

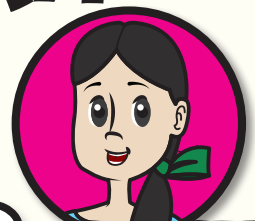
STOP MELTING my HOME

A teacher's companion

My Guide to
**CLIMATE
CHANGE**

Getting to know
climate change with

PIQA



BENNY & JUNIE



Dear teachers,

Explaining climate change to young students is a challenging task. Climate change can be a complex and daunting subject.

At the National Climate Change Secretariat (NCCS), we understand this and hope that the drama show *Stop Melting My Home* featuring Piqa and her friends can introduce the issue of climate change to your students in a fun and easy-to-understand way. To support their learning, we have put together a students' guide to climate change titled ***My Guide to Climate Change: Getting to know climate change with Piqa, Benny & Junie*** which contains age-appropriate information and activities for children, as well as this teachers' resource guide. We hope that they will provide you with the resources and tools to engage students in learning about climate change.

Although we have targeted the students' guide for Primary 4 to 6 students, many of the learning points can be simplified for those in Primary 1 to 3.

We firmly believe that everyone has a role to play in preserving our climate, and that the awareness and willingness to take action need to start from young. If your school has developed effective ways to reduce your students' carbon footprint or an educational climate change programme for students, we would love to hear from you!

We welcome your feedback and suggestions on the drama programme or its accompanying guide books. You can address your comments to Ellen Ng at ellen_ng@nccs.gov.sg.

Sincerely,

Yuen Sai Kuan
Director, 3P Network
National Climate Change Secretariat

HOW TO USE THIS GUIDE

The summaries, learning points, activity answers and explanations provided in this guide follow the flow of the students' guide book.

Learning points linked to topics covered in the curriculum such as Science, Social Studies, as well as Civics and Moral Education are highlighted for your convenience.

This guide also includes suggested projects and activities that can be conducted in the classroom, as well as online reference materials you and your students can look up.

 **CURRICULUM LINKS**
SCIENCE

- The impact of human beings on the environment and climate

SOCIAL STUDIES

- How environment affects human beings, as well as animals and plants

CIVICS & MORAL EDUCATION

- Why it is important to care for the climate and environment

SUMMARY

Climate change refers to significant variations in global weather patterns that persist over an extended period of time. It is a global problem – human beings, flora and fauna are all adversely affected by it.

 **LEARNING POINTS**

- **Climate change threatens wildlife and biodiversity**

Most plants and animals live in areas with very specific climate conditions, such as temperature and rainfall patterns, that enable them to thrive. Any change in the climate of an area can affect the plants and animals living there, as well as the makeup of the entire ecosystem.

As the Earth gets warmer, plants and animals that live in cold places, like on mountain tops or in the Arctic, might not have a suitable place to live. If the Earth keeps getting warmer, up to one-fourth of all the plants and animals on Earth could become extinct within 100 years.¹ Every plant and animal plays a role in the ecosystem (for example, as a source of food, a predator, a pollinator, a source of shelter), so losing one species can affect many others.

In Singapore, mangrove forests are vulnerable to climate change. Mangrove forests require stable sea levels for long-term survival. They are therefore extremely sensitive to current rising sea levels caused by global warming and climate change.²

A rise in sea level can lead to the loss of mangroves, which will not only represent a loss of biodiversity, but can also further aggravate coastal erosion rates. A rise in seawater temperature as a result of global warming can also have a negative impact on marine life, for example, coral bleaching³ which may lead to coral death. Please see pages 4 and 5 for more examples of how climate change will affect the diversity of plants and animals in Singapore.

¹ A Student's Guide to Global Climate Change, <http://www.epa.gov/climatestudents/impacts/effects/ecosystems.html>

² WWF Global website: Mangrove forests: Threats, http://wwf.panda.org/about_our_earth/blue_planet/coasts/mangroves/mangrove_threats/

³ WWF Global website: Impacts of global warming on corals, http://wwf.panda.org/about_our_earth/aboutcc/problems/impacts/coral_reefs/

 **CURRICULUM LINKS**

SCIENCE

- The impact of human beings on the environment and climate

SOCIAL STUDIES

- Consequences of human activities on the environment

CIVICS & MORAL EDUCATION

- Why it is important to care for the climate and environment

SUMMARY

Human activities, such as the burning of fossil fuels, have released Earth-warming greenhouse gases which cause climate change.

 **LEARNING POINTS**

- **Human activities are adding additional greenhouse gases into the atmosphere**

The key to learning about climate change lies in understanding the 'greenhouse effect'. The greenhouse effect maintains a temperature suitable for supporting life. The Earth receives and absorbs energy from the Sun and in turn, radiates some of this energy back into space.

However, greenhouse gases (GHGs) such as carbon dioxide absorb a portion of this energy and re-radiate it back to the Earth's surface, hence trapping some of the outgoing energy.

Climate change is caused by the release of additional GHGs, such as carbon dioxide, into the atmosphere. Most of the additional GHGs are contributed by the burning of fossil fuels (e.g., coal, natural gas) to generate electricity to power homes and factories.

These additional GHGs are responsible for altering the natural balance of the greenhouse effect. As more greenhouse gases are produced, they accumulate in the atmosphere. More of the Sun's energy is then radiated back towards Earth, causing enhanced warming.

- **Human activities are responsible for climate change**

Many may not realise that their everyday activities have a direct effect on our climate. Based on the findings of the Intergovernmental Panel on Climate Change (IPCC), an internationally recognised authority on climate change, human activities are indeed speeding up climate change.

Greenhouse gas emissions from human activities, such as the burning of fossil fuels to produce energy for our everyday activities, including transportation and household appliances, and deforestation are largely responsible for an unprecedented increase in global temperatures in the last 100 years, leading to a rise in sea levels and other effects on the global climate. If the rate of greenhouse gas emissions continues unabated, these changes are projected to continue at an even faster rate in the future.

According to the IPCC's Fourth Assessment Report, world temperatures could rise by between 1.1°C and 6.4°C this century. In Southeast Asia, the temperature is forecast to rise between 1.7°C and 4.4°C.

 **SUGGESTED ACTIVITY**

Is our climate changing?

Get students to interview their family members on their recollections of the weather during their childhood, as well as their thoughts about recent changes in weather patterns. Students can then share their stories in class after they have collected and summarised the interviews.

 **VIDEO RESOURCE**

www.youtube.com/watch?v=VYMjSule0Bw

Produced by the US Environmental Protection Agency, this video explains the greenhouse effect and how it relates to climate change. It starts by describing the natural greenhouse effect. It then explains how human activities are contributing to an enhanced greenhouse effect that causes global warming.

 **CURRICULUM LINKS**
SCIENCE

- The impact of human activities on the environment and climate

SOCIAL STUDIES

- Consequences of human activities on the environment

CIVICS & MORAL EDUCATION

- Why it is important to care for the climate and environment

SUMMARY

A warming Earth sets off all sorts of other changes around the world – on land, in the oceans, and in the atmosphere. These changes affect human beings, plants and animals in many ways.

 **LEARNING POINTS**

- **Climate change affects the Earth, human beings and other living things**

If the Earth's average temperature increases even by a few degrees, drastic changes can happen. Warmer temperatures can lead to a chain reaction of other changes around the world. Increasing air temperature also affects the oceans, weather patterns, snow and ice, plants and animals. The warmer it gets, the more severe the impacts on people and the environment.

- **Impact of climate change globally**

- o Melting of icy regions will cause an increase in volume of melted ice (water), which then flows into streams, rivers, lakes and seas. The result is **rising sea and water levels**, causing floods and destruction to low-lying towns and cities.
- o A changing climate may also cause the **weather to become more extreme**, be it droughts, violent storms or heavy rain.
- o Extreme changes in temperature may cause people to suffer breathing difficulties, headaches, body rashes and other **illnesses**.
- o Climate change also **distorts the natural habitats of plants and animals**. For example, the survival of polar bears and penguins in icy regions are in danger, as they cannot survive anywhere else. Scientists have also reported previously-unheard of migratory activities by animals and insects from tropical to temperate regions.⁴
- o As temperatures rise, more moisture evaporates from land and water, leaving **less water** behind. Some places are getting more rain or snow to make up for it, but other places are getting less. The **prolonged dry periods** can cause droughts and bush fires.

- **Impact of climate change on Singapore**

Being a low-lying island in the tropics, Singapore is vulnerable to climate change. Some potential impacts on our island are:

- More **frequent and intense rainfall** and tropical storms.
- Risk of **coastal erosion and flooding** as a result of rising sea level. Much of Singapore lies only 15m above the mean sea level, with about 30% of our island being less than 5m above the mean sea level.
- **Depletion of water resources** due to hotter, drier weather.
- Climate change will put more people at risk of dengue fever and other **vector-borne diseases**, as more rainfall and warmer temperatures provide optimal conditions for mosquitoes to breed. In addition, frequent and severe instances of warm weather may lead to more occurrences of **heat stress** and discomfort among the elderly and sick.

