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Teaching Climate Change in Classrooms

A toolkit for teachers

For Grade 7-9

WWF Nepal
2007

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Why a toolkit?

This is a resource for educationists teaching Grades 7 to 9. It will help teachers know more about climate change and its impacts. Effort has been made to simplify the science of climate change. Illustrations are widely used. Some chapters have activities to make the learning process much easier!

We would like to thank the British Embassy in Nepal for the financial aid to run the climate change awareness campaign that was a major motivation in producing this education resource. Our thanks goes also to the European Commission for supporting the publication of this toolkit. Last and most importantly, we would like to express our sincere gratitude to all the teachers from the 25 schools in Kathmandu who participated in the year-long "School level awareness campaign 2005" organized by WWF Nepal together with our implementing partner, Clean Energy Nepal.

WWF Nepal

In this toolkit you will find...

Lesson 1: Weather and Climate

Objectives:

- Distinction between weather and climate
- Understanding the link between the climate system and a living environment

Key words: Weather, climate, and climate system

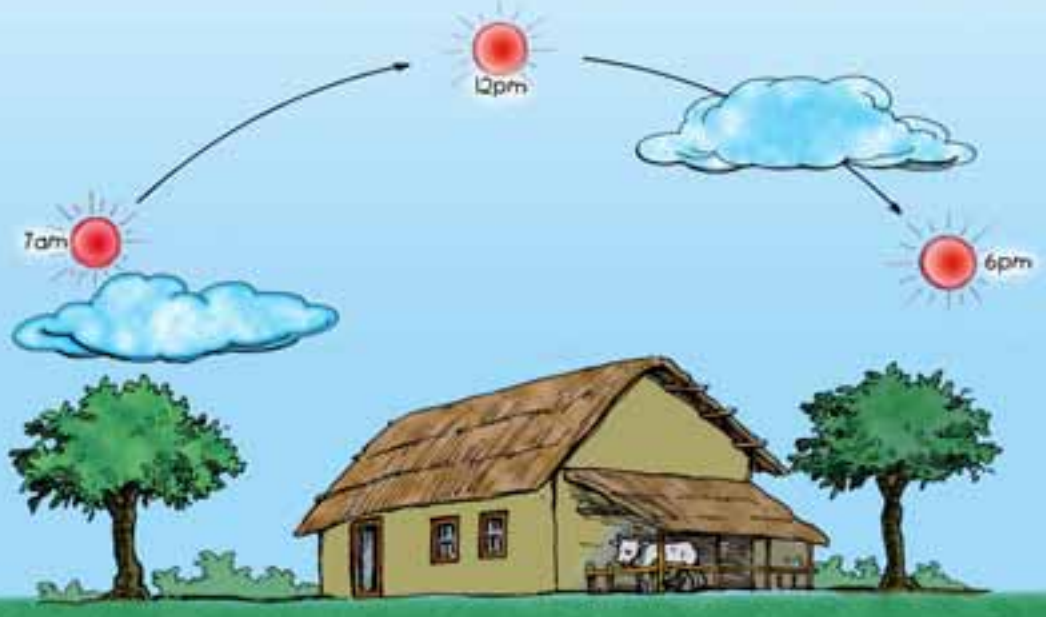
A. Introduction to the lesson

This lesson introduces the concept of 'weather' and 'climate'. It emphasizes the importance of weather and climate to all living creatures while highlighting the differences between the two.

Introductory Activity

"What is the difference between weather and climate?"

Ask the learners how they distinguish between these two terms. Allow them to talk about how weather and climate system are closely interlinked with our daily life. They can prepare a list of activities such as agricultural practices (rice planting, vegetables growing), celebration of festivals (Dashain, Tihar, Ashad 15) and other daily activities that are influenced by specific weather patterns.



B. Content

Weather is the specific condition of the atmosphere at a particular place and time. It is measured in terms of temperature, humidity, cloudiness, sunshine, wind speed, and precipitation. People often make remarks such as “What lovely weather!”, ”It is so hot today.” or “Will it rain tonight?”

Weather could change day-to-day or even hour-to-hour. Changes in weather pattern are easily detected. However, we seldom give serious attention to climate unless we notice some unusual phenomenon such as a long dry season, massive flooding, heavy rainfall, raging storms, extreme heat or cold and so on. This is because changes in the climate take a long time to settle in. Therefore, climate is the average of weather over time, usually taken over a 30 years period, for a particular region.

A simple way of remembering the difference is that ‘climate’ is what you get in long span of time (e.g. cold winters, hot summers) and ‘weather’ is what you get in short span of time (e.g. a sunny day).

