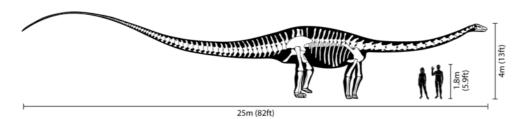Dinosaurs Exercise 1.

What is the biggest possible size a dinosaur could be?

Need: Pen, paper, calculator

Background:
Dinosaurs ranged in size from the size of a chicken to greater than 100 feet long, but most dinosaurs were somewhere in the middle. The modern-day blue whale is the largest animal that ever lived; it is bigger than any dinosaur ever was.

There is great debate about why some of the dinosaurs and other Mesozoic reptiles were so huge and none are today. This is one of the most interesting unanswered questions in paleontology.

The key question here is: what would have been the biggest a dinosaur could ever be? The largest reliable estimate of weight is for *Brachiosaurus,* which weighed perhaps 50 tonnes. Was there any reason a dinosaur could not have reached 100 tonnes, 1000 tonnes even?

Solving the problem:
There are lots of **limiting factors** on body size. Have the class consider what these might be:
- Availability of food (and so size of mouth, size of gut, availability of plants/ animals for food)
- Ecological space (think how much foraging space an elephant needs to find food, and for a herd to function; would a herd of super-giant dinosaurs need a whole continent for their territory)
- Stress and strain on living tissues (just how long can nerves be to function properly; how much weight can a muscle actually lift; when would a leg bone crack under the body mass?)
- Overheating: would an absolutely huge dinosaur have so much core heat that it couldn't keep its body temperature constant throughout, or could not shed heat?
- Fatness of the legs (the circumference/ diameter of a leg is proportional to body mass; so a 2-dimensional measurement is actually proportional to a 3-dimensional measure of mass – this is why gazelles seem to have slender limbs and elephants column-like limbs in silhouette)
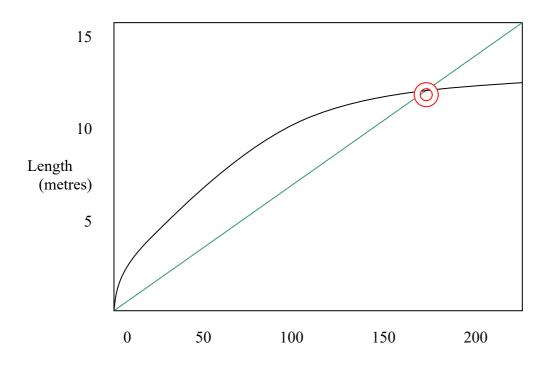
Using the insight about limb diameter, maybe a limit to body mass can be calculated. Assuming a quadruped, there would surely come a point where the legs are so broad, that they cannot engage in locomotion, and the animal stands stock still.

Here are some measurements of body mass, leg diameter, and body length (length from front of forelimb to back of hindlimb):

	Body mass (M)	Leg diameter(D)	Body length (BL)
Gazelle	20 kg (= 0.02 tonne)	2 cm (= 0.02 m)	0.3 m
Horse	0.5 tonne	15 cm (= 0.15 m)	1 m
Elephant	4 tonnes	0.5 m	2 m

What is the proportion between body mass (M) and leg diameter (D)? *Leg diameter (a linear, or one-dimensional measure) is proportional to body mass (a cubic, or three-dimensional measure), and not to body length.*

In the graph below, leg width (black line) and body length (green line) are plotted against body mass. Note the shapes of the two curves. What is special about nthe point at which the lines cross over? *This is the point at which leg width equals body length – i.e. there is no free space between the front and hind legs, and the animal comes to a standstill – it can support its body mass, but cannot walk.*

What body weight is marked by this point of immobility? *Something like 150-160 tonnes.*