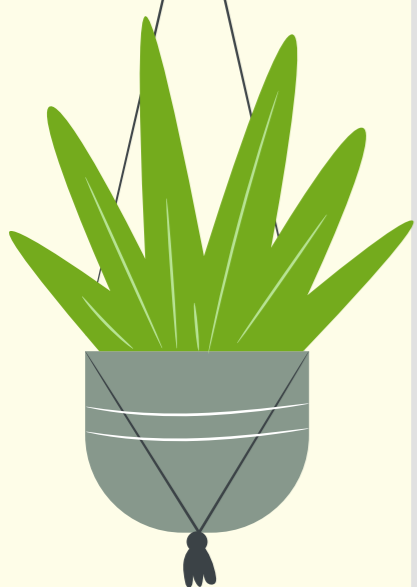
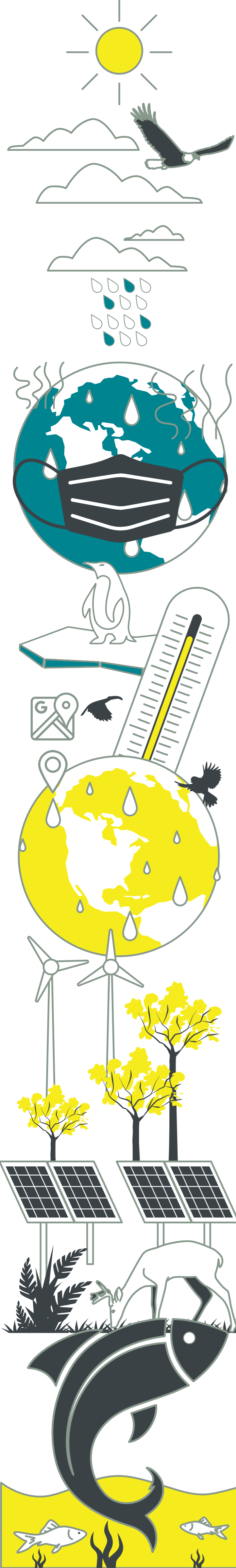


What is Climate Change?

INNOVATIVE WAYS TO ENGAGE STUDENTS
Handbook for Teachers

Presented by





INTRODUCTORY NOTE

Karuna A Singh

NOTE FOR TEACHERS

Subha Das Mollick

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Introductory Note

Earth Day Network India (EDN) is inspired by the global NGO EARTHDAY.ORG, which grew out of the first Earth Day on April 22, 1970, and today engages with over 50,000 organisations in some 190 countries to take the environmental movement forward.

We prioritise the importance of all countries mandating climate education in all phases of education to help solve Climate Change and train citizens to innovate and avail emerging job opportunities in the growing green economy leading to a climate literate population, a more equitable, inclusive, and sustainable economy, and to help develop resilience.

In support of teaching Climate Change-related issues, EDN, and the remarkable organisation Bichitra Pathshala, with whom we have collaborated for over a decade, conducted workshops for teachers of all subjects to enable them to incorporate Climate Change while teaching the current curriculum.

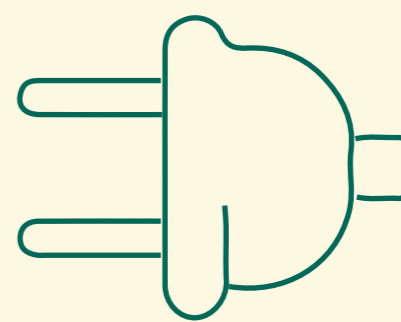
Our three-pronged approach included sessions for teachers to enhance their knowledge about climate-related issues. Innovative strategies were also introduced to hold pupils' attention and inspire them to be stewards of the environment from a young age. We also showcased simple ways for students to be citizen scientists with acts of green that help reduce their carbon footprints and by documenting these and other observations of their environs.

This handbook is an amalgamation of some of the presentations experts made. It is designed for students from class VI to class VIII. We welcome details of additional strategies the reader has used successfully. Please send these to officeofregionaldirector@earthday.org or to bichitrapathshala@gmail.com. You can also contact us to learn more about the many other initiatives we conduct for students. The authors can be reached directly via the email addresses provided for each.

“

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”



Karuna A Singh

Country Director

Earth Day Network India

Note for Teachers

Climate literacy is the need of the hour. The present generation must be helped to understand anthropogenic Climate Change—how this is linked to the quantity of fossil fuels burned, aerosol releases, land alteration from agriculture and deforestation in particular. All of us who inhabit Earth are in this together. Each of us needs to make lifestyle changes that lead to lowered carbon footprints, sustainable development, management of waste, reduction in plastic use and increases in natural wealth.

Teachers can help students understand the urgency to act now to ensure that Climate Change's adverse effects on humans are contained. If we carry on as usual, severe impacts on our health, food production, and climatic conditions (such as extreme heat) are estimated that would make human existence uncomfortable.

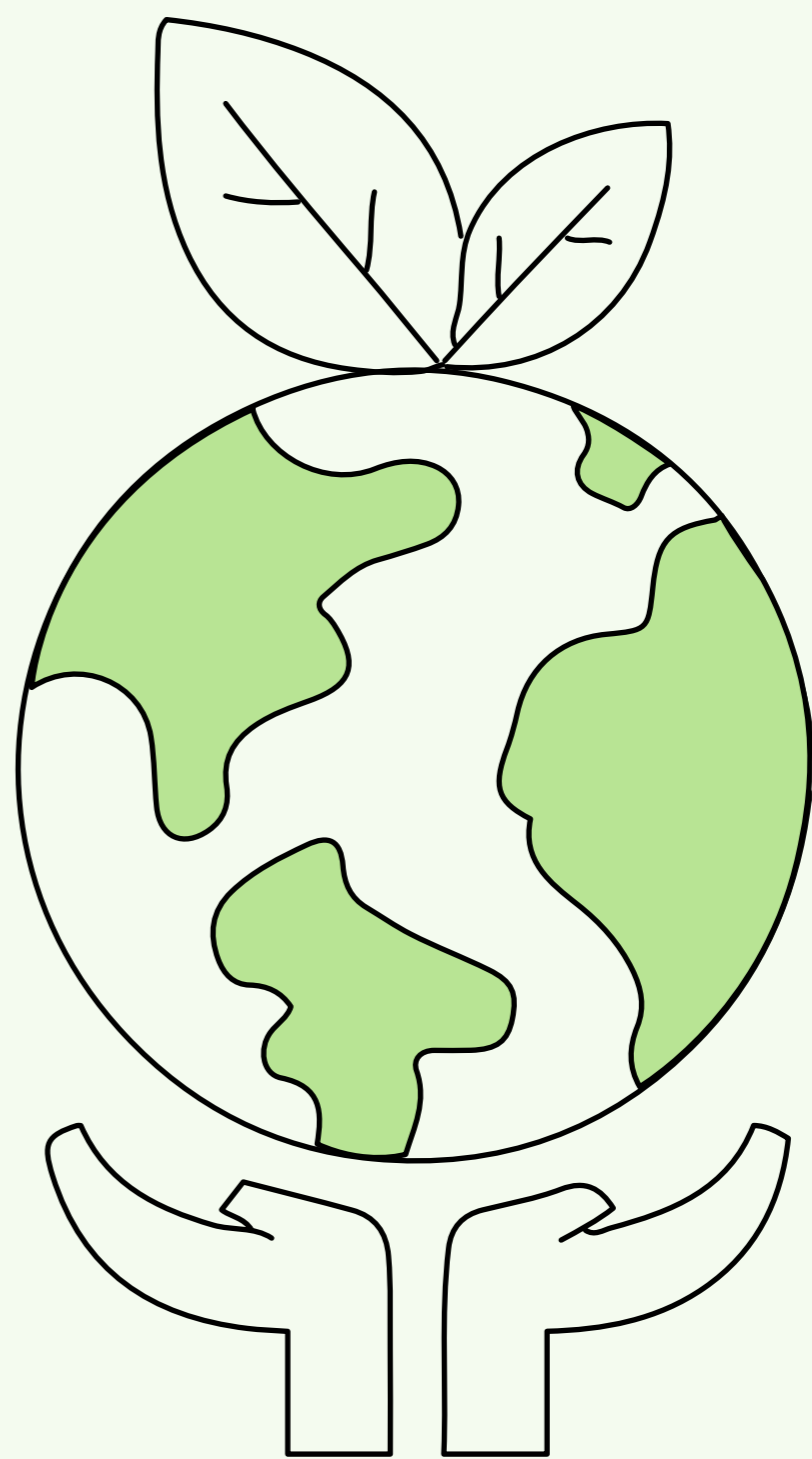
As someone with a long academic career and years spent teaching communication strategies to youth, I know the responsibility lies with us teachers who interact with Gen Next daily. Educators must include topics related to Climate Change while teaching any subject—not just science but humanities and commerce too. The handbook includes explanation of basic scientific phenomena behind Climate Change and some important data and graphs and innovative means 'such as storytelling, films, and puppetry' to draw student attention to environmental issues. My teaching experience confirms that compared to the written word, these means are more effective in holding students' attention. As the younger generation today is very computer savvy, we have included a chapter on the internet as a resource.

Let's all 'Invest in Our Planet' by helping our future citizens be climate literate and stewards of the environment from a young age.

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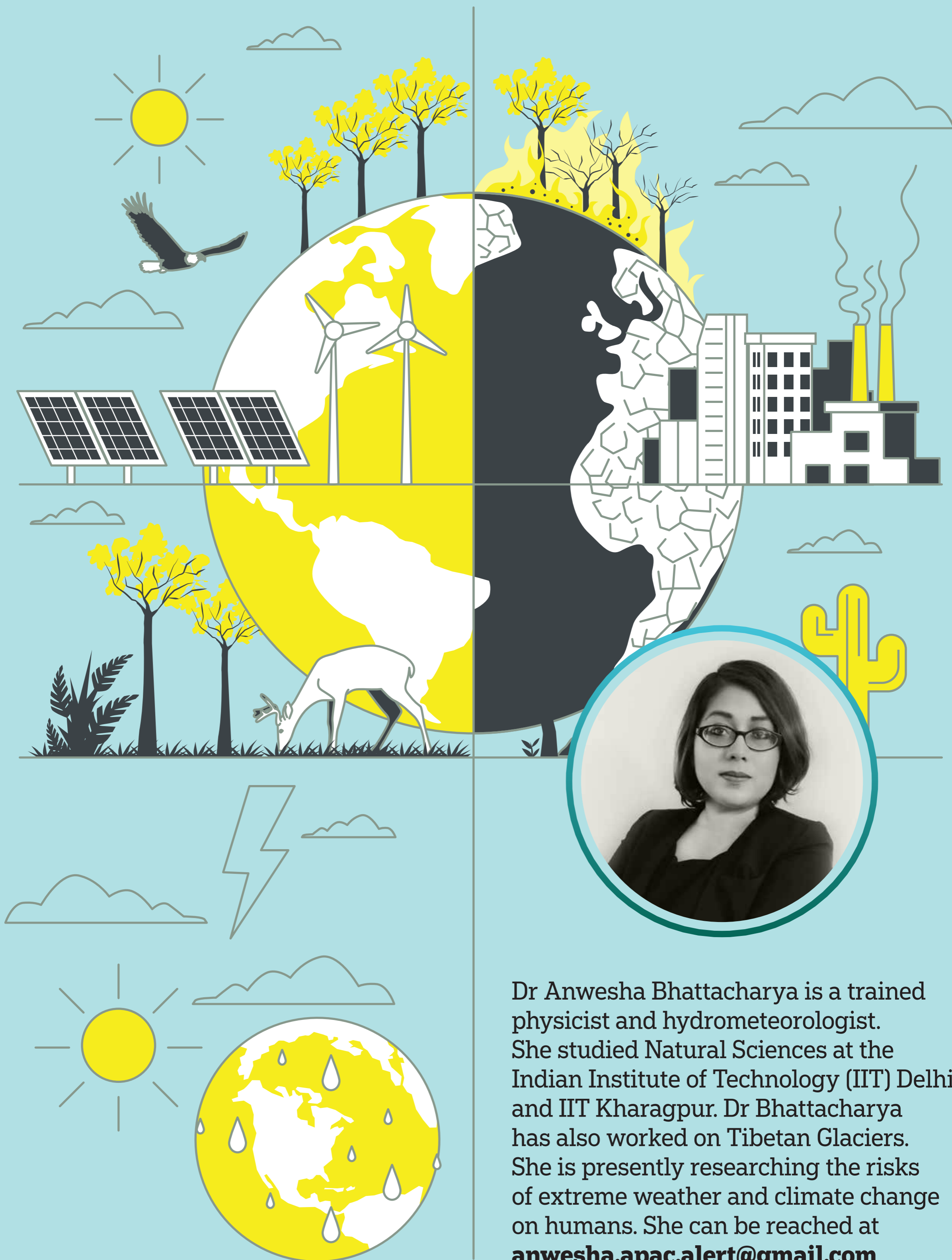


Subha Das Mollick

Founder Secretary
Bichitra Pathshala

01 | Climate Change—demystifying, defining and demonstrating key concepts and trends

Climate Change is the defining issue of our times. Its increasing importance makes it a topic for local, regional and global discussions and debate by all—academics, media and policymakers included. This module explains ways teachers can demystify, define and demonstrate key concepts and trends of climate change to students.



Dr Anwesa Bhattacharya is a trained physicist and hydrometeorologist. She studied Natural Sciences at the Indian Institute of Technology (IIT) Delhi and IIT Kharagpur. Dr Bhattacharya has also worked on Tibetan Glaciers. She is presently researching the risks of extreme weather and climate change on humans. She can be reached at anwesa.apac.alert@gmail.com

Climate and weather— what's in a name?

We must first understand how to distinguish between 'Weather' and 'Climate', two words often mistakenly used interchangeably. These are different in reality.

What is weather?

Weather is the mix of atmospheric events that happen over a limited period. A weather forecast by meteorologists (weather scientists) predicts whether a day/week/fortnight/month will be sunny, rainy, hot or cold.

As the weather is conditioned by our atmosphere, it can change from week to week, day to day, or even from hour to hour or minute to minute. This is because our atmosphere comprises billions of molecules in constant motion. To forecast the likely weather, meteorologists work out complex equations to arrive at conclusions.

However, as the atmosphere is volatile, accuracy in predictions gets reduced the further away in time the forecast is for. For example, tomorrow's weather forecast will likely be more spot-on than that for a week away.

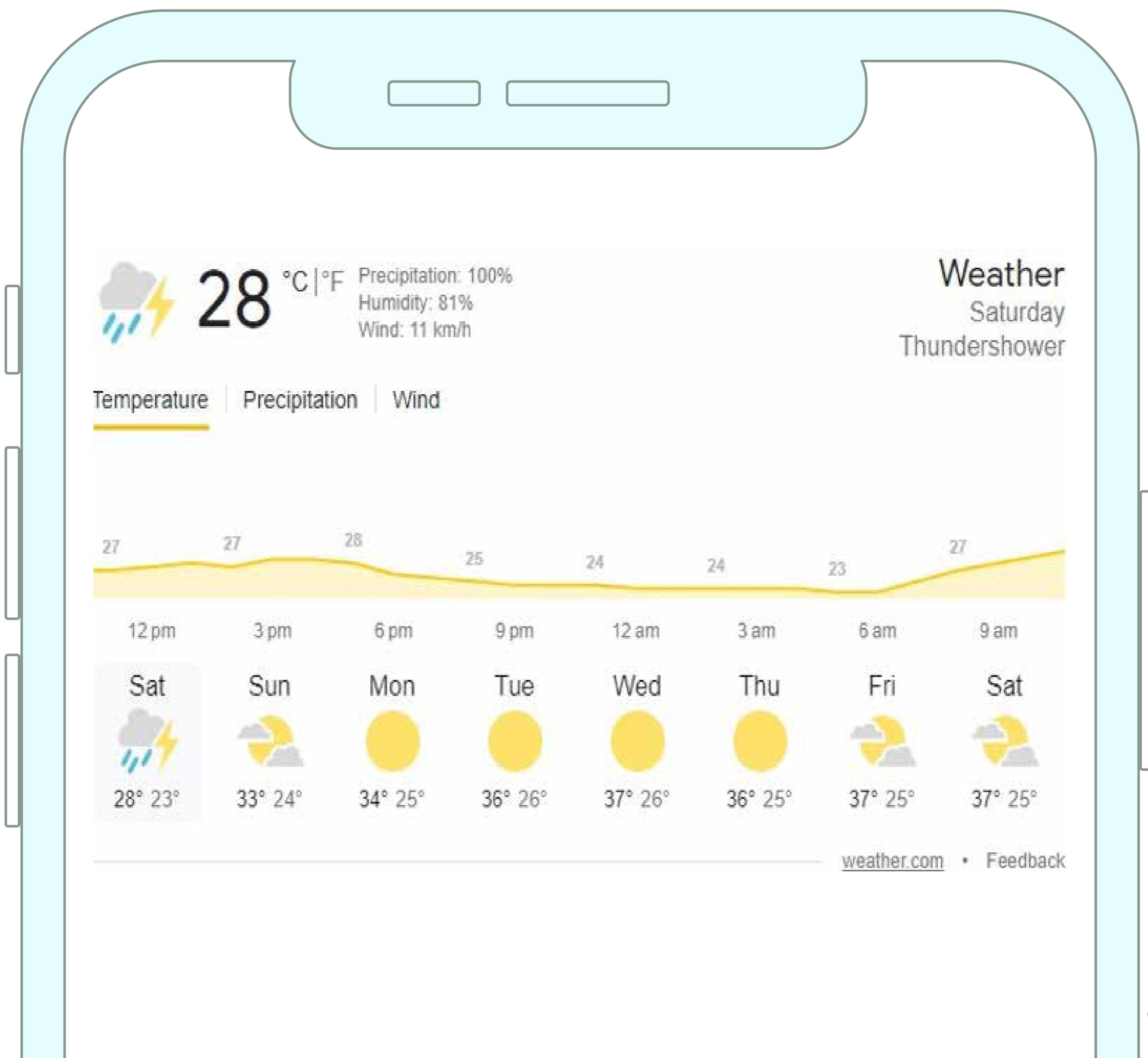
EXERCISE

Search on Google for a weather app that provides data for your location. You will likely see a chart such as Exhibit 1. Try to comprehend what the numbers in it indicate.

How different is today from tomorrow? In exhibit 1, today is Saturday. Note the numbers predicted for the next day (Sunday) and the 5th day (Thursday). Once those days come, compare the actual numbers. Did the predictions match the actual numbers?

If not, what were the differences between the given statistics and those in reality? Was it hotter? Did it rain when the forecast said dry weather?

EXHIBIT 1 A 7-day weather forecast for Kolkata



What is climate?

The climate is the average weather condition of a region considered over several decades (typically over 30 years). Climate, therefore, describes the typical weather at a place during a particular time of the year.

EXERCISE

In Google, search for the climate of your location. This time you will see a forecast such as in Exhibit 2.

Do you understand what each graph is showing?

Which is the hottest month in your region?

In which month do you get the most rain?

Exhibit 2 shows the expected climate of Kolkata in April. That is a maximum temperature of 36°C and a minimum of 24°C. This is arrived at by taking the average of all days in April in Kolkata observed over many years. However, as we have seen from Exhibit 1, the first Saturday has a maximum temperature of 28°C and a minimum temperature of 23°C—this is the weather on that day.

EXHIBIT 2 Climate in Kolkata



Rainfall (millimetres)



What is Climate Change?

As per the Intergovernmental Panel on Climate Change (IPCC), 'Climate change refers to a change in the state of the climate that can be identified (example, by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.'

It refers to any change in climate over time, whether due to natural variability or as a result of human activity. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

EXERCISE

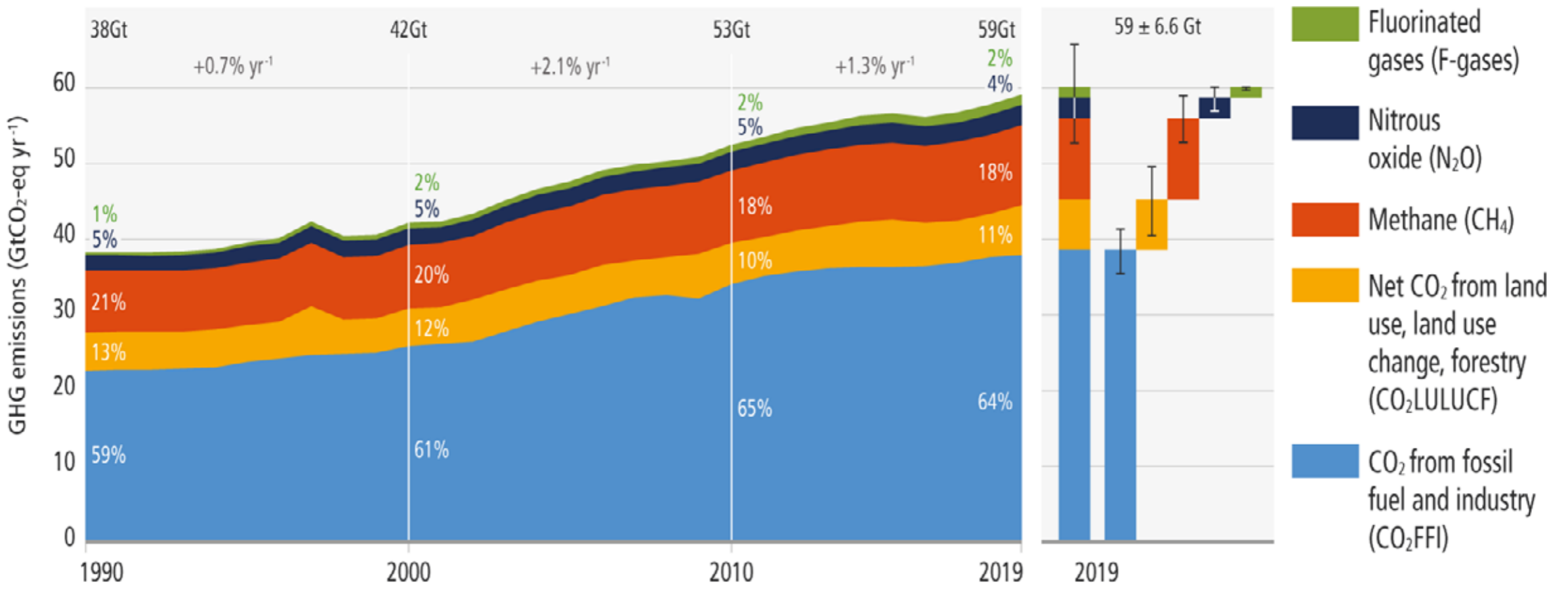
In Google, search for the processes that drive climate change.

What are the natural causes of climate change? What are some of the man-made causes? What is Climate Variability?

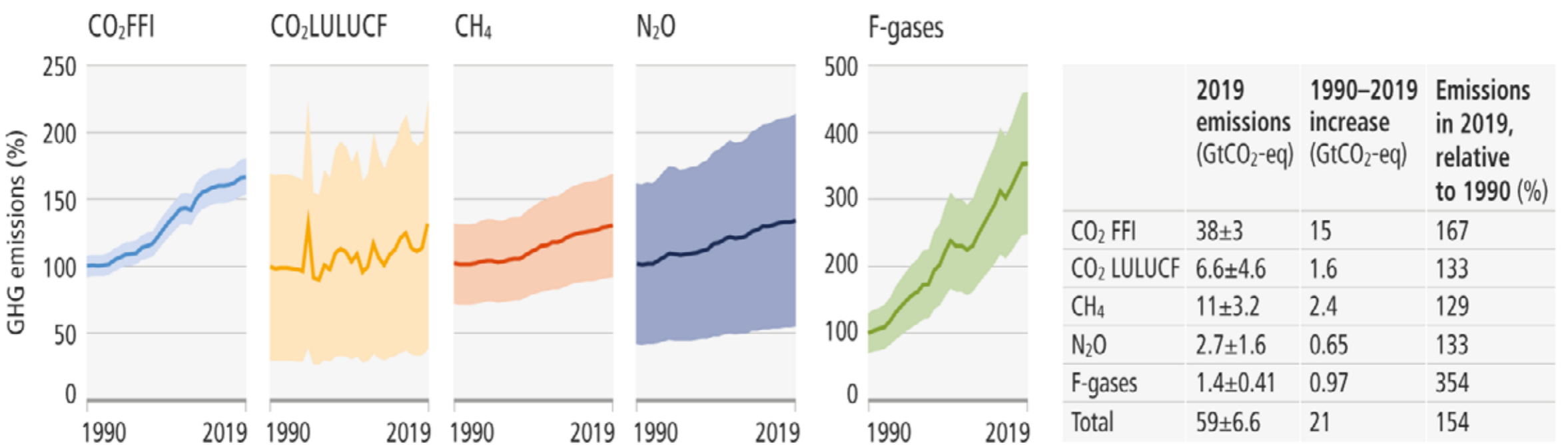
It is important to note the words 'mean' and 'variability' in the above excerpt. Exhibit 3 highlights the essence of climate variability. It refers to the short-term fluctuations in the climate. For example, let us refer back to the example used in Exhibit 2. Taking the averages over a 30-year period, the average daily maximum temperature in Kolkata in May is 36°C. But the average maximum temperature of May in Kolkata of 2023 may not be the same as that of 2019—this is the variability. Even globally, the average temperatures will vary from year to year.

As shown in Exhibit 3, one year can be warmer than another year (variability), but overall, the air temperature shows a long-term warming trend (change of mean). There can be many 'climate drivers' why parameters such as temperature and precipitation vary year to year, such as El Nino Southern Oscillation, Indian Ocean Dipole etc. Science on how climate variability is affected in a warming world is still evolving and a very important topic of research.

a. Global net anthropogenic GHG emissions 1990–2019⁽⁵⁾



b. Global anthropogenic GHG emissions and uncertainties by gas – relative to 1990



The solid line indicates central estimate of emissions trends. The shaded area indicates the uncertainty range.

GLOBAL ANTHROPOGENIC HAVE CONTINUED TO RISE ACROSS ALL MAJOR GROUPS OF GREENHOUSE GASES

The graphs above show various man-made reasons behind climate change

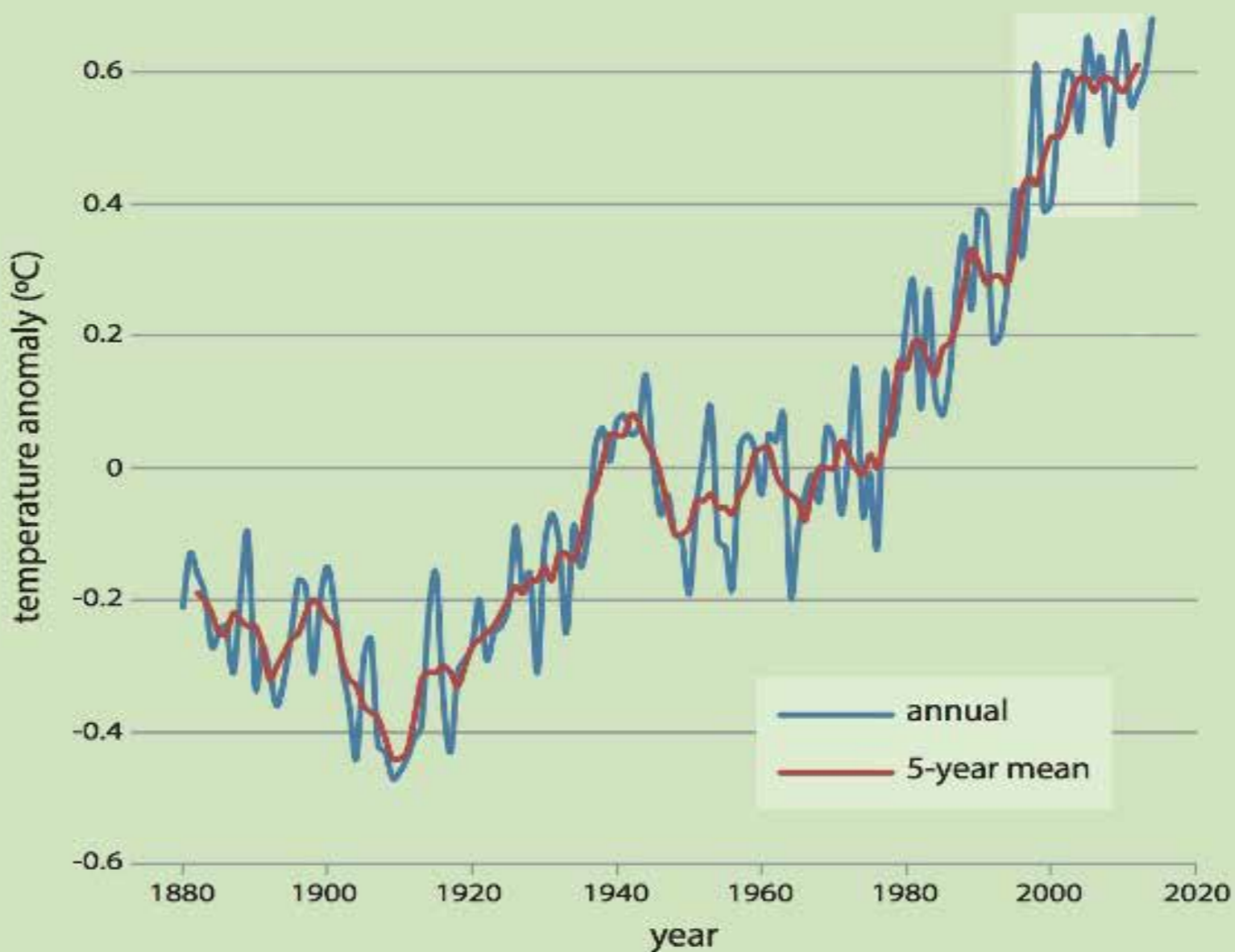
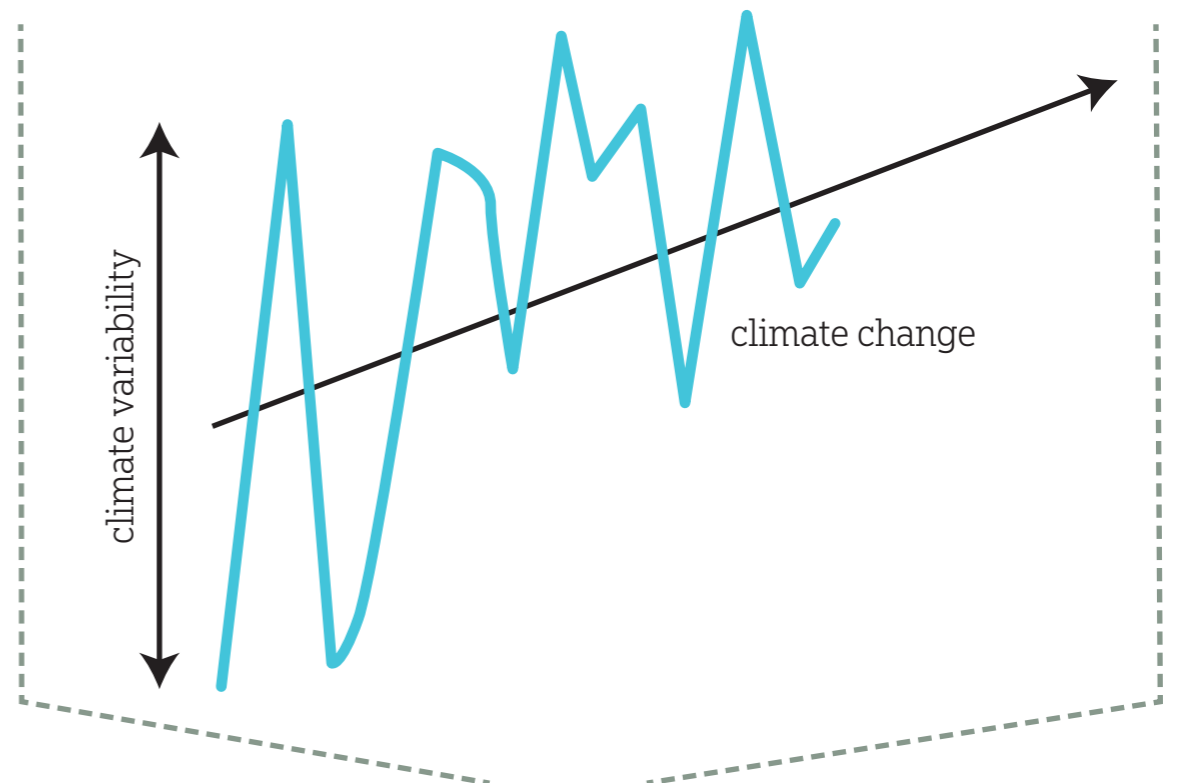
Source IPCC AR6

EXERCISE

In Google, search for the “climate drivers”.

Do you understand how El Nino impacts monsoons in India? Is this year El Nino or La Nina?

Based on your findings above, can you predict the monsoon season this year?



CHANGE IN AIR TEMPERATURE SINCE 1880

Source NASA GISS Surface Temperature Ananlysis (GISTEMP) Analysis 2014

EXHIBIT 3 Difference between Climate Change and Climate Variability

Source Center for Science Education



A deep dive into Climate Change

Climate change is not new. Exhibit 4 shows Earth's surface temperature changes over the past centuries. As discussed above, climate change can be due to internal and external forcings—natural and man-made. However, for the rest of this handbook, we will talk about human-induced or 'anthropogenic' climate change.

The Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.' It is evident that the recent changes to global surface temperatures can only be explained when we consider both natural and human factors, as seen in Exhibit 5.

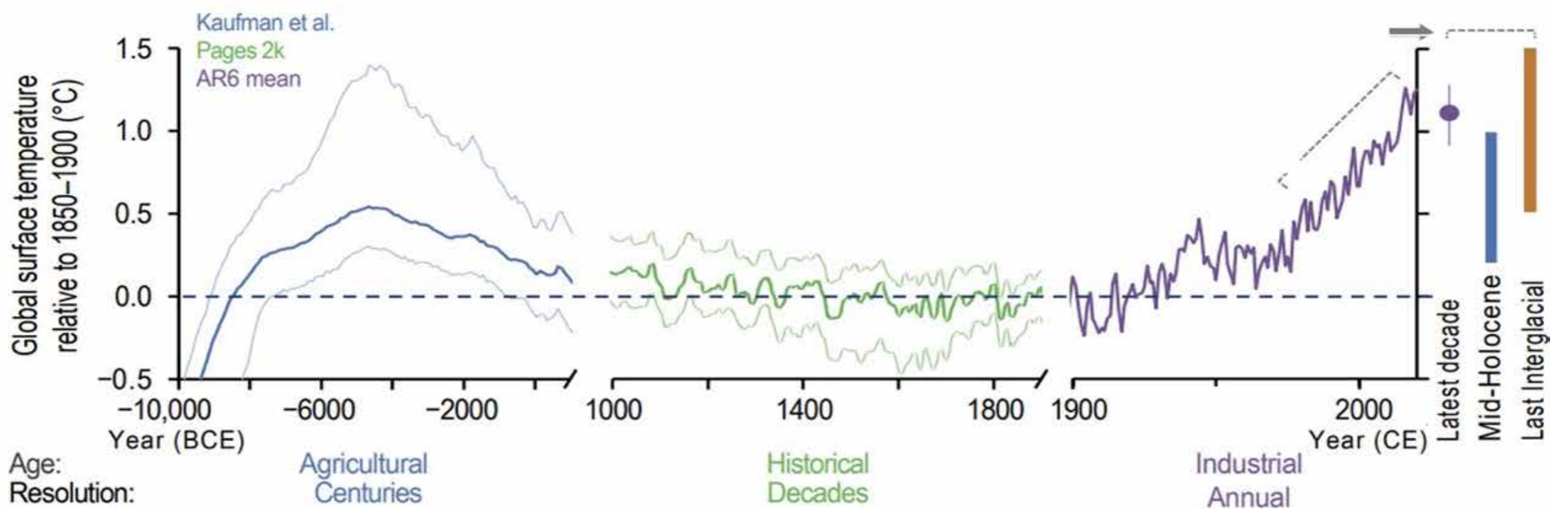


EXHIBIT 4 Changes of Earth's surface temperature over the past centuries
Source IPCC AR6

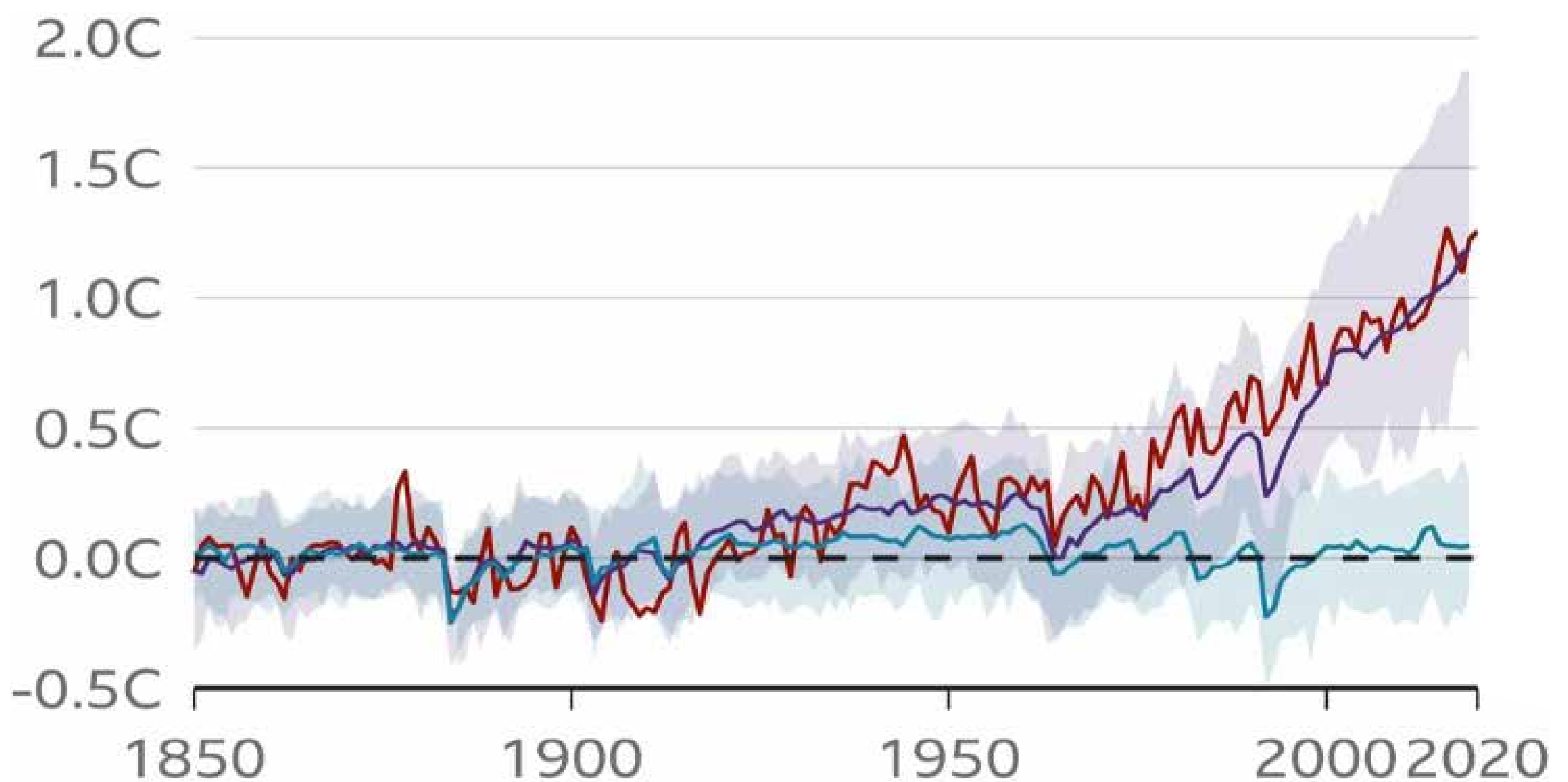


EXHIBIT 5 Changes to global average temperature relative to 1850-1900
Source IPCC 2021

- observed
- simulated human and natural factors
- simulated natural factors only

EXHIBIT 6 shows how a change in the climate would impact extremes such as temperature and precipitation. Climate changes would not mean, for example, that we no longer have freezing days from now onwards but that the probability of icy days may be lesser than in the 'old' climate model. This is a very simplistic example –different parameters react differently to climate change through changes in mean, variance, or even the distribution of the probability of occurrence.

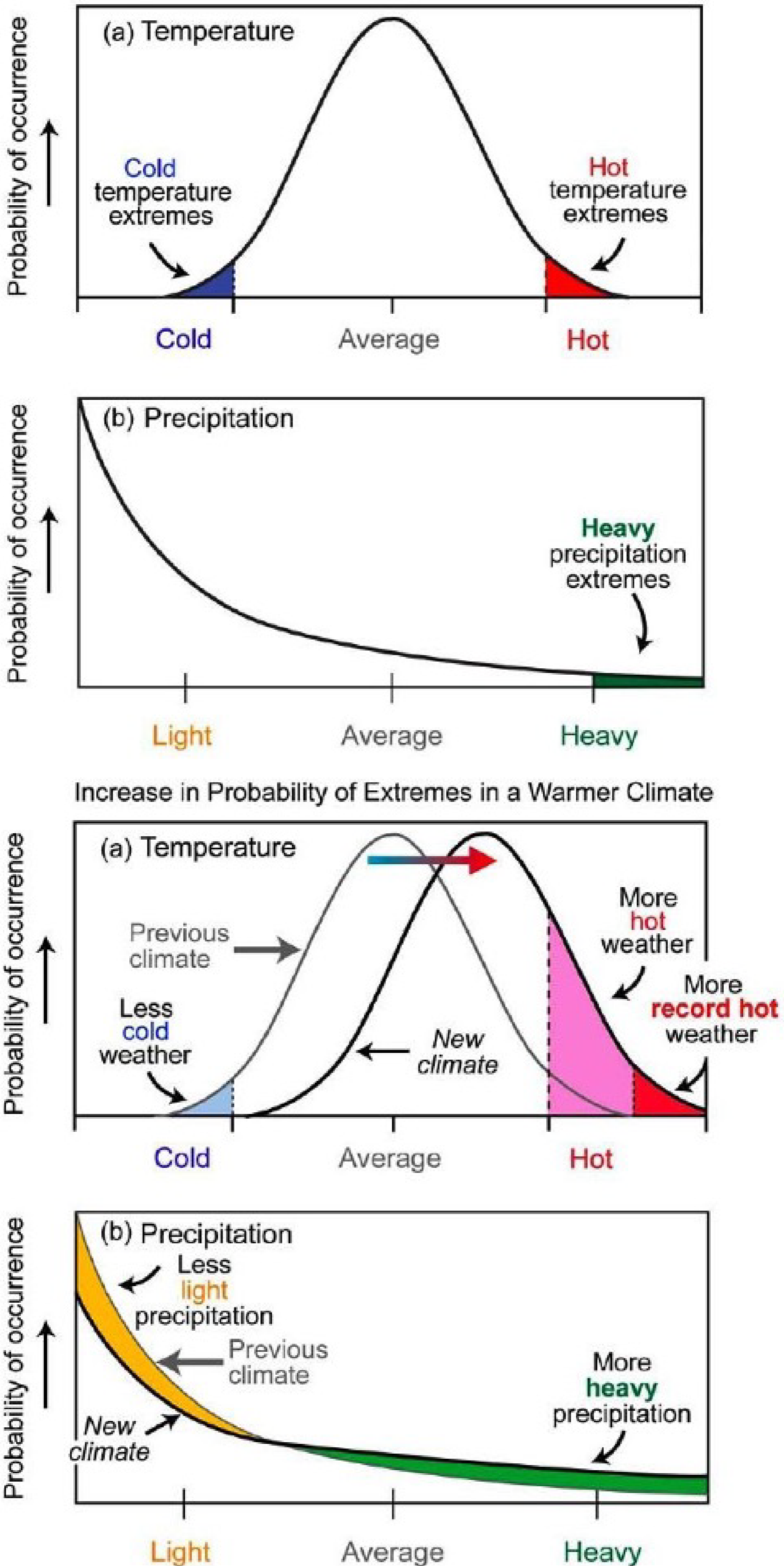


EXHIBIT 6 Changes to Extreme Events
Source Peterson et al, 2008

The impact of Climate Change

Though we often think about **human-induced climate change** as something that will happen in the future, it is an on-going process. People around the world are being impacted today.

But climate change refers to more than an increase in temperature. It also includes sea level rise, changes in weather patterns like drought and flooding, and much more. Things that we depend upon and value—water, energy, transportation, wildlife, agriculture, ecosystems and human health—are experiencing the effects of a changing climate.

The **National Oceanic and Atmospheric Administration** (NOAA) monitors global climate data. Here are some of the changes NOAA recorded. You can explore more at their **Global Climate Dashboard**.

Source NOAA

(<https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts>)

- **Global temperatures** rose about 1.8°F (1°C) from 1901 to 2020.
- **Sea level rise** has accelerated from 1.7 mm/year throughout most of the twentieth century to 3.2 mm/year since 1993.
- **Glaciers** are shrinking—the average thickness of 30 well-studied glaciers has decreased more than 60 feet since 1980.
- The area covered by **sea ice** in the Arctic at the end of summer has shrunk by about 40% since 1979.
- The amount of **carbon dioxide** in the atmosphere has risen by 25% since 1958, and by about 40% since the Industrial Revolution.

A complex issue

The impacts of climate change on different sectors of society are interrelated.

Drought can harm food production and human health.

Human health issues can increase mortality, impact food availability, and limit worker productivity. Climate change impacts are seen throughout every aspect of the world we live in.

Flooding can lead to disease spread and damages to ecosystems and infrastructure.

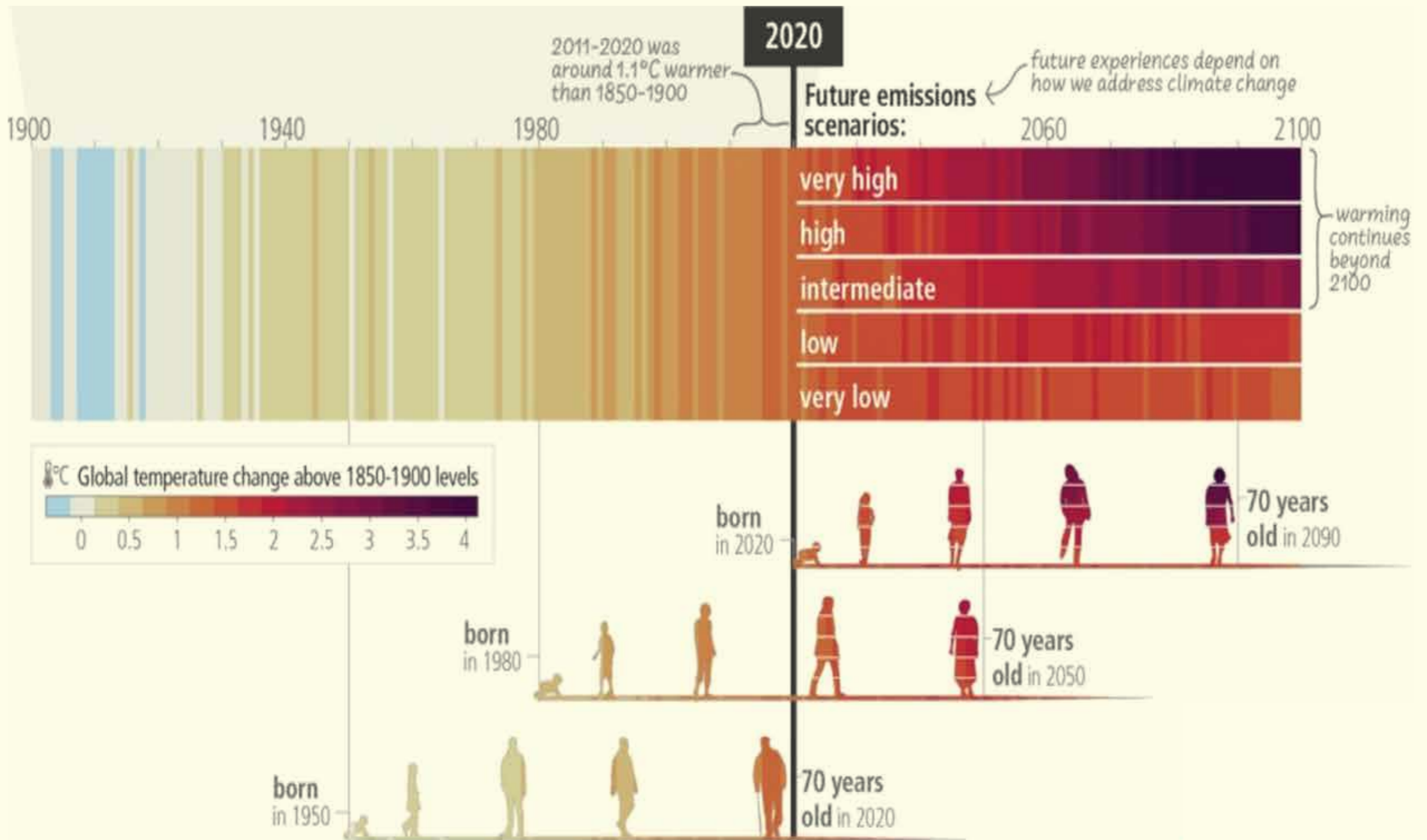
However, climate change impacts are uneven across a country and the world—even within a single community, climate change impacts can differ between neighbourhoods or individuals.

Long-standing **socio-economic inequities** can make underserved groups, who often have the highest exposure to hazards and the fewest resources to respond, more vulnerable.



A climate change-impacted future is inevitable. Some problems are already identified and solutions worked out for them. Ongoing research continues to identify additional impacts. Experts believe that there is still time to avoid the most negative of outcomes by limiting warming and reducing emissions to zero as quickly as possible.

Reducing our emissions of greenhouse gases will require **investment** in new technology and infrastructure, which will spur job growth. Additionally, lowering emissions will **lessen** harmful impacts to human health, saving countless lives and billions of dollars in health-related expenses.



THE EXTENT TO WHICH CURRENT AND FUTURE GENERATIONS WILL EXPERIENCE A HOTTER AND DIFFERENT WORLD DEPENDS ON CHOICES NOW AND IN THE NEAR-TERM

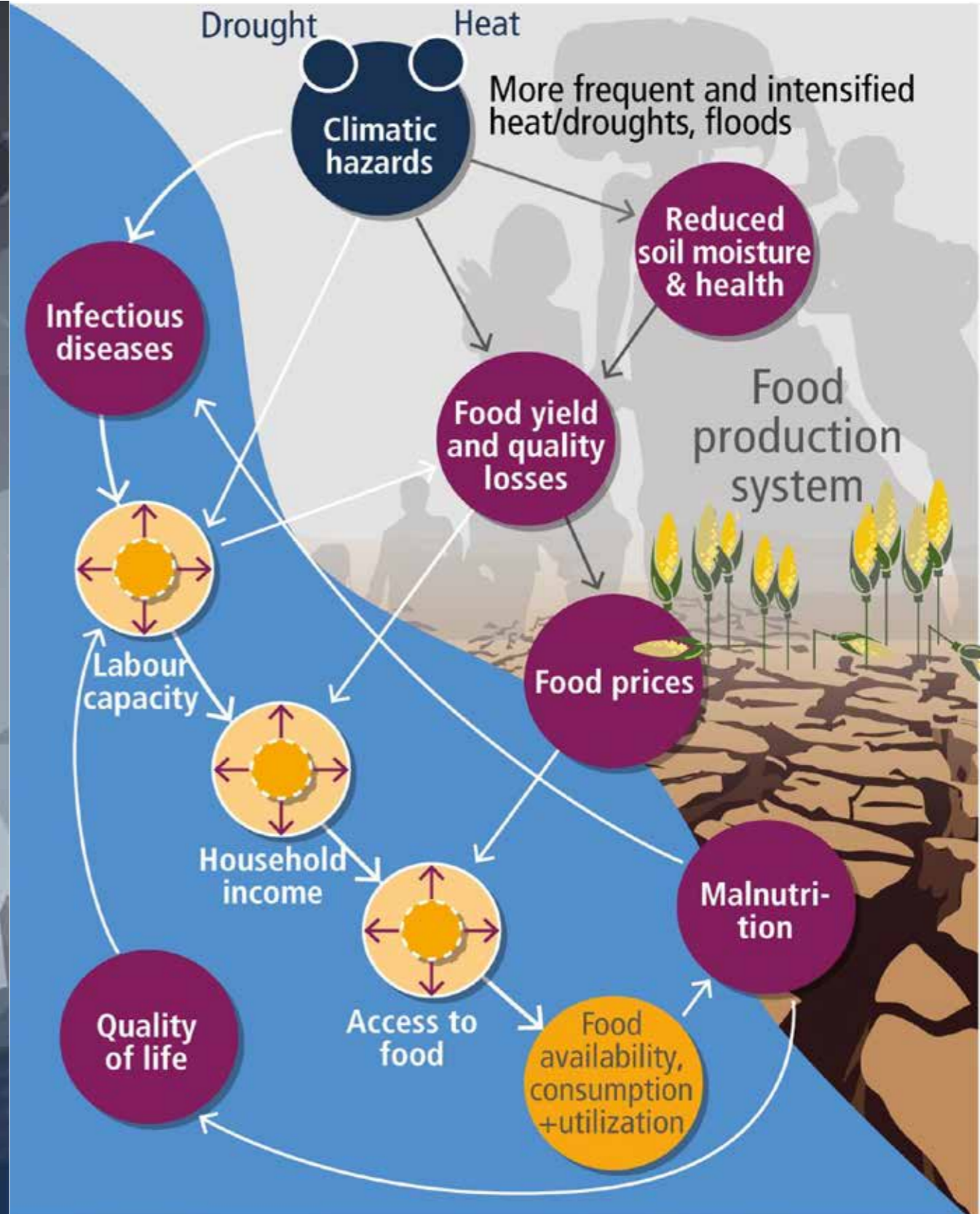
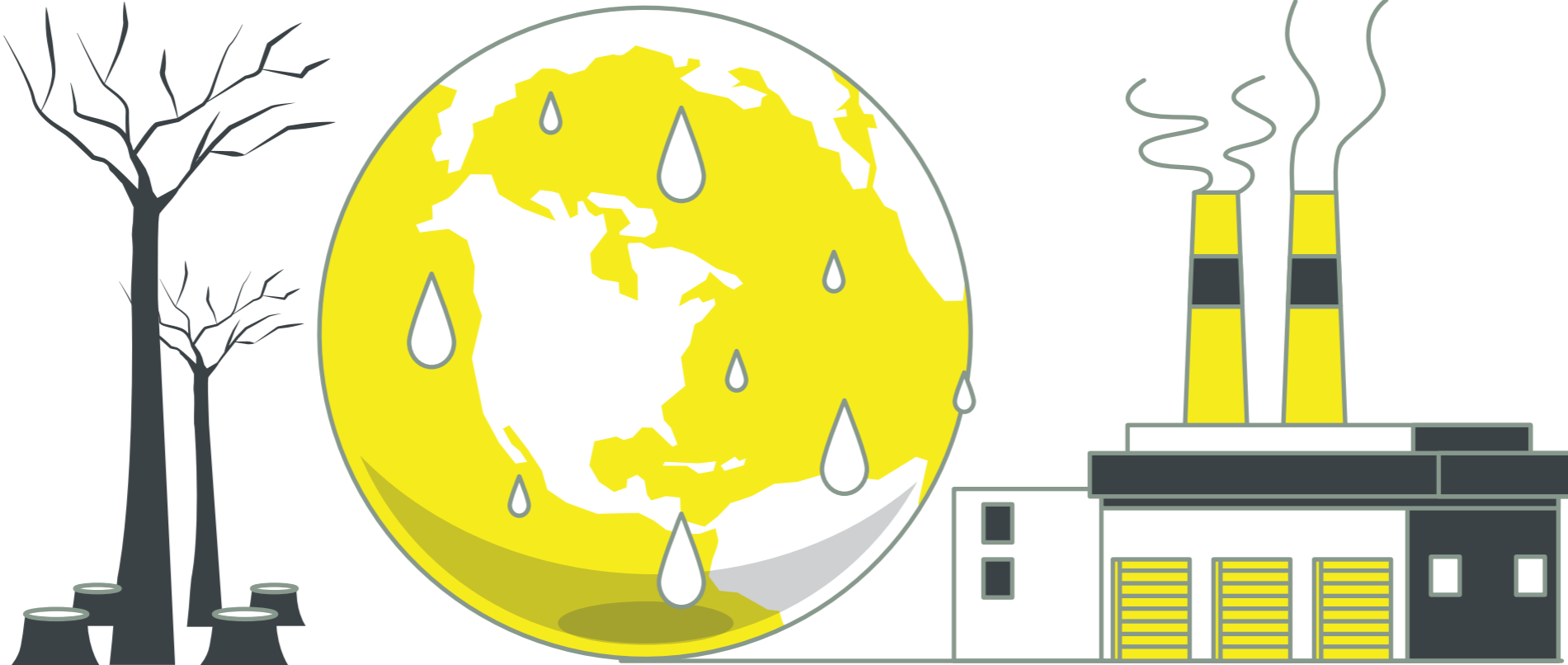
EXHIBIT 7 Potential changes to average temperature based on future emission scenarios
Source IPCC AR6



Many aspects of the climate system react quickly to temperature changes. At progressively higher levels of global warming there are greater consequences (min/max range shown).



RESPONSE OF THE CLIMATE SYSTEM RELATIVE TO 1850-1900
EXHIBIT 8 Response of climate parameters under different climate change scenario
Source IPCC AR6



URBAN INFRASTRUCTURE FAILURES CASCADE RISK AND LOSS ACROSS AND BEYOND CITY

CASCADING IMPACTS OF CLIMATE HAZARDS ON FOOD AND NUTRITION

EXHIBIT 9 & 10 Cascading effect of climate hazard
Source IPCC AR6

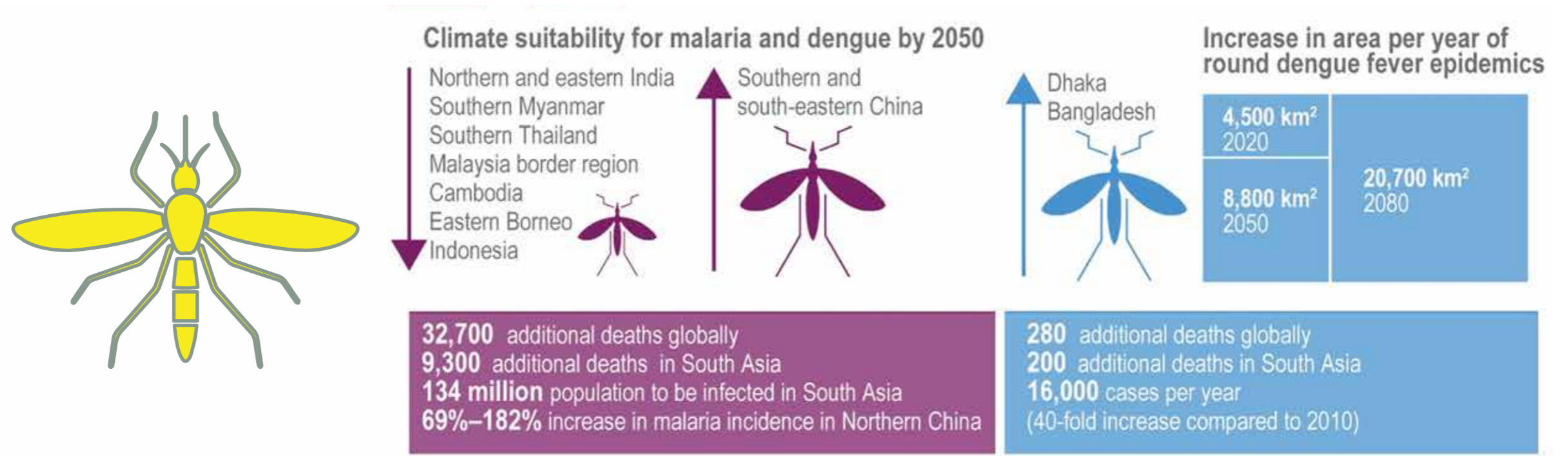
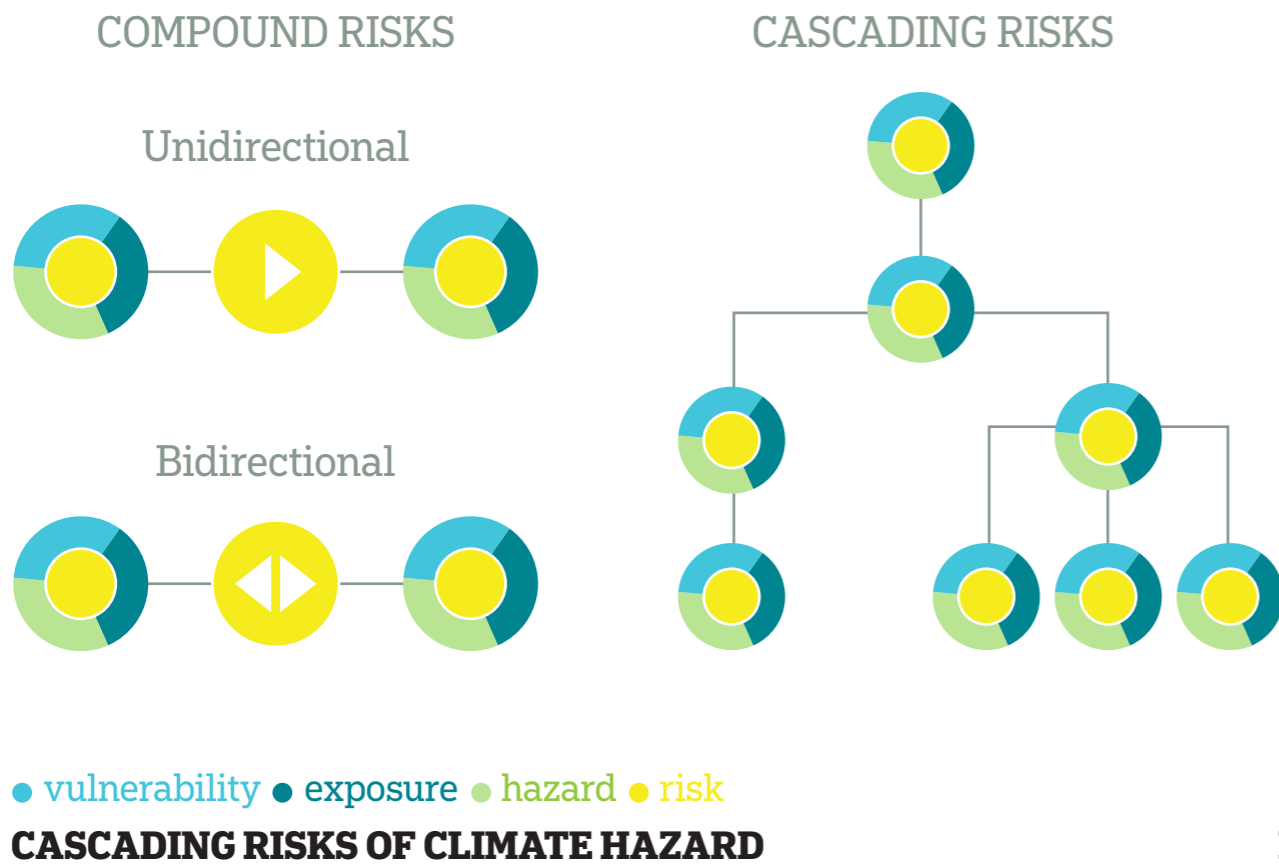
Why do we care?

If the average warming exceeds 1.5°C, scientists have significant confidence in the projection that human and natural systems will experience enhanced risks. Exhibit 7 shows the potential changes to average temperature based on future emission scenarios. The latest IPCC report outlines the response of some key systems to varying degrees of warming, as highlighted by Exhibit 8. Also refer to this excellent set of exhibits from the UN on what a 1.5°C rise implies for various aspects of nature (Appendix 1 at the end of the book).

It is important to realise that the ‘hazard’ changes outlined in Exhibit 8 translate to ‘risk’ only when the hazard interacts with ‘vulnerable exposure’, such as human settlements, flora, fauna, etc. So, risk is a function of hazard, exposure, and vulnerability. More often than not, such interactions are interrelated with far-reaching impacts, as can be seen in Exhibits 9 and 10.



Climate Change risk varies from geography to geography. See exhibits 11 and 12.