Understanding our climate system:

The climate anywhere on our planet is shaped by a delicate balance of the following elements – sun, atmosphere, oceans, water system, plants, living organisms, and topography. The sun plays a vital role in the earth’s climate system. The entire land mass, with its mountains, plains, forests, and ecosystem, guides both local and global climate.

Atmosphere

The atmosphere is a thin layer of mixed gases around the earth's surface and it helps the Earth to maintain the correct temperature, much like clothing does for us. Weather systems, which develop in the lower atmosphere, are driven by heat from the sun, the rotation of the Earth, and pressure variations on the Earth's surface.

Oceans

Oceans cover about 70 per cent of Earth's surface. Their large mass and heat absorbing capacities enable them to store vast quantities of heat. Energy absorbed or lost by the oceans results in a smaller surface temperature change than would occur over land. The atmosphere and ocean constantly exchange energy and matter. For example, water evaporates from the oceans into the atmosphere. This moisture then falls back to the Earth as precipitation – rain, snow, hail, and even the morning dew on the grass. This mechanism results into running of an endless water cycle in nature causing cooling effect and maintenance of moisture.

Land

Land covers 27 per cent of Earth's surface, and land topography influences weather patterns. For example, the weather in the mountains will be completely different from the weather in flat areas like the Terai.

Ice

Ice is the world's largest supply of freshwater. It covers the remaining 3 per cent of the Earth's surface, including most of Antarctica and Greenland. Ice is highly reflective and it plays an important role in regulating climate because of its insulating properties.

Biosphere

The biosphere is that part of the Earth which supports all living organisms. It is the place where all plants and animals, including humans live. Large quantities of carbon dioxide are exchanged between land-based biosphere and the atmosphere. We all know that plants take in carbon dioxide and give off oxygen, and animals inhale oxygen and exhale carbon dioxide.

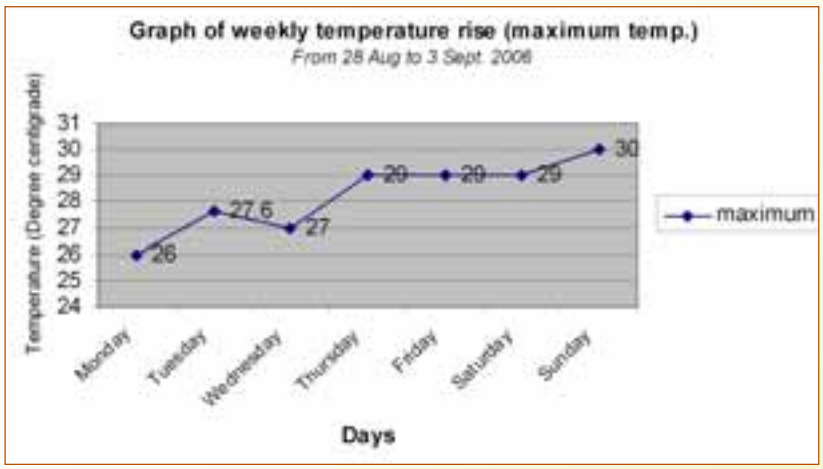
The Earth, with its unique environmental conditions, provides us with the ideal climate to support life: suitable surface temperature, an oxygen rich atmosphere, the chemical composition, and the presence of water.

C. Activity

Temperature check - graph

Duration of the activity: 1 month

- Divide classroom into 4 groups
- Ask a group to collect daily temperature (either maximum or minimum) from newspapers for a week
- Ask group to plot a graph using weelkly data. *See example in the Box 1*
- Stick the graph on a class room notice board
- Repeat the activity with other three groups
- There should be four charts by the end of the month
- Ask each group to take an average temparature of each week and plot one graph for th entire month.



Note: This activity will make learners aware of temperature fluctuations and give them practical knowledge on finding average temperature. This will also give them hands-on experience in distinguishing between climate and weather.

D. Take home messages

- Weather is the short-term pattern of local atmosphere. It is what we expect to happen day today.
- Climate is the long-term pattern of the existing weather. It is what we expect to happen from season to season

Lesson 2: Greenhouse Effect and Global Warming

Objectives:

- Understand the greenhouse effect
- Identify the links between greenhouse effect and global warming

Key words: greenhouse gases, greenhouse effect, and global warming

A. Introduction to the lesson

In this lesson, learners will understand the greenhouse effect and its importance. They will also identify the causes and impacts of global warming.

Introductory Activity

Discuss with learners what a greenhouse is, the use of greenhouses and how it works.

