

You can consider these in your everyday life:

Ecological footprints

- measure the resources used to support our lifestyle and whether it is sustainable, considering the capacity of the planet

Carbon footprints

- measure our impact on global warming by calculating the GHG emissions produced from our lifestyle in a year

4. Transportation

There have been dramatic examples of how less traffic volume is better for our planet. For instance, we could see much cleaner water in the canals of Venice, Italy, during the COVID-19 crisis as there were fewer gondolas.

In this vein, public transportation contributes to reduced traffic volume, gas emissions and pollution.

So, when you are going somewhere, ask these questions to yourself:

- ✓ "Can I walk or cycle easily and safely?"
- ✓ "Is there a way to get to my destination using public transport?"
- ✓ "If I have to use a car, then can I share my journey with someone else or do several things on one journey?"
- ✓ "Are there alternatives to flying and do I need to fly there in the first place?"

Low carbon lifestyles are not the same for everyone in every country like we have already talked about at the end of Topic 7, but we can start from what we learned today!

Be an Earth Citizen!

- Life Attitude of an Earth Citizen –

1. Whenever possible, travel by bicycle or public bus.
2. If you must own a car, choose the most fuel efficient and the lightest car available.
3. Unless absolutely necessary, do not fly.
4. Use energy efficient light bulbs.
5. Use less water, especially hot water.
6. When the weather is mild, use natural ventilation or a fan to replace air conditioning.
7. When leaving a room, turn off air conditioning, ventilation, lights, and other electric appliances.
8. Install triple paned, plastic framed windows and external window shades on your home and do everything possible to add thick insulation to the exterior walls and roof of your home.
9. Buy less non-local food, packaged food and frozen food, and refuse to purchase food and products with excessive packaging.
10. Use baking soda or soap instead of detergent and chemical products.
11. Unless absolutely necessary, do not use disposable products.
12. Do not purchase books and newspapers that will be thrown away after reading.
13. Do not purchase things that your home does not absolutely need.
14. Do not quickly throw away used plastic bags, boxes and bottles.

16. If possible, do your best to grow your own vegetables and raise your own poultry, and do not use herbicides, pesticides, fertilizers, or antibiotics.

17. If possible, in the open space near the place you live and do your best to plant trees and grow them to maturity.

18. Use observation, reading, writing, household work, art and time with family and friends to lead a meaningful life; do not rely on consumption and travel to fill empty spaces in life.

19. Use money saved through environmental protection for culture, education, household services and other non-material, consumption; also use this money to buy organic foods and long-lasting, high quality goods that future generations can inherit. Do not buy a bigger house and luxury cars.

20. At the end of the year calculate the family's total reduction of CO_2 emissions and tell other friends this number. This will increase people's interest in environmental protection. If you use the measurement that one large tree absorbs 18.3kg of CO_2 to calculate the family's CO_2 reduction, then you can make people even more excited about environmental protection. If your environmental behaviors could be converted into 200 trees planting every year, then you have become a real "earth citizen"!

[Topic 8_Activity]

We learned how the choices we make every day have an influence on the environment. By choosing more sustainable options, we can push producers to produce more sustainably as they will want to meet our expectations. We should all try to make the best choices possible to help protect the earth. Let us look at some options and try to choose which option is the more sustainable choice!

- For each question, choose which is the more sustainable option:

Question	Options A	Option B	Your choice
1.	Fruit that is grown locally.	Fruit that is grown abroad.	
2.	Plastic bags (single use).	Paper bags (single use).	
3.	Eating beef and pork.	Eating chicken, fish, and meat substitutes.	
4.	Traveling to school by walking, cycling or public transport.	Traveling to school/work by car.	
5.	Using straws to drink.	Drinking directly from the glass/cup.	
6.	A product with paper packaging.	A product with plastic packaging.	
7.	Using reusable cups.	Using single use paper cups.	

• How to work on this activity

1) For each question choose the more sustainable option, option A or option B.
2) Remember it's not about choosing the perfect option; it's about choosing the better option in terms of sustainability among the two.
3) After selecting your choices, share your answer with your classmates and discuss why you think the option you choose is more sustainable.

