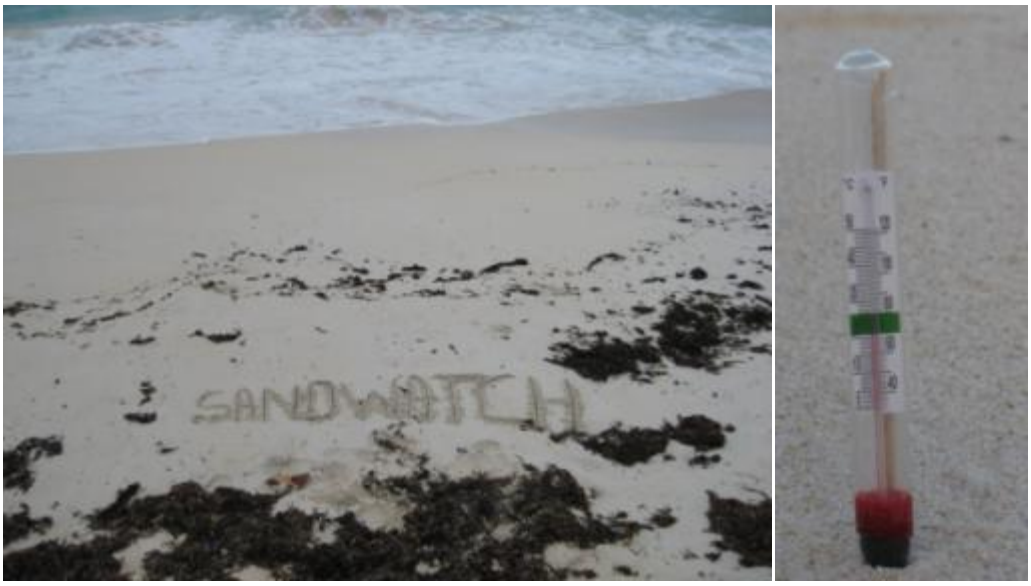


Chapter 2 Climate change adaptation and education for sustainable development

> *"Many Small Island Developing States (SIDS) comprise small, low-lying islands with limited land and freshwater resources. They are likely to be severely impacted by the projected rise in sea levels and the increase in extreme weather events caused by global warming. SIDS are also likely to be among the first countries confronted by the devastating social and human consequences of climate change – such as the forced migration of entire populations away from islands as they become uninhabitable. Faced with these risks, there is an urgent need to develop appropriate educational materials on climate change for SIDS. This means helping small island communities learn to manage their natural resources and ecosystems in a more sustainable way. The flagship UNESCO Sandwatch project is an excellent example of what can be achieved in this regard."*
>
> Address by Mr Koïchiro Matsuura, Director-General of UNESCO, International Seminar on Climate Change Education, UNESCO Paris, 27 July 2009

This chapter explores climate change and ways in which Sandwatch can contribute to adaptation through education for sustainable development.

Weather and climate

People talk a lot about the weather, which is not surprising when you consider the impact it has on our mood, how we dress, what we eat and what we do. Weather is a term that describes the current atmospheric condition at a given place and time and includes temperature, moisture, wind speed, and barometric pressure, among other things. Climate is not the same as weather. Rather it is the **average pattern** of weather for a particular region over a long period of time, usually at least 30 years. So while weather changes from day to day and the changes are easy to see, it is not so easy to detect climate changes, which instead requires long periods of careful measurement. It is impossible to look at short term weather changes for any given area and make valid statements about long-term climate change.

Climate change

Climate on earth has changed continually as the planet has evolved geologically. Natural causes include changes in the amount of the sun's solar radiation reaching the earth, and volcanic eruptions that can shroud the earth in dust thereby reflecting the heat from the sun back into space. Most of the historical changes in climate have occurred on time scales far longer than a human life – centuries, millennia or millions of years.

Natural causes, however, can explain only a small part of the present warming trend that has been observed during the second half of the 20th century. There is now unequivocal evidence that the earth's climate is changing as a result of human activities, principally increased carbon dioxide emissions, since pre-industrial times (1700s). The overwhelming majority of scientists agree that rising concentrations of heat-trapping greenhouse gases in the atmosphere are causing the climate to change.

