BASIC COURSE IN ENVIRONMENTAL EDUCATION

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INTRODUCTION

1. Purposes of the manual

The Training Course Manual on Basic Environmental Education supports a training course on Basic Environmental Education to other teacher trainers, lower secondary teachers and teacher trainees. The objective is to help teachers integrate, mainstream and/or relate to environmental issues and environmental protection in their lessons, not only in those subjects with explicit relations such as Biology or Geography.

This manual provides suggestions for conducting a two and a half day training course on Environemental Education. However, trainers are allowed to select appropriate separate topics for their teaching delivery.

2. Manual development principles and process

The manual covers three topics through a series of activities and is based on various reference materials. Each activity is designed to introduce specific content in a brief, accurate and easy-to-understand way in the resource materials section. Complex environmental issues, such as climate change, greenhouse effect, global warming, and sea level rise, are simplified or presented in simple language.

The manual will help trainers to introduce to trainees important content through an active and participatory approach: building on existing knowledge of learners and a constructivist view in learning. While the manual proposes a specific and workable procedure, trainer/teachers may change such procedure to align specific interests and demands of participants in the specific training course. For



that reason, attached to the training Manual is a CD-ROM with some reference materials, including environmental education activities, games and a series environmental integrated lesson plan sample. All of these materials can be used as resource materials during and after the training course.

During the development of a detailed outline and

selection of topics for this manual, VVOB have sought comments from various key partners in Vietnam. More specifically, VVOB have consulted Kuve &Learn Vietnam, ENV, UNDP, UNESCO, BTC, VNIES, WWF and Hanoi Education University. The experts from those institutions have contributed their thorough and thoughtful feedback to the draft manual.

Environmental education is a big topic, as a foundation and starting point for access to more complex concepts of Education for Sustainable Development. This manual will be used as a resource material and be used along with some other materials for dissemination in the Decade of Education for Sustainable Development (2005-2014). Such other materials are online and include "Teaching and Learning for a Sustainable Development", training materials on environmental education and climate change, commissioned and introduced by UNESCO in Vietnam in collaboration with VVOB. Other than its function as a separate training material, this integration will allow for and encourage teacher training institutions and lecturers/teachers to relate issues in the material to socio-economic reality and wider and more complex ecosystem in and out of Vietnam.

3. Selected topics

The 3 selected topics are environmental topics of significant importance and interest to Vietnam, by both government and the public. These are topical environmental issues of great interest to today's society. They are also closely aligned with holistic environmental protection.

Topic 1 – Climate change

Climate change is a serious concern to the world in general and Vietnam in particular. Located in the subequatorial region with over 3.000 km. of coastline, Vietnam will be seriously affected by global warming, ice melting and sea-level rise. Although Vietnam is not an industrialized country and does not produce as much greenhouse gas as other countries, it is essential to study the causes, negative impacts of climate change and find out measures to minimise them. This will benefit the country in using natural resources efficiently for sustainable development. Before introducing students to the topic, teachers/teacher trainers need to get acquainted with concepts and terminologies related to climate change. These include weather, climate change, the Earth, global climate system, greenhouse gases, greenhouse effect, ecological footprint and carbon footprint. They can then help students understand the causes of climate change and its effects on the world and Vietnam, in particular. Finally, the manual helps readers understand and study measures to cope with climate change.

Topic 2 – Energy saving and efficiency

Energy production and consumption are fundamental issues in a country's development. However, inappropriate and inefficient production and consumption of energy will exploit natural resources and increase greenhouse gases, causing environmental disasters, such as global warming and sea-level rises. All these threaten people's lives. Hence, energy saving and efficiency is not only a concern to the government, organizations and enterprises but also to each family and individual.

The topic "Energy saving and efficiency" will help teachers/teacher trainers master and pass on to their students: concepts related to energy and its origins. Examples include: classification of energy, such as fossil and renewable energies; consequences of inappropriate use of energy; and measures to save energy and use it efficiently. This topic also supports and supplements the topic "Climate change".

Topic 3 – Waste recycling

Waste is a valuable resource because many kinds of waste can be reused or recycled in order to save natural resources and cut down production costs, minimise emission and environmental pollution.

The topic *"Waste recycling"* will facilitate teachers/teacher trainers to understand and pass on to their students concepts and origins of waste, 3R waste management and its benefits. This topic also addresses the identification of waste for recycling and reuse, how to use recycled products and how to reduce waste in our daily lives.



4. Teachers' guide

Principles on designing lesson plans

To make it easier to integrate different topics into other lessons/subjects, each topic is divided into four activities. The teacher can then design many "micro-lessons" of moderate duration, including content that is closely related or independent from one another.

In each lesson, the teacher needs to identify objectives, basic content, methodologies and time frame. After the lesson, the teacher should conduct an overall evaluation and make amendments to future lessons.

The application of ICT (MS, PowerPoint, Internet, etc.) will increase the vividity and attraction of the lessons and help students understand and remember them better.

References

References to climate change, energy saving and waste recycling are now numerous. These sources can be found in newspapers, books, printed documents, lessons, articles, information in the library or on the Internet and mass media. In each topic, some referential resources will be quoted. Teachers capable of using ICT, accessing the Internet or using foreign languages will have advantages in designing and teaching their lessons.

Development of a multiple-choice questionnaire

A multiple-choice questionnaire helps stimulate students to participate more actively, understand and memorize the content better. It is possible to develop many questions/answers for each topic and activity, but they must be simple, clear, brief and avoid ambiguous concepts. Appendices after the resource materials introduce some multiple-choice questions for each topic presented here. Based on these appendices, teachers/teacher trainers can develop more multiple-choice questions.

Designing games

Many students are overloaded in studying nowadays, and organising supportive games is the best way to help them enjoy learning through playing. The teacher

can design many games on one topic or one activity. Games need to be simple and involve some students or groups of students in order to be competitive. Some games are introduced in the Appendices after each topic. Teachers/teacher trainers can also develop more games, based on these appendices.

5. Monitoring and evaluation of outcomes

Monitoring and evaluation of outcomes are carried out in both the short- and long term. The short term includes student attitudes and knowledge. In the long term, they include changes in student behaviour and reactions to their living and learning environments (at school, at home and in society); or the successful integration and maintenance of the issues into different lessons and subjects.



SUGGESTED AGENDA

Time Activity				
Day 1				
8.00-8.20 <i>Warm-up, set rules for the training course</i>				
	Topic 1: Climate Change			
8.20-8.30	Introduction			
8.30-10.30	Activity 1: Concepts			
10.30-10.45	Break			
10.45-11.15	Activity 2: Causes and effects of climate change			
11.15-13.00	Lunch			
13.00-13.30	Activity 2: Causes and effects of climate change (cont.)			
13.30-14.30	Activity 3: Climate Change in Vietnam			
14.30-15.30 Activity 4: Response to Climate Change				
15.30-15.45 Break				
15.45-16.45 Activity 5: Integration of climate change issues into the curricu				
Day 1				
Topic 2: Energy saving and efficiency				
8.00-8.10 Introduction				
8.10-9.10 Activity 1: Concepts				
9.10-10.10 Activity 2: Classification of sources of energy				
10.10-10.25 Break				
10.25-11.25 Activity 3: Consequences of inefficient use of energy				
11.25-13.00	3.00 Lunch			
13.00-14.00	Activity 4: How to save energy and use it efficiently			
14.00-15.00	Activity 5: Integration of issues on energy saving and efficiency into the curriculum			
15.00-15.15	Break			

Topic 3: Waste Recycling			
15.15-15.25 Introduction			
15.25-16.25 Activity 1: Concepts			
16.25-17.25 Activity 2: 3R waste management			
Activity 1: Concepts			
Day 3			
8.00-9.00	Activity 3: Waste Recycling		
9.00-10.00 Activity 4: Reducing your waste			
10.00-10.15 Break			
10.15-11.15	Activity 5: Integration of issues on waste recycling into the curriculum		
11.15-11.30 Discussions on the follow-up			
11.30-11.40	Evaluation		
11.40-11.45	Closing remarks		





TOPIC 1 CLIMATE CHANGE

Introduction

Climate change is a vital issue to mankind. Vietnam is also facing serious problems of temperature increase and sea-level rise. According to UNDP, Vietnam is one of the 5 countries most vulnerable to climate change. If the sea-level rises by 1 metre, 5% of Vietnam's land, 11% of housing, 7% of agricultural output (equivalent to 5 million tons of rice husks) and 10% of GDP would be likely lost.

The 2008 Human Development Report issued by UNDP and the Ministry of Natural Resources and Environment showed that climate change is a risk in various ways. The estimated rainfall would increase and tropical storms would become more severe. The sea level is estimated to rise by 33 c.m. in 2050 and 1 m. in 2100, which is a gloomy picture for the shallow Mekong Delta. The delta would be flooded almost all times of the year if the sea level rose by 1 metre.

If the sea-level rises, many areas such as Hai Phong, Thai Binh, Nam Dinh, Ninh Binh, An Giang, Dong Thap, Tien Giang, Vinh Long and Ca Mau. would be flooded by 2 to 4 metres in the next 100 years. Consequently, 22 million Vietnamese people would lose their houses, and 10% GDP would be lost. Severe flood and storms would hold back development in major residential areas.

Climate change would also have negative impacts on a wide range of areas such as agriculture, industry, the economy, society, the environment, health, culture and tourism, etc. Therefore, everyone should be fully aware of the causes and consequences of climate change as well as ways of reducing them.

Objectives:

The main objective of "Topic 1 – Climate change" is to provide teachers with basic knowledge on climate change, its negative impacts on economic and social environments of the world in general and Vietnam in particular. It is also directed at students and others who want to understand the negative effects of climate change and measures taken to reduce the effects.

This topic can help teachers plan how to allocate time and integrate the content of climate change into different subjects (within the curriculum time or extra curriculum) in the Ministry of Education and Training's curriculum.

In addition, this topic can instruct teachers how to organise games for students so that they are able to understand the basic content as well as instruct teachers on how to use materials available or found on the internet.



ACTIVITY 1

BASIC CONCEPTS

Time:	120 minutes
Objectives	After this activity, trainees will be able to list basic and popular concepts of climate change.
Materials	Laptop, projector, PowerPoint presentation; Pin board, coloured cards, A0 paper, labels (with pictures); Games: <i>(See Appendix 1d)</i> ; Multiple-choice questions.
Steps:	 Trainer divides the class into groups; Groups discuss and come up with definitions listed in "weather and climate change"; Trainers and trainees compare the discussion result with resource materials (Appendix 1a); Trainer sums up; Group study "The Earth and the Earth's climate system" (Appendix 1a). Prepare for presentation on this topic; Group representative gives presentations; Trainer gives lecture on "Greenhouse gas and greenhouse effect" and "Ecological footprint and carbon footprint"; Group study multiple-choice questions (Appendix 1b), label the answers and appoint representative to present; Group plays games (Appendix 1d); Trainer sums up.
Assessment:	Groupwork result Check all students are interested and participate in assignments and games
Notes:	Depending on the time availability, trainer may choose to play both or one game; Content of Activity 1 can be integrated in Geography, Physics, Environmental Education and History lessons, etc.

ACTIVITY 2

CAUSES AND CONSEQUENCES OF GLOBAL CLIMATE CHANGE

Time:	60 minutes
Objectives	After the activity, trainees will be able to list causes and negative impacts of global climate change
Materials	Laptop, projector, PowerPoint presentation; Pin board, coloured cards, A0 paper, labels (with images); Multiple-choice questions.
Steps:	 Trainer divides the class into groups; Groups discuss the causes of climate change; Trainer sums up, compares with resource materials (Appendix 2a); Groups discuss "Negative impacts of climate change"; Trainer sums up, compares with resource materials (Appendix 2a); Groups study multiple-choice questions (Appendix 2b), label the answers and appoint representative to present; Trainer sums up.
Assessment:	Examine the extent to which information is sufficient as a result of group work compared with resource materials; Based on the results of multiple choice questions
Notes:	After group discussions, you can organize a contest to see which group presents more causes and impacts; Content of Activity 2 can be integrated in Geography, Physics, Chemistry, Environmental Education, History lessons.

ACTIVITY 3 CLIMATE CHANGE IN VIETNAM

Time:	60 minutes		
Objectives	Trainees will be able to list negative impacts of climate change on Vietnam as well in location where they are living		
Materials	Laptop, projector; Pin board, coloured cards, A0 paper; Tools, games (see Appendix 3b).		
Steps:	 Trainer divides the class into groups; Groups design a poster on the changes of climate factors, typical weather phenomenon in Vietnam; Group representative gives presentation and receives feedback from the other groups; Trainer gives feedback and sum up on the changes of climate factors and typical weather phenomenon in Vietnam (Appendix 3a); Groups list at least 3 examples on the negative impacts of climate change on Vietnam; Trainer gives feedback and sums up on the negative impacts of climate changes on Vietnam; Trainer gives feedback and sums up on the negative impacts of climate changes on Vietnam (Appendix 3a); Groups play games (Appendix 3d); Trainer sums up. 		
Assessment:	Group work result. Check all students are interested and participate in assignments and games		
Notes:	A small contest may be held to list negative impacts of climate change on Vietnam or respective locality where students live; Content of Activity 3 can be integrated in Geography, Biology, Environmental Education lessons.		

