

Respiratory Anatomy – Form and Function in Reptiles*

J E A N E T T E W Y N E K E N



Jeanette Wyneken, PhD
Department of Biological Sciences
Florida Atlantic University
Boca Raton, FL 33431
jwyneken@fau.edu

Dr. Wyneken received her PhD in biology from the Department of Ecology, Ethology and Evolution, University of Illinois, in 1988. Her dissertation was entitled *Comparative and Functional Considerations of Locomotion in Turtles*. In addition to training graduate and undergraduate students in comparative anatomy at Florida Atlantic University, she teaches conservation and biology of sea turtles at Harbor Branch Oceanographic Institution and Duke University Marine Laboratory. She is a frequent author and speaker, educating through peer-reviewed research publications, book contributions, professional seminars and invited presentations to the public.

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THE PURPOSE OF THIS ARTICLE IS TO PROVIDE A BROAD INTRODUCTION to the major features of gross reptilian pulmonary anatomy. It addresses the overall layout and classification of the reptilian pulmonary systems and compares major differences in broad taxonomic categories. The author discusses a comparison of lung structure and ventilation as these distinctions relate to taxonomy, behavior and ecology of various groups of reptiles.

The respiratory tract of most reptiles is anatomically and physiologically very different from that of mammals. Reptiles lack a bronchial tree and possess distinct air exchange surfaces (ediculi and faveoli) that are structurally different from alveoli of mammals. Ediculi and faveoli are small crypts in the parenchyma rather than terminal alveolar sacs.

Air passes from the nares (external choanae) to the internal choanae, then flows through the glottis, trachea and bronchi from which it enters the lungs. In most reptiles, the secondary palate (hard and/or soft palate portions) is absent or poorly developed, so food and air passages join almost immediately within the buccal cavity. Some turtles have a partially developed secondary palate in the rostral-most part of the mouth. Crocodylians have a virtually complete secondary palate, but lizards and snakes lack a secondary palate of any kind.

The structure of the supporting airways and the form and extent of the lung can be clinically important. An understanding of the normal anatomy is important for basic physical assessment of normal versus pathologic conditions and for designing treatment options.

In all reptiles, the trachea is composed of cartilaginous rings. These structures support the trachea and prevent collapse of the tracheal lumen. The rings are complete in turtles and many snakes, but are incomplete (C-shaped) in most lizards. The trachea of most snakes does not bifurcate into two distinct bronchi except in boas and pythons. Turtles have a long, flexible trachea that bifurcates into two bronchi near the heart. Each bronchus turns laterally to enter the lung.

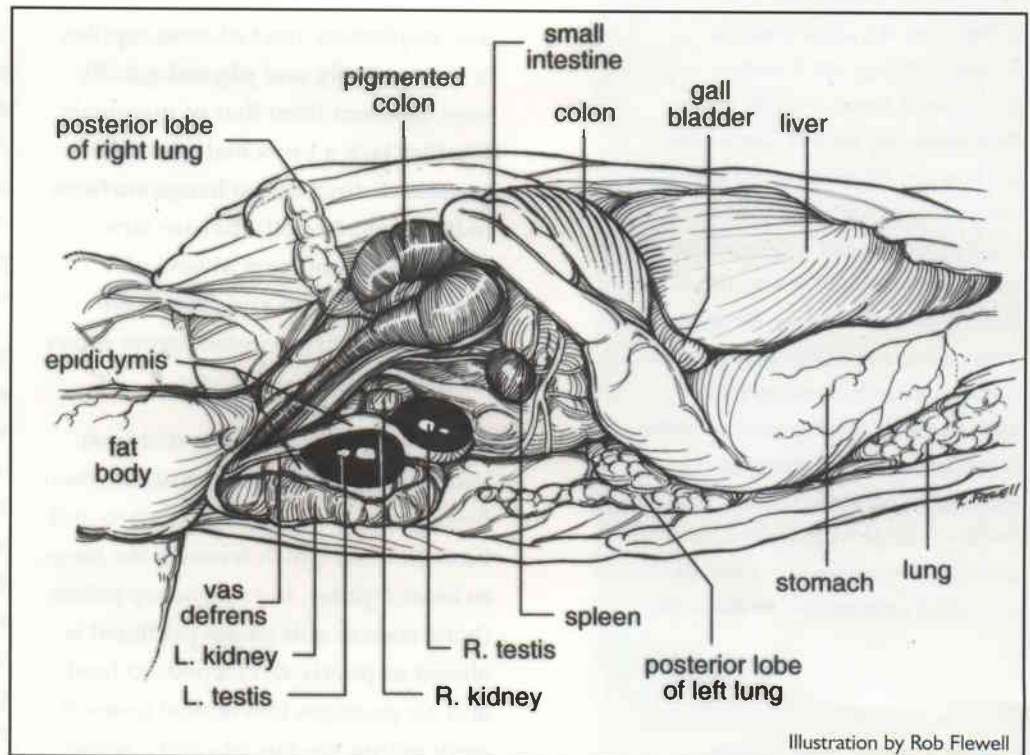
The bronchial anatomy in reptiles typically follows one of two patterns. The bronchus enters the cranial pole of the lung from which it either

extends caudally a very short distance (e.g., in colubrid snakes and chameleons) or traverses the entire length of the lung (e.g., in monitor lizards and sea turtles).

