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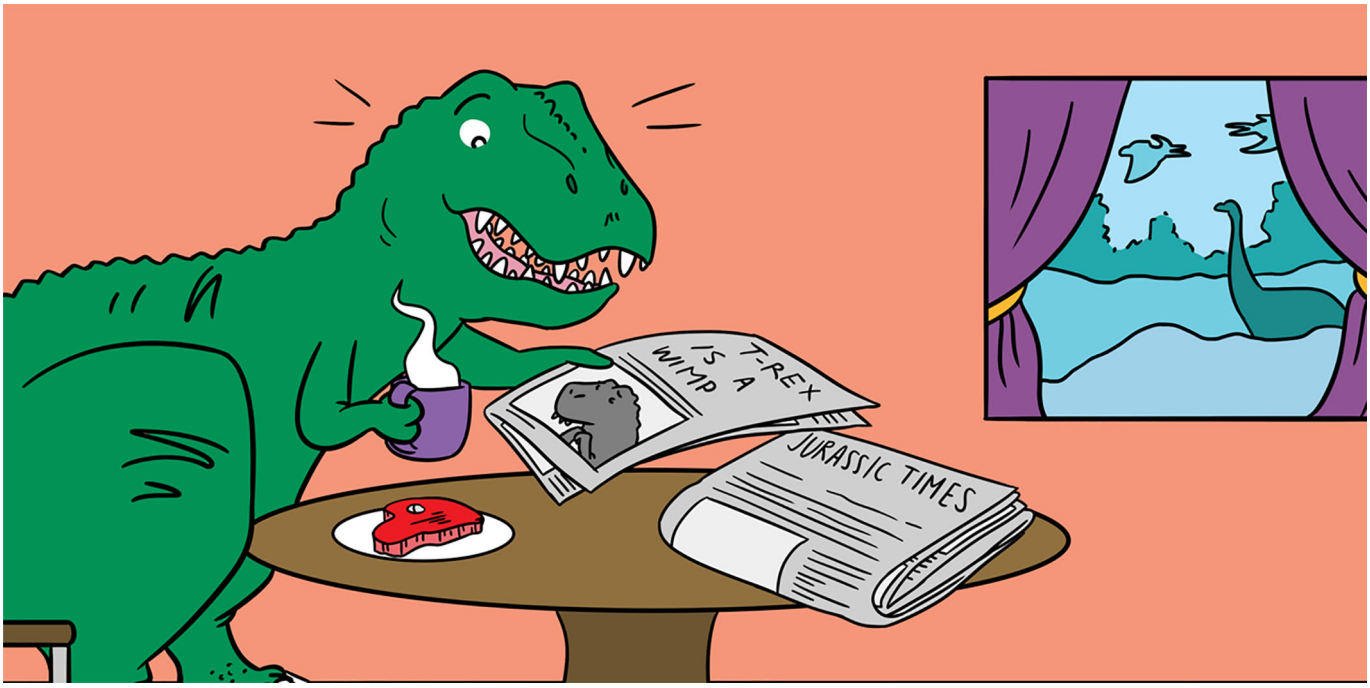

WAS *TYRANNOSAURUS REX* A FEROCIOUS PREDATOR OR A WIMP?

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YOUNG REVIEWERS:

ASHIMA
AGE: 12

AVANI
AGE: 8

SANSKRITI
AGE: 13

Tyrannosaurus rex is the most famous dinosaur in the world: beloved by paleontologists and the public alike (especially kids). How *T. rex* lived is one of the most hotly debated topics in dinosaur research. *T. rex* was the largest predator in its ecosystem with a powerful and (possibly) poisonous bite. It has been suggested, however, that *T. rex* was a scavenger, like the dinosaurian equivalent of a vulture, rather than an active predator. The aim of this article is therefore to examine the behavior and lifestyles of these incredible animals and to provide you with clues on whether *T. rex* was a predator.