Energy from the sun warms the earth's surface and, as the temperature increases, heat is radiated back into the atmosphere as infra-red energy. Some of the energy is absorbed within the atmosphere by 'greenhouse gases'. The atmosphere acts in a similar way to the walls of a greenhouse, letting in the visible light and absorbing the outgoing infra-red energy, keeping it warm inside. However, human activities are adding greenhouse gases, particularly carbon dioxide, methane and nitrous oxide, to the atmosphere, which enhances the natural greenhouse effect and makes the world warmer.

> Climate change is defined as a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and is observed over long time-periods (many decades).

Climate change predictions

There is a large body of information about climate change in published literature and on the Internet, some of it is sensational, some contradictory and some based on sound science. However, it is very difficult for the lay person to distinguish sound knowledge from misleading information.

The Intergovernmental Panel on Climate Change (IPCC) is one of the most accurate sources of information on climate change. The IPCC was established in 1988 to provide decision-makers and others interested in climate change with an objective source of information. The IPCC does not conduct any research nor does it monitor climate related data or parameters. Its role is to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature relating to climate change. The IPCC consists of thousands of scientists from different disciplines, who work together to produce assessment reports at approximately five year intervals. The IPCC supports the United Nations Framework Convention on Climate Change (UNFCCC), which entered into force in 1994 and provides the overall policy framework for addressing climate change. Whilst the IPCC reports are very technical, they do contain supporting material such as 'frequently asked questions' which help the general reader understand the contents. The IPCC reports are available on the website www.ipcc.ch

Projections for climate change vary regionally and readers are advised to contact local sources such as national meteorological offices and national reports on climate change (see each country's national communication available on the UNFCCC website www.unfcc.org) for

country-specific information. Table 1 provides global projected changes up to 2099 based on the IPCC Fourth Assessment Report (2007).

Table 1 Projected Global Climate Changes by 2099 (Source IPCC, 2007)

Parameter	Projected Change
Temperature	Increase of between 1.1 and 6.4^{o}C
Sea level rise	Increase of between 0.18 and 0.59 m
Ocean acidification	Decrease in pH of 0.14 – 0.35 pH units (resulting in increased acidity)
Snow and ice extent	Decrease in areal extent of ice and snow
Extremes: heat waves and heavy precipitation	More extreme events
Tropical cyclones	Stronger tropical cyclones
Precipitation	Changes vary regionally, some areas getting drier, some wetter.

Activity 2.1 Conduct your own weather measurements

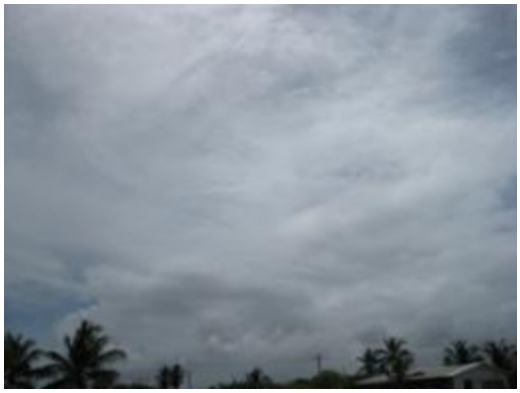
What to measure → Depending on the age of the group, simple or more complex weather characteristics can be observed and/or measured on a daily basis to show how weather changes. Simple weather measurement kits are available, however there are several weather measurements that require no special equipment and are described below.

How to measure→Observe, measure and record the following:

- Cloud cover: clear, partly cloudy (less than half of the sky is covered with cloud), mainly cloudy (more than half the sky is covered with cloud) and completely cloudy;
- Cloud type: descriptors included high and low clouds; cloud colour; cloud type e.g. cumulus, cirrus, stratus clouds;

Simple cloud observations

Partly cloudy, high cirrus clouds;



Completely cloudy, mid-level cumulus clouds.

- Temperature: use a simple thermometer (although be sure to keep it out of direct sunlight);
- Rainfall: collect rainfall in a simple container and then pour the rainfall collected into a graduated cylinder or measuring cup;
- Wind speed and direction: direction from which the wind blows can be estimated by looking at smoke from a chimney or a flag and using a compass to determine the direction; a simple wind meter is required to measure wind speed (see Annex 1).