ACTIVITY 4 COPING WITH CLIMATE CHANGE

Time:	60 minutes
Objectives	Trainees will be able to list ways of coping with climate change in Vietnam and the world and list activities that reduce climate change.
Materials	Laptop, projector; Pin board, coloured cards, A0 paper; Tools, games.
Steps:	 Groups do matching exercise to study "United Nations framework convention on climate change"; "Kyoto Protocol" and "National target program on climate change" (Appendix 4b); Group receives feedback from the other groups; Trainer gives feedback, sums up and adds more information to "United Nations framework convention on climate change"; "Kyoto Protocol" and "National target program on climate change"; Groups discuss "How to reduce climate change"; Group in turns list one example of "How to reduce climate change"; Trainer give feedback and sums up; Groups play games (Appendix 4c); Trainer sums up.
Assessment:	 Groupwork result Check all students are interested and participate in assignments and games
Notes:	Trainer may choose another game as appropriate; Content of Activity 4 can be integrated in Civics Education, Environmental Education and Geography lessons, etc.

ACTIVITY 5 INTEGRATING CLIMATE CHANGE ISSUES

Time:	60 minutes			
Objectives	The trainees will be able to integrate some issues related to climate change into a specific lesson; set a list of lessons which climate change can be integrated into.			
Materials	Laptop, projector; Pin board, coloured cards, A0 paper; Environmental Education Integrated Lesson Plans; Textbooks of some subjects.			
Steps:	 Trainer organizes the group work per subject; Trainees study examples of a lesson plan integrating climate change; Trainees discuss how to add climate change issues into specific lessons; Trainees work in subject groups, to complete the table for exploring climate change educational contents; Trainees share group-work results. 			
Assessment:	Trainees are active in discussion Specific lessons integrating climage change are located.			
Notes:	Some subjects are easy to integrate but others are not. Therefore the numbers of examples may vary widely from group to group. A small contest may be held for participants to design extra- curricular activities in respect of climate change.			



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RESOURCE MATERIALS FOR

TOPIC 1 – CLIMATE CHANGE

RESOURCE MATERIALS FOR ACTIVITY 1

Appendix 1a: Basic concepts of climate change

- 1. Weather and climate change
- Weather: Weather is the set of temperature, humidity, rainfall, air pressure, wind, sunshine, all the phenomena and other meteorological elements occurring, at present or in the near future.
- Climate: Climate encompasses statistics of the above elements in a given region over long periods of time. Climate is the repetition of weather of a specific area over years to become the custom. Climate is also defined as the average of weather occurring over a certain space and period (approx. 30 years).
- Difference
between"Weather" occurs over a short period of time and in a small
area while "Climate" occurs over a long period in a given region.

weather and climate:

- Climate Climate change is the change of the global climate system in the atmosphere, ocean, ice-sphere, biosphere, hydrosphere occurring at present or in the future caused by nature or humans.
- Global Global warming is the increase in the average temperature of the Earth's near-surface air and in the lowest layer of atmosphere. The increase in temperature of the Earth's atmosphere would likely change the global climate. The term "global climate change" can be understood as "global warming" and vice versa.
- Causes of Major causes of climate change are the increase of activities causing greenhouse gas emissions, excessive exploration of greenhouse gas containers such as biogas, forest, inland, coastal, and maritime ecology.

2. The Earth and the Earth's climate system

The planet formed 4.6 billion years ago. For a long time, people Overview: have known that there is a close interaction between humans and nature, including the climate system. It is necessary to follow natural rules strictly to maintain peaceful living.

> The Earth's climate system consists of 5 elements: atmosphere, ocean, ice-sphere, land and biosphere.

Atmosphere: The atmosphere is a layer of gases surrounding the Earth. Thanks to the atmosphere, life exists on Earth. Without the atmosphere, the Earth would be burned by the Sun. There would be no water, no rain, etc.

> The atmosphere's chemical elements include 78% nitrogen (N_2) , 21% oxygen (O_2) , while the remaining 1% includes carbon dioxide (CO₂), water vapor, nitrous oxide (N₂O), methane (CH₄), ozone (O_3) , etc. However, these remaining 1% gases are of great importance, especially greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), water vapor, nitrous oxide (N_2O) , ozone (O_3) , etc. They help balance and circulate energy, humidity, cloud, wind, rain, etc. among the Earth's different regions, creating favorable conditions for life and development.



Figure 1: Gases in the air Source: http://vi.wikipedia.org/wiki/Khí_quyển_Trái_Đất

Approximately 71% of the Earth's surface is covered with ocean (1.340 million km² of water). Apart from supplying seafood and petroleum, the ocean is a huge heat reservoir, regulating the Earth's climate. Just a small change in the temperature of this reservoir can lead to a big change of the Earth's climate.

Ocean:



Ice-sphere: The ice-sphere includes all the regions on Earth or in the ocean surrounded by ice for the whole year. These regions include the South Pole, the North Pole, Greenland, Northern Canada, Northern Siberia and high mountains with minus temperatures all year.

Due to high reflection, ice and snow reflect almost all the radiation of the sun (approx. 90% in some areas of the South Pole) whereas the global average reflection is 30%. If the ice-sphere melts, the Earth would be warmer and the climate would change.

- Mainland: The mainland includes soil, deposit, stone, continents and everything found underground, commonly called the hydrosphere. The mainland accounts for only 29% of the Earth's area and is spread widely throughout the world. Temperatures here change quickly due to the sun and also have a great influence on climate change.
- Biosphere: Biosphere is the global sum of all living organisms (animal, plant, and micro-organism) and their relationships (including all activities of living things on the Earth's surface occuring in the past, present or future).

Activities of all living organisms such as animals, plants and micro-organisms would certainly have great influence on the global climate system.

3. Greenhouse gases and greenhouse effect

Greenhouse Greenhouse gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), water vapor, ozone (O₃), and chlorofluorocarbons (CFCs). While CO₂, CH₄, water vapor, N₂O and ozone are natural or industrial sources, CFCs are generated only by industrial processes.

Different greenhouse gases reflect and radiate reflection in different waves: short waves are invisible and long waves reflective.

The *Greenhouse Effect* is used to describe the phenomenon when energy radiated from sunlight through glass windows or roofs is absorbed and re-radiated to warm the indoor space (not only the place where the sun shines). Greenhouse For a long time, the greenhouse effect has been used for planting or in architecture (to heat houses by solar energy to save fuel).

Referring to climate change, the *Greenhouse Effect* is used to describe the phenomenon of absorbing and emitting radiation of the Sun caused by greenhouse gases found in the Earth's atmosphere.

Short-wave radiation of the Sun through the atmosphere to the ground is re-reflected to become long-wave thermal radiation. The greenhouse gases found in the atmosphere could absorb these and keep the atmosphere warm. The Earth's temperature would be minus 18°C without this natural greenhouse effect, but the Earth would get warmer with excessive greenhouse gases.

The average temperature of the Earth's surface is decided by the balance between energy from sunshine and the Earth's thermal radiation to the rest of the universe.

"Manmade greenhouse effect" is used to describe the "Greenhouse Effect" caused by greenhouse gases generated by human activities.

As well, ozone (O_3) forms in a thin layer in the stratosphere of the atmosphere. The ozone layer helps absorb ultraviolet radiation from the sun and protect life on Earth.



Figure 2: Greenhouse effect Source: http://vi.wikipedia.org/wiki/Kh%C3%AD_nh%C3%A0_k%C3%ADnh



4. Ecological and Carbon Footprints

Ecological The ecological footprint is a measure of human activity on the Earth's ecosystems. It compares human activity with the Earth's ecological capacity to regenerate. It represents the amount of biologically productive land and sea area needed to regenerate the resources a human population consumes and to absorb and render harmless the corresponding waste.

Using this assessment, it is possible to estimate how much of the Earth (or how many planets like Earth) it would take to support humanity if everybody lived a given lifestyle.

For 2006, humanity's total ecological footprint was estimated at 1.4 Earth planets – in other words, humanity uses ecological services 1.4 times as fast as Earth can renew them.

Carbon The carbon footprint is "the total set of greenhouse gas emissions caused by an organization, event or product", often expressed in terms of the amount of carbon dioxide (ton) or its equivalent of other greenhouse gases, emitted.

The equivalent here is understood as the global warming potential of a certain gas compared to CO_2 over a specific period.

For example: for 100 years:

- A molecule of CH₄ has the potential equivalent to 25 molecules of Co₂
- A molecule of N_2O has the potential equivalent to 298 molecules of Co_2
- A molecule of $\text{CHF}_{\scriptscriptstyle 3}$ has the potential equivalent to 14,800 molecules of $\text{CO}_{\scriptscriptstyle 2}$

The carbon footprint can be explained as follows:

When you drive a car, fuel is fired to generate a certain amount of CO_2 depending on the car's fuel consumption and the distance travelled. When heating, cooking by electricity, oil, gas or coal, CO_2 is also generated. CO_2 and other greenhouse gases are also emitted from goods producing and consuming. The carbon footprint of a person (or a nation) is the sum of all CO_2 emissions caused by this person (nation) over a certain period, typically a year.

The carbon footprint is a useful tool for defining the affect of individuals on global warning. It is necessary to calculate and control the carbon footprint of each person to prevent global warning.

Appendix 1b: Multiple-choice questionnaire for Activity 1

1) Which activity does not relate to climate change?
a. Driving a car b. Forestation c. Wearing a raincoat
2) What does "El Nino" mean?
a. The boy b. The storm c. Ice (cream)
3) What are greenhouse gases?
 a. Gases which keeps heat b. Gases which help greenhouse plants grow c. Gases used to heat the greenhouse to make it warm enough for plants to grow
4) Which of the following is not a greenhouse gas?
a. Methane (CH_4) b. Oxygen (O_2) c. Carbon Dioxide (CO_2)
5) Which of the following gases is not a natural one?
a. Methane (CH ₄) b. CFC c. Nitrous Oxide (N ₂ O)
6) Which of the following is not a source of Methane?
a. Disposal area b. Cattle c. Cloud of dust

Appendix 1c: Answers to the questionnaire

1) You have to wear a raincoat when it rains. You are affected by the weather. Driving a car and forestation both relate to climate. Driving a car uses fuel and emits CO_2 into the air, contributing to an increase in the greenhouse effect and the Earth's temperature. Forestation relates to climate because plants absorb CO_2 from the air. Therefore a forest is called a "carbon reservoir".

2) El Nido means "the boy" in Spanish and refers to the child Christ (it is usually noticed around Christmas). This is a weather pattern occurring over a period across the tropical Pacific Ocean, creating increased marine water vapor emission to form storms.

Today, the word El Nido implies the abnormal warming of seawater in the Equatorial Belt (approx. 10,000 km long) from the west coast of South America to Marshall Islands in the middle of the Pacific Ocean. When an El Nino occurs, it badly affects the climate of many regions in the world, causing natural disasters such as storms, flooding and forest fires, creating a huge amount of damage.

3) When the sun shines on the surface of the Earth, the Earth absorbs and radiates it back to the atmosphere. Greenhouse gases such as carbon dioxide (CO_2) , methane (CH_4) , nitrous oxide (N_2O) should keep the heat and make the Earth warm enough to maintain life. If the atmosphere is filled with excessive greenhouse gases, the Earth would get warmer, creating an imbalance in the climate and creating abnormal weather phenomena.

4) Oxygen (O_2) is the gas we breathe to stay alive. It is not a greenhouse gas. Methane (CH_4) and Carbon dioxide (CO_2) are greenhouse gases.

5) CFC (a type of hydrocarbon with halogen origin called halocarbon) is used in domestic things such as air sprays (anti-insect sprayers, deodorisers, etc.), fridges, air conditioners, etc. In nature, nitrous oxide (N_2O) is found on land and in the ocean. Methane (CHB₄) is generated in wetlands or by the anaerobic decaying of organic wastes.

6) A cloud of dust is not a source of methane. The decomposition of land waste (e.g. at garbage dumps) is low in anaerobic conditions (without O_2), which is the source of methane. Cattle are another major source of methane: they emit methane through a digestive process that is unique to ruminant animals called enteric fermentation.



Appendix 1d: Game for Activity 1

1. Game: "Domino Carbon" or "Domino Climate Change"

Objective: To help players remember, notice symbols and concepts related to climate change, the carbon footprint and ways of prevention.

How to play: The game is based on the normal Domino game, which includes 36 cards (made of wood, plastic, etc.). Each card is divided into 2 parts. One part is marked from 1 to 6. The other part has a half (or whole) symbol of a concept related to climate change or ways of prevention.

Rules: The number of players, how to play or how to count the marks are the same as in normal Domino.

2. The Carbon Footprint Game

Objectives: To help players study electric and petroleum devices that are the sources of CO_2 emission, causing climate change. Students will learn how to save energy when using these devices in their daily lives.

Tools: Paper, pen, board and chalk.

How to play: Several teams of players can play this game. Their task is to list devices using electricity, oil and gas, etc. on paper. After submitting their results, group representatives write their results on the board. The group with the highest number of words in a particular period of time (3-5 minutes) wins the game.



RESOURCE MATERIALS FOR ACTIVITY 2

Appendix 2a: Causes and consequences of global climate change

1. Excessive greenhouse gas emissions

Increase of greenhouse of current global climate change. Since the main source of current global climate change. Since the pre-industrial era (about 1750), humans have been using more and more energy, mainly fossil fuel resources (coal, petrol and gas), thus emitting more and more greenhouse gases, causing global warming.