⁴ Nature adapts to survive climate change, <http://www.stuff.co.nz/science/8437670/Nature-adapts-to-survive-climate-change>

- **Impact of climate change on Singapore** (continued)

- Climate change will **affect the diversity of plants and animals**, and this will alter our ecosystem and natural processes such as soil formation, nutrient storage, and pollution absorption. A mean temperature increase of 1.5°C to 2.5°C could place a significant proportion of species in Singapore at risk. Many rare animals in Singapore, such as the Banded Leaf Monkey, the Leopard Cat and other endangered mammals, may be affected. Corals, which require sunlight, may not be able to grow upwards quickly enough to keep pace with rising sea levels.⁵
- The effects of climate change, such as intense storms, flooding and prolonged droughts, **threaten global food security**. Singapore is vulnerable to fluctuations in global food supply and prices, as we import more than 90% of our food.

ANSWERS TO ACTIVITY : "HOW WILL CLIMATE CHANGE AFFECT US?"

HEAT WAVES

FOOD SHORTAGES

RISING SEA LEVELS

HEALTH PROBLEMS

FLOODS

LOSS OF PLANTS AND ANIMALS

DROUGHTS

COMMON MISUNDERSTANDINGS:

- **EARTHQUAKE**

Earthquakes are natural disasters that occur when tectonic plates push against or past each other.

- **HOTTER SUN**

Scientists agree that the Sun is not the cause of recent global warming. In fact, over the past 35 years, the Sun has shown a slight cooling trend, while global temperatures have been increasing.⁶

- **TSUNAMI**

Tsunamis are huge waves of water that are usually caused by earthquakes or volcanic eruptions.

- **HAZE**

Haze occurs when dust and smoke particles accumulate in relatively dry air. The particles originate from soot from forest fires, motor vehicles, and burning of fuel for electricity and industry.

⁵ *Climate Change and Singapore: Challenges. Opportunities. Partnerships.*, <http://app.nccs.gov.sg/nccs-2012/preparing-singapore-areas-of-work-in-progress.html>

⁶ *BBC News: 'No Sun link' to climate change*, <http://news.bbc.co.uk/2/hi/science/nature/6290228.stm>

CURRICULUM LINKS

SCIENCE

- Types of renewable energy
- Importance of energy conservation

SOCIAL STUDIES

- Importance of using resources wisely to conserve the environment

CIVICS & MORAL EDUCATION

- Protection of environment through conservation

SUMMARY

Climate change is a global issue. Countries need to work together to reduce greenhouse gas (GHG) emissions to slow climate change. Singapore is also doing its part.

LEARNING POINTS

- Singapore is reducing emissions by improving energy use in buildings, industries, homes and vehicles.
- Another way to reduce emissions is to use alternative energy sources that do not produce GHGs. As such, Singapore is testing greener energy options such as solar power. Some HDB flats in 30 precincts such as Punggol, Tampines, Bukit Panjang, Jurong, Aljunied, Telok Blangah, Bishan, Ang Mo Kio and Jalan Besar have been installed with solar panels to test-bed solar energy.
- However, not all alternative energy options are feasible for Singapore:
 - o Wind energy: Wind speeds here are too low
 - o Hydroelectric power: Singapore lacks a major river system
 - o Tidal energy: The relatively calm seas around Singapore yield low potential for tidal energy

ANSWERS TO ACTIVITY :

"MATCH THE NAMES OF THE ALTERNATIVE ENERGY OPTIONS TO THE CORRECT PICTURE"

BACKGROUND TO FEATURED ALTERNATIVE ENERGY OPTIONS

SOLAR ENERGY

What is solar energy?

Solar energy is obtained by converting sunlight into heat and electricity.

How do solar panels work?

Solar energy can be converted to electricity using panels which contain solar cells. These are also known as photovoltaic cells. Solar cells can be used to charge batteries in watches, calculators, and even power water heaters and street lamps.

HYDRO POWER

Hydropower is produced by converting the energy of moving water into electricity. Most hydroelectric power stations use water cascading from great heights to drive turbines to produce electric energy.

WIND POWER

Wind power refers to energy generated from rotation of wind turbines due to air movement. Large groups of wind turbines are called wind farms.

