

# **LESSON 15:**

# **CLIMATE**

# **CHANGE**

## **IN THE ARCTIC**



# SeaKeepers Digital Lesson Plans

## Lesson 15: Climate Change in the Arctic



This activity was created in partnership with DISCOVERY Yacht Yeva's captain, Ella Hibbert, as part of SeaKeepers' Inspirational Figures lesson plan series for educational engagement on virtual platforms.

**Activity:** Climate Change in the Arctic

### Preface:

Our oceans face many threats today, including climate change and pollution. In order to protect and preserve our oceans, we need to understand these threats and how the oceans respond to them. The International SeaKeepers Society supports marine research and education by connecting scientists with yacht owners, creating research opportunities for scientists to better understand our oceans – and to create plans to protect them.

Inspired by DISCOVERY Yacht Yeva's voyages across the Arctic Circle, this lesson explores the impacts of climate change on the fragile ecosystems within this polar region. The Arctic is warming faster than anywhere else in the world, causing habitat loss, sea ice melt and sea level rise at an alarming rate. Here, we discuss how these changes are affecting native species and the ways in which climate change is enabling greater access to this no-longer-frozen world. Through the eyes of DISCOVERY Yacht Yeva, students will discover the importance of raising awareness about the impacts of climate change, in order to protect the enigmatic species that live within these threatened Arctic habitats.

**Objectives:** Students participating in this lesson should see improvement in the following areas:

- Investigate how different aspects of climate change could impact the Arctic Circle.
- Understand how climate change could affect native Arctic habitats and species.
- Evaluate the importance of raising awareness about the impacts of climate change on Arctic ecosystems, taking inspiration from DISCOVERY Yacht Yeva's experiences.

**Age Group:** Key Stage 3.

While this lesson plan was produced by SeaKeepers UK Chapter, our lessons are available and applicable to students globally. For further information on which education curriculum standards this lesson meets for your region, please reach out to [programming@seakeepers.org](mailto:programming@seakeepers.org)

**Estimated time:** 70+ minutes

### Required Materials:

Students do not need any background knowledge of climate change or the Arctic environment to take part in this lesson. Teaching resources are included for this lesson, but feel free to use other materials you may have to explain these concepts. To create their posters, students will need:

- Paper
- Pens/pencils

- Erasers
- Rulers (optional)
- Glue/Sellotape/Blu tack (optional)
- Recyclable crafting materials, such as cardboard, ice lolly sticks and newspaper.

### Lesson Breakdown:

- Introduction to the theme of climate change and how it is impacting Arctic Circle biodiversity (20 minutes)
- Activity: Create a poster describing how a particular aspect of climate change would impact the Arctic Circle, highlighting how it will affect native habitats, polar biodiversity, vessel routes and local civilisations, taking inspiration from the experiences of DISCOVERY Yacht Yeva (30+ minutes)
- Wrap up Discussion (15 minutes)
- Clean up (5 minutes)

### Lesson Vocabulary:

- **Biodiversity** – the existence of a wide variety of plant and animal species in their natural environments, which is the aim of conservationists concerned about the indiscriminate destruction of rainforests and other habitats.
- **Carnivore** – an animal that feeds on other animals.
- **Density** – the amount of stuff compacted into a particular space (mass per unit volume).
- **Desalination** – the process of removing salt from seawater, either by taking away the salt itself, or diluting the seawater by adding freshwater.
- **Downwelling** – the downward movement of fluid.
- **Entanglement** – the action or fact of being twisted together or caught in something.
- **Evaporation** – the process of turning from liquid into vapour.
- **Food Web** – a system of interlocking and interdependent food chains (a series of organisms each dependent on the next as a source of food).
- **Glacier** – a slowly moving mass or river of ice formed by the accumulation and compaction of snow on mountains or near the poles.
- **Global Ocean Conveyor Belt** – a constantly moving system of deep-ocean currents driven by temperature and salinity differences, moving water around the globe and playing a crucial role in regulating the Earth's climate.
- **Global Warming** – the gradual increase in the Earth's average surface temperature, primarily caused by human activities that release greenhouse gases into the atmosphere, trapping heat at the surface.
- **Greenhouse effect** – the process through which heat is trapped near the Earth's surface by substances known as 'greenhouse gases'.
- **Habitat** – the natural home or environment of an animal, plant, or other organism.
- **Ice Sheet** – a layer of ice covering an extensive tract of land for a long period of time.
- **Megafauna** – the large mammals of a particular region, habitat, or geological period.
- **Permafrost** – a thick subsurface layer of soil that remains below freezing point throughout the year, occurring chiefly in polar regions.
- **Phytoplankton** – plankton (the small and microscopic organisms drifting or floating in the sea or fresh water) consisting of microscopic plants.
- **Precipitation** – rain, snow, sleet, or hail that falls to or condenses on the ground.
- **Protected area** – a clearly defined geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.
- **Sea Ice** – frozen seawater that floats on the ocean surface, forming and melting entirely within the ocean, unlike icebergs which originate on land.