Scientists discovered that the amount of carbon dioxide in the atmosphere was around 180-200 ppm during the ice ages (about 18,000 years ago), about 70% of the pre-industrial era (280 ppm). Since 1800, the amount of CO_2 has started to rise, exceeded 300 ppm and reached 379 ppm in 2005, a 31% increase compared with the pre-industrial era and far beyond the amount of natural CO_2 in the past 650,000 years.

The amount of other greenhouse gases, such as methane (CH₄) and nitrious oxide (N₂O), also increased from 715 p.p.b. and 270 p.p.b. during the pre-industrial era to 1,774 p.p.b. (by 151%) and 319 p.p.b. (by 17%) respectively in 2005. In particular, chlorofluorocarbon (CFCs) – a greenhouse gas which can warm the Earth many times as much as CO_2 and destroy the advection ozone layer – has been found since the refrigeration and cosmetics industries were developed.

Greenhouse gases emitted by humans:

change:

Greenhouse gases are generated from the energy production processes, industrial and agricultural activities, transportation, waste dumping and treatment, and daily human activities (eating, consuming, using energy and water, etc.)

According to the IPCC (Intergovernmental Panel for Climate Change), the consumption of burned fossil fuels in energy production, industries, transportation and construction, etc., accounts for nearly half (46%) of global warming. Deforestation of tropical forests accounts for 18%, agriculture for about 9%, chemical production (CFC, HCFC) for about 24%, and other activities (waste burial, etc.) account for 3%.

Increase of atmospheric carbon dioxide from 1870 to 2000





Elements of greenhouse gases in the atmosphere:	? ? ? ?	CO ₂ : 50% CFC: 20% CH ₄ : 16% O ₃ : 8% N ₂ O: 6%
Proportion of human activities causing global warming:	? ? ?	Energy consumption: 50% Industry: 24% Agriculture: 13% Deforestation: 14%





Elements of greenhouse gases in the atmosphere (with water vapor included)

Gas	Formula	Contribution(%)
Water Vapor	H ₂ O	36 – 72 %
Carbon Dioxide	CO ₂	9–26 %
Methane	CH4	4 – 9 %
Ozone	O ₃	3 –

Elements of greenhouse gases in the atmosphere (with water vapor excluded)

Gas	Formula	Contribution(%)
Carbon Dioxide		50 %
Chloroflurocarbon	CFC	20 %
Methane	CH4	16 %
Ozone	O ₃	8 %
Nitrious Oxide	N ₂ O	6 %



Proportion of human activities in causing global warming

Energy consumption	50%
Industry	24%
Agriculture	13%
Deforestation	14%

Annual Greenhouse Gas Emissions by Sector



Figure 4: Annual Greenhouse Gas Emission by Sector Source: http://en.wikipedia.org/wiki/File:Greenhouse_Gas_by_Sector.png#file

2. Impacts of climate change

Natural Construction Constructi

Natural ecosystems are those formed and developed according to the principles of nature.

Natural ecosystems (or biodiversity) are valuable resources for the economy, environment and culture of humankind. Climate change relocates climate zones. Species must adapt to new climate conditions. Changes in species will lead to changes of elements and geographical distribution of these ecosystems.

Some species can adapt well to climate change while others, which cannot adapt, will deteriorate. Climate change is a big threat to many species that are vulnerable to climate conditions.

Agriculture, Like the ecosystem, the agriculture, forestation and aquaculture forestry and have a close relationship with weather and climate.

aquaculture: Agriculture is directly affected by the climate. Climate change does not cause immediate problems, but global warming may influence different factors in agriculture, such as seeding time, irrigational systems and pest issues, leading to changes in production and productivity.

> Temperature rise and precipitation fluctuations have different impacts on the forest vegetation and ecosystem: for example, decrease in biomass growth rates of plants, increase in extinction risks of plants and animals, forest fires, growth of pests and diseases.

> Temperature increase causes marine animals and vegetation to disperse, and especially damage coral reefs and subtropical species. Saltwater encroachment takes away the living habitat of some marine fishes while high rainfall causes the massive death of many coastal and brackish species because of incompatibility with changes of salinity.

Coastal Scientists found that if people cannot reduce CO₂ emissions, the average global sea level is predicted to rise by 9 to 88 c.m. in 2100. Sea-level rise in a particular area depends on tides, sea currents and salinity. Sea-level rise in combination with a series of natural disasters, such as storms and floods, will lead to serious consequences in coastal areas.

Sea-level rise will also cause coastal erosion. An increase of 1-2 degrees Celsius can damage coral reefs, which are very vulnerable to temperature changes. Coral reefs play an important role in preventing erosion and provide living habitats for many sea species.

Sea-level rise will make some wetlands disappear and others will be newly formed. If sea-level rise exceeds the adaptation limit, wetland ecosystems will no longer exist.



Water Climate change and sea-level rise will change the distribution of water resources, river currents, water quality and supply.

Temperature increase causes more evaporation and more rain. Rainfall in each reason will either increase or decrease. Such changes will lead to an alteration of river currents, frequency and strength of floods and droughts.

A rise in temperature causes the ice caps in mountains to melt, increasing river flow and floods. After big ice shelves in the mountains melt, the water supply will be exhausted, floods will be reduced, but river flows will also decrease. Some rivers will go dry, leading to serious water shortages.

Reservoirs are also affected by climate change: heavy rains cause erosion and silting, which reduces reservoir volumes and changes water quality.

Sea-level rise causes difficulties in water supply because coastal freshwater resources at both surface and underground levels will become saline.

Human Climate change has direct and indirect impacts on human health, health: especially for people living in the potentially affected areas (e.g. coastal areas at high risk of storms and tsunamis, tropical areas likely to have infectious diseases, etc.)

> Climate change can directly affect human health through mass and energy exchange between the human body and its surroundings, causing changes in human physiology, customs, adaptation and reactions. Continuous hot weather and temperature increase have negative effects on human health, especially for elderly people and those vulnerable to heart attacks, nervous diseases and allergies.

> Climate change also has an indirect influence on human health through sources of disease, increasing infections and outbreaks of epidemics, such as influenza type A/H1N1 and A/H5N1, diarrhoea, cholera, etc. It also raises the occurrence of tropical diseases, such as malaria, petechial fever (e.g. typhoid fever) and Japanese B encephalitis and affects the growth rate of many harmful bacteria and insects (flies, mosquitoes, rats, fleas, etc.)

Climate change is one of the causes for the reoccurrence of tropical infectious diseases (i.e. malaria, Dengue fever, cholera and bubonic plague), the formation of some new infectious diseases (i.e. SARS, influenza type A/H5N1 and A/H1N1) and the promotion of virus mutation in influenza types A/H1N1, H5N1.

Human activities have already changed the ecosystem on land and under water. Illegal hunting caused a significant drop and even extinction of some rare animals. Increasing greenhouse gas emission is the main source of global warming and damages to the ozone layer lead to the intensifying of ultraviolet radiation on Earth, the main cause of skin cancer and eye diseases.

10 strange impacts of the greenhouse effect which can be identified:

- People sneeze more
- Animals migrate to mountainous areas
- Plants grow faster in the Arctic
- Lakes disappear
- Many buildings degrade
- Animals change their biological clock
- Satellites move faster
- Mountains become higher
- The world's wonders are at risk of destruction
- Forest fires occur more frequently

Appendix 2b: Multiple-choice questionnaire for Activity 2

1) Without natural greenhouse gases, the Earth's surface would be colder than today by:		
a. 33 °C b. 88 °C c. Not colder but hotter		
2) What does not help scientists assess climate in the past?		
a. Annual wood circles of trees b. Ancient pottery c. Ice		
 Scientists predict that in 100 years, global climate change will make sea levels: 		
a. Decrease at least 100 c.m. b. Remain unchanged c. Increase by 15 – 95 c.m.		
4) Global warming is a cause of sea-level rise. What is not a reason for sea-level rise when global temperatures increase?		
a. Temperature heats the water and increases its volume		
b. Ice melting makes sea levels rise		
c. Heavy rain increases water in the sea		
5) The current amount of carbon dioxide compared with year 1860 is:		
a. 80% higher b. Lower c. 25% higher		
6) What is the annual CO ₂ increase due to deforestation?		
a. No increase because deforestation does not cause CO_2 emissions b. Increase of 200 – 500 tons c. Increase of 5.5 billion tons		

Appendix 2c: Answers to the questionnaire

1) Natural greenhouse gases are at an appropriate amount to keep the temperature of the Earth's surface suitable for ecosystems and human beings. The global average temperature is currently around 15°C. Without the greenhouse effect, the average global temperature would be about -18 °C. In conclusion, the Earth's surface will be 33°C colder than today – too cold for any living creatures.

2) Trees grow and leave a circle inside the trunk every year. The shape and size of the circle help relay the growing condition and climate changes in the past.

3) Many scenarios estimate that in 100 years, global warming will cause the sea level to rise from 15 - 95 c.m. This will lead to serious floods in coastal areas and a loss of living habitats for community and coastal ecosystems.

4) Scientists predict that in 100 years, global warming will cause the sea level to rise from 15 - 95 c.m. because glaciers near the North and South Poles will melt; and water expands due to temperature increase.

5) The amount of CO_2 at present is 25% higher than in 1986 due to human activities. The two biggest sources of carbon dioxide emissions are fossil fuel consumption and deforestation/forest fires. The more carbon dioxide emitted into the atmosphere, the higher global temperature will rise.

6) Forests are considered as "carbon dioxide reservoirs" since they absorb and store CO_2 from the atmosphere. When trees are cut down and burned, the carbon dioxide stored in them is released back into the atmosphere. Scientists calculate that about 2–5 billion tons of carbon dioxide is emitted into the atmosphere every year due to tree cutting and forest fires.



RESOURCE MATERIALS FOR ACTIVITY 3

Appendix 3a: Climate change in Vietnam

- 1. Changes in climate factors, typical weather issues in Vietnam
- Temperature: Between 1951 and 2000, the annual average temperature in Vietnam increased by 0.7°C. The annual average temperature for four of those decades (1961 2000) was higher than that of the previous three decades (1931 1960). The annual average temperatures between 1991 and 2000 in Hanoi, Danang and Ho Chi Minh City rose by 0.8, 0.4 and 0.6°C respectively when compared with those of 1931-1940. In 2007, the annual average temperature of these three cities was 0.8-1.3°C higher than in the decade 1931 1940 and 0.4-0.5C higher than in the decade 1991-2000.
- Precipitation: Precipitation trends in a particular area over the past nine decades (1911-2000) are fluctuating in different places and time periods. This also varies in different areas of Vietnam.
- Sea level: Observational figures in the past 50 years in Cua Ong and Hon Dau stations show that the average sea level has risen by around 20 c.m.
- Weather
 Cold weather: The number of cold periods has dramatically dropped in the past two decades (the end of the 20th century and beginning of the 21st century). There were only 15-16 cold periods between 1994 and 2007, accounting for 56% of the average figures over many years. Six out of a total seven cases of extraordinarily few cold periods (0-1 period) during winter (December-March) occurred in the past two decades (Mar. 1990, Jan.1993, Feb.1994, Feb.1997, and Nov.1997). One recent extraordinary case of global climate change was an extremely cold period of 38 days in January and February 2008, causing huge damage to agriculture.
 - *Storms:* In recent years, there have been more heavy storms; their orbits especially moving south. Stormy seasons last longer and their orbits are abnormal.
 - *Drizzle:* The number of drizzle days in Hanoi gradually decreased during 1981 1990 to nearly a half (15 days/year) in the past 10 years.
- 2. Excessive greenhouse gas emissions in Vietnam
- Amount of emissions: In 1990, 21.4 million tons of CO_2 were emitted in Vietnam, compared with 98.6 million tons of CO_2 emitted in 2004, five times higher. The total amount of CO_2 emission in Vietnam is estimated to be 233.3 million tons in 2020, 93% higher than that of 1998.
Compared Greenhouse gas emission amounts per capita in Vietnam are 1.2 tons/year. The global average figure is 4.5 tons/year, while Singapore has 12.4 tons, Malaysia 7.5 tons, Thailand 4.2 tons, China 3.8 tons, Indonesia 1.7 tons, the Philippines 1.0 tons, Myanmar 0.2 tons and Laos 0.2 tons.

To conclude, the amount of greenhouse gas emissions in Vietnam has increased quite rapidly in the past 15 years, but is still lower than the world's average and in many regional countries.

3. Impacts of climate change in Vietnam

Overview: Global warming will cause serious consequences to many countries, including Vietnam, from now until 2050. Australian scientists warned that if Vietnam had to combat 10 heavy storms and typhoons in 2006, it would likely have much more and stronger natural catastrophes in the coming years.

Climate change influences all socio-economy activities. Some evaluations of the impact of climate change on water, agriculture, forestry, energy, marine resources and human health are presented below, based on the following scenario of climate change. i.e. Assuming temperatures will increase by 1.5 to 2.5°C and that precipitation will fluctuate from -5% to 10% in 2070. The scenario assumes a sea-level rise of 1 metre in 2100 to evaluate the impacts of climate change on coastal areas.

Impacts on
coastalVietnam has a 3,260 km-long coast, over one million square
kilometres of sea territories, more than 3,000 inshore islands and two
offshore archipelagos. There are many lowland coastal areas, with
more than 80% of the Mekong delta area and more than 30% of the
Red River – Thai Binh delta area less than 2.5 metres high above sea
level. These areas are seriously flooded in the rainy season, and
suffer bad drought and saltwater encroachment in the dry season.
Climate change and sea-level rise can worsen this by increasing
flood areas, erosion and saltwater encroachment, which badly
affects agriculture, domestic water and coastal buildings, such as
sea walls, roads, seaports, plants, urban and residential areas.