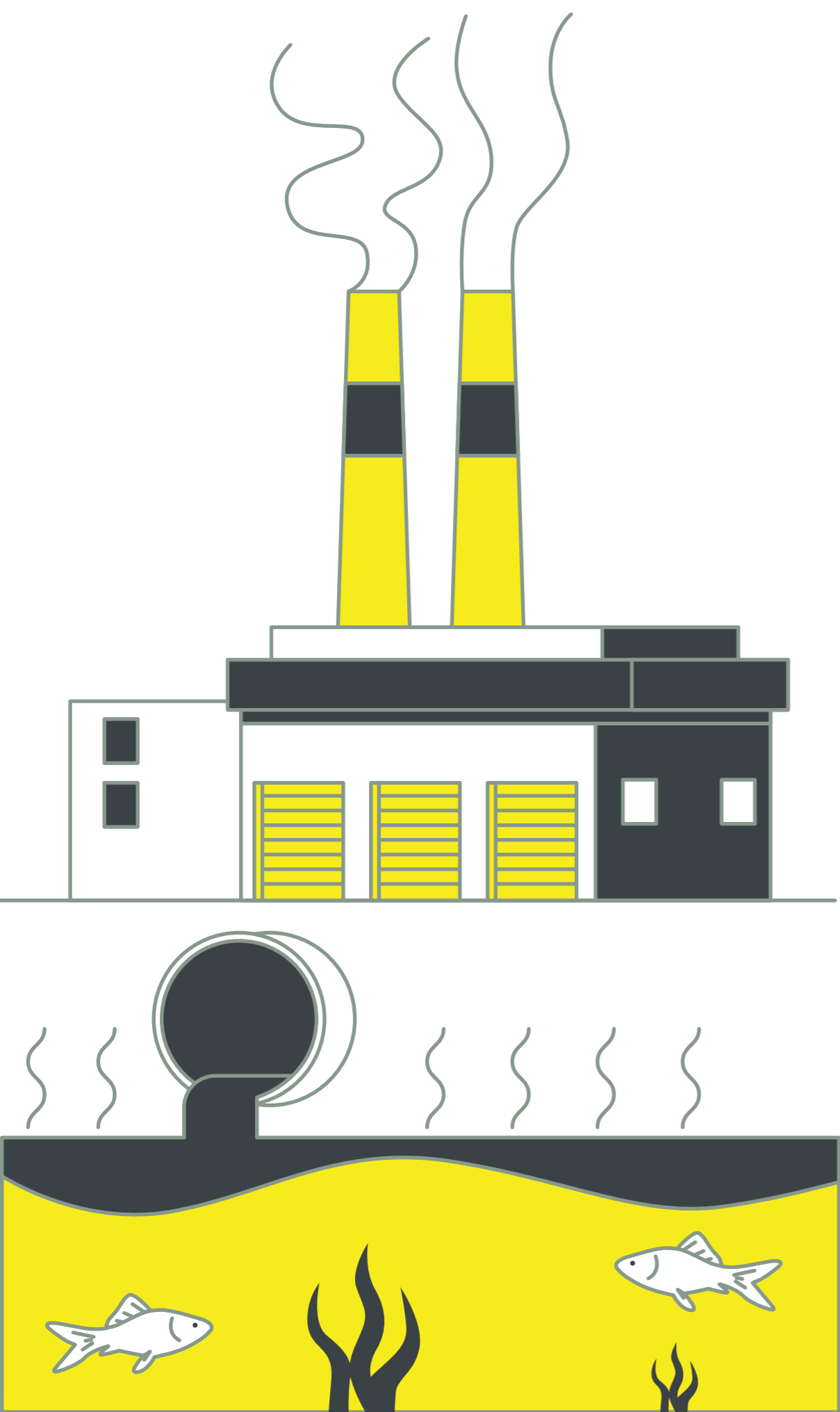
Reduce dietary Iron South and Southeast Asia: highest risk regions for reduced dietary iron intake among women of childbearing age and children under 5 years due to elevated CO₂ concentrations

Other deaths due to climate change

South Asia: additional deaths in children aged under 5 years attributable to moderate and severe stunting in 2030 and 2050 are approximately 20,700 and 16,500, respectively

MALARIA AND DENGUE MORTALITY

EXHIBIT 11 & 12 Hazard expression is regional
Source IPCC AR6



EXERCISE

Use Google to assess your risk and develop a risk chart/map with information that addresses the following questions—

- What are the key hazards that impact your locality? Is it cyclones, floods, drought or certain diseases?
- How does climate change impact such hazards? Is there any scientific evidence? Any observed trends? Does science offer any insight into how these will change in the future?
- Where is the primary vulnerability of the region? For example, the area's dependence on agriculture? The predominance of mud houses? Others?
- What is at primary risk? For example, towns? Biodiversity? Others?



HUMAN ACTIVITIES THAT DEGRADE ECOSYSTEMS ALSO DRIVE GLOBAL WARMING AND NEGATIVELY IMPACT NATURE AND PEOPLE



HUMAN ACTIVITIES THAT PROTECT, CONSERVE AND RESTORE ECOSYSTEMS CONTRIBUTE TO CLIMATE RESILIENT DEVELOPMENT

EXHIBIT 13 Prospects for Climate Resilient Development
Source IPCC AR6

Combating Climate Change—adaptation, mitigation and resilience building

The first step to combating climate change is to understand that we are already seeing changes in the climate and to understand the risks that these pose at global and local levels. Only when we understand the science and assess our risks can we find feasible and effective adaptation measures to reduce such risks to human beings and our environment.

Exhibit 13 shows some human activities that harm, versus some that can mitigate. As we saw in the previous exhibits, risk varies, so mitigation must also vary accordingly.

Exhibit 14 shows a few mitigation measures currently adopted in some Asian cities.

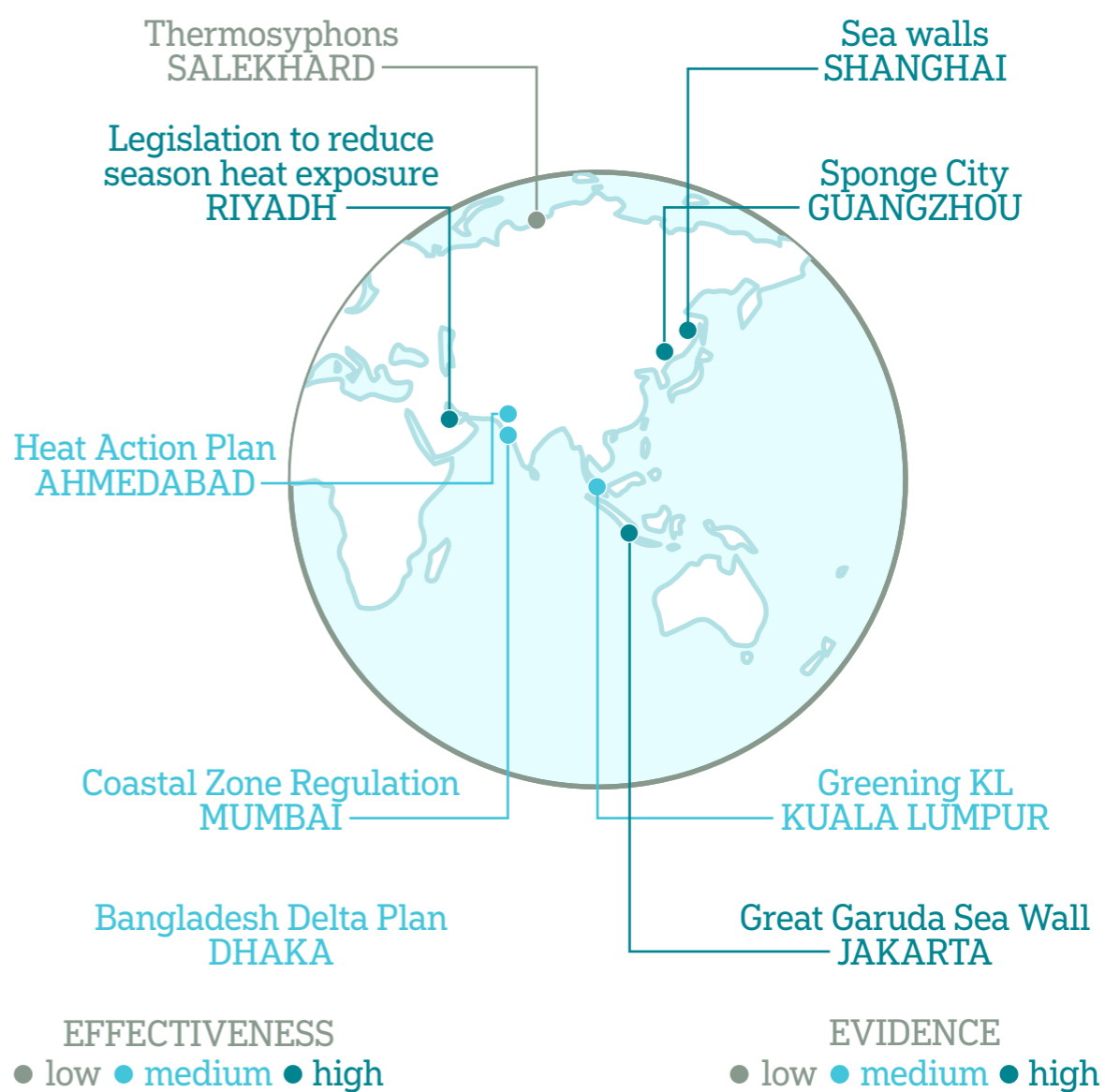
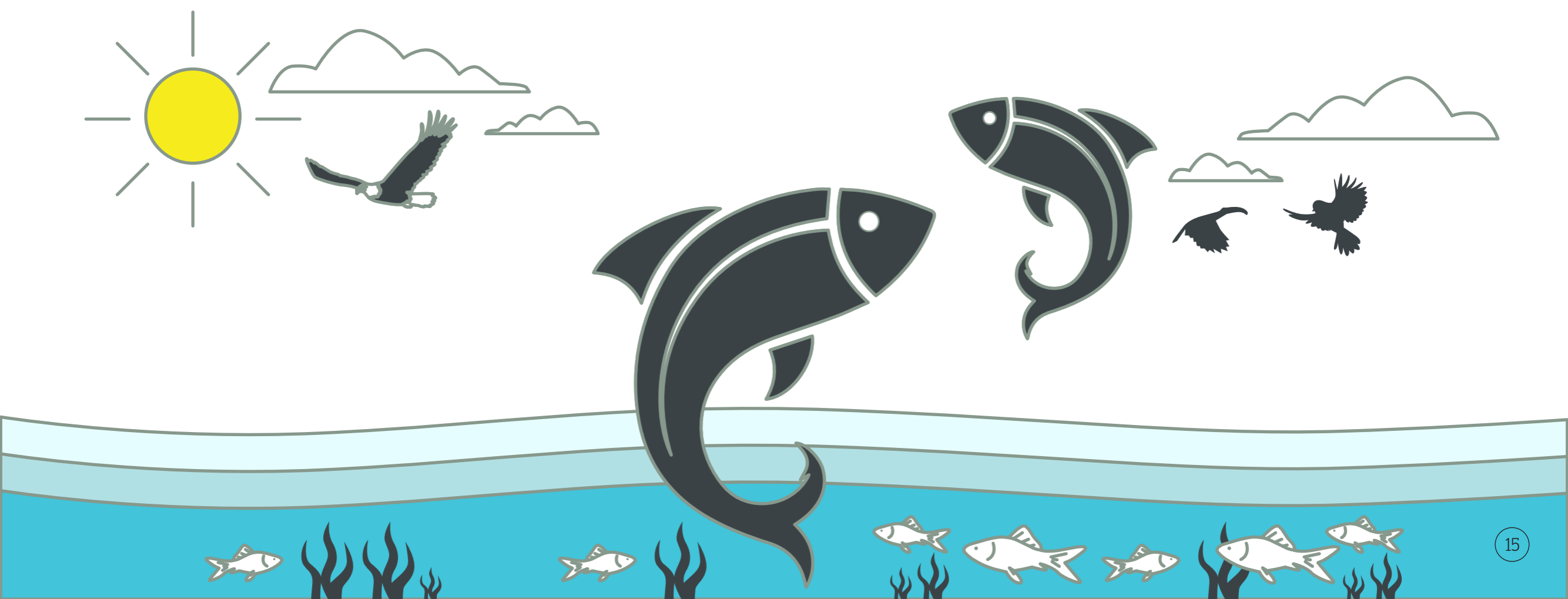
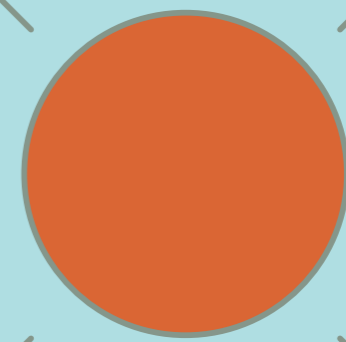
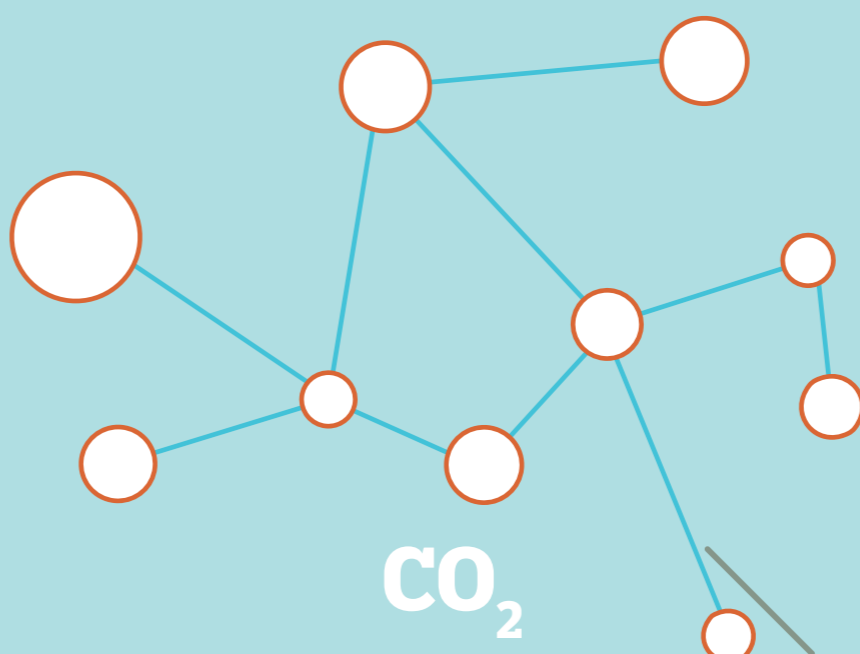


EXHIBIT 14 Examples of adoption measures in some Asian Cities
Source IPCC AR6



02 | The Story of Carbon



CO₂



CO₂



CO₂



STORY BY

Subha Das Mollick is a filmmaker and a professor of media studies & film studies. As the founder secretary of Bichitra Pathshala, she has developed a pedagogy for using film clips as teaching and learning aid. The course material for her course Cinema in the Classroom is available as an open education resource. She can be reached at subha.dasmollick@gmail.com



ART BY

Rashmita Roy is an English Teacher, working in an eminent educational institution, with a deep-felt penchant for dabbling in diverse forms of Art, Reading and Music. She can be reached at rashmitaroy@ivws.org

I am Carbon.

I am found everywhere—in rocks and soil, in the ocean waters and on the ocean floor, high up in the atmosphere and deep down in the bowels of the Earth.

I am a part of the food you eat. I keep your heart warm, and I run the vehicles you ride.

I am there in the stars overhead, in the comets and asteroids, in the planets and their moons, in the pole star and Alpha Centauri and in the Sun.

I am forged in the core of the Sun—and in the core of every ageing star.

I am abundant in the whole universe—more abundant than metals and most gases.

All the Carbon on Earth—all 650,500 metric tons—has come from the Sun we worship every morning. We are made of Sun material.



The Great Carbon Cycle

On Earth, I relentlessly shift my home from the atmosphere to the rocks, from the steadfast rocks to the flowing river to the heaving oceans.

In the atmosphere, I exist only in traces, in the form of a gas called Carbon dioxide. It is a colourless, odourless, non-corrosive, harmless gas. One would hardly notice its presence. But it has one important quality that makes it crucial to life on Earth. Carbon dioxide can absorb the heat rising from the Earth's surface and re-radiate some of the heat back to the Earth. By doing this, it keeps the

Earth warm. That is why it is called a greenhouse gas. Water vapour and methane are also greenhouse gases. If these greenhouse gases were not there, animals and plants would have frozen to death. The Earth would have been a barren place.

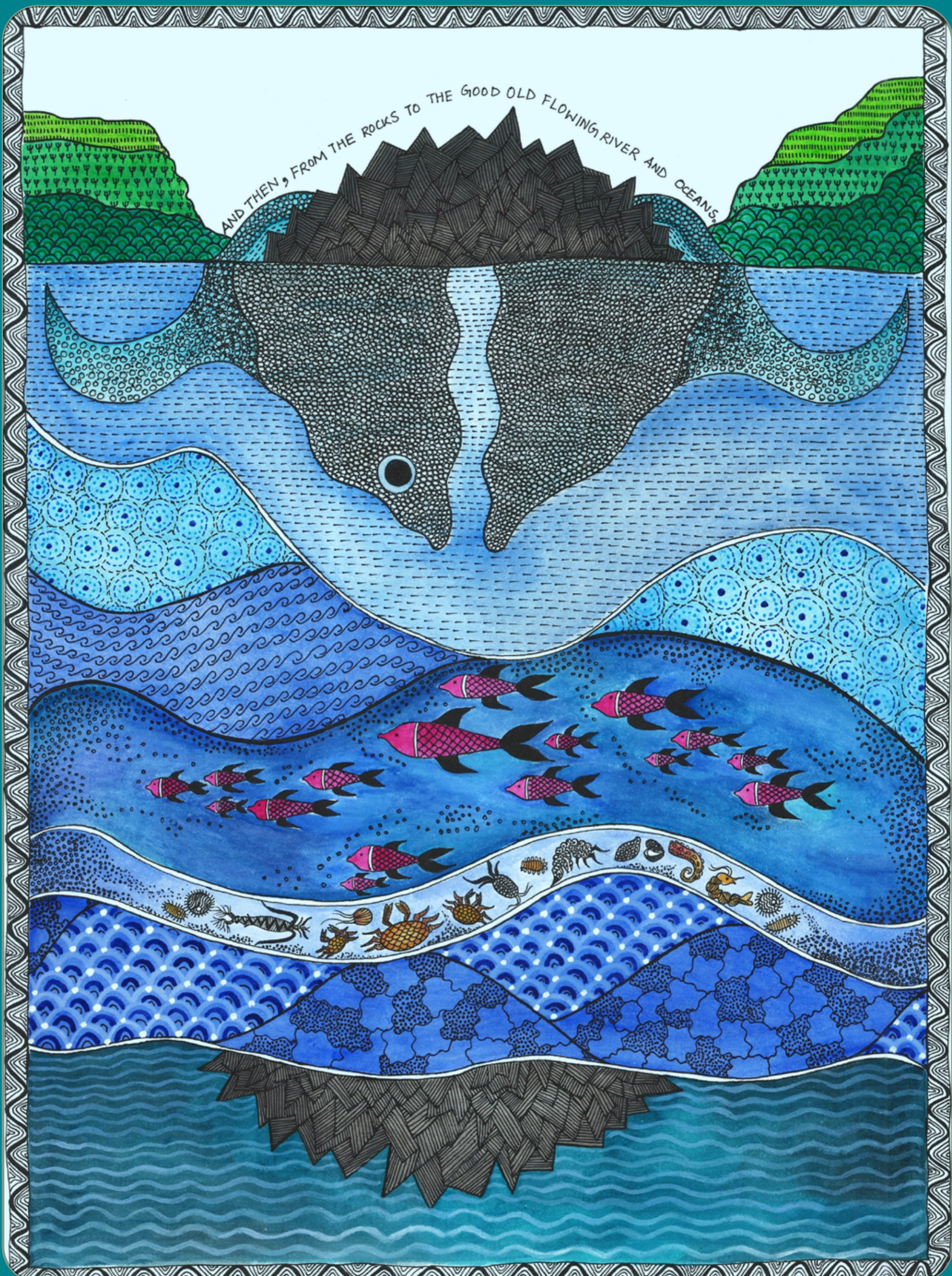
So, my gaseous *avatar* actually sustains life on Earth. When it begins to rain, the raindrops absorb the Carbon dioxide in the air and turn these slightly acidic. The rains bring me down to the rocks. The slightly acidic rain slowly weathers the rocks. Chemicals are released. The rivers wash down these chemicals into the ocean.



The ocean is a fascinating place—heaving, seething, full of life and energy. The ocean water absorbs me from the atmosphere and turns acidic. The chemicals, especially calcium, brought down from the rocks by the rivers, react with the mildly acidic ocean water and form new chemicals.

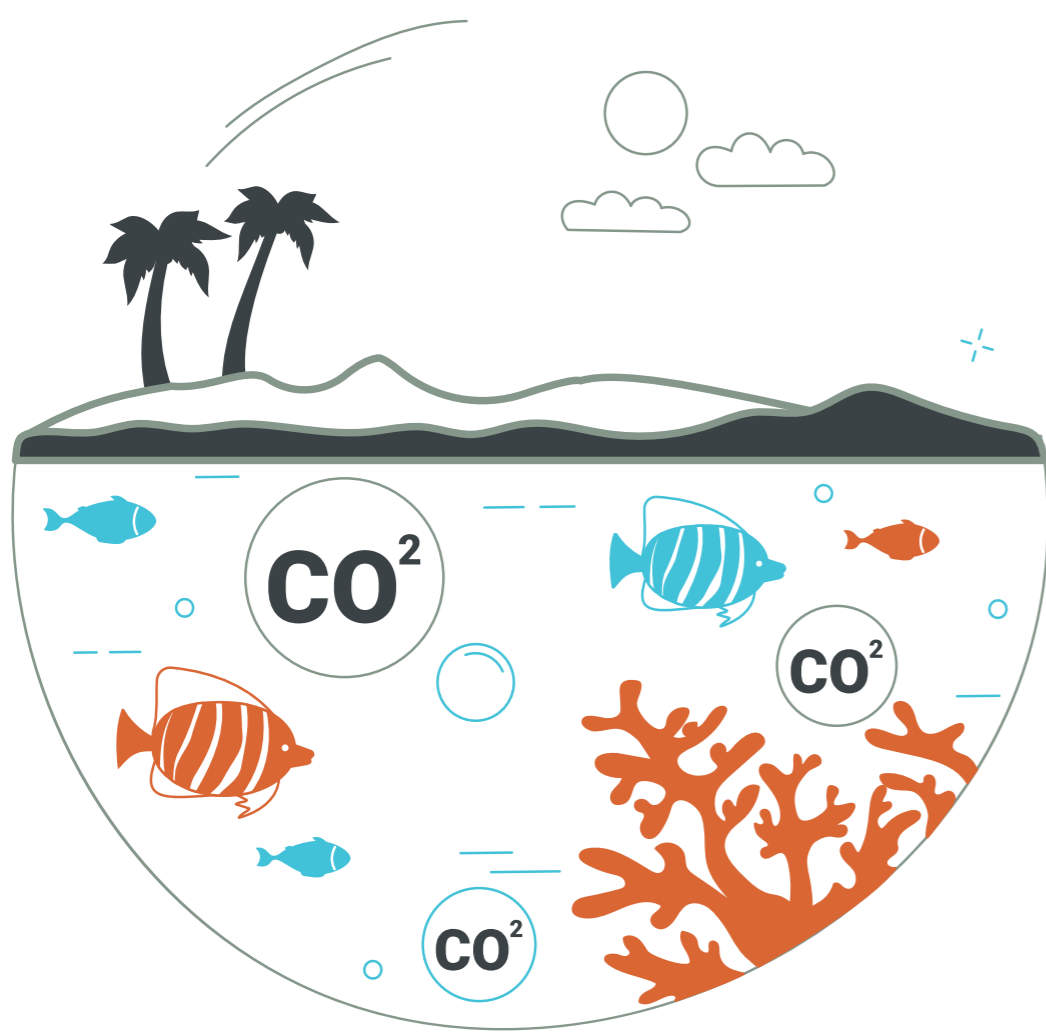
In the ocean, I find a new home in the shells of oysters and lobsters, in coral reefs and in the bodies of plankton. When the animals die, I sink to the ocean floor. Sediments deposit on me, and in thousands of years, I turn into rock.

Someday, there might be a tsunami. The rock will shake, break up, and melt and be thrown up. There will be chemical reactions. I will again be released into the atmosphere as Carbon dioxide. The cycle will be complete in a hundred or two hundred million years. I have lived through this cycle for aeons. It is called the slow Carbon cycle.



The mighty volcanoes give out between 130 and 380 million metric tons of Carbon dioxide annually. Humans emit about 30 billion tons of Carbon dioxide in a year by burning fossil fuels. So, what if we are small! We are ahead of volcanoes by a factor of 100 to 300.

Chemistry regulates my dance between ocean, land, and atmosphere. If the Carbon dioxide increases in the atmosphere, it becomes warm. More water evaporates from the ocean, and there is more rain. More rain creates more weathering of rock. More chemicals are washed into the ocean by the rivers. Eventually, more Carbon is deposited on the ocean floor.



Carbon dioxide in the atmosphere is found in traces. Till the Middle Ages, before mankind became modern, there used to be about 300 molecules of Carbon dioxide to a million molecules of nitrogen, oxygen, water vapour and other gases put together. The ratio is called 300 parts per million. Then came the industrial revolution. Factories were set up for mass production of goods. And everything started changing. Today, mankind's ambition has pushed up the amount of Carbon dioxide to 412 parts per million.

Cycles Within a Cycle

Within the big and slow cycle of my movement from air to rocks to ocean, I dance in another cycle with a much faster rhythm. In this cycle, I move through life forms on Earth. I play an active role in this cycle, stretching out my four arms to form bonds with other atoms. Bonding with oxygen, nitrogen, hydrogen and sometimes with my own kind, I can form an endless variety of molecules found in all living beings.

Carbon has the capacity to form long chains and rings by strongly bonding with itself. Such Carbon chains and rings are the basis of living cells. DNA, that holds the secret code of life, is made of two intertwined molecules built around a Carbon chain. The bonds in the long Carbon chains contain a lot of energy. When the chains break apart, the stored energy is released. This energy makes Carbon an excellent source of fuel—wood, coal, petroleum—you name it.

Tall trees, bushy shrubs, climbers, creepers, grass and tiny phytoplankton, floating in water—they all use me to make their food. Chlorophyll, the pigment that makes them green, absorbs Carbon dioxide from the atmosphere and combines it with water in the presence of sunlight to form sugar, releasing oxygen in the process. Mankind calls this process photosynthesis.

Plants use this food to grow. Animals eat plants to get their food. Plants and plankton die and decay at the end of their life cycle. Their dead bodies are consumed by bacteria. Sometimes, when there is a forest fire, plants burn and turn into ash. In all these processes, oxygen combines with the sugar in the plant body to release Carbon dioxide and energy. I am released back into the atmosphere in my gaseous avatar. My faster cycle is complete.



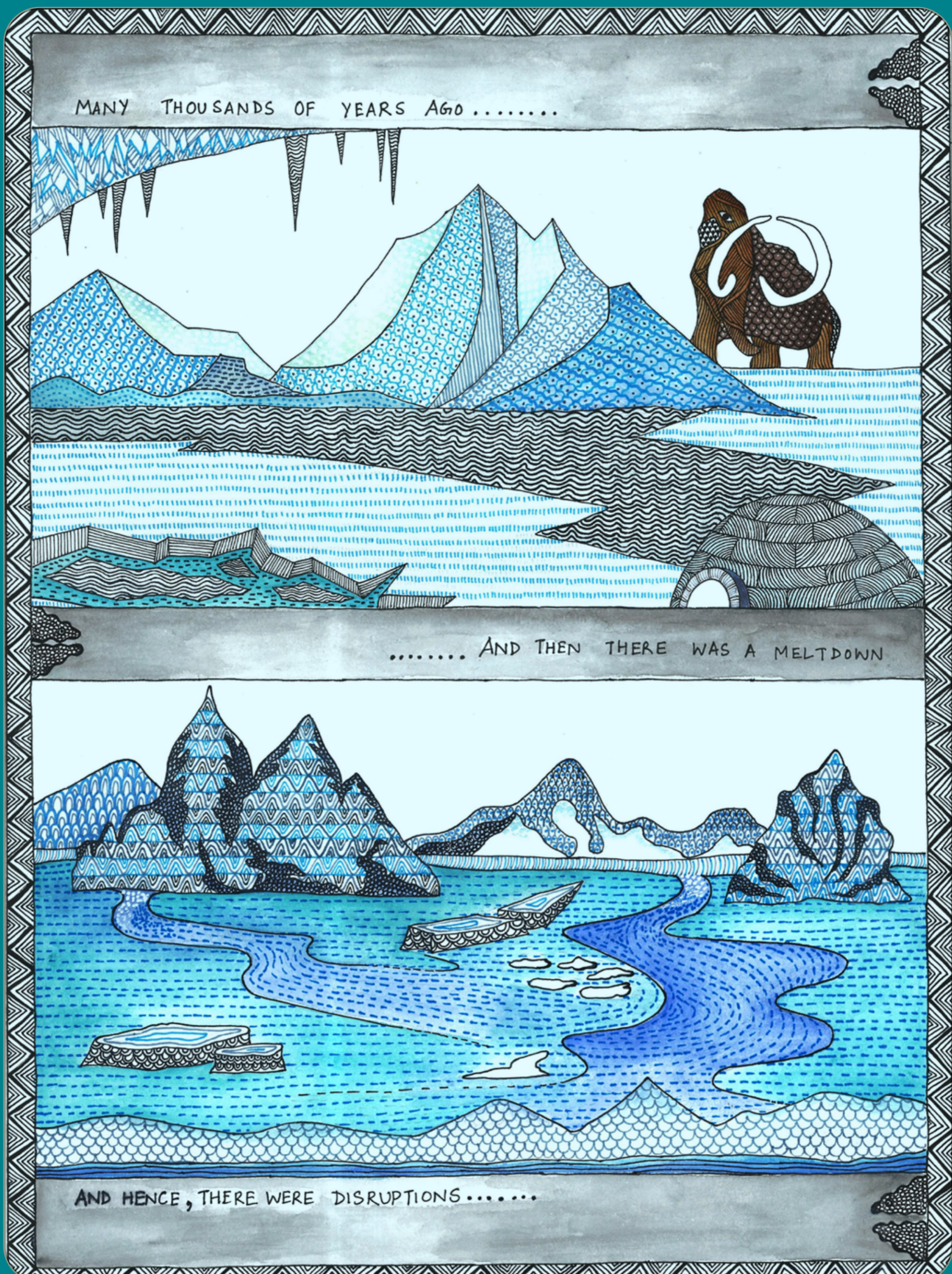
THE AMOUNT OF CARBON DIOXIDE IN THE AIR CHANGES FROM SEASON TO SEASON. IN TEMPERATE ZONES, DURING THE WINTER SEASON, WHEN MOST TREES HAVE SHED THEIR LEAVES, THE CARBON DIOXIDE LEVEL IN THE ATMOSPHERE GOES UP. IN SPRING, WHEN NEW GREEN LEAVES COME OUT, THEY OPEN OUT TO SUNLIGHT AND START PREPARING THEIR OWN FOOD. THE CARBON DIOXIDE LEVEL FALLS. IT IS AS IF THE EARTH IS BREATHING.



Disruptions in the Cycle

My slow and fast rhythmic cycles have maintained a balance of my presence in the atmosphere. Sometimes, in the past, the balance got disrupted. Many thousands of years ago, the Earth started cooling. Ice accumulated on the Earth. Rivers froze and my cycle got slower. In the cooler climate, the phytoplankton in the ocean became more active. The ocean absorbed more Carbon dioxide from the atmosphere and the climate cooled further. Ice age set in. The ice age ended when levels of Carbon dioxide in the air rose dramatically.

The ice age may come again. It happens when one of the hemispheres does not get enough sunlight. But why should it not get its quota of sunlight? Because the Earth's orbit around the Sun would have shifted ever so slightly. These shifts happen in predictable cycles. In about 30,000 years, Earth's orbit will have changed enough to reduce sunlight in the Northern Hemisphere to the levels that led to the last ice age.



Ever since mankind became civilized, he started playing havoc with my cycles. He has been pumping my gaseous avatar Carbon dioxide into the air like never before. He started cutting down trees and removing dense growth of forests to build homes, grow food and make pastures for his cows and pigs and sheep. With disappearing forests, much less Carbon dioxide was absorbed from the atmosphere. The grasslands and agricultural crops can never match up to the tall trees with big canopies in their use of Carbon dioxide. The exposed soil too, started giving out Carbon dioxide from its decayed matter.

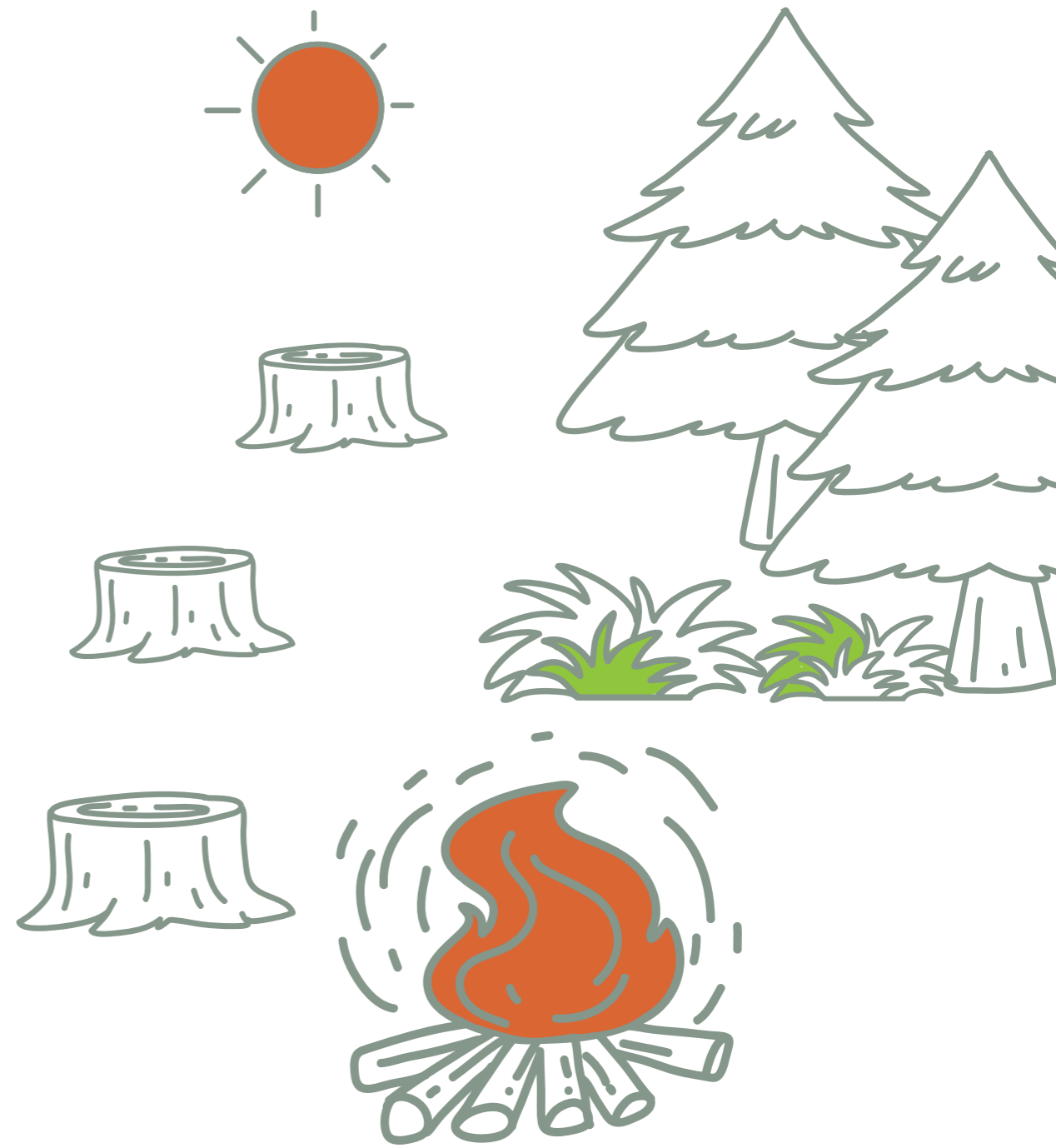
Forests are disappearing. Cities are expanding and multiplying. Jungles are being displaced by concrete. Changes in land use are leading to the emission of just under a billion tons of Carbon into the atmosphere every year!!!



Disruptive Human Activity

Thousands of years ago, mankind also discovered the use of fire to cook with. Very early on, humans developed a taste for roasted meat. After a long day of hunting, they lit a bonfire in the evening and gathered around it to feast on the day's hunt. The burning wood to make the fire directly contributed to the Carbon dioxide in the atmosphere.

And then came the day when I was awakened from my deep underground slumber. Mankind had found something new to burn, something that would yield much more heat than wood.



For aeons, I had been lying in the bowels of the Earth, sometimes comfortable in the dark warmth and sometimes dreaming of life up there—the birds, the bees, the bright sunlight; my rhythmic cycle of moving in and out of the air. For many ages, I had been left out of that hectic activity.

Many, many years ago, I cannot recall exactly how many million years ago, there were dense forests in swampy lands. The forests got destroyed in terrible natural disasters—floods, tsunamis—you name it. The huge trees fell and were covered with mud. Slowly the trees sank underground. The heat and pressure converted the rotting wood into coal. And here I was—dense, black, in my nearly pure form; trapped deep underground for ages and ages...till one-day, mankind stumbled upon me by accident.

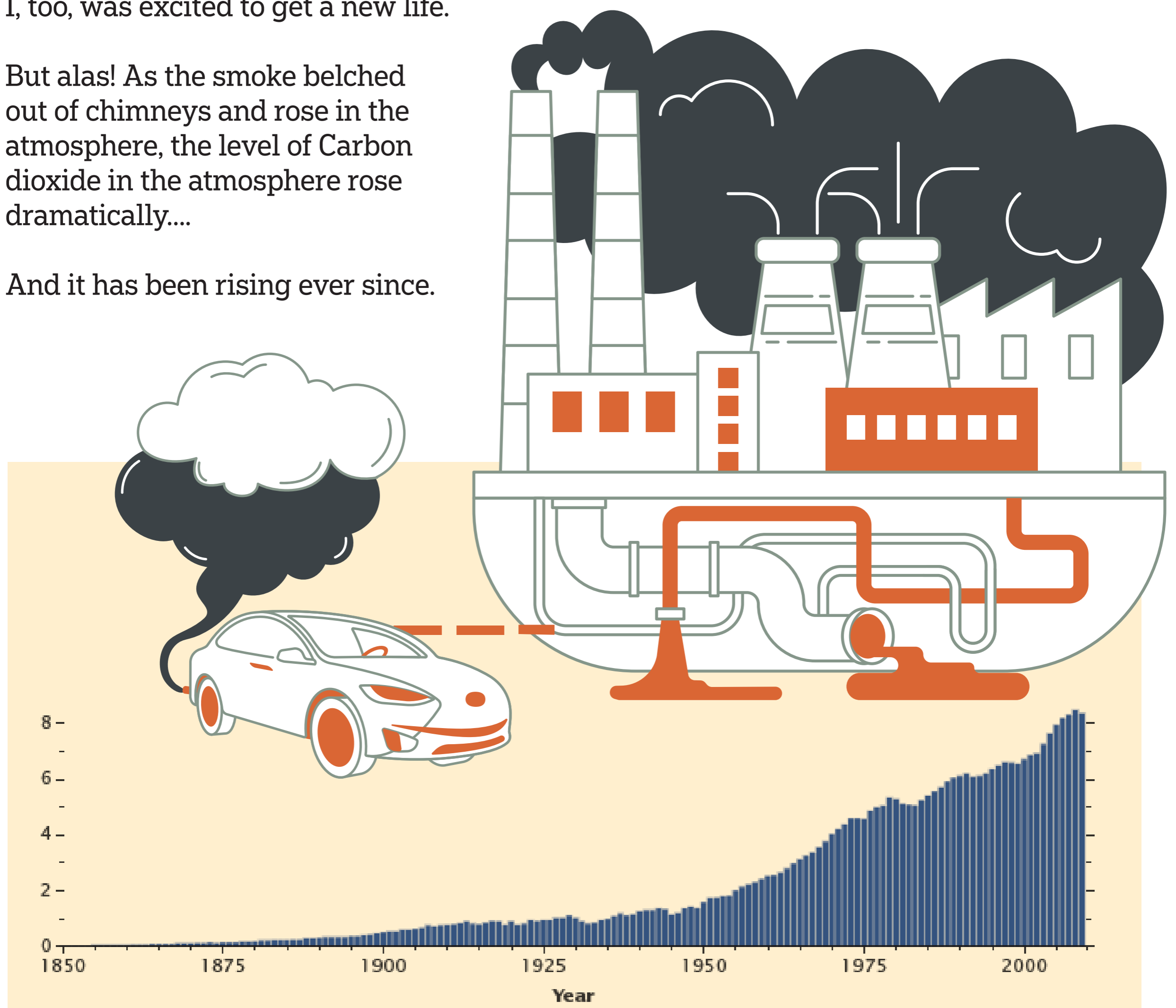
They started digging. Men wearing lights on their heads came down to liberate me. They took me up in shafts. I would be the fuel in their factories and steam engines. I, too, was excited to get a new life.

But alas! As the smoke belched out of chimneys and rose in the atmosphere, the level of Carbon dioxide in the atmosphere rose dramatically...

And it has been rising ever since.

By digging into fossil fuel, mankind has messed up the slow Carbon cycle. If we had left the underground Carbon in deep slumber, then the Carbon in fuels would leak slowly into the atmosphere through volcanic activity over millions of years. By burning coal, oil, and natural gas, we accelerate the process, releasing vast amounts of Carbon that took millions of years to accumulate, into the atmosphere.

By doing so, we move the Carbon from the slow cycle to the fast cycle. In 2009, humans released about 8.4 billion tons of Carbon into the atmosphere by burning fossil fuel.



GLOBAL CARBON DIOXIDE EMISSIONS (gigatons of Carbon per year)

Changing Climate

Trees and the ocean could not cope with the rising level of Carbon dioxide.

The temperature of the Earth began to rise gradually. Excessive Carbon in the atmosphere began to have its rippling effect on land, in the sea, and in the air.

My gaseous *avatar* causes one-fifth of the Earth's greenhouse effect. Water vapour causes half of the total greenhouse effect. But water vapour can condense and fall back on Earth as rain or snow. Carbon dioxide remains a gas. It absorbs the heat radiating from the Earth's surface. By re-radiating some of this heat, it warms the Earth. Warmer Earth would mean greater evaporation of water. Increased amount of water vapour would mean a warmer Earth. So eventually, I—Carbon—hold the key to the temperature of the Earth.

About one-third of the Carbon dioxide that people have put into the atmosphere has diffused into the ocean through direct chemical exchange. Dissolving Carbon dioxide in the ocean increases the acidity of the water. Ocean acidification affects marine life. There is less calcification. The shells of oysters and corals become thinner and more fragile.

When the ocean becomes warmer, the abundance of tiny phytoplankton decreases because these tiny creatures prefer cool, nutrient-rich water. Reduced phytoplankton activity would limit the ocean's ability to take Carbon from the atmosphere through the fast Carbon cycle.

What happens to land plants with a profusion of Carbon dioxide in the air? They should grow more food for themselves and grow up faster—but only if there is enough water and other nutrients to match the increased share of Carbon dioxide.

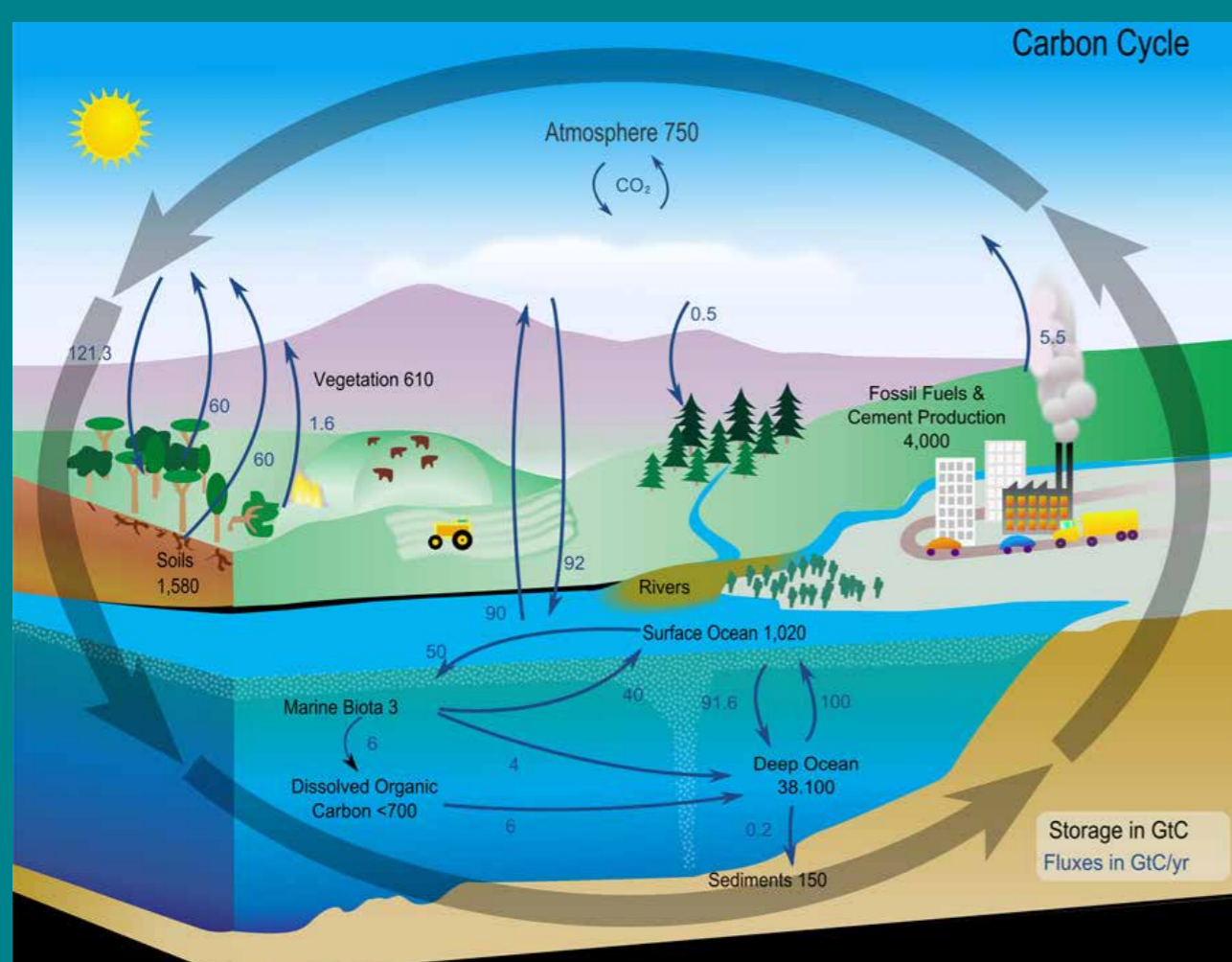
Increased Carbon dioxide makes it hot and humid. It is ideal for plant growth. However, with a longer, warmer growing season, plants need more water to survive.

The warming caused by rising greenhouse gases may also 'bake' the soil. The soil cracks up. In colder climates, the frost covering the soil melts. The soil is exposed. The Carbon trapped in the soil seeps out in the air.

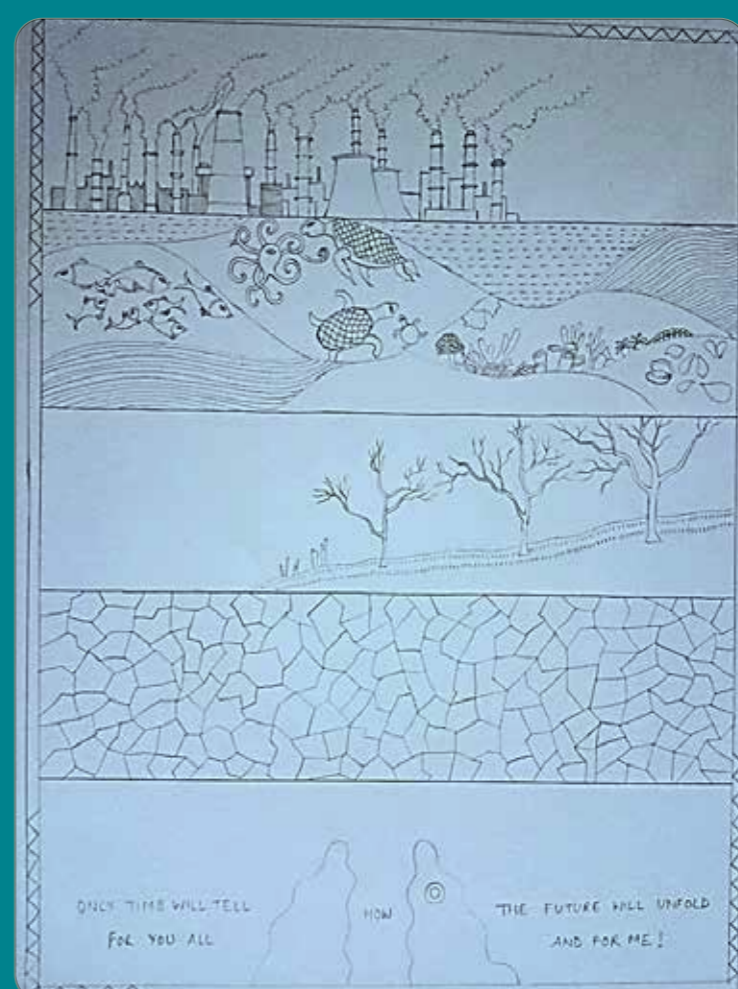
Only time will tell how my increased presence in the atmosphere will affect life on Earth.

For us, the Carbon cycle is the food we eat, the electricity in our homes, the petrol in our cars and the weather over our heads. We are a part of the Carbon cycle, and so our lifestyle ripples across the cycle. Likewise, changes in the Carbon cycle will impact the way we live. As we come to understand our role in the Carbon cycle, we can control our personal impact on the cycle and lead a more responsible life.

Reference earthobservatory.nasa.gov/features/carboncycle



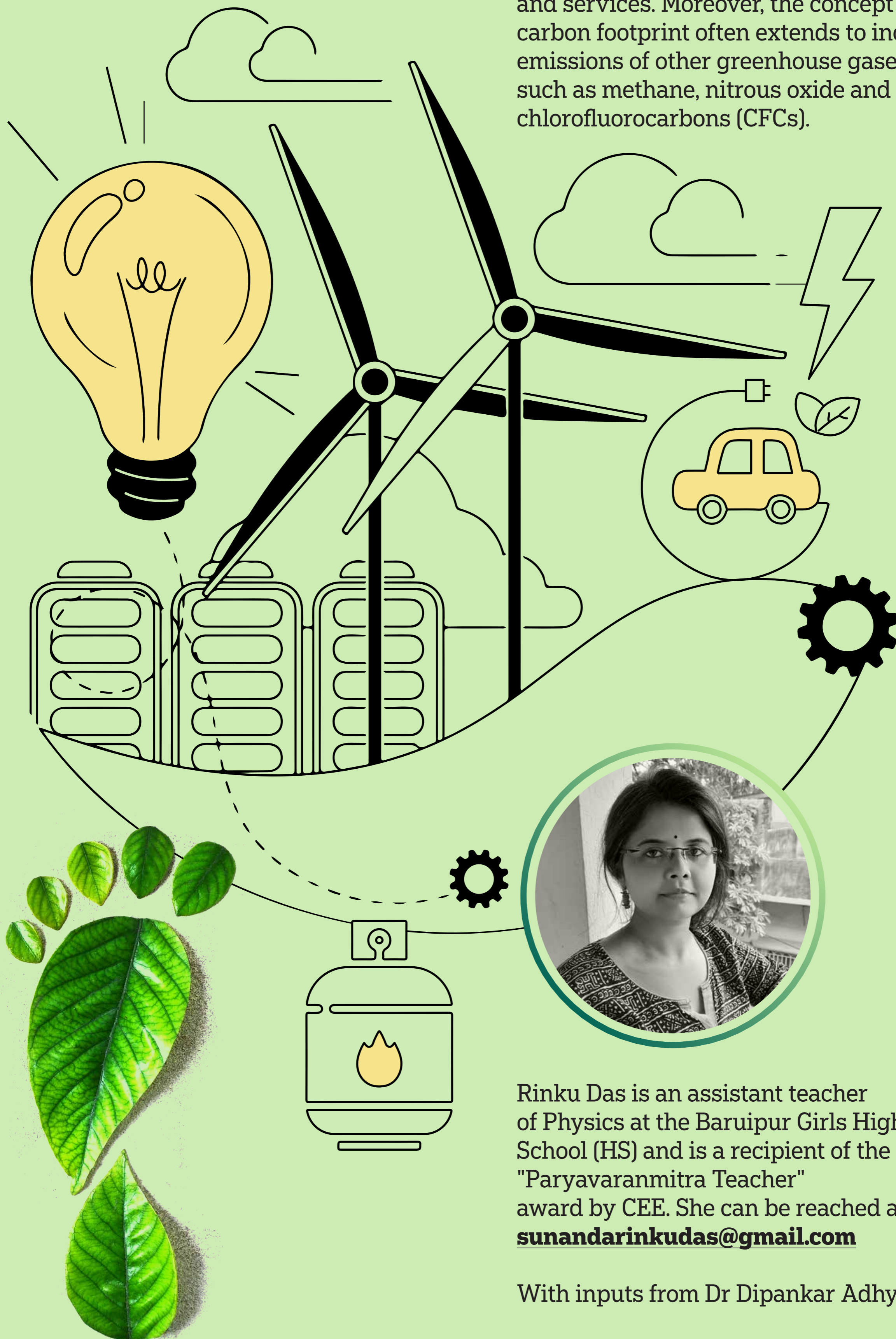
CARBON CYCLE DIAGRAM FROM NASA, CENTER FOR SCIENCE EDUCATION



03 | How to measure Carbon Footprints?

What is a Carbon Footprint?

The carbon footprint refers to the measurement of Carbon dioxide (CO₂) emissions associated with the actions of individuals or entities, such as buildings, corporations or countries. It encompasses both direct emissions, which arise from activities such as fossil fuel combustion in manufacturing, heating and transportation, and indirect emissions produced during the generation of electricity used for goods and services. Moreover, the concept of a carbon footprint often extends to include emissions of other greenhouse gases such as methane, nitrous oxide and chlorofluorocarbons (CFCs).



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With inputs from Dr Dipankar Adhya

In our daily lives, we engage in various activities. We use electricity for lighting, cooling and heating. We burn fossil fuel for transportation – to take us/goods from one place to another. We use coal, kerosene and LPG for cooking etc. Each of these activities contributes to the generation of CO₂. We can thus calculate the carbon footprint associated with each specific activity.

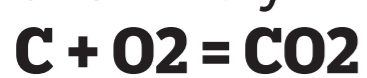


Here are two case studies from our everyday life:-

A

Electricity consumption at home

In India, the major portion of electricity is generated by burning coal. We know the following reaction from studying chemistry

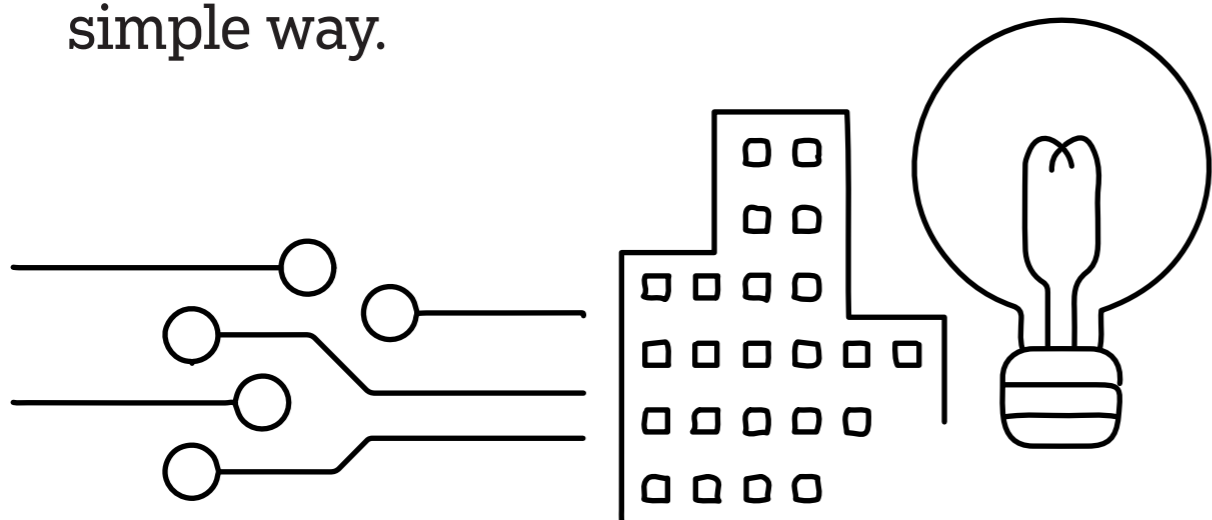


12 g of C on heating produces 44 g of CO₂.

‘Coal mostly consists of carbon but it may have different other elements also. There are different types of coal which contain different percentages of carbon. For example, bituminous coal 84.4% carbon, 5.4% hydrogen, 6.7% oxygen, 1.7% nitrogen, and 1.8% sulphur, on a weight basis.

Beside that, when a particular type of coal is burnt, the energy produced is dependent on the efficiency factor of the burning engine. The efficiency factor also varies from one country to another.

That's why it is really difficult to calculate the amount of carbon di-oxide produced when one unit of electricity is produced in a simple way.

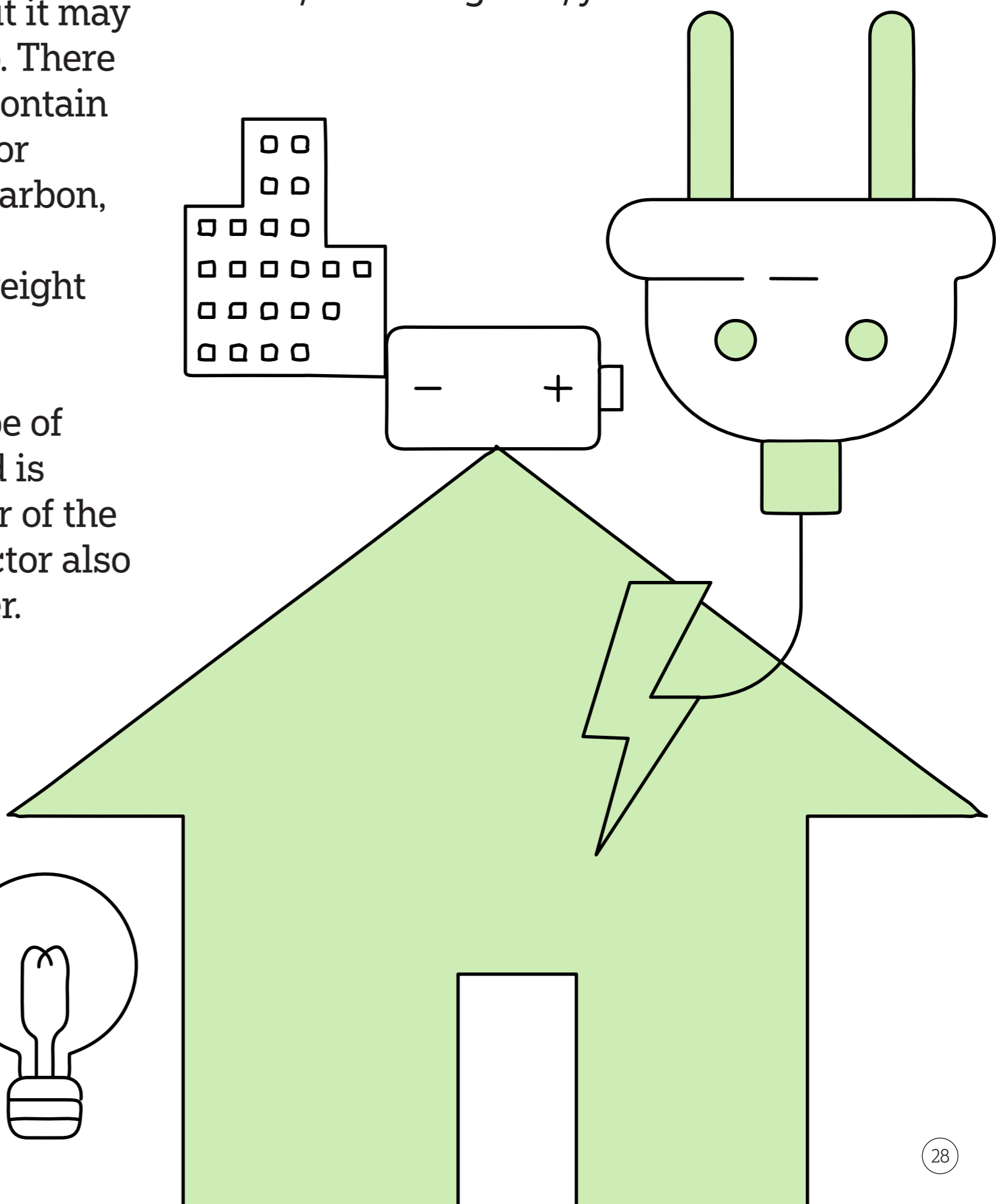


So we will use the following data mentioned in the website of the Ministry of Environment, Forest & Climate Change for our convenience.’

***Emission factor for electricity generation = 0.82 kg CO₂/kWh**
(Average emission of all stations in the grid weighted from net generation)

So, we will assume this CO₂ emission factor for producing 1 unit (kWh) of electricity by burning coal. The calculation can be done in the following steps -

1. Find your monthly electricity consumption in units of kWh from your electricity bill. From this, find the total annual consumption of electricity. Either you add up all the 12 monthly consumptions or you find an average monthly consumption and multiply by 12. Suppose the annual consumption is 360 units.
2. Multiply the number of units by 0.82 to get the amount of CO₂ in kg. It will be $360 \times 0.82 = 295.2 \text{ kg CO}_2/\text{year}$
3. Suppose there are 4 members in your family. The carbon footprint for each member of the family will be $295.2 \text{ kg CO}_2 / 4 = 73.8 \text{ kg CO}_2/\text{year}$.



B

For cooking using Liquid Petroleum Gas (LPG)

Generally, the capacity of an LPG cylinder is 14 kg. So, if we can count the number of LPG cylinders required in one year for a family, then we can calculate the carbon footprint for cooking with LPG.

1. Count the numbers of LPG cylinders used in one year. Suppose one family needs 12 cylinders in a year.

2. Now assume,

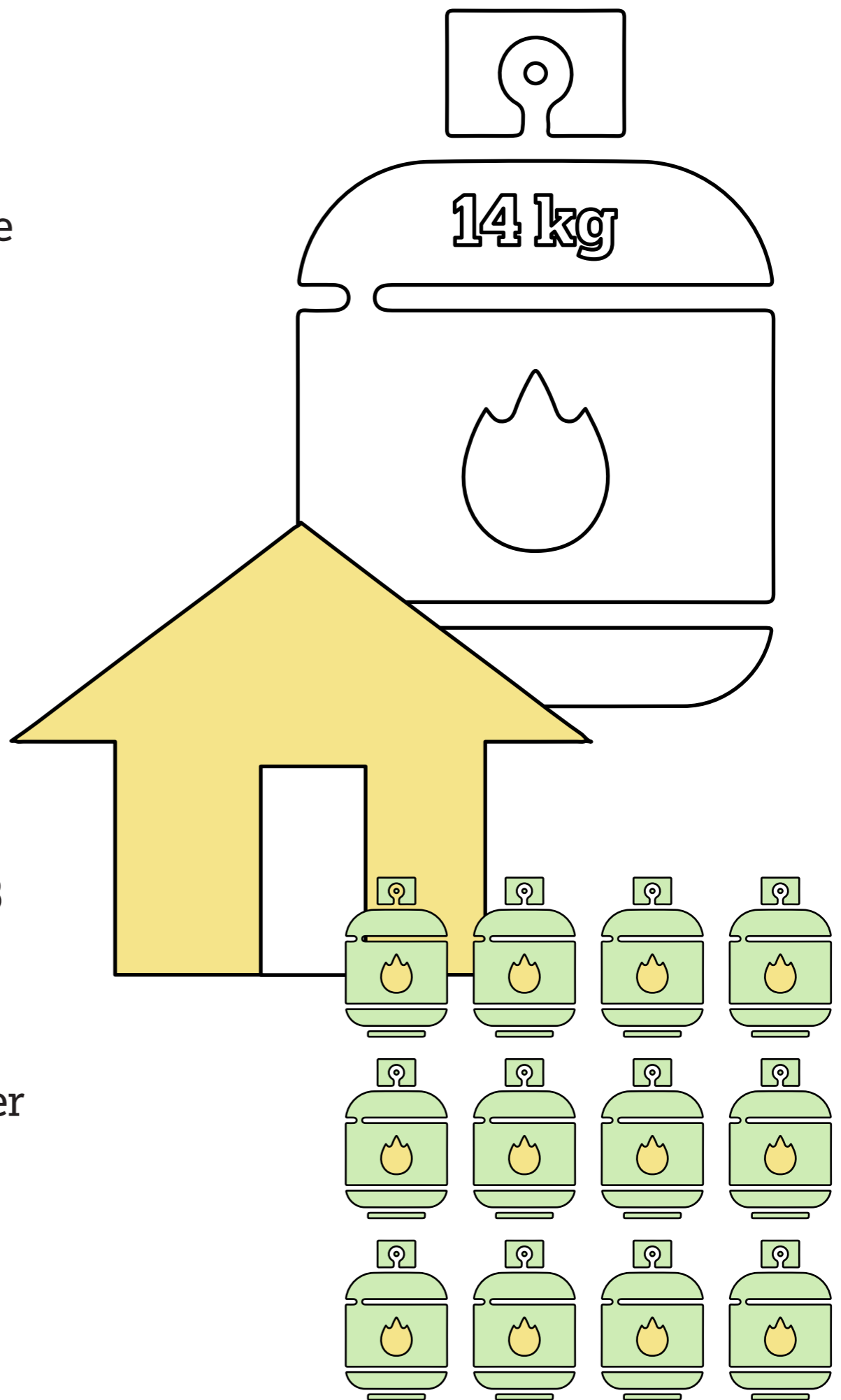
*EMISSION factor for LPG = 3.13 kg CO₂/Kg of LPG

So, this family produces 12 (cylinders) x 14 (weight of LPG in each cylinder) x 3.13 (Emission factor) = 525.84 kKg of CO₂/year.