Most greenhouses are small glass houses that are used to grow plants, especially in winter. Greenhouses work by trapping heat from the sun. The glass panels of the greenhouse let the light in but keep heat from escaping. This causes the greenhouse to heat up and keep the plants warm enough to live through the cold winter.

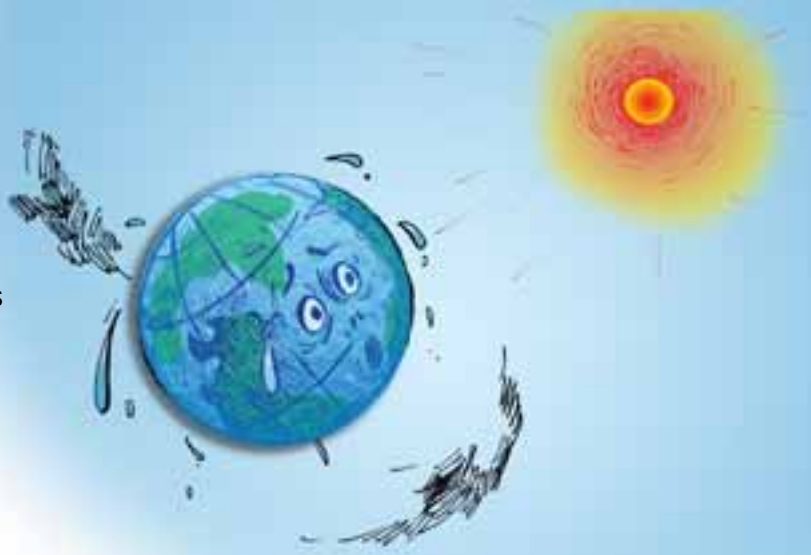
B. Content

The thin layer of air around the Earth is known as the atmosphere. It is what we breathe. The atmosphere comprises 78 per cent nitrogen and 21 per cent oxygen, the remaining 1 per cent is made up of trace gases including greenhouse gases.

Water vapor, methane, carbon dioxide, ozone, nitrous oxides and halocarbons are important greenhouse gases. Greenhouse gases in the atmosphere behave much the same way as the glass panes in a greenhouse. Sunlight enters the Earth's atmosphere, passing through the blanket of greenhouse gases. As it reaches the Earth's surface, land and water absorb heat from sunlight. Once absorbed, this energy is sent back into the atmosphere. Some of the energy passes back into space, but much of it remains trapped in the atmosphere by the greenhouse gases, causing our earth to heat up. The mechanism itself is known as the greenhouse effect, earth's natural temperature control system. If these greenhouse gases were absent, the average temperature of the earth would be as low as – 18^0C. At this temperature living beings would not survive. We need the right amount of greenhouse gases to balance the heat. Too much or too little of it will damage our environment.

Sadly, human activities such as excessive use of fossil fuels (coal, petroleum, etc.) in industries and transportation have dramatically increased greenhouse gases. Of all the greenhouse gases, carbon dioxide (CO_2) is the main gas that is being released in large volumes. As the amount of greenhouse gases slowly start to rise in the atmosphere, more heat gets trapped, resulting in the warming of the earth. This phenomenon is known as global warming.

Scientific evidences have shown that global average temperature has increased substantially since 1860. As the globe warms, it results in changing weather patterns, melting of ice-caps and rise in sea level.



C. Activity

Visit to greenhouse site

Duration of the activity: half a day

- Take learners to a greenhouse site, which could be a botanical garden or an agricultural field
- When at location, ask learners to feel the difference of temperature inside and outside the greenhouse
- Explain the difference between plants that are inside and outside the greenhouse
- Emphasize why plants that need warmer temperatures are found inside
- Explain what is greenhouse gases and greenhouse effect. Use the chart of greenhouse effect

D. Take home messages

- Globally, the 1990s was the hottest decade and 2005 the hottest year.
- It has been estimated that the Earth's surface temperature will rise between 1.4°C and 5.8°C between 1990 and 2100.
- In Nepal, the average temperature is increasing at the rate of approximately 0.06°C annually.
- Nepal is responsible for about 0.025 per cent of annual greenhouse gas emission.