Sea-level rise and sea temperature increases have negative influences on ocean and coastal ecologies, threatening coral reefs, mangrove forests and basic biological conditions for maritime production in coastal areas.

Sea-level rise also affects beaches and coastal tourism areas. Some of them may disappear, while others are eroded close to the mainland, affecting tourism activities. Cultural and historic buildings, conservation areas, eco-tourism areas and other buildings in the regions affected by sea-level rise can be submerged, moved or delayed, causing rising transportation, upgrading and maintenance costs.

As estimated by IPCC, if the sea level rises by one metre, Vietnam would lose more than 12% of its total area, an area where 23% of the country's total 84 million people are living.

According to the UNDP research, sea-level rise could put 5,000 square kilometres of the Red River delta and about 15,000-20,000 square kilometres of the Mekong delta under water.

With rising sea levels, many areas will be unable to cultivate and local people will become new refugees as their living environment is damaged.



Impacts on
surface
waterClimate change has critical impacts on surface water. The annual
flow fluctuates between +4% and -19%, and peak flood discharges
and evaporation rates would also increase. Water resources are at
high risk of depletion due to increasing droughts in some areas.

resources: Vietnam is located downstream of two international rivers: the Red River and the Mekong River. Climate change will decrease the annual flow in these rivers, which makes floods during rainy season and droughts during dry season become more severe (not accounting for the possibility of increasing water use in the headwaters of these rivers because of climate change).

Impacts on agriculture: Climate change means agricultural areas may be reduced. Without appropriate prevention measures, a noticeable part of agriculture area in the coastal plains, Red River and Mekong River deltas will become salt-marsh because of sea-level rise.

> The Mekong delta is considered one of the three most vulnerable areas if the sea level rises by one metre. This is the "granary" of Vietnam, where more than 40% of agricultural output and more than 50% of rice output of Vietnam are produced. Hence, what happens here will influence the whole country.

> The Consultative Group of International Agricultural Research reported that climate change would reduce the food production in Asia by 20%. In Vietnam, the formulation of acid rain due to carbon dioxide increase would significantly diminish sea and rice products, two of its key export items.

> In agriculture, the structure of crops, animals and farming seasons may change in some places. The winter farming season in the North of Vietnam may be shortened or even no longer exist and the summer farming season might last longer. This requires changes in cultivation techniques. Temperature increases and fluctuations and changes in other weather elements will promote the development of insects and diseases, leading to a reduction of productivity and output and an increase of threats to agriculture and food security.

Impacts on forestry: Sea-level rise has narrowed 25,000 hectares of mangroves, and badly influenced 13,000 hectares of cajuput and alum soil forests. Due to climate change, borders between primitive and secondary forests may shift, increasing extinction threats to plants and animals, reducing rare gene sources, increasing forest fires and the development of insects harmful to forests.

High temperatures and increasing droughts will also increase forest fires and the development of harmful insects and diseases, etc.

Impacts on The marine ecosystem, marine products and aquaculture are directly influenced by climate change. It is predicted that sea products will be reduced by 1/3 compared to the present.

		Increasing sea-level rise and salt encroachment leads to the following consequences: salt encroachment damages living habitats of some marine fishes; mangroves are narrowed, affecting the ecosystems of some marine fishes and a decrease in the organism-synthesising capacity of seaweed ecosystem leads to a decline in supplying photosynthetic products and nutrition for benthos (sea organisms). This worsens the living habitat of many marine species.
l	Impacts on energy:	Sea-level rise will affect the operation of oil rigs, gas transportation systems and power plants using gas both offshore and in coastal areas, increasing maintenance and operation costs.
		Sea-level rise will also require more electricity for pumping water out of the coastal lowland areas. Flows of big rivers using hydroelectricity will also be affected seriously.
		Temperature increase will increase costs for air ventilation and cooling systems, reduce output and productivity of power plants and increase domestic electricity consumption and costs for air ventilation in industry, transportation, commerce and other fields. It will also increase the amount of evaporation and fluctuations in rainfall, leading to changes in water levels and flows into hydro- electric rivers.
		Numerous and heavy storms will influence the oil rigs, oil transportation and electricity delivery systems, etc.
 	Impacts on human health:	Temperature increases will have negative influences on human health, increasing health risks for elderly people, those with heart attacks and nervous diseases. Global warming also changes the season structure. In the North, winters will become warmer, which changes people's biological clocks.
		Temperature increase also increases the risks of tropical diseases, such as malaria and petechial fever and stimulates the development of insects and disease carriers, increasing the number of infectious diseases.
		The increasing intensity and frequency of natural disasters, such as storms, floods, droughts, typhoons, etc., will cause human and property damage and indirectly influence human health due to environmental pollution, malnutrition and diseases. The most vulnerable people are poor farmers, ethnic minority people in mountainous areas, elderly people, children and women.
	Extreme weather phenomena:	Increases of extreme weather phenomena and natural disasters in both amount and intensity due to climate change are a regular, short-term and long-term threat to every sector, region and community. Storms, floods, droughts, typhoons, hot weather, cyclones, etc. occur every year in many areas nationwide, damaging production and life.
		Climate change will make these natural disasters harsher, creating serious threats to socio-economic development or wiping out development achievements over many years. The most vulnerable

out able regions to extreme weather phenomena are the Central littoral areas, the Northern and North Central highlands, the Northern delta and the Mekong delta. (According to Report on Climate Change Assessment in Vietnam)

Appendix 3b: Games for Activity 3 Floating Islands – Sunk Islands

Objectives: To help players learn concepts of climate change, negative effects and measures to respond to climate change.

Tools: Some A0 papers divided into cells, with the number of cells equalling the number of multiple-choice questions on climate change.

How to play: Each team is given a sheet of paper divided into cells. Each cell equals one question on climate change. One cell will be cut out when they give a wrong answer. Four or five students from each team can stand on the paper; the last team having an "island" to stand on wins the game.

Reference Questionnaire for "Floating Islands - Sunk Islands" Game

1. Which of the	e following examples is about	climate c	hange:	
	A. A windy day		B. A rainy day	
	C. A sunny day		D. A hot day	
2. Which of th	ne following gases is a gree	nhouse	one?	
	A. Oxygen		B. Carbon Dioxide	
	C. Sulfur Dioxide		D. Ozone	
3. In how ma	ny years has the Earth's ave	erage su	rface temperature of	changed?
	A. 100 years		B. 1 million years	
	C. 1 billion years		D. 5 billion years	
4. How do sc	ientists know that sea levels	s are risi	ng?	
	A. Melting glaciers send more water into the ocean		B. Ozone layer depletion causes global warming.	
	C. Increased rainfall		D. All of the above	
5. Since when be emitted	n, in human history, have sig into the atmosphere?	gnificant	greenhouse gases	started to
	A. Glacial Period C. Industrial Revolution Period		B. Great Depressic Period	on
6. Which of the	e following activities emits mos	st greenh	ouse gases into the	atmosphere?
	A. Driving a car		B. Riding a bike	
	C. Walking		D. Using No Engine Boats	

7. Why could pl	ants and animals in the par	st chan	ge to adap	t to climat	e change?
	A. Because people protected them from climate change.		B. Clima in the pa so plants gradually	te change st occurre and anim change t	d slowly als could o adapt to it.
	C. In the past, the climate did not change, so plants and animals did not have to change to adapt to it.		D. In the animals I from clim	past, benefited nate chang	ge.
8. What can yo	u do to help prevent climat	e chan	ige?		
	A. Save energy		B. Plant	trees	
	C. Reuse		D. All of	the abov	e
9. Of these gas	es, which greenhouse gas	does r	not exist in r	nature?	
	A. Nitreous Oxide		B. Meth	nane	
	C. Halocarbon				
10. What is 350)ppm?				
	A. The safe level of carbon dioxide (COB ₂₈) in Earth's atmos	phere	B. The le we have	vel which surpassed	 d.
	C. The level of emission agreed by some countries.		D. All of	the above	
11. The current	atmospheric carbon dioxi	de (CO	$B_{\scriptscriptstyle 2B}$) level is	:	
	A. 355ppm		B. 378pp	om	
	C. 386ppm		D. 410p	pm	
12. Which is the	e strongest greenhouse ga	.s?			
	A. Water vapor		B. CFC		
	C. Carbon dioxide		D. Metha	ane	
			17. B	8' D	4.A
			11. C	7. B	3. D
			10. D	A.ð	2. B
			Э [.] 6	2.C	1. D

Answers



RESOURCE MATERIALS FOR ACTIVITY 4

Appendix 4a: Responding to climate change

1. The United Nations Framework Convention on Climate Change

Overview: The United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, was organised in Rio de Janeiro, Brazil from June 3 to June 14, 1992. Conference members wanted to protect the climate system and reduce negative impacts of global climate change.

As a result, the United Nations Framework Convention on Climate Change (UNFCCC) was developed, and took effect on 21 March 1994. Up to now, 192 countries in the world (including Vietnam) have approved this Convention.

- Objectives: The main objective of the treaty is to "stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". (Article 2, UNFCCC, updated on 29 October 2009).
- 2. Kyoto Protocol
- Overview: The Kyoto Protocol is an international treaty and a "turning point" arising out of the UNFCCC. The treaty was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. Under the Protocol, 37 industrialized countries and the European Commission committed themselves to reduce their collective greenhouse gas emissions by 5% from the 1990 level in five years, from 2008 to 2012. Up to now, 191 states have signed and ratified the protocol.
- Objectives: The objective of the Kyoto Protocol is to support countries to adapt to the negative effects of climate change by developing and implementing technologies that increase their capacities to cope with climate change. In addition, a special fund was established to finance adaptation projects and programs in developing countries.
- 3. National Target Program to respond to climate change in Vietnam
- Overview: On February 12, 2008, Prime Minister Nguyen Tan Dzung signed Decision Number 158/QĐ-TTg approving a "National Target Program to respond to climate change" with nine tasks and solutions. The Program runs from 2009 to 2015 with a total budget of about 1,965 billion VND.

Objectives: In implementing this decision, ministries, industry sectors and local authorities will assess the extent of climate change in Vietnam and identify measures to respond to climate change in different fields, sectors and regions in specific periods. They will also bring climate change issues into the mainstream in socio-economic, sartorial and local development strategies. Vietnam's efforts will contribute to the mitigation of climate change and protection of the global climatic system.

Climate change In June 2009, the Ministry of Natural Resources and Environment (MoNRE) issued the Climate Change and Sea-level Rise Scenario and sea-level for Vietnam as a foundation for ministries, sectors and local rise scenarios: authorities to implement their action plan and the National Target Program to respond to climate change.

4. How to mitigate climate change?

In order to alleviate negative impacts of climate change, we How to mitigate need to minimise greenhouse gases causing global temperature negative impacts increases. of climate change:

Measures to reduce greenhouse gases:

- Use energy efficiently and economically. The "Earth Hour" event is one way of raising people's awareness of the importance of a cost-effective use of energy.
- Reduce consumption of fossil fuels and nonrenewable energies, such as coal, peat, petroleum, oilsands, petroleum wax, petroleum gas and natural gas, etc. and replace them with renewable energies, such as solar energy, wind power, biomass, geothermal, wave energy, etc.
- Save water to decrease the amount of energy needed to handle both domestic and industrial water needs. This also helps prevent wasting water resources.
- Encourage people to select and use eco-products, environmentally friendly products, recycled and reused products.
- Motivate the community to participate in 3R (reduce, reuse, recycle) activities to use natural resources in an appropriate way.
- Prevent deforestation and forest fires. Participate in planting trees to absorb CO₂ and release O₂ and improve the atmospheric qualities.





Appendix 4b

Title	Date	Location	Descriptions
The United Nations Framework Convention on Climate Change (UNFCCC)	1992	Rio de Janeiro Earth Summit	Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
The Kyoto Protocol	1997, 2005	Kyoto, Japan	 The Kyoto Protocol set binding targets for 37 industrialized countries and the EU to reduce greenhouse gas emissions. It also supports countries to adapt to negative consequences of climate change 184 countries have approved the protocol
National Target Program on Responding to Climate Change in Vietnam	2008	Decision No 158/QD-TTg	 Assesses the degree of climate change in Vietnam Identifies measures for responses for sectors, industries and sub-national jurisdictions in each period Integrates this issue into strategies, programs, masterplans, and socio-economic development plans
Climate change, sea level rise scenarios for Vietnam	2009	The Ministry of Natural Resources and Environment	Acts as a basis for Ministries, sectors and sub-national jurisdictions to implement action plans and effectively deliver the National Target Program on Responding to Climate Change in Vietnam.

Appendix 4c: Game for Activity 4 Memory Game: Action for the Environment

Objectives: To help players remember and become aware of symbols and concepts related to climate change, the carbon footprint, environmental pollution and protection, etc.

Tools: 36 squares, including 18 pairs. Each pair consists of identical images related to climate change, the carbon footprint, activities and organisations against environmental pollution, etc.

How to play: Divide 6 people into two teams of three; two of them play and the third person acts as a referee to monitor the other team. Place 36 squares with the image facing down, mix them up and start the game. Each team starts by turning over one square and trying to find the second square with the same pair. If the wrong square turned over, the next player continues to open other squares until they have created one pair. The team managing to open 18 pairs first will win the game.



