THE ICE AGES: PRESENTER NOTES

INTRODUCTORY SLIDES

SLIDE 1: THE ICE AGES

Presenter notes: it's hard to believe that only 20,000 years ago, the Earth was in the grip of a Great Ice Age. Most of the British Isles were covered by an ice sheet up to three kilometres thick. Southern England lay just south of the ice and was a treeless tundra inhabited by herds of woolly mammoths. However, this Great Ice Age was only the most recent of a series of ice ages that have occurred over the past 2.5 million years. In this talk we will learn more about the Last Ice Age, how it was discovered and what caused it and earlier ice ages.

SLIDE 2: TALK OUTLINE

Presenter notes: In this talk we will discover more about Ice Age Earth.

In Part 1, we will investigate how geologists first discovered that the Earth had been in the grip of an Ice Age until recently. In the investigation that follows we will learn about how fossil beetles can provide information about the climate of the Ice Age.

In Part 2, we will think about what causes Ice Ages. In particular we will see how little wobbles in the Earth's orbit around the Sun are the most likely trigger. In the investigation that follows we will watch the movie, The Day After Tomorrow, which deals with the start of a new Ice Age. We will discuss how much of this movie is fact and how much is fiction.

In Part 3, we will explore what Europe was like at the height of the Last Ice Age. We will understand how this Ice Age completely changed the kind of animals and plants present and even the shape of the coastline.

PART 1: DISCOVERY

SLIDE 3: THE FLOOD

Presenter notes: So, onto our first topic, how was the Ice Age first discovered? Throughout the eighteenth century early geologists noticed a thick layer of sticky clay across much of Europe. Elsewhere giant boulders were found scattered across the landscape. How had these rocks reached their final resting place? Many believed that this was clear evidence for Noah's Flood in the Bible. After all it would have required incredible power to move the giant boulders around. But was there an alternative explanation?

SLIDE 4: THE ALPS

Presenter notes: Scientists had the first inkling that the boulder clay may not been deposited by Noah's Flood in the early 1800s. At that time, the world's climate was a bit colder than now. Glaciers in the French Alps started to advance threatening towns and villages. Later they retreated leaving behind a big pile of rocky debris. Jean de Charpentier was one of the first people to study such glacial deposits.

SLIDE 5: SCOTLAND

Presenter notes: De Charpentier showed his glacial deposits to a young Swiss geologist called Louis Agassiz. In 1840, Agassiz toured around Scotland and saw tell-tale signs that the Scottish landscape had earlier been shaped by ice like those examples he'd seen in the Alps. One bit of evidence that particularly excited him were glacial scratches on a rocky hillside near Edinburgh. Agassiz argued that Scotland had once been covered by a thick ice sheet.

SLIDE 6: ICE AGE LANDFORMS

Presenter notes: Agassiz spent much of his life touring round the world searching for more evidence to support his idea of a 'Great Ice Age' in the recent past. In Scotland he found grand U-shaped valleys which had been cut by glaciers thousands of years earlier. He also found the mounds of rocky debris left behind when they melted. At Glen Roy, he saw parallel marks on the hillside and realized that these indicated the former levels of a lake that had become temporarily dammed by ice sheets.

SLIDE 7: FOSSILS

Presenter notes: At time when on, the evidence for a Great Ice Age got stronger and stronger. Fossil remains of beetles and pollen grains were found in sediments associated with the boulder clay across Britain and North America. These were of a type that are only found in the Arctic today. The remains of giant woolly mammoths and woolly rhinos were also uncovered deep frozen in Siberian glaciers, the evidence of their thick shaggy hair suggest that they were adapted to chilly weather. Here was clear fossil evidence that the climate had been much colder in the recent past.

SLIDE 8: CHEMICAL STUDIES

Presenter notes: In the 1960s chemical studies offered more evidence for a recent Ice Age. It had long been known that oxygen came in two main types – heavy and light. It was also known that the amount of heavy oxygen in seawater was controlled by the size of the polar icecaps. So when the icecaps were really big, there was more heavy oxygen in the sea, and when icecaps were small, there was less heavy oxygen in the sea. As we will see in the next slide, this was soon to provide further evidence for a recent Ice Age.

SLIDE 9: MICROSCOPIC ANIMALS

Presenter notes: In 1967, a Cambridge geologist called Nick Shackleton used this fact to learn more about the Ice Ages. He studied heavy oxygen in the fossil shells of microscopic animals called foraminifera found in deep sea muds. This showed him how heavy oxygen levels had changed in the sea over the last million years. The bugs showed that the icecaps had been much bigger in the recent past and the Earth had been gripped by Ice Ages at various times.

SLIDE 10: ICE ARCHIVE

Presenter notes: In the 1980s another exciting discovery came to light. Scientist started to drill deep cores down into the ice sheets of Greenland and Antarctica. They discovered that the ice contained annual layers, each layer representing one year's

snow fall. The ice cores provided a record of snowfall going back many thousands of years.