Lesson 3: Climate Change and its impacts

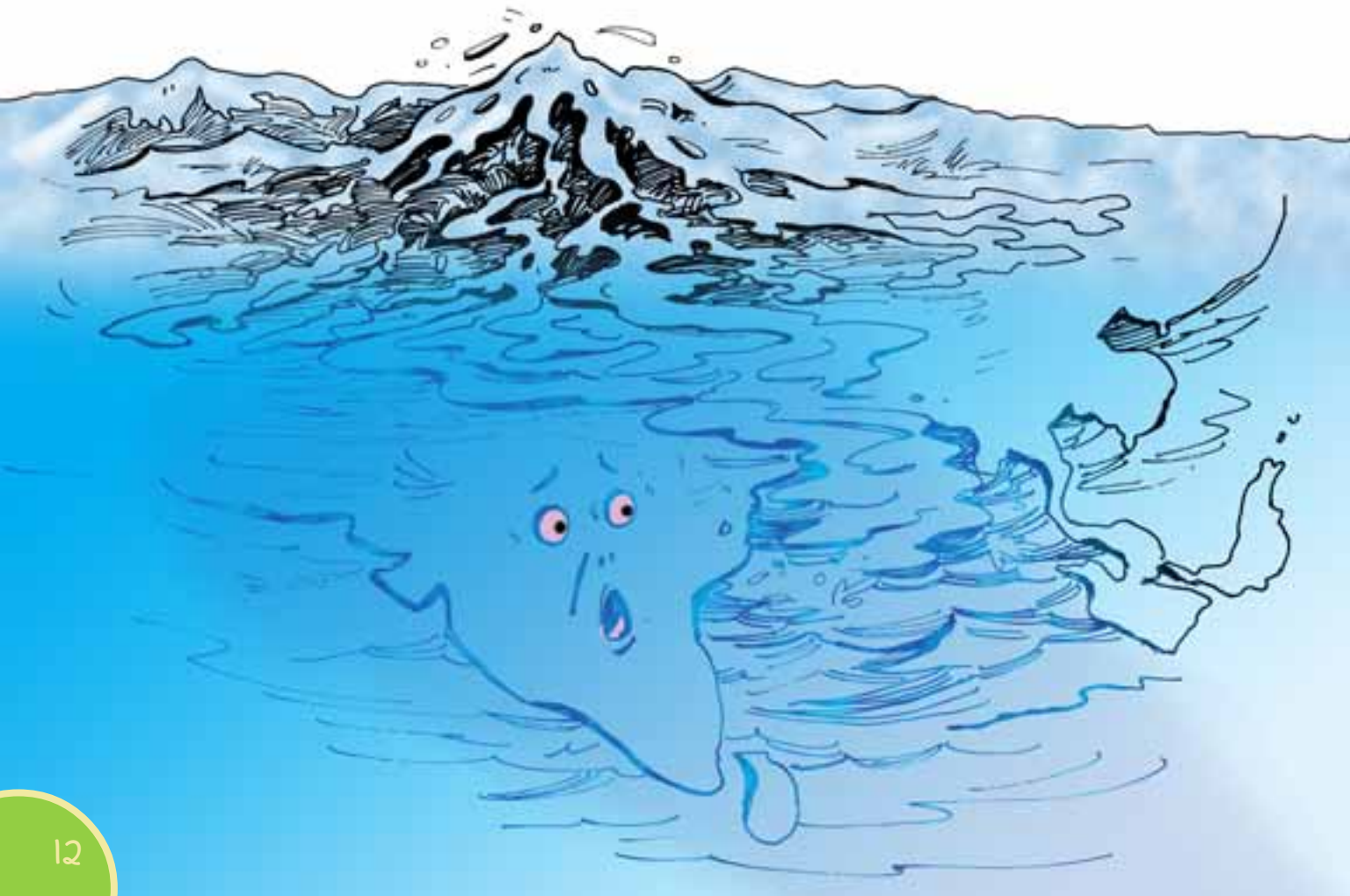
Objectives:

- Understand what is climate change
- Understand the impacts of climate change

Key words: climate change, sea-level rise

A. Introduction to the lesson

In this lesson, learners will understand how climate change occurs. The lesson discusses the major causes, problems and how climate change impacts daily lives.



Introductory Activity

Ask learners what farmers would do if they do not get enough rain for their crops? Talk about drought and forest fires using local examples. Discuss the impact of extreme climatic conditions on agriculture and forests. Make learners realize that change in climate has adverse impact firstly on ecosystems and subsequently on human lives.

Human civilization is vastly influenced by climatic condition. Agriculture, culture, social and economic condition are undeniably related to the climate. Biodiversity of any area is solely directed by the climatic conditions. For example, a desert is formed because there is lack of water, which can be directly related to precipitation pattern.