RESOURCE MATERIALS FOR ACTIVITY 5

Appendix 5a: checklist for contents of climate change education integrated in textbooks

Subject:.....Grade: 6, 7, 8, 9

EDUCATIONAL	11	NTEGRATE	D BY GRAD	E
CONTENTION CLIMATE CHANGE	Grade 6	Grade 7	Grade 8	Grade 9
1. Basic concepts which education climate change can explore				
Basic concepts of climate change				
Causes and effects of climate change				
Climate change in Vietnam				
Consequence of inefficient use of energy				
Responses to climate change				
 Activities for formation and development of skills in climate change 				
Identify climate change-related issues				
Collect information on climate change				
Organize information				
Analyze information				
Propose solution				
Develop an action plan				
Implement action plan				
3. Other activities for contributing to address climate change -related				

(Adapted from "Sample Design of Several Modules for Environmental Education")

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TOPIC 2

ENERGY SAVING AND EFFICIENCY

Introduction

According to the National Target Program's steering committee on energy saving and efficiency, Vietnam is facing a big challenge in balancing energy consumption with the demand to maintain double-digit annual growth rate. In addition, the exploration and exploitation of traditional and new/renewable energies are still limited.

Economic development and an increase in energy consumption demand have led to increasing exploitation and exhaustion of natural resources. At the same time, environmental problems caused by human activities, including exploration and consumption of energies, especially fossil fuels, have affected the balanced development of Earth, of which global climate change is the most evident consequence.

Therefore, energy saving and efficiency is not only a concern for an individual, an organization, or just one country but also a global issue, contributing to the implementation of principles on sustainable development worldwide.

Objectives

Topic 2 – *Energy saving and efficiency* helps students identify different types of energies and distinguish between fossil and renewable energies in order to develop the habit of saving energy and using it efficiently, by using clean energies.

This topic also helps teachers allocate time, integrate/mainstream content on the topic into different subjects (in curriculum time and extra-curriculum) under MOET's curriculum.

In Appendix 1 and 2, teachers can refer to the development and organisation of a multiple-choice questionnaire and supportive games to help students master basic issues on the topic.



ACTIVITY 1 BASIC CONCEPTS

- Time: 60 minutes
- Objectives: Trainees understand basic concepts of energy, such as: What is energy? What are the different kinds of energy? What is energy saving and efficiency? What are the benefits of energy saving and efficiency?

TeachingLaptop, projector, PowerPoint Presentation;aids:Pin board, coloured cards, A0 paper, labels (with images);Multiple-choice questionnaire

Steps:

- 1. Trainer organises group work;
- 2. Trainer introduces different kinds of energy by their origin through pictures. Each group thinks about one kind of energy and display it by image on A0 paper; other groups try to guess;
- 3. When groups give correct guesses of kinds of energy, the trainer sums up and explains in more details (Appendix 1a);
- 4. Each group proposes three ways to save energy;
- Trainer gives feedback, comments and adds more details (Annex 1a);
- 6. Groups study multiple choice questionnaire(Appendix 1b), label on the selected answer and ask one representative to present;
- 7. Trainer gives comments and sums up.
- Assessment: Groups recognize different kinds of energy and propose different measures for saving energy; Answers to multiple-choice questionnaire.
- Notes:In drawing images for different kinds of energy, the trainer may have
to draw the first image as an example;If groups could not identify different kinds of energy, the trainer may
 - have to give prompt;
 - Content of activity 1 can be integrated into Physics, Technology Environmental Education and Fine Arts lessons, etc.



ACTIVITY 2 CLASSIFYING KINDS OF ENERGY

Time:	60 minutes
Objectives:	Trainees can list different renewable and nonrenewable energies, fossil energies and different renewable energies in Vietnam.
Teaching aids:	Laptop, projector, PowerPoint lesson (accompanied by pictures/images); Pin board, color cards; Relevant pictures and images
Steps:	 Trainer organizes group work; Groups play the games on fossil energies; Groups play the game on renewable energies; Trainees identify available energies in Vietnam; Trainer sums up.
Assessment:	Group result of games Trainees answer the questions correctly
Notes:	The trainer may have to prepare large-sized image in lieu of the picture on the computer; Content of activity 2 can be integrated into Physics, Technology and Environmental Education lessons, etc.



ACTIVITY 3 CONSEQUENCES OF INEFFICIENT USE OF ENERGY

Time:	60 minutes
Objectives:	Trainees list consequences of inefficient use of energy.
Teaching aids:	Laptop, projector Pin board, coloured cards, A0 paper; Stop watch; A news video clip (eg. from Youtube); Camera (if any).
Steps:	 Trainer organises the class into two groups; Group One studies lack of natural resources as a result of inappropriate use of energy (Appendix 3a), Group Two researches the increasing greenhouse effect (Appendix 3a); Trainer shows news about the topic; Groups prepare similar news; One representative from each group roleplays being a TV announcer. Trainer records them. Trainer shows the recorded news and the class discuss; Trainer sums up.
Assessment:	Groupwork result
Notes:	Each group has a certain amount of time to release the news, a learner is assigned to keep time; Content of activity 3 can be integrated into Physics, Technology

Environmental Education and Fine Arts lessons, etc.



ACTIVITY 4 HOW TO SAVE ENERGY AND USE IT EFFICIENTLY

Time:	60 minutes
Objectives:	Trainees understand methods of saving energy and using it efficiently, then teach students how to save energy in daily activities.
Teaching aids:	Laptop, projector; Pin board, coloured cards, A0 paper, labels (with images) Multiple-choice questionnaire (see Appendix 4b)
Steps:	 Trainer organises the class into 4 groups; Groups study and discuss methods of saving energy and using it efficiently (Using mindmap); Representative from one group makes presentation; trainer gives feedback; Groups present their proposals on "Green House" and share with other groups; Trainer gives comments and feedback; Groups answer the questionnaire (Appendix 4b) put label on the selected answers and ask one representative to present; Trainer sums up.
Assessment:	Proposals of groups in respect of measures for efficient use of energy and "Green House"; Trainees give correct answers to questions
Notes:	The trainer can give his or her own proposal about the Green House and share with the whole group; Groups can use A0 papers or computers to display their ideas of Green House; The multiple-choice questionnaire can be replaced with the game "Power saving" (Appendix 4d) Content of activity 4 can be integrated into Civics Education, Technology and Fine Arts lessons, etc.



ACTIVITY 5 INTEGRATING ENERGY USE ISSUES INTO THE CURRICULUM

Time: 60 minutes

Objectives: Trainees master how to integrate a part of the topic on energy saving and efficiency into a particular lesson and list names of specific lessons in their subject which can be integrated using these issues.

TeachingA sample lesson plan or an activity which integrates the issue of
energy saving

Steps: 1. Trainer divides the class into subject groups;

- 2. Trainer asks trainees to read sample lesson plans which are integrated with energy saving and efficiency;
- 3. Trainees discuss ways to integrate issues related to energy saving and efficiency into particular lessons;
- 4. Trainees work in subject groups and give examples of specific lessons that integrate energy saving and efficiency issues (Appendix 5a).

Assessment: Groupwork result

Completeness of checklist for exploiting contents of energy saving education

Notes: Some subjects are easy to integrate, but others are not. Therefore, the numbers of examples may vary widely from group to group.



RESOURCE MATERIALS FOR TOPIC 2

ENERGY SAVING AND EFFICIENCY

RESOURCE MATERIALS FOR ACTIVITY 1 Appendix 1a: Energy concepts

- 1. What is energy?
- What is
energy?:Energy is the capacity to produce power. Power is the
transformation of energy to move an object over a particular
distance. The speed of producing power is called power rating.
The rate between force and time identifies the power rating.

BasicEnergy exists in two primary forms: potential energy and kineticforms ofenergy. Potential energy is the accumulated energy. Kineticenergy:energy is the release of potential energy to create motion andfinally produce power. Power is the transformation of energy to
move an object for a particular distance.

2. Forms of energy

- Introduction: Energy exists everywhere and changes from one form to another when it is impacted. There are many forms of energy: kinetic energy moves an object; thermal energy increases the temperature of an object; potential energy is stored in an object, etc. Human life is dependent on many energy transfers.
- Electric Electric energy is the flow of electrons travelling along a chain. energy: Movement of electrons creates an electric ray, producing electricity.

Thermal Thermal energy is the use of heat as a source of energy

Chemical energy:

energy:

Chemical energy is the energy created during the course of a chemical reaction, when chemical bonds of an agent are broken and rearranged to form a new molecule.

RadiantRadiant energy is the energy originating from a light source, such
as the sun. Radiant energy is released from the sun in the form of
photons. These tiny molecules are invisible and move like waves.Nuclear
energy:Nuclear energy is the energy created when parts of a molecule of
some particular material are split in a controlled environment. This
process releases heat (thermal energy), which can then be used

for different purposes, including generating electricity.

3. Energy saving and efficiency

How to save Energy saving and efficiency means reducing the amount of used and use energy efficiently: Energy by preventing wasteful and inappropriate energy consumption. It also implies using energy in an appropriate way, not wasting energy, using devices of low energy consumption. Using energy efficiently means reducing energy consumption for a certain demand, a job or a product unit.

Purposes of energy saving and efficiency: By saving energy and increasing energy efficiency, individuals, households, teams, offices and enterprises will cut down costs and help save the country's resources and protect the environment.



Appendix 1b: Multiple-choice questionnaire for Activity 1

1) Which or	ne is not a fossil fuel?
	a. Petroleum b. Wood c. Coal
2) Coal orig	inates from:
	a. Buried plants b. Fossil dinosaurs c. Chemical reactions
3) Which fo	ssil energy releases the smallest amount of CO ₂ ?
	a. Natural gas b. Coal c. Petroleum
4) Energy is	s generated in the highest amount from:
	a. Hurricane b. Atomic bomb c. Ocean waves



Appendix 1c: Answers to the questionnaire

1) "Fossil" is a terminology implying the remaining parts of plants and animals in stone. "Fossil fuel" indicates fuel formed by the remaining parts of ancient plants and animals in stone. Hence, "fossil fuel" implies different kinds of energy created by anaerobic disintegration of plants and animals that were buried 300 million years ago. Coal, petroleum and natural gas are fossil fuels. Wood is also a fuel (which can be burnt to produce energy), but it is not a fossil fuel.

2) Coal was created from plants growing on marshes millions of years ago. When these plants died, they were buried under layers of mud. As time went by, anaerobic disintegration processes turned them into coal. It takes 440 million years to form coal from plants this way.

3) Natural gas releases the smallest amount of CO_2 when it is burnt. Coal releases the largest amount of CO_2 when it is burnt.

4) A hurricane is a huge storm and can destroy coastal cities. It releases as much energy as 10,000 nuclear bombs.



RESOURCE MATERIALS FOR ACTIVITY 2

Appendix 2a: Forms of energy

- 1. Fossil energy
- Definition: Fossil energy is nonrenewable energy, such as coal, peat, petroleum, oil rocks and gas. It originates from ancient plants, animals and microorganisms as the Earth's crust oscillates. At present, humans have used a large amount of fossil fuel (about 80% of the primary energy resource) for economic development.

How do fossil fuels relate to climate change? How do fossil fuels sulphurous Oxide (SOx) and nitrous oxide (NO₂) when they are burnt. When the amount of CO₂ in the atmosphere increases, the global temperature rises. It is predicted that if people continue to burn fossil fuels and the amount of CO₂ continues to rise, the average global temperature will increase by 2°C, which will significantly affect the Earth. In addition, SOx and NOx are causes of acid rain, which creates huge damage to plants and animals all over the world.

is a nonrenewable energy.

Other

nonrenewable

energies:

2. Renewable energy

Definition: Renewable energy is created from existing resources that are considered unlimited under human standards. Unlimited energy is energy of such a huge amount that it cannot become exhausted by human consumption.

The basic principle of using renewable energy is to take a part of energy from continuing processes in the environment into technical uses.

Nuclear energy created from uranium is not a fossil energy, but it

Some clean and renewable energies for the future include:

Fuel cells: Fuel cells generate energy through the reaction between hydrogen and oxygen. This process does not emit CO₂ or other harmful gases. Hydrogen can be produced from many resources, such as natural gas and methane, which are not burned, thus not creating harmful gases. Japan is the leading country in producing various fuel cell resources, which are used in vehicles and domestic devices such as mobile phones.

Solar energy: Japan, the US and some Western European countries have taken the lead in using solar energy since the 1950s. By 2002, Japan had produced about 520,000 kW of electricity through solar panels, with an average price of 800,000 yen/kW, which is 10 times cheaper than the price in the last decade. If a four-member household in Japan consumes around 3 to 4kW of electricity/hour, they need to have about 30-40 square metres of solar panels. Japan plans to produce over 8.2 million kW of electricity from solar energy.