3. Now divide this amount by the number of family members to get the annual carbon footprint for cooking.

Suppose the family has 4 members.

Then for each member, the carbon footprint will be $525.84 \text{ kg}/4 = 131.46 \text{ kg}$ of CO₂/year.



* The data has been taken from the publication "Low Carbon Lifestyle" published by in the Ministry of Environment, Forest & Climate Change <https://moef.gov.in/en>



Travelling and Transportation

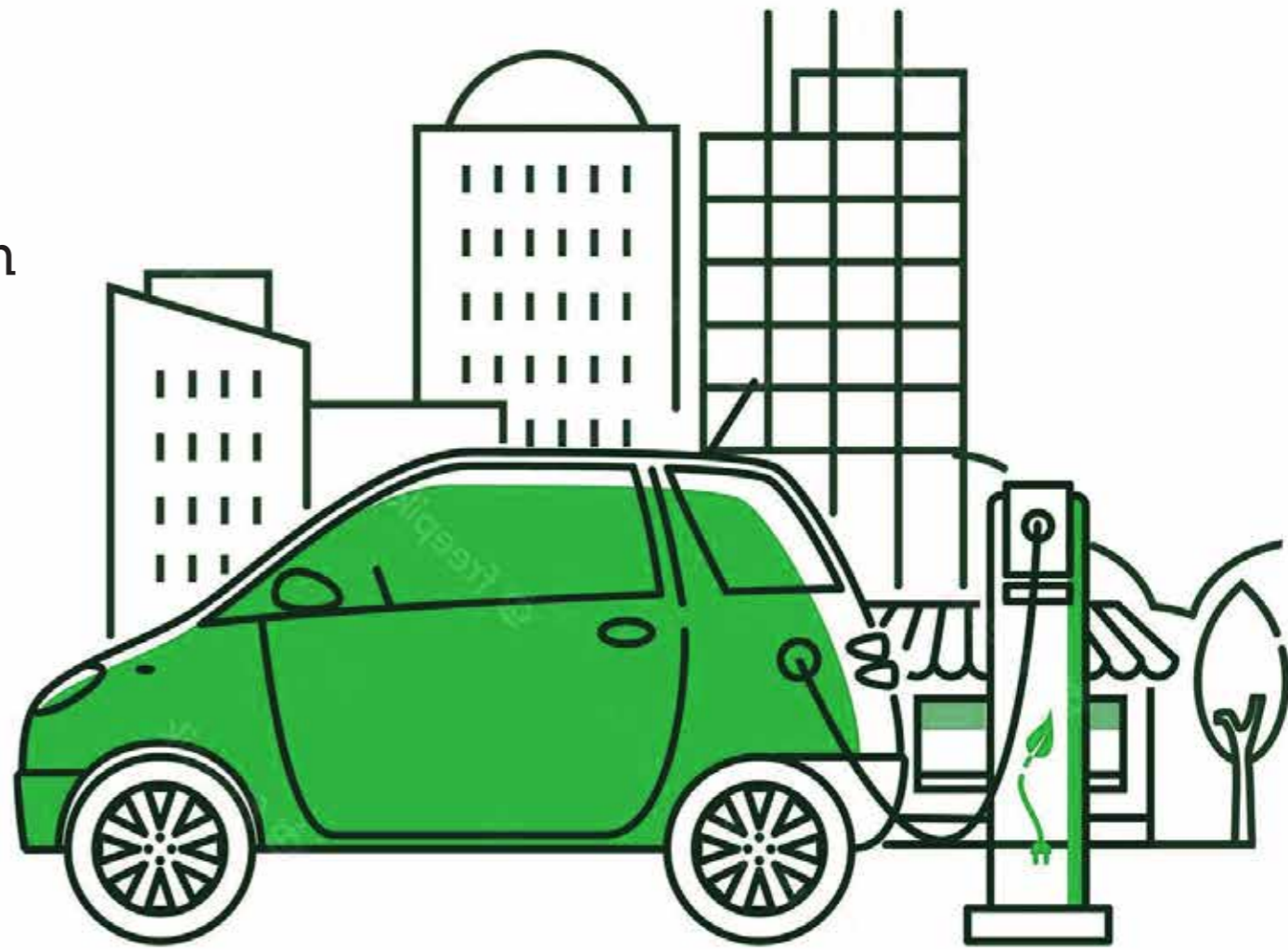
We can also calculate the carbon footprint of vehicles such as cars, trucks, buses, trains, and aeroplanes that run on fossil fuels. Each type of fuel, such as petrol, diesel, unleaded petrol, and jet fuel has its efficiency in burning and releasing Carbon dioxide.

By knowing the fuel type and how much the vehicle can travel on a certain amount of fuel (ie its mileage) we can figure out the carbon footprint of the vehicle.

For example, if you go on a long drive in a Maruti car and know the emission efficiency of the fuel used and the distance you travelled, you can calculate exactly how much Carbon dioxide you produce during your trip. This helps us understand the impact of our journeys on the environment.

Helpful websites and apps

There are several apps and websites that can help you calculate your carbon footprint once you enter the necessary data. These make it easier for you to do so.



TOTAL FAMILY MEMBERS INCLUDING YOURSELF: <input type="text"/>			
ACTIVITY / FUEL USE	QUANTITY	CO2 (KG)	NOTES
Transportation			
Petrol (litres)	<input type="text"/>	<input type="text"/>	Fuel in litres as used in personal vehicle. In case of car pool, divide total fuel volume by total number of people. All people in the car pool need to account for the divided fuel volume.
Diesel fuel (litres)	<input type="text"/>	<input type="text"/>	
Auto LPG (kg)	<input type="text"/>	<input type="text"/>	If you use a car that uses LPG as the fuel.
Taxis (km)	<input type="text"/>	<input type="text"/>	For these modes of Public Transport, fill in approximate distance used.
Local bus (BEST / Company Bus) (km)	<input type="text"/>	<input type="text"/>	
Autorickshaw (km)	<input type="text"/>	<input type="text"/>	
Local train (km)	<input type="text"/>	<input type="text"/>	
Domestic Use			
Number of LPG Cylinders Used for cooking	<input type="text"/>	<input type="text"/>	These reflect your residential consumption. You should get these values from keeping track of the LPG cylinders and from your CNG and electric bills.
Amount of CNG used at home (m3)	<input type="text"/>	<input type="text"/>	

<https://www.tatapower.com/sustainability/sustainability-initiatives/customer/calculate-carbon-footprints.aspx>



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Rotary **ESRAG Oceania** ENVIRONMENTAL SUSTAINABILITY ROTARY ACTION GROUP AUSTRALIA NEW ZEALAND PACIFIC ISLANDS

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LEARN MORE ▾

Average return distance travelled to and from venue by car (Petrol/diesel/hybrid/electric or taxi) - exclude passengers in cars *(Required)*

Average return distance travelled to and from venue by those attending by train, tram or bus *(Required)*

Number of people Walking, Cycling or travelling as passengers in cars

Number of people driving a car - Petrol / Diesel based or attending via taxi

Number of people driving a car - Hybrid

Number of people driving a car - Electric

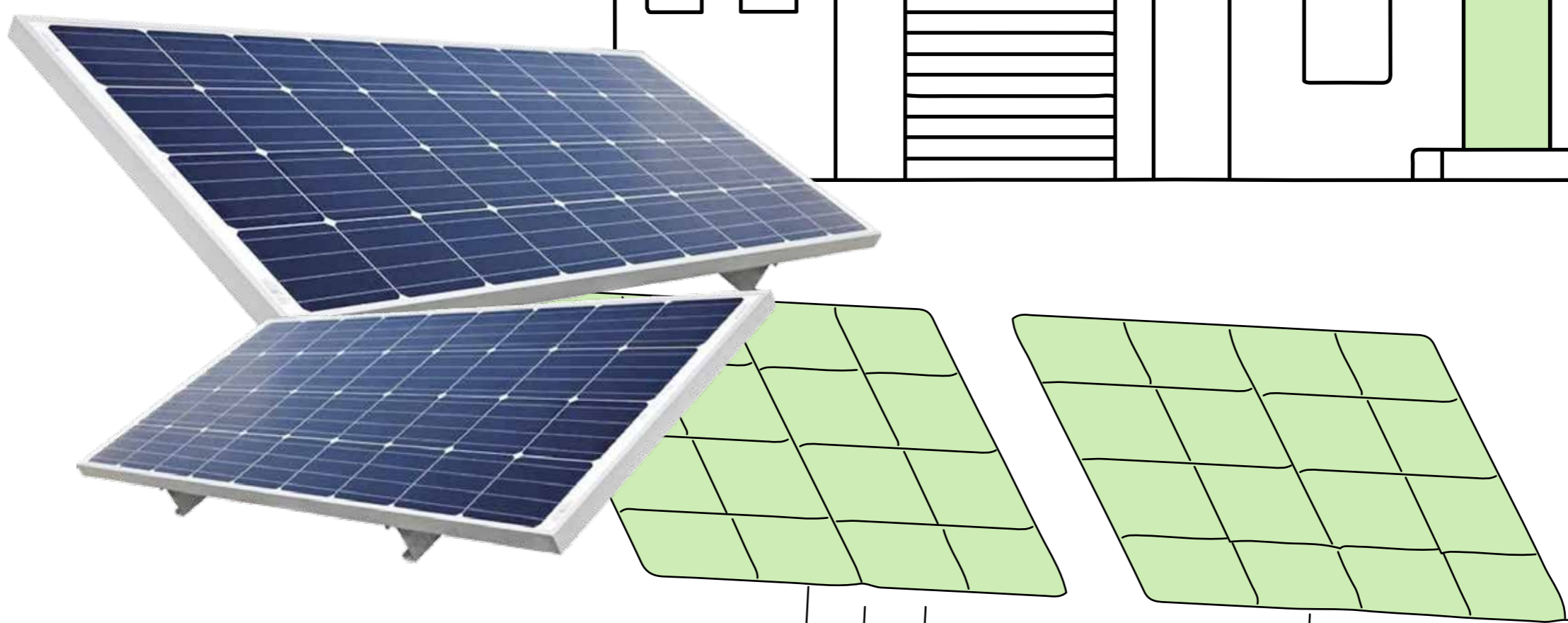
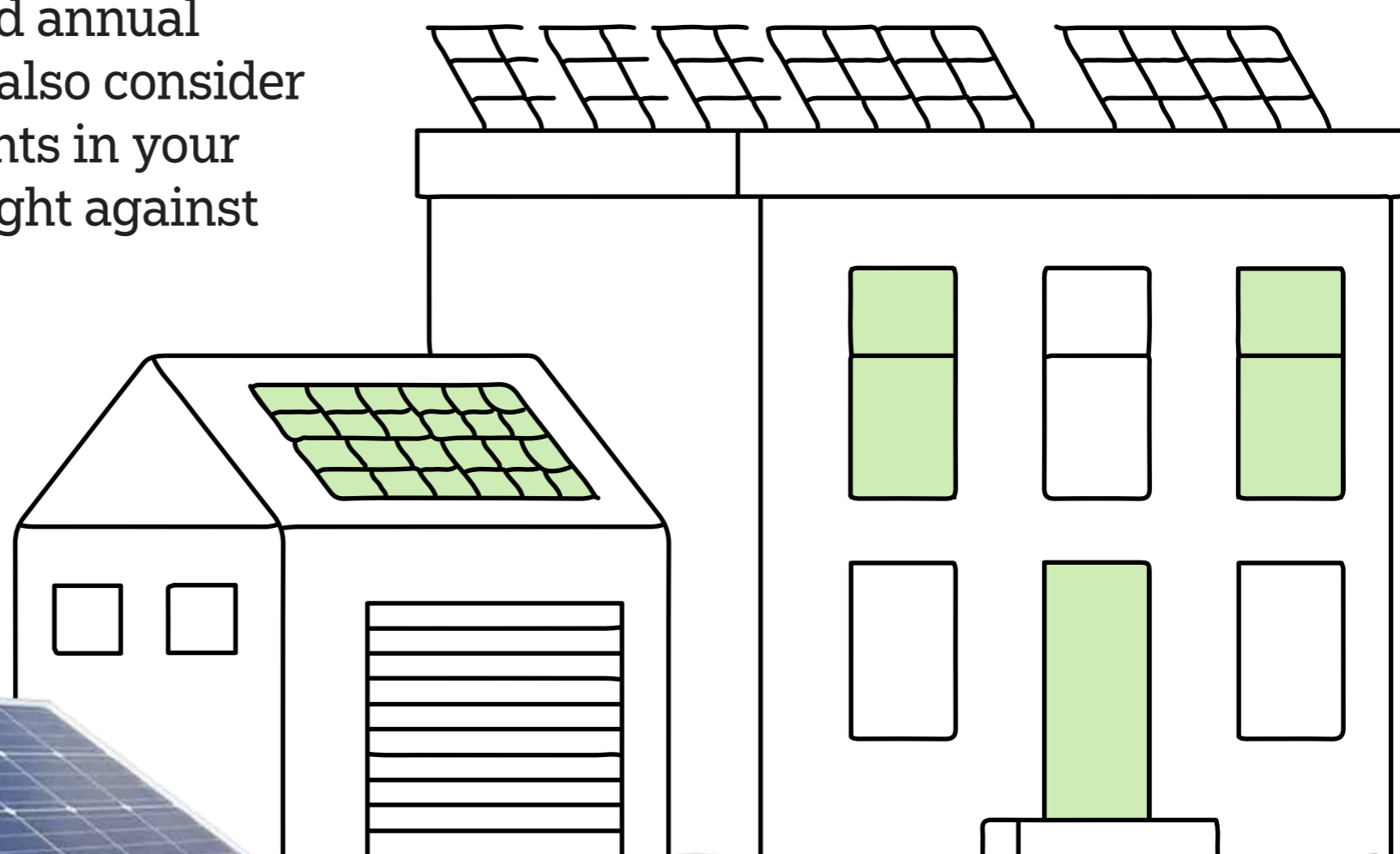
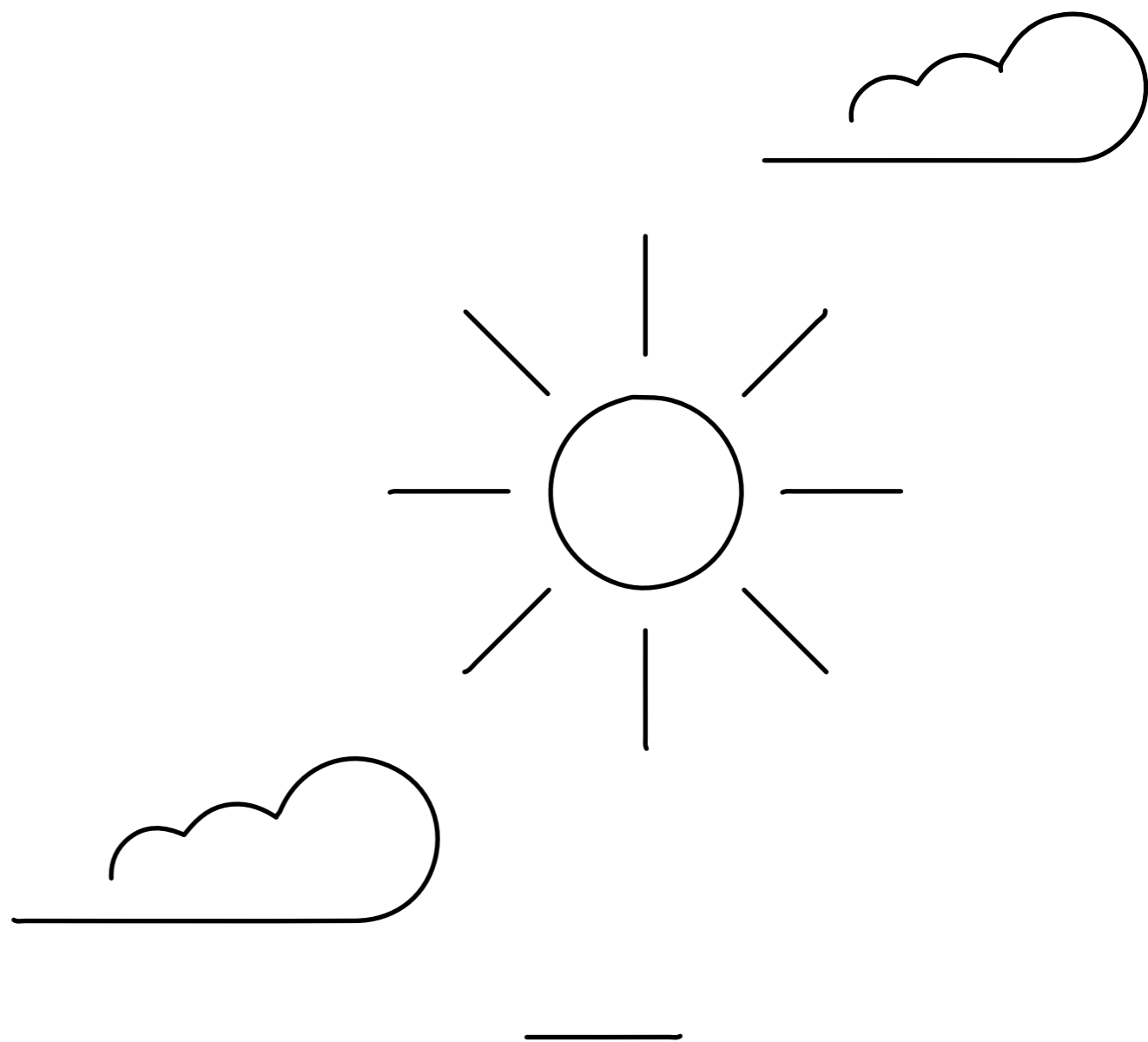
Number of people travelling by Train

Number of people travelling by Tram

<https://esragoceania.org/rotary-club-event-carbon-estimator/>

Author's Note

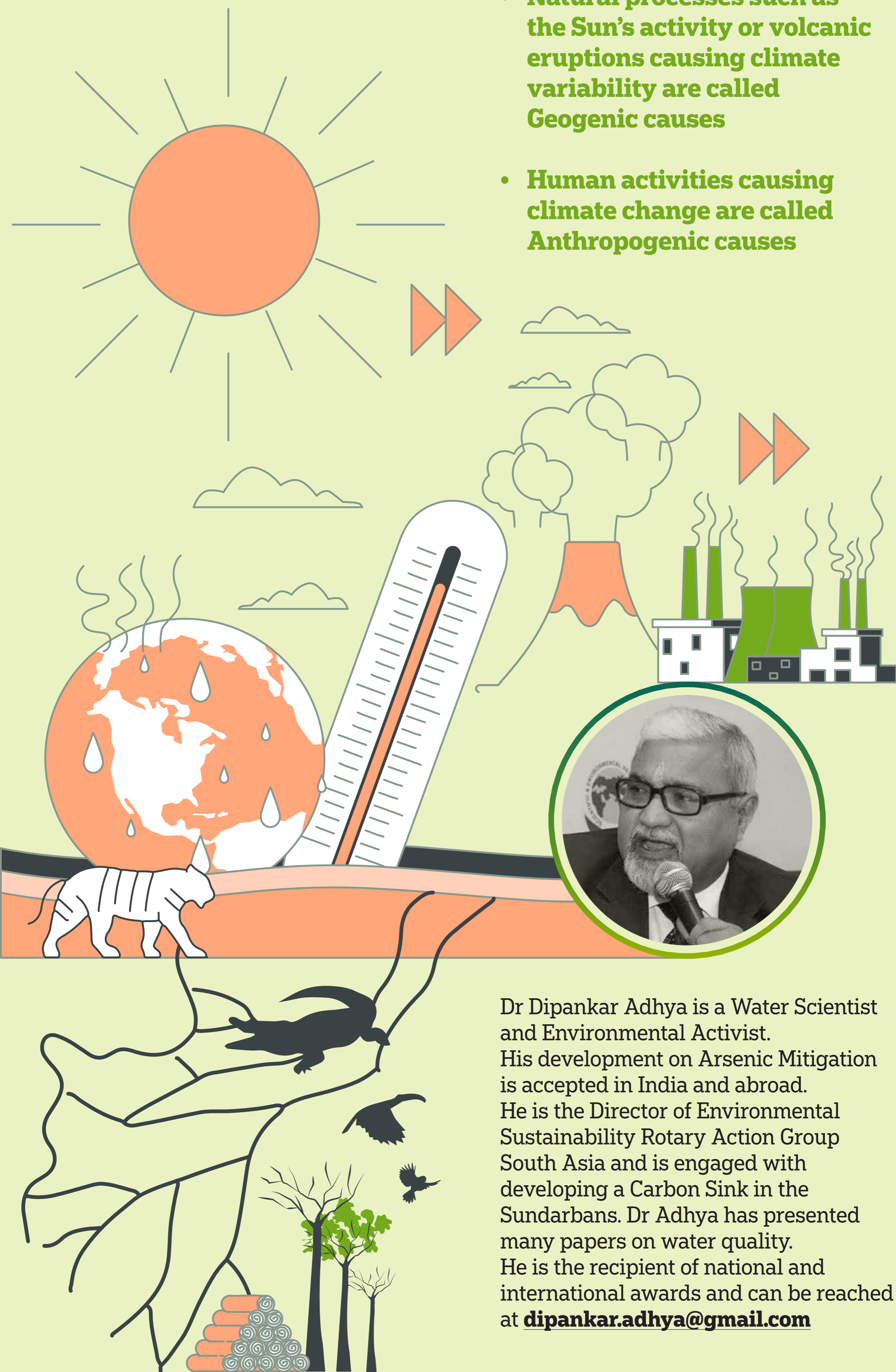
On 5th June 2023, our house began generating electricity with a 2 KW Solar Panel. This arrangement is commonly referred to as an "Elevated Rooftop On-Grid Solar Power Plant." To ensure safety, we have installed a lightning protection system and implemented three types of earthing in accordance with the rules. Many people think it is expensive! But if you opt for an ON-GRID MODEL, then the cost will be significantly reduced, and once net metering is initiated, your electricity bill will be almost zero. As a result, we expect significant reductions in our monthly electricity bills and annual carbon emissions. You can also consider making similar arrangements in your home to contribute to the fight against Climate Change.



04 | Ways to combat Climate Change

Global climate change is identifiable change in the climate of Earth that lasts for an extended period of time (decades or longer).

- **Natural processes such as the Sun's activity or volcanic eruptions causing climate variability are called Geogenic causes**
- **Human activities causing climate change are called Anthropogenic causes**

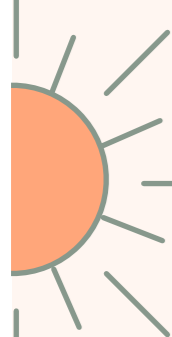


Dr Dipankar Adhya is a Water Scientist and Environmental Activist. His development on Arsenic Mitigation is accepted in India and abroad. He is the Director of Environmental Sustainability Rotary Action Group South Asia and is engaged with developing a Carbon Sink in the Sundarbans. Dr Adhya has presented many papers on water quality. He is the recipient of national and international awards and can be reached at dipankar.adhya@gmail.com

Anthropogenic causes are increasing the amount of Carbon dioxide in the Earth's atmosphere. This is increasing the greenhouse effect and making the Earth warmer.


What is the Greenhouse Effect?

Just as glass traps the heat inside a car and keeps it warm, gases such as Carbon dioxide, water vapour and methane in the Earth's atmosphere trap the heat radiating from the Sun and the radiated heat from Earth's surface as reflected back keep Earth warm. However, excessive heat can lead to all kinds of problems.



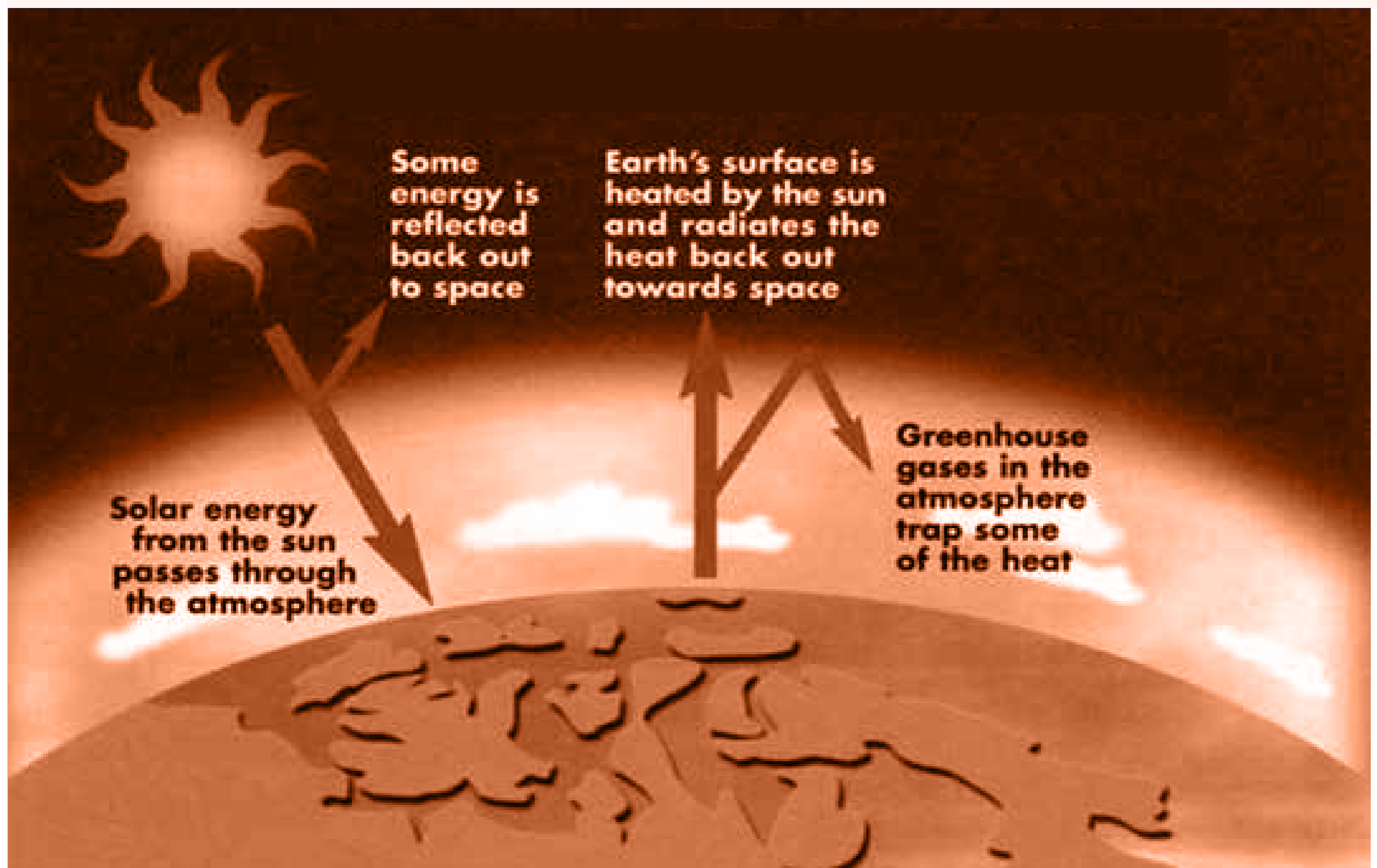
GEOGENIC CAUSES

- Volcanic eruption
- Fluctuation in solar radiation
- Tectonic shifts
- Changes in the Earth's orbit

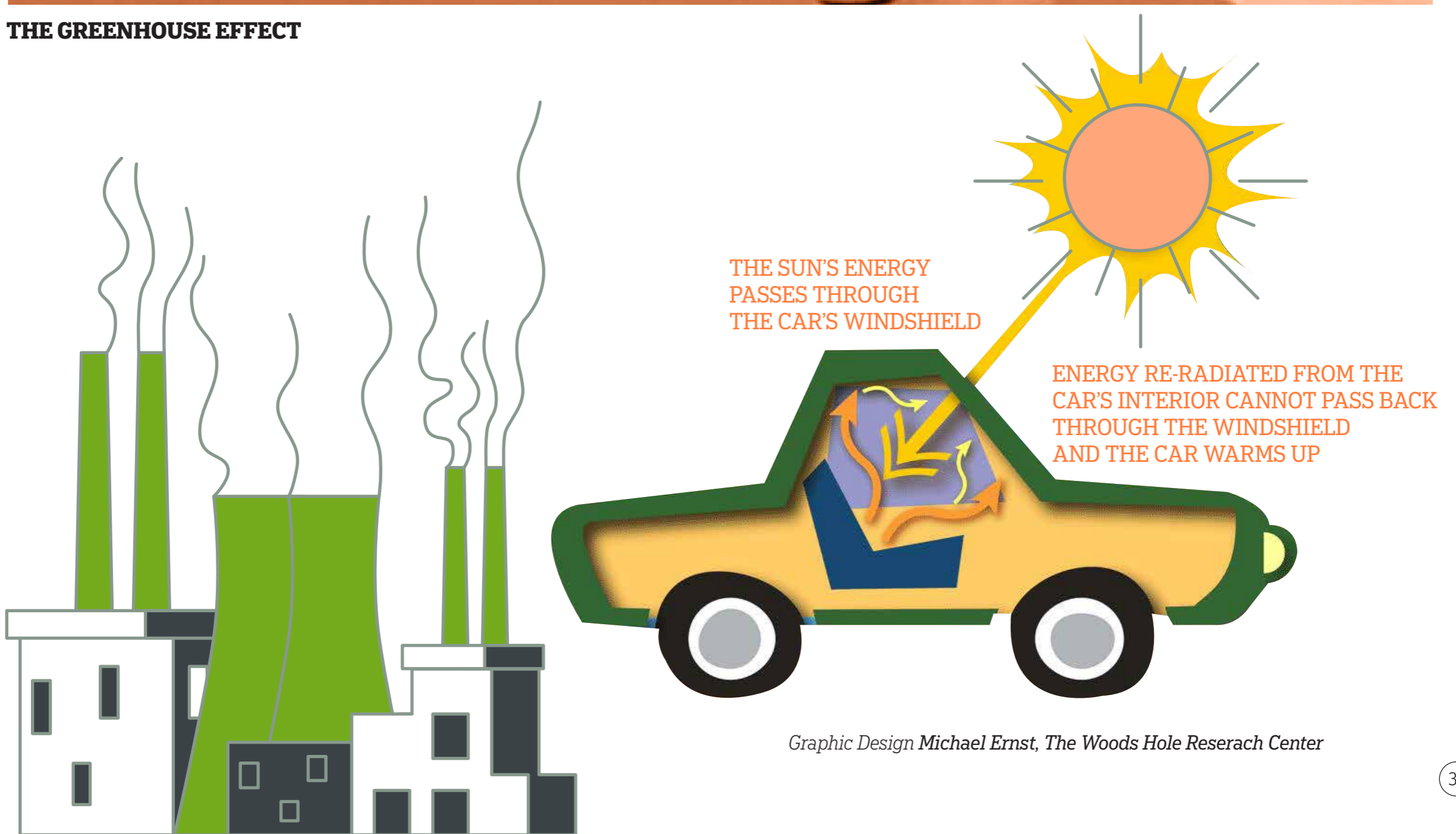


ANTHROPOGENIC CAUSES

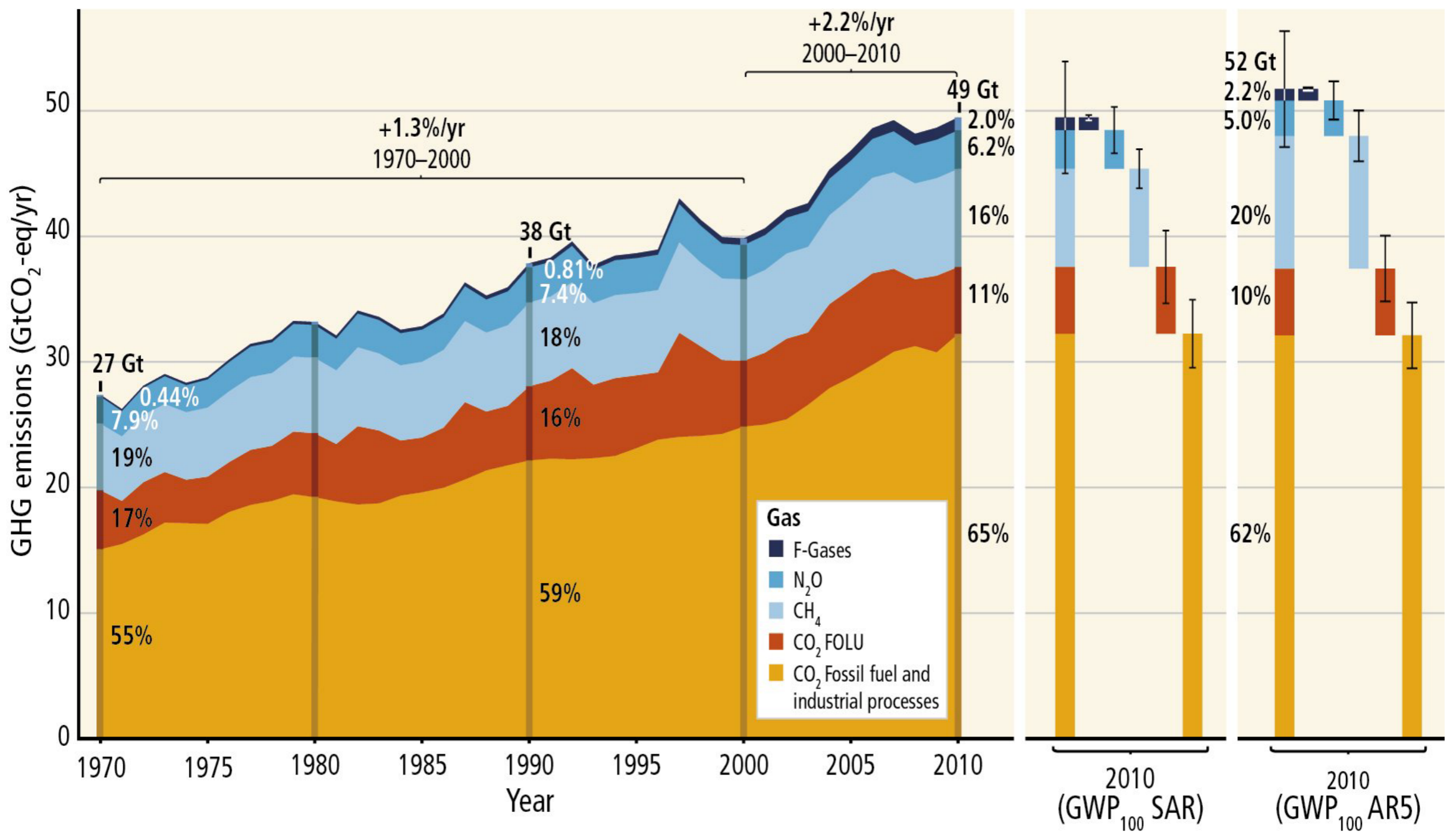
- Burning of fossil fuel
- Manufacturing goods
- Cutting down trees
- Using transportation that run on fossil fuels such as petrol/diesel
- Generation of electricity for domestic and industrial use



THE GREENHOUSE EFFECT

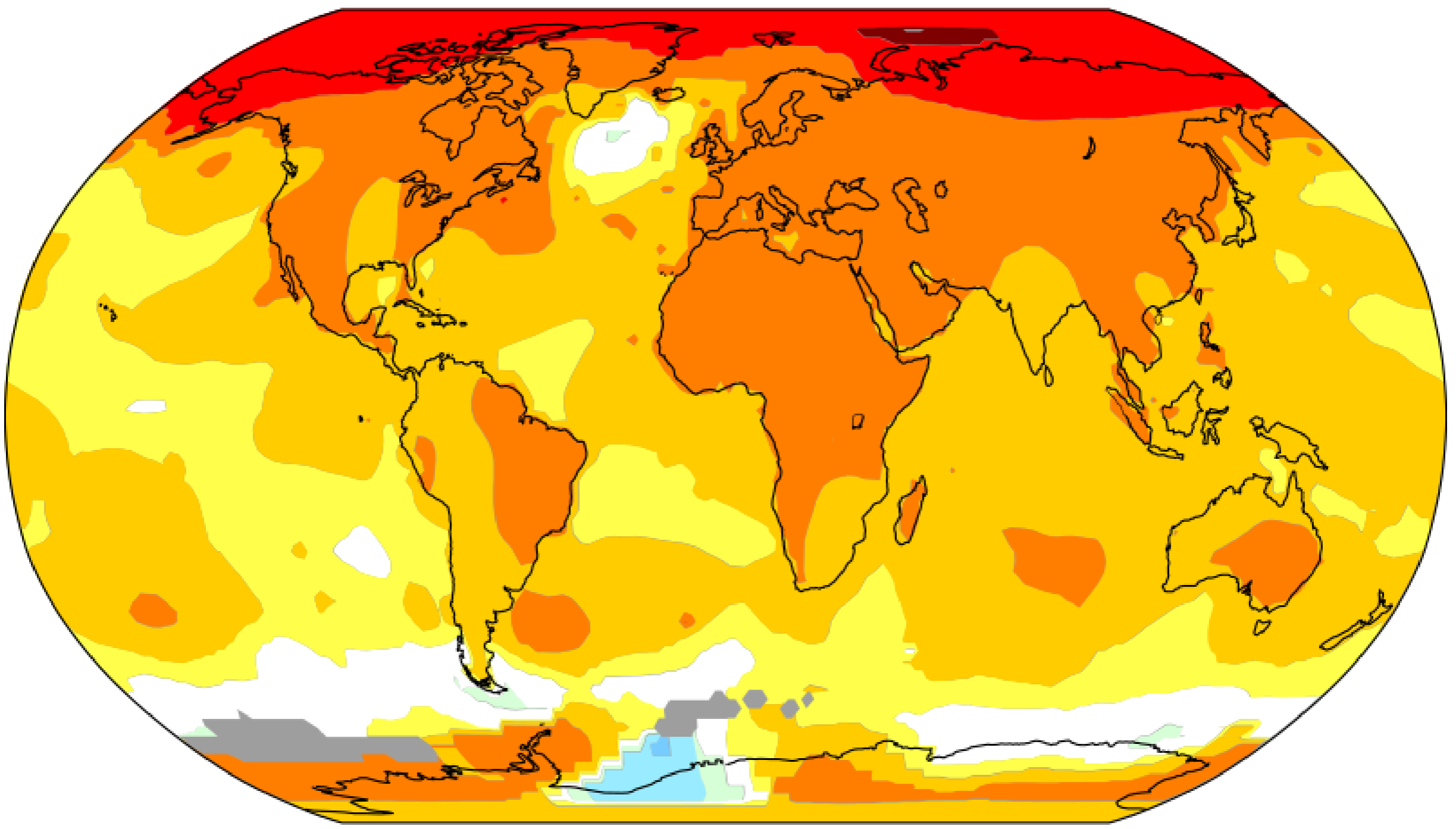
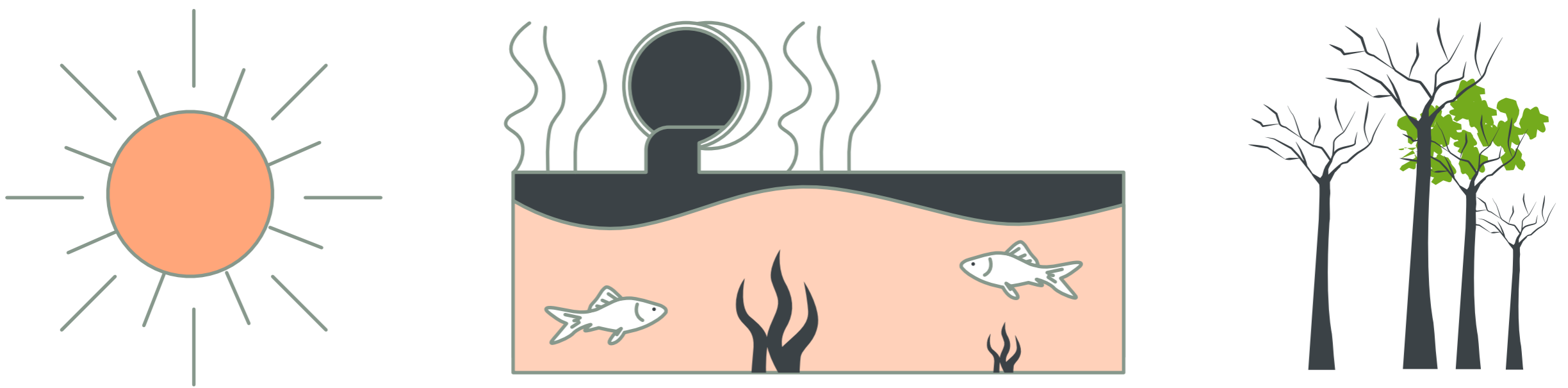


Graphic Design Michael Ernst, The Woods Hole Reserach Center



The graph here and the map below shows how different parts of the globe have warmed up over the years...

TOTAL ANNUAL ANTHROPOGENIC GHG EMISSIONS BY GASES 1970-2010



2011–2021 average vs 1956–1976 baseline

-1.0 -0.5 -0.2 +0.2 +0.5 +1.0 +2.0 +4.0 °C



-1.8 -0.9 -0.4 +0.4 +0.9 +1.8 +3.6 +7.2 °F

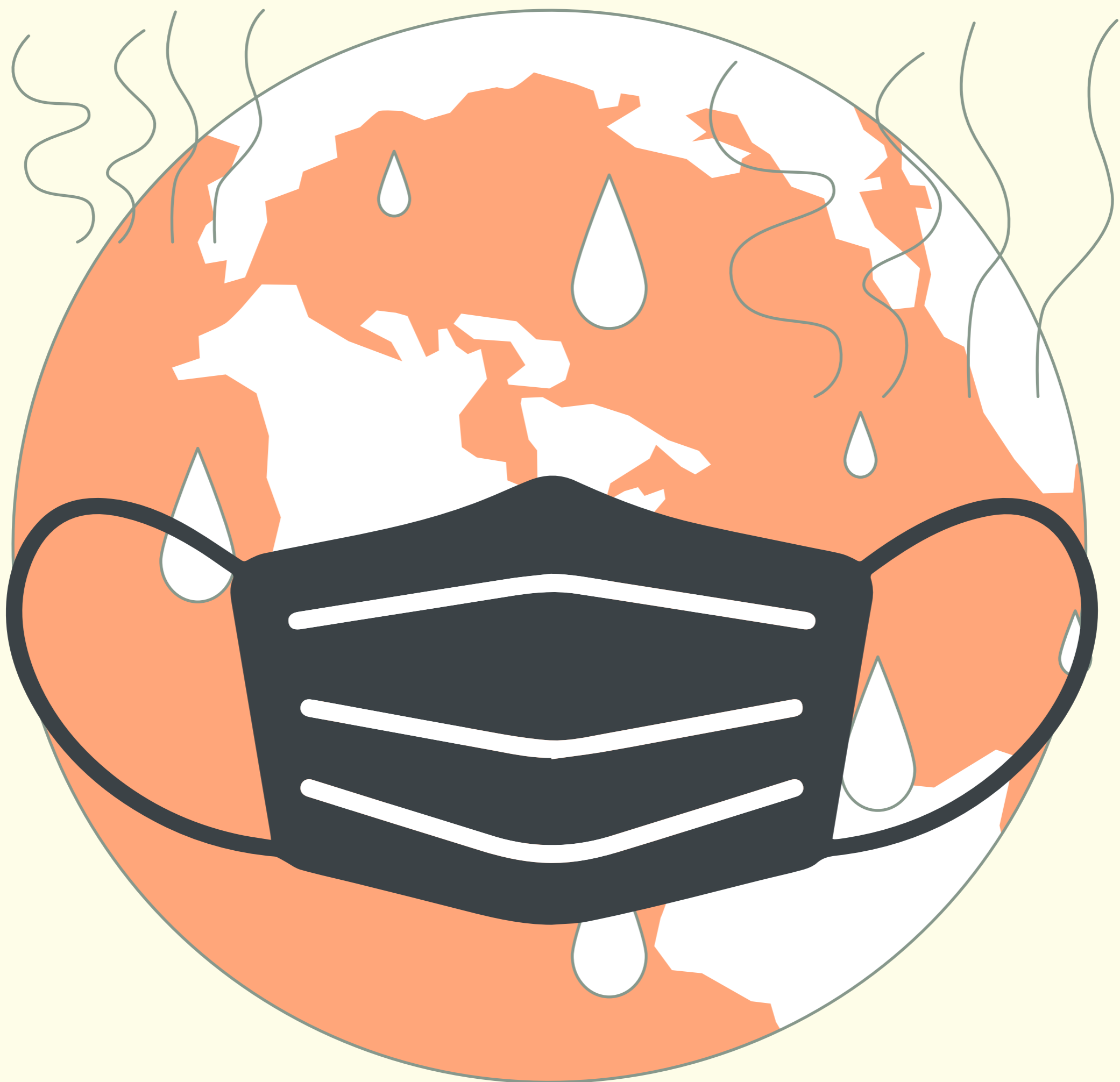
TEMPERATURE CHANGE IN THE LAST 50 YEARS

The Earth has been warming at an alarming rate. But where there is a will, there is a way. We can slow down the process through our collective action. The actions are to be found in the Sustainable Development Goals (SDG) chart developed by UNESCO.

Here is a link to it—

https://sites.ungeneva.org/170actions/climate/documents/PCP170_actions5.pdf

170 ACTIONS TO COMBAT CLIMATE CHANGE



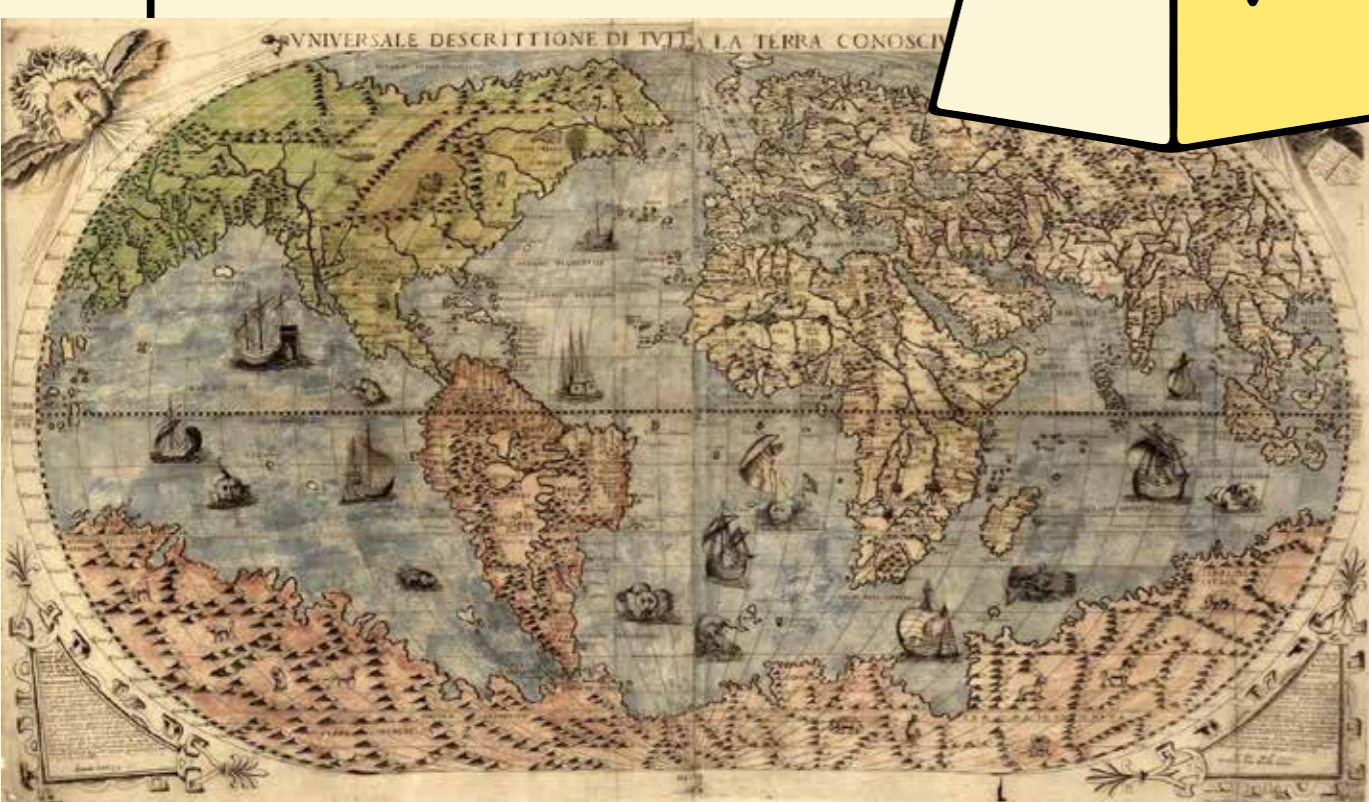
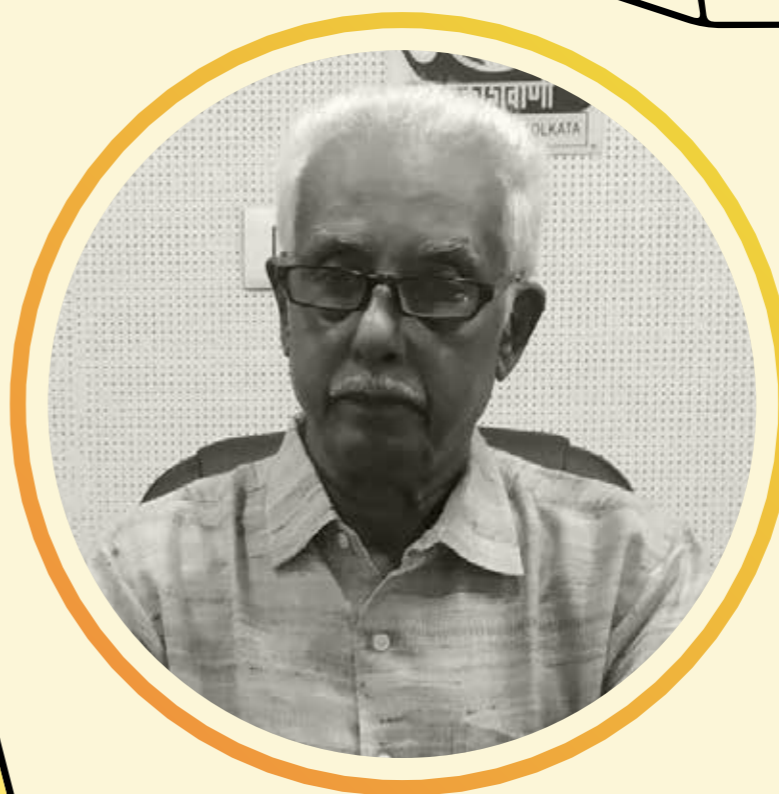
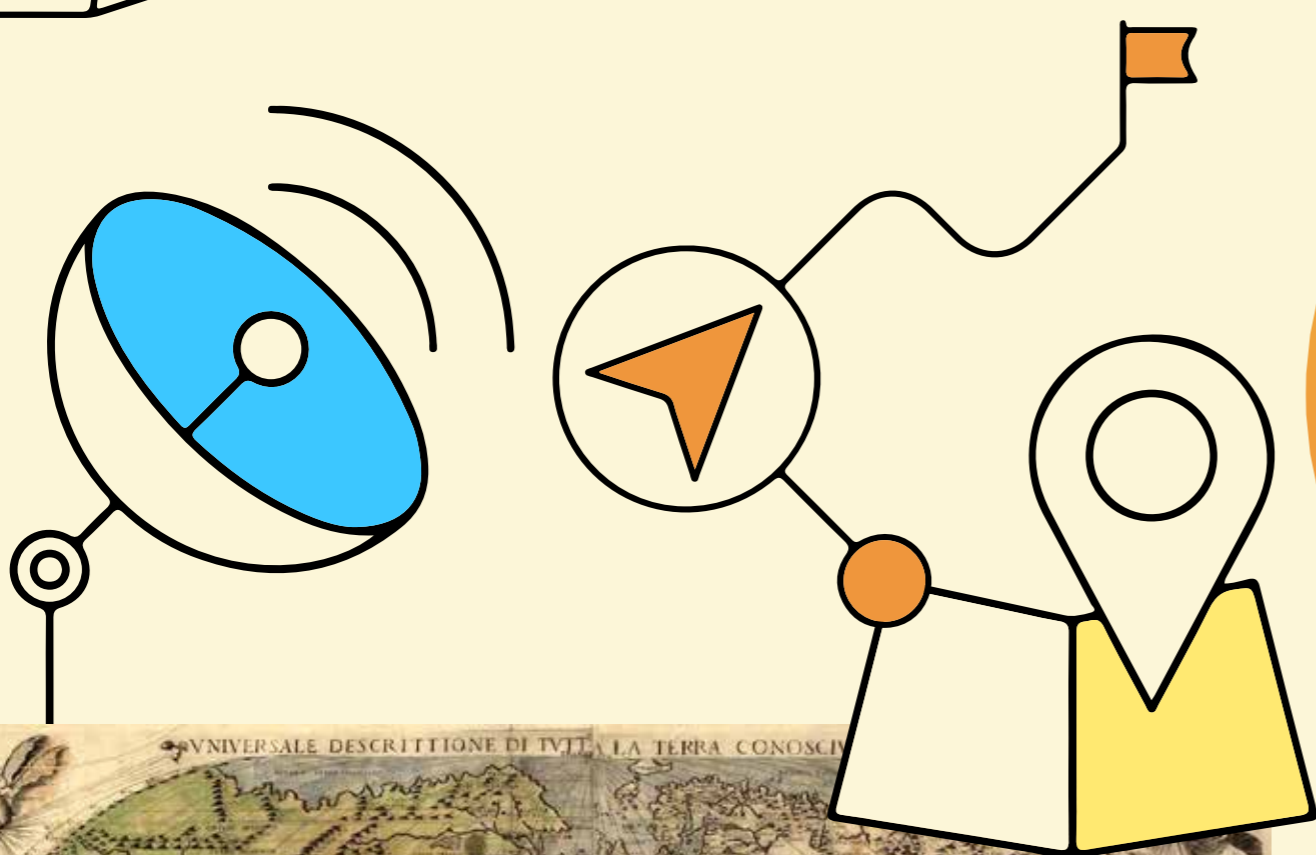
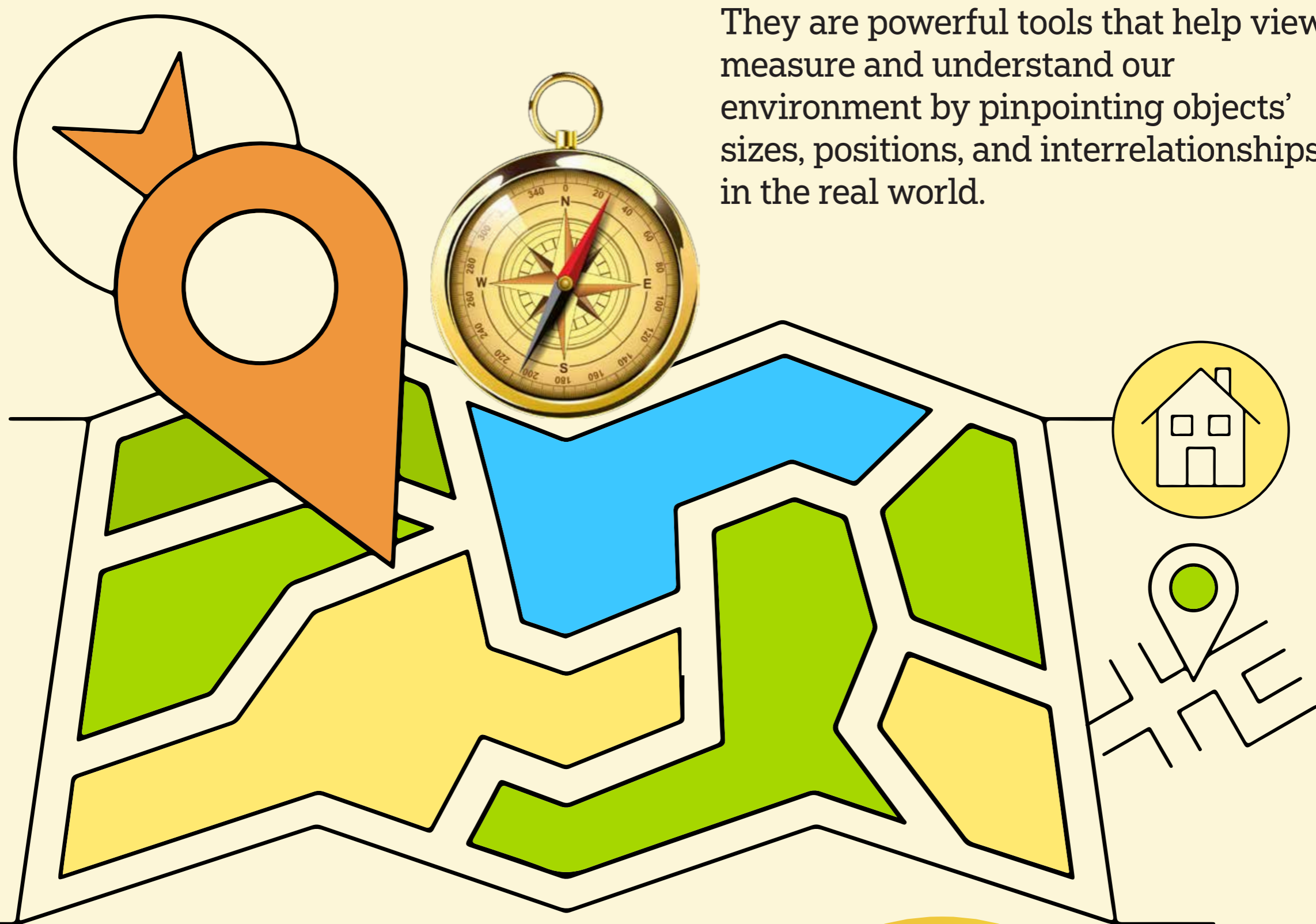
Study the 170 actions listed and then make a list of the actions you would like to take immediately. Which of these actions would bring about a big change in your lifestyle?

Are you ready for this change?
Remember, Earth is asking for help.
We cannot let her down, can we?

05 | Ways to use Google Maps and Google Earth

Presenting ideas and collecting information about natural wealth around us, such as biodiversity, water, soil, air, green energy sources, and more, is important for environmental education. Vistas we see of the natural world trigger appreciation for it and develop thoughts on ways to protect it. We can put together written descriptions, oral speeches, illustrations, photographs, films and maps to communicate our ideas with others.

A map is a geometrically accurate two-dimensional image of a three-dimensional space. Maps can effectively represent the factual world. They are powerful tools that help view, measure and understand our environment by pinpointing objects' sizes, positions, and interrelationships in the real world.



Pradip Sengupta is an independent researcher who has authored several popular science books and articles. A hydrogeologist by profession, his areas of interest also include science fiction, paleoanthropology, colonial memoirs, among others. He can be reached at pksg.60@gmail.com

There are two ways to create a map. We can either draw it by hand on paper or develop it with the help of a computer. We can name the second a digital mapping method or a Geographic Information System (GIS). Even a novice can navigate and create excellent personal maps based on different themes using Google Maps.

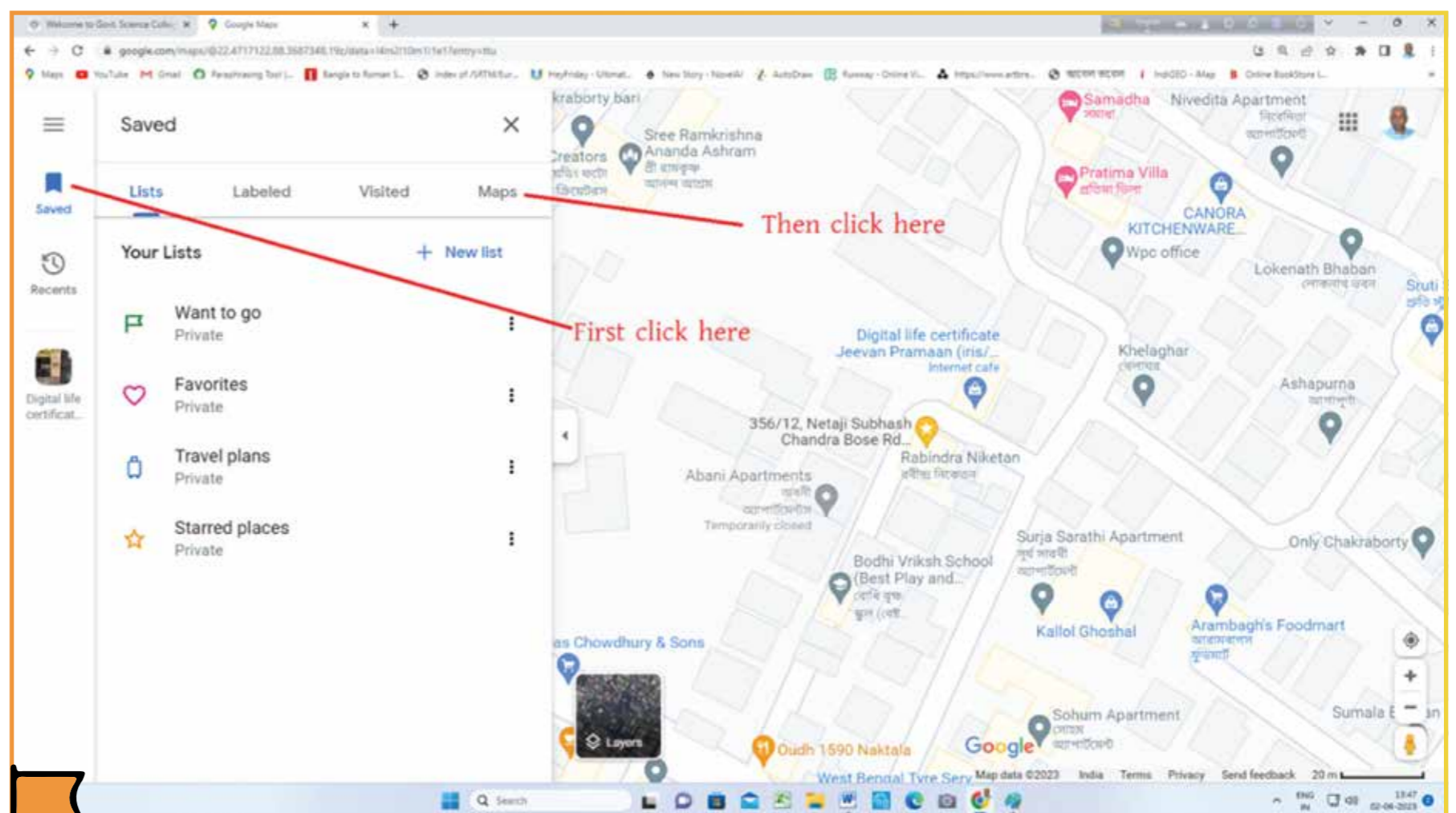
Following is a way to create your own thematic map (local, demographic, travel, natural resource, environment, etc.) with the help of Google Maps.