We all know that the Earth warms due to greenhouse gases, which is balanced in a natural state. Sadly, as we change the composition of the greenhouse gases by various activities, we are shifting our climatic pattern. That shift is called climate change. Historically speaking, climate change has occurs several times but it takes several

thousand years for a small change. The climate change we face today is more rapid because of human induced global warming.

B. Content

The Earth has become hotter by 0.3-0.6 degrees Celsius over the past century. Scientists predict that the average global temperature will increase by 1.4-5.8 degrees Celsius over the next one hundred years. This may not sound like much, but it could change the Earth's climate as never before.

The warming of the atmosphere has resulted in extreme weather patterns, causing more damage to human life, environment, and properties. The rise in heat waves, change in rainfall, snowfall patterns, and floods are the some of the impacts. For example, if Greenland's or Antarctica's ice melts it will cause a 18 to 20 feet rise in sea level. Small island countries like the Maldives and Fiji will be under water. In India and Bangladesh 20 million people would be displaced.

Affect on ecosystem

Climate change will alter the world's habitats and ecosystems. A rapid change in climate would upset the ecosystem balance and seriously endanger many living things. Rapid climate changes will not give plants and animals enough time to adapt. Forests that provide timbers for industries, fuel wood, fodder and, medicines would die if the temperature continues to rise. Most tree species will not be able to survive in their existing habitats causing dramatic decrease in forest coverage. This would in turn bring about many environmental problems such as soil erosion, loss of habitat for wildlife and imbalance to natural ecosystem. It would also bring about big social problems.

Affect on human health

Climate change will affect people's health both directly and indirectly. Heat stress and other heat-related health problems are caused directly by very warm temperatures and high humidity. It is clear that global warming will increase the number of very hot days that occur during the year. Generally, poor people and poor countries will be affected more as they are less equipped to tolerate such extreme changes in their daily lives. Similarly, warmer climatic condition may cause a sharp increase in the spread of vector borne diseases like malaria, dengue, yellow fever, and encephalitis.

Rise in sea-level

Global warming will make the sea level rise. As warmer weather causes glaciers and ice mass to melt, more water is added to the ocean. Warmer temperatures also cause water to expand. Both of these phenomena will cause a rise in sea-level between several inches to as much as 3 feet during the next century. This will affect both natural systems and manmade structures along coastlines. More importantly, island countries like Maldives, Fiji, and other countries such as India and Bangladesh that have large populations inhabiting coastal regions, will be impacted the most. Countries that are only few meters above sea-level are the most vulnerable ones.

C. Activity

Ask your grandparents

Duration of the activity: one day

- Ask each learners to talk to their grandparents or someone much older (at least 25 years older) on the climate 20 years ago.

- While making the queries give the learners the following lead questions:

Monsoon

- When did monsoon arrive 20 years back?
  (eg. Ashad, Shrawan, etc.)
- How long did it rain during the monsoon?
  (A week/More than a week/A Month/More than a month)

Summer

- Has the temperature during summer increased in past 20 years?
- When did summer start 20 years ago?

Winter

- Has the temperature in winter increased or decreased in the last 20 years?
- Are winters longer or shorter compared to 20 years ago?

- When the learners have these answers, conduct an interactive session on changing climate. Encourage learners to share their information.
- Highlight interesting examples brought by learners.
- Conclude the session by emphasizing that climate is changing and it is changing fast.

D. Take home messages

- Even though the Earth is huge, we humans can make an impact to change it.
- Scientists say that one-third of all forests will be affected by climate change.
- Climate change will impact all aspects of human civilization.
- Sea-level may rise between several inches to as much as 3 feet during the next century.

Lesson 4: Impacts of Climate Change in Nepal

Objectives:

- Learn about climate change impacts on high mountains
- Learn how local lives are devastated by a global warming

Key words: glacier, glacial lake outburst flood (GLOF)

A. Introduction to the lesson

This lesson highlights the adverse impacts of climate change on the Nepali Himalayas. Learners will understand how a global problem like climate change has severe local impacts.

Introductory Activity

Start with a statement that Nepal is a mountainous country and we are proud to have the Himalayas. Elaborate on how Nepal welcomes lots of tourists every year and that brings us foreign currency to help our economy. Talk about rivers that originate from these mountains. Those rivers are the source of water and electricity for millions of people not only in Nepal but also in India.

B. Content

Nepal has a sharp variation in altitude ranging from 70m to 8848m. This gives Nepal a diverse climatic condition and biodiversity. But at the same time, this altitudinal variation makes us a fragile country, which is prone to many natural hazards such as flooding, landslides, drought, and famine. These conditions become dangerous when climate change makes these natural disasters more severe and frequent. This causes a lot of damage to our agriculture, health, and economy. Climate change also plays in making our Himalayas more vulnerable as the temperature rises.