NUCLEAR POWER

Nuclear power uses fission (splitting of the atoms) or fusion (joining of atoms) to produce energy. While it does not result in the emission of carbon dioxide, nuclear reactors produce radioactive waste which can be difficult to dispose of safely.

Activity! Match the names of the alternative energy options to the correct picture.

The diagram shows four energy options with arrows pointing to their respective images:

- Hydro Power** points to a dam.
- Nuclear Power** points to nuclear reactors.
- Solar Energy** points to solar panels.
- Wind Power** points to wind turbines.

CURRICULUM LINKS

SCIENCE

- Importance of conservation of energy and limited responsibility towards the climate and environment

SOCIAL STUDIES

- Importance of using resources wisely to conserve the environment
- Responsibility towards the climate and environment

CIVICS & MORAL EDUCATION

- Protection of environment through conservation
- Responsibility towards the climate and environment

LEARNING POINTS

- **One does not have to wait until one is grown up to do something about climate change**

Scientists agree that the burning of fossil fuels which release additional greenhouse gases is causing climate change. Since these fuels are burned to generate electricity, everyone can help to slow climate change just by simply using less energy.

- **It is not difficult to take action on climate change**

Follow the three-step approach:

1. **SAVE ENERGY**
2. **TRAVEL GREEN**
3. **PRACTICE THE 3Rs**

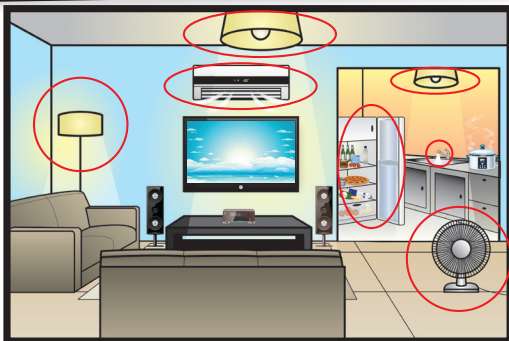
If the three steps taken are multiplied by thousands of people in Singapore and millions all over the world, we can slow down the pace of climate change.

SUMMARY

It is easy to get disheartened or fearful about climate change. Yet we can all make a difference by taking simple actions to change our lifestyle and our behaviour. It is possible to slow the pace of climate change and reduce further global warming.

ANSWERS TO ACTIVITY : "WHAT IS WRONG WITH THIS PICTURE?"

Activity! What is wrong with this picture?
Circle the energy wasting practices you see.



- **Air-conditioner and fan are switched on** at the same time. Using the fan instead of the air-conditioner saves more energy.
- **The door of the refrigerator is left open.** The refrigerator door should not be kept open any longer than needed to prevent the cold air from escaping.
- **The tap is left running.** Energy is used to turn rainwater into drinking water. The more energy we use, the more impact we have on the climate.
- **Too many lights and lamps are switched on.** Switch off unnecessary lighting to save energy at home.

ANSWERS TO ACTIVITY : "DO YOU KNOW YOUR RECYCLABLES?"

Most of the items listed in the activity can be recycled, except for the following:

ELECTRONICS

- Electronic parts containing mercury and other toxic metals

GLASS

- Light bulbs
- Window glass
- Ceramic / clay
- Porcelain

PAPER

- Paper contaminated by food
- Used tissue paper
- Paper cups
- Soiled papers

PLASTIC

- Styrofoam containers
- Disposable plastic cups / containers
- Cling wrap



ONLINE RESOURCES

• ***Climate Change: How Can I Help?***

<http://bit.ly/climatechangehowcanihelp>

Produced by the National Climate Change Secretariat (NCCS), this e-brochure provides simple tips on how individuals can help to address climate change.

• ***Reduce, Reuse, Recycle***

<http://bit.ly/12YdQ3u>

This booklet produced by the National Environment Agency (NEA) provides an overview of the amount of waste generated by Singapore and explains how the 3Rs cut down the amount of waste generated. It also states the items that can and cannot be recycled.

• ***Let's Go Green Shopping***

<http://www.epa.gov/epawaste/education/pubs/shopping.htm>

Published by the United States Environmental Protection Agency, this site advises users how to become a greener shopper by learning to buy products that are good for the planet.



