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Lizard Has One-Way Breathing; Hints at How Dinosaurs Breathed?

Posted by Carrie Arnold in Weird & Wild on December 11, 2013

(11)

The savannah monitor lizard (*Varanus exanthematicus)* doesn't eat like a bird, but it does breathe like one, a new study has discovered.

Air flows only one way through its lungs—other than the American alligator, it's the only other known reptile found to have this trait.

A savannah monitor lizard. Photograph courtesy Cheryl Ertelt

That's surprising, because the unidirectional airflow of birds was thought to have evolved due to the high-oxygen demands of flight: Instead of being partially filled with stale, depleted air like human lungs, avian lungs contain air with a much higher average oxygen content and are much more efficient at getting oxygen to the blood.

So this method of breathing was generally considered to be unique to both warm-blooded animals and birds.

That changed in 2010, when Colleen Farmer of the University of Utah and colleagues found that alligators breathe one way.

Now, Emma Schachner, a postdoctoral researcher in Farmer's lab, has added another species to that list.

"Finding this trait in a [cold-blooded] lizard means that warm-bloodedness and unidirectional airflow have no relationship whatsoever," Schachner said.

But Schachner has another intriguing question: Did dinosaurs also breathe this way? (See "Superlungs Gave Dinosaurs Competitive Edge?")

As I Live and Breathe

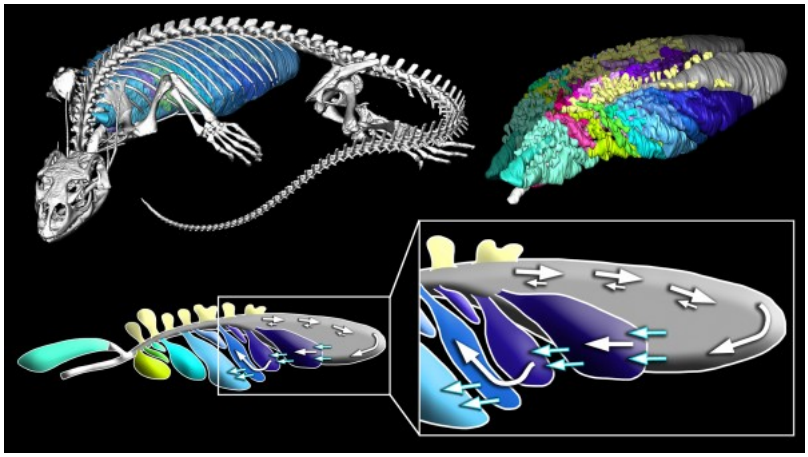
When humans or other mammals breathe, the air flows through the same lung passages during both an inhale and an exhale. As we inhale, the air flows in through our nose and mouth and down through the windpipe, where it splits and flows into a bronchi, or passageway, that leads to each lung.

The airways divide and divide again, each time getting smaller and smaller. Eventually, the air makes it to tiny alveolar sacs, where oxygen travels from the air into the bloodstream.

When we exhale, the oxygen-depleted air travels back through the same passages, up through the windpipe, and out of our nose and mouth. Because air flows both into and out of the lungs using the same passages, our breathing is said to be bidirectional. (Explore an interactive of the human body.)

Birds, on the other hand, have unidirectional airflow when they breathe. Once air hits their bronchi, it either flows into lung-like structures known as parabronchi where oxygen is extracted, or it flows into a set of posterior air sacs in the lower abdomen where the air is temporarily stored.

As the bird exhales, the muscles around the posterior air sacs contract and force some of the air into the parabronchi. This is where oxygen flows from the air into the bloodstream, functioning very similarly to human alveoli. After this is done, the air keeps moving in the same direction and travels into a set of anterior air sacs, which are located in the mid- to upper abdomen.



Illustrations show the skeleton, lungs, and bronchial airflow (clockwise) of the savannah monitor lizard. Illustration courtesy Emma Schachner

"Birds can get oxygen out of air during both inhalation and exhalation, which is not the case for mammals. Mammals can only get oxygen when they inhale. When they're breathing air out, they're not getting any oxygen," said Schachner, whose results were published December 12 in *Nature*.

Dinosaur Breathing

Schachner started out interested in dinosaur biology, but shifted her focus to living reptiles after seeing Farmer's work on American alligators, which belong to a wider group called crocodilians that are among dinosaurs' closest living relatives. (Also see "Dinosaurs Had Supercharged Breathing Like Birds [2007].")

Now Schachner wants to know whether dinosaurs might have also breathed one way. Since the remnants of any respiratory systems would have long since degraded in dinosaur fossils, scientists can only study their descendants, which include birds and reptiles.

She picked the savannah monitor lizard because it branched off from the dinosaur/bird lineage in the distant past. Her rationale: If this species breathed similarly to modern birds, then this trait might have evolved even *before* the dinosaurs, and could provide insights on how dinos lived and breathed.

As of right now, the jury's still out, she said.

"Monitor lizard lungs look very different from bird lungs, so we can't tell yet whether unidirectional airflow evolved in a common ancestor of birds, lizards, crocs, and dinosaurs, or whether it evolved independently until we look at other species." (Take a dinosaur quiz.)

To more conclusively answer this question, Schachner and Farmer intend to study the respiratory systems of several other species of lizard.

Meanwhile, we can breathe easy that there aren't any living dinosaurs to study.

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Keywords:birds, breathing, Colleen Farmer, Crocodilians, dinosaurs, Emma Schachner, respiratory system, savannah monitor lizard, unidirectional airflow (11)

Comments

1. Patrick O'Hanlon
   Delaware
   December 12, 12:42 pm

   So much wrong with this article. Work on your scientific reading comprehension Carrie. Seriously… This is terrible. How does someone with the scientific journalism caliber of Yahoo! News get hired at National Geographic exactly?

   Reptiles are NOT descendants of dinosaurs, they share a common ancestor. Both are diapsids but not only were dinosaurs for the most part warm blooded, but if the uni-directional airflow evolved in dinosaurs, according to the article's logic EVERY species of reptile would have the same lung structure!

   It's even stated in the quote from an actual scientist IN YOUR ARTICLE: