

## What is a dinosaur?

**A.** Although the name dinosaur is derived from the Greek for "terrible lizard", dinosaurs were not, in fact, lizards at all. Like lizards, dinosaurs are included in the class Reptilia, or reptiles, one of the five main classes of Vertebrata, animals with backbones. However, at the next level of classification, within reptiles, significant differences in the skeletal anatomy of lizards and dinosaurs have led scientists to place these groups of animals into two different superorders: Lepidosauria, or lepidosaurs, and Archosauria, or archosaurs.

**B.** Classified as lepidosaurs are lizards and snakes and their prehistoric ancestors. Included among the archosaurs, or "ruling reptiles", are prehistoric and modern crocodiles, and the now extinct thecodonts, pterosaurs and dinosaurs. Palaeontologists believe that both dinosaurs and crocodiles evolved, in the later years of the Triassic Period (c. 248-208 million years ago), from creatures called pseudosuchian thecodonts. Lizards, snakes and different types of thecodont are believed to have evolved earlier in the Triassic Period from reptiles known as eosuchians.

**C.** The most important skeletal differences between dinosaurs and other archosaurs are in the bones of the skull, pelvis and limbs. Dinosaur skulls are found in a great range of shapes and sizes, reflecting the different eating habits and lifestyles of a large and varied group of animals that dominated life on Earth for an extraordinary 165 million years. However, unlike the skulls of any other known animals, the skulls of dinosaurs had two long bones known as vomers. These bones extended on either side of the head, from the front of the snout to the level of the holes on the skull known as the antorbital fenestra, situated in front of the dinosaur's orbits or eyesockets.

**D.** All dinosaurs, whether large or small, quadrupedal or bipedal, fleet-footed or slow-moving, shared a common body plan. Identification of this plan makes it possible to differentiate dinosaurs from any other types of animal, even other archosaurs. Most significantly, in dinosaurs, the pelvis and femur had evolved so that the hind limbs were held vertically beneath the body, rather than sprawling out to the sides like the limbs of a lizard. The femur of a dinosaur had a sharply in-turned neck and a ball-shaped head, which slotted into a fully open acetabulum or hip socket. A supra-acetabular crest helped prevent dislocation of the femur. The position of the knee joint, aligned below the acetabulum, made it possible for the whole hind limb to swing backwards and forwards. This unique combination of features gave dinosaurs what is known as a "fully improved gait". Evolution of this highly efficient method of walking also developed in mammals, but among reptiles it occurred only in dinosaurs.

**E.** For the purpose of further classification, dinosaurs are divided into two orders: Saurischia, or saurischian dinosaurs, and Ornithischia, or ornithischian dinosaurs. This division is made on the basis of their pelvic anatomy. All dinosaurs had a pelvic girdle with each side comprised of three bones: the pubis, ilium and ischium. However, the orientation of these bones follows one of two patterns. In saurischian dinosaurs, also known as lizard-hipped dinosaurs, the pubis points forwards, as is usual in most types of reptile. By contrast, in ornithischian, or bird-hipped, dinosaurs, the pubis points backwards towards the rear of the animal, which is also true of birds.

**F.** Of the two orders of dinosaurs, the Saurischia was the larger and the first to evolve. It is divided into two suborders: Therapoda, or theropods, and Sauropodomorpha, or sauropodomorphs. The theropods, or "beast feet", were bipedal, predatory carnivores. They ranged in size from the mighty Tyrannosaurus rex, 12m long, 5.6m tall and weighing an estimated 6.4 tonnes, to the smallest known dinosaur, Compsognathus, a mere 1.4m long and estimated 3kg in weight when fully grown. The sauropodomorphs, or "lizard feet forms", included both bipedal and quadrupedal dinosaurs. Some sauropodomorphs were carnivorous or omnivorous but later species were typically herbivorous. They included some of the largest and best-known of all dinosaurs, such as Diplodocus, a huge quadruped with an elephant-like body, a long, thin tail and neck that gave it a total length of 27m, and a tiny head.