To start with

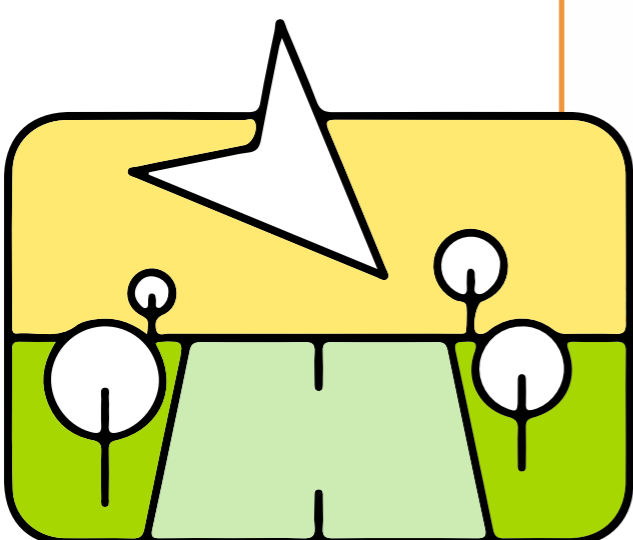
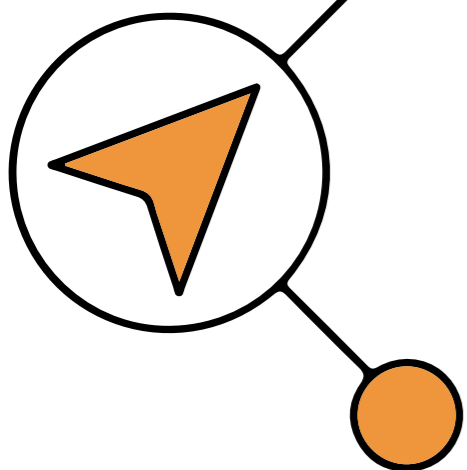
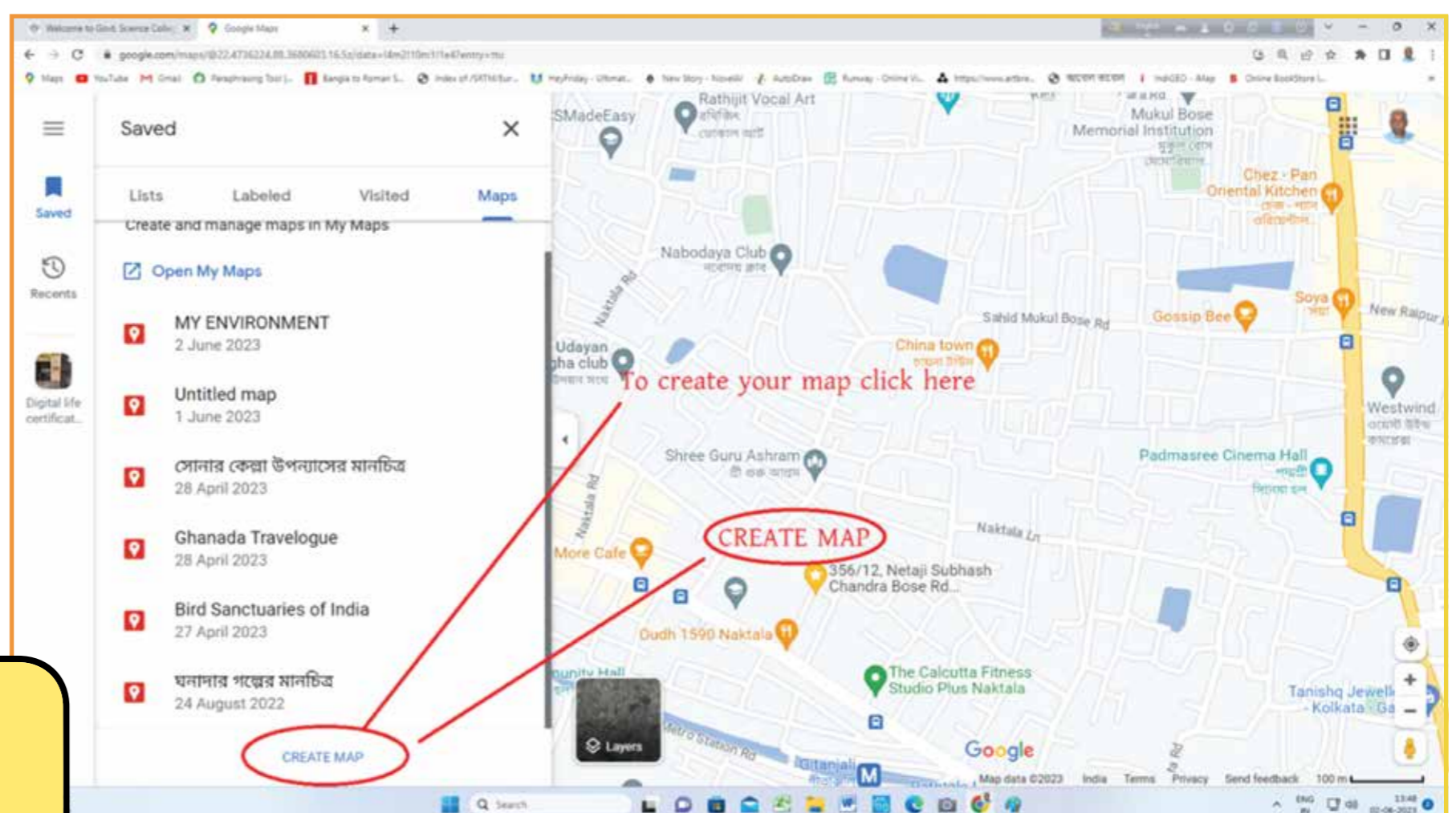
- Participants should use their personal computers or laptops instead of phones
- A Gmail account is required

The Process

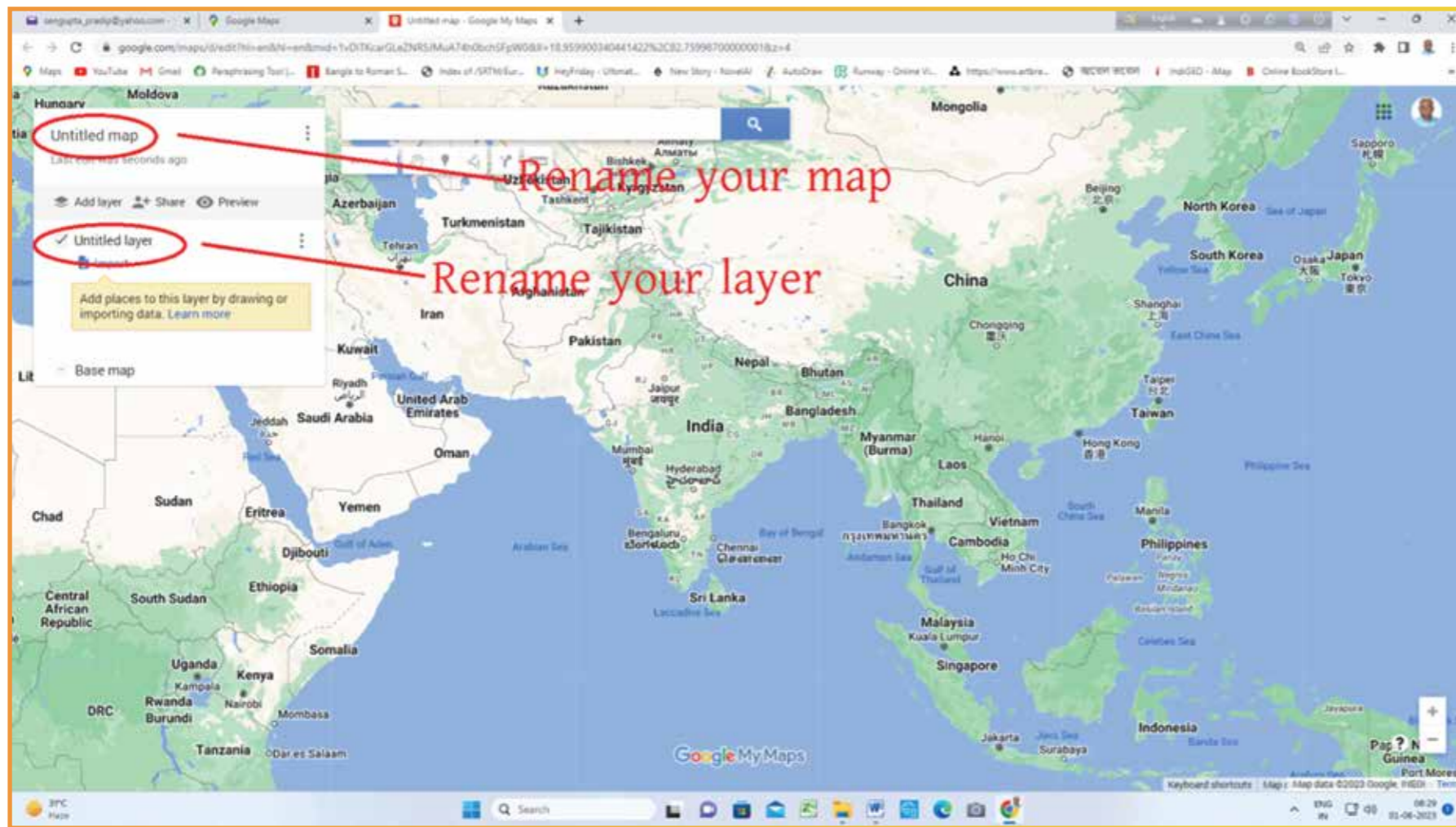
1. Create a Data Folder: The first step is to collect data to prepare an environmental map of an area (maybe of your neighbourhood) by documenting its details such as its demographics, land use and land cover patterns, settlements, green cover, water bodies, factories, hotspots etc. Next, collect photographs of places, trees, biodiversity and landmarks to place on the map. These should be labelled and filed separately under different heads in a folder. Give the folder a name.
2. Open Google Maps
3. Click Menu. A drop-down menu will open. Click on the 'saved' icons to open another menu. There you have to click on MAPS. (Figure 1)



4. Clicking on MAPS will open another menu. At the very bottom of that menu is CREATE MAPS. Click there. (Figure 2)

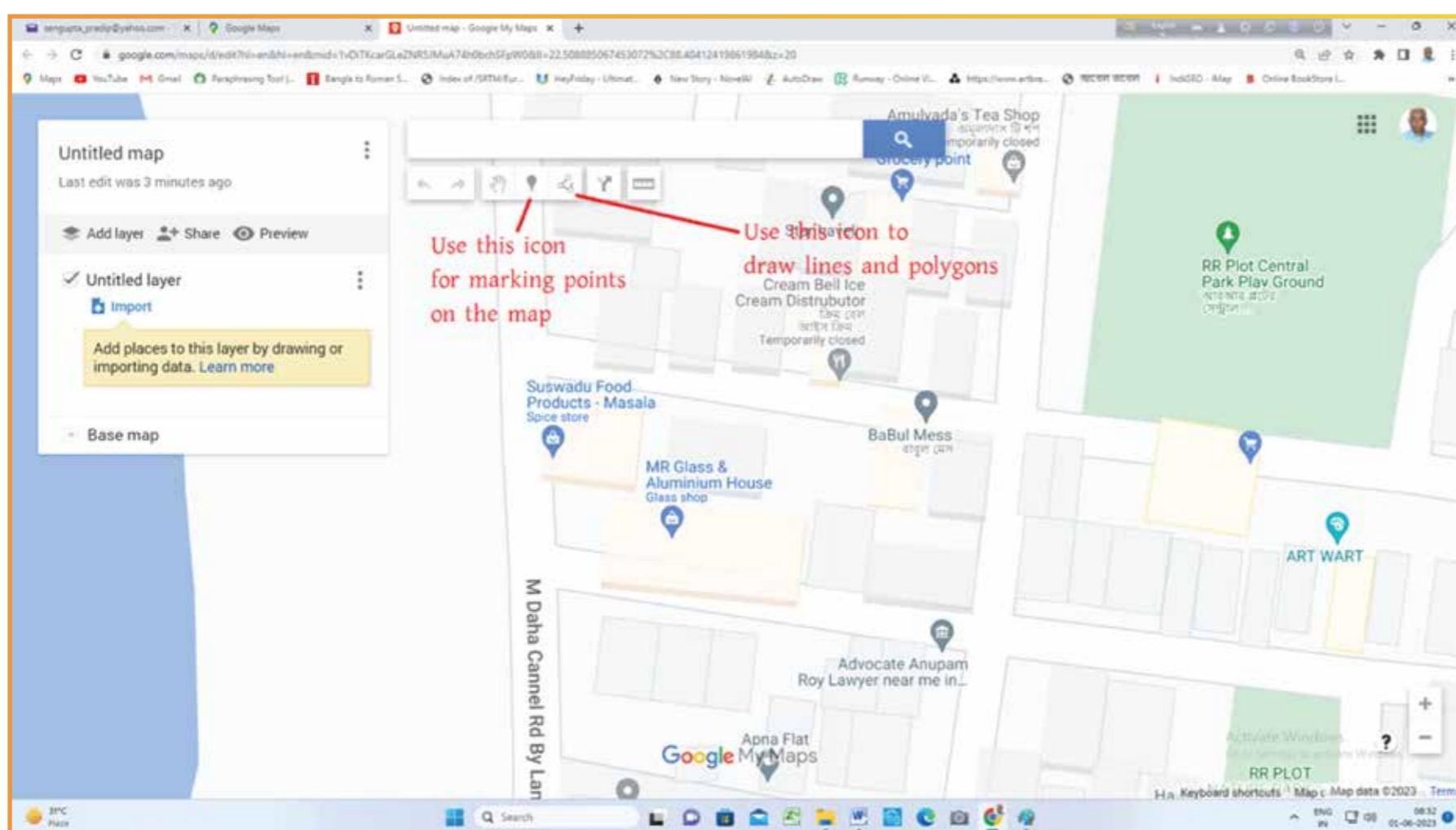


5. A new window will open, showing a map of the whole world. Clicking on the tab 'Untitled map' will open a pop-up window. Write the name you want to give your map and save it there. Name the layer where your data will be. (Figure 3)



6. Scroll the mouse to enlarge the map on the screen. Make it so large that your house and neighbouring streets are visible. Now rename your layer or add a new layer. There are icons to draw points,

lines and polygons on the map. This map has several keys to input your data. Click on the icon, such as the pin (inverted water drop) and drag this with the cursor to the point you want to mark on the map.



7. When you mark a point, line, or polygon on the map, a pop-up window will appear for each mark. This window will enable you to add data or attributes against that particular object. You can add any type of data, such as dimensions (example, the height of a tree, depth of a well) or any demographic data against a

polygon (example, people living in a house, their occupation, energy/water consumption, etc.) Add your photographs to this map. You can add a map by clicking on the camera icon on the data entry pop-up window.

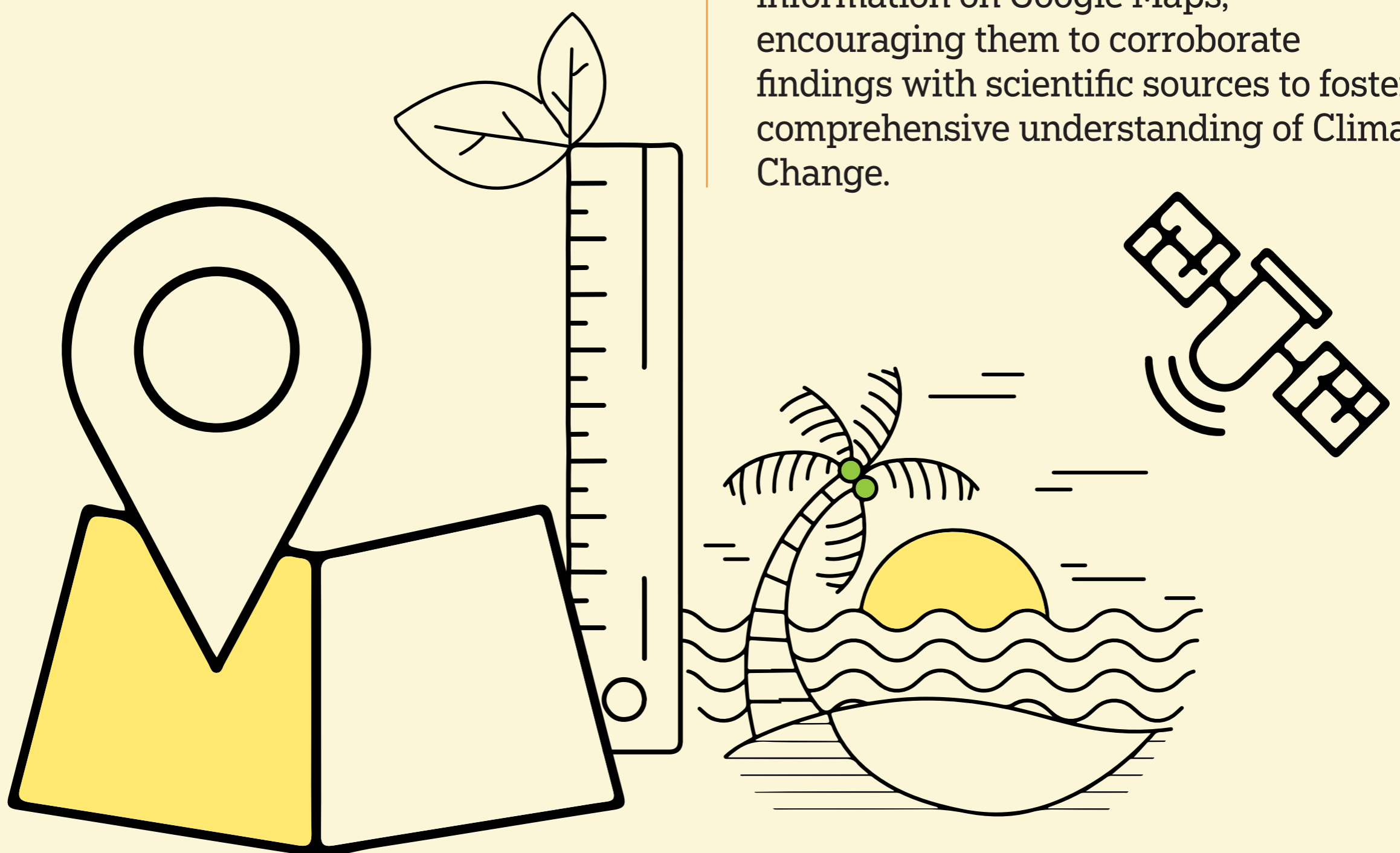
Google Maps can be used to create amazing maps on any subject

Google Maps can be a powerful educational tool for school children to learn about Climate Change. Here are some ways it can be utilised

- **Interactive Geography Lessons:** Google Maps offers an interactive platform for geography lessons focused on Climate Change. Teachers can use the map to show students the distribution of different climates around the world, the impact of Climate Change on various regions and the relationship between climate and ecosystems.
- **Virtual Field Trips:** Google Maps enable virtual field trips to locations significantly impacted by Climate Change. Students can explore areas such as those with melting glaciers, deforested regions, or coastal areas affected by rising sea levels. This virtual experience helps them understand the real-life consequences of Climate Change without leaving the classroom.
- **Visualising Data:** Google Maps can be used to visualise climate data, such as temperature variations or sea level rise, on a global scale. Teachers can overlay this data on the map to demonstrate the changing climate patterns over time. This visual representation helps students comprehend complex concepts and observe the effects of Climate Change in different parts of the world.

- **Analysing Local Impacts:** Students can use Google Maps to investigate Climate Change impacts in their local communities. They can search for specific locations and identify vulnerable areas or changes in vegetation, observe urban heat island effects, or analyse the proximity of renewable energy installations. This hands-on exploration encourages students to think critically about how Climate Change affects their immediate surroundings.
- **Research and Data Analysis:** Google Maps provide access to a vast amount of geospatial data. Students can use this data to conduct research projects related to Climate Change. For example, they can analyse deforestation rates, compare the carbon footprints of different cities, or study the relationship between temperature changes and biodiversity. This promotes data literacy and encourages independent learning.
- **Collaborative Projects:** Google Maps allows for collaborative projects among students. They can work together to create interactive maps showcasing the impacts of Climate Change in different regions, annotate the areas of concern and propose solutions for mitigating Climate Change. This collaborative approach fosters teamwork, critical thinking, and creativity.

Teachers should guide students to critically analyse and interpret the information on Google Maps, encouraging them to corroborate findings with scientific sources to foster a comprehensive understanding of Climate Change.

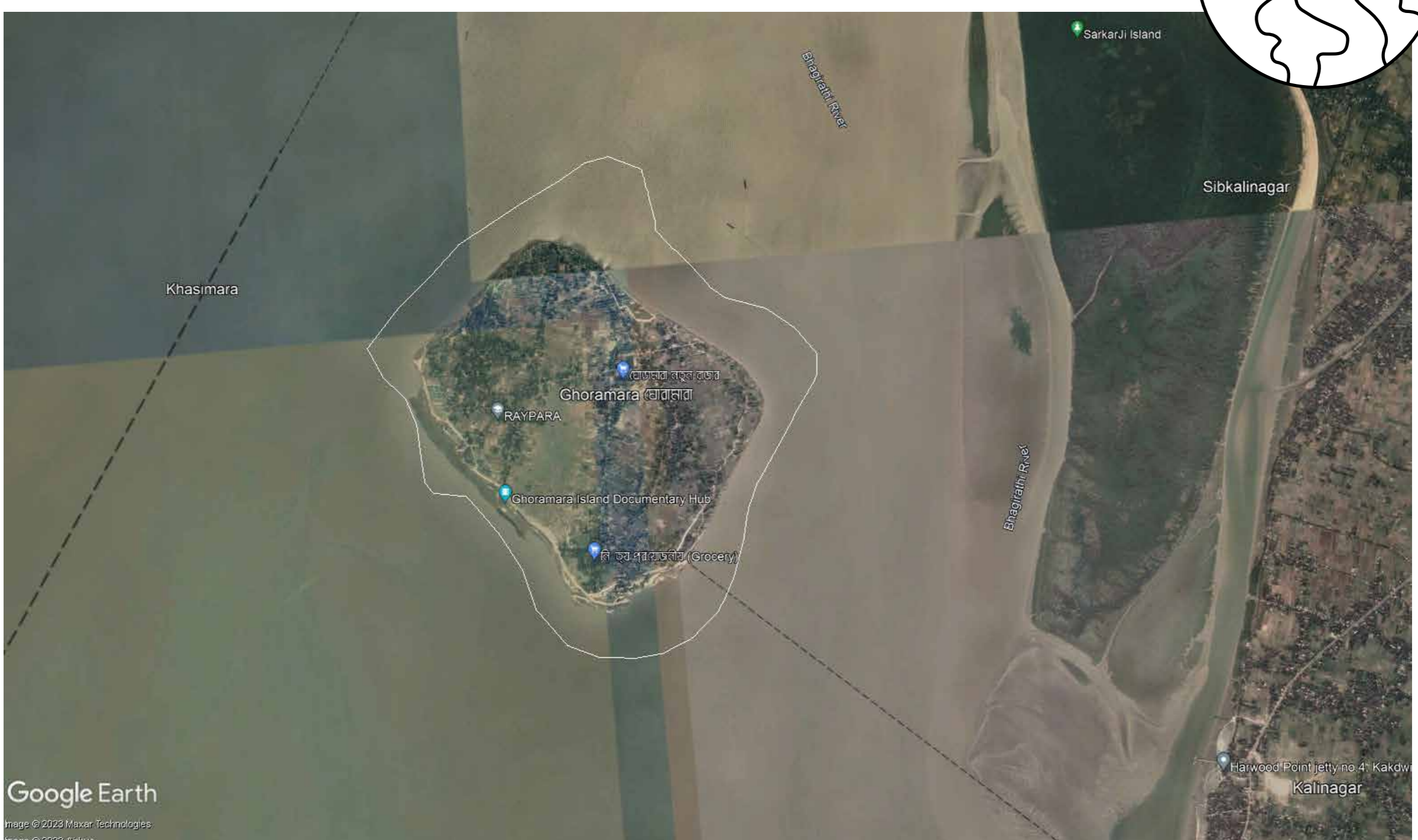
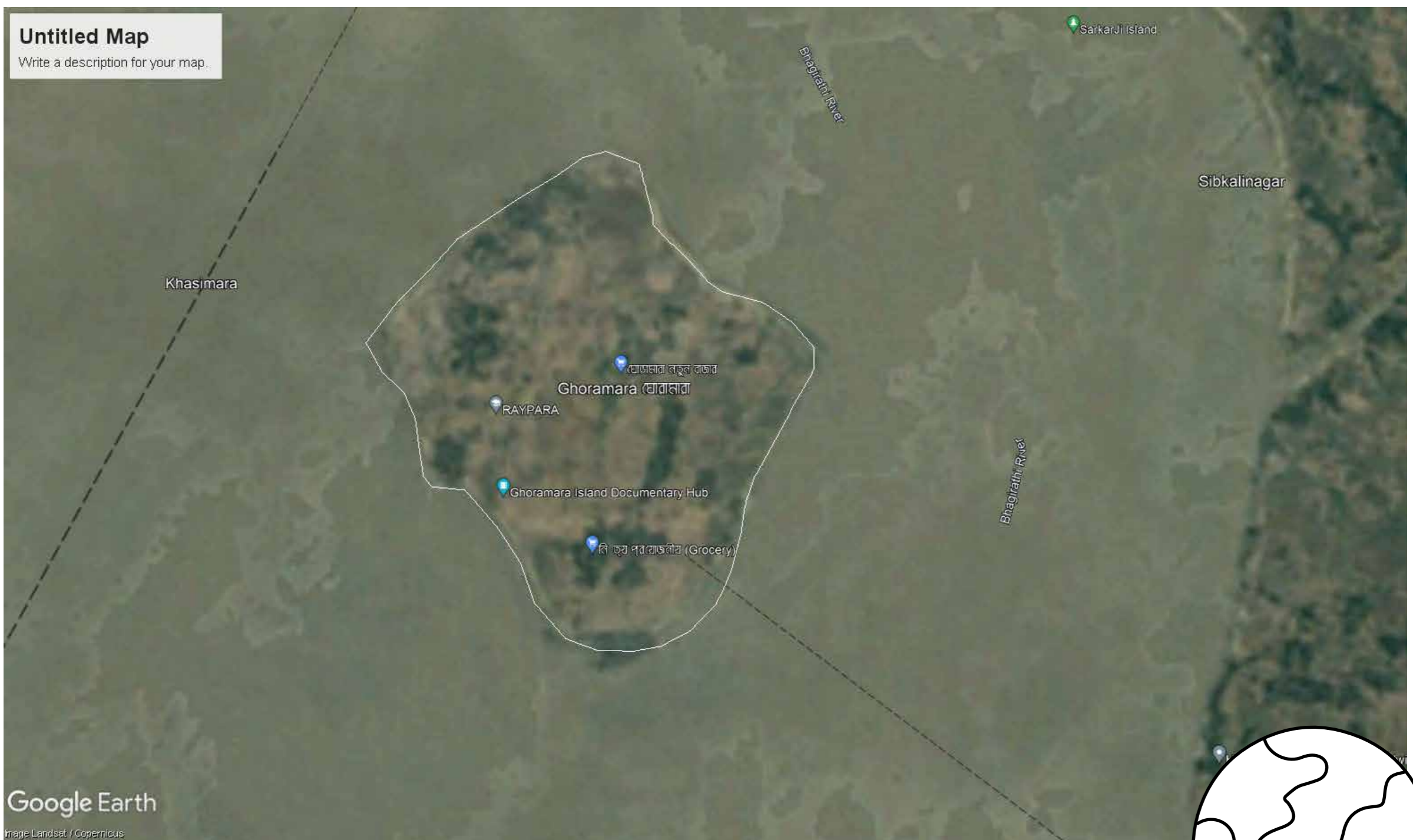


Using Google Earth to understand long-term changes in the contours of places

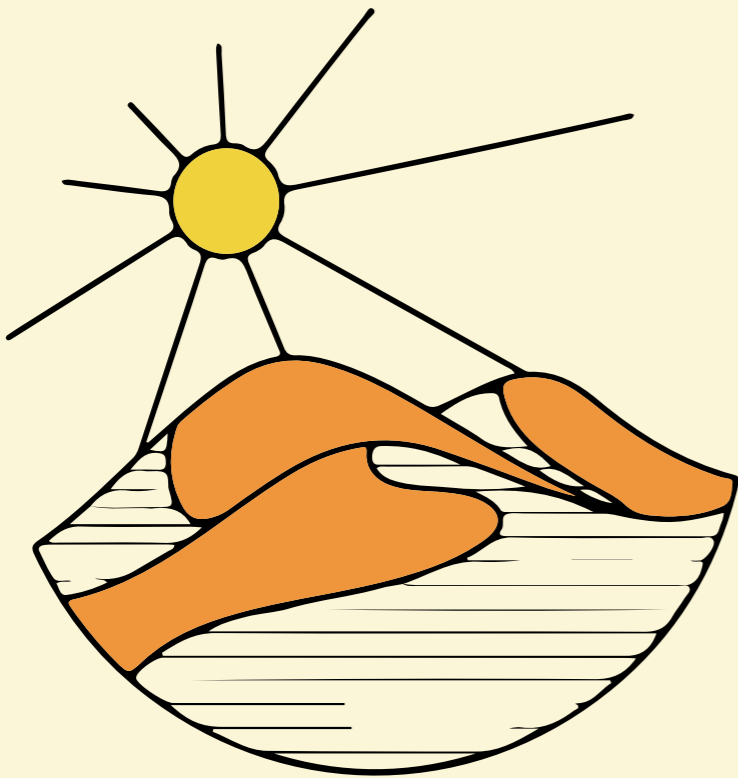
Google Earth, like Google Maps, can be a valuable tool for children to understand Climate Change. Here are some ways Google Earth can be beneficial in this context:

1. Visualising Global Changes: Google Earth provides a 3D representation of the Earth's surface, allowing children a way to explore the planet virtually. They can

observe changes in landforms, vegetation patterns, and water bodies affected by Climate Change. This visual approach helps children grasp the magnitude and scale of environmental transformations. Take the case of Ghoramara Island at the estuary of the Hooghly River. This island is sinking, possibly due to the rise in sea level. The two maps below show how much Ghoramara Island has shrunk over the past ten years.



3. Exploring Climate Zones: Google Earth offers the ability to explore different climate zones and biomes across the globe. Children can navigate between regions and examine the characteristics of various ecosystems, such as rainforests, deserts, or the tundra. This first-hand exploration helps them understand how climate influences biodiversity and the vulnerability of different habitats to Climate Change.

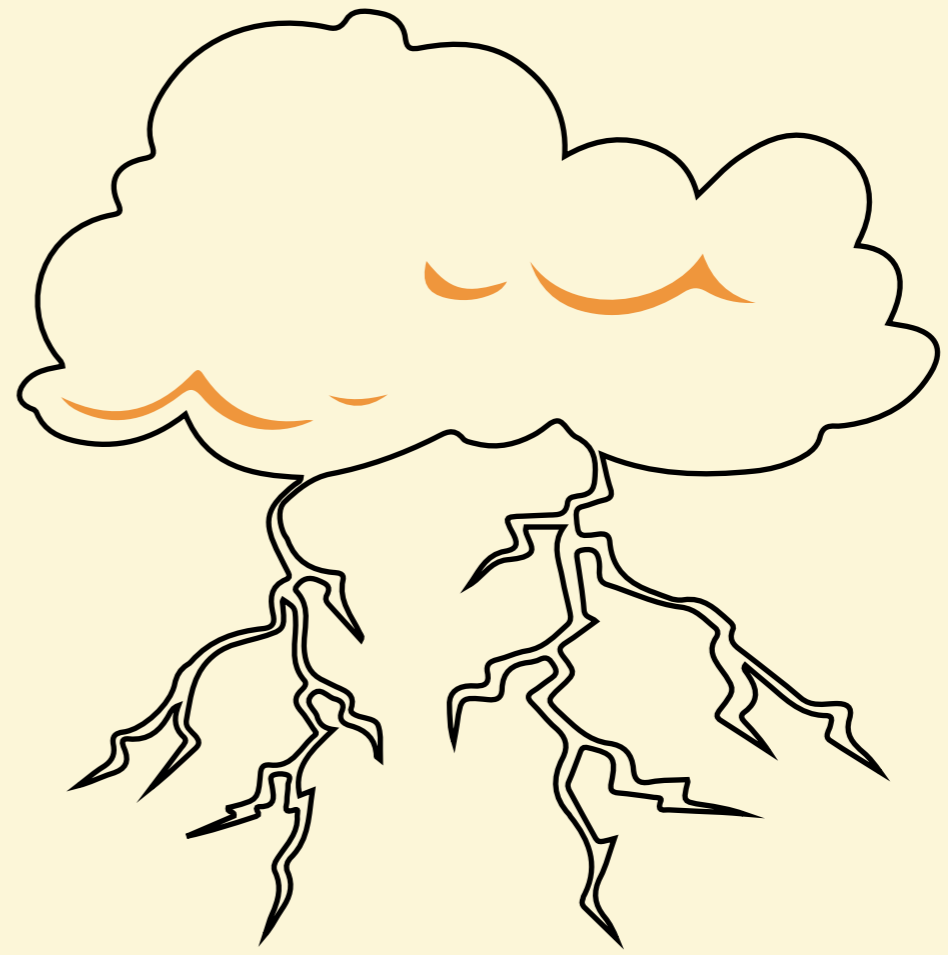


4. Investigating Extreme Weather Events: Children can use Google Earth to investigate extreme weather events associated with Climate Change. They can examine regions affected by hurricanes, floods, or wildfires and analyse the factors contributing to these events. By exploring the aftermath of such events, children gain awareness of the link between Climate Change and the frequency or intensity of extreme weather phenomena.



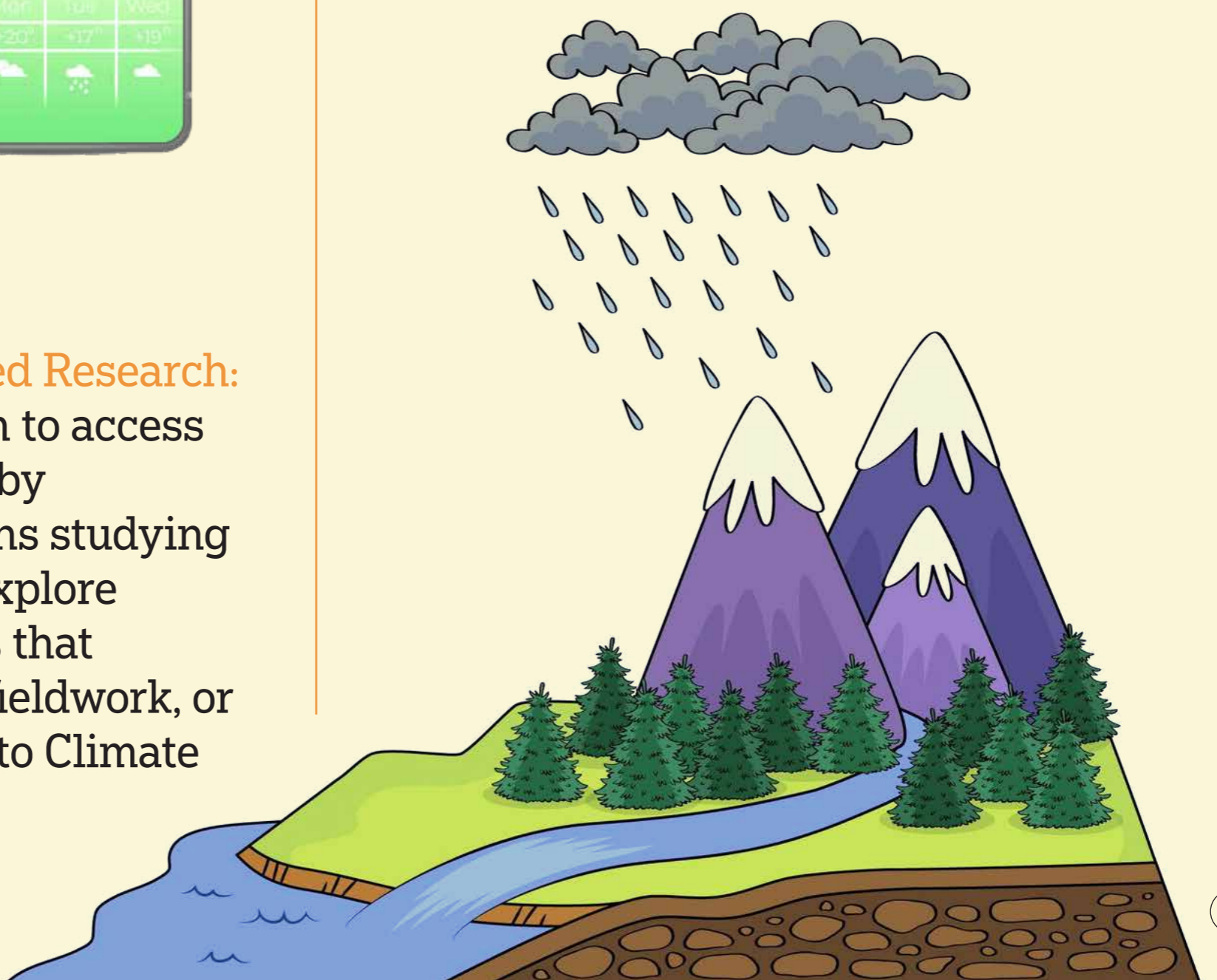
5. Discovering Climate-related Research: Google Earth allows children to access layers of information added by researchers and organisations studying Climate Change. They can explore markers, images, and videos that highlight scientific studies, fieldwork, or conservation efforts related to Climate

Change. This exposure to on-going research fosters curiosity and encourages children to engage with scientific concepts.



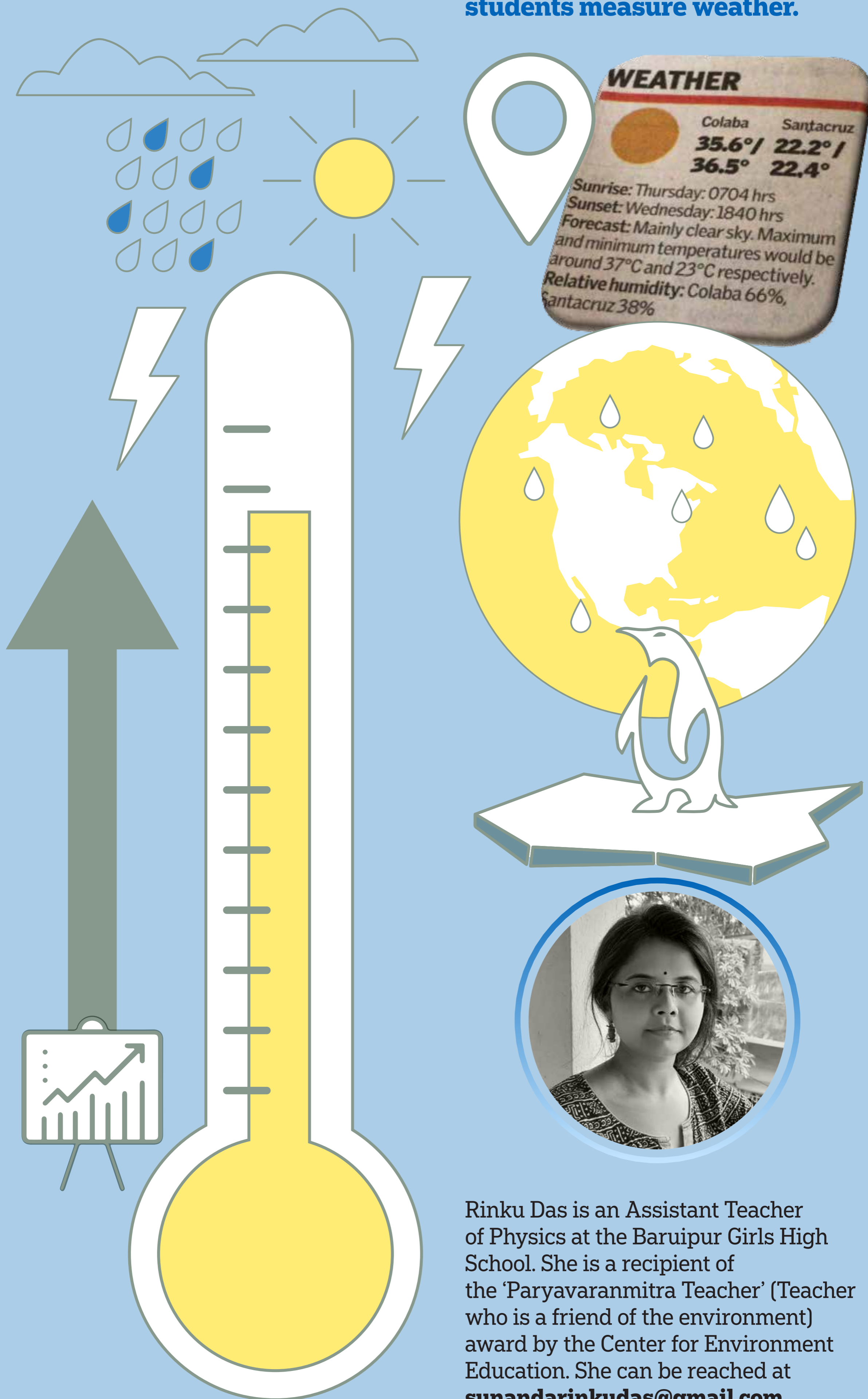
6. Localising Climate Solutions: Google Earth can be used to locate renewable energy installations, sustainable initiatives, or conservation projects around the world. Children can explore these locations, learn about renewable energy technologies, and understand how communities are taking action to mitigate Climate Change. By identifying local solutions, children gain a sense of empowerment and the understanding that individual and collective efforts can make a difference.

Teachers and parents should guide children's exploration of Google Earth, encourage critical thinking, and help them connect the information to broader concepts related to Climate Change. It's important to complement these digital experiences with hands-on activities, discussions, and accessing to reputable educational resources.



06 | Measuring weather

In Chapter 1, we discussed the differences between climate and weather. In this chapter, we demonstrate simple experiments that can help students measure weather.



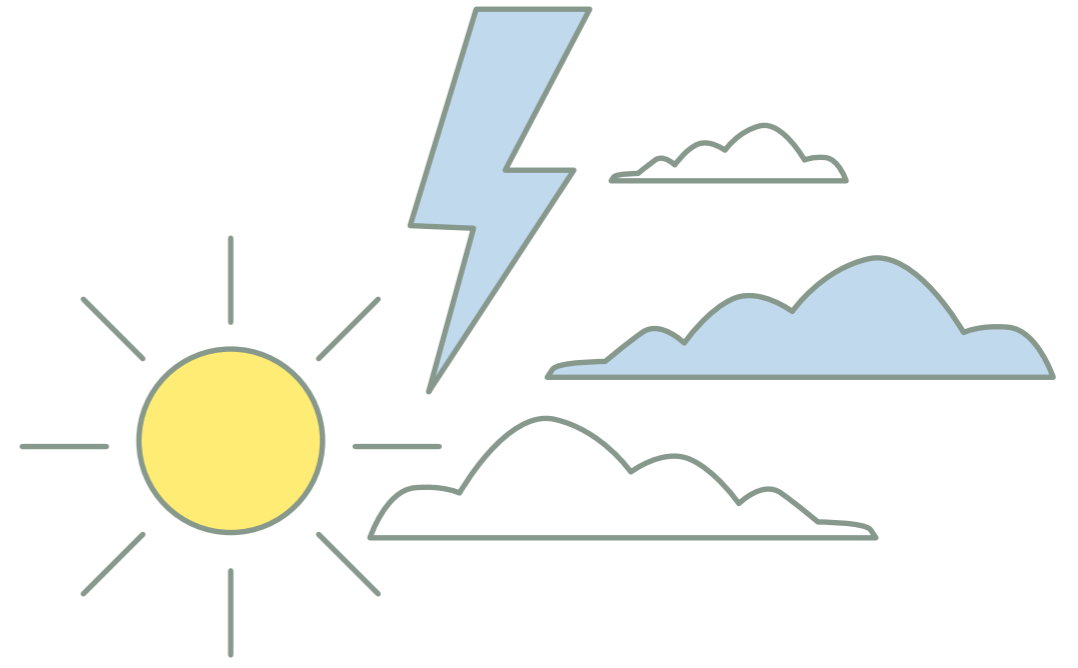
WEATHER

Colaba	Santacruz
35.6° / 36.5°	22.2° / 22.4°

Sunrise: Thursday: 0704 hrs
Sunset: Wednesday: 1840 hrs
Forecast: Mainly clear sky. Maximum and minimum temperatures would be around 37°C and 23°C respectively.
Relative humidity: Colaba 66%, Santacruz 38%

Rinku Das is an Assistant Teacher of Physics at the Baruipur Girls High School. She is a recipient of the 'Paryavaranmitra Teacher' (Teacher who is a friend of the environment) award by the Center for Environment Education. She can be reached at sunandarinkudas@gmail.com

As you know, weather forecasts are readily available. Meteorological units use sophisticated equipment to calculate the most likely weather. This is then made available in newspapers, on weather channels such as **CNN** and **BBC** and on weather apps such as the **Google Weather app** and the **Apple Weather app**.



Late monsoon is not a big worry: 5 reasons why

In the past five years, only once has the onset of monsoon happened on its normal date of 1 June—in 2020.

*Source Express Web Desk, New Delhi
Updated May 17, 2023 18:43 IST*

No heatwave conditions for next 5 days with rainfall on the cards over most of India

The IMD has predicted thunderstorms in Uttarakhand, Punjab, Haryana, Delhi, Chandigarh, Uttar Pradesh and Rajasthan today (May 25).

*Source Express Web Desk, New Delhi
Updated May 25, 2023 12:53 IST*

Temp down to 33.9°C a day after squalls

Although Tuesday evening's double squall produced only minor precipitation in some parts of Kolkata, the squalls managed to bring respite from hot and uncomfortable weather by reducing the maximum temperature by almost four notches.

*Source Aheli Banerjee/TNN/
Updated May 25, 2023, 09:57 IST*

Tonight	Tuesday	Wednesday	Thursday	Friday
Mostly Cloudy Winds N 3-6	Partly Cloudy Winds E/SE 3-7	Chance of Showers/Storms Winds S 4-8	Showers/Storms Likely Winds E 4-9	Mostly Cloudy Winds NE 5-12
High 51° Low 51°	High 75° Low 54°	High 76° Low 58°	High 74° Low 58°	High 71° Low 53°
Feels Like: 50°	Feels Like: 75°	Feels Like: 76°	Feels Like: 74°	Feels Like: 71°

Make a simple rain gauge and put it up on a terrace.

WHAT YOU NEED

- 2-litre PET bottle
- Scissors
- Scale
- Measuring cylinder (cylinder with graduation marks in cm and mm)
- Cellotape

TO MAKE

Neatly cut off the upper conical portion of the PET bottle. This will function as a funnel. Place the funnel on the cylindrical portion of the cutoff PET bottle and secure that with cellotape. Place the bottle on the terrace to catch the rain when it falls. Secure the bottle on all four sides with bricks so it does not blow away when windy.

RECORD

Leave your rain gauge in the open for at least 24 hours. After that, transfer the rainwater collected in it into a measuring cylinder without spilling any water. Centimetres of rainfall can be read on the measuring cylinder.

Here is a [link](#) to the video demonstrating the setting up and use of the rain gauge.

You, too, can record the weather in your locality. Let us see how.

WHAT YOU NEED

- 2 Celsius thermometers, preferably of the same graduation
- Support stand or any other stable arrangement for holding the thermometers
- Beaker or glass
- Clock
- Notebook, pen, pencil

TO MAKE

The thermometers need to be suspended where direct sunlight does not fall on them. The bulbs should be heated only by the molecules of air or water that they are in contact with. The place chosen should have good air circulation, maybe under the shade of a tree or a shady place on the roof. Dip the bulb of one thermometer in water. Hang the other thermometer in a shaded spot.

RECORD

Record the temperature of air and water at intervals of 1 hour from sunrise to sunset.

Document the maximum and minimum temperature for that date. Develop a graph of temperature vs time for air and water separately.

Compare the two graphs.



Recording air and water temperatures in a shady spot on the roof



Recording air temperature on the balcony

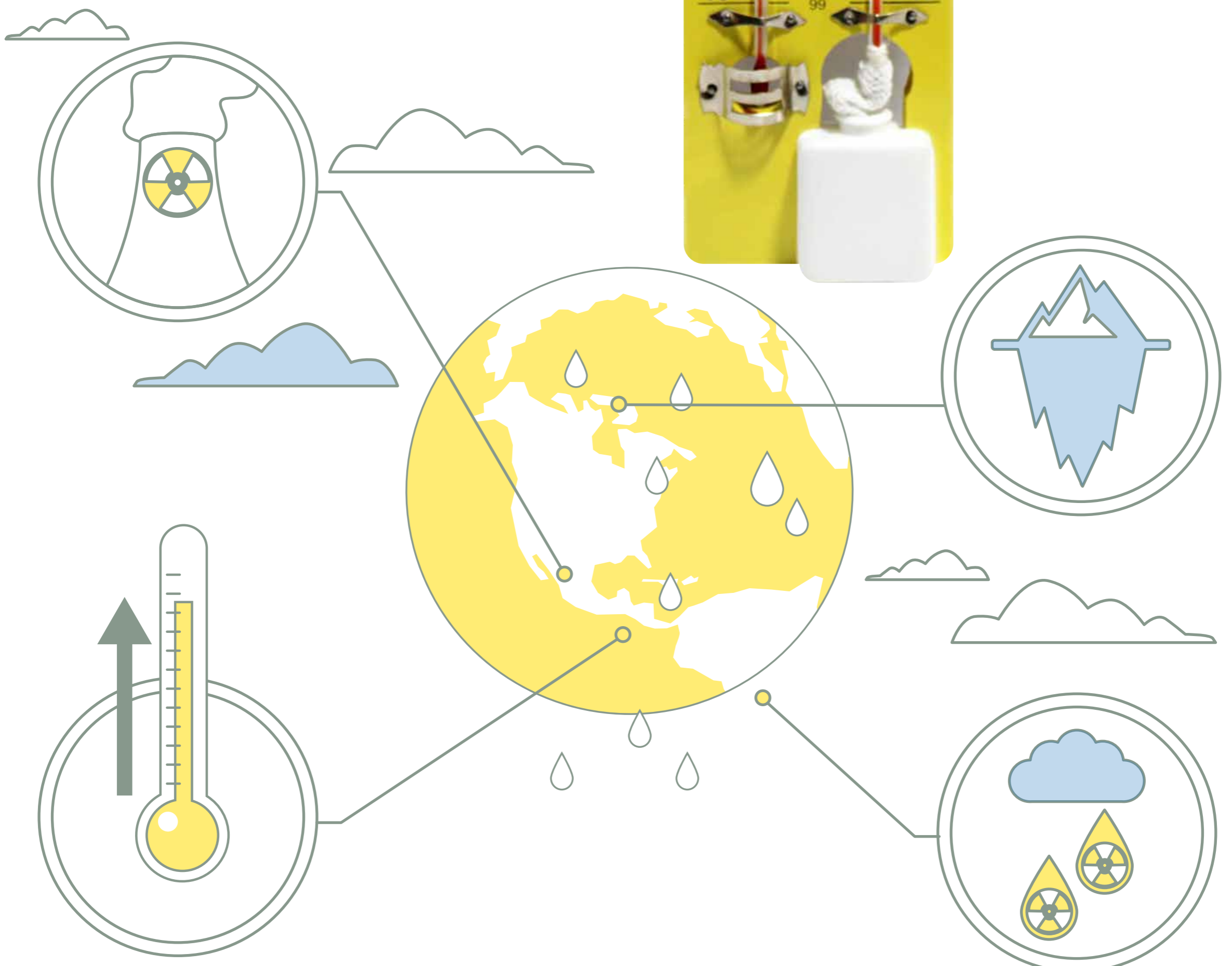
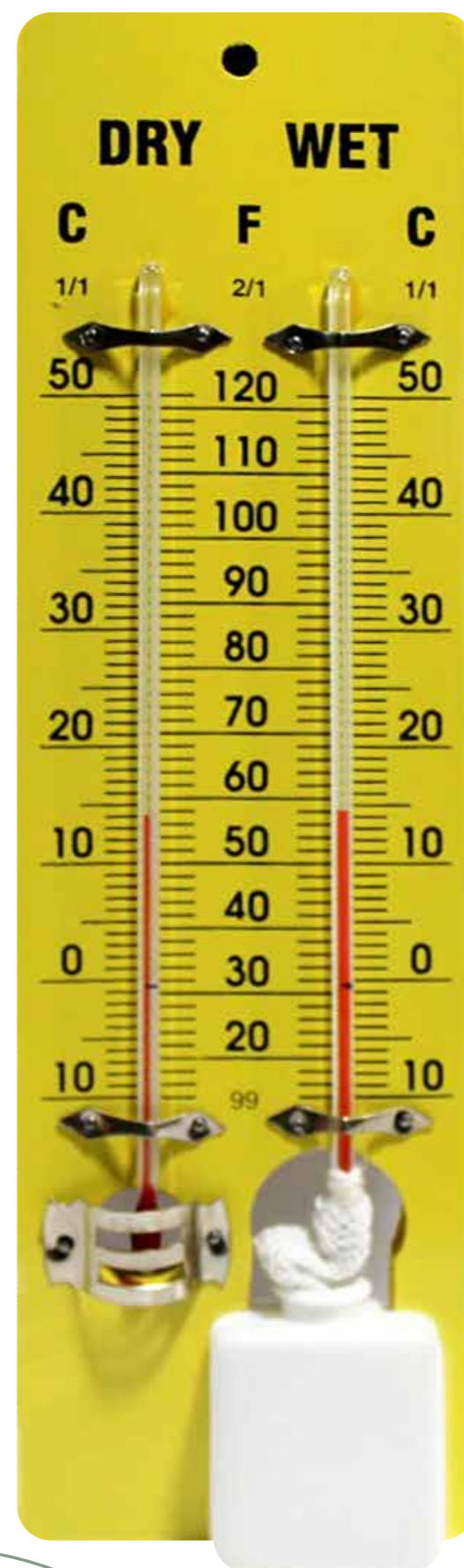
DATE	TIME	TEMP (AIR)	TEMP (WATER)	COMMENTS
	6am			
	7am			
	8am			
	9am			

Do you expect your results to tally with published data?

The results will not be exactly the same, but will approximate published forecasts. This is because published statistics are calculated with high-tech instruments and readings are given for large areas—probably the entire city. The locally measured weather parameters depend on the amount of green cover, the presence of water bodies, radiation from concrete etc. So when the student measures weather at a spot, it might deviate within a limited range from that which is published.

Determination of relative humidity with a dry and a wet bulb thermometer

Relative humidity is the amount of water vapour present in air expressed as a percentage of the amount needed for saturation at the same temperature. The rate of vaporisation depends on the water vapour content in the air. In a wet bulb thermometer, water always gets converted to vapour. This process keeps the thermometer cool. That is why the temperature of a wet bulb thermometer is always lower than a dry bulb thermometer.



Measuring relative humidity at home

WHAT YOU NEED

- You can use the readymade set of dry and wet thermometers or take the thermometers used in the previous experiment
- Wrap one thermometer's bulb with cotton rope/a piece of cotton
- A container filled with water
- An arrangement to suspend the thermometers

WHAT AND HOW TO MEASURE

Suspend the wrapped bulb of the thermometer so that one end of the rope is dipped in water and the other end covers the bulb of the thermometer completely. Measure the readings of both thermometers. Then use a standard chart to find the relative humidity at that time and in that area.



Dry-bulb temperature	Dry-bulb temperature minus wet-bulb temperature, °C									
	1	2	3	4	5	6	7	8	9	10
10°C	88	77	66	55	44	34	24	15	6	
11°C	89	78	67	56	46	36	27	18	9	
12°C	89	78	68	58	48	39	29	21	12	
13°C	89	79	69	59	50	41	32	22	15	7
14°C	90	79	70	60	51	42	34	26	18	10
15°C	90	80	71	61	53	44	36	27	20	13
16°C	90	81	71	63	54	46	38	30	23	15
17°C	90	81	72	64	55	47	40	32	25	18
18°C	91	82	73	65	57	49	41	34	27	20
19°C	91	82	74	65	58	40	43	36	29	22
20°C	91	83	74	66	59	51	44	37	31	24
21°C	91	83	75	67	60	53	46	39	32	26
22°C	92	83	76	68	61	54	47	40	34	28
23°C	92	84	76	69	62	55	48	42	36	30
24°C	92	84	77	69	62	56	49	43	37	31
25°C	92	84	77	70	63	57	50	44	39	33
26°C	92	85	78	71	64	58	51	46	40	34
27°C	92	85	78	71	65	58	52	47	41	36
28°C	93	85	78	72	65	59	53	48	42	37
29°C	93	86	79	72	66	60	54	49	43	38
30°C	93	86	79	73	67	61	55	50	44	39

A RELATIVE HUMIDITY CHART

Source <https://sites.google.com/a/markham.edu.pe/mr-carter-s-igcse-geography/weather/how-to-read-humidity>

SUPPOSE

Dry Bulb Temperature = 30° C
Wet Bulb Temperature = 27° C

Temperature Difference = 3° C
Relative Humidity = 79%

Heat Index

Heat index is the perceived rather than the actual temperature. For example, a temperature of 29°C with a relative humidity of 70% would result in an estimated 34°C perceived temperature. This difference is the perceived temperature—the actual temperature results from a combination of air temperature, relative humidity and wind speed.

Relative Humidity %	Air temperature °C										
	21	24	27	29	32	35	38	41	43	46	49
0	18	21	23	26	28	31	33	35	37	39	42
10	18	21	24	27	29	32	35	38	41	44	47
20	19	22	25	28	31	34	37	41	44	49	54
30	19	23	26	29	32	36	40	45	51	57	64
40	20	23	26	30	34	38	43	51	58	66	
50	21	24	27	31	36	42	49	57	66		
60	21	24	28	32	38	46	56	65			
70	21	25	29	34	41	51	62				
80	22	26	30	36	45	58					
90	22	26	31	39	50						
100	22	27	33	42							

- Serious risk to health - heatstroke imminent
- Prolonged exposure and activity could lead to heatstroke
- Prolonged exposure and activity may lead to fatigue

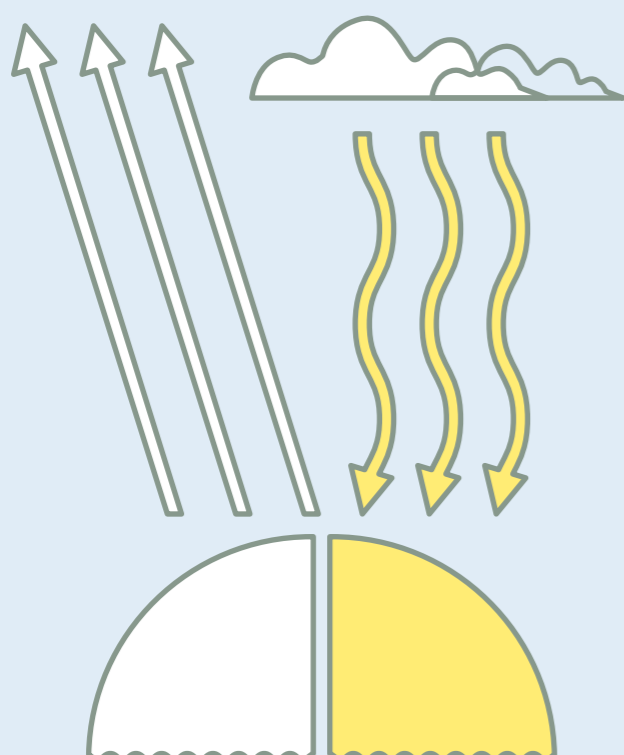
Image Courtesy https://www.researchgate.net/figure/Apparent-temperature-heat-index-in-degrees-Celsius-according-to-air-temperature-and_fig2_325471848

Understanding the Greenhouse Effect with a simple experiment



WHAT YOU NEED

- Two thermometers of the same graduation
- Two cardboard boxes. One box will have no cover, and the other, a glass cover



WHAT AND HOW TO MEASURE

- 1 Take two smaller boxes to place the thermometers inside so that only the bulb of the thermometers is in contact with air. The bulbs should not touch the bottom of the boxes.
- 2 Keep this arrangement undisturbed for 30 minutes.
- 3 Measure the ambient air temperature by holding the thermometer under the shade. It is 35°C in both thermometers.

OBSERVATION

You will observe that the reading on the thermometer inside the glass cover is more than the reading on the thermometer without the glass cover.

For instance you may get the following result after 30 minutes—
 Without glass cover = 49°C
 With glass cover = 61°C

CONCLUSION The glass cover has trapped the Sun's heat. Through the transparent glass, high-frequency infrared energy enters. The cardboard box absorbs this heat and radiates low-frequency infrared energy, which the glass blocks. As a result of this heat accumulation, the air inside the box gets heated. This is the greenhouse effect.

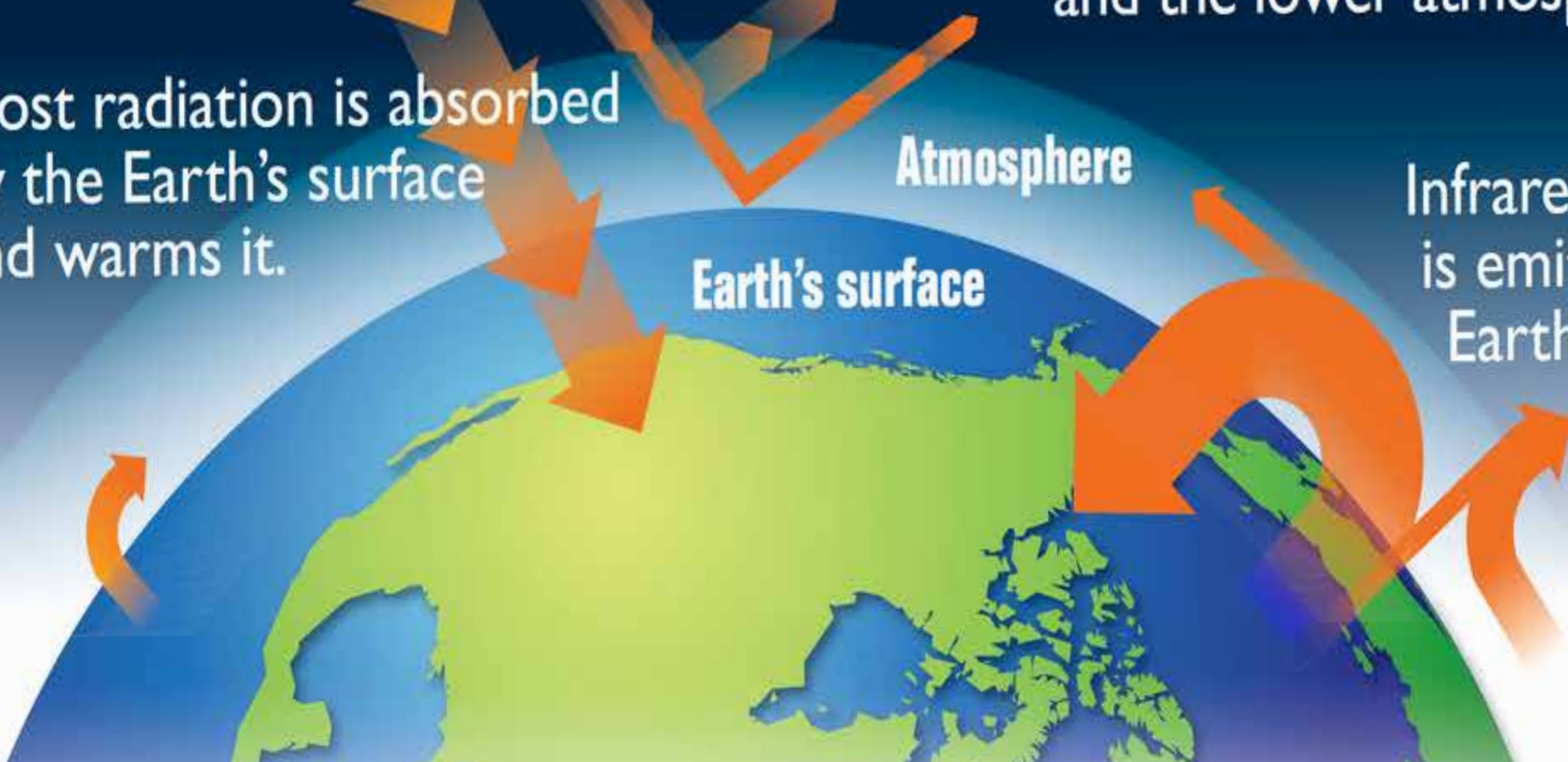
The Greenhouse Effect

Some solar radiation is reflected by the Earth and the atmosphere.

Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.

Most radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted by the Earth's surface.



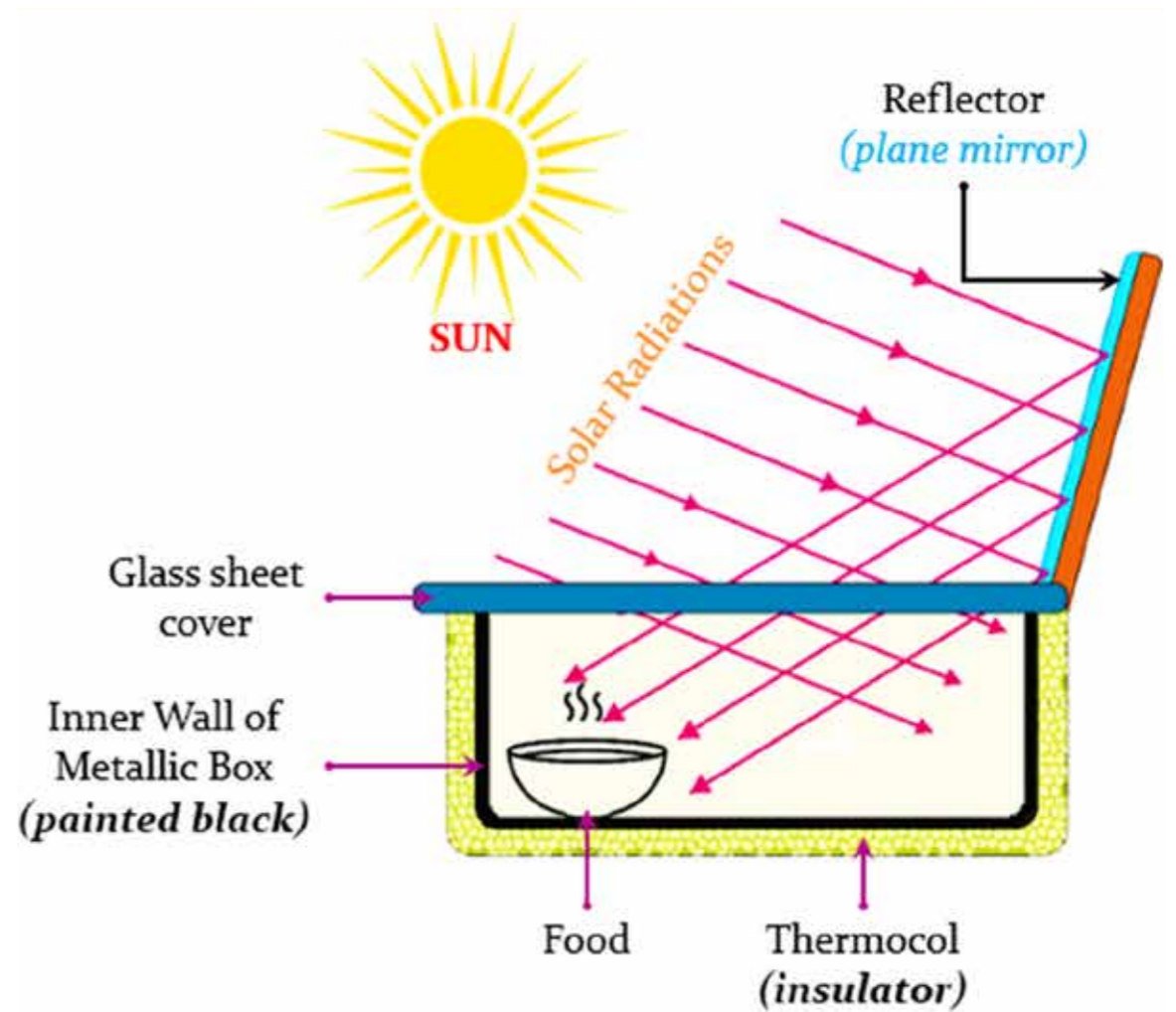
APPLYING THE GREENHOUSE EFFECT TO DESIGN A SOLAR COOKER



MODEL OF A HOMEMADE SOLAR COOKER

A solar cooker is a type of solar thermal collector. It 'gathers' and traps the Sun's thermal heat energy. Heat is produced when high-frequency light (visible and ultraviolet) is converted into low-frequency infrared radiation. The cooker's bottom surface is darkened so that it absorbs heat. Other surfaces are covered with aluminium foil to reflect heat.