INTRODUCTION

Tyrannosaurus rex is the most famous and most beloved dinosaur on the planet. The genus *Tyrannosaurus* only contained a single species, *T. rex.* The name *T. rex* appropriately translates to *Tyrant Lizard King.* The first *T. rex* skeleton was unearthed by Barnum Brown in 1900 and was described and named by Henry Fairfield Osborn 5 years

Figure 1

Drawing of a *T. rex* skull compared to that of a human.

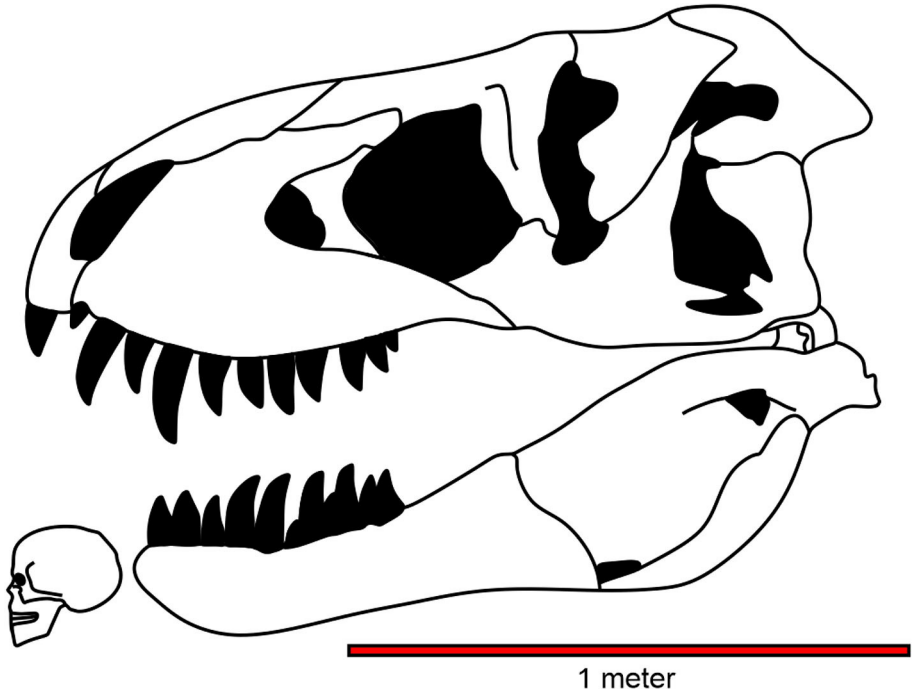

Figure 1

PREDATOR

A meat-eating animal that kills its own prey.

CRETACEOUS

The final period of the Mesozoic (which also included the Triassic and Jurassic) which lasted from 145 to 66 million years ago.

later [1]. *T. rex* was the largest **predator** in North America during the Late **Cretaceous**—the last period in which dinosaurs (not including birds) lived—between 68 and 66 million years ago. Much of what we know about *T. rex* comes from the mid-western United States. *T. rex* was a theropod (the group of predominantly meat-eating dinosaurs) that could reach up to 12 m (or 40 feet) in length and could have weighed as much as 8 metric tons, which is much more than an African Elephant bull!

A GIANT SKULL WITH THE BITE EVER

The most striking feature of *Tyrannosaurus* is their giant skulls which could reach a colossal 1.52 m (5 ft) in length (Figure 1). It is thought that *T. rex* had the strongest bite force of any land animal that has ever lived. Computer simulations based on the shape and strength of *T. rex*'s skull showed that its bite force was incredibly powerful. For you to have an idea of how powerful it was, *T. rex*'s bite was up to 114 times stronger than that of most humans [2].

TYRANNOSAURIDS

A group of giant meat-eating dinosaurs that lived in North America and Asia during the latter part of the Cretaceous. Includes *Tyrannosaurus* and its closest relatives, such as *Albertosaurus* and the Asian *Tarbosaurus*.

In contrast to the thin and blade-like teeth of most other theropods (which include *Allosaurus, Velociraptor*, and even birds), the teeth of **tyrannosaurids** were oval in cross-section. The thick cross-section of tyrannosaurid teeth shows that they were very strong, and this was confirmed by a 20-cm coprolite (fossilized poo) from Canada, which was packed with bone fragments. The broad teeth of tyrannosaurids

provided structural support to withstand the stresses associated with subduing struggling prey.

