Weigh a Dinosaur!

Can you use dinosaur footprints to estimate the mass of the animal?

Student Introduction

- Scientists use the fossilised remains of parts of animals or plants to work out their size, mass and other features
- Dinosaur footprint casts can also be used to tell us many things about a dinosaur such as their size and weight

Background

All across the Isle of Wight, dinosaur footprints have been discovered - many of which can still be seen on our beaches at low tide.

These footprints were made in wet mud or sand which then hardened to leave trace fossils.

The team at Dinosaur Isle museum have created casts of some of these footprints.

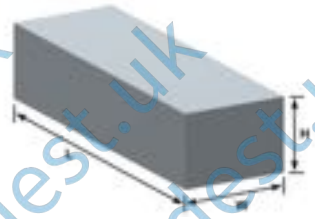
In this experiment you will use one of these casts (from a dinosaur called 'Polacanthus') and the relationship between pressure, force and area to work out the approximate mass of the dinosaur which made it.

Step One: on-site at Dinosaur Isle

Using a ruler to determine the correct scale, draw an outline of the Polacanthus footprint cast onto the graph paper supplied. Counting squares, estimate the overall area occupied by the footprint in cm^2.

Now using a tape measure and/or rulers to measure, draw an approximate profile of the centre of the footprint, along the line X-Y, showing the depth of the footprint along its length.

Step Two: at school



You will need:

- soft, waterlogged sand in a container approx. 10cm or more deep
- a rectangular block of wood or plastic marked at 1cm intervals along its length - the ideal width and height would be 2cm
- a 1kg mass
- a calculator and a ruler

1. First ensure that the sand is completely waterlogged by overfilling the container and then draining off the excess water until only wet sand remains.
This will reproduce the environment in which the original footprint was made.

2. Now place the rectangular block **upright** onto the sand and place the 1kg mass on top so that the block begins to sink into the wet sand. This 1kg mass delivers a 10N force.

3. You may need to steady this with a finger or two to prevent it toppling over - be careful not to add to the mass when doing this.

4. After a short time the block will not sink any further into the sand - you now need to record the depth that it went to.

Calculation Time!

Known values:

A. Area of footprint _____ cm^2

B. Average depth of footprint _____ cm

C. Width of rectangular block used for measuring _____ cm

D. Height of rectangular block used for measuring _____ cm

E. Sinking depth of rectangular block into sand with 1kg mass _____ cm

Calculation:

F. Area of base of rectangular block = C x D = _____ cm^2

G. Pressure exerted by rectangular block = 1kg ÷ F = _____ kg/cm^2

H. Pressure exerted by dinosaur's foot overall = G x B = ? x E = ? x A = _____ N

J. Mass of dinosaur = H ÷ 10 _____ kg

Assumptions: sinking depth is proportional to pressure. 1kg = 10N

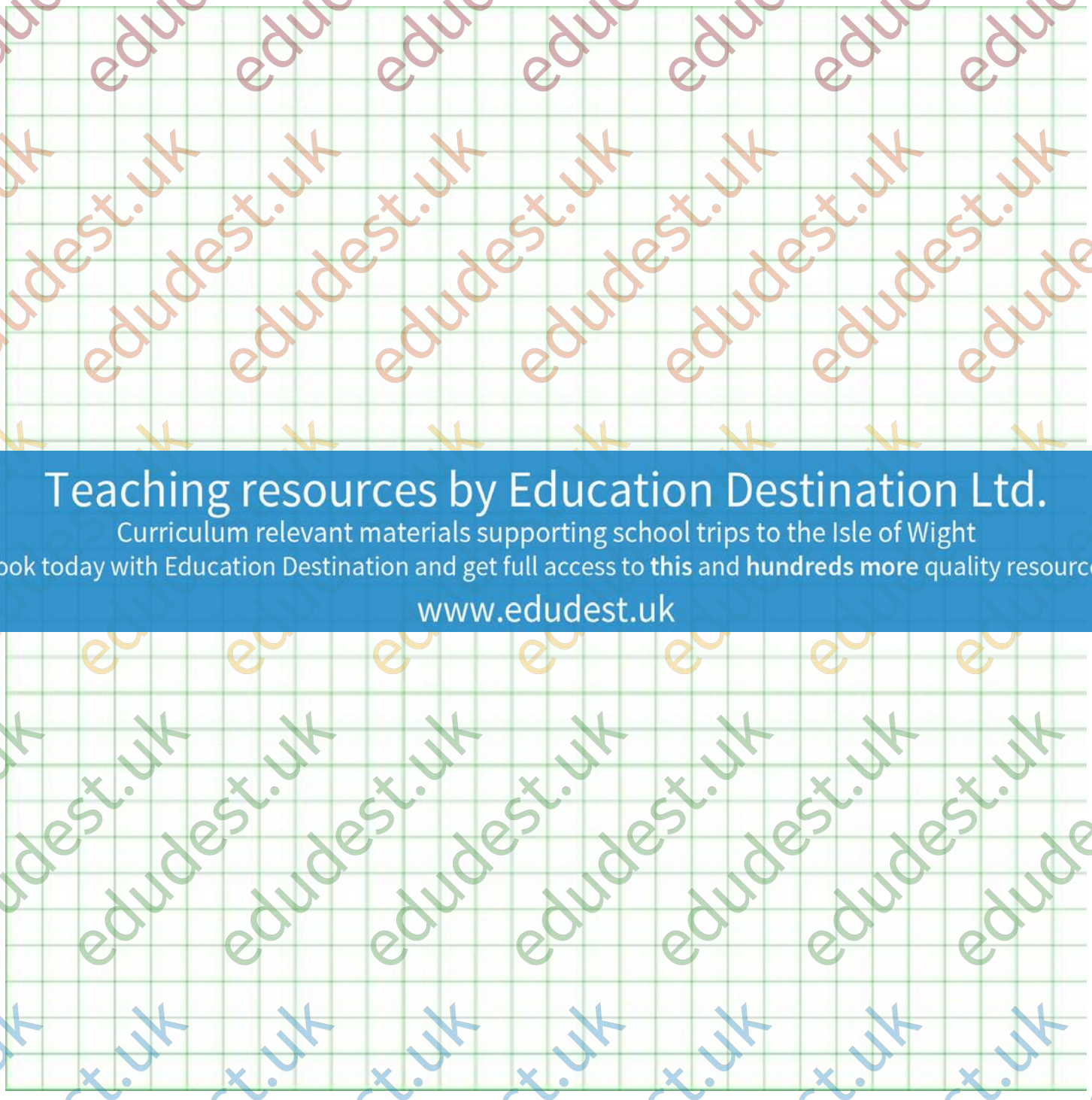
Discussion Points

1. How does the dinosaur's mass compare to YOUR mass?

2. As we're measuring just one footprint, should this value need to be doubled or quadrupled to calculate the total mass of the Polacanthus as it's a four-legged dinosaur?

3. How would the result differ if the dinosaur was known to be running rather than standing still?

Y



X

Dinosaur Footprint

SCALE: 1 square = 1cm^2

Approximate Area

_____ cm^2

Dinosaur Footprint Profile along centre (X-Y)

SCALE: 1 square = 1cm

Average Depth

_____cm