Compile the data into tables and prepare graphs showing how the weather changes (or does not change) from day to day.

When to measure→Conduct the weather observations and measurements daily at the same time of day for a week. Repeat the measurements at a different season, e.g. wet and dry seasons, winter and summer.

What the measurements show→The measurements will show how the weather changes from day to day and there are likely to be quite significant changes between one day and the next. Comparisons of the data taken at different seasons of the year will also show further differences.

Use the data to show how difficult it is to make any statement about climate based on the daily weather pattern, and emphasises the important work of climatologists collecting daily data for decades in order to compile climate records.

Use the global climate change projections in Table 1 to discuss how the projected global changes might change your weather.

As a further activity, ask the students to interview parents and older members of the community about their memories of weather 20, 40, 60 years ago, and compare these findings with the climate records for your area.

Extension of this activity→ set up a permanent weather station at your school.

Responding to climate change

Two main ways to respond to global climate change are through mitigation and adaptation. Mitigation involves attempting to slow the process of global climate change by lowering the amount of greenhouse gases in the atmosphere. Within the framework of the UNFCCC, countries around the world are working to reduce their carbon emissions. There are also many actions that individuals can take, e.g. reducing their own energy consumption, using renewable sources of energy, reducing their use of excess packaging, and planting trees that absorb carbon dioxide from the air and store it in the soil or in their trunks and roots. However, it is necessary to appreciate the inevitable nature of climate change, some aspects of which (e.g. sea level rise) will continue for centuries even if greenhouse gas concentrations were stabilized now.

Adaptation relates to how to live with the degree of global warming that cannot be stopped. It involves developing ways to protect people and places by reducing their vulnerability to climate impacts. Examples of adaptation include building seawalls or relocating buildings to higher

ground to protect communities against increased sea flooding. Other adaptation measures may simply be an extension of sound development practices such as keeping beaches and coastal waters clean.

Activity 2.2 Learning about climate change adaptation and mitigation

What to do→Divide the class/persons into small groups and ask each group to list adaptation and mitigation measures for different levels:

- national level – the country or island, e.g. building sea walls to protect the coastline from rising sea levels (this contributes to adaptation by coping with rising sea levels);
- community level, e.g. starting a recycling programme (this contributes to mitigation by reducing energy usage, and to adaptation by reducing the solid waste dumped in rivers and on beaches, thereby keeping ecosystems more healthy and resilient); and
- individual level, e.g. conserving energy by turning out the lights when no one is in the room (this contributes to mitigation through reducing energy use and greenhouse gases).

After the groups have shared and discussed their lists, ask each person to select one activity from the individual level list, and implement that activity in their home life for a week.

After the week, persons report on their implementation success, problems encountered, and how their family members responded to the activity.

What the activity shows→Participants will learn about mitigation and adaptation actions for different levels of governance and will find that many appropriate actions contribute to both mitigation and adaptation. They can also discuss whether it was easy or difficult to implement the one activity over the course of a week, and whether they intend to continue and involve more of their family members in the activity.

Climate change and beaches

As key recreational sites, beaches are of prime social, cultural, environmental and economic importance and dominate the world's coastlines. They are important ecosystems and also fulfil protective functions safeguarding coastal lands from flooding. Furthermore, beaches are among the most dynamic and fast changing environmental systems.

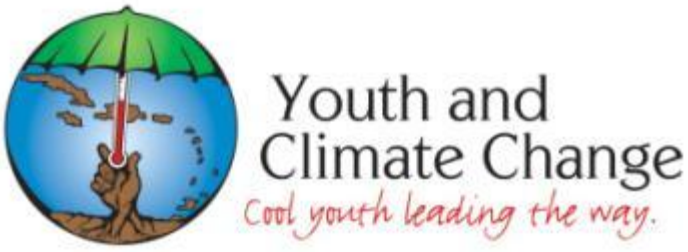
Climate change is already affecting beaches in a number of different ways. These changes are likely to intensify over time and include:

- rising sea levels, resulting in increased beach erosion, reducing the area of beaches and impacting coastal habitats;
- extreme weather events and changes in cyclone and storm behaviour, producing higher and more powerful waves, increasing beach erosion;
- changing precipitation patterns with more floods and altered freshwater flow to the oceans, affecting beach ecology, sediment budgets and the formation of beachrock;
- rising temperatures, affecting the animals and plants living on and near the beach, e.g. bleaching of coral reefs; and
- acidification of the oceans, negatively affecting marine organisms that need calcium carbonate to form skeletons or shells.