SEPTIC BITE

This is when a bite allows bacteria to move from the mouth to a wound which leads to a bacterial infection and eventually blood poisoning—a condition called sepsis.

It has been hypothesized that tyrannosaurs had **septic bites**. The shape and angle of the spaces between tooth serrations of tyrannosaurids most closely resemble those of Komodo dragons, a species known for their septic bites. Grease and other food particles become trapped between the *T.* rex's teeth serrations leading to colonization by septic bacteria, meaning that a non-fatal bite by a tyrannosaur would have led to a serious bacterial infection [3]. However, the tooth serrations are like those found in other theropods, so it would be hard to argue that tyrannosaurs were exceptional in this regard. Besides, because tyrannosaur mostly hunted prey much smaller than themselves, a septic bite would not have made that much difference to their effectiveness as a predator.

THE SENSES OF *T. REX*

T. rex had an amazing sense of smell. We know this because the size of the parts of the brain responsible for smell (the olfactory bulbs) are bigger compared to other theropods suggesting that this was behaviorally important to tyrannosaurs [4]. *T. rex* could locate prey over great distances like a Cretaceous vulture.

Their eyes were large for a theropod of its size, and computerized tomography scans of its fossilized brain and skull—which creates thousands of sequential X-ray images along with the fossilized brain and skull—show that the optic nerve, which carries information from the eyes to the brain, is very well-developed. On top of this, the eyes of tyrannosaurs faced forward. This would have given *T. rex* good depth perception. It could, therefore, judge distances, an adaption common to modern hunters. The size and position of the eyes, as well as brain structure, has led scientists to think that *T. rex* had eyesight as good as modern-day birds of prey [4].

THE TINY POWERFUL ARMS OF *T. REX*

The arms of *T. rex* were relatively tiny, about the size of a human's, though with different proportions and only two fingers (Figure 2). There has been much debate about the possible functions of their forelimbs. Rather than being useless, *T. rex* arms were muscular some estimates able to pull 180 kg (400 lbs) as estimated by the size of their biceps—though this is at the higher end of the estimates. This suggests that their arms did serve a purpose, but the exact nature of that purpose is still debated by paleontologists [5]. They are smaller and with less sharp claws than ancestral tyrannosaurs, so whatever they were doing with their arms, they were doing it less than their forbears.

Figure 2

Diagram of a *T. rex* arm showing the bones of the arm (left) and how it would have looked when the animal was alive (right).

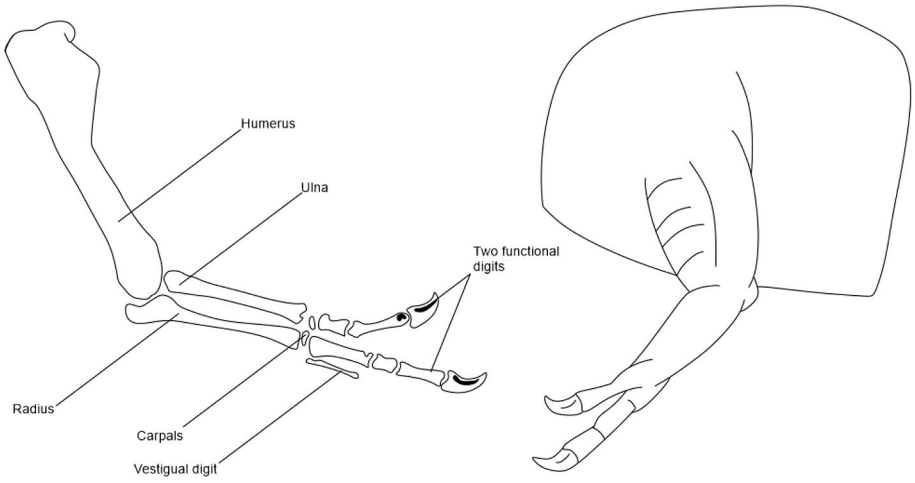

Figure 2

GROWING UP

Just like how human change as we get older so did dinosaurs. Unlike the large-headed and bulky adults, juvenile *T. rex*'s were different with smaller, slender heads, long legs and thinner and more blade-like teeth. So, paleontologists concluded that young tyrannosaurs had a different lifestyle than adults. The longer limbs and more slender bodies meant that juveniles could run much faster than the adults, while the smaller skulls and bladed teeth imply that they did not crush bone like the adults.

