

Big question:

Lesson	Essential Knowledge
1: Down by the River	<p>You, me and 7.6 billion other human beings need water to survive. Water covers 71% of the planet. The oceans make up 96.5% of the planet's surface water, the other 3.5% is freshwater. This is the water found in rivers and lakes, and the frozen water locked in glaciers and frozen ice caps. Humans can survive for 3 weeks without food, but only 3 days without water! WATER IS KEY TO THE SURVIVAL OF ALL LIFE ON EARTH! A drainage basin is the area of land drained by a major river and its tributaries. All rivers flow from the source (often in the mountains) to the mouth (the sea). The drainage basin is regarded as a closed system because water never leaves. The watershed is an imaginary line that separates one river basin from the next. A river flows downhill often through a valley; an area with high land on each side. Smaller rivers which join the main river are called tributaries. The point where two rivers joins is called a confluence. The flat land beside the river which may flood when the river overflows is called its floodplain. A river carves out a channel for itself. The sides of the channel are called the river bank and the bottom of the channel is called the river bed. The river channel characteristics change from the source to the mouth, it gets wider and deeper. The mouth of the river is where it flows into a lake or the sea. A wide river mouth into the sea is called an estuary. Here fresh river water mixes with salty sea water. A river's long profile shows a cross-section of the land that the river covers. There are 3 courses; the upper course where the slope is steepest, middle course and lower course where the river flattens out. A river is an ecosystem. You can see all the wildlife that the river supports. Without the river none of these animals would be in this area. Rivers carry water and nutrients to areas all around the earth. They play a very important part in the water cycle, acting as drainage channels for surface water. Flora: all the plant life present in a particular region or time, generally the naturally occurring native plants. Fauna: all of the animal life present in a particular region or time. In July 2019 the Leicester Mercury reported that a number of fish had been seen floating in the River Soar. The Environment Agency were called and investigated. Community - a group of people living in the same place or having a particular characteristic in common. We depend on rivers for a variety of reasons; as a water supply; producing electricity; in factories to cool equipment; in farming to help grow crops; for transporting cargo; for transporting people; for fishing and for sport and leisure activities. Rivers are multipurpose which means they have many uses. The main river running through Leicester is the River Soar. Leicester Riverside Festival, now in its 23rd year, is spread over four areas this free two-day festival features fun on and off the water.</p>
2: A Frozen World	<p>The Arctic is a polar region located at the northernmost part of Earth. The Arctic consists of the Arctic Ocean, adjacent seas, and parts of Alaska, Canada, Finland, Greenland, Iceland, Norway, Russia, and Sweden. The Arctic ocean is the smallest of the world's 5 oceans. Climate - The white sea ice is better at reflecting solar energy, whilst the black waters absorb more energy from the sun. Loss of sea ice contributes to a warming Arctic. Habitat loss - Microscopic plants and animals rely on the brine channels within the ice as a habitat and other larger animals, such as polar bears, use the ice for hunting. The famous North West passage could become a reality for international shipping, and oil and gas companies are already exploring the region looking for new fields to drill. Geopolitical importance; Russia claimed the North Pole in 2007 and the Canadian military is increasing its presence in the Arctic region. Decreasing sea ice means that nations are jostling for their share of the available oil and mineral deposits in the region. The Catlin Arctic Surveys were a series of journeys undertaken to discover how the Arctic is changing. Satellite imagery and data collected by ship-based science expeditions aimed to discover how the remotest parts of the frozen north are changing due to the impacts of climate</p>

	<p>change. They were able to collect data on; Sea ice depth from transects; Background temperature and climate readings; pH levels (the acidity of the water); Zooplankton counts (including copepods). Air temperatures never rose above -15°C for the duration of the expedition, and got as low as -48°C at some points. Antarctica, the southernmost continent and site of the South Pole, is a virtually uninhabited, ice-covered landmass. The peninsula's isolated terrain also shelters rich wildlife, including many penguins. The Antarctic ice sheet covers 98% of Antarctica. 60% of all fresh water on Earth is held here and if it melted it would cause a 58m rise in sea level! An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life. Ecosystems contain biotic or living, parts, as well as abiotic factors, or non-living parts. Ocean currents are the continuous, predictable, directional movement of seawater driven by gravity, wind (Coriolis Effect), and water density. Ocean water moves in two directions: horizontally and vertically. Horizontal movements are referred to as currents, while vertical changes are called upwellings or downwellings. These currents redistribute heat and nutrients around the planet. Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO₂) from the atmosphere. The main cause of ocean acidification is the burning of fossil fuels.</p>
<p>3: From Coral Reefs to the Abyss</p>	<p>A coral reef: Coral reefs are beautiful underwater colonies of tiny animals (polyps - related to sea anemones) built up gradually into hard structures from the calcium carbonate that they secrete. The greatest variety of plants and animals can be found in the Earth's shallow seas, which are enriched with nutrients carried by rivers. Shallow tropical waters are hotspots for marine diversity. In the depths of the oceans, fish and other animals must adapt to survive the harsh conditions. Even though they cover less than 1% of the Earth's surface, they are home to over 25% of all marine life. There are more than 2,000 coral reefs in the world - some of them off the coast of the UK! A coral reef is made up of millions of coral polyps. These are tiny animals, but they contain plants called algae. The algae convert sunlight into energy for the reef itself. The coral polyps make hard calcium carbonate which builds up over thousands of years to form reefs. Coral reefs provide many economic benefits. Skeletons of coral provide sand for beaches, and these spectacular landscapes attract tourists who provide valuable income for local people. Coral reefs protect coastlines from strong currents, waves and tropical storms, and reef fish feed local populations with a valuable source of protein. There are many threats to the biodiversity of this important ecosystem, some are threatened by souvenir collection from divers, and shallow reefs can be trampled by visitors. Fuel spills from powerboats and jet skis. Other threats come from local people, including overfishing, local sewage disposal and runoff from farm fertilisers are additional problems. Coral reefs also suffer damage from large-scale projects like new port developments, and extraction of coral limestone for use in the construction industry. Reef bleaching continues to be a present and potential future problem due to the effects of global warming and increasing water temperatures. Sensitive sustainable management can protect the coral reefs for future generations without harming the prospects of people using them today. Through effective policing of protected areas, catch quotas and education programmes providing information. While local coral farming can help to develop new reef areas. Controls on global warming need international co-operation, but would help to reduce the issue of coral reef bleaching. Oceanographers divide the ocean into zones both vertically and horizontally. Sunlight only penetrates the sea surface to a depth of about 200 m, creating the photic zone ("photic" means light). Organisms that photosynthesise depend on sunlight for food. Since tiny photosynthetic organisms, known as phytoplankton, supply nearly all of the energy and nutrients to the rest of the marine food web, most other marine organisms live in or at least visit the photic zone. In the aphotic zone there is not enough light for photosynthesis. The aphotic zone makes up the majority of the ocean, but has a</p>

	<p>relatively small amount of its life. Abyssopelagic Zone is also called the Abyssal Zone or the Abyss – derived from the Greek word meaning “bottomless sea.” From 3000 meters down to about 6000m. Marine biologists do research on ocean and marine environment. Using advanced technologies, marine biology helps us to improve our food deriving ability, water disposal, energy sources, and transportation using oceans.</p>
<p>4: Waterways of the World – Transport, Trade and Tourism</p>	<p>The Fertile Crescent is a crescent-shaped region in the Middle East. The region is one of the cradles of civilization because it is where settled farming first emerged as people started the process of clearance and modification of natural vegetation in order to grow newly domesticated plants as crops. Early human civilizations such as Sumer in Mesopotamia flourished as a result. Technological advances in the region include the development of agriculture and the use of irrigation, of writing, the wheel, and glass. Irrigation and agriculture developed here because of the fertile soil found near these rivers. Access to water helped with farming and trade routes. This led to an exchange of culture and ideas, and advancements in the region as writing (cuneiform), math, and religion all soon developed. Increased population and demands on the rivers from urbanisation have depleted the once-fertile soil. The construction of multiple dams has also put more pressure on the area and have been stated as a secondary reason for the conflicts in Syria. Shipping trade lanes have played an important role throughout history. Today Over 90% of all products made and sold globally are transported by ship, making the oceans, seas and rivers of the world an important part of the supply chain of many businesses. The construction of man-made waterways, which has had a significant impact of increasing the efficiency of this invaluable industry. The canal network of the United Kingdom played a vital role in the Industrial Revolution. The canals permitted the creation of wealth, by industry, that led to the British Empire in the Victorian Era. The UK was the first country to develop a nationwide canal network, which expanded to nearly 4,000 miles (6,400 kilometres) in length. Internationally, the Suez Canal, connects the Mediterranean Sea to the Red Sea. One of the world’s most heavily used shipping lanes. The canal provides the shortest route between Europe and the lands the Indian and western Pacific oceans. In April 2021 the canal was blocked by a huge container ship which meant that lots of the world’s products were held up. Also, the Panama Canal connects the Atlantic Ocean (via the Caribbean Sea) to the Pacific Ocean and serves more than 144 of the world's trade routes. Rutland Water Nature Reserve, and the wider reservoir, is an outstanding haven for wildlife in the heart of England. The secret to success has been the relationship between Leicestershire and Rutland Wildlife Trust and Anglian Water. As well as watching wildlife and walking, there are a number of other activities to take part in, making Rutland Water a major recreational hub for the East Midlands.</p>
<p>5: Precious Water</p>	<p>Almost wherever you were across the British Isles, March 2019 was particularly wet. As precipitation hit 140 percent of the monthly average, rain caused road accidents in Scotland, rivers burst their banks in Yorkshire, snow stopped traffic in Cumbria, railway lines were washed away in Wales, shoppers waded through the streets of Manchester, storms lashed London and the southeast, and there were landslides in Kenton and flooding in Northern Ireland. The idea that we could run low on water seemed incredible—there was too much water, not too little. But as Britain pulled on its wellies and opened its umbrellas that March, Sir James Bevan, the CEO of the Environment Agency, was painting a very different picture: in 25 years England would not have enough freshwater to meet demand. The key drivers of future water stress in England, notably climate change contributing to a decrease in water supply and population growth causing an increase in</p>