**G.** Ornithischian dinosaurs were bipedal or quadrupedal herbivores. They are now usually divided into three suborders: Ornithipoda, Thyreophora and Marginocephalia. The ornithopods, or "bird feet", both large and small, could walk or run on their long hind legs, balancing their body by holding their tails stiffly off the ground behind them. An example is Iguanodon, up to 9m long, 5m tall and weighing 4.5 tonnes. The thyreophorans, or "shield bearers", also known as armoured dinosaurs, were quadrupeds with rows of protective bony spikes, studs, or plates along their backs and tails. They included Stegosaurus, 9m long and weighing 2 tonnes.

**H.** The marginocephalians, or "margined heads", were bipedal or quadrupedal ornithischians with a deep bony frill or narrow shelf at the back of the skull. An example is Triceratops, a rhinoceros-like dinosaur, 9m long, weighing 5.4 tonnes and bearing a prominent neck frill and three large horns.

Choose the most suitable heading for each paragraph from the List of headings below.

Write the appropriate numbers (**i-xiii**).

One of the headings has been done for you as an example.

**NB.** There are more headings than paragraphs, so you will not use all of them.

1. Paragraph A

2. Paragraph B

3. Paragraph C

4. Paragraph D

5. Paragraph E

6. Paragraph F

7. Paragraph G

*Example: Paragraph H     Answer: x*

### **List of headings**

- i. 165 million years
- ii. The body plan of archosaurs
- iii. Dinosaurs - terrible lizards
- iv. Classification according to pelvic anatomy
- v. The suborders of Saurischia
- vi. Lizards and dinosaurs - two distinct superorders
- vii. Unique body plan helps identify dinosaurs from other animals
- viii. Herbivore dinosaurs
- ix. Lepidosaurs
- x. Frills and shelves
- xi. The origins of dinosaurs and lizards
- xii. Bird-hipped dinosaurs
- xiii. Skull bones distinguish dinosaurs from other archosaurs

### Questions 8-10

Complete the sentences below.

Use **NO MORE THAN THREE WORDS** from the passage for each blank space.

8. Lizards and dinosaurs are classified into two different superorders because of the difference in their .....

9. In the Triassic Period, ..... evolved into thecodonts, for example, lizards and snakes.

10. Dinosaur skulls differed from those of any other known animals because of the presence of vomers: .....

## A new ice age

William Curry is a serious, sober climate scientist, not an art critic. But he has spent a lot of time perusing Emanuel Gottlieb Leutze's famous painting "George Washington Crossing the Delaware", which depicts a boatload of colonial American soldiers making their way to attack English and Hessian troops the day after Christmas in 1776. "Most people think these other guys in the boat are rowing, but they are actually pushing the ice away," says Curry, tapping his finger on a reproduction of the painting. Sure enough, the lead oarsman is bashing the frozen river with his boot. "I grew up in Philadelphia. The place in this painting is 30 minutes away by car. I can tell you, this kind of thing just doesn't happen anymore."

But it may again soon. And ice-choked scenes, similar to those immortalised by the 16th-century Flemish painter Pieter Brueghel the Elder, may also return to Europe. His works, including the 1565 masterpiece "Hunters in the Snow", make the now-temperate European landscapes look more like Lapland. Such frigid settings were commonplace during a period dating roughly from 1300 to 1850 because much of North America and Europe was in the throes of a little ice age. And now there is mounting evidence that the chill could return. A growing number of scientists believe conditions are ripe for another prolonged cooldown, or small ice age. While no one is predicting a brutal ice sheet like the one that covered the Northern Hemisphere with glaciers about 12,000 years ago, the next cooling trend could drop average temperatures 5 degrees Fahrenheit over much of the United States and 10 degrees in the Northeast, northern Europe, and northern Asia.