This homemade solar cooker can easily cook eggs, instant noodles etc.



BOX TYPE SOLAR COOKER

Fluctuating weather/steady climate

As we know, weather can change from day to day or even from hour to hour. However, the climate of a region is steadier. If the climatic pattern of a region begins to change over the years, then it is cause for alarm.



EARTH'S 2015 SURFACE TEMPERATURES WERE THE WARMEST SINCE MODERN RECORD KEEPING BEGAN IN 1880. SOURCE: NASA

February 2016



If we wish to keep temperature rise below 1.5° degrees we must declare a climate emergency and stop burning fossil fuels now. If we wish to keep temperature rise below 2° degrees we cannot burn all of the fossil fuels that are in existing mines and wells.

CLIMATE RISKS: 1.5°C VS 2°C GLOBAL WARMING



EXTREME WEATHER

100% increase in flood risk. | VS | 170% increase in flood risk.

SPECIES

6% of insects, 8% of plants and 4% of vertebrates will be affected. | VS | 18% of insects, 16% of plants and 8% of vertebrates will be affected.

WATER AVAILABILITY

350 million urban residents exposed to severe drought by 2100. | VS | 410 million urban residents exposed to severe drought by 2100.

ARCTIC SEA ICE

Ice-free summers in the Arctic at least once every 100 years. | VS | Ice-free summers in the Arctic at least once every 10 years.

PEOPLE

9% of the world's population (700 million people) will be exposed to extreme heat waves at least once every 20 years. | VS | 28% of the world's population (2 billion people) will be exposed to extreme heat waves at least once every 20 years.

SEA-LEVEL RISE

46 million people impacted by sea-level rise of 48cm by 2100. | VS | 49 million people impacted by sea-level rise of 56cm by 2100.

OCEANS

Lower risks to marine biodiversity, ecosystems and their ecological functions and services at 1.5°C compared to 2°C.

COSTS

Lower economic growth at 2°C than at 1.5°C for many countries, particularly low-income countries.

CORAL BLEACHING

70% of world's coral reefs are lost by 2100. | VS | Virtually all coral reefs are lost by 2100.

FOOD

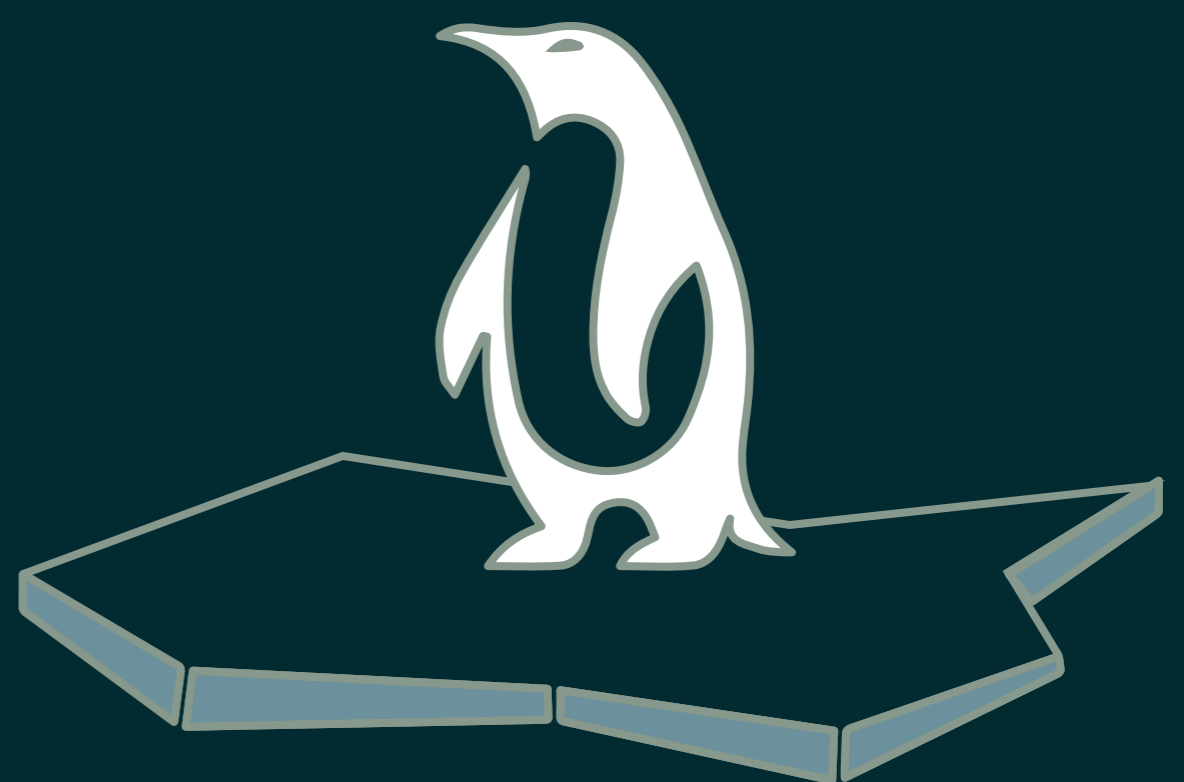
Every half degree warming will consistently lead to lower yields and lower nutritional content in tropical regions.



Why is the melting of ice occurring in Antarctica?

We know that due to the greenhouse effect, polar ice is melting at a faster rate. Antarctica's ice mass is melting at an average rate of about 150 billion tons per year. According to NASA, Greenland is losing about 270 billion tons per year, adding to sea level rise.

How does the salinity of seawater affect the melting of ice? Watch this [video](#) to get the answers explained with easy experiments.



A short study of Climate Change in Kolkata

AIMS/OBJECTIVES

- 1 To study the change of maximum and minimum temperature of Kolkata over 11-years (2011-2021)
- 2 To study the change in annual rainfall in Gangetic West Bengal. This analysis can assess the change in the rainfall pattern of Kolkata as the city is situated on the eastern bank of the River Hooghly.

METHODOLOGY

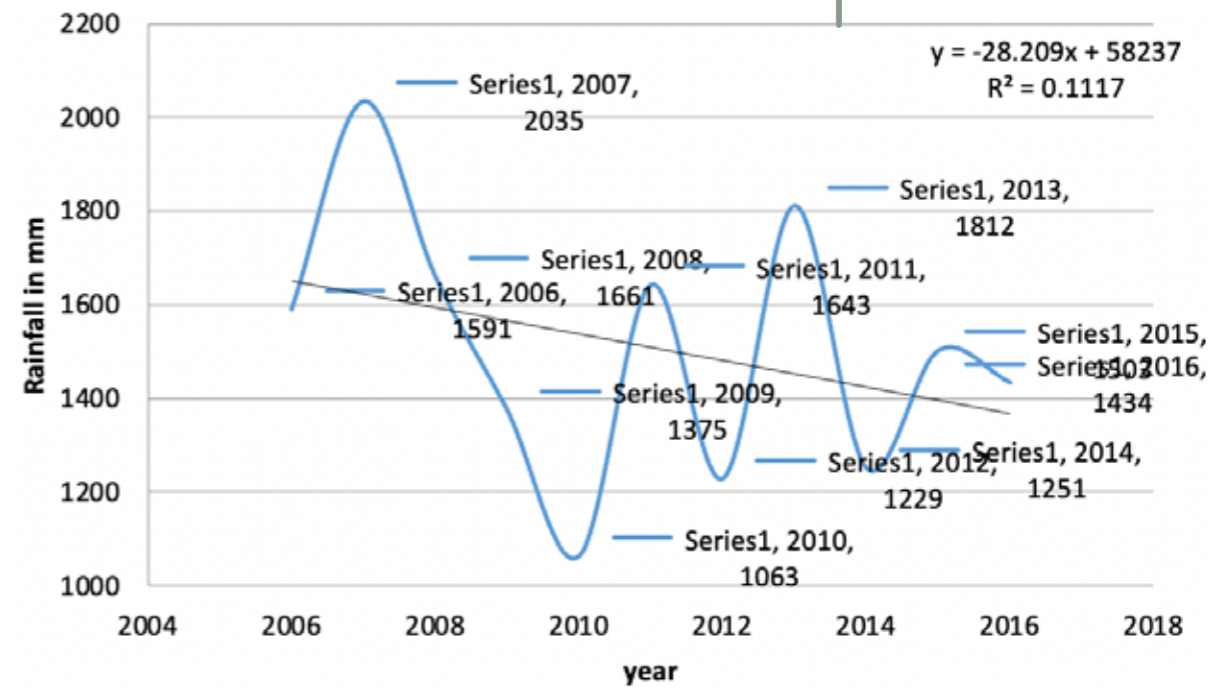
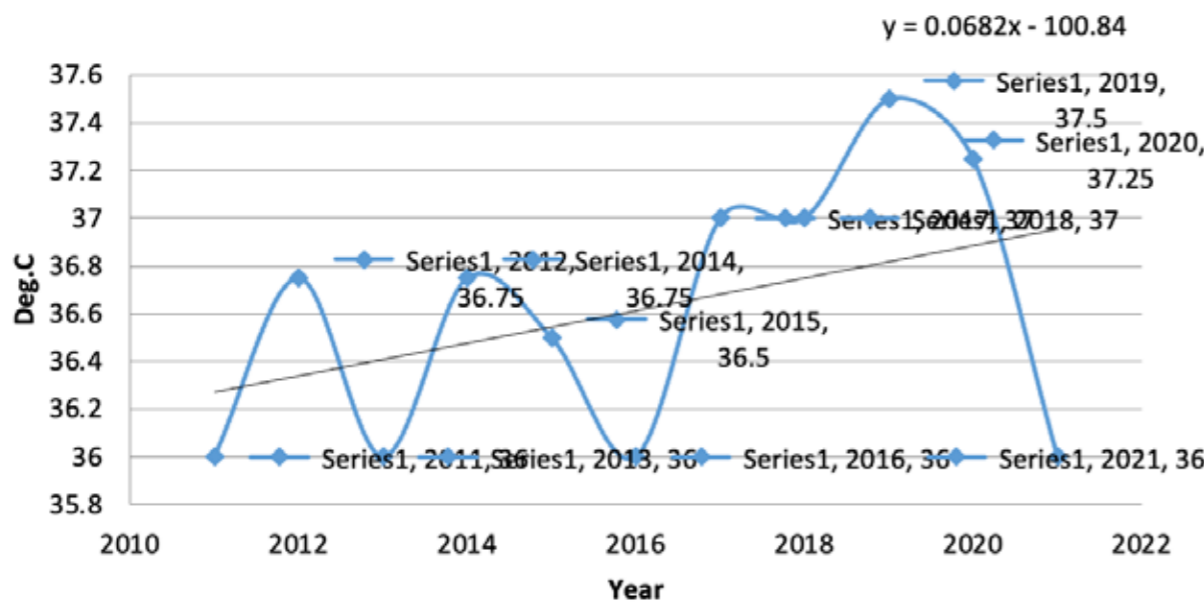
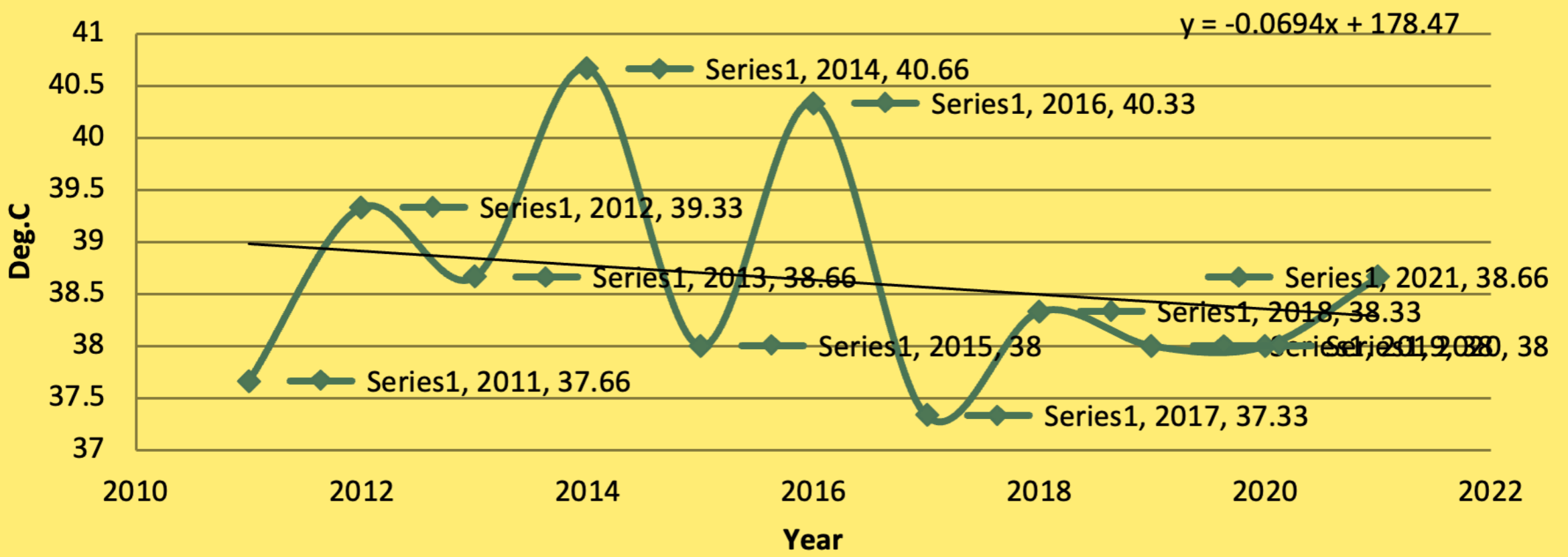
Note the calculated average maximum and minimum temperatures in different seasons. Take the months of March-May for Summer, June-September for the Monsoons and December-January for Winter.

Study the historical data of Annual Rainfall in Gangetic West-Bengal, obtained from the [Indian Institute of Tropical Meteorology \(IITM\), Pune](#), during 1986-2016.

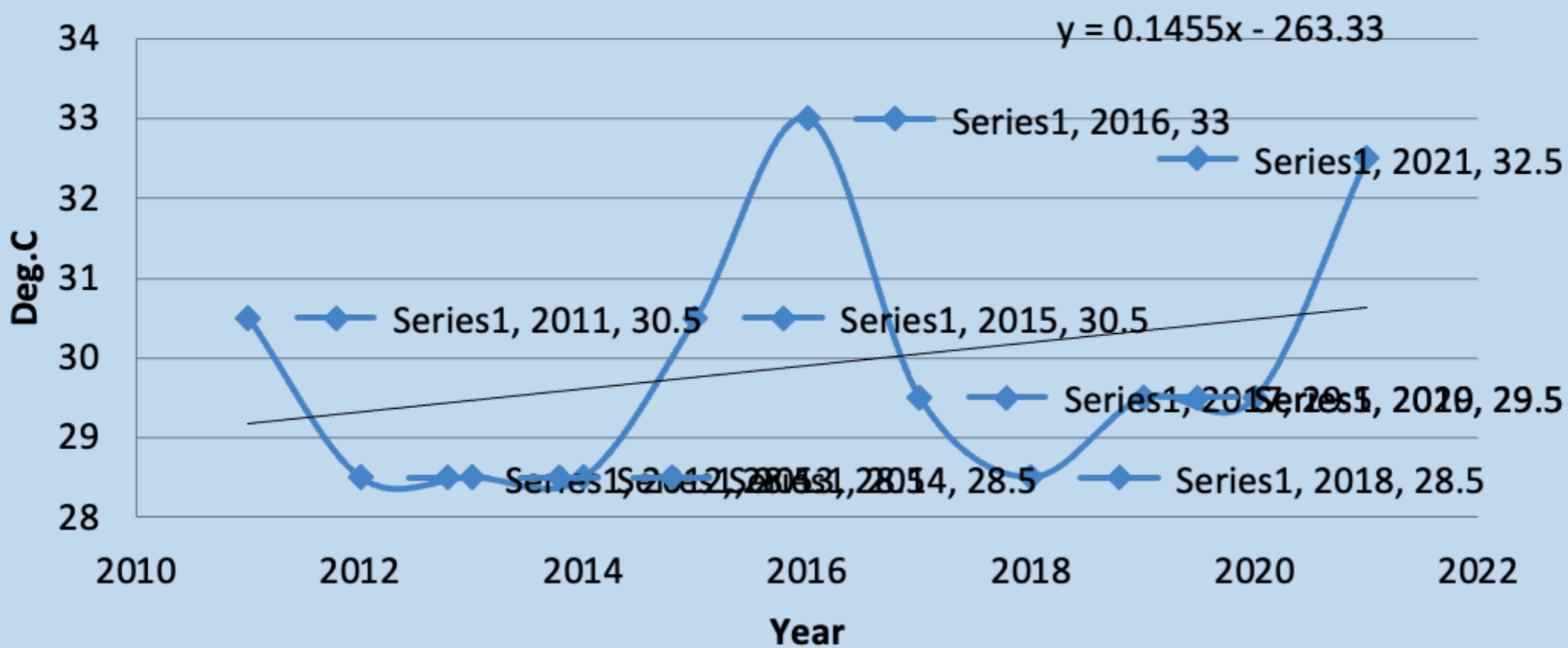
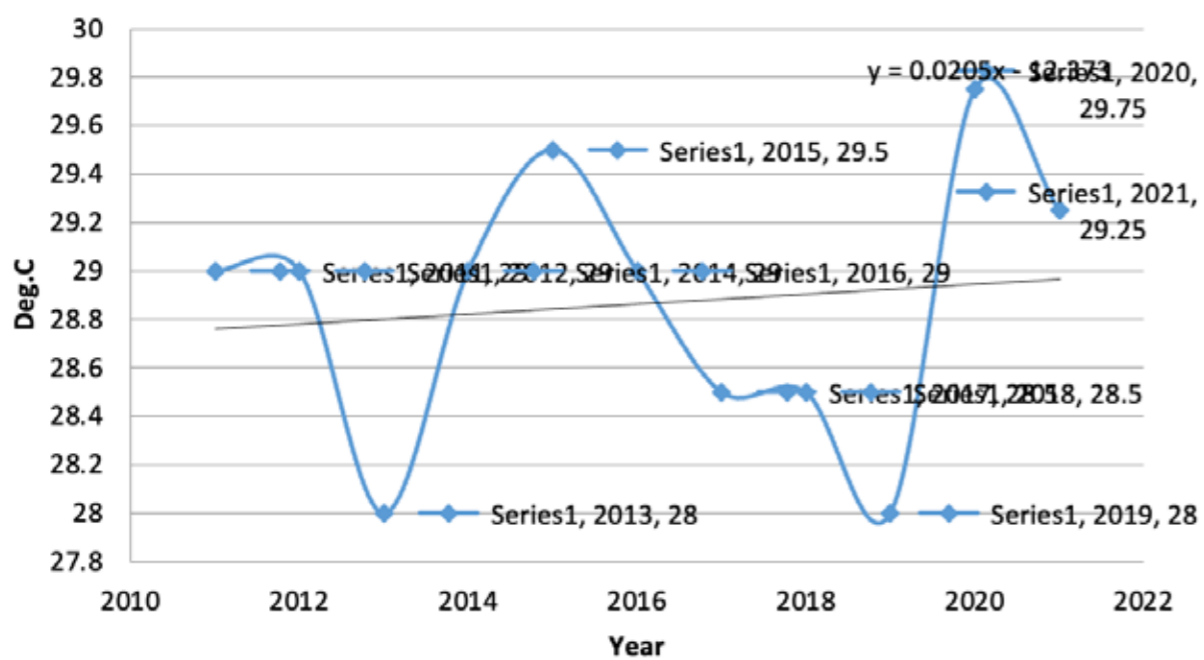


Source <https://www.wunderground.com/history/monthly/in/dum-dum/VECC/date/2021-10>

RESULT OF THE STUDY



MONSOON MONTHS MAXIMUM



WINTER MONTHS MAXIMUM

The maximum temperature of the Monsoon and Winter months has increased slightly

CO2-earth

Numbers for living on Earth

Daily CO₂

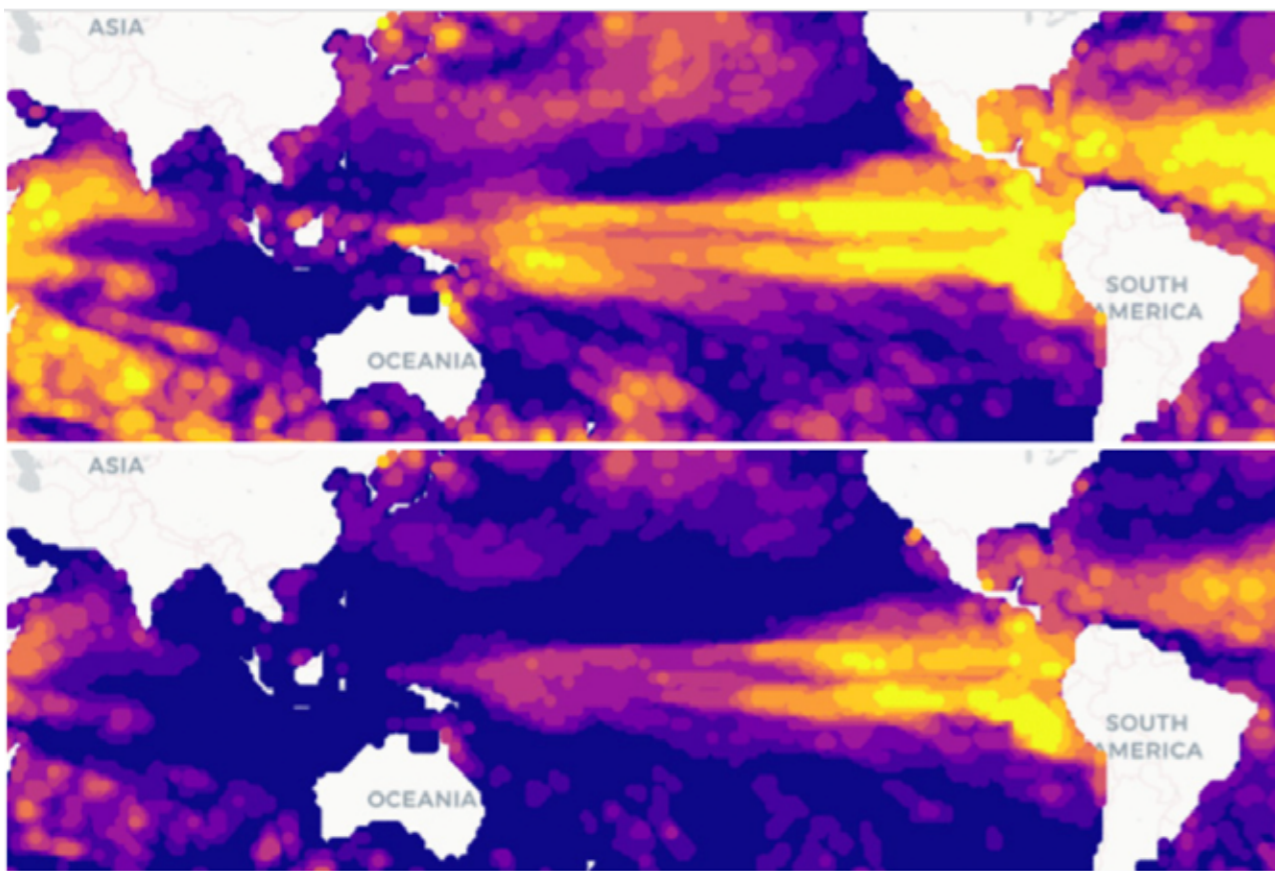
Jul. 8, 2023 = Unavailable
Jul. 8, 2022 = 419.16 ppm

June CO₂

June 2023 = 423.68 ppm
June 2022 = 420.99 ppm

May Temperature

+1.22°C relative to 1880-1920



OCEAN WARMING SINCE 1991 DOUBLES THE SIZE OF THE MARINE HEAT WAVE FORECASTED FOR SEPTEMBER 2023

350.org

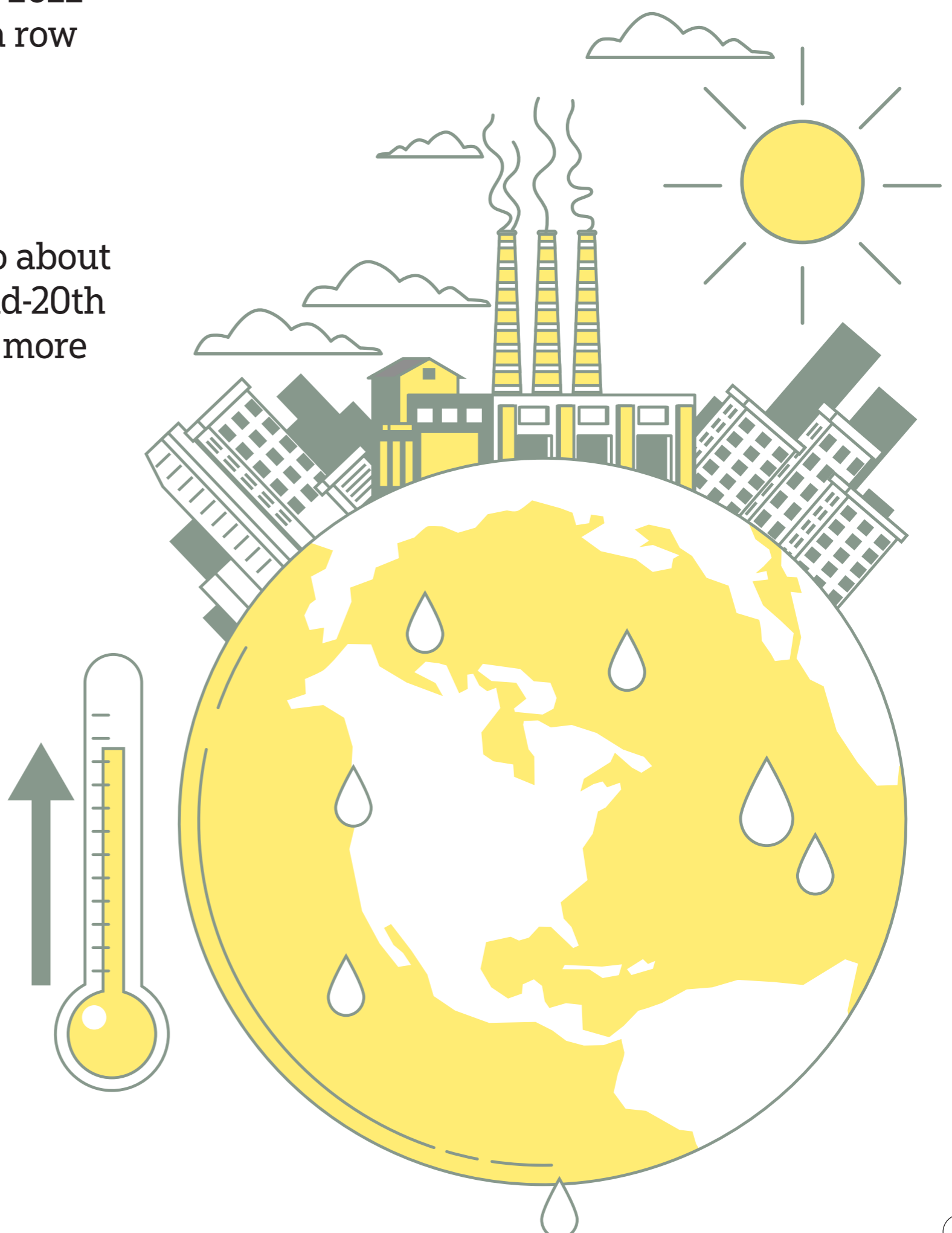


CARBON DIOXIDE LEVEL IN THE ATMOSPHERE -0.035% (350 PPM)

Based on [the annual report from the National Oceanic and Atmospheric Administration \(NOAA's\) Global Monitoring Lab](#), the global average atmospheric Carbon dioxide (CO₂) was 417.06 parts per million ('ppm' for short) in 2022, setting a new record high. The increase between 2021 and 2022 was 2.13 ppm—the 11th year in a row where the amount of CO₂ in the atmosphere increased by more than 2 ppm.

Emissions of CO₂ rose slowly to about 5 billion tons per year in the mid-20th century before skyrocketing to more than 35 billion tons per year by the end of the century.

Do visit these websites—
<https://350.org/>
<https://www.co2.earth/daily-co2>
www.climate.gov



07 | Learning with Moving Images

Films on Climate Change

Films are excellent tools for teachers to help students learn and to trigger their critical and creative thinking. Bichitra Pathshala promotes 'learning with moving images' and has developed a simple method to enable this.

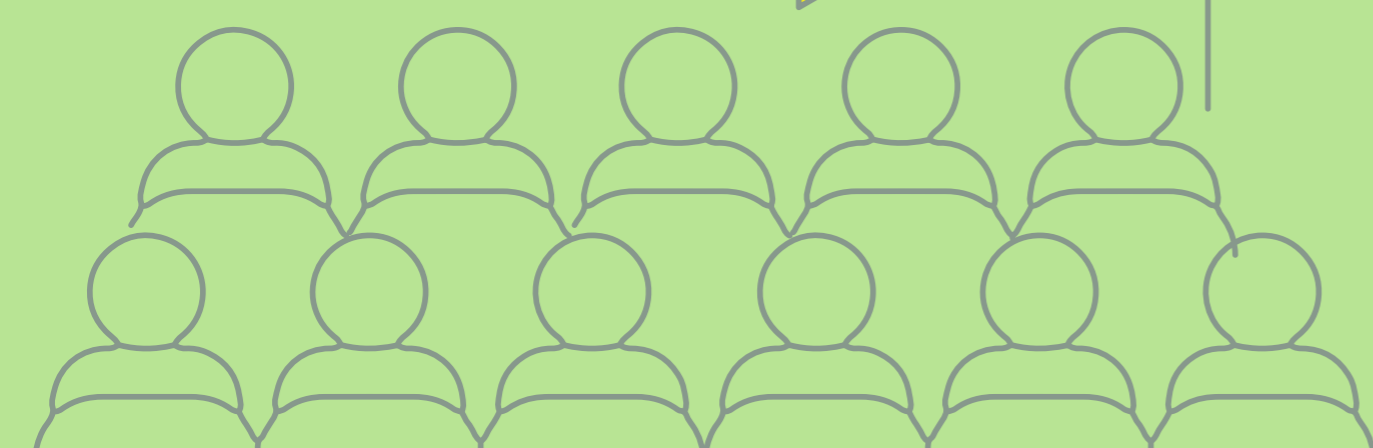
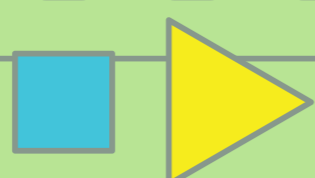
This comprises the following steps:

- Choose an appropriate film/clip in line with the learning objectives.
- For a 40-minute class, the clip should be at most 5 to 6 minutes long. Not more.
- Have a pre-screening discussion in class. The discussion is necessary to consolidate the students' knowledge of the subject and arouse their curiosity about the film.
- After the screening, have a prolonged discussion to gauge the thought processes set off by the film. This discussion will help to make the learning participatory. Allow students to construct their own knowledge from the film material.
- Round off the session with an activity—preferably a group one.

Following the above, topics related to Climate Change can be effectively discussed with students of all age groups. The choice of the film or film clip must be age appropriate for this exercise to yield good results.

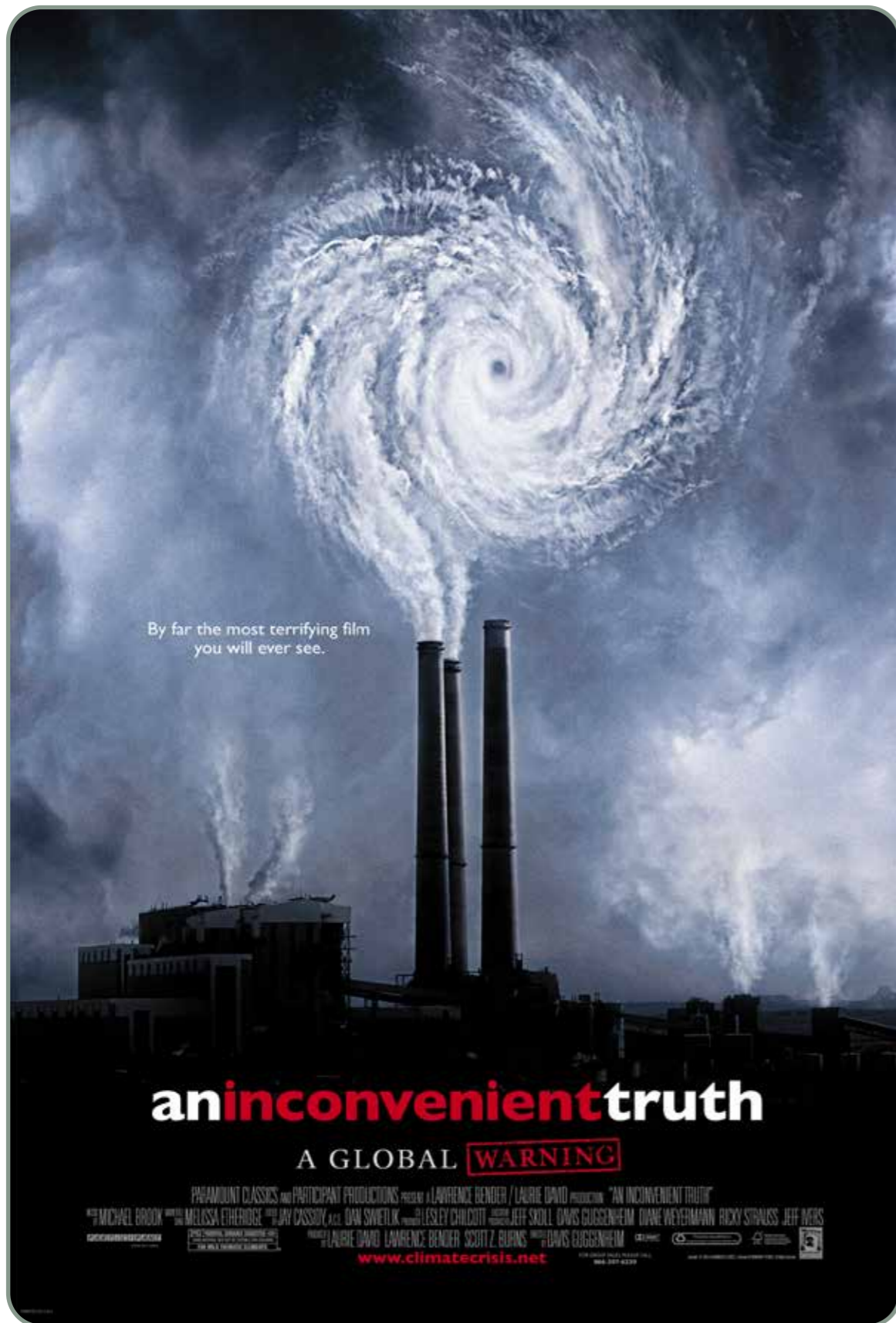


Subha Das Mollick is a filmmaker and a professor of media studies and film studies. As the founder secretary of Bichitra Pathshala, she has developed a pedagogy for using film clips as teaching and learning aids. The material for her course 'Cinema in the Classroom' is available as an open education resource. She can be reached at subha.dasmollick@gmail.com



Here are some suggested films.
The first two films in the list have attained the status of 'textbooks on Climate Change' and are widely used as educational material.

01
An Inconvenient Truth
(2006) Duration 97 mins



Director
Davis Guggenheim

Written by
Al Gore

Winner of two Academic Awards (Best Feature Length Documentary and Best Original Song) in 2007

The film is available on
Amazon Prime

About the film
This is one of the most talked about documentaries.

Director Davis Guggenheim eloquently weaves the science of global warming with former Vice President Al Gore's personal history and lifelong commitment to reversing the effects of global Climate Change.

A favourite with audiences and critics alike, *An Inconvenient Truth* makes the compelling case that global warming is real, it is man-made, and its effects will be cataclysmic if we don't act now. Gore presents a wide array of facts and information thoughtfully and compellingly: often humorous, frequently emotional, and always fascinating. The theme song 'I need to Wake Up' has also captured tremendous popular imagination. *An Inconvenient Truth* accomplishes what all great films should: it leaves the viewer shaken, involved, and inspired.

Source Amazon

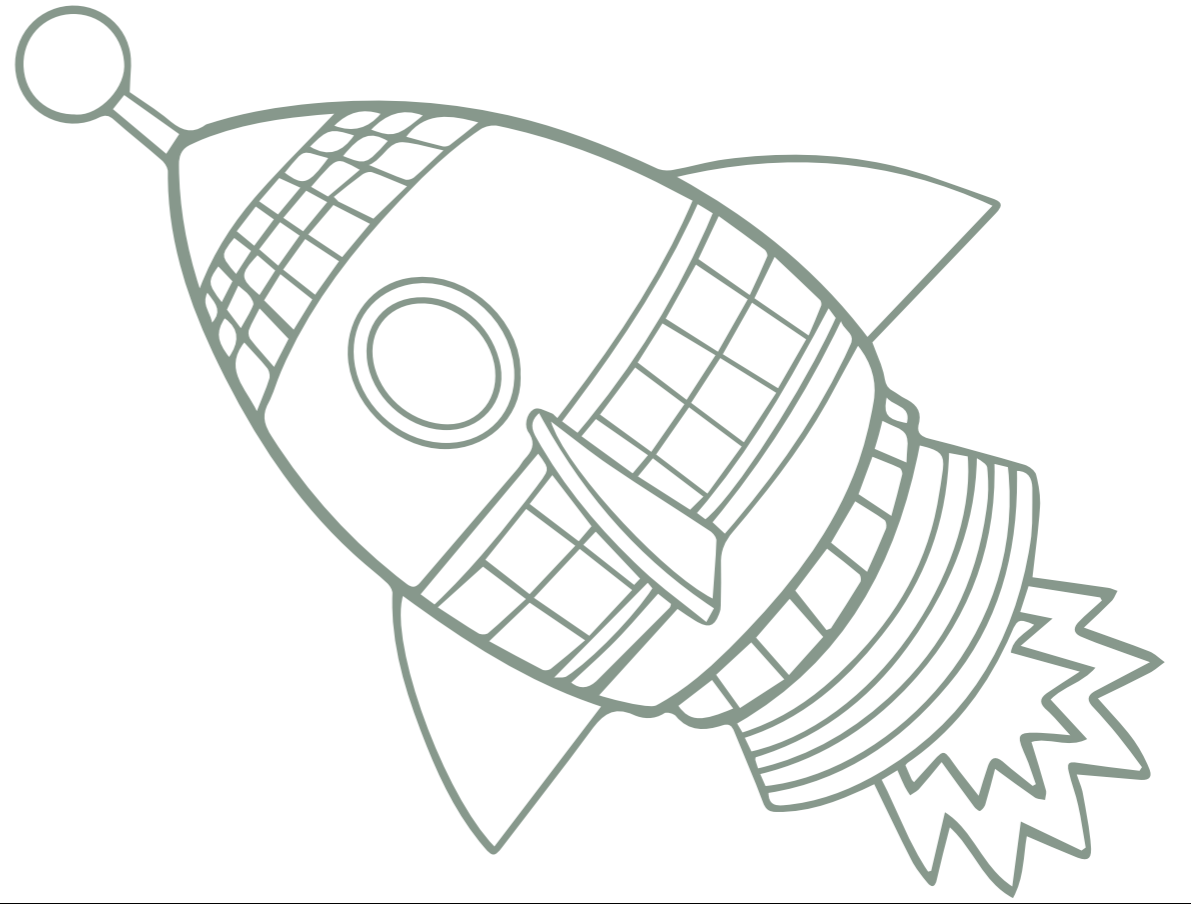
Ways to use the film in the Classroom

Depending on the age group of the students, the teacher can use different parts of the film to generate discussion at different levels. For example, the clip from the Futurama episode can be used to humorously teach the greenhouse effect to the students of Class VI.

Students of Classes VIII and IX may be asked to work on the data about Carbon dioxide emissions and the rise of Earth's temperature. The film presents data up to 2005. The students can do their own fact-finding and update the data. They can also research how the Earth's average temperature is calculated and thus speculate on the authenticity of the data.

Students of all classes will likely be interested in the plight of animals vulnerable to global warming. The animated sequences in the film will have students relate to their pets or the animals they encounter in their immediate environment. The students can create their own animation or storyboards inspired by film sequences.

Among the film's stunning visuals are 'Earthrise' and 'Blue Marble.' The teacher can download these iconic visuals from the internet and narrate the history of when and how these were taken. The students can compare these images of the Earth with those of Mars and Venus. A discussion can be held on voyages in the past, ongoing and planned to other planets and signs of life beyond Earth.



EARTH RISE CAPTURED BY APOLLO 8



THE BLUE MARBLE CAPTURED BY APOLLO 17

Students can bring an Indian perspective to the film by downloading pictures of drought, deforestation, flood etc, in India and relate those to Google Earth visuals. They can also identify an eminent environmentalist in India (as Al Gore is) and write about the person/make a film on the person. FYI: filmmaking is a popular activity in all schools today. The students can analyse *An Inconvenient Truth* from a filmmaker's perspective and figure out why this film works so well with the audience and how it is an exemplary piece of science communication.

Instead of showing the film in one session, it is strongly recommended that it be shown in 3 parts on 3 consecutive days. On day 2 and day 3, the session can begin with a recap discussion. The pre-screening and post-screening discussions by the teacher/facilitator need to be carefully planned.

A group activity to be assigned after the last screening session. Here are some suggested group activities:

- Make a table of the 2006 climate-related data as shown in the film and compare it with data for 2023.
- Write a story of the journey of the River Ganga from Gangotri to Ganga Sagar. Do internet-based research on the Gangotri glacier that feeds the Ganga. Speak to trekkers who regularly visit Gangotri. Ask them if they have noticed any changes in recent years.
- Classes VI and VII students may be shown selected portions of the film instead of the entire film. They can then be given the exercise of identifying and depicting major greenhouse gases in the atmosphere and research and document the sources of these gases. Students with a penchant for drawing can prepare their storyboard of the greenhouse effect/design a poster for the film *An Inconvenient Truth*.

02

BEFORE THE FLOOD

(2016) Duration 96 mins

Director

Fisher Stevens

Written by

Mark Monroe

<https://youtu.be/zbEnOYtsXHA>

About the film

Before the Flood is a film that alerts viewers to the urgent need to comprehend and implement anthropogenic actions that could help avert Earth's environmental crisis. The film follows UN Messenger of Peace and famous actor Leonardo DiCaprio on his incredible journeys to five continents and the Arctic to witness the devastating impacts of Climate Change first-hand. It appeals to all to help prevent the catastrophic disruption of life on our planet should Climate Change be allowed to become irreversible.



 NATIONAL
GEOGRAPHIC



THE GARDEN OF EARTHLY DELIGHTS BY HIERONIMUS BOSCH (BETWEEN 1490 AND 1510)

Ways to use the film in the Classroom

Leonardo DiCaprio has a large fan following. As a warm-up discussion before the screening, students may be asked which films of Leonardo they like the best and whether they remember the names of the characters played by Leonardo. Then the students can be told that they will now watch a film in which Leonardo has appeared as Leonardo.

In the film's opening sequence, the students learn about Leonardo's childhood and the significance of the triptych 'The Garden of Earthly Delights' that hung over his crib. The Earth's impending climate crisis (if we don't do something to rectify things) could be related to the triptych's final panel that shows destruction. The triptych picture can be shown to the class, and the students encouraged to interpret the image and identify the different elements.

Students can be asked to look for an Indian equivalent of the triptych that depicts the world's creation, preservation, and destruction. It could be related to the trinity—Brahma, Vishnu, Maheshwar, perhaps.

The film could be divided into several segments depending on the places Leonardo visited and the people he interacted with. Probably Indian students will relate most readily to the Indian segment (33:24–39:30).

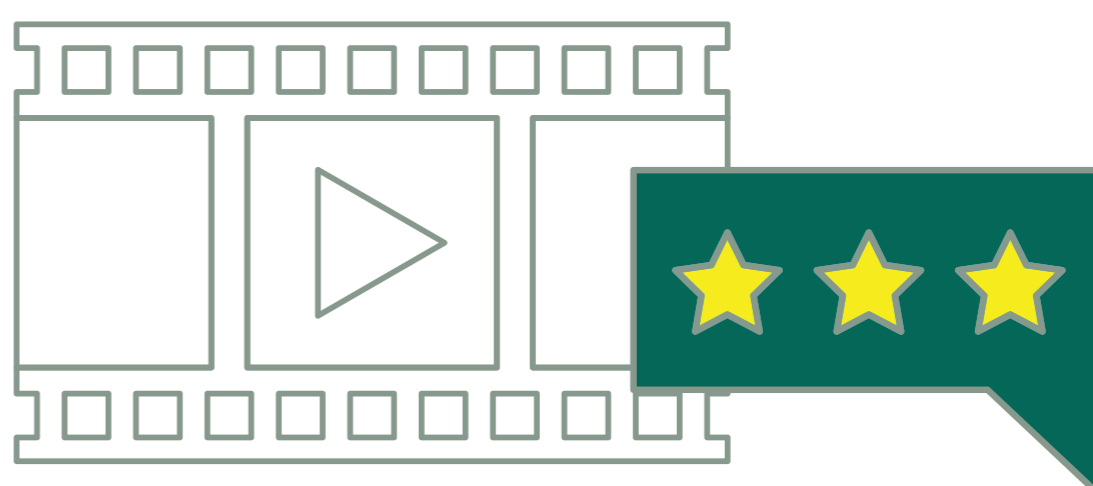
- Students can be asked to write about where they would take Leonardo if they were given the job of being his guide.
- As an exercise, they can also write an imaginary conversation between Leonardo and themselves or between Leonardo and the wise old man of the village Leonardo visited.

The segment where Leonardo visits the Arctic and Greenland is also interesting. With younger students, this segment can be related to animation films such as *Ice Age*. This animation film shows both extinct animals and imaginary animals.

Discussions can be held on the life forms found in the Arctic region and how these are likely to be affected by the melting of ice.

The film introduces the concept of 'Carbon Tax'. This new concept may be discussed with the students—how Carbon Tax could help and how much tax ought to be levied.

Lastly, the students can be asked to plan an Indian version of *Before the Flood* with a star of their choice.



Two Guide Books

Teachers may be interested in referring to the discussion guide on *Before the Flood*, created by National Geographic.

[Here is the link](#)

This guide book focuses on core issues discussed in the film and gives details of the experts who have appeared in the film. Page 16 is titled 'Take Action: Solutions Do Exist'. On page 17 are the points for discussion.

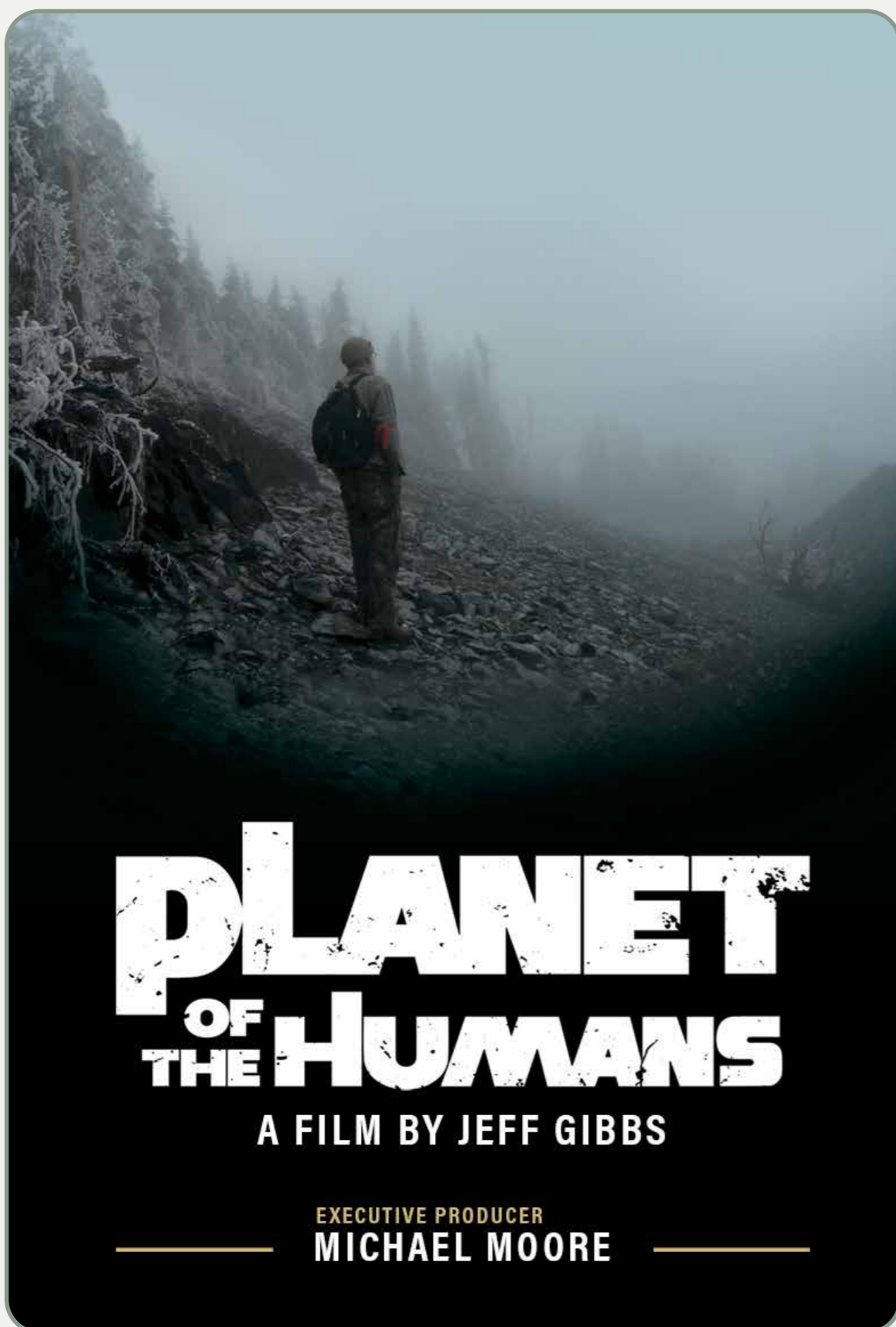
For example, there is a question: In *Before the Flood*, we saw countless ways that our consumption is ruining the environment. What outcomes were most shocking to you? What solutions provided you with the most optimism for the future?

On page 18 the statistics mentioned in the film and page 19 onwards are the details of the resources referred to in the film. The last page has a beautiful underwater picture of Leonardo deep in the Pacific Ocean and a link to a feedback form.

03

PLANET OF THE HUMANS

(2019) Duration 100 mins



Director & Producer
Jeff Gibbs

About the Film

The film *Planet of the Humans* questions whether green energy alone can solve society's expanding resource depletion without simultaneously reducing consumption and/or population growth, as all existing forms of energy generation require some consumption of finite resources.

Why this Film

Screening the film for students can have several educational benefits. Here are some reasons why the film may prove to be valuable:

- **Has Engaging Visuals**
The documentary combines visual storytelling with informative content, making it an engaging student medium. It can capture their attention and spark discussions, helping them connect with the subject matter more deeply.
- **Develops Critical Thinking**
The film encourages students to think critically about all pros and cons. It presents alternative perspectives and challenges common assumptions, promoting a deeper understanding of the complexities involved in addressing environmental issues.

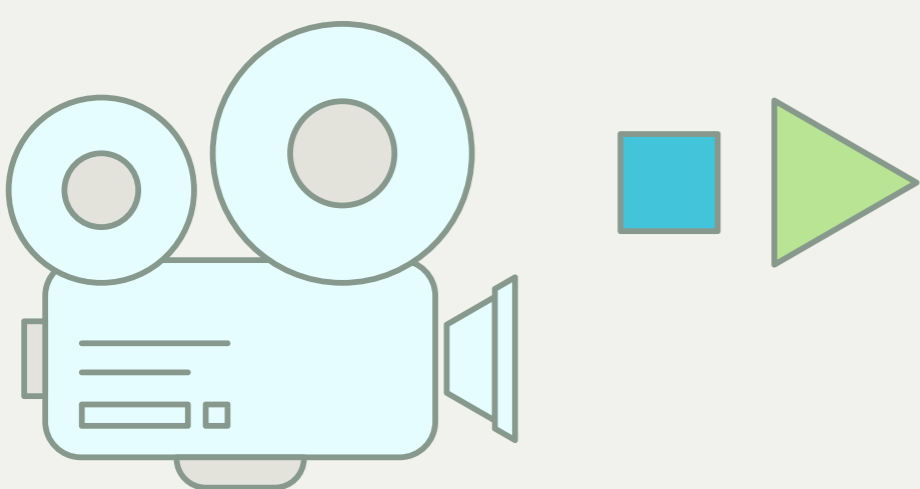
<https://www.youtube.com/watch?v=Zk11vI-7czE&themeRefresh=1>

- **Expands Environmental Awareness**
By watching the film, students can gain a greater awareness of the environmental impact of human activities and look to responsible and informed decision-making to ensure a sustainable future.
- **Encourages Systematic Thinking**
As the film emphasises the importance of the interconnectedness of various aspects of environmental sustainability (such as energy production, consumption patterns and corporate influence), it encourages students to think holistically and understand the broader implications of any actions.
- **Empowers Action**
The film encourages students to participate actively in shaping a sustainable future. It fosters a sense of responsibility and inspires them to explore innovative solutions and advocate for community change.
- **Energy Transition Debate**
Organise a debate where students can take on different roles, such as those of government officials, environmental activists, industry representatives and community members. Assign them to argue for or against the transition to renewable energy in India. This activity promotes critical thinking, persuasive skills, and understanding of diverse perspectives.
- **Documentary Critical Analysis**
Have students critically analyse and review the documentary itself. They can write an essay or create a video presentation discussing the film's storytelling techniques and overall effectiveness in delivering its message. This activity allows students to apply their analytical and communication skills while reflecting on the power of documentaries as a medium for raising awareness. As critics have noted certain fallacies in this film, the activity will make the students go on a research spree to clarify what is true and what is not.

Activities with the film

After students watch the film about renewable energy's advantages and challenges, several activities can be designed to engage the students further and reinforce their understanding. Here are some suggestions:

- **Renewable Energy Research**
Divide students into small groups and assign each group a specific renewable energy source (solar/wind/hydroelectricity/nuclear). Have each group research and create a presentation or poster showcasing the benefits, limitations, and potential applications of that energy source in India. Encourage the students to explore current initiatives and projects in India related to their chosen energy source.
- **Community Awareness Campaign**
Have students create a community awareness campaign on renewable energy. They can design posters, pamphlets, or short videos that highlight the benefits and importance of renewable energy adoption. Encourage them to consider local contexts (their home or school) and address specific challenges or misconceptions related to renewable energy in India. They can share their campaigns with the school community or even present them to local authorities or community organisations.
- **Creative Writing**
Invite students to engage in creative writing exercises inspired by the film. They can write poems, short stories, or even scripts for short films or plays that explore the themes of renewable energy, environmental sustainability, or the consequences of human actions on the planet. Encourage them to think imaginatively and use their writing skills to convey powerful messages.





04 OUR PLANET

An 8-part Series Narrated by Emmy and BAFTA winner Sir David Attenborough (English-speaking countries), Salma Hayek (Latin America) and Penélope Cruz (Spain)

Executive producers

Alastair Fothergill, Keith Scholey and Colin Butfield

The docuseries is available on Netflix

<https://www.netflix.com/in/title/80049832?source=35>

About the series

Winner of two Emmy Awards—*Our Planet* is a groundbreaking Netflix original documentary series. Voiced by Sir David Attenborough, the series showcases the world's incredible species and most at-risk habitats in ways they have never been seen before—from ice caps and deep oceans to deserts and remote forests.

More than just a showcase of the planet's wonders, *Our Planet* aims to inspire people worldwide to understand the natural world as never before. The series addresses conservation issues while featuring these desperate animals in their respective home regions. It has been noted for its greater focus on humans' environmental impact than traditional nature documentaries.

The series also focuses on the breadth of the diversity and fragility of habitats around the world, including the Arctic wilderness, the deep sea, the vast landscapes of Africa and the diverse jungles of South America.

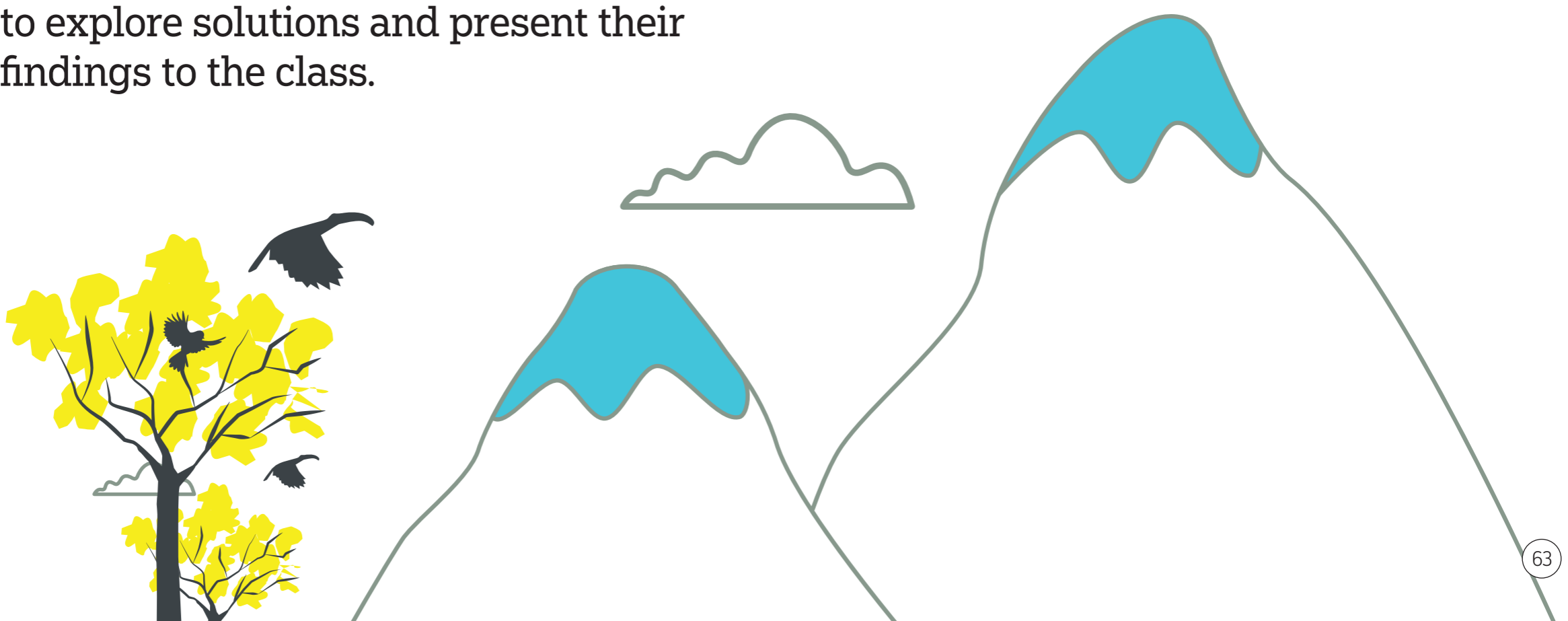


Ways to use the film in the Classroom

The series can be a valuable resource for incorporating environmental education in schools. Here are some ways it can be utilised:

- **Introduction to Environmental Issues**
Show selected episodes or segments from the series to introduce students to various environmental challenges such as Climate Change, deforestation, habitat loss, and species extinction. These visuals can help students understand the urgency and complexity of these issues.
- **Discussion Starters**
Use the series as a starting point for classroom discussions on environmental topics. After watching an episode, engage students in critical thinking and open-ended discussions. Encourage them to share their thoughts, ideas, and concerns about the issues highlighted in the series.
- **Case Studies**
Use specific episodes or species-focused segments from the series as case studies. Explore the ecological interactions, adaptations, and the impact of human activities on these habitats and species. This approach helps students understand the interconnectedness of ecosystems and the consequences of human actions.
- **Research Projects**
Assign research projects based on themes covered in the series. For example, students could investigate the effects of plastic pollution on marine life or the consequences of deforestation on biodiversity. Encourage students to explore solutions and present their findings to the class.
- **Visual and Multimedia Learning**
The stunning visuals and captivating narratives in the series can engage students in visual and multimedia learning experiences. Use clips or images from the series to enhance classroom presentations or create multimedia projects.
- **Cross-Curricular Integration**
Integrate the 'Our Planet' series across various subjects. For example, in science classes, focus on ecological concepts and environmental science. In language arts classes, students can write reflections, poems, or essays inspired by the series. In art classes, they can create artwork that represents environmental themes or issues.
- **Field Trips and Outdoor Activities**
Organise field trips to nature reserves, wildlife sanctuaries, or local parks as an extension of the series. Encourage students to observe and document local flora, fauna, and natural processes. This hands-on experience helps them connect what they've learned from the series to their surroundings.
- **Follow-up Research and Action**
Encourage students to conduct further research on environmental issues highlighted in the series. This can lead to the development of action plans, such as organising awareness campaigns, initiating recycling programs, or participating in local conservation projects.

Remember to supplement the series with additional resources, guest speakers, and hands-on activities to provide students with a comprehensive and well-rounded environmental education experience.



SOME INDIAN FILMS

05

THE ELEPHANT WHISPERERS

Winner of the 2023 Oscar for Best Documentary Short Film. The film's win is celebrated across India. However, not much is written about what the film teaches.

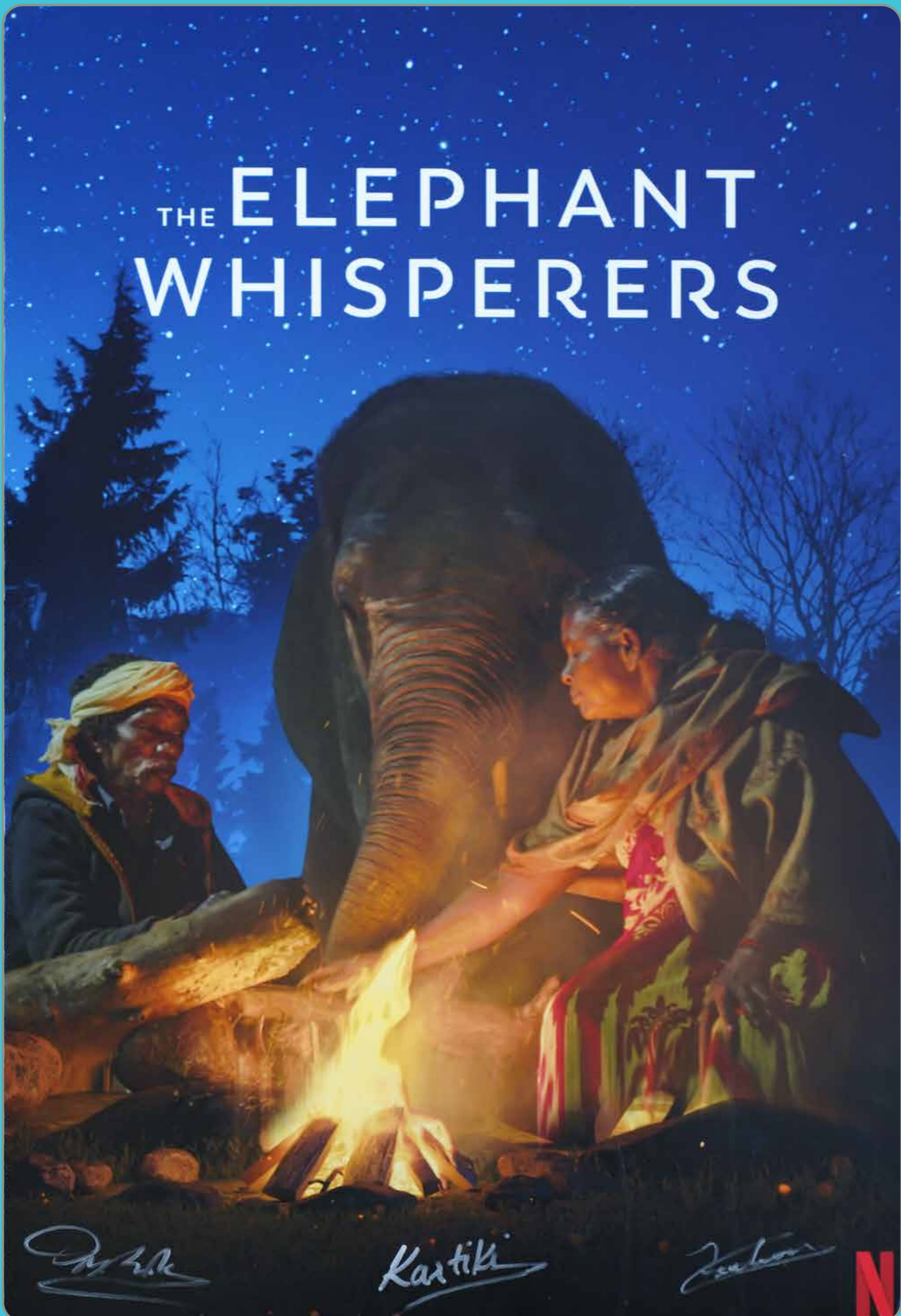
(2022) Duration 41 mins

Director
Kartiki Gonsalves

Producer
Sikhya Films

Winner of the 2023 Academy Award 'Best Documentary Short Film'

The film is available on
Netflix



About the Film

The Elephant Whisperers tells the story of an indigenous couple named Bomman and Bellie who are entrusted with an orphaned baby Indian elephant named Raghu. They take great pains to ensure that the fragile, injured infant survives and grows to be a healthy juvenile. A strong bond develops between the couple and the elephant. They adopt another elephant Ammukutty and eventually must give up Raghu. Set in the Mudumalai National Park on the border of Karnataka and Tamil Nadu, the documentary also highlights the natural beauty of the location. It explores the life of the tribal people who exist in harmony with nature. The film is not just a heart-touching story of a bond between animals and humans and co-existence but also showcases Indian culture and traditions of environment conservation.