Impacts of climate change on the Himalayas

Glaciers form 70 per cent of the world's freshwater reservoir, which is very sensitive to temperature variations. Evidence shows that global warming is causing glaciers to melt faster all over the world. Scientific estimation shows that a rise of 4 degree Celsius will dissolve every glacier on the planet. This fact itself is a big threat for Nepal considering that there are over 3,000 glaciers and 2,000 glacial lakes in our country. National record on temperature shows that the Himalayan region is warming faster than any other regions in the country. Almost 67 per cent of the glaciers in the Himalayas have retreated. In Nepal this process is as rapid as 10 m a year, which used to be a few millimeters previously. As the glaciers melting process accelerates, more and more glacial lakes are formed. As ice melts into water faster, the risk of a glacial lake outburst flood (GLOF) increases.

The Sagarmatha and Kangchenjunga regions have already experienced several GLOF events in the past few decades. According to a study, there are 20 potential glacial lakes which are in danger of bursting.

Case Study: Glacial Lake Outburst Floods

Langmoche Glacier, also known as Dig Tsho Glacial Lake, burst on 4 August 1985. That Glacier Lake Outburst Flood (GLOF) swept away the entire village of Ghat in the Sagarmatha region.

Many people became homeless and landless due to that disastrous events. The flood also destroyed the almost complete small micro-hydropower plant in Thamo, which was a huge lost to that community. Sadly this is not one time event; there are many more lakes on the verge of GLOF events making the entire Ghat village vulnerable to such climate change impact. It is feared that if GLOF events keep occurring, the life of local communities would be devastated.

D. Take home messages

- Nepal has more than 3,000 glaciers and 2,000 glacial lakes.
- There are 20 potential dangerous glacial lakes on the verge of bursting.

Lesson 5: Finding Solutions to climate change

Objectives:

- Understand the global initiative in minimizing climate change
- Individual efforts to lower the effect of climate change

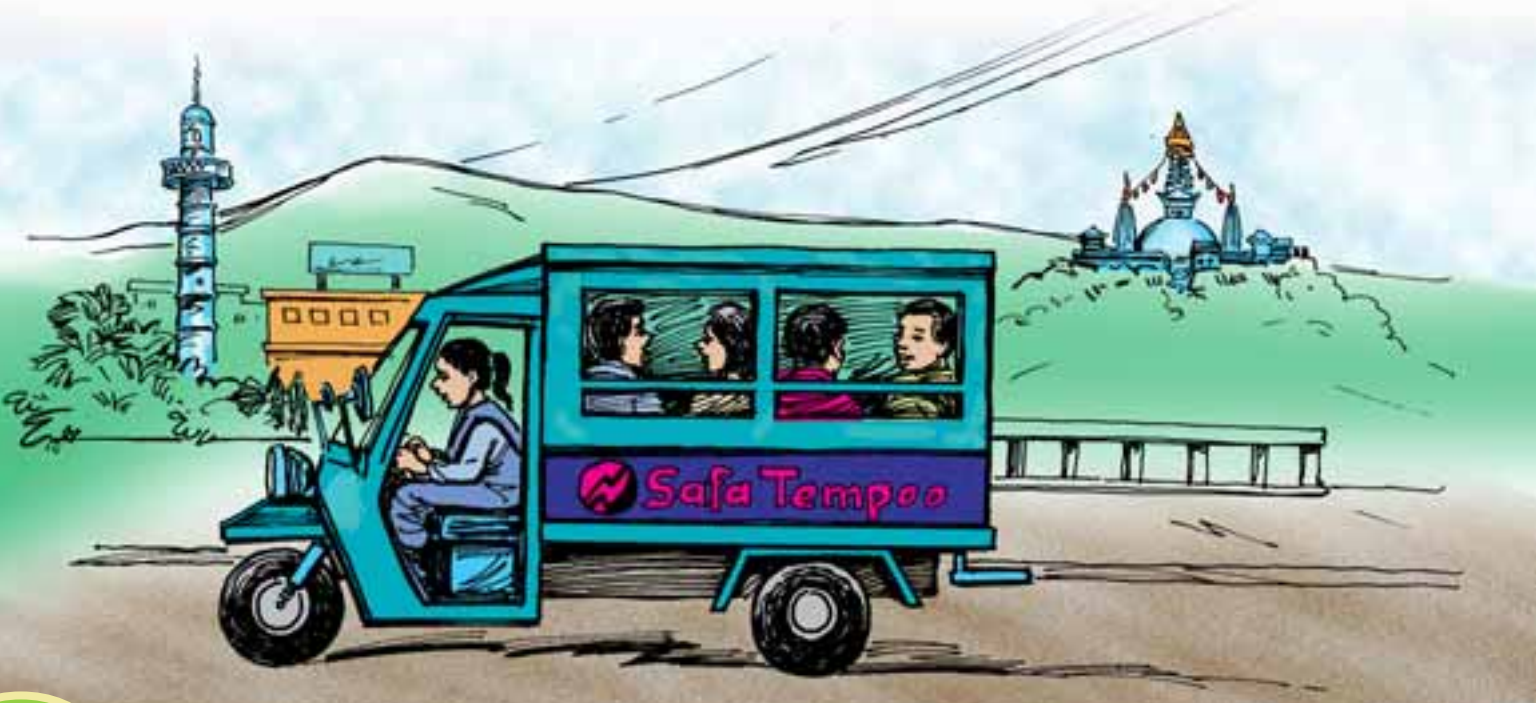
Key words: UNFCCC, Kyoto Protocol, and renewable energy

