DON'T FEAR THE KING

THE STORY OF SURFACE TO VOLUME RATIO AND THE SIZE AND SHAPE OF ANIMALS

Animals are physical objects and they are subject to the same laws of physics as all other physical objects. The size of an animal is one of the main factors affecting its form.

Even though insects are restricted to being relatively small, they can perform feats we can only dream of. Insects walk on walls or across the surface of water because surface forces overpower the minimal pull of gravity on their bodies. Our bodies, on the other hand are forever restricted by gravity.

It might be possible to have a creature as large as King Kong, but it would probably look like other big animals -- that is, it would look like an elephant!

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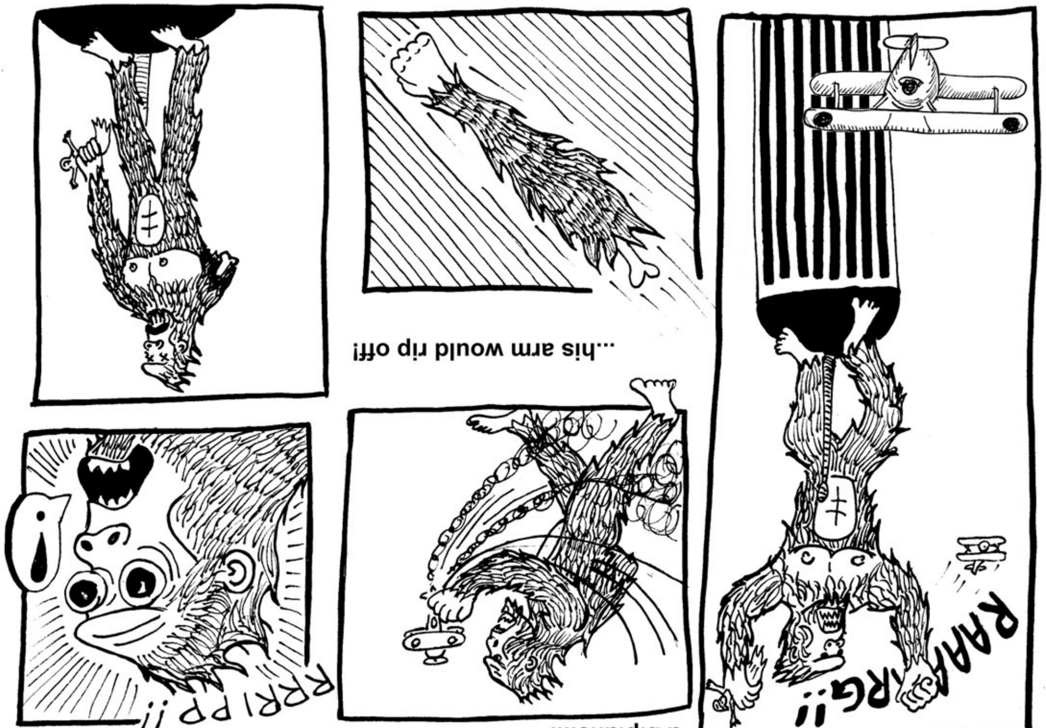
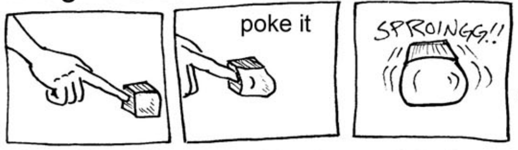
So what about KING KONG ?

An ape the size of King Kong would require bones much thicker than his body would allow. The way he is now, if he tried to swat down a biplane....

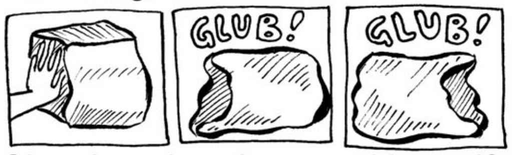


...his arm would rip off!

Imagine a cubic inch of Jello --



Now imagine a cubic foot of Jello --



Okay, but what about a cubic yard?

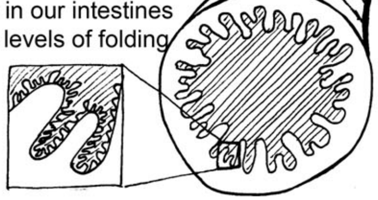
As the cube of Jello gets larger, its ability to stick together decreases.This is because as you increase the length of a three-dimensional object, its volume increases as a cube (length x length x length) while its surface area only increases as a square (length x length)...in other words, volume increases a lot faster than surface area!

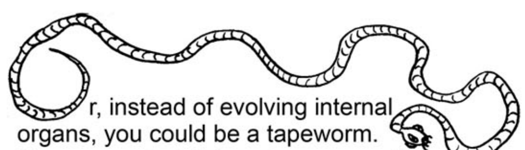
The size and shape of animals is controlled by the same geometric property that allows the cubic inch of Jello to stick together while the cubic yard of Jello falls apart as soon as we take it out of the mold. The relationship of surface area and volume puts a limit on how big animals can get.

Functions like nutrient absorption also limit the size of animals. Nutrient absorption requires large amounts of surface area. The problem is animals don't have enough external surface area to get the nutrients they need to stay alive.

The solution animals have evolved is turning inwards -- creating lots of surface area on the inside.

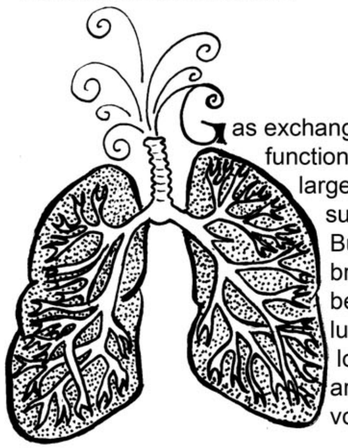
Big animals like humans create surface area in our intestines with multiple levels of folding ending with tiny, fingerlike projections called "villi."



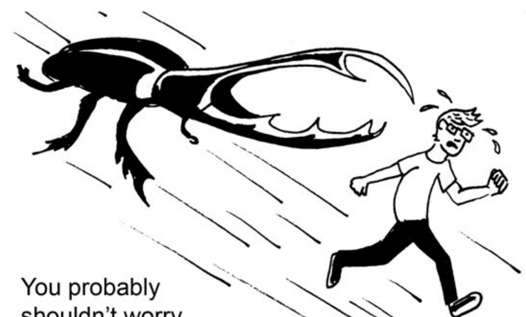


r, instead of evolving internal organs, you could be a tapeworm. Tapeworms lack internal organs and absorb nutrients and oxygen through their skin.

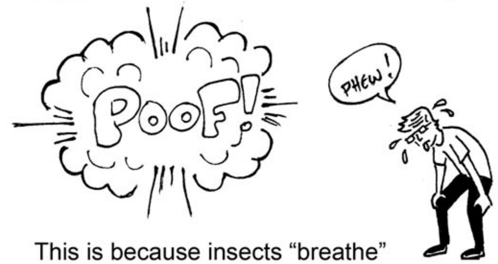
They can grow to be 20 feet long, but are only a fraction of an inch thick -- almost all surface area and minimal volume.



Gas exchange is another function that requires large amounts of surface area. But you can breathe easy because your lungs pack lots of surface area into a small volume.



You probably shouldn't worry about giant insects -- they're stuck being small.



This is because insects "breathe" through pores in their bodies. To get enough oxygen to survive, an insect the size of a cat would need so many pores it would be more pore than insect!