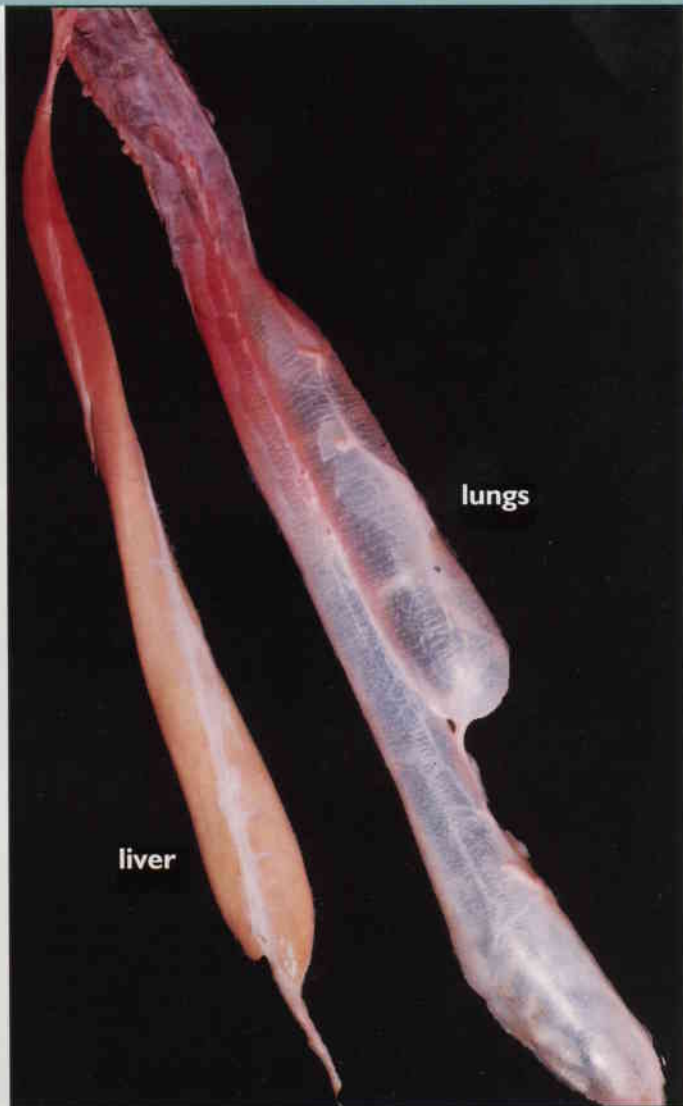
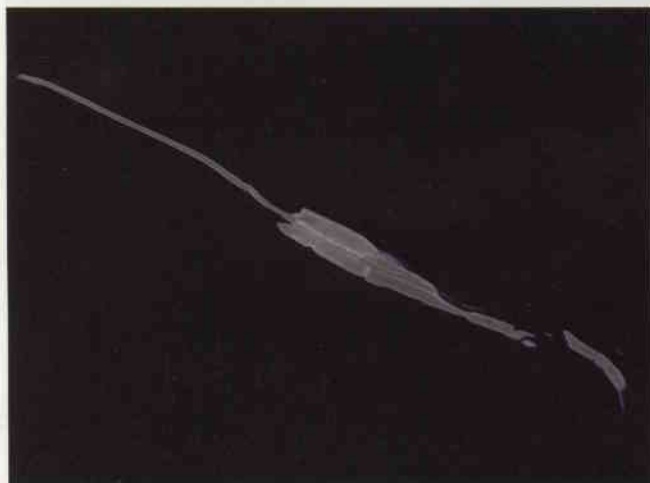
Lung structure and function vary among the four most common reptilian groups: turtles, snakes, lizards and crocodylians. Lung forms can be grouped into three categories: single-chambered, transitional (a single chamber divided by large septa), and multi-chambered (lungs with internally developed lobes generally not visible from the lung's outer surface).

Lizards cover all three categories of lung structure. Geckos have single-chambered lungs, while varanids (monitor lizards) and heloderms (beaded lizards) have multi-chambered lungs with branched bronchi. Iguanas and chameleons have transitional lungs (see below).

Crocodylians have very complex multi-chambered lungs with high-density parenchyma. A complex branching system of bronchi leads into lungs with multiple internal lobes.



Dissection of a chameleon's (*Fulcifer pardalis*) pleuroperitoneal cavity, ventral view, anterior to right. The lungs are transitional, having internal separations and posterior lobes, or diverticula. The lungs extend along the dorsal and lateral body cavity so that the GI tract, which was large in this animal, passes between and ventral to them.