- **Species** – a group of organisms that can interbreed and produce fertile offspring, forming a distinct group reproductively isolated from other groups.
- **Terrestrial** – on or relating to the earth.
- **Thawing** – the process of ice, snow, or another frozen substance becoming liquid or soft as a result of warming up.
- **Weathering** – the process of wearing or being worn by long exposure to the atmosphere.

## **Lesson Introduction/Overview:**

### **What is climate change?**

Climate change is defined as the long-term change in global temperatures and precipitation, including any shifts in atmospheric weather patterns. In recent years, climate change has specifically referred to the rapid change in global climate as a result of human activities.

The Earth's atmosphere contains naturally-occurring gases, called greenhouse gases (GHGs) that surround the planet and prevent solar rays from escaping. These gases, such as carbon dioxide, water vapour and methane, act like a blanket, trapping this heat near the planet's surface to make the environment hospitable. However, human activities, such as burning fossil fuels, release excessive quantities of these gases into the atmosphere. These additional GHGs increase the size of this blanket, trapping more solar rays within the atmosphere and increasing global temperatures to above the norm, enhancing the natural greenhouse effect through a process called Global Warming. These unprecedented temperature increases affect both terrestrial and marine ecosystems, forcing species to either migrate to more hospitable regions or adapt to these new temperatures and associated environmental changes, to ensure their survival.

### **How will climate change impact the Arctic region?**

Climate change affects every region worldwide; however, the impacts are more significant in the Arctic. The Arctic is warming three times faster than any other region on Earth. This is due to a process called Arctic amplification. Where previously white ice and snow covered the surface of the region, global temperature increases have caused these to melt and the darker rocks and earth underneath to emerge. The lighter and brighter snow and ice are able to reflect more solar rays (as they have a greater albedo) than the darker ocean, rock and earth below (as they have a lower albedo), causing more solar rays to be absorbed into this now-uncovered surface. The greater absorption of these rays causes the Earth's surface to increase in temperature, prompting an increase in snow and ice melt, and the process to repeat itself. This amplification therefore leads to further warming, called the ice-albedo feedback. In the last 20 years, this feedback loop has caused more than 50% of ice floes, glaciers and land masses to begin to significantly deteriorate, with summer sea ice shrinking at a rate of 13% every 10 years. Arctic environments are therefore greatly threatened by climate change, both on land and at sea, significantly impacting local marine ecosystems and global ocean currents.

Terrestrial Arctic habitats are often characterised by glaciers and ice sheets, covering the surface in white snow and ice. However, as Arctic amplification causes these to melt, the water stored within is released into the ocean, causing global sea levels to rise. Scientists have estimated that if all Arctic ice sheets and glaciers melted, the ocean's height would increase by approximately 7 meters - that's the equivalent of almost 2 double decker buses! Rising sea levels lead to excessive coastal flooding, threatening both Arctic species that breed in these habitats and local human communities that rely on the ocean to sustain their livelihoods.

Rising ocean temperatures are also causing sea ice to melt, releasing the water stored within into the ocean as well. The global oceans are filled with salt water, however, the water released from glaciers, ice sheets and sea ice is freshwater. This influx of freshwater causes the Arctic Ocean to become less saline at the surface, and therefore less dense. In regular conditions, global ocean circulation begins with the sinking of



more dense, colder, saltier water in the Arctic (termed downwelling). This forces deep ocean water movement towards the equator, where the water warms and becomes less dense. Here, the less dense water rises and transports deep-water nutrients to the surface, enriching tropical marine ecosystems and maintaining the Global Ocean Conveyor Belt. However, the decrease in Arctic water density due to freshwater influxes interferes with this process by preventing Arctic downwelling. Increases in Arctic snow and ice melt and subsequent ocean desalination therefore have the potential to disrupt global ocean heat and nutrient circulation, threatening the survival of not only Arctic species, but global populations.