A. Introduction to the lesson

This lesson explains how the global community has responded to the issue of climate change. The lesson covers the solutions that have emerged to reduce global warming so far. It also deals with individual efforts that make a huge difference.

Introductory Activity

Start by saying that we share one Earth. We do not have another planet to go to if we mess this up. Issues such as climate change have global implications and no one nation



can be held responsible for the damage. Introduce a sense of responsibility of each and every individual. Make learners realize that we share **one** earth and it is **our** problem and **we** have to work together to find a solution. Explain how developed and developing nations both have to take part in making the earth a better place for future generations.

B. Content

Climate change is a global phenomenon with local impacts. As we share one earth, it is our collective responsibility to find solutions for climate change. It does not matter whether we are a developing or developed nation. Both have to work together to combat the climate crisis. The United Nations has already taken the initiative to address this global issue.

United Nation Framework Convention on Climate Change (UNFCCC)

During 1992 at the Earth Summit in Brazil, 185 countries signed the United Nation Framework Convention on Climate Change (UNFCCC). UNFCCC is in a way, a global level agreement that has the objective of reducing human-induced greenhouse gas emission within a given timeframe before it reaches dangerous levels. If this is achieved, it will allow ecosystems to adapt naturally to climate change, ensuring food production, and enabling economic development to proceed in a sustainable manner. The convention recognized that climate change is unavoidable, and that adaptive as well as preventive measures must be taken.

Nepal signed the UNFCCC on 12 June 1992. The UNFCCC also gave birth to the Kyoto Protocol that is instrumental in reducing greenhouse gases emission.

Kyoto Protocol

In 1997, the global community took an important step by devising the Kyoto Protocol. This is a legally binding document whose principle directs countries that sign it to reduce its greenhouse gas emission. It is an indication that globally we are willing to face reality and take concrete steps to minimize climate change risks. The protocol divides the globe into two categories, Annex I (developed) countries and Non-Annex I (developing) countries.

The Kyoto Protocol entered into force on 16 February 2005 after the Russia, the second largest greenhouse gas emitter, ratified it in November 2004. Nepal agreed to the Kyoto Protocol on 16 September 2005. The protocol has a provision where developed (Annex I) nations will have to reduce greenhouse gases by 5.2 per cent from its 1990 level. The timeframe for this protocol is from 2008 to 2012, which is also known as the "first commitment period".

However, emission reduction is not an easy task for developed nation whose economic backbone is fossil fuel and coal. Dealing with greenhouse gases reduction for many industrialized nations would be an expensive activity. To simplify this process, the Kyoto Protocol brought three mechanisms by which Annex I and Non-Annex I countries can participate in greenhouse gases reduction. They are:

Emission Trading (ET): Those countries that are able to limit or reduce emissions more than the agreed target set by Kyoto Protocol will be able to sell the excess credits to countries that find it more difficult or more expensive to meet their own targets. ET will allow industrialized (Annex I) countries to buy and sell emissions credits amongst themselves.

Joint implementation (JI): A mechanism that allows developed (Annex I) country to finance projects in another developed (Annex I) country. A country that has a high cost for reducing domestic greenhouse gases emissions will be allowed to invest in low-emission technologies for other countries. This leads to a win- win scenario, with one country getting credit for reducing emissions at a lowered cost and the other country receiving foreign investments and advanced technologies.