Final Exam

Time: 40 minutes
Total marks: 80

General instructions:

i) The question paper consists of 13 questions. (7 multiple and 6 essay questions)

ii) Parts are divided into multiple choice and essay questions.

iii) All multiple choices are compulsory, and 5 marks are allocated to each.

iv) Out of 6 essay questions, choose only 3 to answer. No more than 3 answers will be graded, and 15 marks are allocated to each question.

Multiple choice: Choose the correct answer from the given alternatives

1. Choose the statement that is correct.

   ① Climate mitigation and climate adaptation are basically the same concepts.

   ② The greenhouse effect is a natural phenomenon but is becoming an issue as GHG emissions are increasing at an unprecedented speed due to anthropogenic factors.

   ③ Conserving biodiversity is important for protection of ecosystems but not for food security.

   ④ We can use water unlimitedly because around 70% of the earth consists of water.

   ⑤ Terrestrial ecosystems are important to us because we live on the land, but marine ecosystems do not matter as much as terrestrial ecosystems do.

2. Read the short story given below and choose the statements that properly explains the issues in the story.

   A is a 13-year-old girl who lives in a remote area where water is a limited resource. She has to go to get water from a well, which takes more than 3 hours by walking. Since she is the only girl among the children in the household, she has to go get water with her mother while her male siblings go to school. Adults are saying that the water of the well is becoming less clean due to some contaminants that are observed from the

construction site nearby the well.

① Once the water source is near by the town, everyone can access water equally.

② Gender inequality is observable as it is usually women and girls who travel a great distance to get water.

③ The water can always be kept clean.

④ Accessibility to clean water is not given to everyone.

⑤ To address the water issue, we should take diverse factors into consideration such as regional differences, gender dynamics, social situations, and so on.

3. Below is a diary of a teenager. Read the content and choose statements that explain mistakes s/he made regarding one's behaviors depicted in the story.

> *It was a very sunny day, so I decided to go to my favorite café nearby the beach and ordered coffee. As soon as I received my coffee, I just realized that I can actually drink the coffee sitting at the beach! So I asked a server to put my coffee in a plastic cup so that I can take it out. It was perfect! The blue sky, the sound of waves, people hanging around and eating ordered food… And there was a vendor who sells sundae with chocolate syrup! How could I deny it? Soon I had coffee and sundae in my hands. The amount of both coffee and sundae were too much for me though. I had to throw about half of them away, but they tasted really good so no regrets 😊. There was no trash bin at the beach so I just put them in the corner of the road just like other people. On my way home, I dropped by a mart and found out that my favorite pen was sold at a discounted price! It was only half of the original price – I HAD to buy them though I know that I already had that pen for like… 3 bunches at home. It was really a happy day.*

① The writer did not properly recycle the used products.

② The writer's consumption should not be criticized at all because it made him/her happy.

③ The writer could have saved resources if s/he had used a personal cup instead of the plastic one.

④ The overall pattern of the writer's consumption can be said to be 'overconsumption'.

⑤ Buying a pen at a lower price is always a good choice even though one already has abundant pens.

4. Environment, energy, and resources are the basic factors for human survival and development. Which statement is incorrect?
   ① Coal, oil and natural gas are important fossil fuels.
   ② Solar energy and wind energy are new energy sources which are being utilized and developed by human beings.
   ③ The processes of hydropower are that falling water provides kinetic energy and the turbine converts it into mechanical energy. Then the generator transfers the mechanical energy into electricity energy.
   ④ Renewable energy is totally clean, so in order to reduce carbon dioxide emissions, we should completely abandon fossil energy and only rely on renewable energy in our future.

5. Solar panels, wind turbines and geothermal are examples of renewable energy because:
   ① We can utilize them easily
   ② Energy from the wind, sun, or ground does not run out
   ③ They are more efficient
   ④ None of the above

6. Which statement is incorrect?
   ① Using fossil fuels will result in climate change, and climate change will heavily impact our health.
   ② Eating more local food is a good way to achieve a sustainable diet.
   ③ Industry developments bring our world many economic benefits and make our lives more convenient, so we should continue and ignore other impacts.
   ④ Mental health is important for people's ability to participate in healthy behaviors and maintain good physical health.

7. Find the statement that is incorrect.

① SDG 13 is “take urgent action to combat climate change and its impacts”.

② The Paris Agreement aims to keep a global temperature rise below 2℃ above pre-industrial levels.