As Arctic temperatures rise and sea ice melts, the ocean becomes more open and sparse of frozen features. This puts greater quantities of surface water in direct contact with the atmosphere, allowing more molecules to readily evaporate. This increase in evaporation combined with the warmer temperatures allows more moisture to be held in the atmosphere, amplifying the amount of precipitation able to fall over the Arctic region. However, this precipitation is likely to become rain-dominated as the warmer temperatures prevent the formation of snow and ice in the atmosphere, leading to greater river discharge, global sea level rise, decreased ice thickness due to physical weathering, increased permafrost thawing, or ecosystem harm. These impacts will greatly affect the Arctic landscape, potentially making permanent changes to the environment that will challenge species survival.

### **How will climate change affect polar biodiversity?**

Sea level rise due to climate change will cause significant coastal flooding across the Arctic Circle, disrupting the resting and breeding patterns of marine megafauna, such as walrus and seals, and causing a loss in seabird nesting sites. Seals and walrus haul themselves onto beaches to rest after long periods of at-sea, and often use sea ice instead of land to breed. However, as sea ice and coastal regions become flooded, these species are forced to either compete with each other for available space, leading to overcrowding and less resource availability, or travel further inland to breed and rest, increasing their risk of human-wildlife conflict. Many seabirds also nest along the Arctic coastlines, including various species of puffin, tern, gulls, shearwater and skua. Rising sea levels threaten seabird young as increases in ocean height can flood and subsequently drown their nests. If a group of nests were submerged, an entire generation would be eradicated, threatening the survival of the population as fewer birds would be available to breed in subsequent years.

Sea ice melt and the increased influx of freshwater from glacier and ice sheet melt affects the growth rate of the organisms at the base of the marine food web - microscopic plants called phytoplankton. In the Arctic summer, phytoplankton blooms form as the increased sunlight triggers the growth of these tiny organisms in the nutrient-rich surface waters. However, as sea ice melts and retreats to leave a more open ocean with greater solar influx, and the surface water becomes less saline due to snow and ice melt, phytoplankton blooms are able to form both earlier in the year and in larger quantities. Climate change is therefore increasing productivity at the base of the marine food web, providing a greater source of nutrition to the entire Arctic Ocean ecosystem.

On the contrary, sea ice loss is threatening and harming various marine megafauna, including polar bears, narwhal and beluga. Polar bears rely on sea ice as a platform for hunting seals and other animals in the water, breeding and raising their young, and resting. Due to earlier sea ice melt in the Spring and later re-establishing in the Autumn, polar bears are forced to spend more time either in the water or on land searching for food, leading to ineffective hunting strategies and a subsequent lack of nutrition, greater energy exertion from longer periods of swimming, and an increased risk of harm from human interactions. As a result, recent encounters have found many polar bears to be smaller in size and in poorer condition than previously, proving that the loss of sea ice is greatly affecting the population. For those living below the water, such as narwhal and beluga, the sea ice acts as a refuge from predators, such as killer whales, as their lack of dorsal fin allows them to stay closer to the ice. However, the loss of sea ice reduces the availability of suitable shelter, increasing the likelihood of capture by larger carnivores. Without this habitat and resource,

many Arctic species will become increasingly threatened. It is important that we change our behaviours to better protect this highly valuable frozen landscape to ensure the enigmatic species that characterise this environment remain present in the ecosystem for future generations.

### **Why is DISCOVERY Yacht Yeva exploring the Arctic Circle?**

DISCOVERY Yacht Yeva, captained by solo-ocean sailor Ella Hibbert, is undertaking a record-setting sailing voyage by circumnavigating the Arctic. As she travels from the UK to Iceland, Greenland, through the Northwest Passage to Canada, across Northern Alaska to Russia and back to Norway through the Northeast Passage, Ella will be raising awareness about global climate change and the endangerment of the Arctic ecosystem. Before 2008, the Northwest and Northeast passages were impassable for vessels due to sea ice blocking the path. However, since then, climate change has opened these shipping routes to provide vessel access to the Arctic. Whether for tourism or transportation, increasing human activity in the Arctic Ocean will greatly endanger both native and vulnerable species, such as through vessel strikes, plastic entanglement or ingestion, and marine pollution. Fundamentally, Ella's trip proves that climate change has affected the Arctic landscape in the recent past, as "if we were doing our best to protect the Arctic, Ella's intended trip wouldn't even be feasible". Despite the Arctic Ocean's unique vulnerabilities, it is still the least protected of all the world's oceans, with less than 1.5% classified as a protected area. By spreading her story and passion for the Arctic with the wider community, Ella is inspiring positive change. She encourages others to make small lifestyle changes or petition for large-scale conservation to improve Arctic health and protect this frozen landscape for the next generation of ocean enthusiasts.