"WARRIOR" OR "WIMP"?

SCAVENGER

A meat-eating animal that finds and eats animals that are already dead.

The classic view of *T. rex* is that it was a terrifying predator and saying anything else seems almost heretical. In 1994, American paleontologist Jack Horner published an article that suggested that a view of *T. rex* for over a 100 years should be turned on its head ... *T. rex*, the Tyrant Lizard King, was a **scavenger**. The theory that *T. rex* and its close relatives were scavengers are based on tooth shape, sense of smell, and the size of the arms [6]. Many of these points have already been discussed in this paper, so what do you think? Was *T. rex* a scavenger or a predator?

The best answer is that, like most living carnivores *T. rex* both! There are good examples in the fossil record of large tyrannosaurs acting as scavengers [7], but there is definitive evidence of *T. rex* hunting, or at least trying to. Paleontologists have found several examples of failed attempts of predation where tyrannosaurs have left marks, or even teeth behind in their prey. One good example is seen is a duck-billed hadrosaur—a medium sized plant-eating dinosaurs called *Edmontosaurus annectens,* and very common during

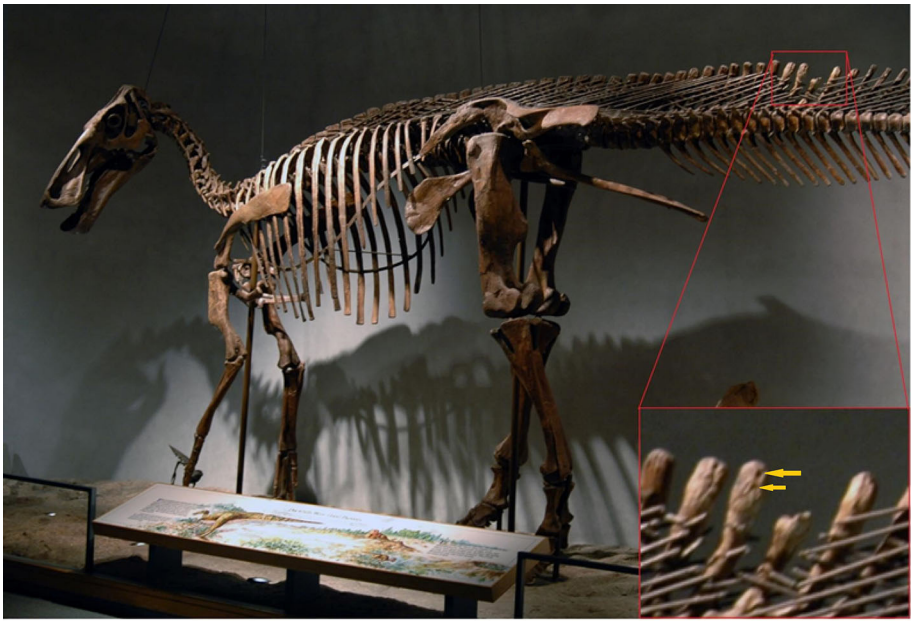

Figure 3

In the tail of this dinosaur, *Edmontosaurus annectens*, there is clear evidence of predation of the tail. As you can see, one of the neural spines has been bitten of and the spine to the left of it has two puncture holes made by a tyrannosaur tooth pointed out by the yellow arrows. CC BY-SA 3.0.

the Cretaceous—with a bite mark that removed parts of the tail (Figure 3). The bone regrowth around the tooth puncture marks shows that the animal survived *T. rex*'s attack [8]. Other examples of failed predation include a hadrosaur vertebrae from the Hell Creek Formation of South Dakota that has a tyrannosaur tooth preserved inside the bone, which has healed and grown around it [9].