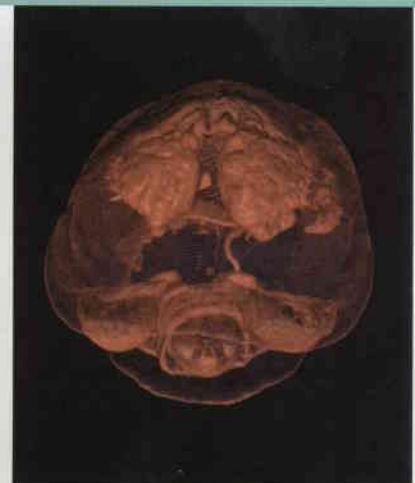
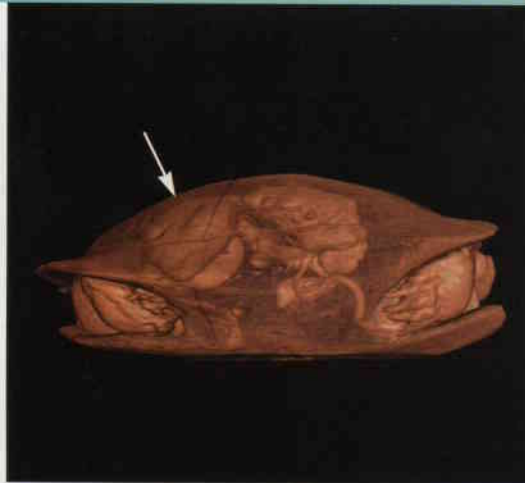


Primitive snakes (boas and pythons) have two lungs, and the right lung is longer than the left. In most other snakes, the left lung is either reduced in size (e.g., viperids and many colubrids) or absent. Shown here is a computed tomography (CT) scan of an immature python (*Python molurus*) ventral view, showing the trachea, the long right lung and the shorter left lung. The extent of the right lung (lower) in this image was interrupted by a blank space (motion artifact) when the snake took a breath.

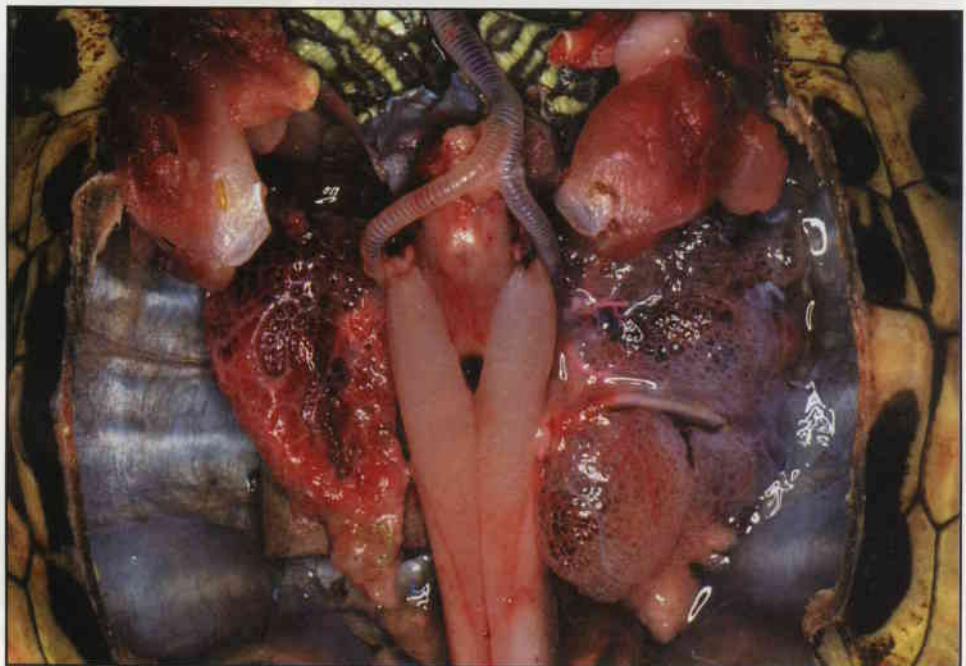
Snake lungs are elongated and consist of a highly vascular anterior portion (respiratory lung) and an avascular posterior portion with sac-like extensions that lack parenchyma (saccular lung). Shown here is a dissection of the lungs of a ball python (*Python regius*) with the respiratory lung in the upper left of the photo. The liver is separated to the left.

In many turtle species, the trachea is highly flexible and can coil when the head is retracted. These are CT scans of an adult female slider (*Trachemys scripta*). The partially deflated lungs are located dorsally, beneath the carapace. The long trachea is coiled near its bifurcation into the bronchi. The urinary bladder and large paired accessory bladders (white arrow) are also seen clearly in the left image.

The turtle's head is facing right in the lateral view and facing forward in the anterodorsal view.



Dissection of the lungs of an adult slider (*Trachemys scripta*), ventral view. The trachea is dissected clear of the esophagus and connective tissue, and the GI tract and heart have been removed. The turtle's left lung is partially inflated and the right lung is deflated. Turtles' lungs are rich in parenchyma.



All turtles have multi-chambered lungs located dorsally beneath the carapace. Each lung has an unbranched central bronchus extending to the caudal aspect of the lung. This dissection of a sea turtle lung shows the long central bronchus running the length of the lung. Sea turtles have a particularly large-bore trachea and bronchus. The extent of the cartilaginous supports of the bronchus may differ in lungs of other turtles, and the lung parenchyma is usually less spongy.