"It could happen in 10 years," says Terrence Joyce, who chairs the Woods Hole Physical Oceanography Department. "Once it does, it can take hundreds of years to reverse." And he is alarmed that Americans have yet to take the threat seriously.

A drop of 5 to 10 degrees entails much more than simply bumping up the thermostat and carrying on. Both economically and ecologically, such quick, persistent chilling could have devastating consequences. A 2002 report titled "Abrupt Climate Change: Inevitable Surprises", produced by the National Academy of Sciences, pegged the cost from agricultural losses alone at \$100 billion to \$250 billion while also predicting that damage to ecologies could be vast and incalculable. A grim sampler: disappearing forests, increased housing expenses, dwindling fresh water, lower crop yields, and accelerated species extinctions.

The reason for such huge effects is simple. A quick climate change wreaks far more

disruption than a slow one. People, animals, plants, and the economies that depend on them are like rivers; says the report: "For example, high water in a river will pose few problems until the water runs over the bank, after which levees can be breached and massive flooding can occur. Many biological processes undergo shifts at particular thresholds of temperature and precipitation."

Political changes since the last ice age could make survival far more difficult for the world's poor. During previous cooling periods, whole tribes simply picked up and moved south, but that option doesn't work in the modern, tense world of closed borders. "To the extent that abrupt climate change may cause rapid and extensive changes of fortune for those who live off the land, the inability to migrate may remove one of the major safety nets for distressed people," says the report.

But first things first. Isn't the earth actually warming? Indeed it is, says Joyce. ' In his cluttered office, full of soft light from the foggy Cape Cod morning, he explains how such warming could actually be the surprising culprit of the next mini-ice age. The paradox is a result of the appearance over the past 30 years in the North Atlantic of huge rivers of fresh water - the equivalent of a 10-foot-thick layer - mixed into the salty sea. No one is certain where the fresh torrents are coming from, but a prime suspect is melting Arctic ice, caused by a build-up of carbon dioxide in the atmosphere that traps solar energy.

The freshwater trend is major news in ocean-science circles. Bob Dickson, a British oceanographer who sounded an alarm at a February conference in Honolulu, has termed the drop in salinity and temperature in the Labrador Sea - a body of water between northeastern Canada and Greenland that adjoins the Atlantic - "arguably the largest full-depth changes observed in the modern instrumental oceanographic record".

The trend could cause a little ice age by subverting the northern penetration of Gulf Stream waters. Normally, the Gulf Stream, laden with heat soaked up in the tropics, meanders up the east coasts of the United States and Canada. As it flows northward, the stream surrenders heat to the air. Because the prevailing North Atlantic winds blow eastward, a lot of the heat wafts to Europe. That's why many scientists believe winter temperatures on the Continent are as much as 36 degrees Fahrenheit warmer than those in North America at the same latitude. Frigid Boston, for example, lies at almost precisely the same latitude as balmy Rome. And some scientists say the heat also warms Americans and Canadians. "It's a real mistake to think of this solely as a European phenomenon," says Joyce.

Having given up its heat to the air, the now-cooler water becomes denser and sinks into the North Atlantic by a mile or more in a process oceanographers call thermohaline circulation. This massive column of cascading cold is the main engine powering a deep-water current called the Great Ocean Conveyor that snakes through all the world's oceans. But as the North Atlantic fills with fresh water, it grows less dense, making the waters carried northward by the Gulf Stream less able to sink. The new mass of relatively fresh water sits on top of the ocean like a big thermal blanket, threatening the thermohaline circulation. That, in turn, could make the Gulf Stream slow or veer southward. At some point, the whole system could simply shut down, and do so quickly. "There is increasing evidence that we are getting closer to a transition point, from which we can jump to a new state."

Complete the flow chart below.

Choose **NO MORE THAN THREE WORDS** from the passage for each answer.

Write your answers in boxes **23-26** on your answer sheet.