- Ocean This is a very rich resource of energy, especially in countries with energy: large ocean surface areas. Waves and tides are used to rotate electric turbines. Electricity generated using this technology can be used directly for operating lighthouses, pontoons, quays and navigation systems, etc.
- Wind wind power is considered an abundant green energy available everywhere. Wind can be used to turn electric turbines, as in the Netherlands, the UK and the US. Recently, the North Powen Group in Japan has succeeded in creating a microturbine. This turbine is named NP 103, and uses a generator with a propeller 20 c.m. long capable of producing 3W of electricity for lighting bicycle lights.
- Snow The Energy Research Associates in Bihai, Japan have successfully used snow to freeze products in stock and cool the atmosphere of houses in hot weather. In their project, snow is kept in stock to keep the temperature from 0°C to 4°C, an ideal temperature for preserving agricultural products, thus reducing production costs and product prices.
- Geothermal This source of energy is found deep under islands and volcanoes. It can be produced by absorbing hot water thousands of metres underground to rotate electric turbines. There are 17 geothermal power plants now in Japan. The largest, Hatchobaru Power Plant in Oita Prefecture, Kyushu, has a total productivity of 110,000 kW, enough for 3,700 families.
- Methane Methane hydrate gas is considered a hidden source of energy deep hydrate gas: Methane hydrate gas is considered a hidden source of energy deep underground. It is as white as ice; causing blockages in gas pipes underground and is called "burnable ice". Methane hydrate is a crystalised agent consisting of a water molecule and methane, which remains stable in low temperatures and high pressures. It is mostly found under permanent ice and geologic layers under oceans, and used as an alternative to petroleum and coal.

Biofermentati on energy:

This source of energy is created through the bio-fermentation process of domestic waste. Waste is sorted and stored in pools in order to produce biogas through bio-fermentation.

Biogas is a gas mixture, with methane gas (CHB_{4B}) the main component. It is produced by anaerobic digestion of biodegradable materials. After the fermentation process is complete, the remaining material is used as fertilizer.

There are two types of materials used to produce biogas:

Materials from animals: Excrement from humans, cattle and poultry are the most popular ones. Already processed through the digestion system, they are easily degraded and rapidly produce biogas. However, while the disintegration period is not long (from 2 to 3 months), the total amount of gas per kilogram produced is not large. Excrement from buffalos, cows and pigs degrades faster but has lower productivity than that of humans and poultry in producing biogas.

Materials from plants: They include crop by-products, such as straw, leaves and stems of maize, potatoes and peas, etc., wild plants, such as water-ferns and other water plants.

Biofuel: Biofuels are a wide range of fuels that derive from biomass, i.e plants, animals and their by-products. They exist in solid, liquid and gas forms.

Biofuels can be divided into two types:

- ? Biofuels made from agricultural and forestry products which are in fact food energy crops, such as maize, soya, cassava, colza, wheat, sugar beet, sugar cane and palm butter, etc.
- Piofuels made from non-food energy crops, such as Jatropha curcas L., Switchgrass or Panicum virgatum, Buffalograss or Buchloe dactyloides and algae, etc.

Popular biofuel products in the world include:

- Piodiesel (BD), which is mainly produced from fats and natural oils, such as soya oil and coconut oil. It is used in diesel engines.
- Pioalcohol includes bioethanol, biobutanol and biomethanol, the most popular of which is biomethanol (BE), produced from starchy seeds, sugar trees, wood and other agricultural wastes.

Solid biofuels, of which the most popular are wood pellets.



3. Renewable energy in Vietnam

Overview: With favourable natural resources and soil, Vietnam is considered a country with good potential for using renewable energies. According to some international experts, Vietnam could produce 100% of its electricity from renewable energies.

Vietnam currently has the goal of using 3% renewable energy out of the total electricity output in 2010 and 6% in 2020 (the rate in Germany in 2004 was 9.6%; the expected rate in Thailand in 2020 is 8-9%).

- SolarVietnam has 2,000 to 2,500 sunny hours per year with the totalenergy:solar radiation amount of 150 Cal/ cm²/ year. This is quite an
abundant energy in Vietnam, which is not available everywhere.
- WindThe average wind speed in the central areas and islands is 4m/spower:and wind turbines can be installed at a minimum of 12 metres
above ground.
- GeothermalThere are more than 300 hot spring water resources at 30 1050energy:°C in the Northeast and Central regions. They are expected to
produce about 200 400 MW of electricity in 2025.
- Hydroelectricity: Vietnam is one of 14 countries with the richest potential of hydroelectricity. Up to now, many hydro-electricity plants have been built in the country.



NERGY SAVIN

Appendix 2b: Game for Activity 2

1. The trainer shows the whole class different pictures representing different forms of energy;

2. Trainees guess what form of energy is represented by respective picture and then add information to that form of energy.

Note: The trainer can introduce renewable energy and non-renewable energy in succession.

Non-renewable energy:

Coal ¢ource: http://en.wikipedia.org/wiki/Coal)





Peat (Nguồn: http://en.wikipedia.org/wiki/Peat)

Petroleum (Source: http://en.wikipedia.org/wiki/Petroleum)





Oil shale (Source: http://www.greenchange.org/article.php?id=3314)

Natural Gas Source: http://greenmotion.org/natural_gas.html



Renewable Energy:

Fuel Cell (Source: http://en.wikipedia.org/wiki/Fuel_cell)





Solar Energy (Source: http://en.wikipedia.org/wiki/Solar_energy)

Ocean Energy (Source: http://penbay.org/audio/ff09 /ff09_oceanenergy.html)





Wind Power Energy (Source: http://en.wikipedia.org/wiki/Wind_power)

Geothermal Energy (Source: http://en.wikipedia.org/wiki/ Geothermal_energy)





Gas hydrate (Source: http://en.wikipedia.org/wiki /Methane_hydrate)

Bio-fermentation (Source: http://www.svlele.com/intro.htm)





Bio-energy (Source: http://bio-fuel-watch.blogspot.com /2009_01_01_archive.html)

RESOURCE MATERIALS FOR ACTIVITY 3

Appendix 3a: Consequences of inefficient use of energy

Overview: In order to earn \$1,000 US GDP, Vietnam has to consume around 600 kilograms of oil equivalent, 1.5 times as much as Thailand and two times as much as the world's average. Energy wasting is still very common in Vietnam. The energy consumption efficiency of power plants using coal and petroleum is only 28-32% in Vietnam, 10% lower than that of developed countries. In addition, productivity of industrial steam generators is around 60%, about 20% lower than the world average. It is estimated that energy intensity in Vietnamese industry is 1.5-1.7 times as much as that of Thailand and Malaysia (i.e in order to make the same product, Vietnam has to consume 1.5-1.7 times as much energy as in Thailand and Malaysia).

The ratio between the increase of energy demand and GDP growth in Vietnam is 2 while the rate in developed countries is below 1.

More than 80% of energy consumed in Vietnam is fossil fuels or fuels originating from organic substances. Therefore, burning energy causes serious environmental pollution. Gases emitted from burning energy make a significant contribution to the increase of greenhouse gases in the Earth's atmosphere, resulting in global climate change.

- 1. Exhaustion of natural resources
- Overview: Natural resources are priceless properties accumulated over billions of years on Earth, but they are not unlimited. Natural resources will become exhausted sooner or later, depending on time and human activities.

ExhaustionPeople have consumed a huge amount of fossil fuels, such as coalof fossiland petroleum, for the sake of economic development. We are nowfuels:dependent in fossil fuels, which account for 80% of primary energy
resources.

Global energy consumption is now 8.5 million tons of oil equivalents, including 40% of oil, 26% of coal and about 24% of natural gases.

According to many predictions, global oil demand will increase for at least 5 years before reaching its peak. The demand for natural gases and uranium will also continue to rise for one or two decades before reaching the highest point and starting to decrease. Mineral resources like coal are also being exhausted.

The latest predictions show that people can only exploit oil worldwide for the next 40 years, natural gases for 60 years and coal for 230 years before they run out.

2. Increase in the Greenhouse Effect

- Statistics: Utilization of energy causes environmental pollution, including consumption of fossil fuels, the main source of greenhouse gases. Gases like CO₂, emitted when burning fossil fuels, are the major causes for global warming. According to the International Energy Outlook (IEO) magazine in 2004, out of 24 billion tons of global CO₂ gas emissions in 2001, oil consumption accounted for 10 million; coal for a similar amount; and the remaining part came from natural gases.
- Consequen-When the amount of CO₂ increases in the atmosphere, the global temperature also rises due to the greenhouse effect, resulting in a changing climate in some regions. This will likely affect the vegetation, reduce agricultural output and gradually turn dry areas into deserts.



RESOURCE MATERIALS FOR ACTIVITY 4

Appendix 4a: How to save energy and use it efficiently

1. Energy saving

General
solution:Excessive consumption of energy will exhaust natural resources
and create gases which cause climate change. For three sectors
using the largest amount of energy, i.e transportation, industry and
domestic use, the three following measures need to be
implemented:

- Increase energy efficiency in order to reduce energy demand and greenhouse gases.
- Office and houses:
- Use an alternative source of energy which is still abundant, renewable, cheaper and/or less polluting in order to save current energy for technologies which must use this particular type of energy.
- Use other technologies to bring about one or both of the above results.

Three methods to increase energy efficiency in industry include:

- Produce the right quantity at the right moment.
- Combine electrical and thermal energy production in one thermal power plant; produce electricity using two or three successive thermodynamic periods (combining periods).
- Deliver energy in two ways: either deliver electricity or steam to two places at different times or deliver electricity to one place and water to the other.

In addition, it is also possible to use an alternative energy or a new manufacturing process that consumes less energy.

Some ways to increase energy efficiency in offices and houses include:

- Cooking: using stoves with high energy efficiency.
- Heating water and air conditioners: developing architectural layouts which are energy efficient and adaptable to the local climate based on the four guidelines below:
 - Store solar energy during daytime to be used at night, and store solar energy in the hot season to be used in the cold season.
 - Design buildings and use the natural environment in ways to prevent the sun coming into houses in hot weather and bring the sun into houses in cold weather.
 - Use insulation layers to reduce temperature transfer between indoor and outdoor atmosphere.
 - Adapt chimneys so that the air automatically moves between lower floors and the higher ones, blowing polluted air out.

- Operation of domestic devices:
 - Use power-saving bulbs instead of incandescent ones.
 - Use electric devices (air conditioner, refrigerator, television, water heater, iron, electric fan, computer, etc.) properly.
 - Turn off the lights before leaving and when not being used.
 - Turn off electric devices when not necessary.
 - Save gas and fossil fuels (coal, wood, straw, etc.).
 - Use high quality electric devices that have low energy consumption.
- Use other forms of energy:
 - Make use of cattle excrement to produce biogas for cooking and operating electric equipment.
 - Replace petroleum with gas in heating water for domestic use and running air conditioners.
 - Build houses according to bioclimatic architecture in order to utilise solar energy for air conditioning.
- Change living habits:
 - Use insulation systems or design houses according to bioclimatic architecture.
 - Live in urban areas and near the office to reduce travelling.
 - Wear warm clothes during winter to decrease heating demand.
 - Wear light clothes with no ties during summer to adapt to hot weather.
 - Buy food and cook enough food for each meal or each day to avoid freezing and defrosting.
 - Turn off the lights and air conditioners when no one is in the room
 - Do not leave an electric device on "stand-by" status when no one is using it.

2. Using energy efficiently

Greenhouse solution:

- Use power-saving bulbs and devices.
- Avoid water leakage in the kitchen and toilet.
- Go to work by bicycle and by bus instead of motorbike.
- Eat at home instead of going to restaurants.
- Use harmless chemicals to clean your house.
- Dry clothes naturally instead of using clothes dryers.
- Turn on taps and showers a little way and do not leave water running whilt cleaning your teeth and face.
- Maintain motorbikes and cars regularly to reduce repairs, replacement and petrol consumption.

Appendix 4b: Multiple-choice questionnaire for Activity 4

 How much CO₂ is emitted into the atmosphere on average when one litre of petrol is used to run a car? 		
a. None, since using petrol does not emit CO_2		
b. 2.4 kilograms		
c. 24 kilograms		
2) Which human activity is the main cause of climate change?		
a. Driving motorbikes		
b. Cutting trees		
c. Using fossil fuels to produce energy		
3) What temperature should you set your refrigerator at in order to save	e enerav?	
	55	
a. From -5°C to -2°C		
b. From 2°C to 5°C		
c. From 12°C to 15°C		
4) What type of light bulb uses energy the most efficiently?		
a. Incandescent bulbs		
b. Compact bulbs		
c. Fluorescent tubes		
5) In your opinion, which is the most economical way of using wat	er?	
a. Using water directly from a half-open tap (not fully	open)	
b. Using a bathtub		
c. Using showers		

6) Which room colour helps save more energy?

- a. Light yellow
- b. Dark blue
- c. Not important because room colour has no affect on energy use

7) The best way to cook soup is:

- a. Using an oven
- b. Using an electric stove
- c. Using a roaster

8) Which ways can you use to save energy and use it efficiently?

- a. Go on foot, by bicycle or bus to school
- b. Use shower instead of tub
- c. Use power-saving bulbs (compact bulbs, LED)
- d. Do not leave electric devices (computers, televisions) on stand-by status
- e. Turn off the light when you leave the room, even just in a few minutes
- f. Reuse/recycle glass bottles, cans, papers and metal furniture



Appendix 4c: Answers to the questionnaire (Appendix 4b)

1) Each litre of petrol used in a car emits 2.4 kilograms of CO_2 on average. Worldwide, vehicles (trucks, buses, cars, motorbikes, airplanes, etc.) send around 900 million tons of CO_2 into the atmosphere on average.

2) Using fossil fuels to produce energy is the main cause of global warming. About 90% of energy used globally is made from petroleum, natural gas and coal. The CO_2 emitted from producing and using fossil energy is the biggest source of greenhouse gases created by human activities.

