## Introduction for Students

This term, to complement the work you are doing in *Understanding Ecology and Biodiversity*, you have the opportunity to learn about how naturalists – explorers and ecologists – worked to create a body of scientific knowledge which founded our understanding of ecology and biodiversity. You will take a look into the lives of some of the many scientists who have worked tirelessly to allow us to better understand the natural world. These are the men and women who travelled to unknown lands, encountered animals and plants they had never seen before (nor had anyone else at home) and tried to determine how they fitted into their current understanding of the plant and animal kingdoms they did know.

While a lot of focus today is on concerns about the loss of species and fears of extinction of plants and animals, many of these scientists were experiencing quite a different end of the spectrum: they were faced with needing to identify and name species they had never seen before and species that people back home were wanting to hear about. To families in Britain at the time, Sir Joseph Banks' descriptions of kangaroos seemed unimaginable and the colourful plumage of birds that John Audubon from America and John Gould in Australia documented were unheard of. This was a time of science where there was great wonder about many new and exciting discoveries that were being made.

In most lessons there are two individuals to read about and you'll find a little more information within the Complementary Links too. Sometimes an excerpt from a Living Book is provided, giving you the benefit of different voices and perspectives on this topic. Simply read the text for the lesson provided and write a short narration on what you've learned.

Lesson 8 is a little different: it gives you the opportunity to research and profile a naturalist of your own choosing. A short list is given for you to choose from, but there are many more you may wish to investigate. This is a great opportunity to apply your scientific research skills and gives you the chance to practice your writing skills in this field of scientific research.

As you read the text provided, focus on how these people collected their information and documented their findings. Notice how they sought to find certainties when they were faced with unknowns. While reading, ask yourself questions like:

- What did their field work look like?

- What skills did they bring and need to develop?
- How did they work to collect reliable data to share with others?
- Could their findings and observations always be trusted? Why or why not?
- What were the reasons and motivations for these explorers and ecologists? How could those differ to scientists working in the field of scientific exploration, ecology and biodiversity now?
- What institutions sought to advance science at the time and how did they do this?
- How might we do this type of scientific research today?
- How did the scientific community test their findings then and how might they do that today?
- What were the values and the needs of the society at that time compared to today?
- What equipment was available to them then?
- What equipment do scientists use now?

Being curious is an important aspect of science and yet, sometimes this can be lost when the focus is on learning and remembering information about science topics. It is interesting to see *how* science occurs, how it happens, what it looks like and what scientists actually do, particularly when you compare it to what it used to look like in years past.

Looking at the lives and contributions of these naturalists is inspiring, but please don't think it relegated to just adults. Lesson 7 shows how a Year 9 student gave a huge contribution to the field of science, all while sneaking out at night to conduct his research! While I do not support you heading out at night for science adventures without your parents' knowledge and consent, I do think you will be intrigued to learn about his antics and contributions and see just what science can look like.

Jo Lloyd

# Lesson 1: Plants: William Bartram and Sir Joseph Banks

## William Bartram (1739 – 1823)

William Bartram is often referred to as "the first ecologist". Born in 1739, he spent his childhood traipsing through parts of the eastern seaboard of North America with his father on plant-collecting trips, giving him many years of experience as a field naturalist and teaching himself how to paint and draw to document the plants he saw and collected. You have probably spent a lot of time preparing Nature Notebook entries, observing items closely for you to be able to draw or paint them in the book. So it was with Bartram. His time outdoors and in nature with his father taught him so much about the environment around him and taught him how to be a good observer. His artistic skills developed and his drawings were accurate and detailed, and, together with his notes and data on his observations, these fieldnotes gave a full picture of the living environment of the east coast of North America at the time.