Source Wikipedia

Ways to use the film in the Classroom

The pre-screening discussion could be on films that include elephants. For example, *Jungle Book*, *Safed Haathi*, *Haathi Mere Sathi*, among others.

Children can be encouraged to narrate their experiences, if any, of close encounters with elephants.

Conversations about national parks the children might have visited, leading to discussions on the importance of forest and wildlife reserves could follow.

The film begins by establishing the Mudumalai National Park. It then brings in the three lead characters—Bomman, Bellie and Raghu. All three have different relationships with the forest. After the first 10 minutes, the teacher can pause the film and discuss how each character relates to the forest.

Before pressing the 'Play' button again, ask some pointed questions about the lifestyles of Bomman and Bellie, their daily routine, and their Carbon footprints. A comparison could then be made about the Carbon footprints of each student.

The remaining 30 minutes of the film can be watched in one go. A discussion to follow on the scenes the students liked the best and why these and not others. Questions such as the following could also be asked.

'How is your lifestyle different from that of Bomman's?'

Would you like to step into Bomman's position for three days? If so, why?'

Some follow up activities are:

What constitutes a Forest Reserve?

What is the difference between a Forest Reserve and a Wildlife Sanctuary?

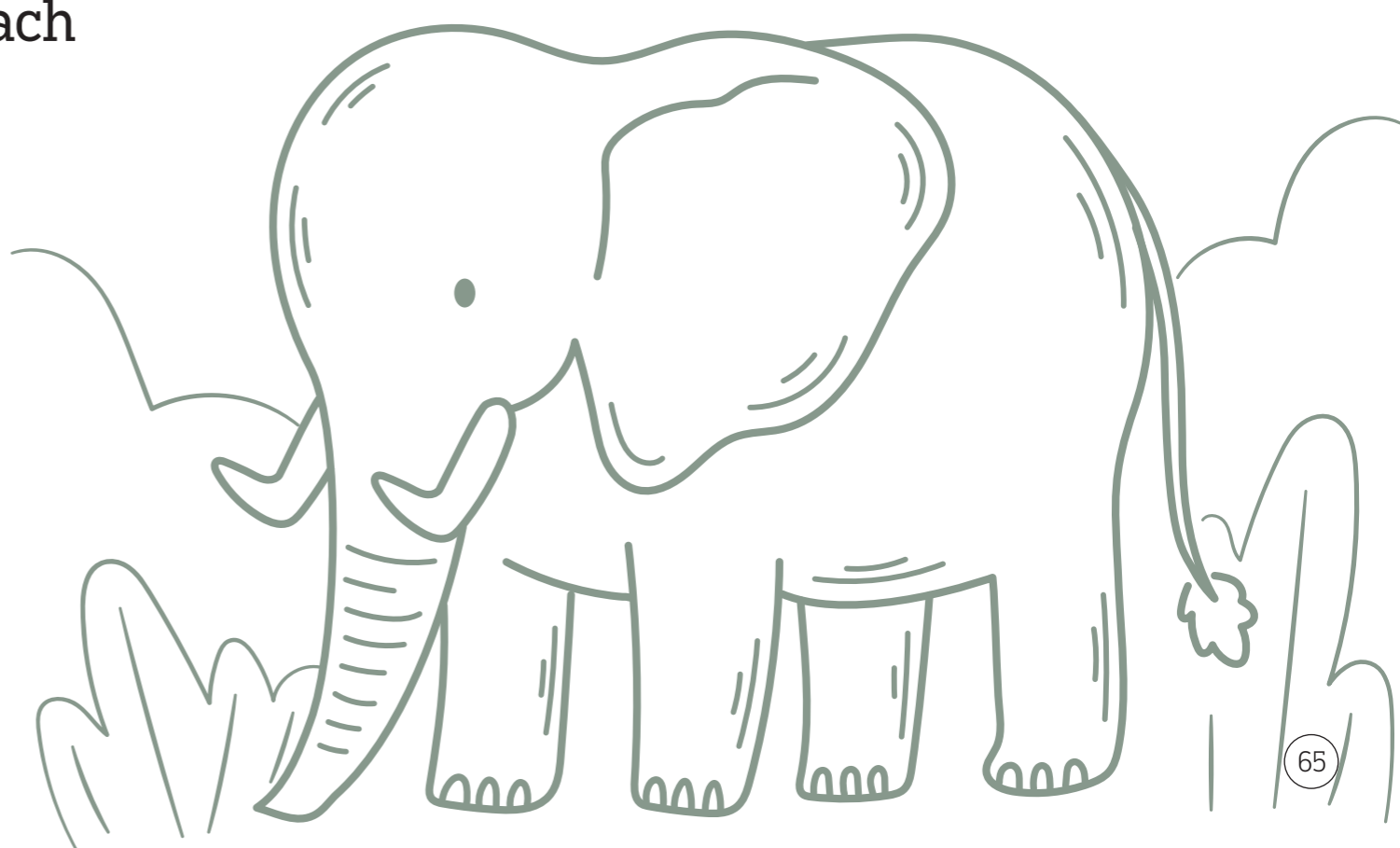
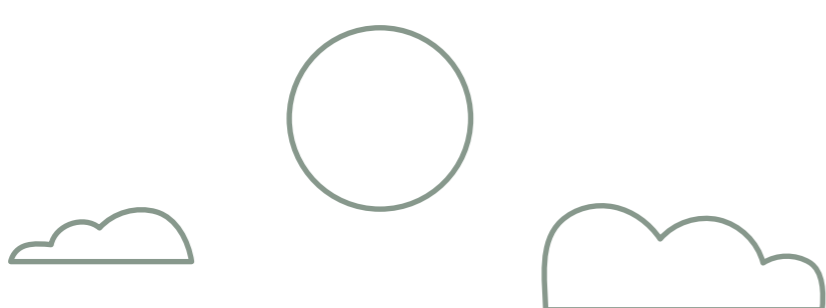
List of India's Forest Reserves

A study of the Mudumalai National Reserve—the geographical location, average rainfall, climatic conditions, average temperature in different months of the year, dominant flora, and fauna

How will Climate Change likely affect Mudumalai?

Research how elephants are depicted in India's folk and classical art

Write about elephants in Indian folklore and mythology





06
ALL THAT BREATHES
(2022) Duration 97 mins

Director
Shaunak Sen

Winner, the Golden Eye Award at Cannes, Grierson Award at London, NBR Award, USA, Grand Jury Prize in World Cinema Documentary Competition at Sundance. Nominated for the Best Feature Length Documentary, 2023 Academy Awards

The film is available on
Disney+ Hotstar

About the film

Two brothers living in New Delhi, watch the sky speckled with black kites who come to feed on meat that their relatives toss up—as Muslims believe that feeding these birds of prey would dispel their troubles. Some birds fall from the sky and the two brothers make it their life's work to care for the injured black kites. The brothers operate a bird clinic where 20,000 raptors have been cured over the last 20 years. Impressed with their dedication and the spirit, Shaunak Sen, the director decided to film them.

He says: 'I am drawn by the subject of the interconnectedness of an ecosystem—one that humans are a part of, not apart from. How man, animals share space and become part of the whole. It is a valuable story.'

Ways to use the film in the Classroom

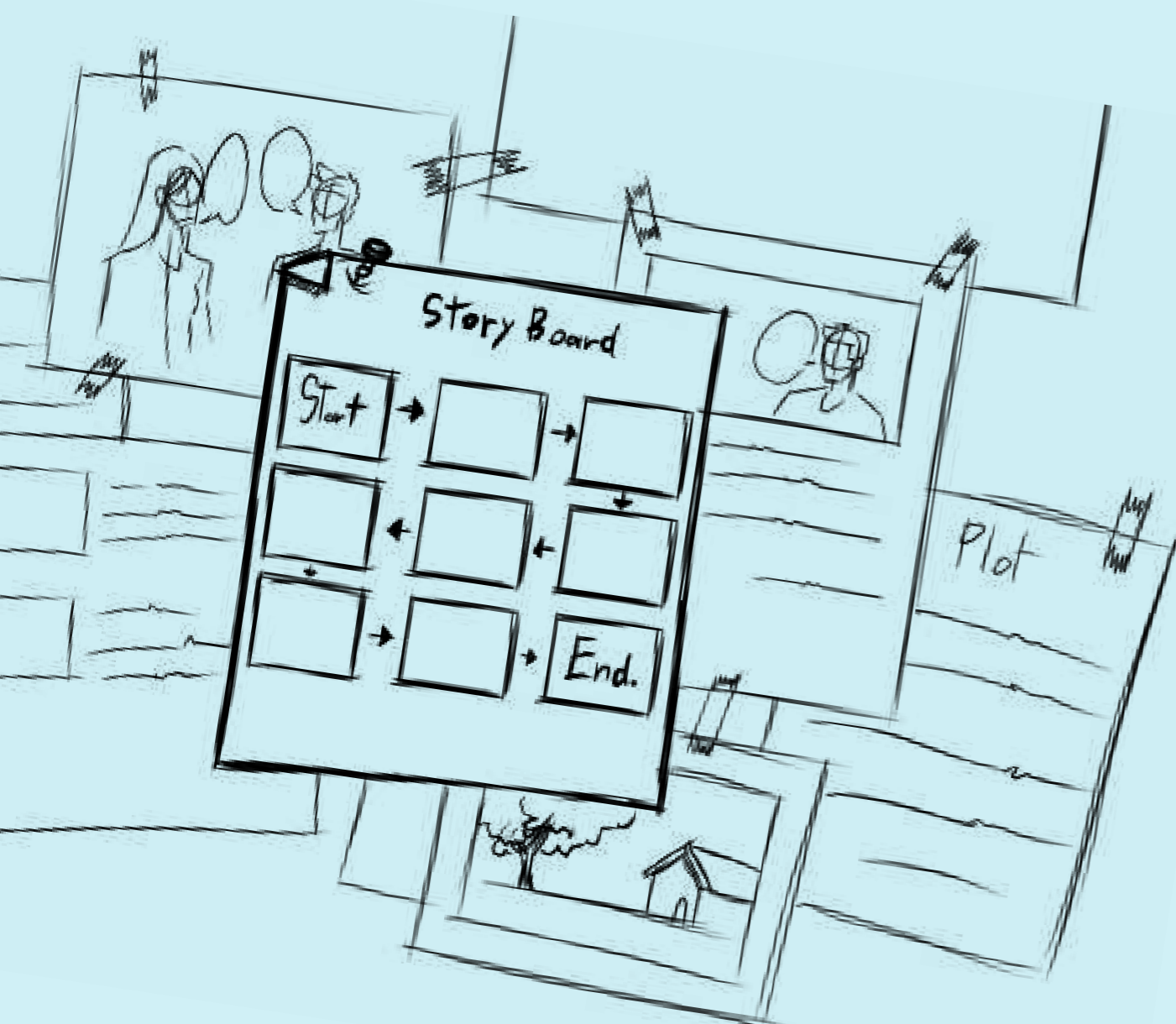
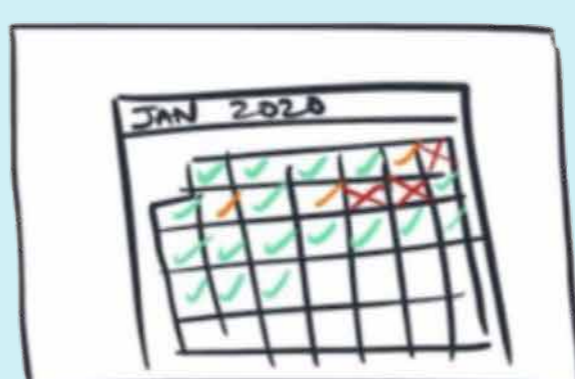
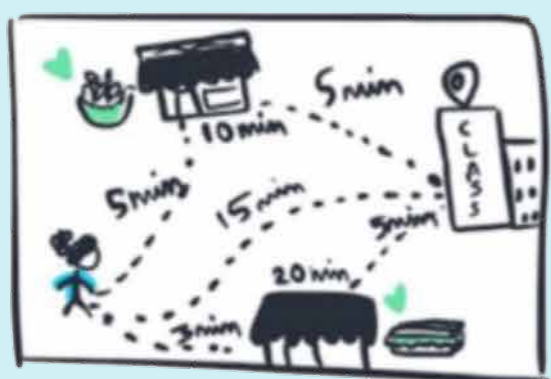
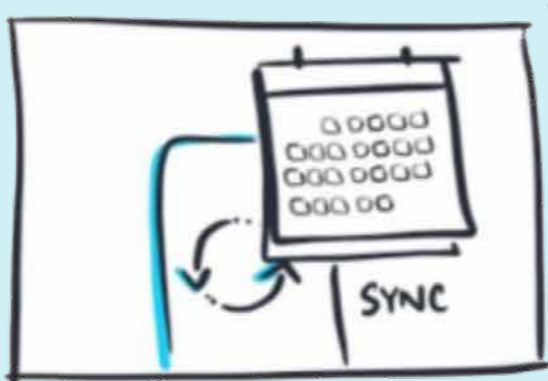
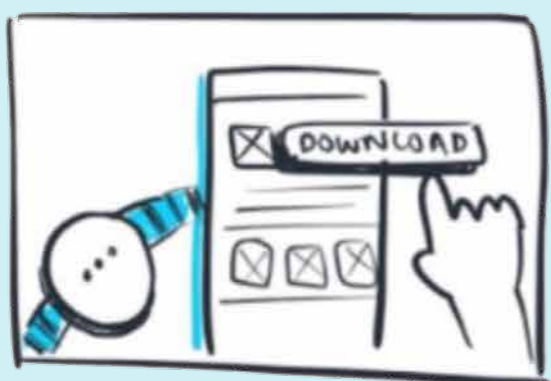
- **Explore a theme or big idea**
Choose a theme or a big idea that relates to the film, such as ecology, culture, resilience, or compassion. Ask students to discuss how the film illustrates this theme or idea and provide examples from the film.
- **Name of the film**
Generate a discussion on the name of the film. Is the name appropriate? The name *All that Breathes* is taken from a comment made by one of the characters. Can the students recall the comment? Would they like to give some other name to the film.
- **The urban landscape**
Ask the students to list the animals seen in the film and tally it with the animals they find in their homes or immediate surroundings. As an exercise they can create a food chain with these animals.
- **Critical appreciation of the film**
Ask the students which scenes in the film they liked the most and why. Give them the exercise of writing the character sketch of the three characters—the two brothers and the young cousin. Ask them which parts of the film were most difficult to shoot. Regarding the structure of the film, ask them whether they find any similarity between the way the film begins and the way it ends. Can they spot such similarities in the camera work in any other portion of the film?
- **Points of view**
The film *All that Breathes* has been narrated from whose point of view? Can the students narrate at least part of the story from the kites' point of view?
- **Locale of the film**
The film is set in Delhi—the capital of India. For those who have never visited Delhi, what impression of Delhi will they get from the film?

Suggested Group Activities

- **Research and present**
Ask students to research about the black kites, their habitat, threats to them, and conservation efforts for them. They can use online sources or books to find reliable information. They should then present their findings to the Class using slides, posters, or videos. They can also include questions for discussion or suggestions for action.
- They can also do this for any other endangered animal of their choice.
- **Animal lovers in urban spaces**
The students can identify animal lovers among their friends, relatives or neighbours. Once they identify animal lovers, the students can interview them, take photos, shoot a video, write a feature that includes ways each individual cares for other species. Set up bird feeders and shelters for birds on their balcony or terrace. Others may make efforts to feed stray dogs in the neighbourhood. Still others could be caring for injured birds or animals.
- **Creatures in the concrete jungle**
Students can take pictures or short videos of animals, birds, insects in their home or neighbourhood and create a montage with the pictures.
- **Write a letter or an email**
Ask students to write a letter or an email to a local or national authority, such as a politician, a journalist, or an activist, expressing their concerns and opinions about the issue of pollution and its impacts on the people and the birds in New Delhi. They should include a summary of the main points from the film, a description of the impacts and challenges of pollution, and a request for action or support. They should also use specific examples from the film or other sources to support their claims.

Films are thus a powerful tool for awakening the mind to new thoughts and ideas and even for a call to action. Teachers can delve into the rich resources of cinema and take film viewing way beyond 'popcorn viewing'. Besides the films discussed in this chapter, many other films focus on environmental issues. It is suggested that teachers create a repertoire of these films and make notes on how they would like to use each while teaching.

08 | Ways to develop and use storyboards



Shankar Subramaniam is an artist, photographer, animator, and graphic designer. He teaches Visual Arts and Photography at The Heritage School, Kolkata. Shankar also freelances. He can be reached at shankarsubramaniam1362@gmail.com

The Storyboard -Taking the First Step

Ask students if they prefer the mundane exercise of reading through a lot of text or viewing moving images. 'Watching films or television is more exciting' will be the likely response.

The traditional education system largely depended on chapters taught through textbooks or notes compiled from printed sources. Today, audio-visual aids are overtaking as educators say these enhance comprehension, engage students, and create an interactive learning environment.

Thus, visual and auditory elements, such as videos, images, animations, and sound clips are good to include in the teaching process. When conducting classes with the help of audio-visuals, the sequence of visuals we use becomes very important. Firstly, the lesson plan should include an introduction to the topic, its elaboration and a conclusion with a concise summary for reference. Next is to work out steps for using audio-visual means. The first step is vital - to create a Storyboard.

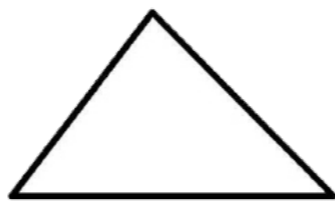
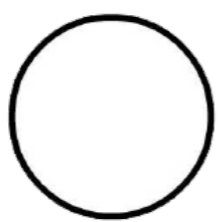
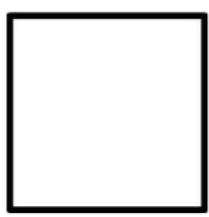
What is a Storyboard?

Storyboards are visually compelling classroom material. These can be created by the teacher as well as by the students (the latter generally prefer working on storyboard assignments rather than a written one). Storyboards can also be given as exercises to the students.

A storyboard comprises several boxes with illustrations or pictures in the order we want to narrate. Dialogues and other information are written within or below each frame. We all love to hear stories. The storyboard is very useful in converting the subject topic into a simplified storyline to be understood by all. Think of it as a comic book version of your story (subject). It also helps us decide the order of the sequence of images and videos we will use in our

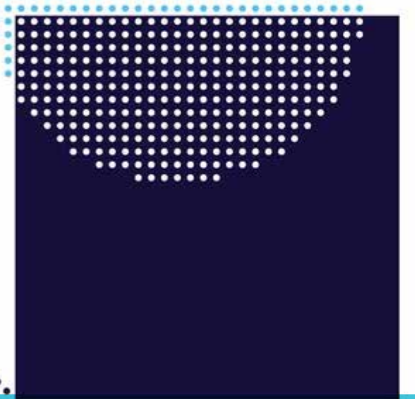
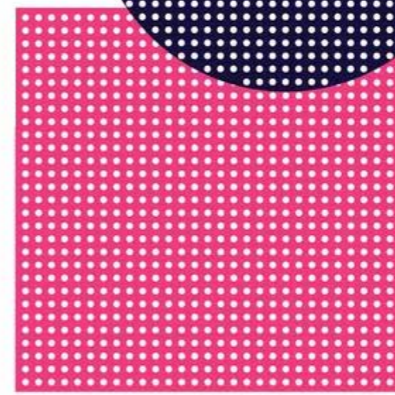
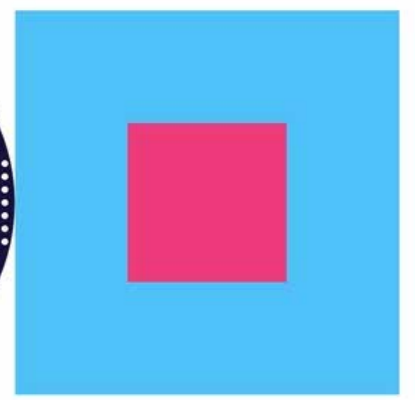
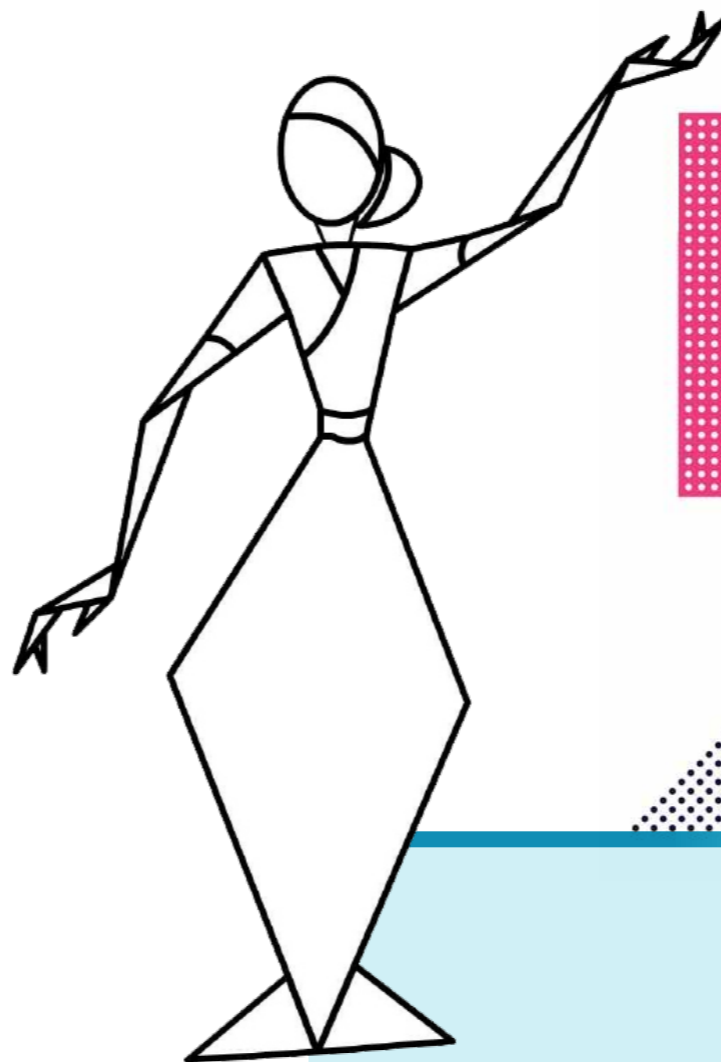
presentation. A storyboard in front of us helps us visualise the flow of our presentation before we put in the effort of creating clippings and slides for our final presentation. It is easier to make changes in our plan and shuffle the order as per needs rather than changing it in the final presentation, which we would have done with much effort.

Storyboards are usually done with simplified basic drawings. One does not need to be a skilled artist to do an effectively communicative storyboard. Using simple shapes and symbols is adequate to convey the concept. The storyboard developed illustrates the concept/story/lesson plan in a sequence. Going frame by frame helps the students follow the concept logically.



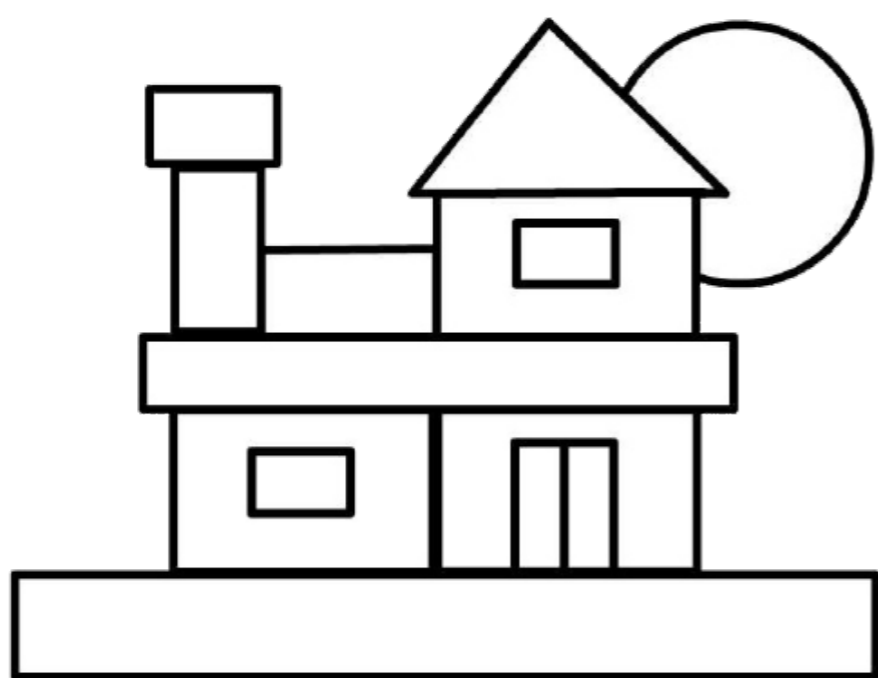
Like every language, we use 'alphabets' to communicate our thoughts through drawings.

There are three 'alphabets'— circle, square, and triangle which can be stretched and squashed to any extent to produce shapes and contours.



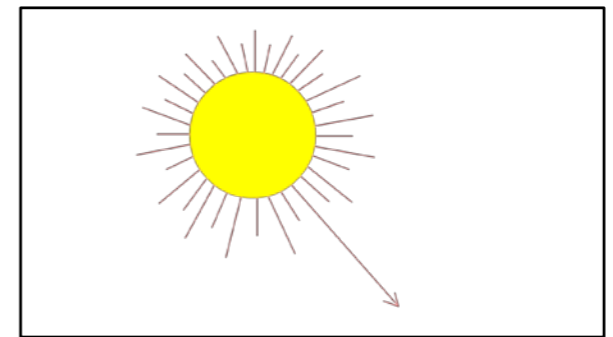
Drawing with basic shapes

Visual communication is an integral part of our thinking and understanding process. Drawing is a powerful medium of visual expression and communication. Learning to draw is just like learning a new language. Like every language, we use 'alphabets' to communicate our thoughts through drawings. There are three 'alphabets'— circle, square, and triangle which can be stretched and squashed to any extent to produce shapes and contours in a simplified form that help us draw images that may otherwise seem too complicated. Even human forms can be easily drawn using these shapes.



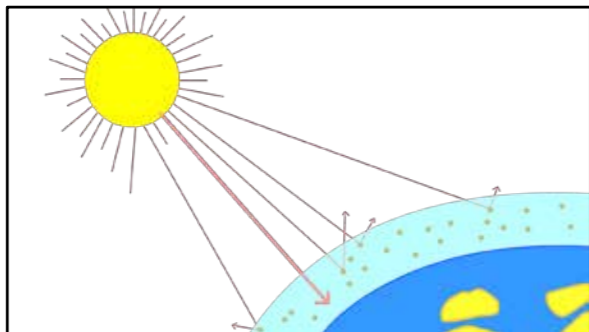
The Greenhouse Effect

1



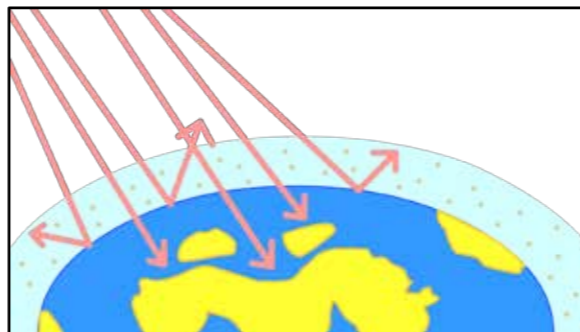
Sunrays begin their journey

2



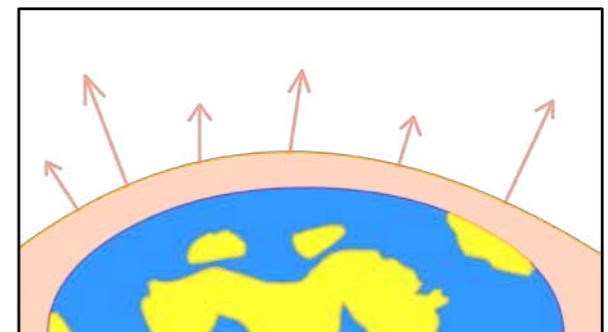
After 8 minutes they reach the earth. A few get reflected and scattered by the atmosphere

3



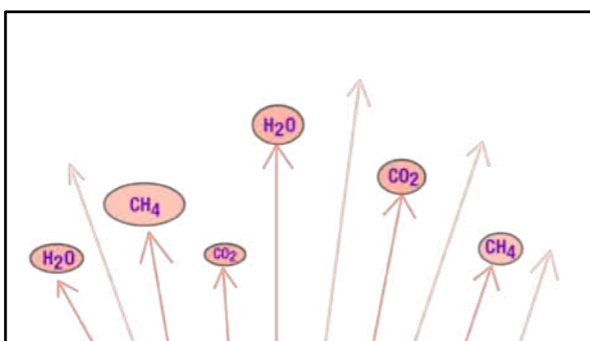
The rest reach the earth's surface. They are partly reflected, mostly absorbed.

4



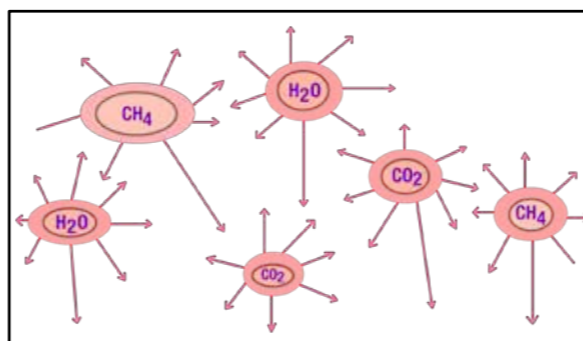
The earth gradually warms up. It re-radiates the heat

5



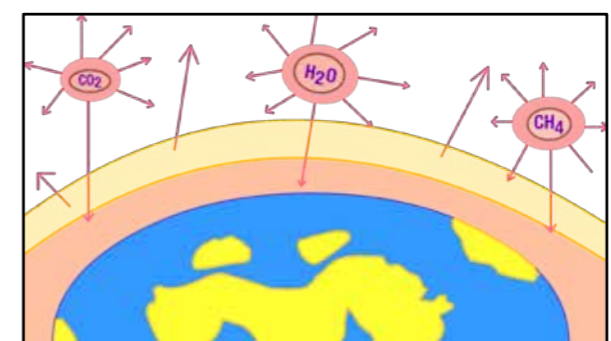
A lot of the reradiated heat escapes. Some get trapped by CO₂, H₂O, CH₄ etc

6



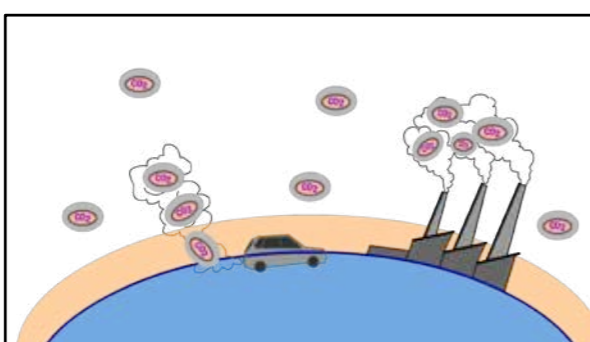
These molecules reradiate the heat. Part of it escapes out. Part of it moves back towards the earth.

7



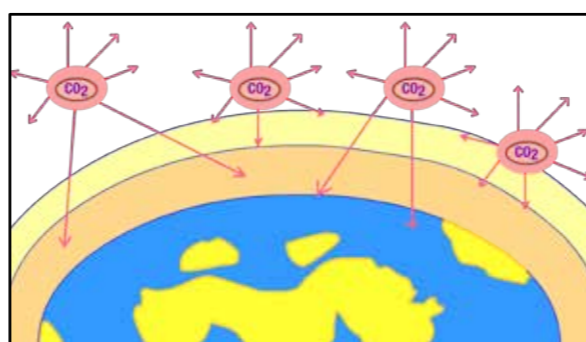
The earth stays warm. Life flourishes on earth.

8



Human activity like factories and automobiles spew CO₂ relentlessly

9



More heat is re-radiated back to earth

10

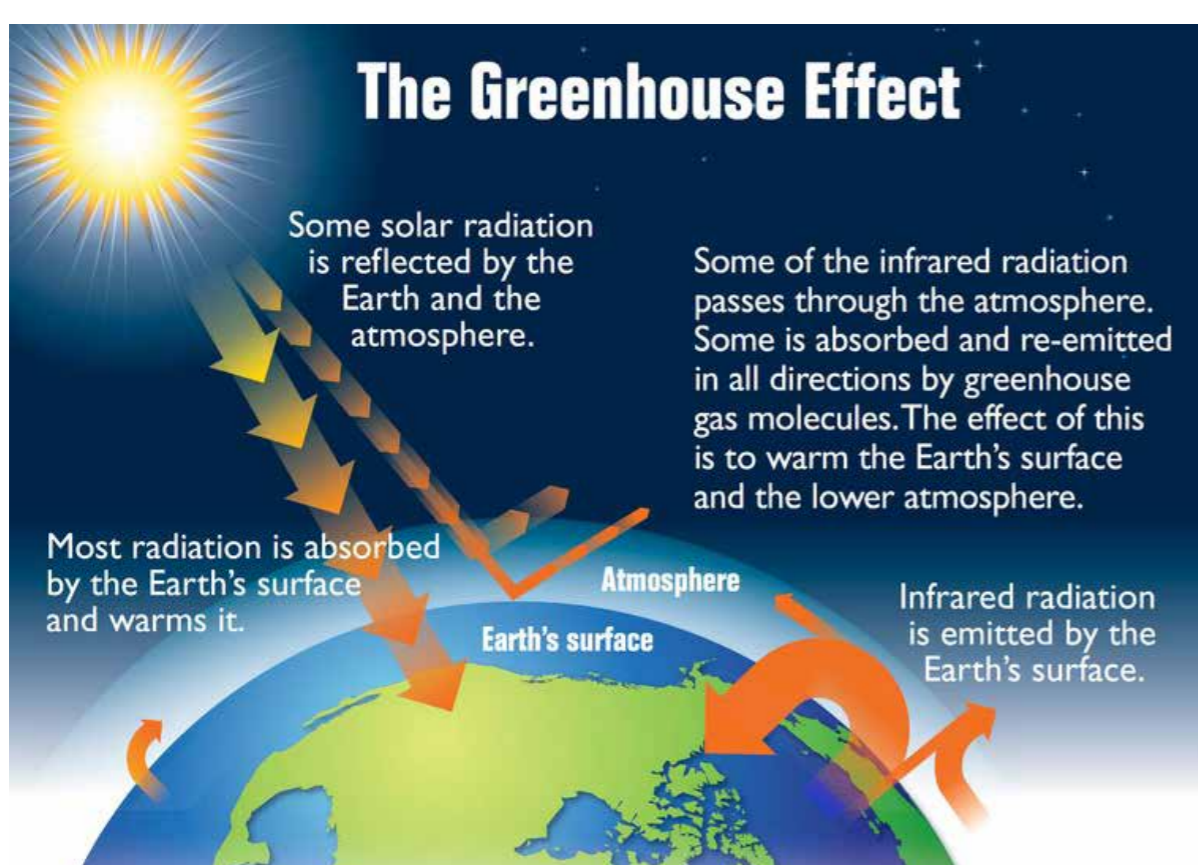


The earth grows warmer

EXAMPLE

The Greenhouse Effect

Generally, in textbooks, the complicated greenhouse effect process is depicted as one visual, like the one given below. But the concepts get clearer when the students break it into stages and depict it as a storyboard.



Students may be asked to make storyboards for photosynthesis, the water cycle, the carbon cycle and many other processes of nature - or even of human activities such as the journey of coal from the mines to factories, homes and into the atmosphere. Once they have the storyboard in front of them, they can point out at which stages of the journey the environment is being harmed.

Thus, storyboards help us to convert complex processes into stories. And stories, as we all know, are the best way to understand things around us.

09 | Learning to make and use puppets

Creative activities for children in a nature study camp

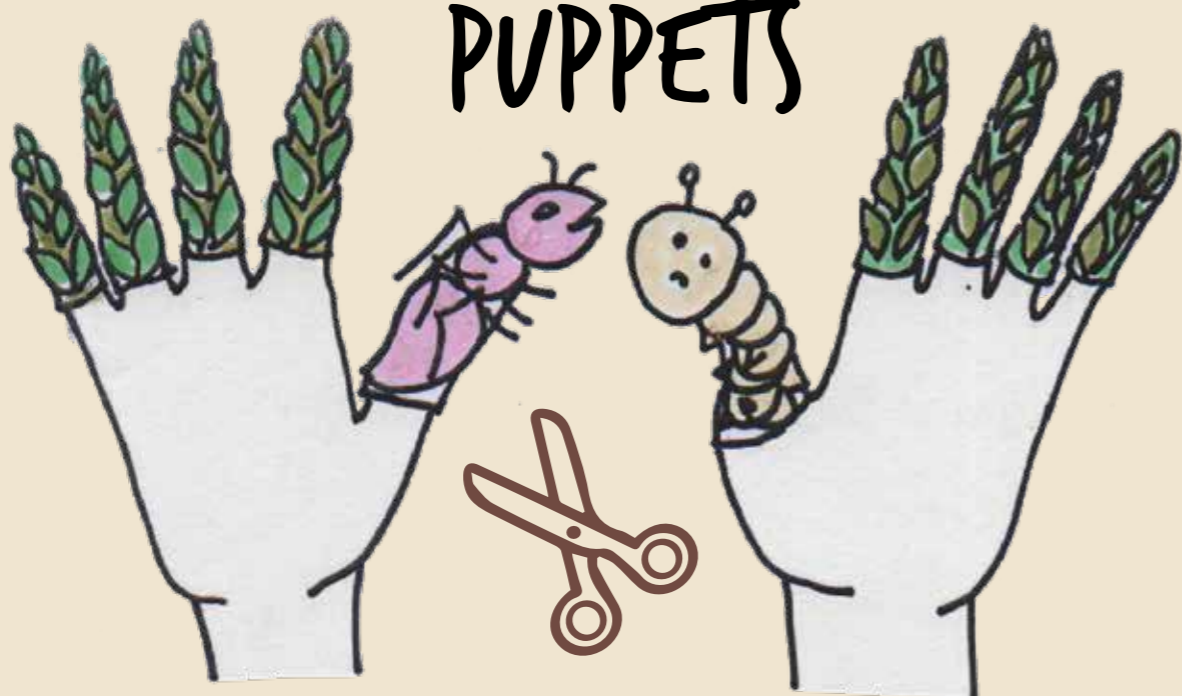
The objective of using dramatic expression as a medium of education is two-fold—it provides teachers with a proven medium to help students absorb what is taught. Other methods don't appear to lead to similar retention levels. It has also been noted that students who participate in such activities develop their powers of imagination, communication skills, self-confidence, and creative expression. In addition, good dramatic expression is entertaining, even if its main aim is to inform or instruct.

Regular crafts classes in school can be set aside to teach students how to make puppets. Step-by-step, illustrations with easy-to-follow instructions to make puppets, masks, nature crafts, toys etc, will significantly help. Waste items such as mineral water bottles, thermocol plates, matchboxes, and poly bags that are usually thrown away can be upcycled to make these items. Such exercises help develop an eco-friendly attitude in students who learn that waste has value.



Dr Sima Mukhopadhyay has been in the field of science communication for about four decades. She was a programme coordinator at the West Bengal State Resource Center for adult education and editor of a monthly newspaper for neo-literates. In 2005, she was awarded the Gopal Chandra Bhattacharjee Award from the Science Association of Bengal for popularising science in the print media. Dr Mukhopadhyay has authored many booklets and a book on popular science and science communication in Bengali. She can be reached at sima.ekdalia@gmail.com

FINGER PUPPETS



GLOVE PUPPETS



PAPER BAG PUPPETS



SHADOW PUPPETS



Puppetry

Puppetry is the magical art of bringing inanimate objects to life. Over the ages, in cultures worldwide, puppets have charmed and inspired people. Puppets are also powerful educational tools, as most children are fascinated by them.

Puppets are of different types. Here are a few examples.

Finger Puppets

Generally, puppets are used from behind the screen. In the case of Finger Puppets, screens are not needed.

WHAT YOU NEED

- Chart paper/throw away stiff paper box
- Coloured paper
- Glue
- Coloured felt pens
- Scissors



TO MAKE



3 x 3 square pieces of stiff paper

Roll it into a tube according to the size of the paper

Draw the face of the puppet with coloured felt pen on a separate paper

Attach the cut-out of the puppet face on the tube

SAMPLE STORY

The Caterpillar and the Ant

CHARACTERS

Caterpillar

Ant

Small twigs

(Caterpillar is crying)

ANT Why are you crying, caterpillar?

CATERPILLAR I am feeling very hungry.

ANT So many bright green leaves are in front of you! Why don't you have those?

CATERPILLAR Oh no! Those leaves are very bitter to taste.

ANT Why?

CATERPILLAR Perhaps the gardener sprinkled pesticides on the leaves.

ANT Oh my god! OK, don't worry. I am sending you a stick. You can crawl on it and come to this side. This part of the garden is maintained as an organic garden. No pesticides or chemical fertilisers are used here.

CATERPILLAR Is it true?

ANT Yes. Here bio fertiliser and bio-pesticides are used to maintain the garden.

CATERPILLAR Thank you, Mr Ant. I'm coming over.

(After eating a tasty leaf from the organic garden, the caterpillar is very happy)

CATERPILLAR Thank you, Mr Ant. So kind of you!

ANT No. No, it's my duty to help whoever is in distress.

CATERPILLAR Mr Ant, I have a wish. After finishing my complete life cycle, when I get transformed into a butterfly, I want to take you on my beautiful wings for a joy ride.

ANT Oh! That's a brilliant idea. Thank you, soon-to-be butterfly.

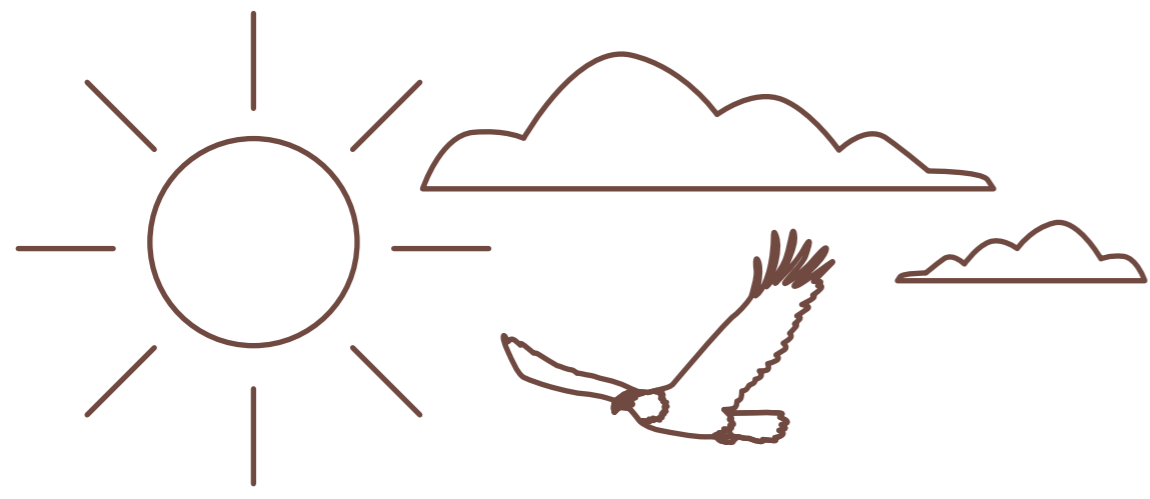


Glove Puppets

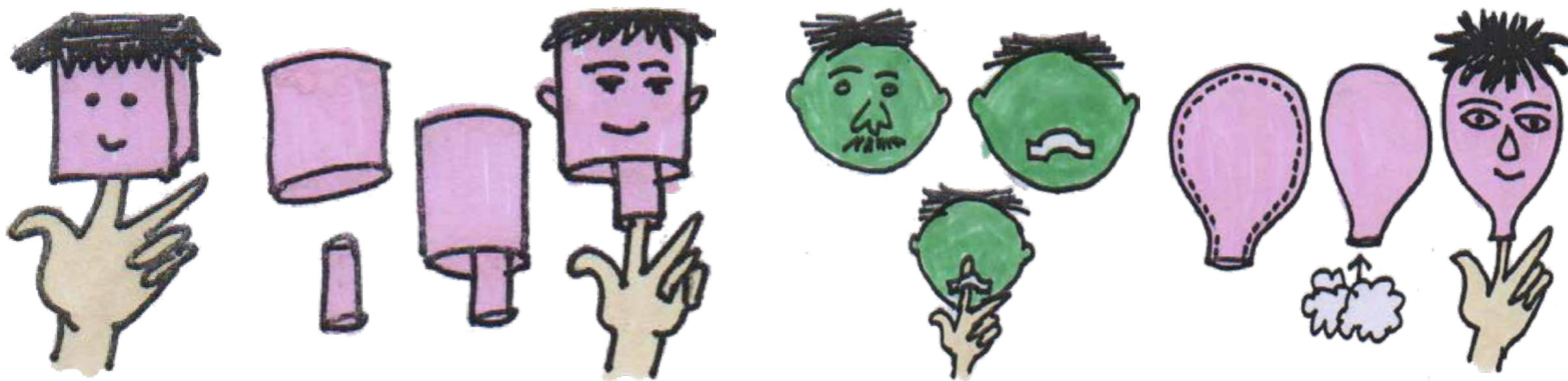
This is a very popular form of puppetry. The puppets are usually made from fabric and cover the whole hand and part of the arm.

WHAT YOU NEED

- Black cloth
- Coloured paper (Black, Yellow, Brown, Sky Blue)
- Thin cardboard
- Cotton
- Wool
- Needle and thread
- Scissors
- Adhesive
- Marker Pens (Red, Black, Blue, Green)
- Pencil and eraser
- Rubber bands
- Empty matchboxes
- Cloth pieces of different colours



TO MAKE THE HEAD



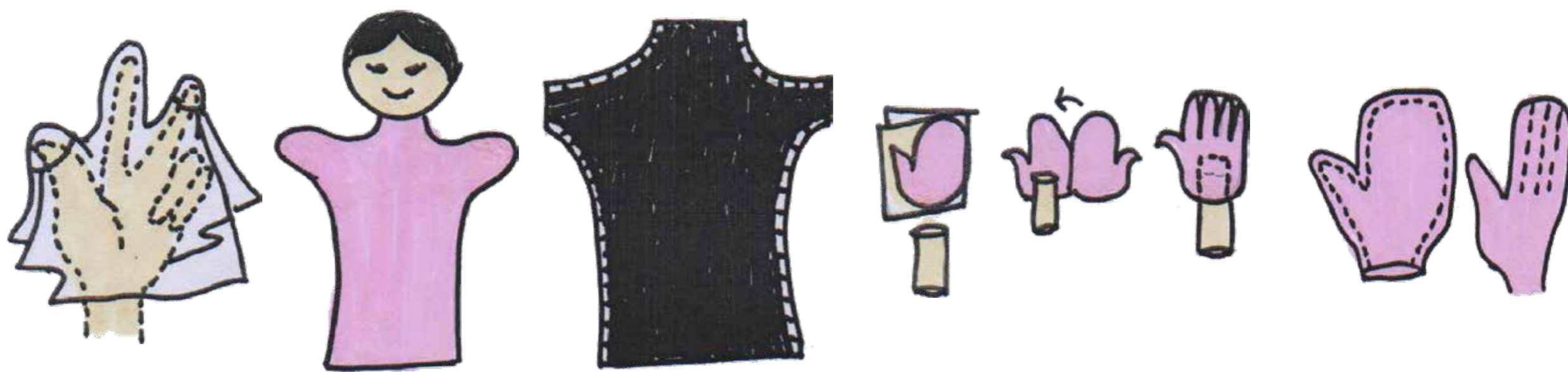
Head made of matchbox

Head made of cardboard

Head made of cardboard tube

Head made of cloth

TO MAKE THE BODY, DRESS AND HANDS OF THE PUPPET



Body made of handkerchief

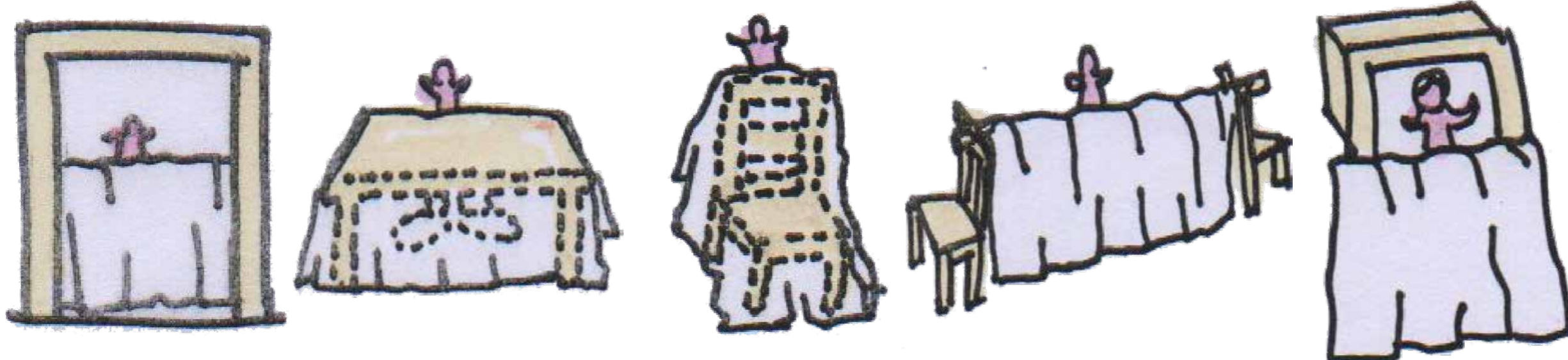
Stitched up body

Standard design for body

Hand made of cardboard

Hands made of cloth

TO MAKE A SIMPLE STAGE FOR A PUPPET SHOW



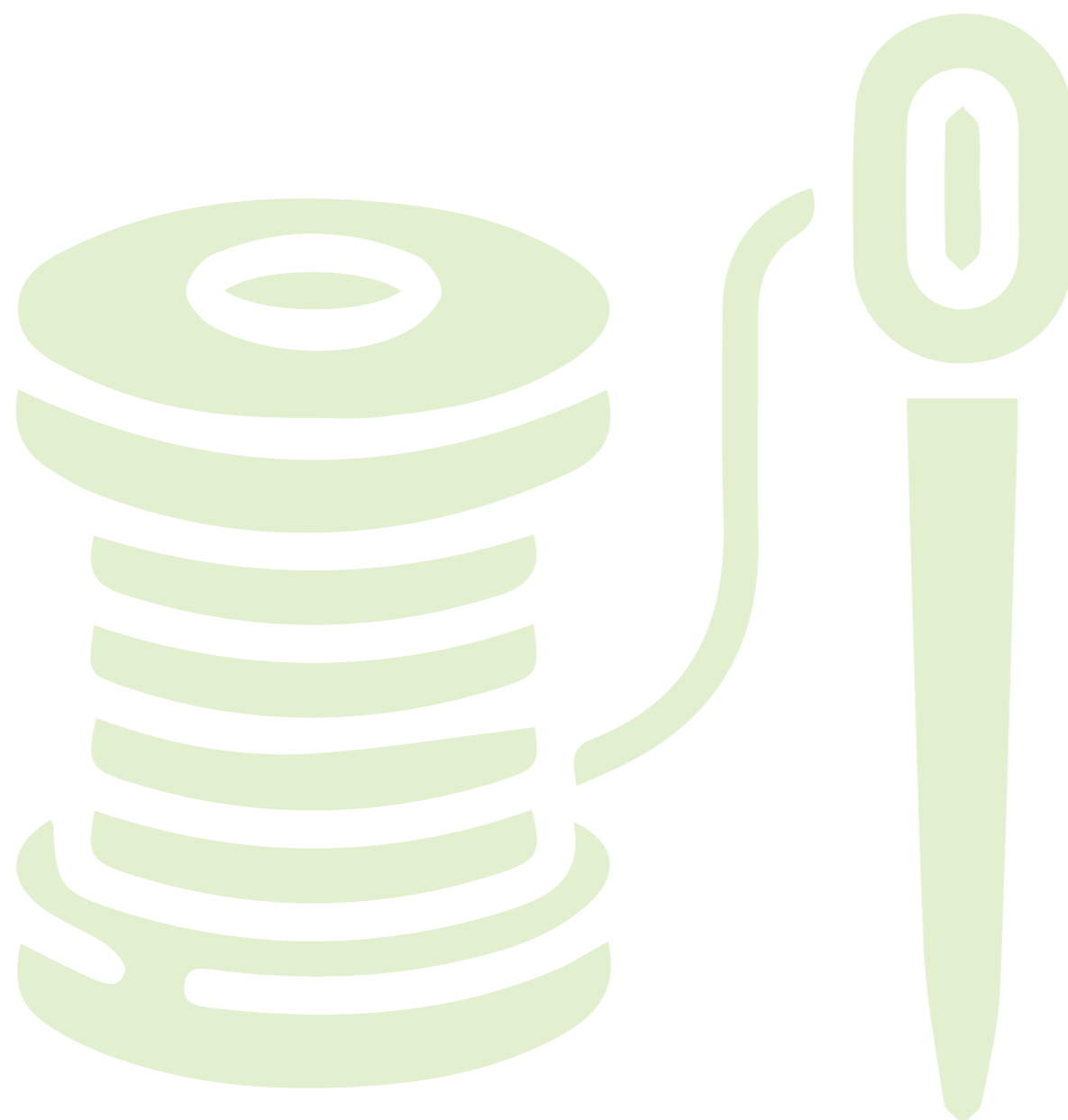
Using a doorframe

Using a table

Using 1 chair

Using 2 chairs

Using a box



SAMPLE STORY

Catching Frogs

CHARACTERS

Teacher

Haru (Frog Catcher)

Chinu (Daughter)

TEACHER What are you searching for in the dark?

HARU Sir, I am trying to catch frogs in this bush.

TEACHER What? Why do you collect frogs?

HARU A man from our nearby town pays me for the frogs I collect. It is more than what one gets for daily labour. That's why I do this.

TEACHER Do you know this is an illegal practice?

HARU Why, Sir? Frogs are not useful creatures.

TEACHER You don't know the importance of frogs in nature. OK. Come with me to my house. It is not far from here. I will show you how frogs are helping us maintain the balance of nature.

HARU Sir, I am an illiterate person. This knowledge is of no use to me.

TEACHER No, that's not true. I have a nice pictorial poster developed by my students. I will explain this matter to you with images.

HARU OK, Sir, I will come with you.

(Both of them enter the teacher's residence)

TEACHER Chinu, come here. Bring that poster from my table.

CHINU Papa that poster done by your students yesterday?

TEACHER Yes, bring it quickly and show us. I will explain it to Haru.

CHINU OK, just a minute Papa. Let me unfold the poster.

TEACHER See Haru, a real crisis will appear when frogs disappear. Shortage of food for snakes will start. At the same time, the number of insects, including mosquitoes and flies, will increase. This will lead to the spread of diseases.

HARU Sir, I hadn't thought about it before. Please excuse me, Sir.

TEACHER Not you; the main culprit is that man who collects frogs for his illegal export business.

CHINU Papa exporting frogs will disturb our natural world?

TEACHER Yes, our ecological balance will get disturbed.

HARU Sir, I understand the problem. I will not catch frogs in future.

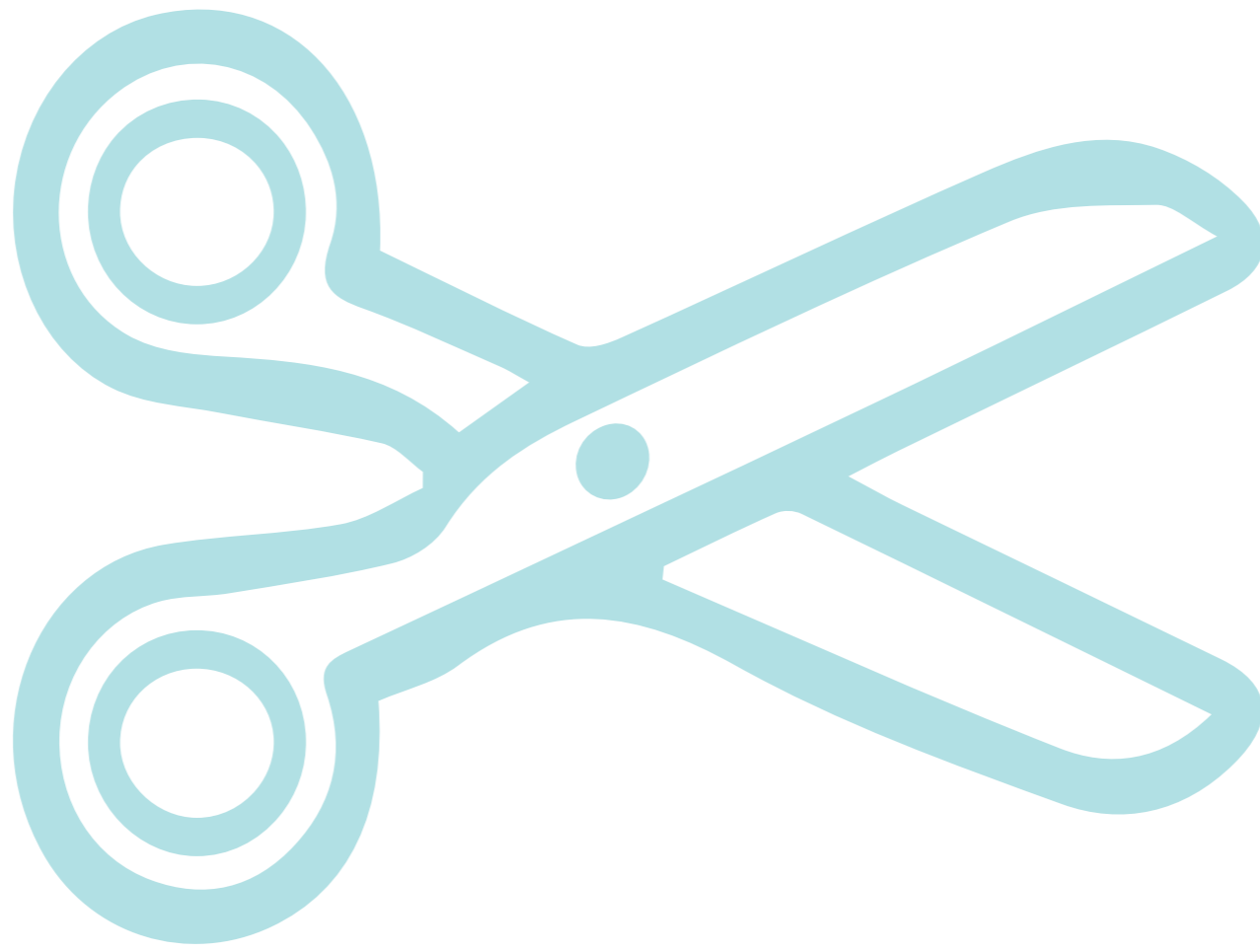
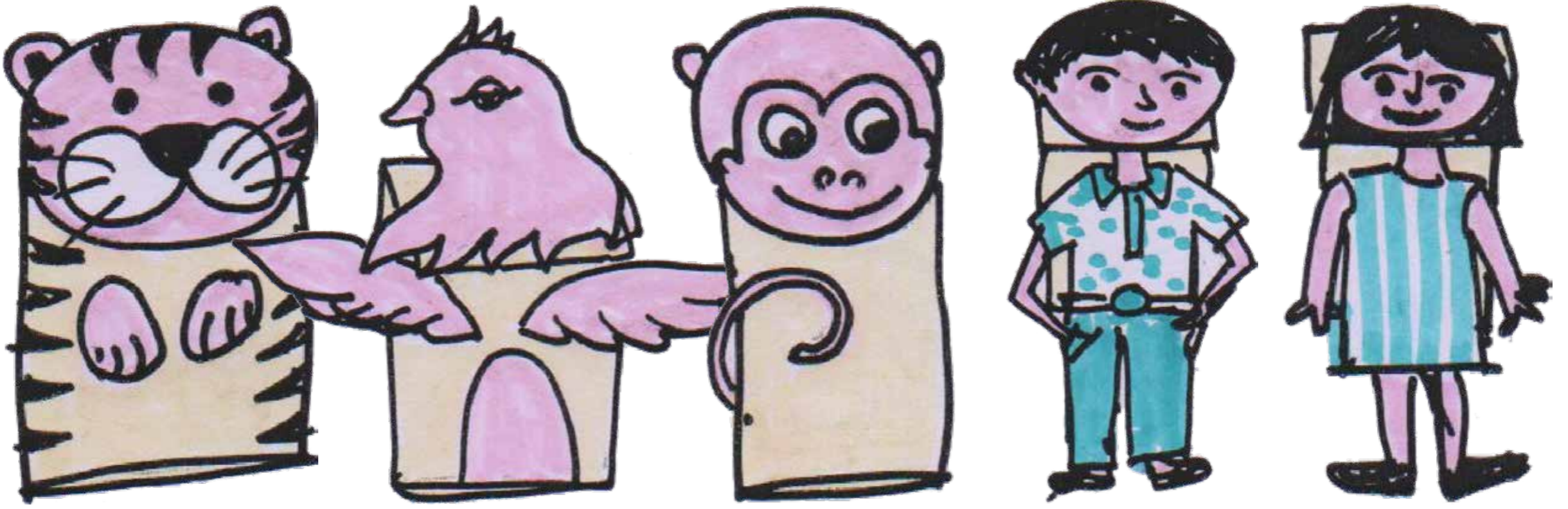


Paper Bag Puppets

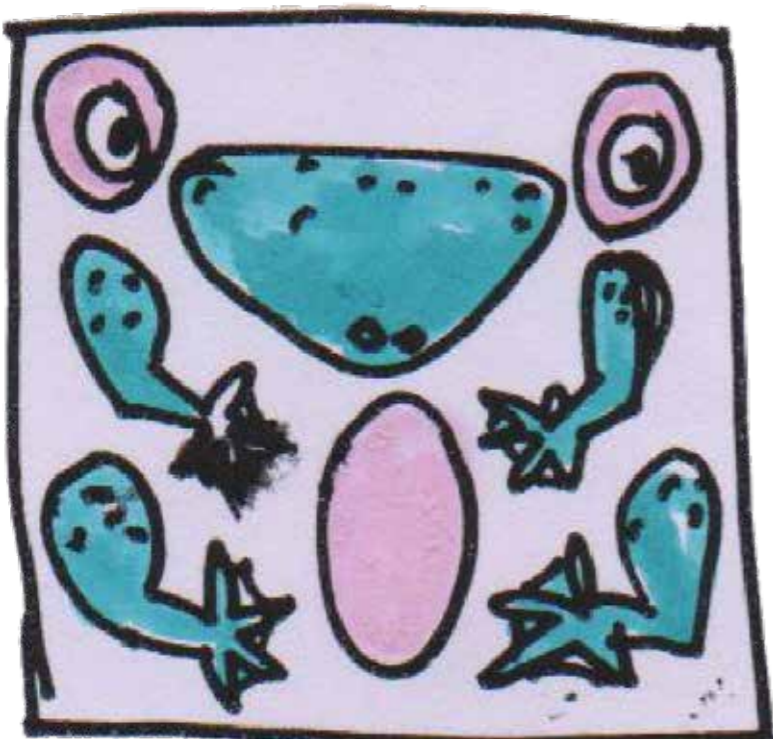
Paper bag puppets are simple hand puppets. Children can use the paper bag puppet to tell stories and for other children to enjoy. Grocery paper bags are cheap and just the right size for little hands. If not readily available, anybody can easily make a paper bag.