3) The best temperature for a domestic refrigerator is from 2°C to 5°C. This is an ideal temperature to preserve food. Lower temperatures will waste energy.

4) Compact bulbs consume one-quarter as much as energy as incandescent ones and last for 10 times as long as incandescent ones. Fluorescent tubes use about 60-80% of energy of incandescent bulbs and last for 10 – 20 times as long as incandescent ones.

5) A bathtub contains around 200 litres of water. A shower sprays about 15 -20 litres of water in one minute. Therefore, the best way to use a shower is with a half-open tap.

6) Walls painted in bright colours reflect 80% of light and need less lights than the bright ones. Dark walls absorb light.

7) An electric stove consumes only half as much energy as an oven.


Annex 4d

Game "Power saving"

Objective: To help players learn different ways to save electricity.

Tools: Papers, pens, boards and chalk

How to play: Groups of 3-4 persons play in 3-5 minutes. Each group lists as many power saving ways as possible on a paper. The group having the longest list will win the game.



RESOURCE MATERIALS FOR ACTIVITY 5

Annex 5a:

checklist for contents of efficient use of energy integrated in textbooks Subject:.....Grade: 6, 7, 8, 9

ENVIRONMETAL	INTEGRATED BY GRADE			
EDUCATION CONTENT IN ENERGY	Grade 6	Grade 7	Grade 8	Grade 9
1. Basic concepts which education on efficient use of energy can exploit				
Basic concepts of forms of energy				
Basic concepts of sources of energy				
Sources of energy in Vietnam				
Consequence of inefficient use of energy				
Measures for efficient use of energy				
2. Activities for formation and development of skills in efficient use of energy				
Awareness of energy-related issues				
Collect information on energy				
Organize information				
Analyze information				
Propose solution				
Develop an action plan				
Implement action plan				
3. Other activities for contributing to address energy-related issues				

(Adapted from "Sample Design of Several Modules for Environmental Education")

References:

Ministry of Education and Training. (2009). Thiết kế mẫu một số mô đun Giáo dục Môi trường [Design of some modules for environmetal education].

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TOPIC 3 WASTE RECYCLING

Introduction

With the increasing world population and rapid growth of societies, often excessively in some areas, vast quantities of waste are being produced. While much organic waste can be re-used, a lot of inorganic waste cannot, or is difficult to recycle. There are also many other dangerous toxic substances.

Increased waste causes great harm to the environment and people's health, as well as reducing the amount of land available, due to landfills. Thus, it is essential to limit the production – consumption process and promote the reuse of goods and services to reduce waste. The collection and recycling of waste is one of the world's and Vietnam's biggest concerns.

The three topics on "Waste recycling", "Climate Change" and "Energy saving and efficiency" in this material will form a baseline knowledge for students.

Objectives

This topic provides students with basic information on waste, waste classification and 3R waste management (Reduce, Re-use, Recycle), as well as reorganization and usage of recycled products. It will also help teachers develop their lesson plans to integrate content into different lessons and subjects.



ACTIVITY 1 BASIC CONCEPTS

Time:	60 minutes			
Objectives:	Trainees understand definitions of waste, waste classification, reasons for waste management and its benefits.			
Materials	Laptop, projector, PowerPoint presentation; Pin board, coloured cards, A0 paper; Game tools (See Appendix 1b).			
Steps:	 Trainer organises class into groups; Groups make a mindmap on waste classification; Groups estimate the proportion of household wastes, whereby, a table of overall percentages for household wastes is presented; Group discuss the importance and benefits of waste management; Group's representative gives presentation; Trainer sums up; Trainer divide class into groups to play games (Appendix 1b); Trainer sums up. 			
Assessment:	Groupwork result The game engages students' participation			
Notes:	For Activity 1, it is possible to suggest groups to create a mindmap on waste classification by sector and region; The content of Activity 1 can be integrated in Technology, Biology, and Environmental Education lessons, etc.			



ACTIVITY 2 3R WASTE MANAGEMENT

Time:	60 mins			
Objectives:	Trainees understand the concepts of 3R, its benefits and the basic know-how of 3R implementation to reduce waste.			
Materials	Laptop, projector, PowerPoint presentation; Pin board, coloured cards, A0 paper Game tools			
Steps:	 Trainer organises class into groups; Groups discuss and provide concepts of basic definitions of 3R and benefits of 3R; Trainer sums up; Groups discuss how to implement 3R; the group with more ideas will win; Trainer divides the class into groups to play games (Appendix 2b); Trainer sums up. 			
Assessment:	Groupwork result Number of ideas on for implementing 3R			
Notes:	It is possible to replace Activity 2 with a small contest, in which each team list different measures for implementing 3R, the team with more ideas will win; Based on the ideas of Appendix 2b, the trainer may request individuals or groups to produce different toys; The content of Activity 2 can be integrated in Technology, Biology and Environmental Education lessons, etc.			

ACTIVITY 3 WASTE RECYCLING

Time:	60 mins			
Objectives:	Trainees are able to list wastes that can be recycled and understand the methods for recycling some common waste.			
Materials	Laptop, projector; PowerPoint Presentation Pin board, coloured cards, A0 paper, stickers (with images_ Multiple-choice questionnaires			
Steps:	 Trainer divides class into groups; Groups discuss the topic "Waste that can be recycled and some typical recycling activities"; Group present the group discussion result; Trainer sums up; Groups work on the questionnaire, post their stickers on the chosen answers and appoint one member to present; Trainer sums up. 			
Assessment:	Students answer the questions correctly; Groupwork results.			
Notes:	The trainer can show the entire group a video clip on waster recycling activities and discuss how such activities cause impact on environment, how to reconcile between recycling and environmental protection; The trainer may choose the game "Waste recycling" (Appendix 3d); The content of Activity 3 can be integrated in Technology and Biology lessons			

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/	ATIVITY 4 REDUCE YOUR WASTE		
T !			
l'ime:	60 mins		
Objectives:	Trainees get to recognise eco-friendly products by their eco labels and are able to list some methods of reducing waste in households.		
Materials	Laptop, projector, PowerPoint presentation (if necessary) Pin board, coloured cards, A0 paper, stickers; Multiple choice exercises (Appendix 4d); Game tools.		
Steps:	 Trainer divides the class into groups; Groups participate in the contest on "The Users of eco friendly products" (the group with more ideas will win); Trainer lectures"eco labels"; Groups design their own posters on reducing domest wastes; The trainer gives comments and additions; Groups work on the questionnaire (Appendix 4b), post the stickers on the chosen answers and appoint one member for present; Trainer sums up. 		
Assessment:	Students answer the questions correctly; Groupwork result.		
Notes:	Groups may design posters on computer; The content of Activity 4 can be integrated in Technology; Civics Education and Fine Arts lessons, etc.		

ACTIVITY 5

INTEGRATING WASTE RECYCLING ISSUES INTO THE CURRICULUM

Time: 60 mins

Steps:

- Objectives: Trainees learn how to integrate part of the content in waste recycling into a specific lesson; and list lessons in some subjects they think are suitable for integration
- Materials Sample lesson plans

1. Trainer organises class into groups by subjects taught;

- 2. Trainees asked to read an example of the integrated lesson plan on waste recycling concepts;
- 3. Trainees discuss how to integrate waste recycling concepts into the curriculum;
- 4. Trainees work in groups by subjects, give examples on specific lessons that are suitable for integration.

Assessment: Group work results;

The completeness of the contents for integration of waste recycling aspects in textbooks.

Notes: The difficulty of integrating this material varies with different subjects, so each group categorised by subjects may present very different examples



RESOURCE MATERIALS FOR TOPIC 3

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WASTE RECYCLING

RESOURCE MATERIALS FOR ACTIVITY 1 Appendix 1a: Definitions of waste

1. What is waste?

What isWaste is the name given to everything that people discard in
the process of living.

2. Waste classification

Waste classificati There are many types of waste and they can be categorised by origin, or its physical or chemical nature. For example, municipal, industrial, agricultural, transportation, tourism, sea products, medical, hospitals, offices, schools, villages, hazardous, inorganic, organic, gas, liquid, solid, recyclable and non-recyclable.

Waste classification is relative given the fact that a certain type of waste can arise from an unclarified source.

Naste		Percentage of the component within the wastCau DienViet TriHa NoiPhu ThoChung, Ha		thin the waste (%)
component	Components			Lai Xa, Kim Chung, Ha Noi
	Organic waste Shredded paper Cloth, wood Rubber, plastic Snails, bones, brick, soil, stone, gravel, glazed terracotta porcelain, glass Metal, cans Crushed garbage (dust) <10mm	53 4 - 5,5 1 - 1,5 4 - 6 5 - 7 0,1- 0,5 30-35	78 - 80 1 1 -1,5 2,5 - 3,0 2 - 4 0,1 8 - 10	80 - 82 4,1 1,3 5,9 1,6 <0,1 5 - 10

Source: Building a model for waste handling on a small scale (village, town) - Assoc. Prof. Ly Kim Bang, Ph.D, Tang Thi Chinh, PhD.

3. Waste management

Waste loads The amount of waste discharged daily through people's production and domestic activities is massive. In 2007, statisticians predicted that until 2010, the amount of solid waste in Vietnam would increase from 24 to 30% or 45 million tons of waste per year, not including liquid and gas waste. The garbage/waste collection system is able to process 80% of the large amount of waste, of which only 10% can be recycled, while the rest is treated by landfilling.

Purpose of waste management system should be organised nationwide with the involvement and participation of relevant authorities, the community and individuals. This would reduce environmental pollution and avoid the situation of usable land wasted on landfills. Instead, waste should be considered a valuable resource for recycling and re-use.

Benefits of waste by the perspective of waste treatment experts, every single ton of plastic soda cans is equivalent to 700 kilograms of recycled raw material. In order to have 1 ton of plastic bottles, people use 6 tons of oil; 1 ton of metal waste is equivalent to 900 k.g. of recycled metal; and 1 ton of paper waste is equivalent to 850 k.g. of recycled paper.

These figures indicate that good waste management would make our society a "recycled world" – a Japanese concept referring to a method of using material sources effectively. In that world, everything can be recycled, re-used under many forms and types of usage for the sake of the environment.



Appendix 1b: Game for Activity 1

The Waste Classification game

Objective: To help participants understand the classification of waste by its nature, recycling potential and hazardous level

Tools: Paper, pens, board and chalk

How to play: Play in groups of 3-4 people. Within a fixed period of time (4-5 minutes), each group will have to list and classify as much waste as possible by its nature: organic, inorganic, metal, plastic, paper; and by waste recycling potential. The group with the longest list wins the game.



RESOURCE MATERIALS FOR ACTIVITY 2

Appendix 2a: 3R waste management

- 1. Definition of 3R
- Definition : 3R is the combination of the three initial letters: Reduce Reuse Recycle.
- Reduce: Reduce means to cut down the waste load through changing behaviour in living, consuming, improving the production processes and promoting clean purchases. For example: Replace plastic bags with baskets and cloth bags while shopping to reduce the amount of plastic bags being discarded daily; share and rent equipment and tools, etc.
- Reuse: Reuse means to use again a product or a part of a product for its original purpose, or differently. For example: reuse glass or plastic bottles to hold water, boxes and containers to hold different things, use equipment for different purposes, etc.
- Recycle: Recycling means to reclaim waste for other useful items. For example: recycling paper, plastic, glass or metal.
- 2. The benefits of 3R



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3. 3R implementation



How to implement 3R effectively:

Though 3R may sound simple, it needs comprehensive cooperation from all levels of society, ranging from different levels of government to each individual citizen. The sorting of waste in households and residential areas will not be successful if afterward the sorted waste is mixed together at waste collection centres.



Appendix 2b: Game for Activity 2 Game: Making toys from old objects

Preparation: Small phials, i.e. for containing eye/nose drops, hard color papers, color cloth, glue and sticky tape

Objective: To encourage people to recycle and reuse old materials to produce useful objects.

How to play:

- Use two pieces of color papers and stick them to both sides of phial covers to produce bird's eyes.
- Use hard color paper and stick it phial cover to produce the bird's beak
- Use color papers and stick it around to produce the bird's body

Use color papers to make wings

Upon completion, you have produced a toy for a little child.



RESOURCE MATERIALS FOR ACTIVITY 3

Appendix 3a: Waste Recycling

1. Some recycled waste

1. Which •	Organic waste (plants and animals): vegetables, roots, fruits, meat, fish, etc.			
waste can	Metals: copper, aluminum, iron, steel, tin and precious metals			
be 📍	General plastics: products from PVC, PE, PP, etc.			
recycled?	Paper, cartons: Old newspapers, books, notebooks, cartons, boards, packaging, etc.			
:	Glass			
	Industrial waste: batteries, chemicals, gases, etc.			
•	Electronic waste: computers, hand-phones, fax machines, photocopiers, etc.			
2. Some typical	recycling activities			

Producing Compost, a kind of nutritious fertilizer, is produced by recycling organic

compost:

waste from the kitchen or from farms

There are two composting methods :

Aerobic: In this method, organic ingredients need to be mixed up to receive oxygen. Microorganisms help decompose organic matter, and in the process produce a lot of heat and more quickly than by anaeobic methods.

Anaerobic: This method uses closed containers with no oxygen, which needs more time and does not cause as much heat.