In 1765 Bartram's father, John, was appointed by King George III as the Botanist for Florida. William travelled to Florida with his father and the two of them spent 10 months exploring and documenting this part of America in terms of the plants and animals too. Together they sent boxes of samples of plants found in the area back to Britain for examination. Ten years later William returned to spend four more years in the region, but going as far as Georgia too, heading over the Mississippi River and creating astonishing fieldnotes and drawings of all that he observed on land and water and throughout the seasons. He collated his findings and in 1791 published them as *Travels Through North and South Carolina, Georgia, East and West Florida.* His book is still in print today and you can see it through the Complementary Links for this lesson.

One of the most inspiring aspects of Bartram's writings was the way that he attributed the beauty and astonishing aspects of nature to God. While his father John was a Botanist and nurseryman, he was also raised in the Quaker tradition, and John saw the power of nature in worship, writing lines like:

*my chief happiness consisted in tracing and admiring the infinite power, majesty and perfection of the great Almighty Creator.*

As well as the inspiring grandeur of nature, Bartram noticed the various components of landscapes, and this is why he is called "the first ecologist". Bartram was interested in the connections and interrelations between plants,

animals and the dependency of species on one another. For example, in his drawings he didn't draw just one lone specimen of a plant, which was the usual practice, showing the plant as an isolated specimen. Instead, he would draw other plants that would be found in the area and animals too. He relied on his knowledge of the broader landscape within which the specimen would be found to contextualise it. In fact, many times Bartram was specifically asked to draw scientific drawings in the Linnaean manner because his preference was to draw it in relation to other organisms. Some of his drawings even showed the life cycle of a plant, which wasn't the convention at the time. Bartram compared species and looked at the differences between various landscapes, seeking to find similarities as well as contrasting factors alongside considering the differences in developmental stages. In looking at his drawings we see the insights of an explorer and an ecologist. He was a man who closely observed the natural world and sought to understand the complex relationships and interdependence between species to better understand the land he viewed.

Today we see this as an ecological view, and others have drawn the thread back of this analysis of an organic connection between lifeforms back to William Bartram and his amazing contributions, however, we note that was not a term Bartram himself would have used, as environmental science as such wasn't studied until the late nineteenth century while Bartram died in 1823.

## Sir Joseph Banks (1743 – 1820)

When it comes to explorers and ecologists Sir Joseph Banks definitely needs to be included! While there are many fabulous accounts of his life and his contributions to science, this account by Simon Werrett is particularly good. It is an excerpt from the book *Nature's Explorers – Adventurers who Recorded the Wonders of the Natural World* published by the Natural History Museum in London in 2019. Each chapter is rather long so it has not all been included here however, I thoroughly recommend you find this book in your local library if you are at all interested in the lives of men and women who made amazing discoveries about our natural world.

*Today it is quite normal to sit down to a meal of international foods. There might be tomatoes, originally from the Americas, brioche buns from France, falafel from the Middle East and hummus from Egypt and the Levant, to name but a few. With trade-links traversing the continents, the exchange of foods and recipes is easy, and a multitude of fruits and vegetables have long been*

*acclimatized to grow in other countries. But it was not always so. Our current enjoyment of such cuisine is thanks to people like Sir Joseph Banks, whose studies of exotic plants and animals enabled their movement and trade around the world.*

*Joseph Banks was born on 13 February 1743, the only son of William, a wealthy Lincolnshire landowner, and his wife Sarah. During his education at the elite schools of Harrow and Eton he expressed an interested in natural history, perhaps after discovering a sixteenth-century herbal by John Gerard. Bank's botanical studies developed at Oxford University, where he enrolled as a student in Christ Church College. Oxford's professor of botany did not teach so Banks hired a lecturer on the subject from Cambridge. He was able to afford this thanks to a very considerable inheritance after the death of his father in 1761. Banks left Oxford without a degree in 1764 and settled in London, where he had access to the natural history collections of the British Museums and scientific societies such as the Royal Society, to which he was elected in 1766. Probably in 1764, Banks befriended Daniel Solander, the assistant librarian at the British Museum and a student of the most famous naturalist of the era, Carl Linnaeus. Through Solander, Banks would learn about Linnaeus' new botanical methods and ingenious systems of classification…*

*Part of Banks' significance to natural history lay in his use of Linnaeus's system to name and classify many of the newly-discovered plants from around the world, fitting them into a system still used by botanists today. The opportunity came as Banks began participating in expeditions beyond British shores. His first voyage was to Labrador in Newfoundland, with his friend from Eton, Constantine Phipps, a naval officer. On the voyage the two men enthusiastically collected and classified birds and plants, and considered whether or not they were good to eat – knowledge of great value for long-distance travellers with limited food stocks.*

*Banks' Newfoundland trip of 1766 was followed two years later by an even more ambitious voyage, led by Captain James Cook, to traverse the world to Tahiti in order to observe the Transit of Venus. Astronomers were excited about this rare astronomical event because, if it was properly observed around the world, it would enable a measurement of the distance between the sun and the Earth. The expedition also provided opportunities to explore new continents, with Cook given secret instructions to chart the coast of Australia and claim new lands for the King, George III. Banks, together with Solander, two artists, and a secretary in Banks's employ, joined Cook as a self-financing naturalist on the voyage and by April 1769, Cook's ship* Endeavour *had arrived in Tahiti to observe the Transit.*

*At Tahiti, and on many brief visits to Pacific Islands during the voyage, Banks collected hundreds of new species of flora and fauna, working with the artist Sydney Parkinson to record and classify them, often an overwhelming task. In Australia, in June 1770, Banks encountered the kangaroo, which he described as 'an animal as large as a greyhound, of mouse colour and very swift'. It also tasted excellent. Banks used the pelt of a kangaroo and a dingo, later taken to Britain, to commission the artist George Stubbs to paint the first European paintings of these animals…*

*Such voyages might be seen as nothing more than the exotic leisure pursuits of an extremely wealthy English gentleman, and perhaps they were. Over time, however, Banks' many and varied pursuits served to build up the fortunes of the growing British Empire as botany was understood to serve the Empire at this time. Linnaeus promoted botany as a means to boost Sweden's wealth in the aftermath of an expensive international conflict, the Great Northern War with Russia… This was 'oeconomic' botany, 'oeconomy' referring to the circulation of plants and animals around the world to serve the improvement and wealth of those who managed this process. Britain's oeconomic projects often relied on Banks's connections to succeed. Over time thousands of species would move between Britain, the West Indies, India, China, Tahiti, Africa, Australia, and New Zealand…*

*Unlike the later Victorian idea of the 'economy', the earlier idea of 'oeconomy' involved both a search for financial benefit and a concern for moral improvement, good order, and an appreciation of – and wonder at – divine providence. 'Oeconomical' botany entailed contributing to the good order of the world, bringing it into alignment with an imagined divine plan. Connecting people and projects together served this end, and Banks was ideally placed to achieve this. As a member of the Board of Longitude, the Board of Agriculture, the Privy Council Committee on Trade and the Royal Observatory, Banks's efforts led to closer links between science, government and empire…*

*Banks thus participated in, and supported, a transformation in the global exchange of plants and animals in the late eighteenth and early nineteenth centuries, though this was by no means a predetermined goal for him. In the process he recorded and classified thousands of species and spent decades connecting individuals and institutions who sought to move them around the world for a variety of commercial, imperial and scientific ends. So voluminous was this enterprise that tracing these global exchanges and their consequences has only just begun. Assessing these consequences will take time. While Banks's efforts may have helped to increase knowledge of global flora and fauna, not to mention diversifying the diets of people around the world, they*

*caused damage to the environment, and contributed to institutions that we reject today much as slavery and imperialism. Like Captain Cook, though much less well known than Captain Cook, Banks enjoys a mixed legacy today, as a pioneer in the sciences and exploration, but also as a sometimes unwitting agent of destruction and domination. In either case Banks remains a critical figure in the history of botany and natural history.*