SLIDE 11: AIR BUBBLES

Presenter notes: Most exciting of all was the fact that tiny air bubbles were locked up in the ice. These had become trapped when the snow had first fallen. By analyzing the air it became possible to work out the make-up of the atmosphere back through time. This work showed how the amount of greenhouse gases in the air had changed over time. As we will see later this was really important for understanding what causes Ice Ages.

SLIDE 12: PRACTICAL, FOSSIL BEETLES AND CLIMATE

Presenter notes: Before we go on to look at what causes Ice Ages, let's first think a little more about how we know that there was an Ice Age in recent times. In this first investigation we will study fossil remains of beetles and see what they can tell us about the climate of the recent past.

PART 2: CAUSE

SLIDE 13: INTRODUCTION

Presenter notes: When the Last Ice Age was at it's maximum, 20,000 years ago, ice sheets spread over much of Europe and North America. In this second part, we will investigate what causes Ice Ages.

SLIDE 14: MANY ICE AGES

Presenter notes: For a very long time, geologists had known that there hadn't been just one Ice Age. By studying the layers of gravel left behind by ice sheets, they knew that there had been many ice ages over the past 2.5 million years, each separated by a short warm period.

SLIDE 15: WOBBLES

Presenter notes: In the 1940s, a Yugoslavian mathematician came up with a great idea to explain why the Earth seemed to flip in and out of ice ages. He worked out that as the Earth orbited the Sun it wobbled on it's axis. Although these wobbles were tiny, they had huge effects on the amount of heat reaching the Earth. Could this be enough to push the Earth in and out of Ice Ages?

SLIDE 16: CYCLES

Presenter notes: There were lots of different wobbles in the Earth's orbit. When Milankovic had added them all up (a difficult sum!) he predicted that they would cause Ice Ages in a regular cycle, say once every 100,000 years.

SLIDE 17: SUN'S PACEMAKER

Presenter notes: Now you'll remember that in the 1960s, Nick Shackleton had figured out a way to see how the polar icecaps had contracted and expanded through time using heavy oxygen in microscopic marine animals. In 1976 Shackleton further showed that ice ages happened every 100,000 years just as Milankovic had predicted.

Here was crucial evidence that wobbles in the Earth's orbit around the Sun were acting like a sort of pacemaker, causing the planet to flip in and out of Ice Ages.

SLIDE 18: THE BIG QUESTION

Presenter notes: But one big question remained: Exactly how did changes in the amount of solar energy reaching the Earth trigger Ice Ages? So far, this is a question that scientists have been unable to answer. However, we have three good ideas.

SLIDE 19: COLOUR OF THE POLES

Presenter notes: The first idea concerns the colour of the poles. If the Earth started to cool down, we can imagine that green forests in the far north would eventually get replaced by white ice. Ice reflects back more of the sun's energy so this would cause further cooling. In turn this would result in more ice at poles. We call this kind of process a positive feedback loop. Once the Earth starts to cool, changes lead to further cooling, and a downward spiral into an Ice Age.

SLIDE 20: GREENHOUSE GASES

Presenter notes: A second idea is that changes in greenhouse gas levels in the atmosphere were to blame for the Ice Ages. The sun heats the Earth and the Earth re-radiates some of this heat. Greenhouse gases absorb this re-radiated heat – keeping the Earth warm.

You'll remember how scientists found air bubbles in polar ice cores. This tells us that the amount of greenhouse gas in the atmosphere dropped during Ice Ages. This would have sped up the cooling of the Earth.

SLIDE 21: OCEAN CURRENTS

Presenter notes: A third idea is that ocean currents like the Gulf Stream were important. Today, this current carries heat from the equator and heats up the Arctic. If it wasn't for the Gulf Stream, Britain would have a cold climate like Newfoundland! If the Gulf Stream ever switched off for some reason, this would cool the Arctic further and increase the likelihood of an Ice Age.

SLIDE 22: PRACTICAL, THE DAY AFTER TOMORROW

Presenter notes: And that leads us nicely onto our next investigation. In this exercise we will watch the Hollywood blockbuster movie, The Day After Tomorrow (2004). This movie deals with the scenario we've just discussed, i.e. the idea that if the Gulf Stream switched off it would increase the likelihood of an Ice Age. But how realistic is the film? How much is fact and how much is fiction? You decide.

PART 3: ICE AGE EUROPE

SLIDE 23: GEOGRAPHY

Presenter notes: In this final section, we are going to explore what Europe was like at the height of the Last Ice Age about 20,000 years ago. At this time, northern Europe was covered by an ice sheet more than three kilometres thick. However, we will focus our attention on southern England, which evidence shows was a frozen and treeless tundra just south of the ice sheets.