Compost helps increase fermentation and organic humus in the soil, keeps it moist, absorbs and filters it better, avoids soil exhaustion, gradually releases nutrients, increases mineral absorption, controls erosion, improves physical properties of soil, increases drought tolerance, makes it disease resistant, and reduces landfill waste, etc.

Paper Used paper or Recycling: organisations, airports, etc.⁻¹ recyclable. No

Used paper can be found in many places: houses, schools, offices, organisations, companies, factories, supermarkets, shops, stations and airports, etc. There are two types of used paper: recyclable and non-recyclable. Non-recyclable paper includes thermal paper, sticky paper, tape, transparent paper (for presentations), carbon paper, cellophane, paper covered with plastic or wax, containers of milk, candy wraps, covers of photocopy paper, lunch boxes, paper cups and plates, used tissue, paper containers of paint and paper covers for food products or containing chemicals, etc.

Recycled paper is collected, classified, shredded, heated and processed chemically, then rolled, flattened, dried, and cut (see Paper Recycling game - Appendix 3) to make different kinds of papers, depending on the input quality of the paper being recycled.



One ton of recycled paper prevents one ton of paper being buried or burned. Paper can be recycled 4 to 6 times before the paper fibres become too short for the recycling process.

Recycling one ton of paper can save more than 4,200 kW of electricity (this number is enough for a 4-person family to last one year), save 32 cu.m. of water and 17 trees.

Metal There are ferrous and non-ferrous metals.

Recycling: Non-ferrous metals include (i) light metals (aluminum, titan, magnesium), (ii) heavy metal (copper, lead, nickel, zinc, tin), (iii) precious metals (gold, silver and platinum).

Ferrous metal is an alloy of iron and steel.

Metal is popularly used so it is also discharged everywhere. Since it is a highly valued waste (e.g. electronic waste contains lots of precious metal), it is not buried as organic waste or construction waste (bricks, tiles, stone, and concrete), paper, plastic bags, etc. Metal waste is collected and sorted for recycling.

Metal recycling should use proper techniques and be strictly managed because this process usually causes air and water pollution. Currently, many villages in Bac Ninh province, Vietnam specialise in ferrous metal recycling. Pollution in this area is quite severe due to high levels of dust, smoke and waste water containing toxic chemicals.

Recycling All types of plastic such as PVC (Polyvinylchloride), PE (Polyethylene), plastic: and PP (Polypropylene) can be recycled to create many things for domestic use. Plastic waste has a high value so it is collected and recycled.

In villages, the recycling process involves simply sorting, melting, spinning, and chopping to make plastic seeds as a raw material for subsequent processes (extrusion, pressing, blowing). Due to rudimentary and manual equipment, the air and waste water are seriously polluted. As well, temperatures in the plastic recycling process are not high and the sorting process is not good enough. Plastic waste after recycling may contain many types of pathogens if, for example, the recycled plastic waste is collected from a hospital.

Plastic waste, especially plastic bags once thrown out, is hazardous because it takes hundreds of years for these bags to be degraded. While landfilling, this waste can cause pollution, congestion of ground water, and hinder metabolism of air cycles in the soil. Burned at normal temperature, this will create a toxic gas capable of causing cancer.

Appendix 3b: Multiple-choice questionnaire for Activity 3

1) Which type	of waste below is biodegradable?
	a. Soda cans
	b. Waste paper
	c. Apple peelings, vegetables, leftover food
2) Which type	of waste below is the most difficult one to recycle?
	a. Carton boxes
	b. Plastic covers
	c. Plastic and aluminum covers
3) How many	times can paper be recycled?
	a. 1 time
	b. About 7 times
	c. About 50 times
4) How many	times can plastic covers be recycled?
	a. 1 time
	b. 3 times maximum
	c. 4 times at least
5) PVC (is)	material
	a. Recyclable
	b. Non recyclable
	c. Used to produce compost fertilizer
6) What percer	ntage (%) of household waste can be used to produce compost?
	a. 30%
	b. 50%
	c. 70%

Appendix 3c: Answers to the questionnaire

1) Organic waste (apple peelings, vegetables, etc.) is quickly degradable by bacteria, microorganisms and other small animals such as worms.

2) Covers made of plastic & cartons or plastic & aluminum are most difficult to recycle.

3) Paper can be recycled 7 times to make newspaper, toilet paper or even notebooks. However, the paper fibre becomes smaller and loses its adhesive gradually each time.

4) Plastic materials can be recycled many times. However, after each recycling time with repetitive heating and processing, plastic materials will gradually lose their physical structure.

5) PVC is one of 7 general plastics used for making toys, construction material, etc. and is recyclable.

6) 70% of household waste can be used to produce compost; this process would reduce the amount of waste to be landfilled and turn recycled waste into soil. This type of soil can be used for planting trees in houses or gardens.

Appendix 3d: Game for Activity 3

Paper recycling game

Objectives: To help participants understand the paper recycling process, this encourages them to use paper economically.

Preparation: Wooden case and tray for paper making.

- A wooden case is made from 4 wooden sticks which are connected into an A4-sized rectangle shape, more or less. One side of the case is covered by a metal or aluminum net
- Tray for paper pulp: The size of the tray is bigger and higher than the wooden case's. This ensures the wooden case to fit in the tray totally.

Pulp preparation:

- Soak some old newspaper into a bowl of water for a couple of hours, rub the wet newspaper so that they dissolve in the water creating a liquid of water and pulp.
- Check the condensity of the pulp and adjust appropriate amount of water. Pour in some starch (tapioca, wheat, rice powder) to create the adhesive of the solution.

Making paper (Decoration):

- Pour the paper pulp into the tray; stir it up. Put the wooden case onto the tray, slightly shake it so that the paper pulp to stick onto the case and the surface of the net;
- Shake and take the case out of the tray, continue to shake slightly for the water to come off;
- Put some petals, leaves or color paper onto the pulp surface for decoration;
- ? Spread a cotton cloth and put the wooden case with the decorated surface facing down the cloth. Take another cotton cloth and put onto the net surface of the case to absorb the remaining water;
- Slightly take the case out, leaving the paper pulp on the cloth surface. Slightly move the paper pulp onto a piece of cardboard, with the decorated surface facing up;
- Leave the cardboard to dry out, and then detach the pieces of paper from the cardboard. It can be reshaped, framed and hang for decoration.

RESOURCE MATERIALS FOR ACTIVITY 4

Appendix 4a: Reduce your waste

Waste is all around us. Thus, we need to think carefully before buying or throwing anything away since it could be used for another purpose. People should also consider the harm to the environment of the waste being discarded.

1. Using eco-friendly products

What is an
eco-friendlyAn eco-friendly product is one in which all processes of raw
material exploitation, production, existence, use and after
disposal cause less harm to the environment than similar
products. It is granted the eco-label by a state or governmental
organisation.

Eco-friendly products:

Some eco-friendly products are:

- Packaging which allows easy decomposition into organic materials (bags, bottles and boxes)
- Machines which do not use fossil fuels and have no emissions or less emissions of harmful gases when compared to similar products (motor vehicles, equipment, refrigeration)
- Recycled products

2. Eco-labels

What is an Eco-label (also referred to as an environmental label) informs customers about the environmental friendliness of a product (or group of products) in comparison with similar products or services.

Purpose of Eco-labelling is to encourage people to produce and consume eco-labelling: environmentally friendly products, raising awareness of protecting the environment and society in association with economical benefits to enterprises.

This also helps consumers identify which products/services of which enterprises/organisation are more environmentally friendly, and an eco-labeled product will be preferable to many consumers.

Vietnam Green Label:

Vietnam's eco-label – the Vietnam Green Label – is used to certify environmentally friendly products, which shows the manufacturers' commitment to environmental protection. The efforts and contribution of the products themselves will also be conveyed to consumers through the eco-label.

3. Reduce domestic waste

Ways of reducing domestic waste:

- Make more homemade food rather than purchasing cooked and canned food
- Make gifts and greeting cards yourself for friends and family instead of buying them at a shop
- Plant vegetables and flowers yourself
- Purchase old books, not new ones
- Mend old clothes, equipment and toys rather than buy new ones
- Rent and share stuff whenever possible instead of buying something new
- Before and while shopping:
 - $\sqrt{}$ Use a shopping list
 - $\sqrt{}$ Only buy necessary things
 - $\sqrt{}$ Avoid goods with heavy packaging
 - $\sqrt{}$ Do not buy single-use products such as towels and napkins
 - $\sqrt{}$ Buy strong and durable products
 - $\sqrt{}$ Bring your bag/basket along with you when you go shopping.

Sorting domestic waste:

- Separate recyclable waste: paper, cotton, boxes, plastic bottles, plastic bags, glass bottles
- Use a double-compartment bin or 2 separate dustbins to store organic and inorganic waste with different colours (for example green for organic and red for inorganic). Logos or symbols should make the sorting process easier. Note: The identifying colours and symbols for each type of waste should be consistent and synchronous everywhere to avoid confusion
- Organic waste: fruit, vegetables, leftover food, coffee and tea, soil, leaves, etc.
- Inorganic waste: bones, toys, branches, shells, used tissues, manmade clothes, coal, glasses, plastic bags, cigarette butts.

Appendix 4b: Multiple-choice questionnaire for Activity 4

1) If 1 ton of p	aper is recycled, how many trees will be saved?
a.	12 trees
D. C.	23 trees
2) Which type	of cup do you choose to reduce waste?
a.	Glass
b.	Plastic
C.	Paper
3) How do yo	u deal with cans after drinking?
a.	Send for recycling
b.	Use for another purpose (use as food carrier for birds, for example)
C.	Put in a dustbin
4) What woul	d you do if you saw a can on the grass?
a.	Pick it up and put it into a recycle bin
b.	Kick it into the road
C.	Throw it into a dustbin
5) What would	d you do with a container of leftover paint?
a.	Pour into a storm drain
b.	Throw into dustbin
C.	Give it to someone who needs it
6) Which type of a	creatures below boost the decomposition of organic matter into soil naturally?
a.	Butterflies
b.	Earthworms
С.	Squirrels

7) What would you do with old clothes?

- a. Send to a charity fund
- b. Throw away
- c. Put in a corner of house

8) You see many beautiful T-shirts in the supermarket. What do you do?

- a. Buy all the styles you like as you want to wear a different style each day
- b. Buy all of them, but when you don't like them anymore, hand on to your brother/sister
- ^{C.} Buy the one you really want

9) At the counter, the cashier gives you a plastic bag. What do you do?

- a. Use it to carry your shopping
- b. Reject it since you've brought your own along
- c. Ask for one more bag because you bought a lot of things

10) What do you do after cooking?

- a. Clean up, put waste into recycle bin
- b. Let your parents or someone else clean the kitchen Clean up and sort waste: organic waste for making compost
- c. fertilizer, plastic for recycling, put rest put into the dustbin.

11) After cutting weeds in the garden, what do you do?

- a. Leave the weeds in the garden
- b. Collect, put in a plastic bag and put in a dustbin
- c. Put it in the street gutters

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Appendix 4c: Answers to the questionnaire

1) Using one ton of recycled paper, you will save 17 trees. Besides, recycling one ton of paper can save 32 m^3 of water, 1.6 m^3 FO oil, 4,200 kWh of electricity and about 2.3 m^3 of buried waste.

2) Plastic and paper cups are discarded after use while glass cups can be used many times and do not add to the waste load.

3) Try your best to use things for different purposes before recycling.

4) Collecting waste is saving the environment. Recycling waste is saving natural resources and reducing landfill areas.

5) Thrown-away paint might become dangerous. It is best to give the leftover paint to other people and recycle the can afterward.

6) Earthworms eat organic waste to create worm castings or manure.

7) Reuse first and then recycle. Send old clothes to help the poor.

8) Only buying necessary things helps reduce waste.

9) Try not to use plastic bags whenever possible. Plastic bags are made of polyethylene (PE), are oil-based and take a long time to degrade. According to research, without high temperatures and sunlight, this process would take 500 to 1000 years.

Once discarded in the environment, under the effect of sunlight, the molecules of plastic bags break into many smaller molecules, then become more poisonous and pollute the land and water resources. They can also damage people and animals. According to the World Wildlife Fund (WWF), many of the 200 species of marine creatures (whales, dolphins, seals, turtles, etc.) died from eating plastic bags, and many sea species died from suffocation after creeping into plastic bags. Annually, a Vietnamese person uses 35 kilograms of plastic-based products on average and Vietnam discharges about 2,500 tons of plastic rubbish to the environment every day.

10) You can help solve waste problems by sorting them at home first.

11) Leaving the cut weeds in the garden not only helps to reduce waste but also keeps land moist and saves water.



RESOURCE MATERIALS FOR ACTIVITY 5

Annex 5a: Checklist for contents of waste recycling and reduction integrated in textbooks

Subject:.....Grade: 6, 7, 8, 9

EDUCATIONAL CONTENT	INTEGRATED BY GRADE			
AND REDUCTION	Grade 6	Grade 7	Grade 8	Grade 9
1. Basic concepts which education on waste recycling and reduction can exploit				
Basic concepts of waste				
3R management				
Waste recycling				
Waste reduction				
2. Activities for formation and development of skills in waste recycling and reduction				
Awareness of waste-related issues				
Collect information on waste				
Organize information				
Analyze information				
Propose solution				
Develop an action plan				
Implement action plan				
3. Other activities for contributing to address waste-related issues				

(Adapted from "Sample Design of Several Modules for Environmental Education")

References

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