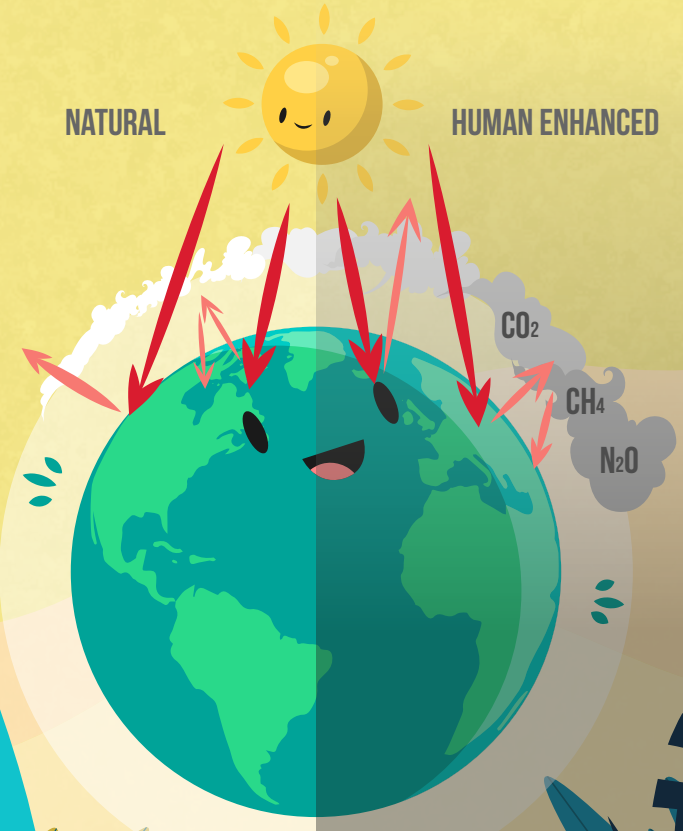
CLIMATE CHANGE & BIODIVERSITY

Global warming. A topic that is no stranger to us, you would surely have heard this term before. Other than us literally feeling the heat and having to switch on our air-conditioning, what does global warming actually mean for Earth and all the other life on it?

Let's recap how **global warming** comes about. The **greenhouse effect** is important in maintaining the warmth of our Earth so that life can survive, but human actions enhance this greenhouse effect. The main driver of this enhancement is increasing concentrations of **greenhouse gases** (carbon dioxide, methane, nitrous oxide and others), which absorb and re-emit infrared radiation. This leads to an increase in global temperatures, and changes in other aspects of climate such as rainfall.



Think: In the past 5-10 years, have you noticed any change in the temperature and climate of the country you live in?

Singapore is taking climate change very seriously. In 2020, the National Climate Change Secretariat (NCSS) was established to coordinate all aspects of Singapore's response to global climate change. The agency's website (www.nccs.gov.sg) reports the findings of a study suggesting that by 2100, average temperatures in Singapore will have increased by 2.7 – 4.2°C.

How does this affect other organisms, you may wonder? With a few exceptions such as people and urban pigeons, most species on our planet occupy only small parts of it, within limits set by unsuitable climates. The range of climates each species can tolerate is known as its **climate envelope**. If you walk up Mount Kinabalu or travel overland from Singapore to Thailand, you will see species drop out as their climatic tolerances are exceeded (i.e. it becomes too cold or too dry). In their place, other species appear that can tolerate these conditions. But even if you stay in Singapore for the rest of your life, the climate will change. How will species react then?