③ Both international and national strategies are significant in tackling climate change.

④ The UN Framework Convention on Climate Change (UNFCCC) is implemented based on SDG 13.

⑤ The Green Economy and Green Growth do not take economic development into consideration.

Essay questions

8. Explain how climate change and a changing environment are affecting different ecosystems (name one terrestrial and one aquatic example).

9. Today, more and more scientists and engineers aim to promote renewable energy development. Do you think we should move away from using fossil fuels in our society or not? Explain your reasons.

10. Briefly describe the impact of climate change on human health, and how we can protect ourselves?

11. How is fresh water replenished by the water cycle? How do human activities affect the water cycle and the supply of fresh water? What is the impact(s)? Mention at least one sector and further explain.

12. What are practical actions we as individuals can do to help protect the environment and live more sustainably? For each action, explain which problem that action helps to solve, and the expected outcome of the action.

13. Explain how we can choose a better product as consumers when we choose food, clothing, or transportation. Include at least one example of a ‘better’ product for each category.

Final Exam Guide for Teachers

Multiple choice

1. ②
2. ②,④,⑤
3. ①,③,④
4. ④
5. ②
6. ③
7. ⑤

Essay questions

8. **Explain how climate change and the changing environment are affecting different ecosystems (name one terrestrial and one aquatic example).**

   Instruction for teachers:

   This essay question asks about the content of Module 1 and Module 2.

   The content discussed in class should be presented and described through the examples of two different ecosystems, one terrestrial and one aquatic. First, the term climate change needs to be defined. Then, the current effects of climate change, such as melting ice, raising temperatures, changing weather patterns, and dangerous species thriving, should be outlined. After this it is important that the term ecosystem is explained, as well as the distinction between terrestrial and aquatic ecosystems. Chosen examples on which basis the effects of climate change might be demonstrated can be for example, in the case of the terrestrial ecosystem, the tropical rainforest, tundra, taigas, forests, grassland, or deserts (basically any terrestrial ecosystem, however since the rainforest was discussed as an example in class it might be the most commonly used example). No matter which ecosystem chosen, its basic characteristics should be mentioned.
   For an example of an aquatic ecosystem any water-based ecosystem might be chosen, and its characteristics should be explained.

   Effects of climate change on the ecosystems include:
   Human factors: population growth, transforming and modifying ecosystems or even

changing them completely by deforestation, pollution (regarding marine pollution: chemical contamination and marine trash), over-exploitation, shrinking biodiversity, vanishing of species.

Future effects of climate change can be mentioned in order to stress its urgency such as continuously raising sea levels, the increased occurrences of natural disasters, freshwater shortages, disease spreading, and most importantly changing and dying ecosystems. Another plus is the mentioning of the importance of plants and why they are so crucial for our planet.
Some of these key terms should be mentioned and explained:

Climate Change
Deforestation
Ecosystem
Terrestrial Ecosystem
Aquatic Ecosystem
Tropical Rainforest
Coral Reef
Pollution
Biodiversity
Over-exploitation
Over-logging
Permafrost
Endangered Species
Conservation

The overall structure of the essay should be clear and well organized so that it is easily understood by the reader. Good grammar and the use and explanation of key terms is important, and as much detail as possible should be provided. 'What', 'How' and 'Why' questions should be answered by the explanation.

Answer example:

Our environment is constantly changing, and climate change poses a threat to many ecosystems. Climate change is the change of weather patterns, such as temperature and rainfall, which occurs over a time scale of decades. We already can see our environment

changing by the rising global temperatures and melting ice. This has a major effect on various ecosystems, an area where biotic and abiotic things live and work together. One example is the tropical rainforest. One of the factors that contributes to climate change, deforestation, damaging ecosystems and threatens many species is the destruction of rainforests. Population growth, logging and clearance for agriculture is leading to the destruction of forests and leaving an empty ecosystem behind. Another example of an ecosystem that is threatened by climate change is an aquatic ecosystem: coral reefs. Marine pollution, including chemical contamination, such as fertilizer washed into ocean, and marine trash, mostly plastic trash that leaves long-lasting damage behind, is causing the ecosystem to shrink and die. The corals in the reef are animals which create a base for many other aquatic creatures to live in and they are very fragile and currently at risk due to rising temperatures and decreasing salinity. With shrinking ecosystems, more and more species become extinct, hence threatening biodiversity. It is very urgent to fight climate change so that many ecosystems can be preserved.