demand. With increasing pressure being placed on our water sources, projections are that water shortages will begin to affect all parts of the UK. While our **temperate climate** brings frequent rain, an average of 133 days totalling 885 millimetres, our notoriously **variable weather** means that dry spells can come at any time of year. This **unpredictability** is partly due to Britain's **geographical location** in the **mid-latitudes**, where warm and dry tropical air from the south collides with cold and wet polar air from the north; whichever **air mass** gains dominance will dictate our weather. At the same time, warm moist air from the sea is driven by our prevailing south westerly winds onto our western uplands where it rises over the mountains, cools, **condenses**, and releases rain. In the last two **decades** we have had nine of our ten warmest years on record. By 2040, more than half our summers could be hotter than some of the hottest **heatwaves** the UK has already experienced, river levels could drop by as much as 80 percent, and **water shortages** could be significant. The pattern of rainfall is also shifting: winters will be generally wetter and summers would be much drier. **Drought** occurs during an extended period of unusually dry weather when **evaporation** and **transpiration** by plants exceeds precipitation. In the UK, it is specifically defined as a period of at least 15 consecutive days in which rainfall doesn't exceed 0.2 millimetres. **Water authorities** take water from our rain-fed rivers, **reservoirs**, and **aquifers**, treat it, and then pump it into our homes through some 208,000 miles of pipes. Our **wastewater** is then collected, treated, and **discharged** back into rivers and the sea, where it evaporates, rises, and condenses to form clouds, and so the cycle continues. By 2050 the UK is **projected** to have an extra 12 million people increasing demand on a what could very well be a **diminishing** water supply. **Water scarcity (water stress or water crisis)** is the lack of fresh water resources to meet the standard water demand. For example, according to the **Falkenmark Water Stress Indicator**, a country or region is said to experience "water stress" when **annual** water supplies drop below 1,700 cubic metres per person per year. When water supplies drop below 1,000 cubic metres per person per year, the country faces "water scarcity". **Consumption** means that a resource is used to satisfy current wants or needs. **Innovation** is the practical implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services. A **solution** is a means of solving a problem or dealing with a difficult situation. Ideas include: **Life Straw, distributed** in the 2010 Haiti earthquake, 2010 Pakistan floods, 2011 Thailand floods, and 2016 Ecuador earthquake, the Kenya **Red Cross** supplied filters to 3,750 school children. Also, **Rainwater harvesting** is the collection and storage of rain, rather than allowing it to **run off**. Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit, aquifer, or a reservoir with percolation. Dew and fog can also be collected with nets or other tools. **Center-pivot irrigation**, is a method of **crop irrigation** in which equipment rotates around a pivot and crops are watered with sprinklers. A circular area centered on the pivot is irrigated, often creating a circular pattern in crops when viewed from above. **Wastewater** reuse is a long-established practice used for **irrigation**, especially in **arid** countries. Reusing wastewater as part of **sustainable water management** allows water to remain as an alternative water source for human activities. This can reduce **scarcity** and **alleviate** pressures on **groundwater** and other natural water bodies. And finally, **desalination** is the process that makes seawater suitable for human **consumption**.