SLIDE 24: COASTS

Presenter notes: With so much water locked up as ice, sea level was much lower at the height of the Last Ice Age. In fact you could have walked from Germany to England across land where the North Sea is today. Consequently, it was fairly easy for Ice Age animals and human hunters to migrate between Britain and Europe.

SLIDE 25: PLANTS

Presenter notes: It was so cold in the Last Ice Age that almost no trees could survive in southern England. Evidence from fossil pollen show that the main plants were grasses and sedge in addition to a few stunted trees such as the arctic willow, dwarf birch and dwarf juniper. All these plants probably only grew a few centimetres high as they do today. They covered the landscape with a springy carpet of vegetation. We find pollen from one common flower, the mountain saxifrage (*Saxifraga*) and willow (*Salix*), so this would have brought a bit of colour on the tundra landscape.

SLIDE 26: MAMMALS

Presenter notes: Although cold and inhospitable, many large animals survived on the tundra of southern England. Best known is the woolly mammoth whose shaggy coat was well adapted to these harsh conditions. Some complete mammoths have even been found, deep frozen in the ice of Siberia. In fact there are several stories of explorers having eaten mammoth meat after stumbling over the frozen carcasses! Other animals that lived on the tundra included woolly rhinos, reindeer, horses, musk ox, and even lions and spotted hyaenas. Today we think of lions and hyaenas as exotic animals characteristic of the African savannas. However, this distribution is a result of human hunting and competition. Without humans, lions would be a normal part of the British fauna!

SLIDE 27: NEANDERTHALS

Presenter notes: Europe during the Last Ice Age was also the hunting ground of early humans like the Neanderthal Man. This is an extinct species of human whose fossil bones show a thickset body that was very well adapted to life on the ice. Neanderthals got wiped out near the end of the Last Ice Age. No one is quite sure why this happened. Maybe when modern humans arrived, they ate the Neanderthal foods and the Neanderthals couldn't compete. Although our brain sizes are similar in size, modern humans had the edge over Neanderthals because of cultural and social abilities (eg. fully developed speech, art, a more complex toolkit). This helped them to survive and thrive during the Last Ice Age when the Neanderthals failed.

SLIDE 28: OUR ANCESTORS

Presenter notes: Fossil evidence shows that our modern human ancestors arrived in Europe right at the end of the Last Ice Age. They left spectacular artwork in caves that tell us what life was like at that time. The most famous cave art is in the Lascaux Cave in France and shows many of the animals which were hunted for food. Ice Age hunters also lived in southern Britain. Burial chambers have been found in South Wales and some cave art has even been found in Derbyshire recently.

SLIDE 29: MELT WATER

Presenter notes: As the Last Ice Age came to end about 14,000 years ago, huge volumes of melt waters flooded over northern Europe. In many part of England you can still see the effects of these catastrophe floods. For example in Yorkshire, the deep gorge at Goredale Scar was cut by floodwater. As this flowed downstream it formed a colossal waterfall at Malham Cove!

SLIDE 30: SEA LEVEL

Presenter notes: Another effect of the melting ice was to significantly raise sea level. Over a period of about seven thousand years, there is evidence from around the world that sea level rose by an amazing 120 metres (more than twice the height of Nelson's column). The English Channel and North Sea flooded and Britain became an island. Fishing boats trawling the North Sea bottom today occasionally find mammoth tusks left behind from the animals that used to graze on these Ice Age lands.

SLIDE 31: REBOUND

Presenter notes: The huge weight of the ice sheets over northern Britain pressed it down into the crust. When the ice completely melted, Britain started to rebound upwards, in much the same way that a rubber duck will bob back to the surface of a bath when released – but much more slowly! We can observe the effects of this rebound in Scotland today. On the Isle of Arran we can find old sea caves which are now high and dry and well above sea level. This rebound is still going on today with Scotland rising by a few millimetres each year.

CONCLUDING SLIDE

SLIDE 32: THE ICE AGES

Presenter notes: So that brings us to the end of our exploration of the Ice Ages. We've looked at how geologists first got an inkling that there had been an Ice Age in the recent past. We've discussed what causes Ice Ages and we've explored what Europe was like at the height of the Last Ice Age. it's hard to imagine a thick ice sheet lying over the top of Manchester just 20,000 years ago. But what the ice age tells us is that climate can change dramatically over only a few hundred years.

As we close, here are some questions to think about and discuss: So what about the Day after the Day After Tomorrow? Could the Earth continue to warm due to greenhouse gas emissions, and if so, what would this mean for the sea level of the UK? What would it mean for us? Or could Earth's orbital wobble trigger another Ice Age in near future? – as scientists thought was happening just 30 years ago. If so, what would this mean for the sea level and climate of the UK? What would it mean for us?