9. **Today, more and more scientists and engineers aim to promote renewable energy development. Do you think we should move away from using fossil fuels in our society or not? Explain your reasons.**

   Instruction for teachers:

   In the textbook, we studied basic knowledge of renewable energy. This question mainly examines if students have a comprehensive understanding of renewable energy. Students can answer this question by referencing different aspects and consequences of various energy sources relevant to their environmental outcome, such as the connection between climate change, biodiversity, health, sustainable development, and energy. Additionally, students need to mention some of the disadvantages of renewable energy.

   Answer example:

   I think we should move away from using fossil fuels and increase our use of renewable energy. Fossil fuels release greenhouse gases (GHGs) when they are burned to release energy and create electricity. In this course, we learned that greenhouse gases emission lead to the damage of ecological and environmental systems. In addition, GHGs also have an impact on human health. Renewable energy is clean, so it will greatly reduce the emission of carbon dioxide, which is a major greenhouse gas. Renewable energy

resources are unlimited and they can be utilized to achieve sustainable development. Although renewable energy sources have some negative impacts on the environment, for example, solar energy panels take up a lot of land and wind energy turbines may injury to birds. However, in general, the advantages outweigh the disadvantages of renewable energy. Therefore, I think renewable energy should be developed in the future and we should move away from using fossil fuels as the main energy source in our society.

10. Briefly describe the impact of climate change on human health, and how we can protect ourselves?

Instruction for teachers:

This question examines whether students understand the basic knowledge in module 5 or not. In module 5, we talked about the impact of climate conditions on human health and how human beings should protect themselves and minimize negative impacts on their environment. Natural disasters such as floods, hurricanes and tsunamis directly cause human death and permanent disabilities. Additionally, they destroy local infrastructure. Temperature increases cause heat waves and droughts. Heat waves cause humans to suffer from heat stroke and dehydration, and drought impacts our agriculture and leads to shortages of food and water supplies. Low air quality causes asthma attacks and other respiratory illnesses. More greenhouse gases in our atmosphere affects food safety and nutrition as crop quality decreases causing humans get reduced nutrition from their food. Warmer temperatures provide a better habitat for some pests such as mosquitoes and ticks. These pests usually carry viruses and bacteria. Therefore, to protect ourselves from these impacts, we should mitigate and adapt to climate change. We can save energy to reduce GHG emissions, and when the air quality is very low, we should reduce the time we spend outdoors and wear a mask. We also need to know some basic knowledge of disaster prevention and build strong infrastructure which can withstand disasters.

11. How is fresh water replenished by the water cycle? How do human activities affect the water cycle and the supply of fresh water? What are the impact(s)? Mention at least one sector and further explain.

Instruction for teachers:

This question investigates whether or not students understood and acquired the knowledge outlined in module 4, where basic information about the water cycle and the link between human and water were elaborated. Students are expected to possess and demonstrate a clear understanding of the water cycle and how human activity affects water quality. The first part of the answer should summarize the process of the water cycle. The second part of the question should outline some negative impacts that are brought about by human activities. Agricultural, industrial, daily activities etc. could all be accepted as examples as long as the student provides specific information about the progress of how these activities affect water. Student should also make clear that the whole ecosystem, including humans, would be affected by improper use of water.

Answer example:

The heat from the sun causes the evaporation of surface water from oceans and lakes. Water vapor in the atmosphere condenses into clouds. Water falls from the sky in the form of rain, snow, and ice. This process is known as precipitation. Oceans and lakes collect water that has fallen. This is the process in which freshwater is filled, known as collection. Many human activities affect the water cycle, for example, agriculture. Improperly managed agricultural activities may impact surface water by contributing nutrients, pesticides, bacteria etc. into the water cycle. The chemicals in fertilizer and pesticides used during crop production can easily seep underground or flow into rivers and lakes, affecting water quality and ecosystems. Grazing and other agriculture practices may also intensify erosion processes, raising sediment input to nearby water sources. Increased sediment loads make drinking water treatment more difficult while also negatively affecting ecosystems.