Clean Development Mechanism (CDM): This is the only mechanism that involves developing (Non-Annex I) countries. It allows developed (Annex I) nations to achieve part of their reduction obligations through projects in developing countries that reduce or sequester carbon dioxide from the atmosphere. However, CDM projects must have a major output in the sustainable development processes of the host country.

What can we do?

Climate change is a serious problem but we can address it if we take appropriate steps on time. Most importantly, being Nepali we have to understand that our country is very vulnerable to the impacts of climate change. Each of us should work toward being part of the solution. We all know that greenhouse gases should be reduced to decrease the rate of global warming. This reduction is going to happen only when each and every individual thinks wisely and uses energy efficiently. Clean energy sources such a solar, wind power, hydro-power, bio-gas and geo-thermal have to be promoted at a larger scale to replace fossil fuel.

Similarly and more importantly, awareness on climate change by knowledge sharing has to be prioritized by everyone. As a vulnerable nation, Nepal should play a vital role in increasing the level of awareness at the international level. We cannot pretend anymore that we know nothing about this problem and wait for developed countries to take the initiative to stop climate chaos.

By sharing knowledge, we can educate our family, friends and other people. We should talk about climate change and not hesitate to contribute in whatever way we can. Here are a few tips to help you act wisely.

TIPS

Save Energy

Whenever we use energy, for example, by burning wood to warm ourselves in winter, riding a vehicle while going for a movie and so on, we usually emit greenhouse gases. You can be part of the solution if you can think critically and act wisely. Next time when you are cold and think of lighting a fire, why not add a layer of warm clothing and see if that works!

Promote Renewable Energy

Solar power and hydro-power should be promoted. Be positive about renewable energy and you can make a difference!

Talk to Your Family and Friends

Talk about global warming with your family and friends. Let them know what you've learned. Just by sharing information, you are actually being the part of the solution!

Plant a tree

Planting trees is fun and a great way to reduce greenhouse gases. Trees absorb carbon dioxide, a greenhouse gas, from the air. Don't miss any occasion to plant a tree. Organize an event among your friends to plant a tree!

Some Things to Think About: Recycle

Recycle cans, bottles, plastic bags, and newspapers. When you recycle, you send less trash to the landfill and you help save natural resources, like trees, oil, and elements such as aluminum.

Did you know that you can help the environment if you buy recyclable products instead of non-recyclable ones? Look for the recycle mark (♻) on the package. It usually takes less energy to make recycled products than to make new ones. These small activities can save lots of energy.

D. Take home messages

- The problem of global warming and climate change can be improved if we act now.
- The United Nations Framework Convention on Climate Change is the global level effort to address climate change.
- The Kyoto Protocol is a legally binding document that instructs developed industrialized nations to reduce greenhouse gas emissions.
- Use renewable energy sources to reduce greenhouse gases emission.
- Reduce the use of fossil fuel.

Glossary

Adverse effects of Climate Change	Changes in the physical environment or ecosystem resulting from climate change have significant negative effects on the composition, resilience or productivity of natural and managed ecosystems, on the operation of socio-economic system, and on human health and welfare.
Climate Change	A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere. In addition to natural climate variability, this is observed over comparable time periods.
Climate System	The totality of the atmosphere, hydrosphere, biosphere and geo-sphere and their interactions
Climate	It is the long-term pattern of the existing weather. It is what we expect to happen season to season.
Emission	The release of greenhouse gases and/or their precursors into the atmosphere over a specific area and period of time.
Glacier	Glaciers are slow moving masses of ice.
Glacial lake outburst flood (GLOF)	Glacial lakes are fed by glaciers and are surrounded by natural moraine walls. These can withstand only a certain amount of water pressure. When the pressure is too great, the moraine wall breaks and a huge volume of water and debris are unleashed, causing a massive flood.

Greenhouse gases (GHG)	Those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation. Some GHG gases are carbon dioxide, methane, carbon monoxide, nitrogen oxides, chlorofluorocarbons, water-vapor, ozone, and halo carbons.
Sink	Any process, activity or mechanism that removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere
United Nations' Framework Convention on Climate Change (UNFCCC)	This UN convention, established in 1992, is the first to acknowledge that change is the Earth's climate and its adverse effects are a common concern of humankind.
Weather	It is the short-term pattern of a local atmosphere. It is what we expect to happen day to day

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WWF is the world's largest and most experienced independent conservation organization, with almost 5 million supporters and a global network active in more than 90 countries.

WWF's Mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by:

- Conserving the world's biological diversity;
- Ensuring that the use of renewable natural resources is sustainable; and
- Reducing pollution and wasteful consumption

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