WHAT YOU NEED

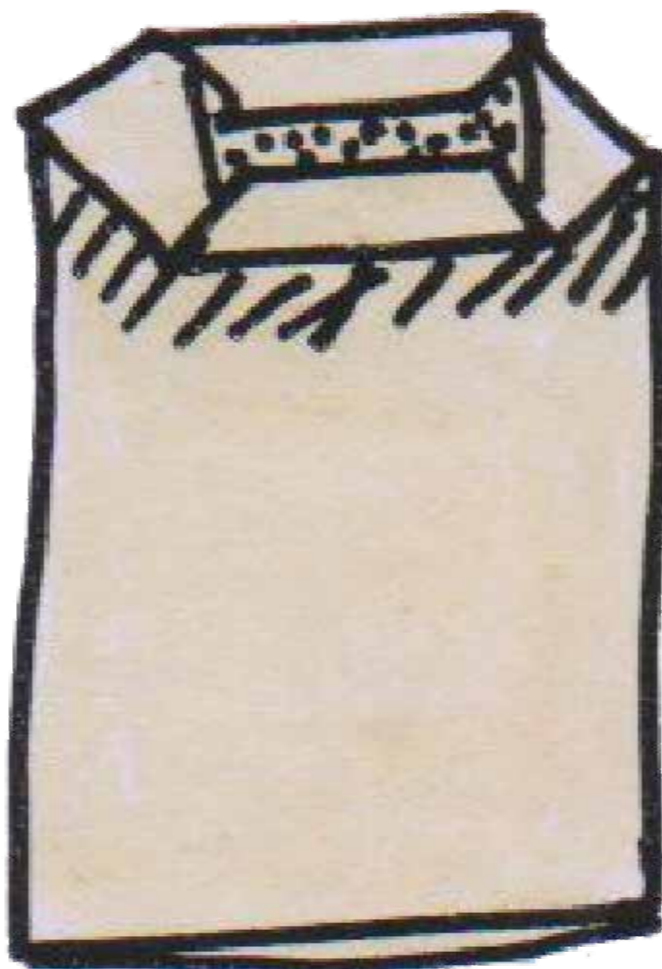
- White paper
- Paper bag
- Coloured pencils or marker pens
- Scissors
- Glue



TO MAKE



Draw and colour different parts of the animal and cut them out



Keep the paper bag folded



Glue the head of the animal on to the bottom flap of the paper bag, with the chin positioned just over the bottom edge. Give the body of the animal onto the front of the paper bag. Position the top edge just under the animal chin. Now it's ready for the performance!

SAMPLE STORY

A Little Paper Bag Boy

CHARACTERS

Paper bags

Boy

(Two paper bags are singing and dancing)

PAPER BAGS *(singing)* We shall overcome... We shall overcome...

BOY What happened to you, paper bags? Why are you singing and dancing?

PAPER BAGS This area is now declared a 'No Plastic Zone'. Nobody can use single-use plastic bags.

BOY Yes. That's a very important decision. When the wind blows, thin plastic bags fly here and there. They block the drainage system. Water logging conditions appear even with a light shower.

PAPER BAGS You people throw discarded food items in thin plastic bags, which creates a problem in animals' digestive systems.

BOY Yes, you are right. Even in oceans, sea tortoises ingest plastic bags by mistake. Habitats of aquatic species now polluted with an overload of plastic threaten the species.

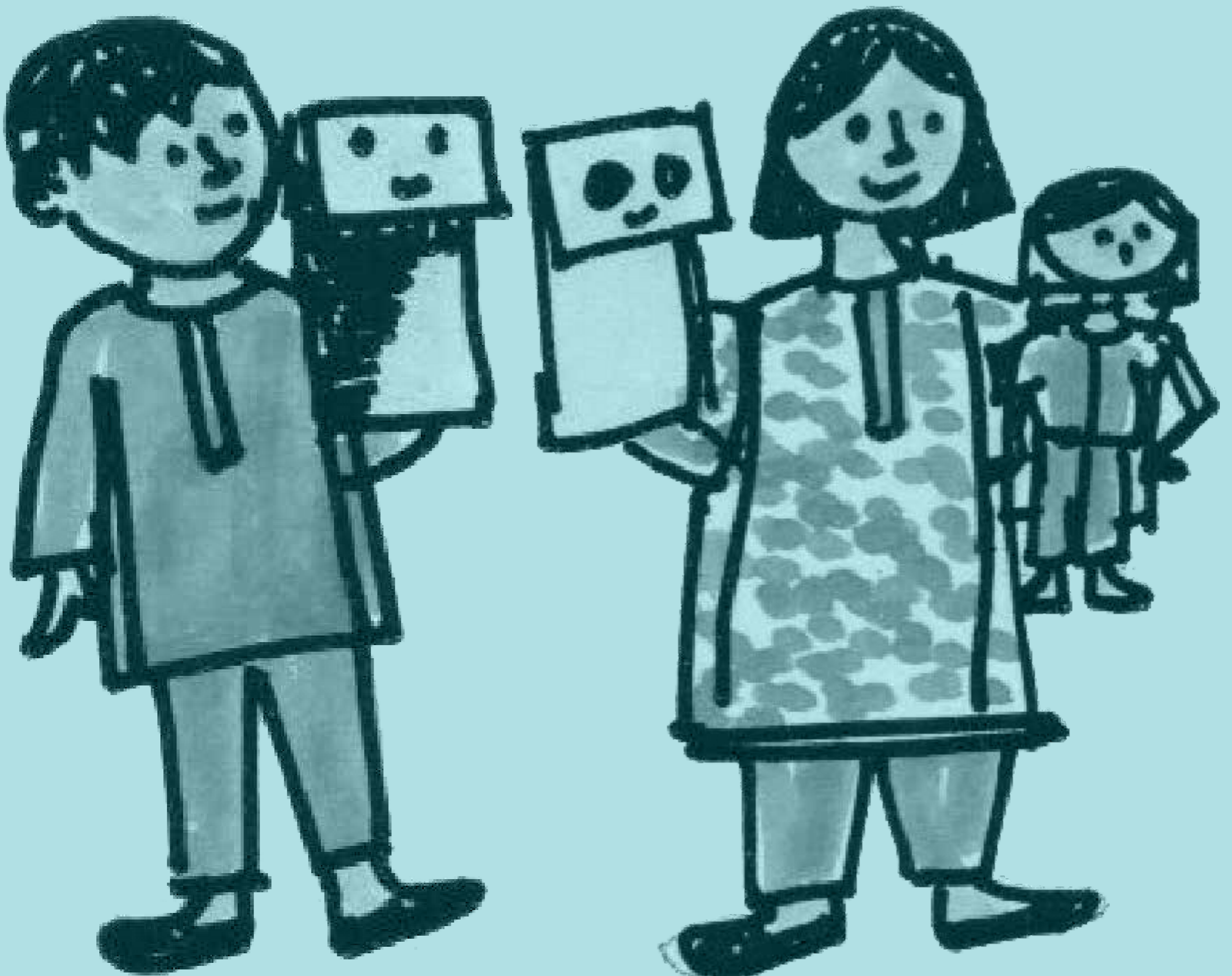
PAPER BAGS Aquatic animals don't use plastic bags in their daily lives. You, people, are the main culprit for this situation. You throw plastic bags here and there.

BOY I agree with you, hundred per cent. We must change our habits. See, we have developed this poster.

- Think before throwing plastics.
- Segregate plastic items at source in your homes and store these in a separate garbage bin.
- Instead of plastic bags, use cloth or jute bags for marketing.

PAPER BAGS Use us. We are biodegradable.

BOY Yes. Yes. We all pledge to use only paper bags.



Shadow Puppets

Shadow play is an ancient form of storytelling. This entertainment art uses flat articulated cut-out figures (Shadow Puppet), held between a light source and a translucent screen. The cut-out shapes of the puppets sometimes include translucent colours.

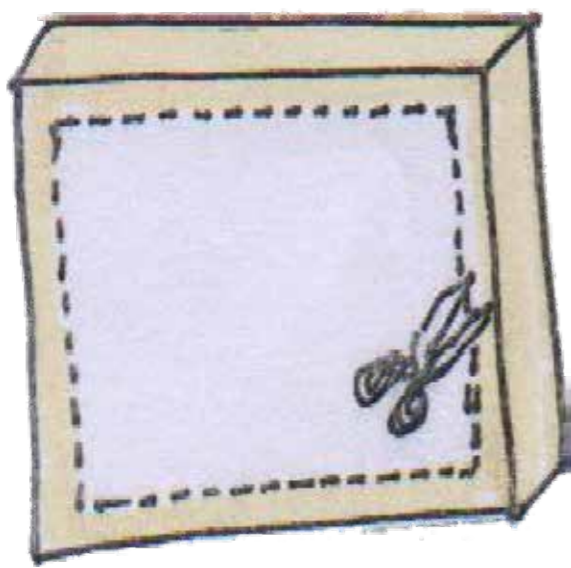
At a Nature Study Camp, learners can easily make shadow puppets to depict their field experience and construct a simple skit around these to both educate and entertain other campmates.

WHAT YOU NEED

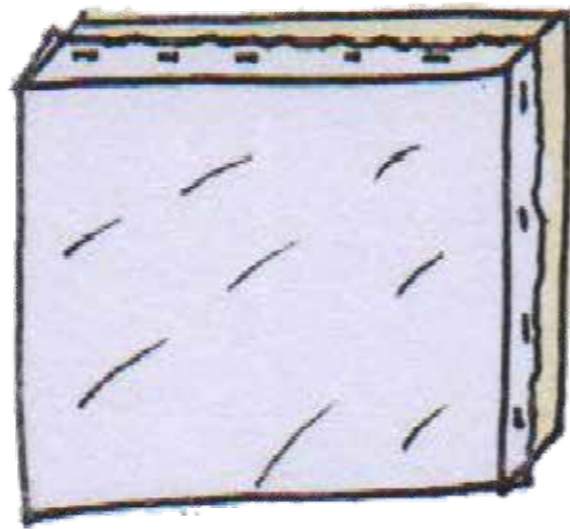
- Stiff board
- Discarded garment or a shoe box
- White cloth or thick tracing paper
- Thick black paper
- Scissors
- Stapler
- Pencil and eraser
- Thin wooden stick or broomstick
- Black tape
- Coloured Cellophane Paper
- Fevicol
- Torch or Table lamp



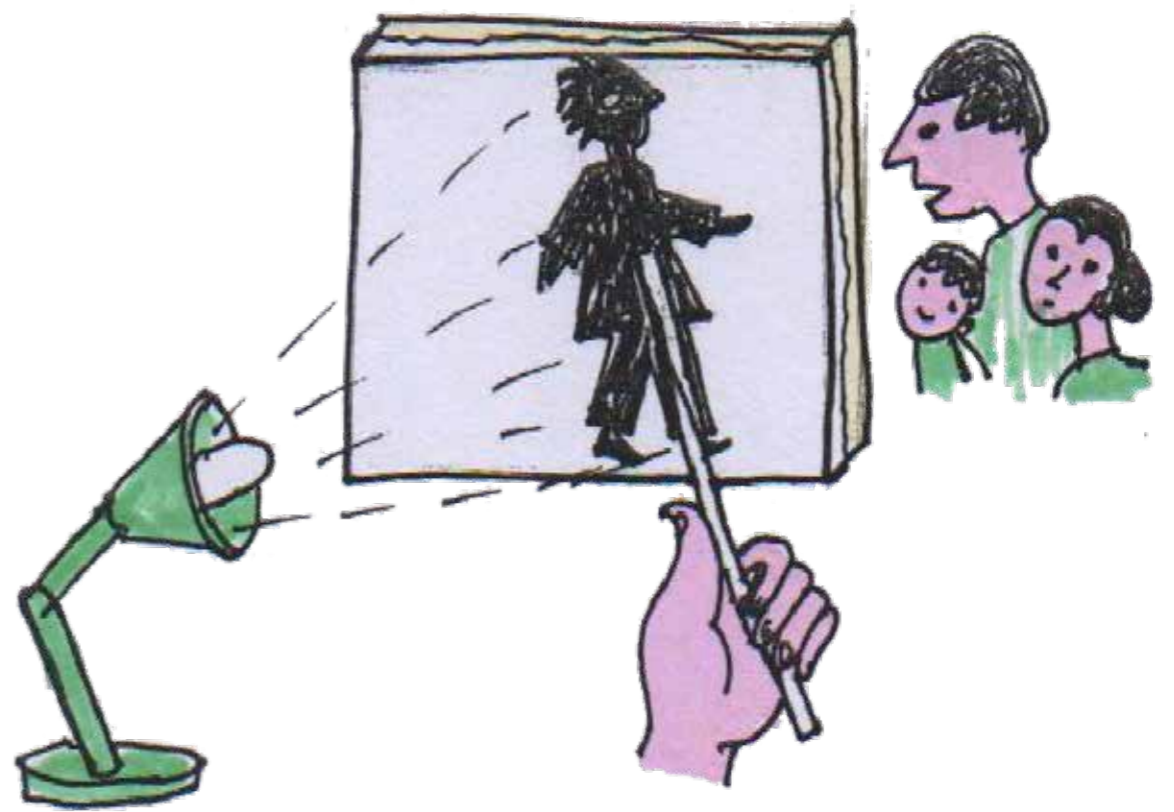
TO MAKE A SIMPLE SHADOW SCREEN



Cut away

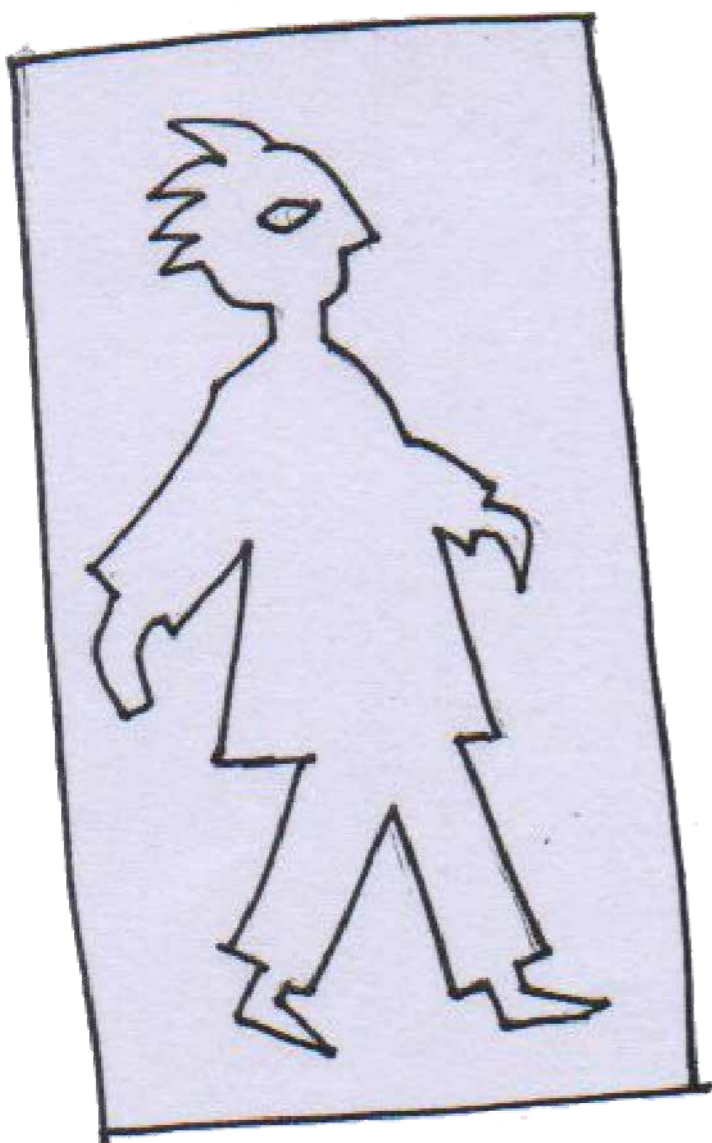


White cloth



Lamp/Puppeteer/ Shadow screen

TO MAKE A SIMPLE SHADOW PUPPET



Draw the image of the puppet on a sheet of paper



Stick it on black paper and cut it out using scissors



Place a wooden stick on the back of the cut-out and attach it using black tape



SAMPLE STORY
A Pond's Bank

CHARACTERS

Frog

Grasshopper

(One frog sitting under an umbrella is singing in a cheerful voice)

GRASSHOPPER *(singing)* Hello, Mr Frog!
What makes you sing?

FROG Why are you disturbing me,
Grasshopper?

GRASSHOPPER Have you not heard
the latest about our pond?

FROG No. Nothing.

GRASSHOPPER Then listen.
Soon the bank of this pond will be
cemented with bricks.

FROG Why? Then from where will we get
our food?

GRASSHOPPER Foolish people thought
the pond would be maintained by
cementing it. They don't realise that this
will disturb the entire pond's ecosystem.

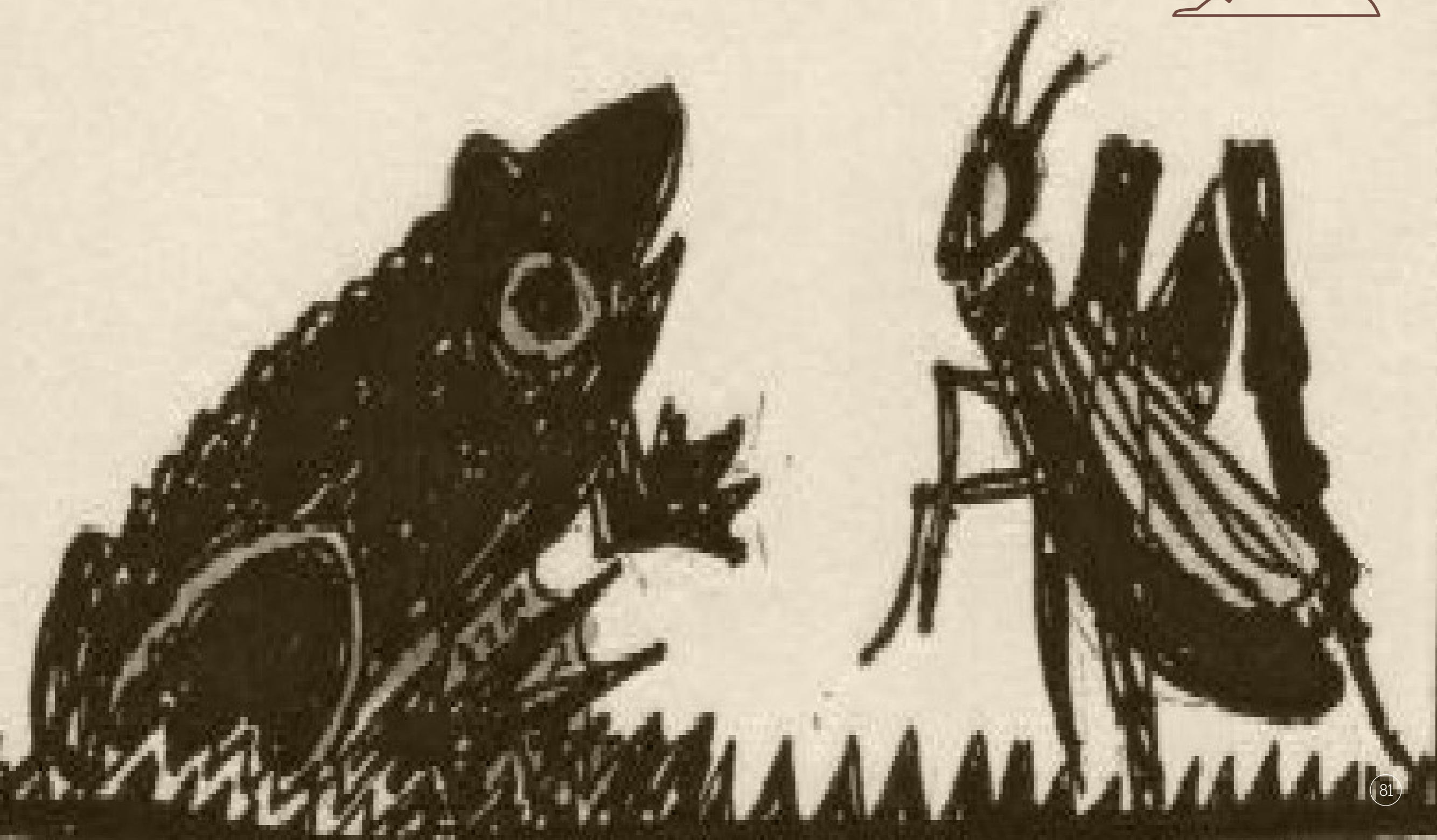
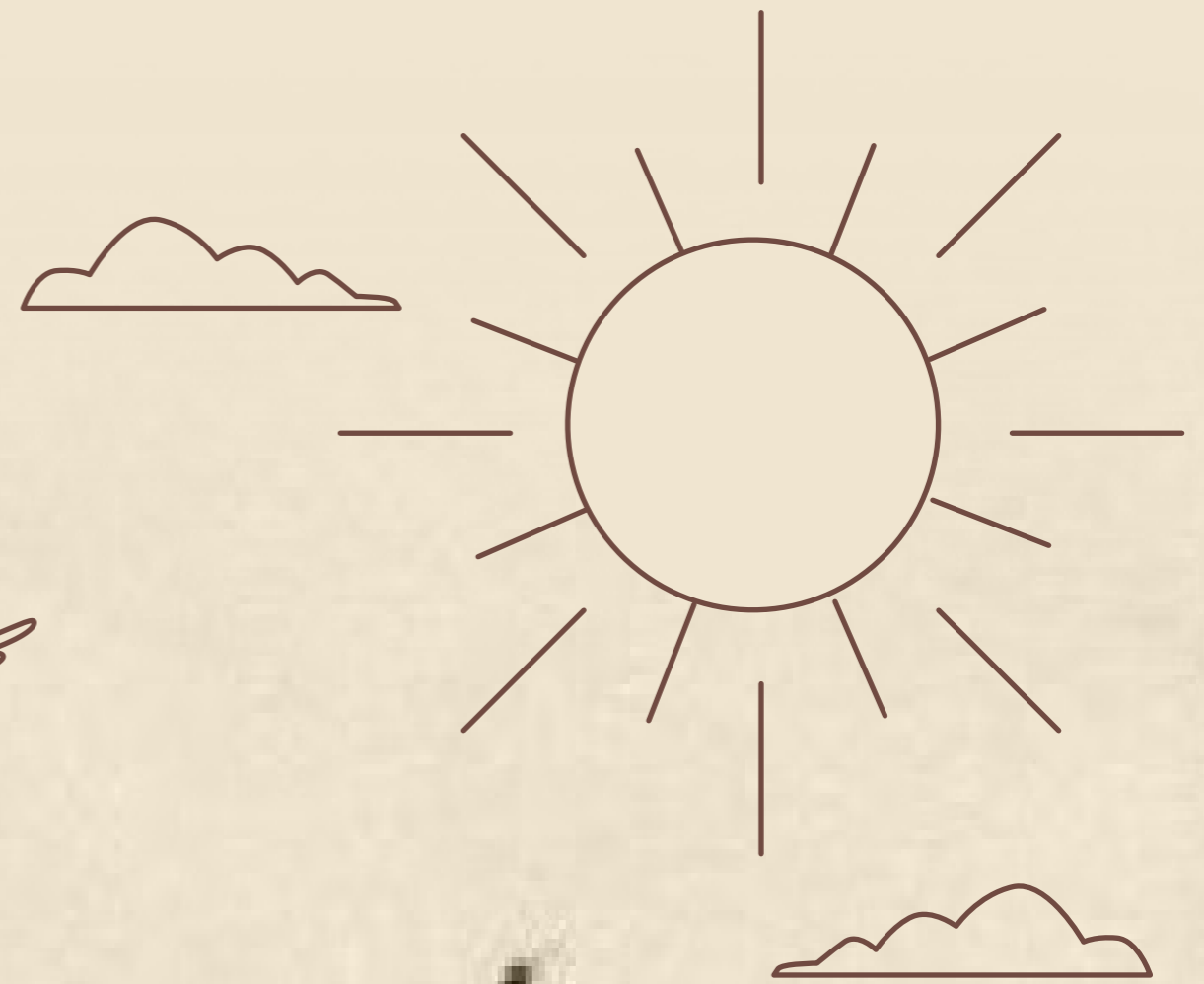
FROG Yes. You are right. In that case,
we must leave the place.

Cementing will increase the swarms of
mosquitoes in the area around the pond.
Only then will humans understand
the damage done to the ecosystem.

GRASSHOPPER We must do something.

FROG OK. Let's call all our neighbours for
an urgent meeting—snails, earthworms,
ants, squirrels, bulbuls, butterflies
and bees.

Ultimately, they try to solve their
problem with the help of a small boy
who is a 'Nature Lover'.



10 | Music as a tool to inspire Climate Stewardship

Children relate very well to music. The teacher can utilise this genre as an effective vehicle to transport information about climate change and generate students' interest to take on roles of stewards of the environment.



Neela Majumdar is Director Education and Outreach, South and South East Asia for the global environmental NGO EARTHDAY.ORG. She leads Climate Literacy initiatives in the region and has identified innovative strategies that help educators focus on climate-related issues while teaching all subjects. The many student-focused programmes she runs in India have inspired many youths to be climate stewards from a young age. She can be reached at majumdar@earthday.org

Songs of the Earth

Songs of the Earth is a music album that directs attention to climate change.

Each song highlights a specific environmental concern. Issues range from floods and eco-fashion to deforestation and industrialisation, as experienced through the eyes of Asha, a young climate refugee from India.

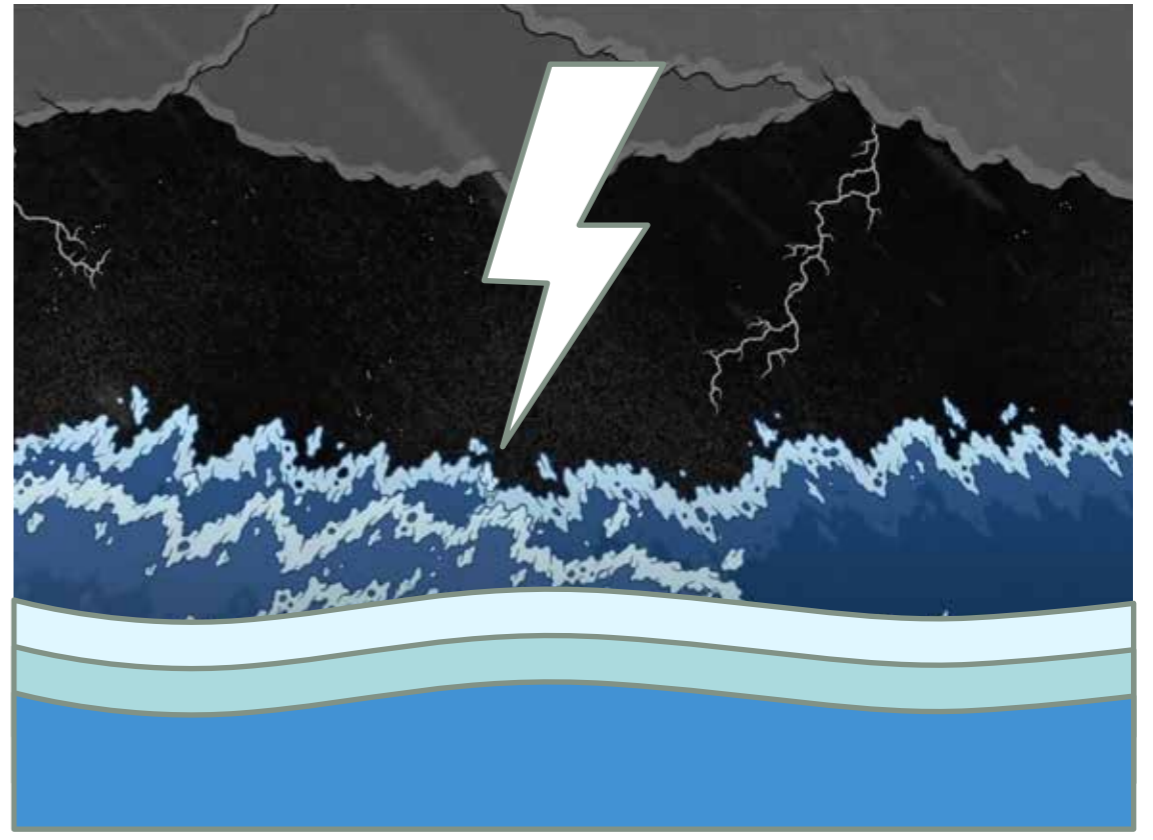
These are featured in eight videos of four minutes each. The unique narrative of the videos has viewers follow Asha through the flood banks of the Sundarban Delta, burning forests and melting polar ice caps. The songs are—

- *History*
- *Ocean Rising*
- *Chemical Design*
- *Baba*
- *Fields of Hope*
- *She Will Protect You*
- *Asha*
- *I Am Your Sky*

British Council commissioned the project for the Conference of Parties (COP) 26 in Glasgow. **Soumik Dutta Arts, Earth Day Network India**, Hawkwood Centre and The Space put the series together.

Available at

<https://www.soumikdatta.com/projects/songs-of-the-earth>



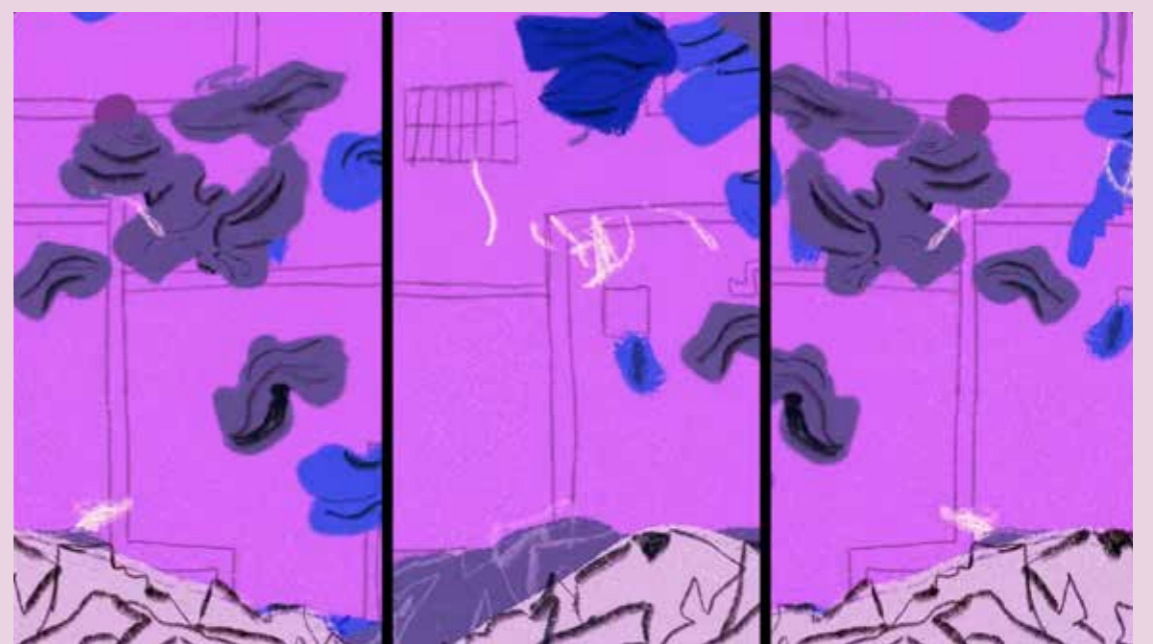


How the material can be used in the classroom

Play the video [Chemical Design](#)

Following that, the teacher can initiate a discussion on **Sustainable Fashion**. The students can be asked to respond to—

- What new clothes have you got over the past year?
- What were your criteria when choosing these? Price? Fashion? Material? Which one was most important to you?
- Did you really need the new garments, or did the items just add to your already crammed wardrobe?
- Have you ever thought about the environmental impact of each item?



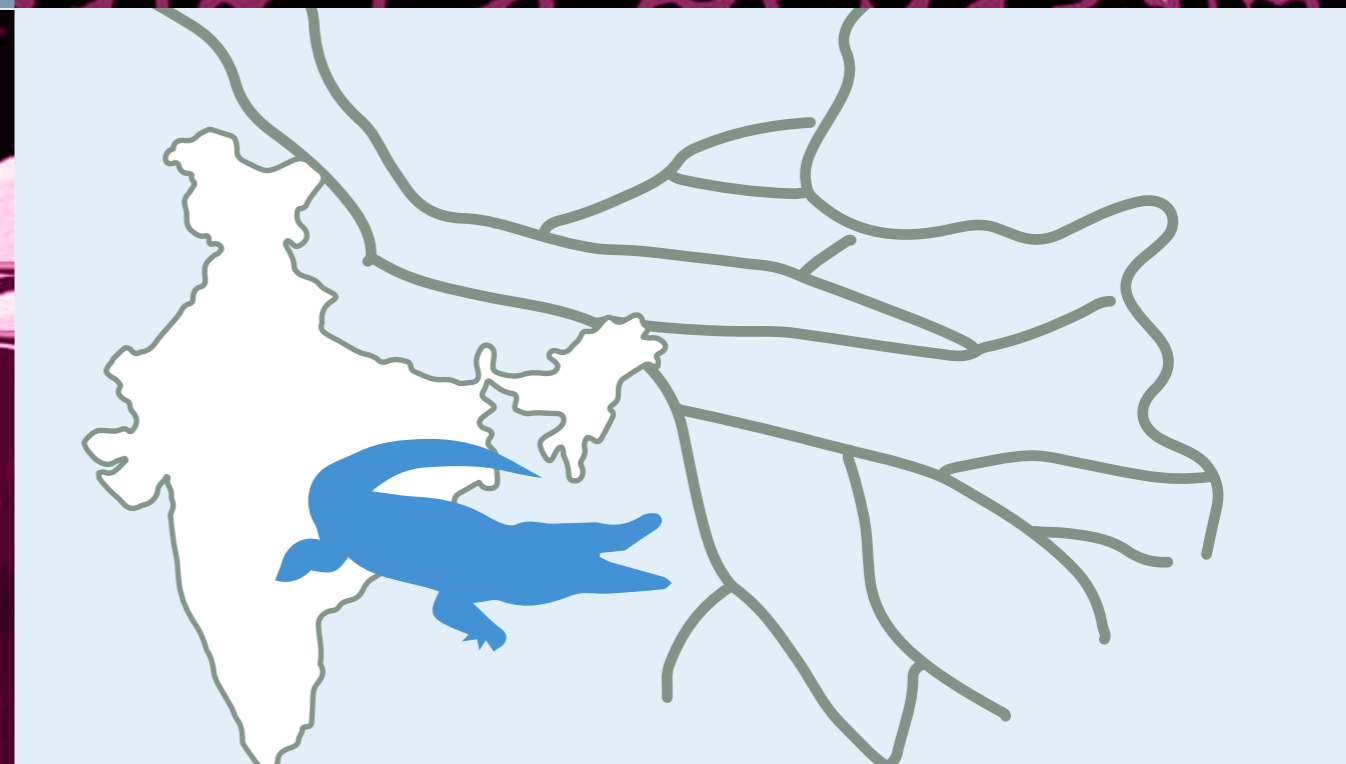
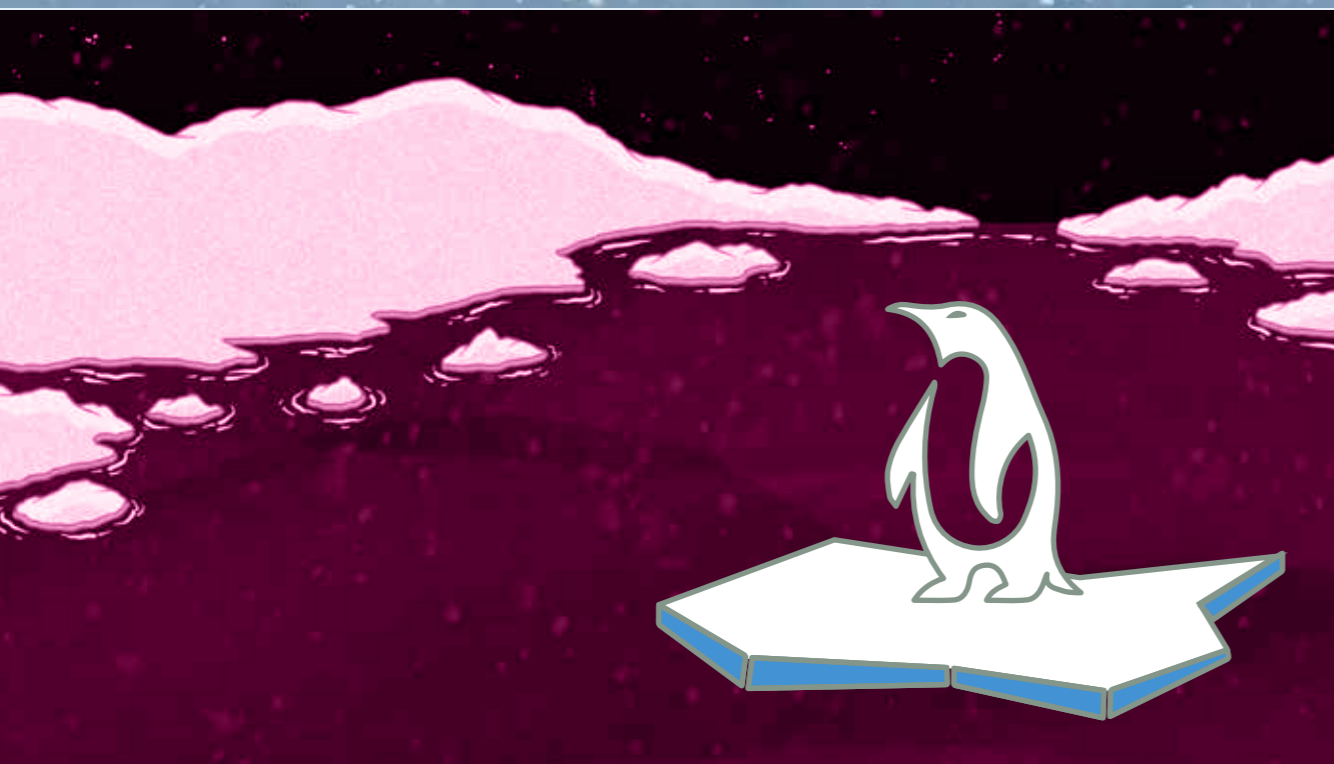
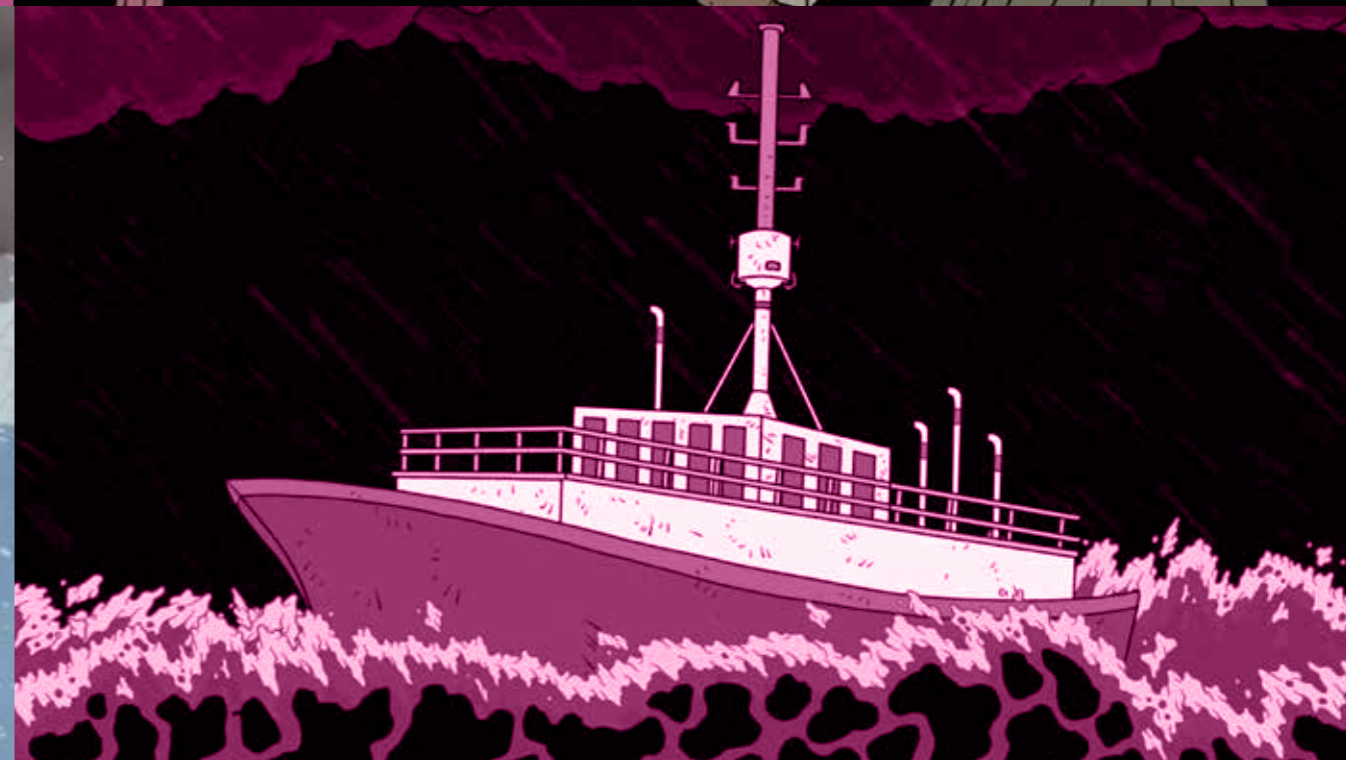
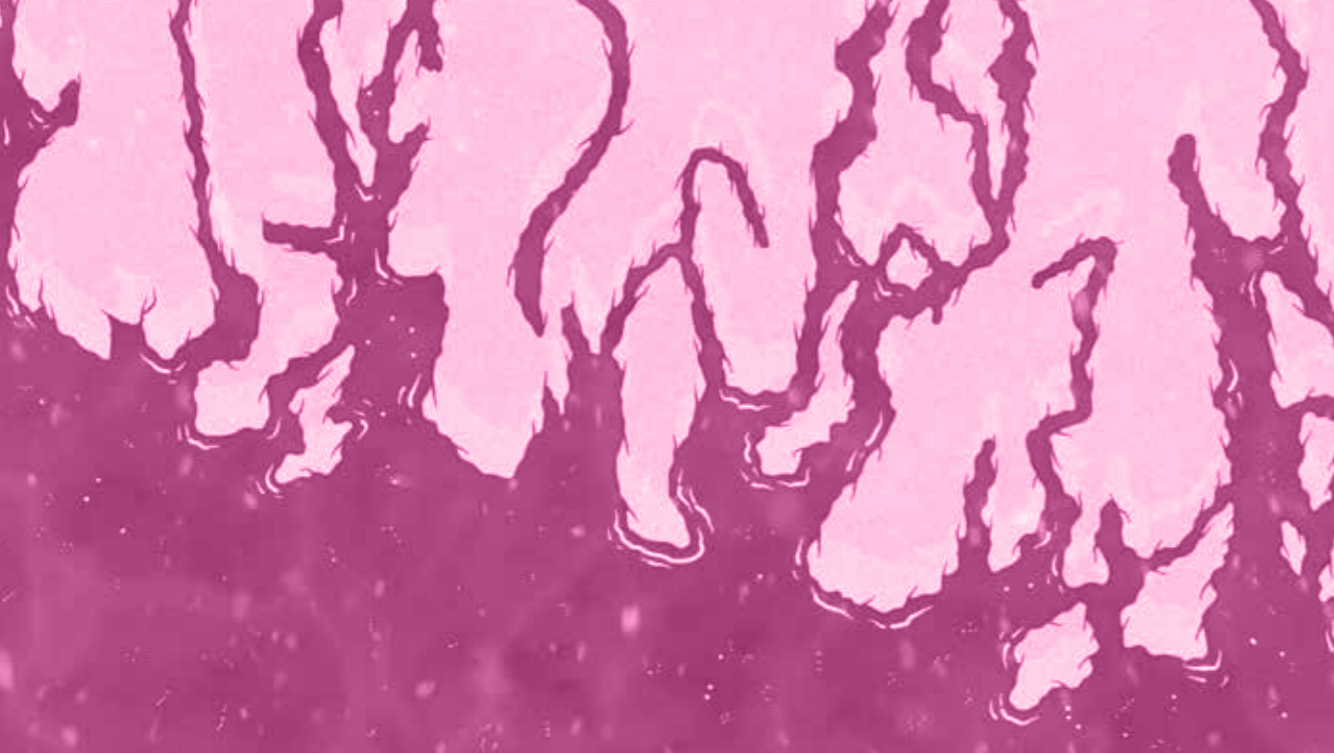
The teacher can then elaborate on the following—the fashion industry is a leading polluter. It accounts for 10% of global carbon emissions. Yearly, 85% of textiles end up in landfills or incinerators. Washing synthetic cloth contributes to 35% of all ocean microplastic pollution. Most clothes are worn for a short time and then disposed of.



The teacher can suggest swapping to disrupt this pattern as it keeps clothes in circulation.

The teacher can lead the students through EARTHDAY.ORG'S Toolkit that details ways to organise a **Swap for the Earth**.





How the material can be used in the classroom

Play the video [Oceans Rising](#)

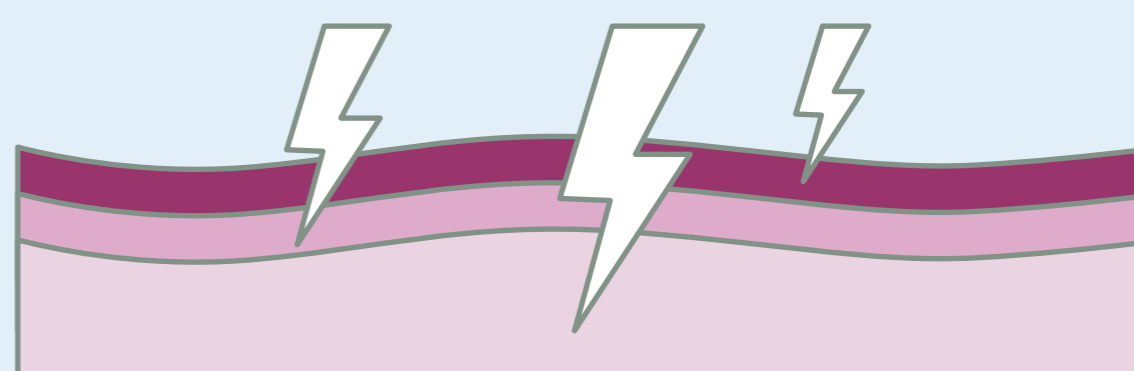
The teacher can then initiate discussions related to water—

(A) GENERAL

- How much of Earth consists of water?
- What percentage is drinkable?
- What is the per-person estimated requirement of water in India?
To expand on this, check this [USGS](#) site.
The teacher can then explain that India has been declared a water-stressed country.
- How has climate change added to the water crisis?
To expand on this, check the [UNICEF](#) site.
- What are some of the ways students can ensure water is not wasted? She can also take them through some examples in our eBook [Restore Our Earth: Rejuvenating Water](#), which has 25 case studies showcasing traditional and other ways to rejuvenate and judiciously use water.

(B) RIVERS Students can be asked to research and document statistics on the present status of the principal rivers of India—

- Which civilisations grew around these?
- Which populated sites were abandoned because rivers changed their courses?
- What is the current water-carrying capacity of each river compared to 50 years ago? If it is less, what could be the reason for this?
- How can we help increase the quantity?
- What is the water quality of each river?
- Can students suggest ways to purify river waters?
- Which are the well-known aquatic creatures that live in rivers?
- What is their present status?



(C) UNDERGROUND WATER Focus attention on the status of India's water table today compared to 50 years ago. Ask students to think about reasons why it has gone down. Explain how climate change affects it. The teacher can also lead them through the water cycle to help them better understand how aquifers get replenished. *More information is available at the [National Oceanic and Oceanic Administration](#) site.*

(D) PLASTIC POLLUTION IN OCEANS Initiate a discussion on how plastic in oceans jeopardises the entire ecosystem and poses health risks to humans. *More information available here [UNEP](#).*

Discussion points for the teacher—

- Explain how plastic is made.
- Why is it considered a hazard?
- What is single-use plastic?
- Which laws in India ban its use?

This **Toolkit** explains steps to help end plastic pollution. The school can also start a waste plastic collection drive. Let the students meet with the local counsellor to understand how the municipality scientifically treats waste plastic. Their efforts can be recorded on EARTHDAY.ORG's **Great Global Cleanup Map** for others to see.



IN 2021, THIS NUMBER HAD RISEN TO 390 MILLION METRIC TONS OF PLASTIC PRODUCED PER YEAR
Source 2022-Plastic-Pollution-Primer-and-Action-Toolkit.pdf | Jambeck et al., Science 2015



How the material can be used in the classroom

Before screening the video [Fields of Hope](#)

the teacher can explain how climate change has negatively impacted humanity. Next, speak about how climate change has led to people being displaced and becoming climate refugees.

Questions can be—

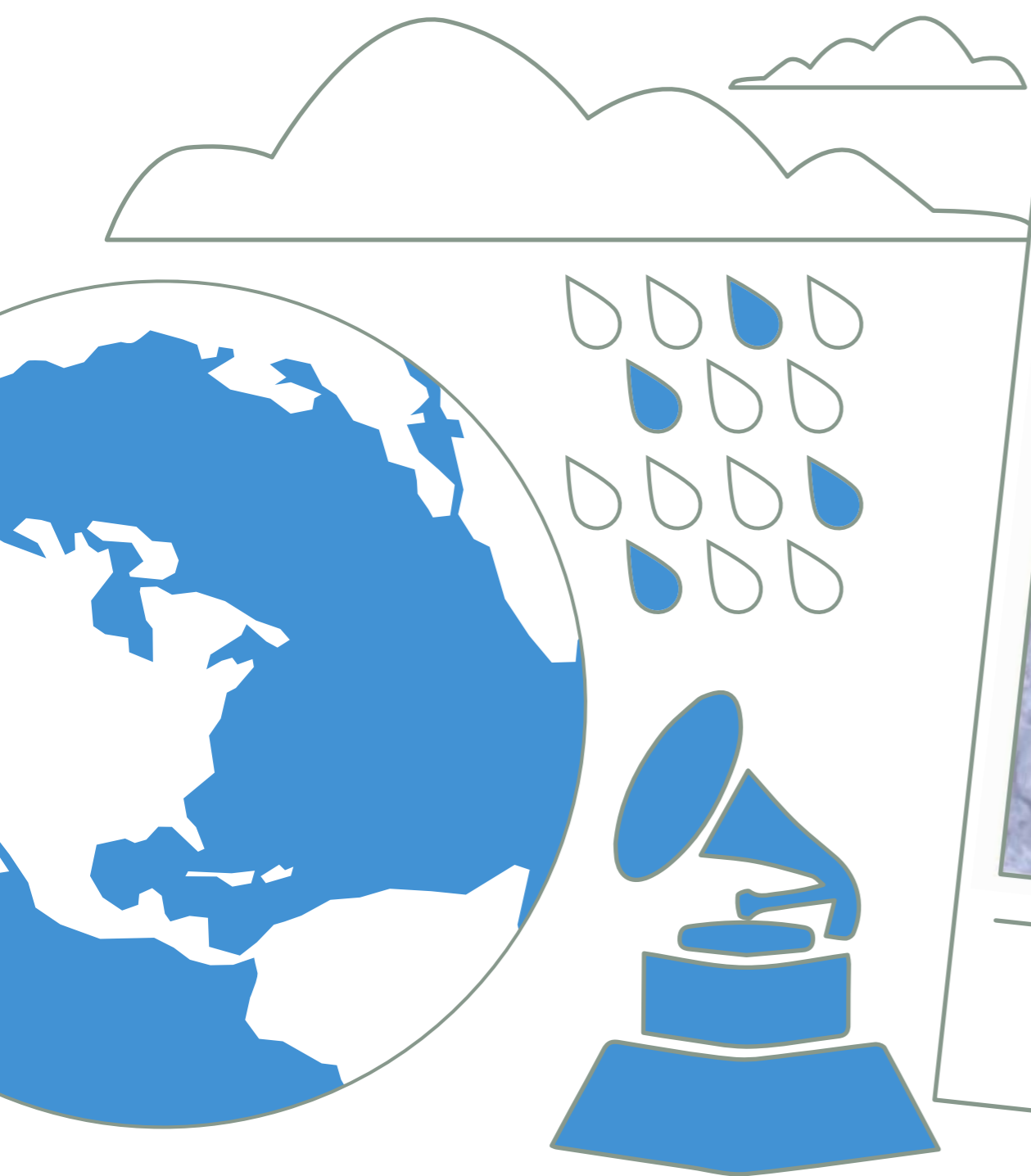
- Have you engaged with anyone who has had to move away from their original homes because of climate change-related issues?
- Where did the displaced shift to?
- Which countries are likely to face the issue of climate refugees most? Low-lying areas and islands? Other vulnerable spots?
- Can the problem of climate refugees increase tensions across borders?

More information [here](#).

The same video can also be a scene setter to discuss Earth's natural wealth, such as its green canopy. The students can be asked to list the many advantages of trees besides the two most valuable—providing food and oxygen.

Other points students can research are—

- What is the present status of tree cover in India?
- What was it 50 years ago? Why has this gone down? How can we help increase it?
- Will students pledge to plant a tree on their birthday and nurture it to grow?
- Which fruit trees are common in your area? What is the estimated time taken from seed to harvest for each type? As an activity, the students could make seed balls.



World Rain Day

'Rain Day' is on July 29 each year.

Earth Day Network's Rain Day Fest

is an amalgamation of information about rain and changes in rainfall patterns due to climate change. It also includes how the rainy season, the blessing of rain, and other rainfall-related elements are eulogised by countries across all continents.

The teacher can refer to the experiments with a simple rain gauge explained in Chapter 7. Also, discuss the advantages of rainwater harvesting and how their school can harvest water.

My Earth Songs

'Music is a powerful tool', says Ricky Kej, a 3X Grammy winner and Ambassador for Earth Day Network India.

"We remember the songs we learn in our childhood; their morals stick with us," he adds. Here is a [link](#) to his album of 'My Earth Songs' and an eBook related to the songs. Teachers can develop several exercises for their students using this material.

Let's help Restore Our Earth
Artists from 20 countries
Join Earth Day Network's
Rain Day Commemoration



Through innovative core programs, Agastya ignites an initial spark of curiosity in a child in their labs, where teachers trained in our hands-on methods excite students about Science, Art, and Mathematics.

There are many Agastya-created programmes teachers can avail to help spark curiosity about climate change and equip the students to get clarity of the Science behind climate change. And these are accessible even in the remotest of areas.

Following are a few examples

Mobile Science Lab

In a country as vast as India, with varied and challenging terrains, many of the country's underserved children live and attend school in remote areas. How does one reach them? Agastya has a network of Mobile Labs that deliver Science lessons and models to these children. Innovatively fitted vans travel widely to impart knowledge and bring Science to life for children, even those with limited access to hands-on learning. These Mobile Labs make understanding abstract concepts easy to grasp through working models. The young experimenters learn scientific concepts hands-on by exploring, experimenting, and experiencing. Two experts accompany each van.

Agastya has a network of Mobile Labs that deliver Science lessons and models to these children. Innovatively fitted vans travel widely to impart knowledge and bring Science to life for children, even those with limited access to hands-on learning.



20 YEARS OF AGASTYA – A TimeLine of Highlights

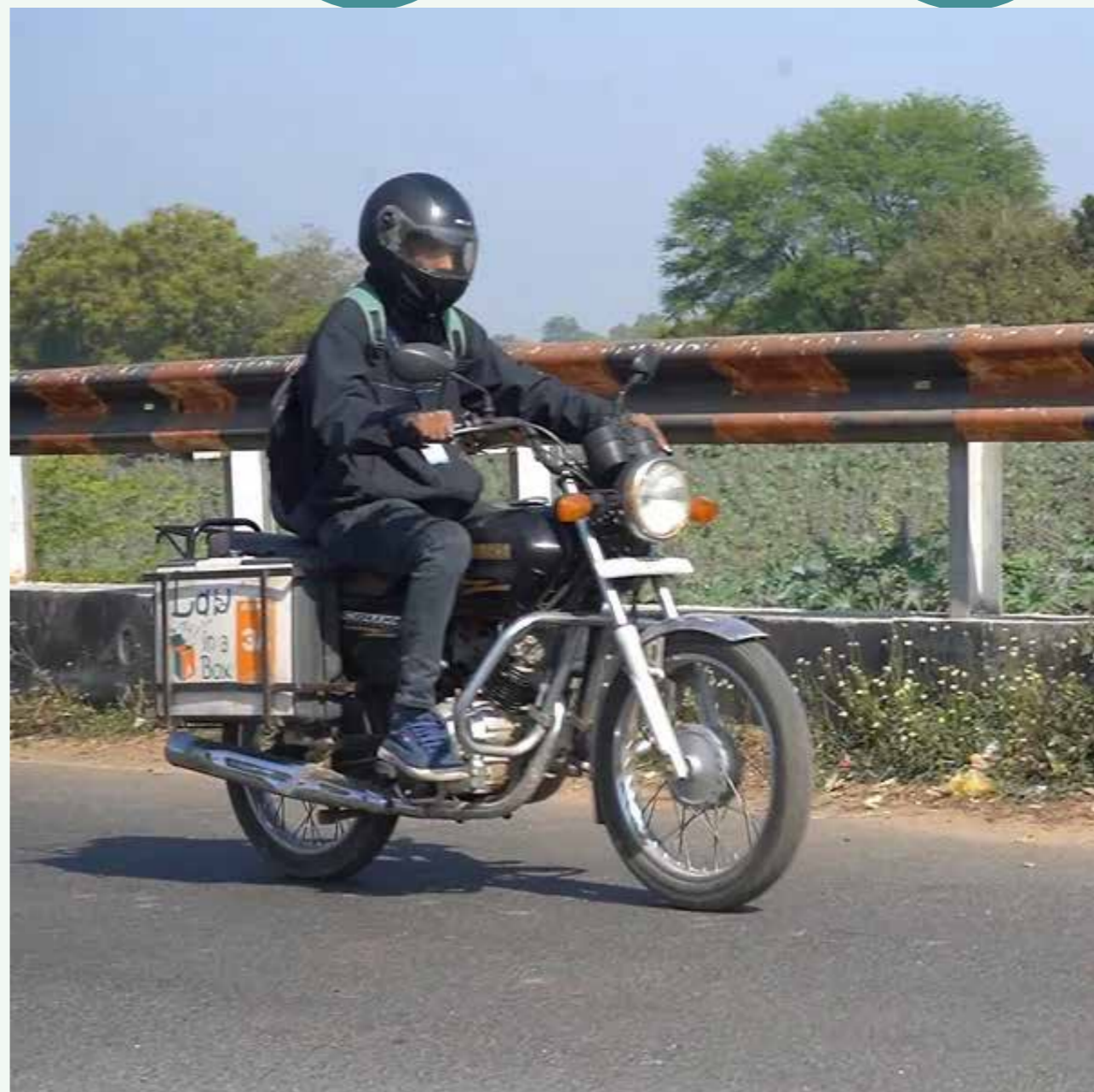
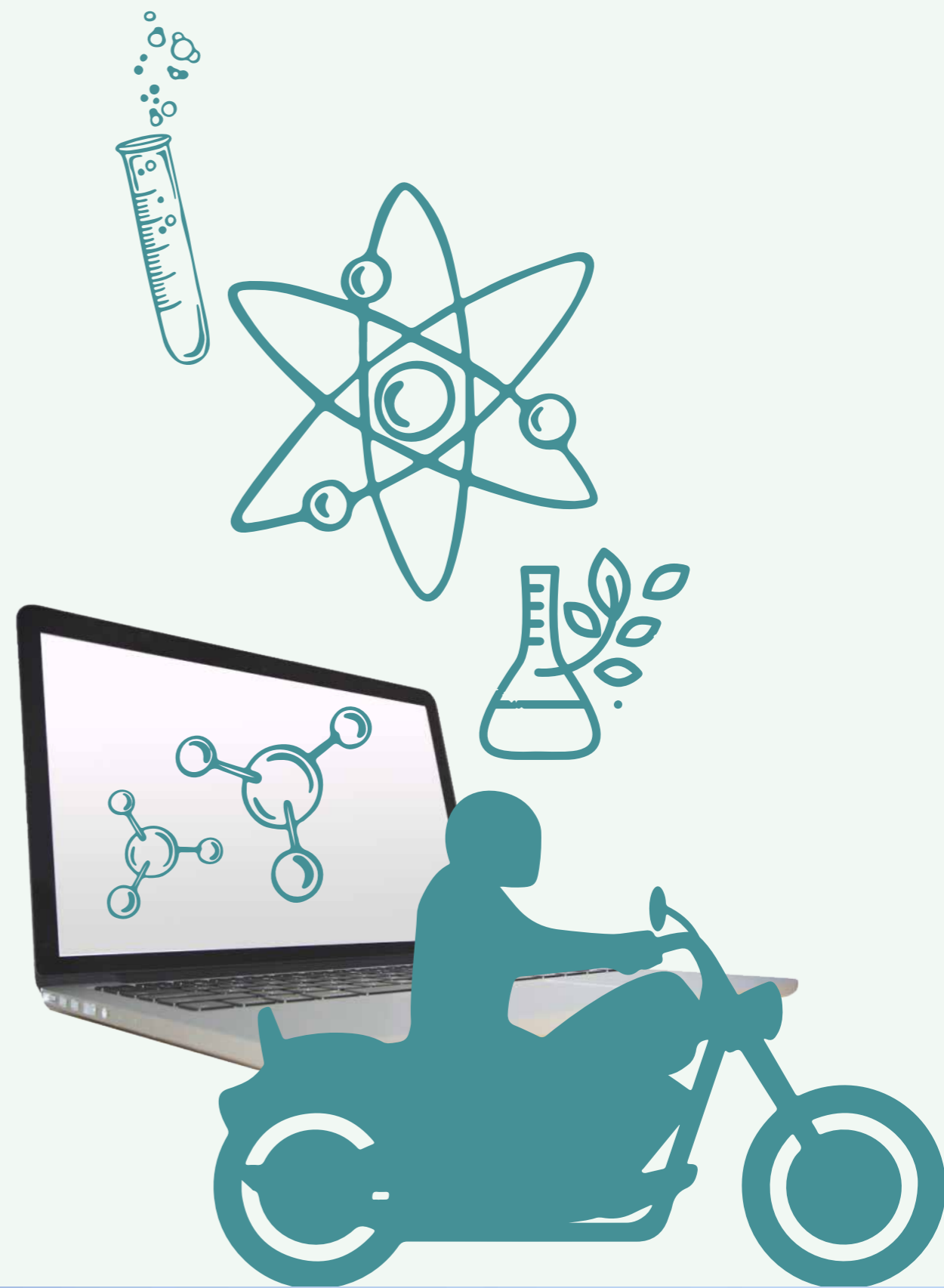


Lab-on-a-Bike and Lab-in-a-Box

These are other innovative delivery methods. The mobility of a motorbike, driven by an Agastya instructor, enables knowledge to the last mile of remotest corners, where accessibility for vans is difficult. The bikes have a laptop and portable internet connection, with access to language-neutral science videos, quizzes and more. The Lab-in-a-Box contains simple hands-on experiments that teach scientific concepts in a simple yet engaging manner.

Agastya's Teacher Training Programme

This is instrumental in training thousands of educators. The curriculum is designed to ensure teachers are equipped with tools and techniques to conduct classes using the Constructivist approach ('constructing' knowledge out of experiences) and develop low-cost models and teaching aids. This training empowers them to facilitate 'knowledge construction' in children. The training is conducted at the 172 acres Kuppam Agastya campus in Chittoor district, Andhra Pradesh, in the eastern Deccan plateau region. Dr Yellappa Reddy, an eminent environmentalist, guided the campus eco-regenerative effort through exclusively nature-based processes based on ecological principles. Agastya has introduced environment education in its curriculum integrating its on-campus environment and management efforts in its teaching module.



12 | The Earth Warriors

Approach to Teaching Climate Change



Shweta Bahri is the Co-Founder of **Earth Warriors**, whose mission is to empower 2 billion children to take climate action through age-appropriate climate education. Shweta is an education policy specialist who grew up in India. She has worked with governments, multilateral organisations and civil society in South Asia and Africa over the last 10 years. She is also the founder of **No More Waste**, a platform to promote sustainable solutions. Shweta has a Master's degree in Public Administration from the London School of Economics and an undergraduate in Land Economy from Cambridge University.

Eco-anxiety is a new malaise affecting younger generations in particular. It usually develops mainly in young minds anxious about the environment's current and projected future state and worried that anthropogenic actions aggravate Climate Change. 'Our students will have no choice but to bear the consequences of our action and inaction. Our job is to prepare them for the work ahead, encourage them to look for solutions, and help them recognise that they have some degree of agency over their futures.

Source **Harvard Business Publication**

Teachers play a vital role in preparing the next generation to face the changing climate as it manifests itself currently and be aware of how it will manifest in the future. They need to be made hopeful that Climate Change will not overwhelm the planet, get dealt with, and feel confident they can be a part of the solution.

As an educator, there are ways to help your students work towards this. Following are a few suggestions.

Shortlist the Climate Change issues your students are most passionate about

Is it the increasing heat waves? Rising pollution levels? Mounting garbage? Reduced natural wealth, such as the green canopy and e water? Impacts on health, such as the microplastics we ingest? Others? Once these are identified, the students can be helped to connect with other students globally who share similar concerns so that they realise that they are not alone, the concerns are common, this is a global struggle.

Introduce students to real-life climate activists in their city or country

This is an effective way for them to know that there are people who are making a huge difference and get inspired to follow the examples of these idols.

Practise what you preach Sustainability in the classroom

The easiest way to teach students about Climate Change is to practice climate-positive and sustainable habits yourself. Students look up to their teachers and observe everything they do. Making sustainable living a part of your daily routine will normalise it. Then it will seem natural to your students. It can be as simple as having a recycling bin in your classroom or choosing DIY materials rather than buying new plastic supplies.