12. What are practical actions we as individuals can do to help protect the environment and live more sustainably? For each action, explain which problem that action helps to solve, and the expected outcome of the action.

Instruction for teachers:

This question examines students understanding of how our actions as individuals can contribute to protecting the environment. In the modules, particularly module 3 and 6, numerous methods of living more sustainably are outlined. This question also assesses students' comprehension of the actual process of how the actions they can take help solve the problem. In answering this question it is essential that students explain clearly

the connection between the action and the problem it is helping to address, as well as the expected outcome of taking that particular action.

Answer example:

There are numerous practical actions we can take as individuals to help protect the environment and live more sustainably. We should consider our energy use and try to reduce how much electricity we use by turning off lights, fans, and air conditioning when not using the room, using low energy use appliances, not leaving the refrigerator open for too long, and unplugging or switching off the power outlet when not using it. All of these actions save electricity which is currently mostly produced using fossils fuels, which when burned emit greenhouse gases which cause climate change. By doing these actions, the positive outcome we can expect is that less GHG emissions will be emitted because of our lifestyle.

13. Explain how we can choose a better product as consumers when we choose food, clothing, or transportation. Include at least one example of a 'better' product for each category.

Instruction for teachers:

i) All of three categories should be incorporated into the answer.

ii) Clothing

- The answer might include one of the following components: fair-trade, organic, recycled, reused, produced locally, cruelty-free, natural fibers, refashioned or second-hand clothes, no fast fashion, sustainable or less packaging, etc.

iii) Food

- The answer might include one of the following components: local food, seasonal food, food with lower carbon footprints, meat-free meals, vegetarian, less (red) meat, etc.

iv) Transportation

- The answer might include one of the following components: leave a smaller ecological or carbon footprint, use public transportation, travel only when it is needed, walk or ride a bicycle, share a car, etc.

v) Apart from (ii)~(iv), students may refer to the “Life Attitude of an Earth Citizen”, which is also okay.

Answer example:

To buy better clothing, I can look for second-hand or recycled items rather than excessively buying fast fashion products. If the products are fair-traded, cruelty-free or produced locally, they are even better. And when shopping, I can use my own bag rather than buying a single use plastic bag every time. Also, I can consume less red meat and try to live more like vegans, trying to buy food that is produced locally because these foods create a much smaller carbon footprint. When traveling, I can walk or ride a bicycle rather than driving a private car. Or I might use public transportation or share a car with my friends or other people I know who are traveling to a nearby place. Personally, I do not want to have more than one child in the future because it is becoming harder for the planet to sustain rapid growth in population.

Self-Assessment

Directions: Please circle the number (0-10) which best reflects your response to the following describing your academic achievement.

1. I can explain the definition of Sustainable Development Goals and understand the relationship between environment and humanity.

0 1 2 3 4 5 6 7 8 9 10
(Strongly disagree) (Strongly agree)

2. After going through 6 modules, I can come up with my own ways to save the environment. Now, I can start to contribute in moderating negative impacts of climate change with several daily-life methods.

0 1 2 3 4 5 6 7 8 9 10
(Strongly disagree) (Strongly agree)

3. I understand the importance of recycling and became able to explain proper ways to throw out different kinds of products. Now, I know how much energy can be saved through my change of habit.

0 1 2 3 4 5 6 7 8 9 10
(Strongly disagree) (Strongly agree)

4. When someone asks about some causes and effects between environmental degradation and human health, I can fluently explain about 2-3 relationships and recommend ways to tackle each problem.

0 1 2 3 4 5 6 7 8 9 10
(Strongly disagree) (Strongly agree)

5. After learning all the modules, I think education on sustainable development should be promoted more in schools. I would like to recommend the SDG courses to the other students in order to save the environment together.

0 1 2 3 4 5 6 7 8 9 10
(Strongly disagree) (Strongly agree)

Course Evaluation

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. The course offers overall information on the needs and content of the environment.					
2. The course is organized thoroughly with informative contents and activities.					
3. The course helps me to develop my thoughts and knowledge about environment.					
4. The contents of the course is neatly organized.					
5. The course helps to reshape my daily behaviors towards more environment-friendly actions.					
6. My teacher explained all concepts fully with various examples.					
7. If you have any comments or feedback, please write in.					

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