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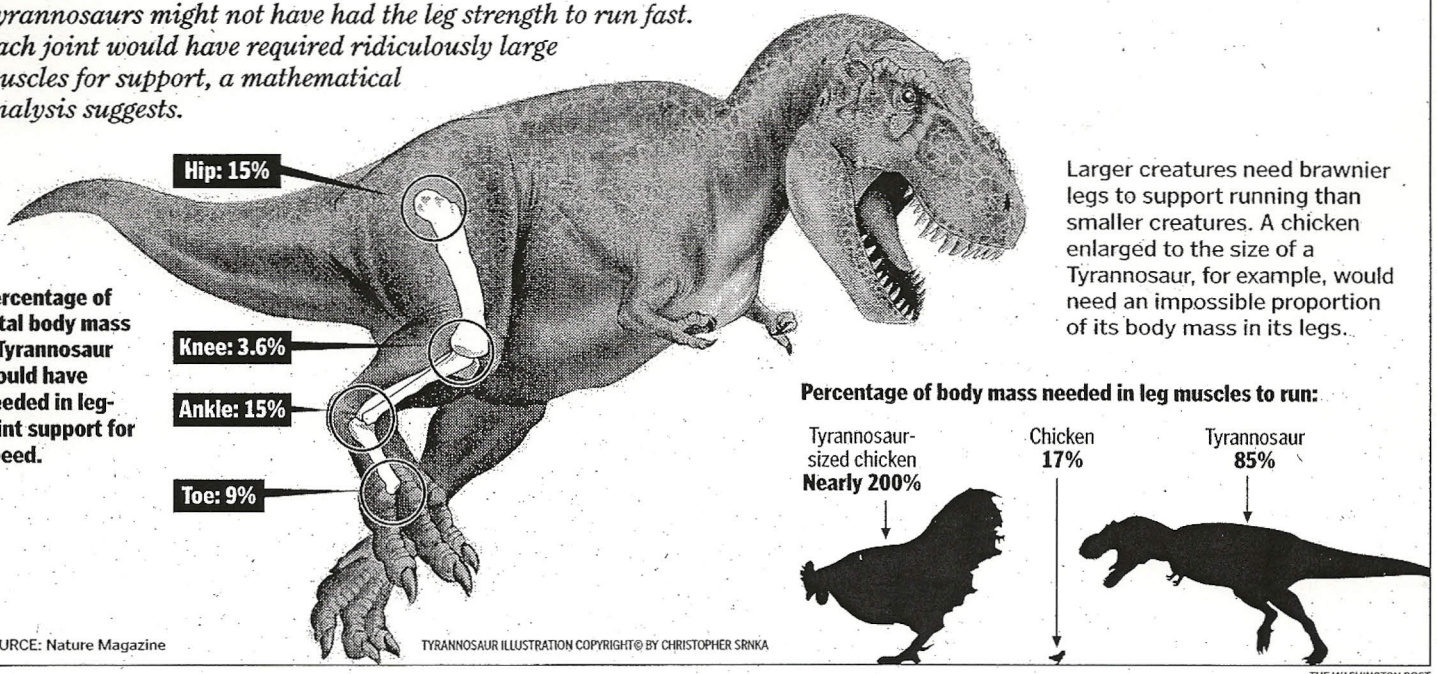
More Like a Pedestrian

Tyrannosaurs might not have had the leg strength to run fast. Each joint would have required ridiculously large muscles for support, a mathematical analysis suggests.



Larger creatures need brawnier legs to support running than smaller creatures. A chicken enlarged to the size of a Tyrannosaur, for example, would need an impossible proportion of its body mass in its legs.

Percentage of body mass needed in leg muscles to run:

THE WASHINGTON POST

Rampaging T. Rex? Hold On a Minute

Or Maybe an Hour. Scientists Say the Dinosaur Was Not Quite a Roadrunner

By GUY GUGLIOTTA
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It was a six-ton meat-eater with a head the size of a steam shovel and a mouthful of teeth six inches long, a truly fearsome beast. But the legend of *Tyrannosaurus rex* rampaging along like a prehistoric SUV appears to be incorrect. New research suggests that T. rex just didn't have the legs.

Instead, says Stanford biomechanist John R. Hutchinson, this great carnivore was a relatively slow-moving, 10-mile-per-hour walker, which, if it could run, just might have managed a 25-mph lumber, but "that's pushing it."

"He's too big," Hutchinson said. "It's the same reason you don't see elephants jumping over fences or galloping. That's why you don't see 1,000-kilogram birds. They're not like chipmunks."

To demonstrate the point, Hutchinson and co-researcher Mariano Garcia constructed a biomechanical computer model showing that for a crouching T. rex to run 45 mph, as some studies have suggested, more than 80 percent of its muscle mass would have to be concentrated in its two legs.

"We did the model in many different poses," Hutchinson said. "We started with a birdlike crouch, but then tried a more upright, columnar model. We could lower the muscle mass estimate to about 17 percent per leg, which is still way too high."

Writing in today's edition of the journal Nature, Hutchinson and Garcia noted that fast-moving bipeds—like chickens—typically need between 1 and 10 percent of their muscle mass to generate high speeds.

Problems arise for larger animals because of a relatively simple biomechanical principle: the force a muscle exerts is a function of its two-dimensional area, while muscle mass is a three-dimensional volume measurement. Muscle force grows much more slowly than muscle mass, with the ratio worsening as an animal becomes larger.

Thus, Hutchinson said, if a modern chicken weighed six tons, like T. rex, it would need to have 200 percent of its body weight in its legs to be able to run fast, a physical impossibility.

The Hutchinson-Garcia research adds to an old debate about T. rex, which lived in North America and Asia between 85 million and 65 million years ago and is one of the largest bipeds and carnivores of all time.

As evidence has mounted over the last 20 years linking dinosaurs to modern birds, many paleontologists have suggested that T. rex was a fleet-footed, avian-style runner like the modern ostrich, rather than an elephantine plodder.

"Their anatomy says they can run," said Baltimore-based paleontologist and artist Greg Paul. "They look like giant birds, and birds can run fast. Elephants can't run" because "they have immobile ankles. T. rex of all types have bird-like feet."

Paul said he is not convinced by the "incredible values" in the Hutchinson-Garcia calculations, suggesting that anatomy is a speed determinant, not simply body size. "This area is still very controversial and will take a lot more work," he said.

But the University of Iowa's Christopher A. Brochu, a leading authority on T. rex, praised the new research for bringing "far more rigor and precision than has ever been possible to a long-standing debate.

"This paper doesn't firmly establish T. rex as a nonrunner, but it really lends strong support to the idea," Brochu said. "T. rex is about as big as a biped can get. To move and balance, it has a tail and a center of gravity at the hip. The whole thing is operating like a giant seesaw."

The new research was also greeted enthusiastically by Jack Horner, curator of paleontology at the Museum of the Rockies, in Bozeman, Mont., and developer of the theory that T. rex was a scavenger rather than a predator.

"They're definitely not running animals," Horner said. "Ostriches have long shins and short thighs, but T. rex's thigh and shin are about the same length, like ours. About the only animal we can outrun that's our own size is a big sloth or a big Galapagos turtle."

But Hutchinson cautioned that just because T. rex was not a fast runner, "it can still move at absolute speeds that are pretty respectable: 10 to 12 miles per hour walking," which is about as fast as the speed an average running human can reach.

And slow pace doesn't necessarily say anything about what eats. "It's the same principle that if you're going to swim with the sharks, go with somebody who swims slower than you do," Brochu added. "T. rex just has to travel [as] fast or faster than the animals it's trying to catch."