CONCLUSION

T. rex was the largest predator in North America during the last 2 million years of the age of dinosaurs. By analyzing the fossil remains of *T. rex*, paleontologists have discovered much about the behavior of these incredible animals. By studying the strength of their skulls, we know that they had the strongest bite force of any land animal that has ever lived. Although *T. rex* was an active predator, like most large predators, it also engaged in scavenging behaviors too when the opportunities arose.

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REFERENCES

1. Osborn, H. F. 1905. *Tyrannosaurus* and other Cretaceous carnivorous dinosaurs. *Bull. AMNH* 21:259–65.
2. Bates, K. T., and Falkingham, P. L. 2012. Estimating maximum bite performance in *Tyrannosaurus rex* using multi-body dynamics. *Biol. Lett.* 8:660–4. doi: 10.1098/rsbl.2012.0056
3. Abler, W. 1999. The teeth of the *Tyrannosaurus*. *Sci. Am.* 281:40–1.
4. Witmer, L. M., and Ridgely, R. C. 2009. New insights into the brain, braincase, and ear region of tyrannosaurs (Dinosauria, Theropoda), with implications for sensory organization and behavior. *Anat. Rec.* 292:1266–96. doi: 10.1002/ar.20983
5. Smith, M., and Carpenter, K. 1990. Forelimb biomechanics of *Tyrannosaurus rex*. *J. Verteb. Paleontol.* 10:43A.
6. Horner, J. 1994. Steak knives, beady eyes, and tiny little arms (a portrait of *T. rex* as a scavenger). *Paleontol. Soc. Spec. Publ.* 7:157–64. doi: 10.1017/S2475262200009497
7. Hone, D. W. E., and Watabe, M. 2010. New information on scavenging and selective feeding behaviour of tyrannosaurids. *Acta Palaeontol. Pol.* 55:627–34. doi: 10.4202/app.2009.0133
8. Carpenter, K. 1998. Evidence of predatory behavior by carnivorous dinosaurs. *Gaia* 15:135–44.
9. DePalma, R. A., Burnham, D. A., Martin, L. D., Rothschild, B. M., and Larson, P. L. 2013. Physical evidence of predatory behavior in *Tyrannosaurus rex*. *Proc. Natl. Acad. Sci. U.S.A.* 110:12560–4. doi: 10.1073/pnas.1216534110

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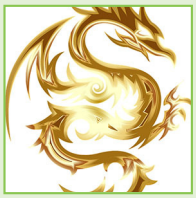
YOUNG REVIEWERS

ASHIMA, AGE: 12

Hi, I am Ashima. I like to read fiction books and swim. I love to study. My favorite subject is mathematics. Quadratic functions are my favorite topic in mathematics.



AVANI, AGE: 8

Hello, I am Avani, I like to play a lot of games of every type. I also like playing with my puppy and video games. I like animals and nature a lot! So, in warm weather, I go outside and look at my beautiful surroundings, and nature around me! And in cold weather, I ski and play in the snow! Those are some things about me!

SANSKRITI, AGE: 13

Hello, my name is Sanskriti. I am 13 years old, and am going into eighth grade. My hobbies are crafting and reading. When I grow older I want to go into either biology or coding.

AUTHORS

JACK THOMAS RHODES WILKIN

I am a paleontologist and M.Sc. in geology student at the Camborne School of Mines, University of Exeter, in the United Kingdom. Before starting at CSM, I completed his B.Sc. (Hons.) in paleontology from the University of Portsmouth in 2017. I have helped look for fossils in the UK, Germany, France, and Poland. My research focuses on using the chemistry from fossils to help work out how the climate changed in the geological past. *jack.wilkin@btinternet.com

DAVID W. E. HONE

I am a paleontologist specializing in the behavior and ecology of dinosaurs and pterosaurs. I have helped find fossils in the UK, China, Canada, and Mexico and have named more than a dozen new species of ancient reptiles. Working out how extinct animals lived and behaved is really exciting as it involves trying to solve a complex problem with very limited information. I think this kind of work can be really inspiring to young people and a great demonstration of how science works to reveal new information.