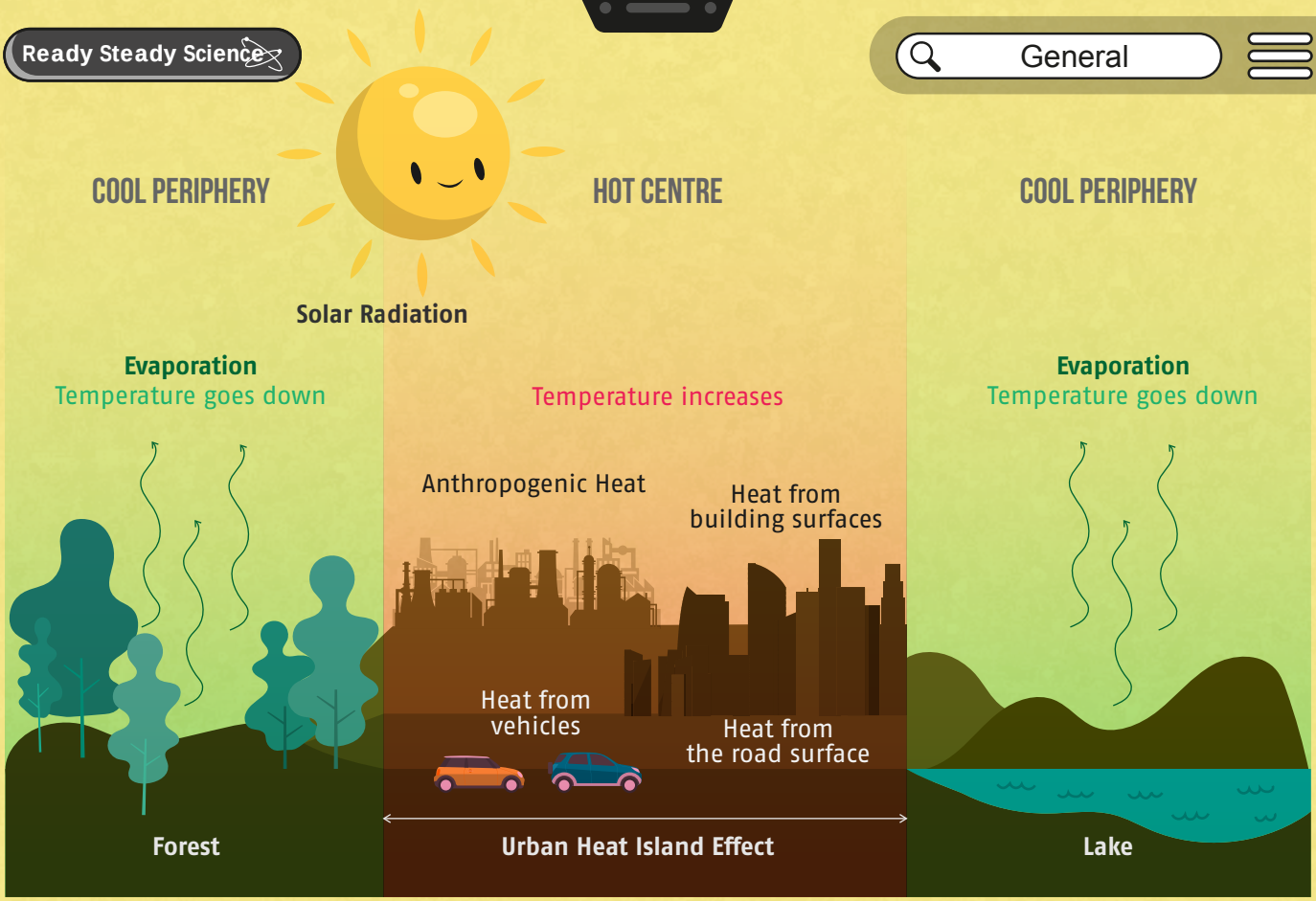
If the changes stay within the climate envelopes of our local species, then the impact will probably be small. Plants may flower at different times or frequencies, birds may breed at a different time of the year, and some wild species may have a change in population number, but the overall impact will not be huge. Yet as the changes start to move outside of the climate envelopes, what may possibly happen?

Think: How can species survive a change in climate? Can you think of any examples?

Species may acclimate to the new climate. **Acclimation** is physiological adjustment without any genetic change and occurs within the lifetime of an individual organism. **Evolutionary adaption** is also a strategy, but evolution takes multiple generations, which means that only species with short life cycles, such as insects, have the opportunity to evolve substantially in climatic tolerance by 2100.

Another option is to move. If an organism moves 500 metres up a mountain, the temperature falls by approximately 3°C, so movement is a practical way for a species to stay within its current climatic envelope in a warming world. But only if you live near a mountain that is tall enough! The closest option we have in Singapore would be Bukit Timah Hill. The summit of Bukit Timah is only half a degree cooler than the bottom, and there is not much room for more species up there anyway. Moving North (or South) is not an option either for most species in Singapore, since temperatures do not get significantly cooler until you approach the edge of the tropics, thousands of kilometres away.

Acclimate, adapt, move or die: which will it be? The outcome will certainly vary between species, but a substantial loss of native biodiversity in Singapore seems likely if temperatures rise by more than 1 – 2°C. Moreover, non-native species with higher temperature tolerances will probably move into Singapore, increasing the pressure on the surviving native species.



What can we do to reduce the impacts, not just on plants and animals, but also on people? The best possibility for local action is to reduce the so-called **urban heat island effect**, which is responsible for making built-up areas in Singapore several degrees warmer than the nature reserves. The major cause of this is the gradual release of heat stored during the day in buildings, pavements and roads. Increasing the density of trees in urban areas can help reduce this heat storage, as can the use of green roofs and the careful choice of building materials. However, achieving a degree or so reduction in urban temperatures is probably the best we can hope for, and this will not cool the nature reserves where most of our wild species live.

The only real answer is to stop global warming and this requires global collaboration. Singapore must do its part by reducing its own greenhouse gas emissions, but as an individual, how can we contribute? We can help by reducing our personal **carbon footprint** – the several tonnes of carbon dioxide emissions per year that we are each responsible for. Some of this is obvious, like the fossil fuels burned for generating electricity and our daily transport; but much of our personal contribution to global warming is hidden in things that we import from fuel-burning factories in other countries. So be aware of what you are choosing to use in your everyday life!

Activity:

Identify the different electrical appliances that you use in your house and note down how much electricity each of those appliances consume (in kWh).

Think of how long those electrical appliances are switched on per day. What is consuming the most electricity in your household?

Think of alternatives for these electrical appliances that are more energy efficient.