SUGGESTED ACTIVITIES

Become A Climate Champion

Get students to take on the role of climate champions. The climate champion's job is to make sure lights, computers, and other electronic devices in the classroom are switched off when no one is in the classroom. The climate champion can also be tasked to collect recyclable items (such as clean paper/cardboard packaging, plastic containers, and aluminium drink containers) from the class so that the items can be contributed to the school's recycling bin at the end of the week.

Recycling Is Cool

Organise a competition to see who can make the coolest or most useful object from unwanted items that would otherwise be thrown away. Students can team up to create the object and make a presentation to their classmates on their choice of unwanted items, the steps they took in reusing them and how the new object can be used.

Are You Recycling Correctly?

Prepare a number of objects (or show pictures of objects), and ask students which ones are recyclable. Explain why their answers are right or wrong.

 **CURRICULUM LINKS****SCIENCE**

- Responsibility towards the climate and environment

SOCIAL STUDIES

- Responsibility towards the climate and environment

CIVICS & MORAL EDUCATION

- Responsibility towards the climate and environment

SUMMARY

Understanding the size of one's carbon footprint is a simple first step to address climate change. Carbon footprint refers to the amount of carbon emissions that result directly and indirectly from one's daily activities.

 **LEARNING POINTS**

- ***Being aware of one's carbon footprint helps identify activities which generate more carbon emissions, and steps that one can take to change his/her lifestyle.***

 **ONLINE RESOURCES**

- ***My Carbon Footprint***

<http://bit.ly/mycarbonfootprintsg>

Developed in partnership with the Singapore Polytechnic, Hemisphere Foundation's carbon footprint calculator allows users to compute their carbon footprint based on their daily habits and lifestyles. Hemisphere Foundation is an organisation that aims to raise environmental awareness amongst youths.

 **SUGGESTED ACTIVITIES**

- **Make a Pledge, Spread the Word!**


Get students to come up with a pledge comprising 5 ways of saving energy at home and 5 ways of saving energy in school. The pledges to save energy can be pinned up in the classroom to remind students of their commitment to action. At the end of every week, check with students on their progress.

- **Shrinking Footprints**

Lead a discussion about carbon footprints, explaining to students that every time they use electricity – for instance, turning on the computer – a small amount of carbon dioxide is released into the atmosphere. Electricity is also used in the production of items we buy. Therefore, reducing unnecessary consumption and recycling resources will help to reduce our carbon footprint. In small groups, invite students to list down objects or activities that produce a large carbon footprint. Possible answers might be buying drinks in disposable cups, leaving the lights on unnecessarily, or using private transport instead of public transport.



MORE WEB RESOURCES

- **www.epa.gov/climatestudents**
The United States Environmental Protection Agency's site for kids contains information, links and games on weather and climate change.
- **www1.eere.energy.gov/kids**
The US Department of Energy's site for kids titled 'Kids Saving Energy' contains games, tips and facts to encourage children to save energy.
- **climatekids.nasa.gov**
The National Aeronautics and Space Administration's site allows students to travel back in time to learn about climate change or fly along with a NASA satellite to check on the planet's vital signs.
- **tiki.oneworld.net**
Tiki the penguin explains climate change, greenhouse gases and what children can do to stop it.
- **meetthegreens.pbskids.org**
The GREENS is a site for kids from WGBH, a public broadcaster based in Boston, USA, about sustainability and green living. It encourages kids to make informed choices and meaningful changes to their lifestyles through animated episodes.
- **www.contespedagogiques.be/pages/accueil_angl.html**
 Climate change, explained through short stories that appeal to young students.

MORE ACTIVITY IDEAS

- **Climate change wall/corner**
Get your class to reflect on what they have learnt and create a wall or corner to showcase their thoughts and ideas on climate change. Students can decide on what information or aspect of climate change they want to focus on, such as how climate change is endangering animals and plants, or how students can spread the message on climate change to their friends and family members. In small groups, students can be encouraged to create posters, make collages and write poems for display on the classroom wall or designated climate change corner within the classroom.
- **Take part in the National Climate Change Competition**
The National Climate Change Competition (NCCC) is part of the National Climate Change Secretariat's outreach efforts to raise awareness and to encourage individual action on climate change among students in Singapore. NCCC 2013 took the form of a video competition where students across different levels were invited to submit short videos to inspire Singaporeans to take action for climate change. For more information on the NCCC, visit www.nccc.gov.sg.

This guide is produced by:



NCCS

NATIONAL CLIMATE CHANGE SECRETARIAT
PRIME MINISTER'S OFFICE SINGAPORE

www.nccs.gov.sg

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