### **Activity Instructions:**

#### **Main Activity**

1. Students can either complete the activity alone, or in small groups (less than 4).
2. Educators should provide a piece of paper and an aspect of climate change to each student/group to create their poster.
3. Students/Groups should create a poster discussing their aspect of climate change using recyclable crafting materials. Their posters should discuss how their aspect of climate change will impact:
  - a. Arctic habitats (where plants and animals live).
  - b. Arctic biodiversity (the plants and animals themselves).
  - c. Vessel access to the region.
  - d. Human use of the region.
4. To focus the student's thoughts, consider these questions:
  - a. Will your aspect of climate change cause habitat loss or gain? Why?
  - b. Would animals need to adapt to new conditions if your aspect of climate change affected the Arctic? What adaptations would they need?
  - c. Would your aspect of climate change enable more or less vessels to travel through the Arctic Circle? Why?
  - d. Will more or fewer people be able to live in the Arctic if it were affected by your aspect of climate change? Why?
  - e. In relation to the previous two questions: if your aspect of climate change would enable more people to access the Arctic Circle, would this have a positive or negative impact on the local environment? Why?

### **Wrap up Discussion:**

After the poster discussion, educators should take inspiration from the session to begin a discussion about how the students could better protect Arctic habitats and ecosystems from afar, without travelling to the polar regions themselves. Educators can use the questions below to stimulate the discussion:

- How can your school make positive changes to limit their contribution to climate change?
- How can you as individuals make positive changes to limit your contribution to climate change?
- How would these changes better protect Arctic ecosystems for the effects of climate change?
- How can vessel users travelling through the Arctic Circle raise awareness for the impacts of climate change on this fragile ecosystem?
- Why is it important to raise awareness for the impacts of climate change on the Arctic Circle?

For more information, here are some useful websites:

DISCOVERY Yacht Yeva and Ella Hibbert:

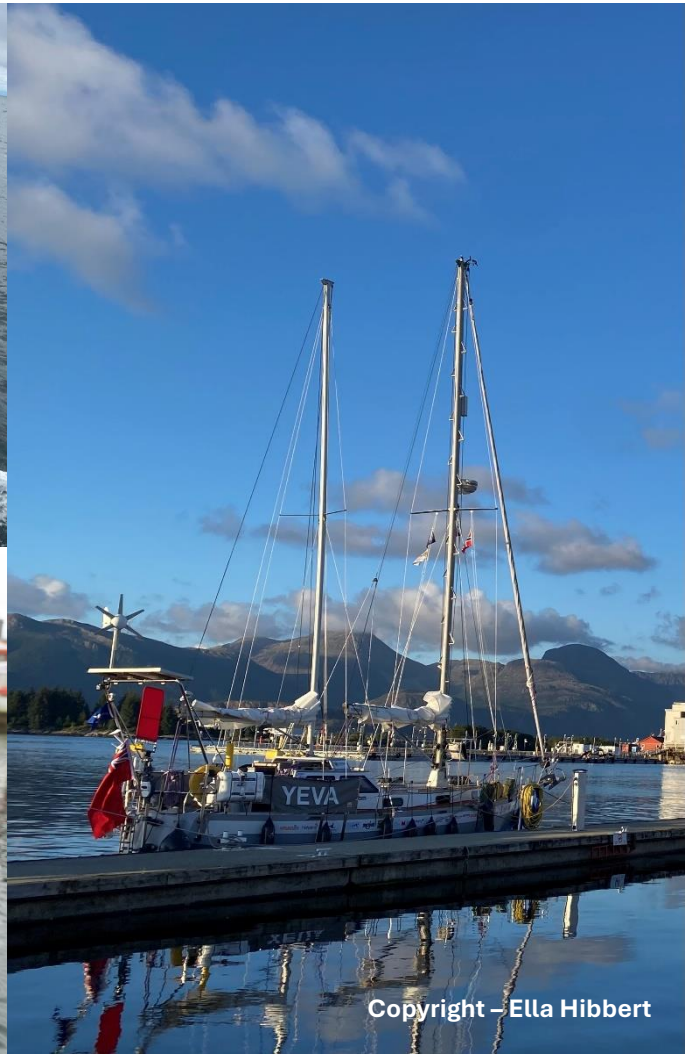
- <https://ellainthearctic.co.uk/>

Climate Change in the Arctic:

- [WWF: Arctic](#)
- [The Arctic Council](#)
- [NOAA: 2024 Arctic Report Card](#)
- [Scripps Institution of Oceanography](#)
- [National Snow and Ice Data Centre](#)



## Media:



**Ella Hibbert and DISCOVERY Yacht Yeva**



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**Images of Climate Change in the Arctic**