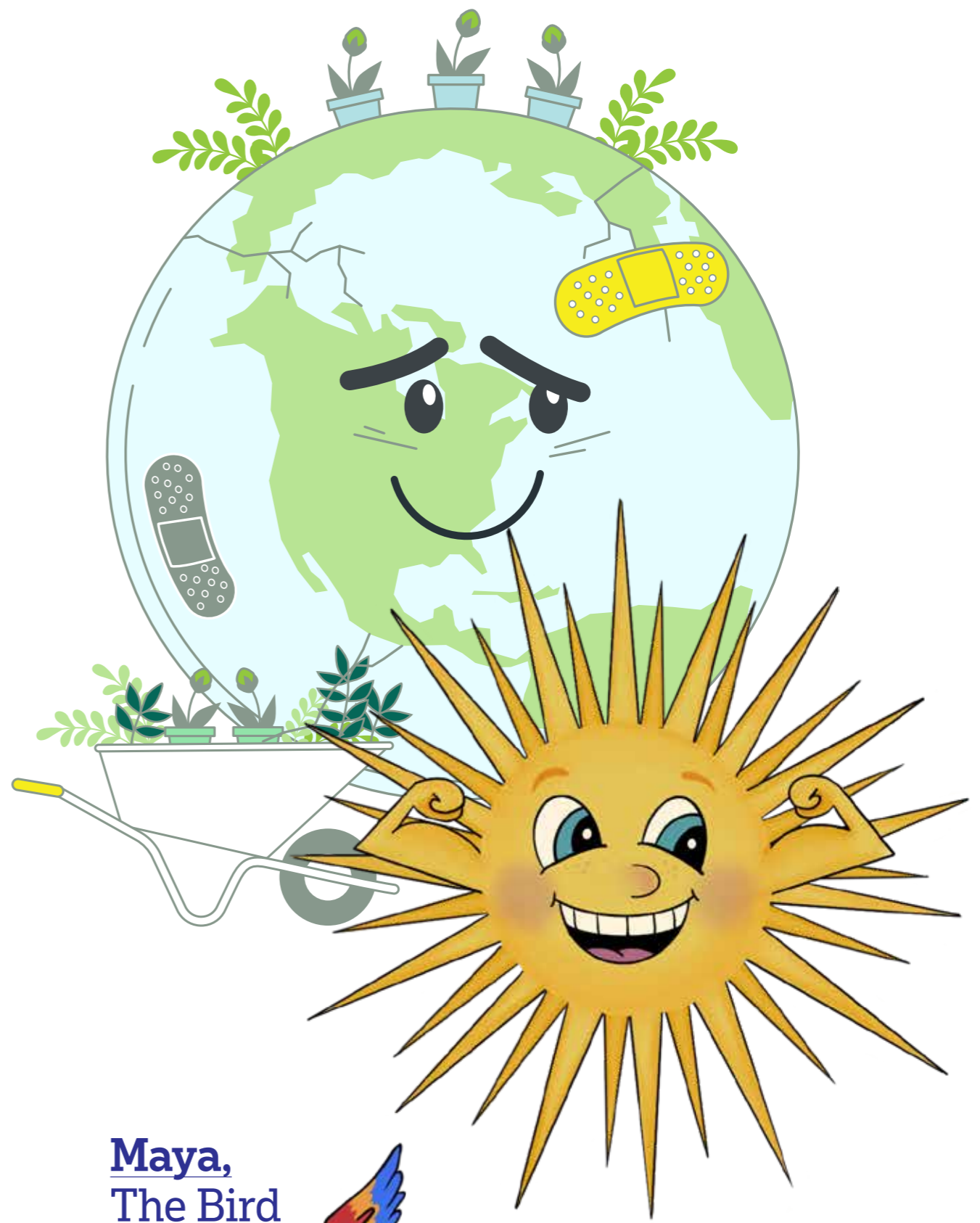
Have open positive conversations

There is a tendency to want to shield or protect children from Climate Change. However, children are clever, and they can see what is going on regarding extreme weather events and how their community is being impacted by Climate Change. We have found it's better to openly talk to your students about Climate Change and see what they already know. Then you can provide support and a safe space to discuss their feelings. This will also help in reducing eco anxiety.



For young children

We have found that using characters is a great way to teach them about these complex topics in a fun and engaging way. Our students decide if they want to be Earth Warriors and which Earth Warrior they identify with the most (Land, Water or Sky Earth Warrior). Storytelling, using our characters, has been an extremely engaging way to explain Climate Change concepts to our students and empower them to feel confident to take climate action. For instance, Bo the Evil Plastic Bottle is used in our lessons to demonstrate the dangers of plastic while the Water Earth Warrior is fighting Bo and finding solutions to ocean plastic pollution. The characters inspire children to want to be Earth Warriors that work together to find remedies to protect the planet. They also give students role models they can identify with and aspire to be.



Maya,
The Bird

Sol, The Sun

Characters



Smokey,
The Pollution
Cloud



Sky
Earth
Warrior



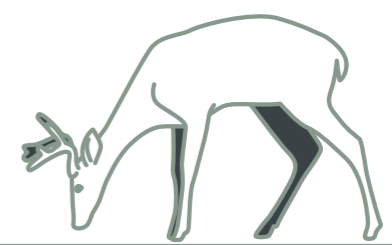
Land
Earth
Warrior



Po, The Polar Bear



Rooty, The Tree



Bo,
The Evil Plastic
Bottle and his
sidekick Straw



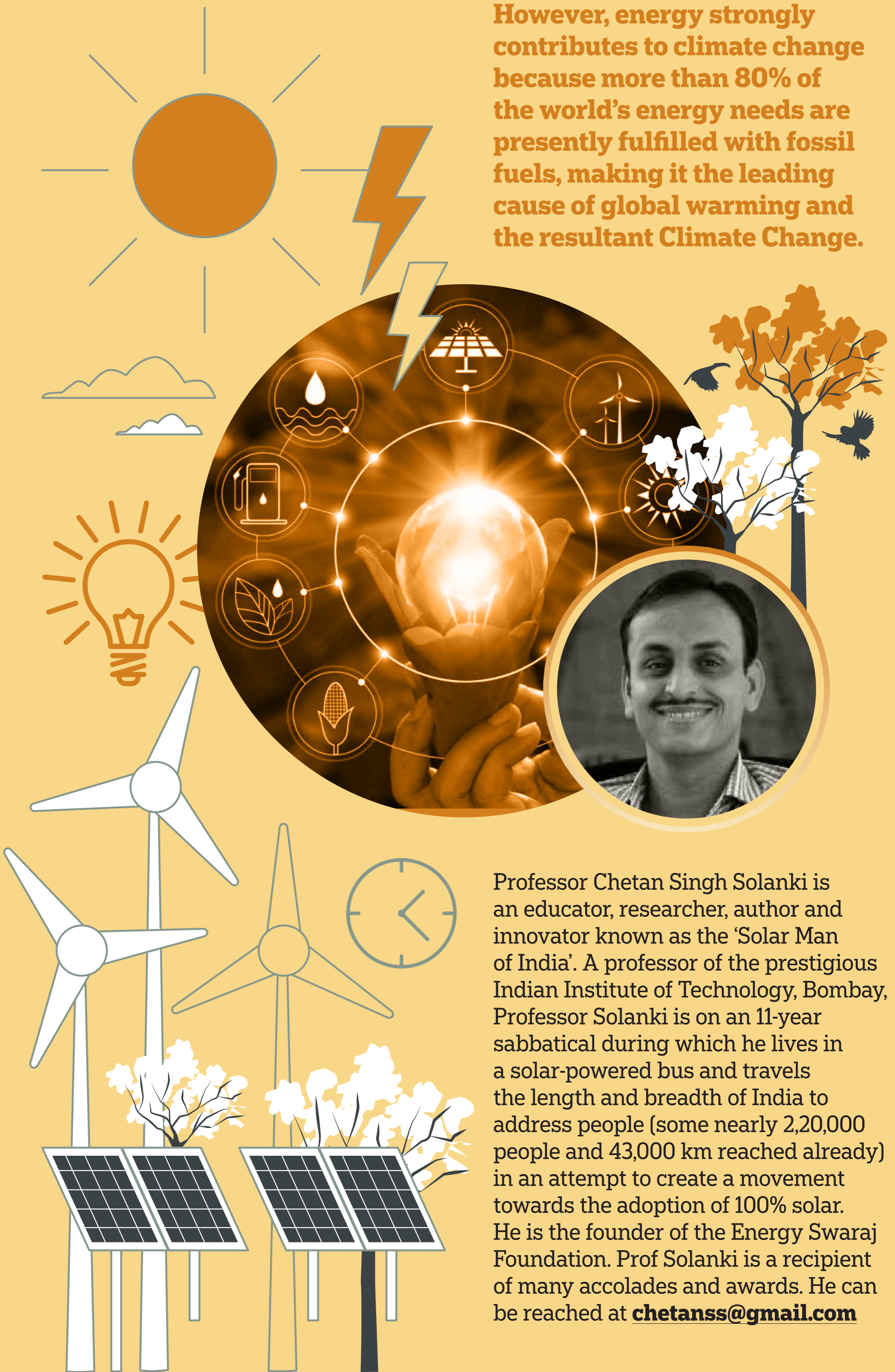
Water Earth
Warrior

Inky, The Octopus

13 | Develop Energy Literacy

Energy is the key driver of social and economic growth. Access to reliable energy has enabled communities and countries to grow technologically and economically faster than others without such access.

However, energy strongly contributes to climate change because more than 80% of the world's energy needs are presently fulfilled with fossil fuels, making it the leading cause of global warming and the resultant Climate Change.

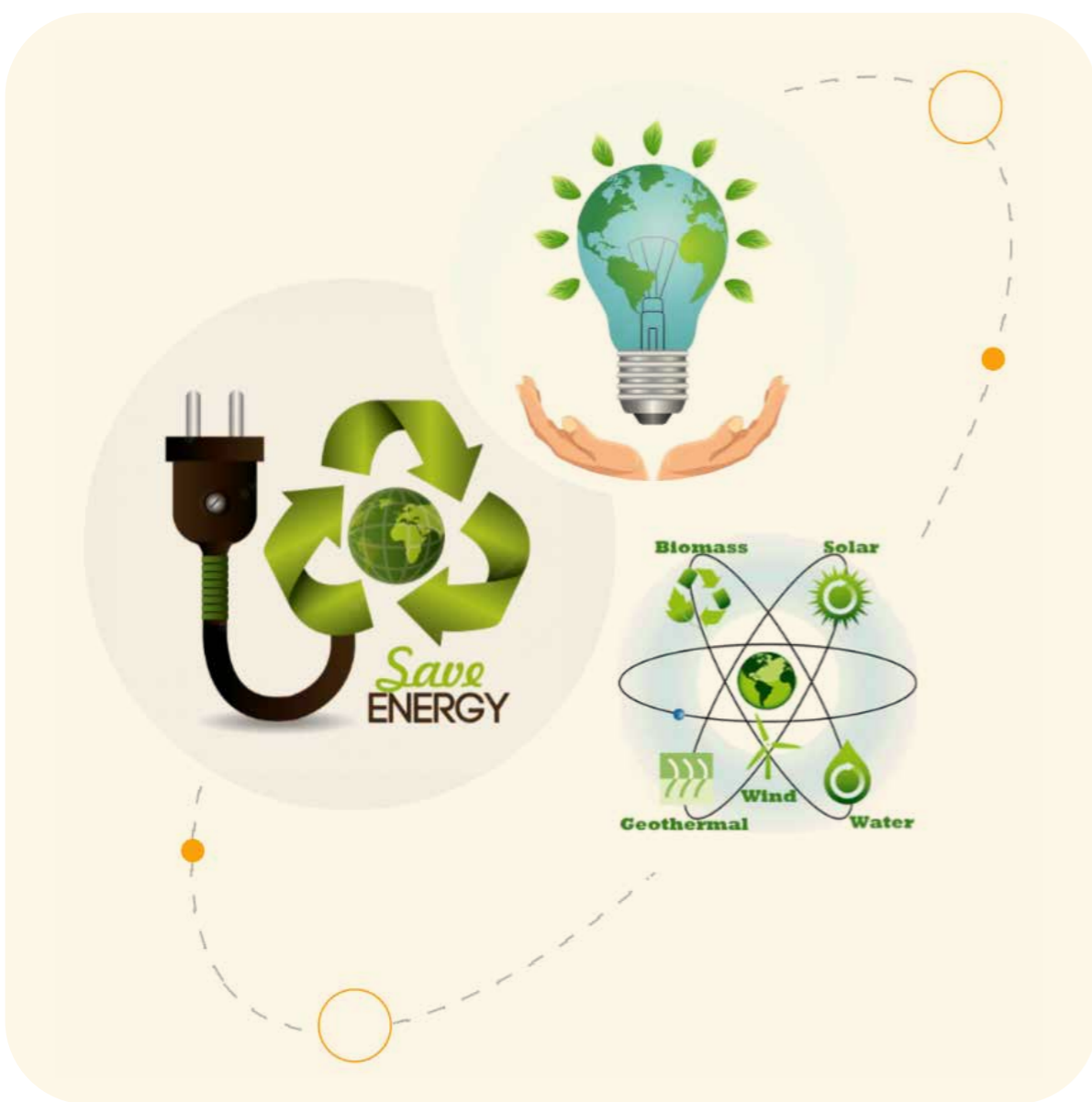


Professor Chetan Singh Solanki is an educator, researcher, author and innovator known as the 'Solar Man of India'. A professor of the prestigious Indian Institute of Technology, Bombay, Professor Solanki is on an 11-year sabbatical during which he lives in a solar-powered bus and travels the length and breadth of India to address people (some nearly 2,20,000 people and 43,000 km reached already) in an attempt to create a movement towards the adoption of 100% solar. He is the founder of the Energy Swaraj Foundation. Prof Solanki is a recipient of many accolades and awards. He can be reached at chetanss@gmail.com

Knowing the basics about energy usage and its negative environmental impact is therefore essential.

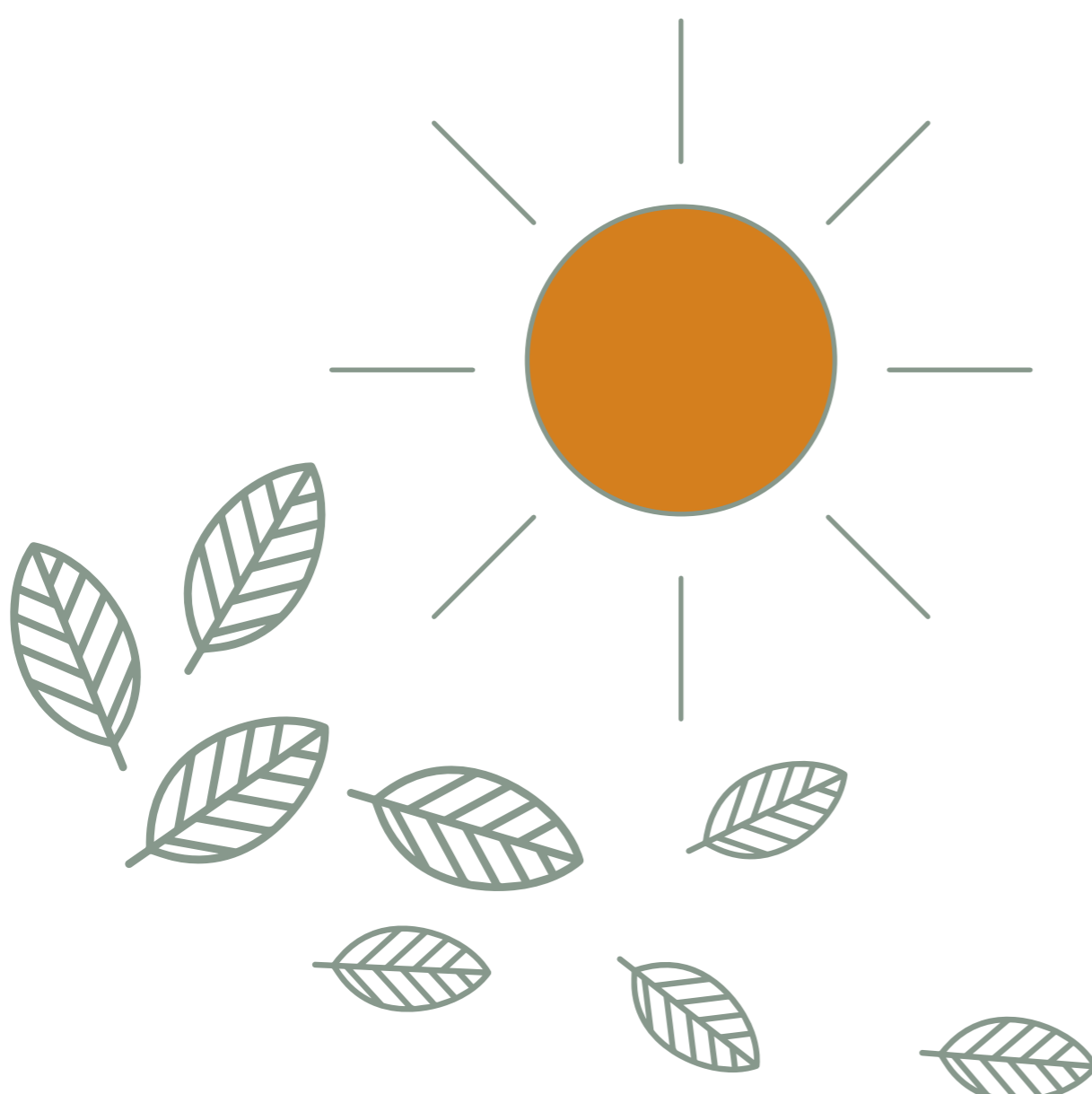
Like needing a driving license to drive a vehicle, being energy literate is the license required to use energy. Without this license, we are ignorant and place our lives and those of others too at significant risk.

The first step is for the teacher to elaborate on this so that students become aware of why energy use must be reduced and the many benefits of renewable energies.



Energy Swaraj Foundation

Energy by Locals for Locals



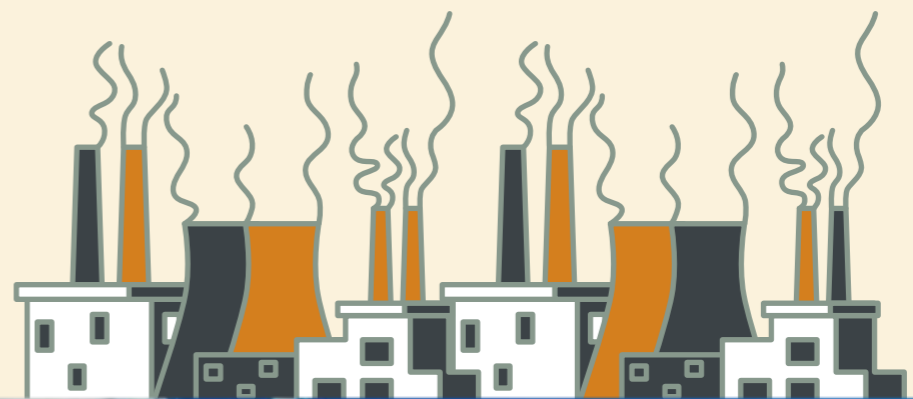
Once a basic understanding is reached, the teacher can introduce the **Energy Swaraj Foundation** Energy Literacy course, which will help students understand energy generation, consumption, use, misuse and inefficient use, and opportunities to conserve energy and generate clean energy. The Foundation has designed this course with the belief that excessive use of fossil energy or bad energy has created an imbalance, degradation of nature and climate change in the world and that all these can be corrected through the use of the right energy (such as the clean and sustainable energy the Sun provides).

The Energy Literacy course includes 12 modules of 15 minutes each. The training can be taken online or offline at each person's convenience. Each module is enjoyable and engages participants through examples, exercises and simple multiple-choice questions. Each training module is divided into four sections or four 'E's, as listed below—

- **SECTION 1 (5-8 min)**
Establish the concept of a given module
- **SECTION 2 (3-4 min)**
Example to clarify the module concept
- **SECTION 3 (2-3 min)**
Exercise to strengthen the grasp of the concept
- **SECTION 4**
Examination to check the understanding of the concept
- **SECTION 5 (2-3 min)**
Multiple Choice Questions (MCQs)

Once the students have completed the course, they are expected to be energy sensitive and knowledgeable about its use. The following questions test how much the students have learnt and shortlist any points the teacher needs to further elaborate on.

- How much energy is being used?
- From where is the energy coming from?
- What is their carbon footprint?
- What are the impacts of energy use on the environment?
- What are possible alternatives?
- What is the best approach for energy generation and consumption?





THE MOST
IMPORTANT
NUMBER IN
THE WORLD

DEADLINE TIME LEFT TO LIMIT GLOBAL WARMING TO 1.5°C

5 YRS **346** DAYS **08:41:21**

LIFELINE WOMEN IN PARLIAMENTS GLOBALLY

26.5% WOMEN

CLIMATE CLOCK

THE CLIMATE CLOCK MELTS ART, SCIENCE, TECHNOLOGY, AND GRASSROOTS ORGANISING TO GET THE WORLD TO #ACTINTIME

Source www.climateclock.world/

To keep the students engaged on the topic of Climate Change, the school can apply at climateclock@energyswaraj.org for the Energy Swaraj Foundation to include them whenever students are invited to assemble a climate clock in their area.

The Climate Clock, launched in 2018, is a measuring stick that shows the time left for the average global temperature to reach a 1.5°C warming mark. It is significant as this marks the start of irreversible changes in climate.

'I firmly believe that the effect of climate change can be seen everywhere. The Climate Clock will help focus immediate awareness about the rising temperature and the urgent need to mitigate climate change.'

-CHETAN SINGH SOLANKI

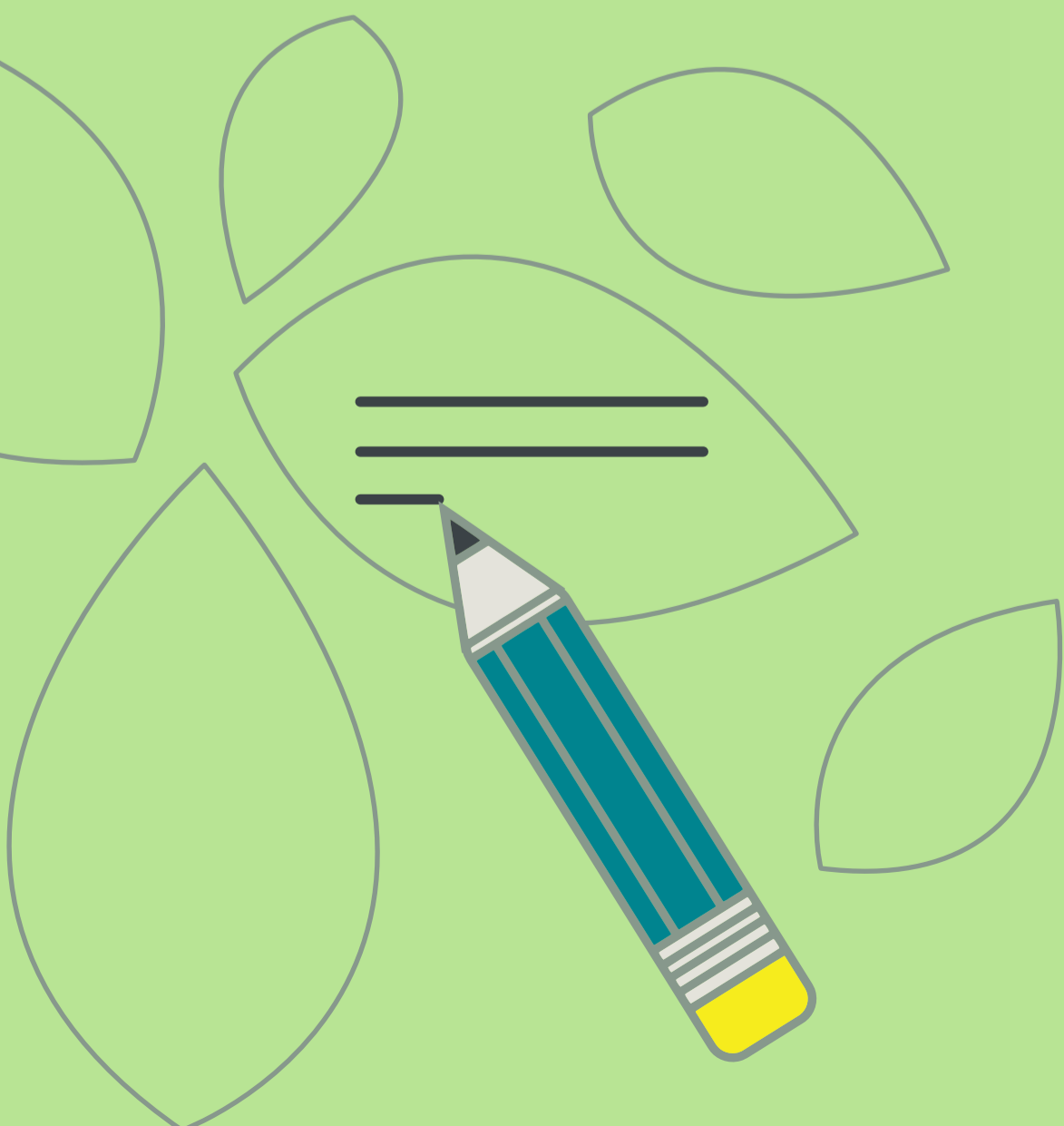


14 | Making a *Sankalp Vriksha* (Tree of Pledges)

Each leaf represents a pledge that must be honoured



Rupali Sachdev taught at Mahadevi Birla World Academy in Kolkata from 1987-2022. Presently, she is the Academic Advisor, Senior Wing at the Sarala Birla Public School, Ranchi. She can be reached at rupalisachdev@yahoo.co.in



Sankalp Vriksha **A Call For Action**

I remember spending a sleepless night thinking about the mythical *Kalpataru*, the wish-fulfilling tree that my grandmother spoke about. After listening to her, I was convinced dreams could indeed be fulfilled. Action was what was needed to accomplish ambitions.

A few decades later, I was asked to organise an exhibition on environmental issues in my school. I named it 'Only one Earth'. The Rio Summit was in the news. To update myself, I started reading books available in our library on environment-related issues to shortlist ideas. One illustration, in particular, caught my eye: a tree with leaves and a bubble with a resolution written on it.

I connected the dots in my mind. A resolution was made, and it now needed action! I recalled my grandmother's story about the *Kalpataru* and decided to develop a project which I named *Sankalp Vriksha*. We would ask our visitors to put down their pledges to save the planet.

The project would serve as an interdisciplinary approach to learning. India's National Education Policy 2020 states that pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and enjoyable. I was convinced this project would accomplish that.

Here are the details.

Project—Sankalp Vriksha

Preparation

- Make the trunk and branches of a tree using gum and brown cardboard/papier mache.
- Draw leaves on chart paper and cut them out, one sheet provides 20–23 leaves. A variety of templates were used, as well as different chart paper in different colours in a bid to get leaves of different shapes, sizes and hues thereby celebrating diversity.
- Punch a hole at one end of each leaf and keep them ready to string onto the branches of the tree with jute, cotton thread or wool.
- The number of leaves will depend on the occasion. 40 may be enough for a class event but hundreds may be required for an inter-school occasion.
- Type resolutions on white paper. Print 10–12 of the same kind on A4 paper. After printing, cut and paste the strips on each leaf. Have six different resolutions to offer visitors with a choice.
- Place these in a separate cardboard box.
- Post a chart in a prominent place enumerating the resolutions and the box containing each.





SANKALP VRIKSHA—BEFORE THE LEAVES WITH RESOLUTIONS WERE PLACED

Activity

Aim to have the tree full of leaves with pledges by the end of the day.

- Place the *Sankalp Vriksha* (without leaves) one side of a table.
- Keep the six boxes on the table.
- Have volunteers on hand to invite students/teachers/visitors to choose their resolution from the box, sign their name, put the date on the slip, and use the string to tie the paper onto the tree.

The learning outcomes will be there for all to see. The children learnt to engage, explore, collaborate, think creatively and

critically, connect real life with their syllabus, and integrate art.

Mahadevi Birla World Academy, Lakshmiapat Singhania Academy, Akshar, M P Birla Foundation, St Thomas' Day School, St Thomas' Girls' School, DPS Howrah have worked on *Sankalp tree* projects. At the exhibitions, it was noticed that the tree was what was most photographed.

It will be wonderful to see *Sankalp Vriksha* in courtyards of all schools.

SANKALP VRIKSHA—AFTER THE RESOLUTIONS WERE STRUNG



FAQs

SAMPLES OF OUR RESOLUTIONS

Can we staple the leaf on the branches?

No. Using staple pins means using metal, which means encouraging more mining. And the tribals are affected the most when mining operations happen on land which is rightfully theirs. What they get as compensation is a fraction of what the industrialist profits. Instead, punch a hole, and use string to tie the leaf to the branch.

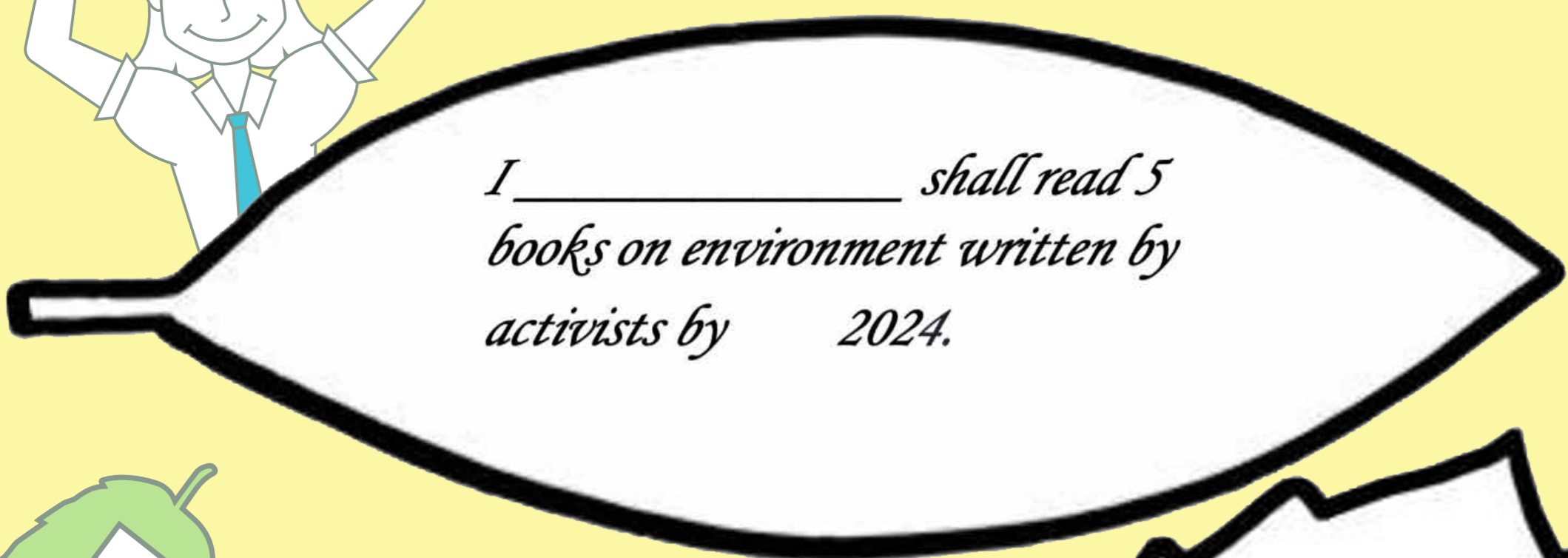
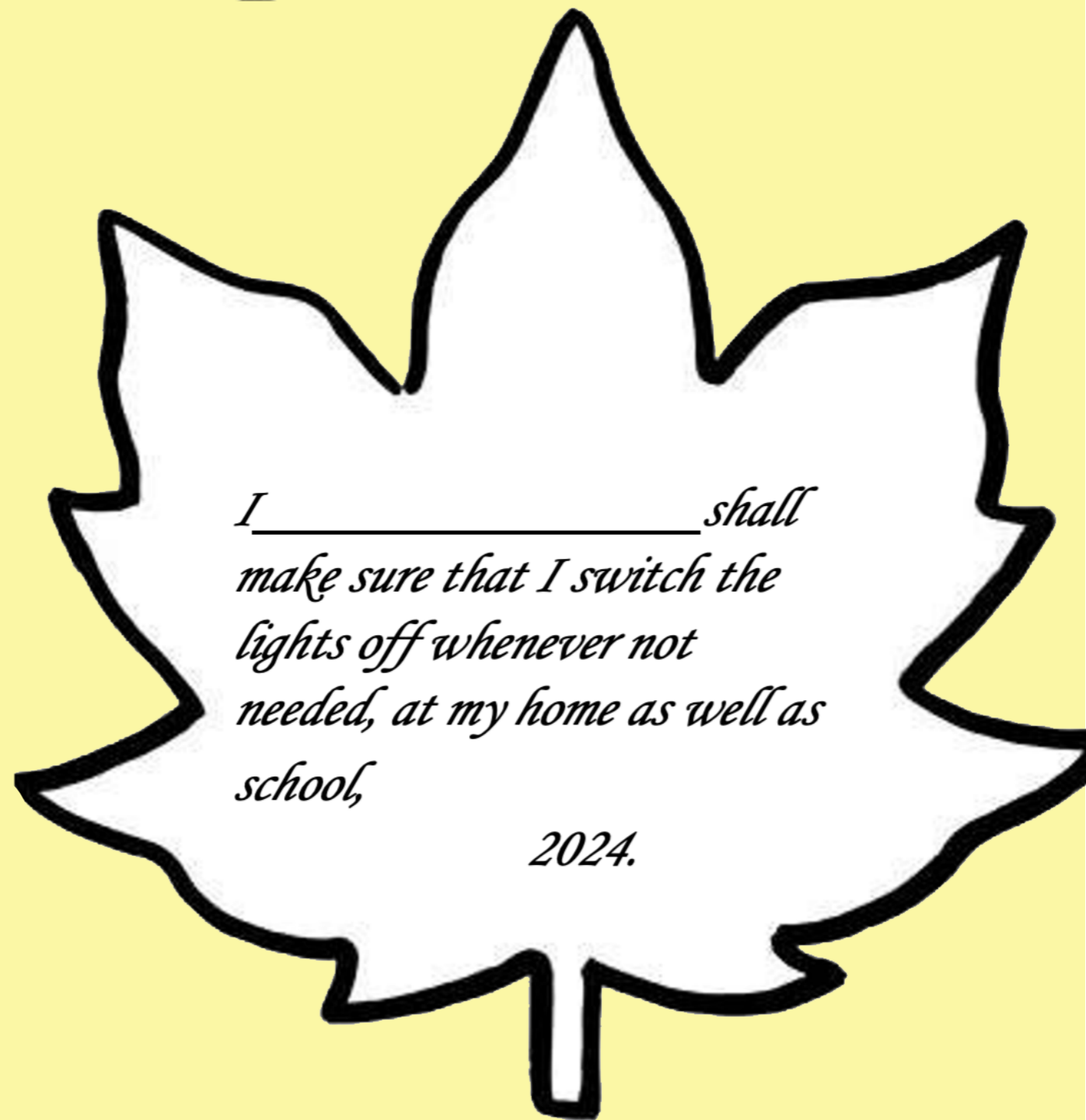
The act of tying gives a few moments to the person to reflect on their resolution and read others as well.

Why should we use gum and not Fevicol /Fevistick when making the tree with papier mache or pasting resolutions on the leaf?

Gum is more eco-friendly. Buy big bottles (preferably glass) of gum. For the same amount of adhesive, you would need several sticks/tubes of Fevicol—all made out of plastic, a material that pollutes the Earth.

Can we change the content in the pledge?

Yes, if the pledge, directly or indirectly, helps in protecting our environment.



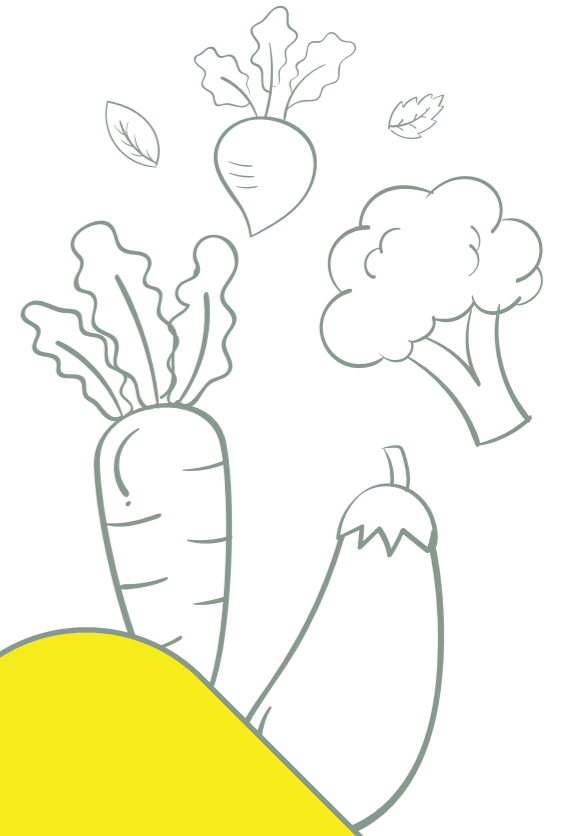
There are many sources on the open net to get more suggestions for pledges. For example, take a look at the UNESCO sustainable development goals at <https://en.unesco.org/sustainabledevelopmentgoals>

All one needs to ensure is that the pledge (*sankalp*) has a definite action and is time-bound. Only then will there be accountability.

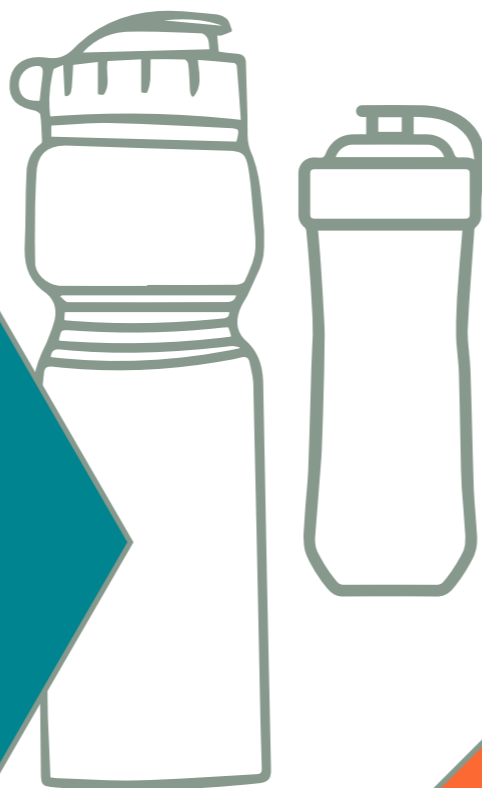
I will use
pool
car/bicycle
for commuting.



I will eat
seasonal
vegetables and
fruits.



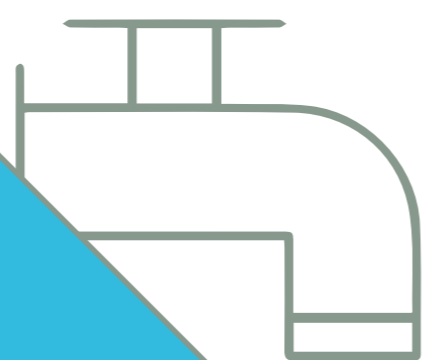
I will use a
reusable water
bottle, to avoid
plastic waste.



I will repair
my old clothes
instead of
buying new
ones!



I will turn off
the tap while
brushing
my teeth.



I will use stairs
instead of a lift
or elevator.



15 | Traditional and Indigenous Practices for Climate Resilience in India



Many traditional practices in India are regenerative, restorative, and circular. These time-tested practices have helped people live in harmony with nature for centuries. Unfortunately, with the development of modern technology and the growth of cities, many of these are side-lined today. To bring these environment-friendly practices back to centre stage so that everyone can appreciate their value (planners, policymakers included), the National Institute of Urban Affairs has elaborated on 25 such practices in their manual **[Traditional & Indigenous Practices For Climate Resilience in India](#)**. From the saffron fields of Kashmir to the Khazan salt dunes of Goa, the floating gardens of Manipur to water conservation practices of Rajasthan, these offer a virtual tour of the length and breadth of India, celebrating cultural diversity along with traditional wisdom.

A geography teacher can integrate excerpts from this **manual** into their geography lessons.

Practices are classified under 5 chapters: Land Management; Water Security; Food Security; Urban Ecology and Circulatory.

The manual demonstrates how these practices may be adapted in an urban set-up. Teachers can simplify the ideas and ask the students to try them out on a small scale at school or at home.



Here are three examples

01 Phumdis and Ataphams of Manipur

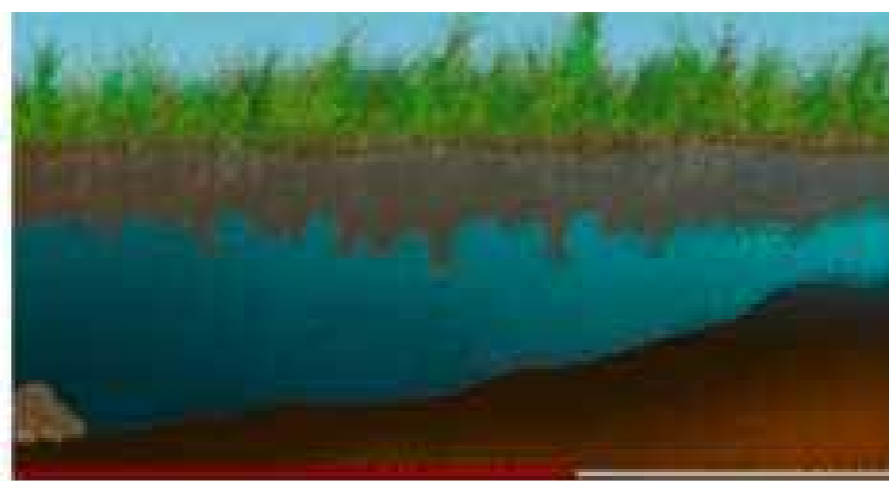
Phumdis are floating circular masses of decomposed vegetation, soil, and organic matter on Loktak Lake in Northeast India. These create diverse habitats for flora and fauna, including endangered species, and play a crucial role in the lake's ecosystem and ecological balance. Ataphams, on the other hand, are man-made floating gardens built for

anthropogenic needs. Both Phumdis and Ataphams hold significant ecological, cultural, and economic value, showcasing the sustainable practices of local communities in harmony with nature.

WHAT STUDENTS CAN DO

Students can get large tubs, fill these with water and make floating gardens using compost cakes, dry leaves, hay etc.

The once submerged Phumdi emerges to surface again and floats due to high proportion of vegetative material.



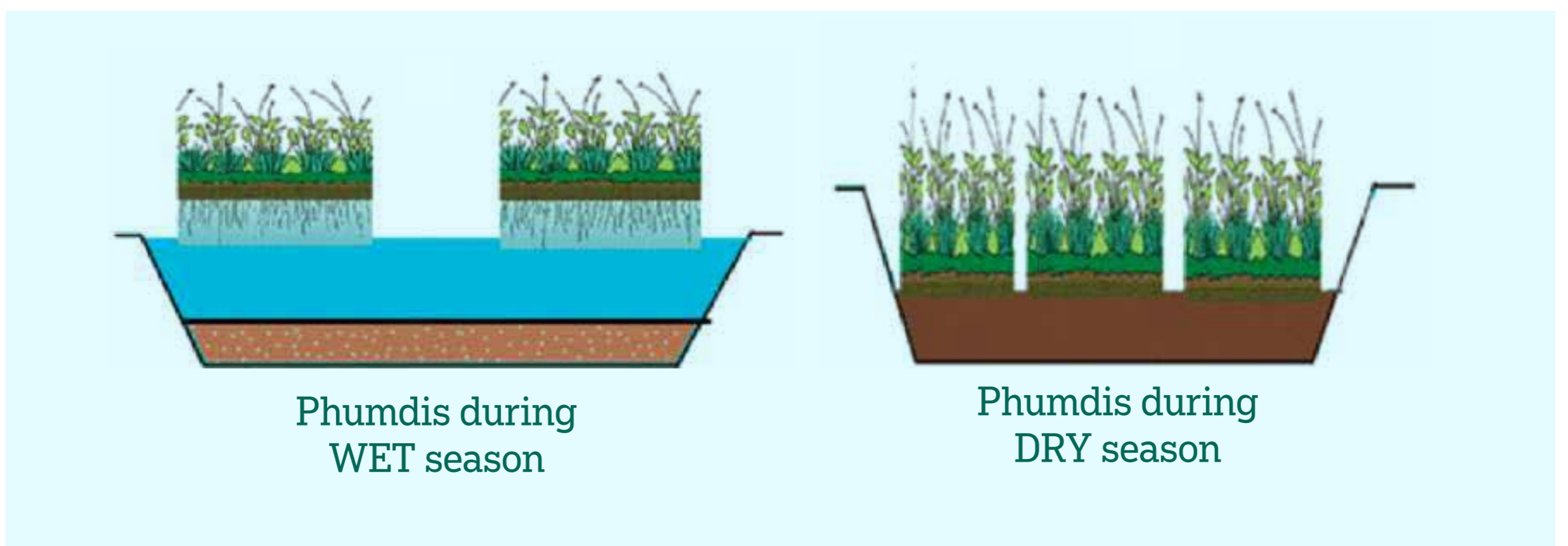
The beginning of the natural cycle is marked by Phumdi settling down to the lake bed during dry months.



With the onset of monsoon Phumdi almost submerges in the rising water level.



The detained roots during this season absorb minerals and nutrients from the bed.



Functioning of phumdis
Image Source Neelam Khare



02 Ahar Pynes System of South Bihar

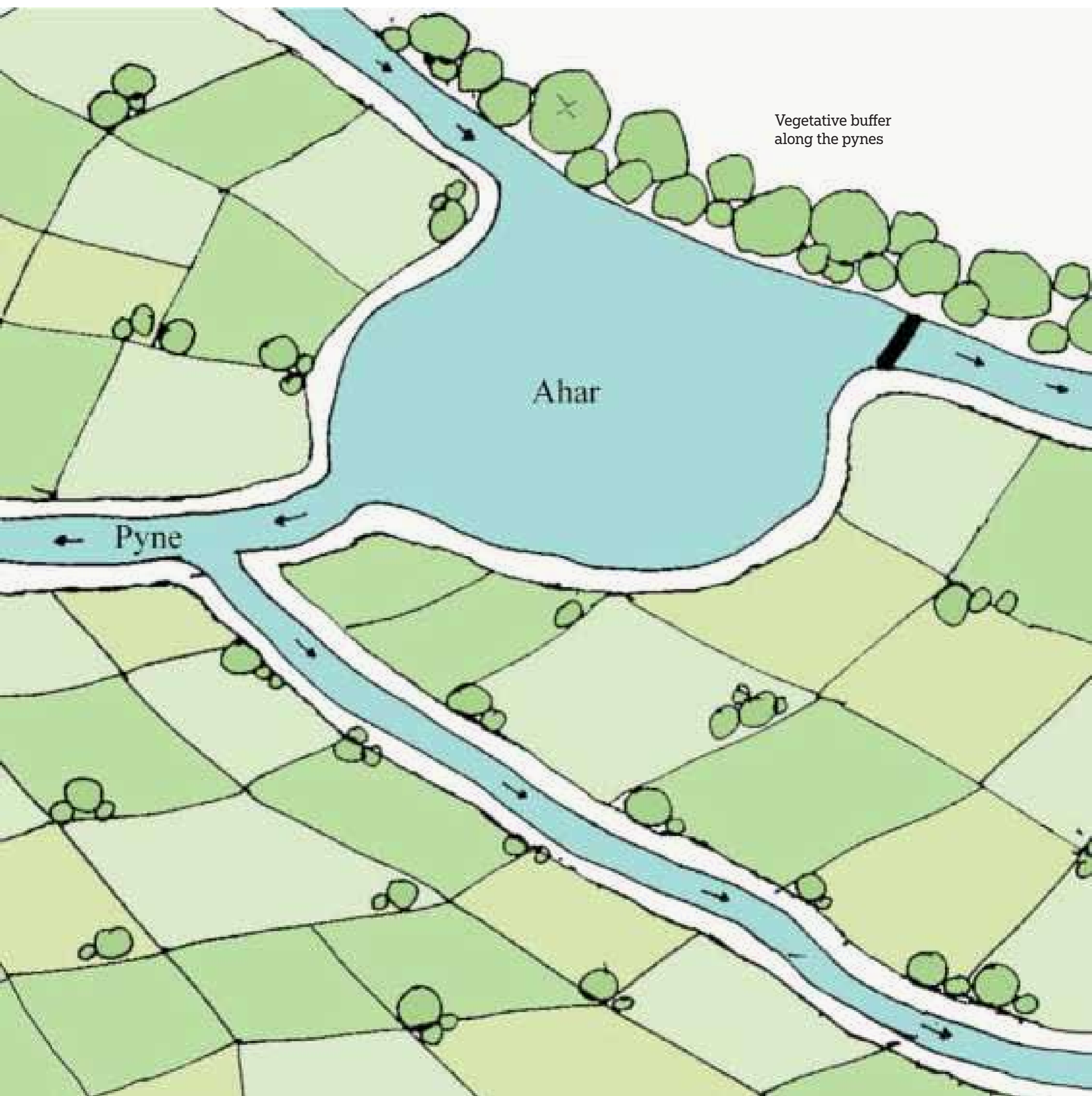
The practice of Ahar Pynes is based on harnessing floodwaters for irrigation and domestic purposes in the otherwise relatively water-deficit and rocky terrain of South Bihar. Traditionally, this diversion-cum-storage system helped control and harvest floodwaters in many areas of the state. The system directed floodwater into a reservoir and also helped turn land suitable for cultivation once the water was drained out.

Gaya district, where 3,000 of 20,000 such structures are now defunct, is often in the news today because of destruction caused by floods.

WHAT STUDENTS CAN DO

Students can create an Ahar Pynes System in their school kitchen garden and explore various rainwater harvesting methods.

ECOSYSTEM OF AHAR AND PYNES



Source Barbhuiya et al., 2022



03 Oran System of the Thar Desert

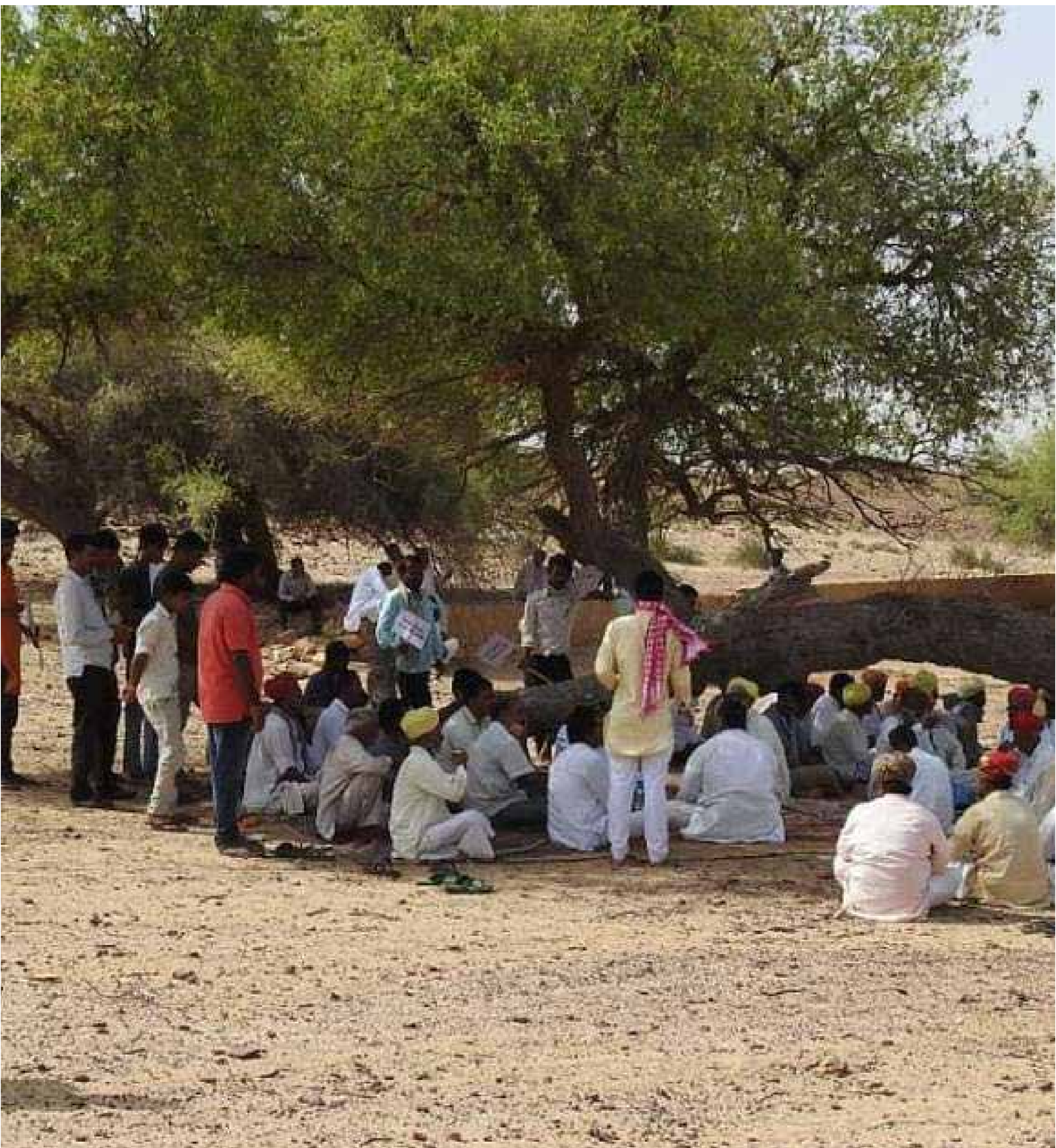
Orans are sacred groves or forest patches considered community-managed protected areas. This traditional community-based forest management practice has been adopted for centuries by the local communities. It helped maintain the ecological balance and overall biodiversity in the Thar Desert.

WHAT STUDENTS CAN DO

Research on sacred groves and document in which parts of India one finds these and what the vegetation normally found there is. If the school has a large compound, then the students can create a sacred grove in one corner of the garden or in a field adjacent to the school.

SACRED GROVES OF THAR DESERT MANAGED AND CONSERVED BY LOCAL COMMUNITIES

Image Source Sumer Singh Bhati



<https://niua.in/intranet/sites/default/files/2853.pdf>



16 | A shortlist of climate related resources available on the internet

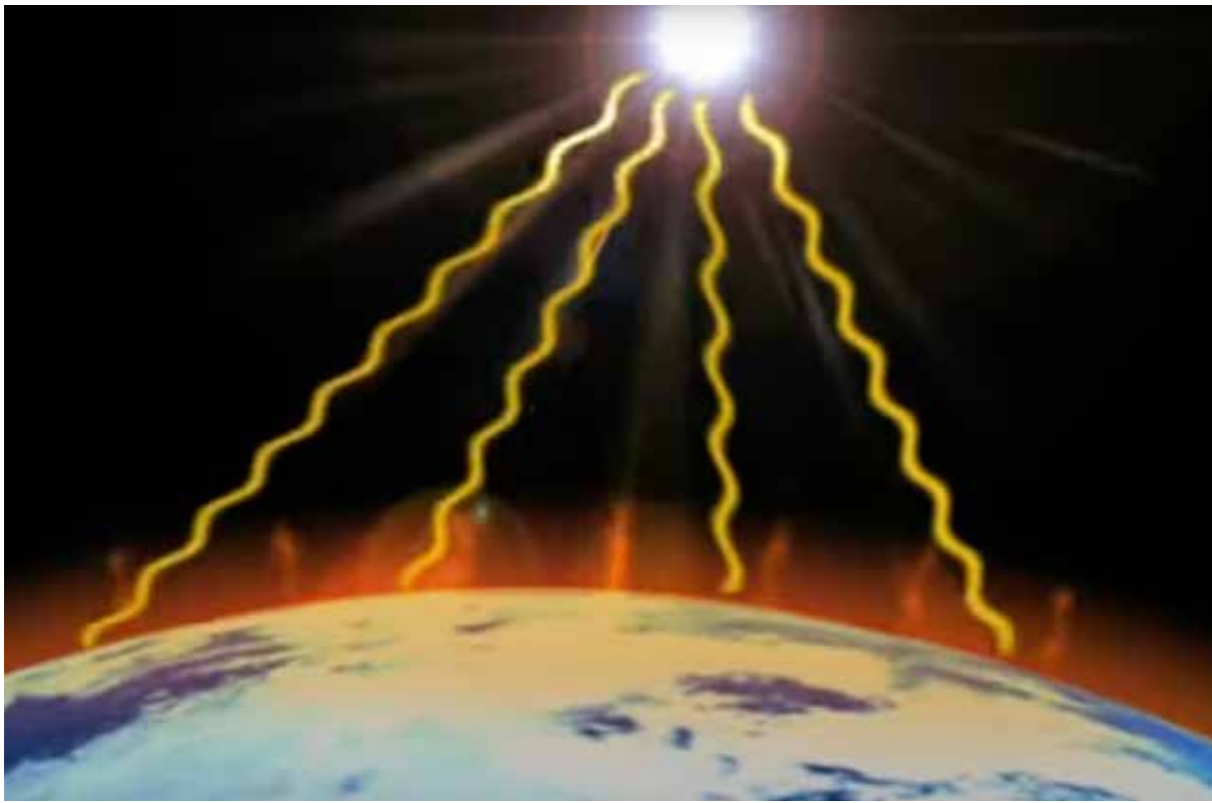
① National Aeronautics and Space Administration (NASA)'s 'The Effects of Climate Change' explains that the effects of human-caused global warming are happening now, are irreversible for people alive today, and will worsen as long as humans add greenhouse gases to the atmosphere.

<https://climate.nasa.gov/effects/>



Sayantan Mukherjee: Kolkata-based filmmaker, video editor, and writer exploring the intersections of art and science in life. He can be reached at satanshady@gmail.com

2 United States Environmental Protection Agency (EPA)'s Climate Change Resources for Educators and Students. This page provides federal and non-governmental resources for students and educators to learn about and teach Climate Change.
<https://www.epa.gov/climate-change/climate-change-resources-educators-and-students>



3 WWF—Climate Change Resources produced by WWF offers a range of curriculum-linked resources for the classroom to help pupils explore Climate Change issues in an engaging and motivating way.
<https://www.wwf.org.uk/get-involved/schools/resources/climate-change-resources>



4 National Institute of Urbans Affairs' 'Traditional & Indigenous Practices for Climate Resilience in India' delineates how each Indian state innovatively employs climate resilience using indigenous means.

<https://niua.in/intranet/sites/default/files/2853.pdf>



Love

in the Times of Climate Change



Poems of Hope

Amandeep Singh | Helly Shah | Priya Malik | Priyanshi Bansal | Sainee Raj | Simar Singh | Shubham Shyam



5 Council of Energy, Environment and Water's 'Love in the Times of Climate Change' is an ensemble of spoken-word poems on Climate Change in Hindi and English by seven leading Indian performance poets. The campaign offers a fresh approach to sustainability literature by exploring the theme of 'love' while acknowledging Climate Change as an accepted reality.

<https://shorturl.at/EIP78>



6 The Economist's video depicts the likely catastrophic conditions predicted should global warming reach 3 degrees Celcius above pre-industrial levels.

<https://youtu.be/uynhvHZU00o>

- 7 Wade | Indian Animated Short Film - The film follows a group of Climate Change refugees in Kolkata, India, streak of Royal Bengal Tigers attack them. It imagines futures around sea level rise, global warming, ecological disruption and mass migration.

<https://youtu.be/KSKjxrLOMWo>



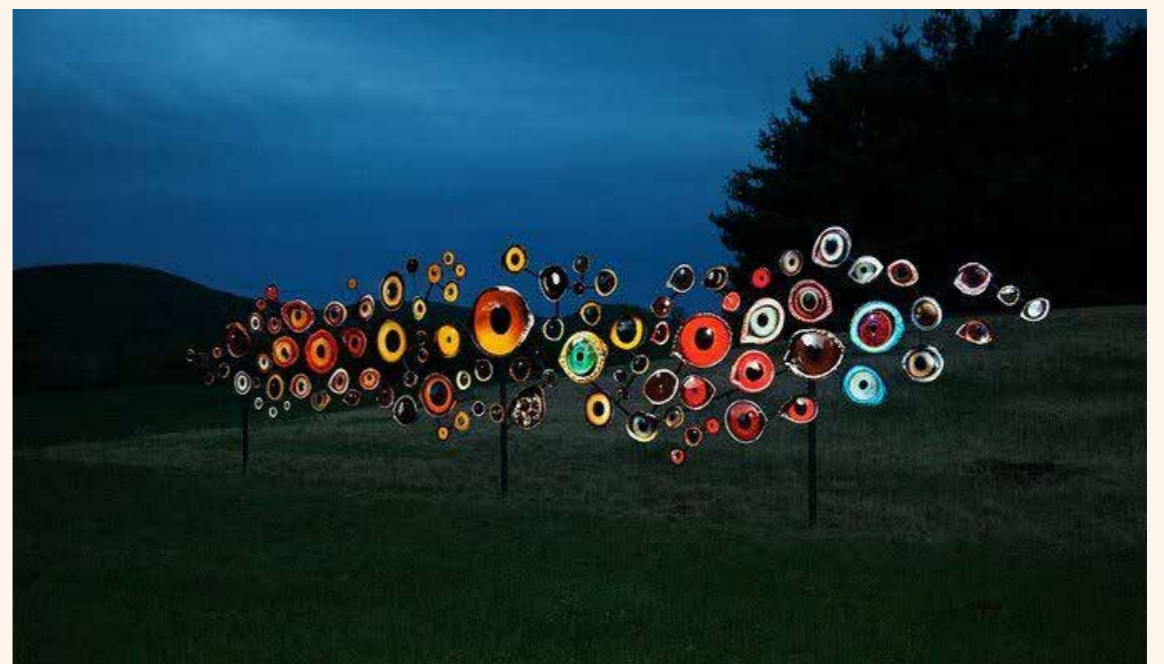
- 8 A paper by Chris Riedy explains Climate Change in detail.

https://www.researchgate.net/publication/311301385_Climate_Change



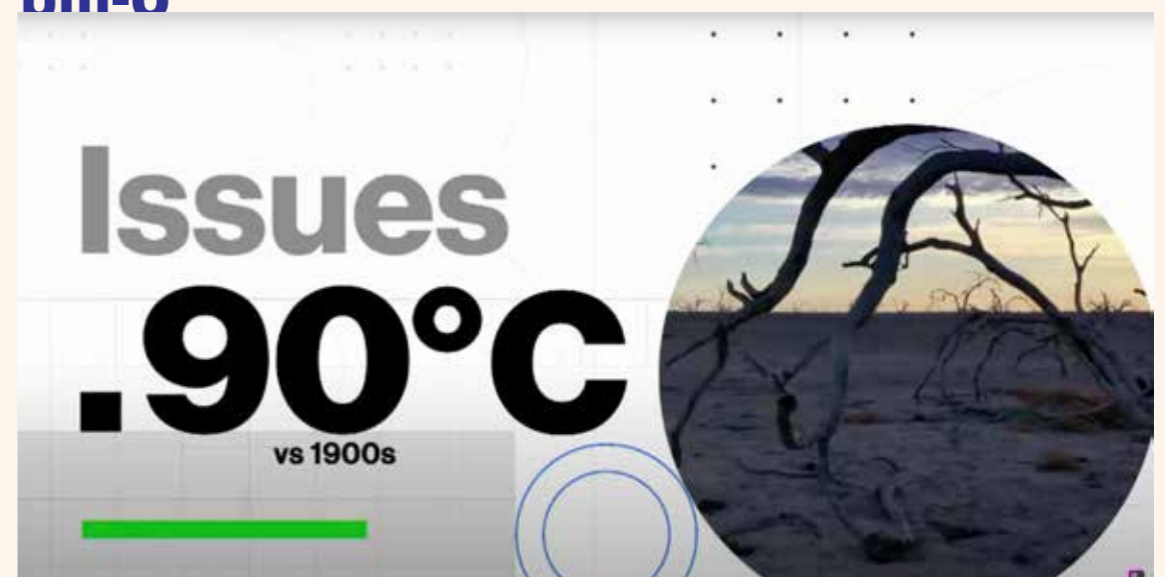
- 9 Artists Confronting Climate Change Discover artists who focus on environmental movements and how they respond to the climate crisis.

<https://www.riseart.com/article/2485/9-artists-confronting-climate-change>



- 10 Your City Is Not Climate-Proof. More than half of humanity is crowded together in cities: working, commuting, and polluting. That's only set to grow. Urban concrete jungles are on the front lines of the climate crisis. Because no matter how much the world warms, cities will have it worse. This video looks at how we solve today's climate problems and what we need to do to build the sustainable cities of tomorrow.

https://youtu.be/jXOqobmFPkA?list=P_Lqq4LnWs3olXwON9HOW4Ud-9e7n_0nm-0





IT'S URGENT TO TAKE SOME ACTION.
AS WE HAVE NO OTHER OPTION

*Graphic Design Mahua Roy, Class XI student of Subhas Gram Nabatara Vidypith
sketched this while participating in a water sustainability project.
She wants to show how climate change is affecting our water cycle.*



LEARNING WITH
MOVING IMAGES

Earth Day Network India thanks Bichitra Pathshala for bringing our concept to fruition and for the research, text and outreach to the experts featured. We join Bichitra Pathshala in thanking each of the contributors for their valuable inputs.

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[@earthday_network](https://www.pinterest.com/earthday_network)

Disclaimer Both primary data from the nominations forms and that available in the public domain helped us compile the texts for this eBook to showcase examples of how teachers discuss innovative ways to engage students in 'What is Climate Change'. Our apologies in advance for any inadvertent inaccuracies.