Sandwatch and climate change adaptation

One of the ways in which humans can adapt to climate change is by ensuring that ecosystems are more resilient and healthy not just for today but for the long term. A wide beach backed by a coastal forest and protected by a healthy coral reef can better withstand sea level rise and future high wave events than a narrow beach confined by concrete infrastructure on the landward side and a degraded, dying coral reef on the seaward side. Sandwatch, with its focus on the use of scientific monitoring of beach changes to inform effective action to enhance and care for beach ecosystems, is ideally suited to contribute to climate change adaptation.

In November, 2008, Sandwatch joined with Counterpart Caribbean and other partner organizations to work with Caribbean teachers and youth to learn more about climate change and how they could spread the word to other persons and groups in their countries. Thirty teachers and students worked for three days to improve their communication skills including drama and storytelling, video production and web-based tools. In the six months since the event, the participants reached out to more than 30,000 people through news stories, videos, exhibitions and presentations.



Y*outh will have to lead the way on climate change adaptation (Logo from Youth and Climate Change Workshop, Barbados, November 2008)*

Drama is an effective way of portraying information about climate change (Dramatic presentation at a Youth and Climate Change Workshop, Barbados, November 2008)

This revised manual is designed to help new and established Sandwatch groups learn about climate change and how they can contribute to climate change adaptation through Sandwatch.

Education for sustainable development

Education for Sustainable Development (ESD) is an approach to teaching and learning that seeks to empower people of all ages to assume responsibility for creating and enjoying a sustainable future. It prepares people of all walks of life to plan for, cope with, and find solutions

for issues that threaten the sustainability of our planet, and encourages changes in behaviour that will create a more sustainable future.

Put simply, ESD promotes five types of learning as the basis for fostering sustainable development. These are:

- learning to know;
- learning to do;
- learning to live together;
- learning to be; and
- learning to transform oneself and one's society.

Education for sustainable development is education for life.

More than just one discipline, ESD requires an understanding of science, economics, mathematics, geography, ethics, politics, and history. Moreover, addressing the interaction between humans and the environment is critical, making it necessary to incorporate subjects such as human ecology, philosophy, psychology and language. It is not necessary to be a scientist or an environmental expert, rather it is a case of facilitating learning, and knowing how and when to get other teaching colleagues and experts involved. ESD involves decision-making, communication and creative skills, in other words, it is education for life. Venturing into unknown areas and learning about new issues are other exciting aspects. For more information on ESD, please see www.unesco.org/education/esd.

Sandwatch and education for sustainable development

Sandwatch brings together different aspects of education for sustainable development. It focuses on taking education outside the classroom and learning about real problems and issues and what can be done to find solutions. This is not done by youth in isolation, but in collaboration with their peers, communities and other focus groups. Thus young people learn inter-personal communication skills, such as how to communicate with others having different levels of understanding and different priorities, and this is an important skill for life after school.

Sandwatch takes a holistic view of the environment, involving natural, human, economic and political components. The activities or projects designed by the students are based on the principles of science: data collection, data analysis and critical thinking. Students learn to organize and prioritize their information, and how to critically select the salient points and key issues. The process also provides for self-discipline whilst providing scope for lateral thinking and creativity. Virtually every subject in the school curriculum can be integrated into Sandwatch, from drama to language skills and from mathematics to woodwork. Of particular importance is the teaching of many life skills in a practical learning-by-doing framework. Sandwatch provides opportunities for students to learn to share information and even more importantly to listen to others. They learn to appreciate the principles of environmental stewardship and responsible citizenship by working for the benefit of the community rather than their own personal advantage. They also learn to understand the benefits that can be derived from sound scientific monitoring which can often be rather repetitious. Finally, Sandwatch also develops a sense of caring for the environment and the world about us.