

Respiratory system: purpose and physiology



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The purpose of the respiratory system is to allow gas exchange throughout all body parts of most animals. The evolution of the respiratory system is responsible for different respiratory structures in diverse animals and it has allowed them to keep up with their oxygen demands. It functions by removing carbon dioxide from the lungs and replenishing it with oxygen. In this paper I will compare the respiratory system of *Tursiops truncatus* and *Chelonia mydas*. The bottlenose dolphins (*Tursiops truncatus*) are warm blooded mammals that live all of their life in the ocean. *Tursiops truncatus* are from the kingdom Animalia, class Mammalia, order Cetacea, and family Delphinidae. They belong to the genus *Tursiops* and species *truncatus*. On the other hand, the *Chelonia mydas* are cold blooded reptiles that live most of their life in the ocean but return to the land to lay their eggs. The *Chelonia mydas* are from the kingdom Animalia as well, and just like the *Tursiops truncatus*, they both belong to the phylum Chordata. Also, *Chelonia mydas* are from the class Reptilia, order Testudines, family Cheloniidae, genus *Chelonia* and species *mydas* (Lecointre, 2007). The *Tursiops truncatus* and *Chelonia mydas* spend their lives in the ocean and spend a vast amount of time submerged in water and yet the physiology of their respiratory system varies greatly, however; their lung capacity, and gas exchange methods, can be found to have certain similarities (Reynolds, et. al., 2000, Spotila, 2004).

The physiology of respiratory system of the *Tursiops truncatus* and the *Chelonia mydas* are dissimilar in many aspects. To begin, *Tursiops truncatus* do not breathe through their mouths, instead they breathe through a blowhole which is located at the top of their head (Reynolds, et. Al., 2000). Also, *Tursiops truncatus* are involuntary breathers, which mean that they

have to constantly remember that they have to go to the surface and breathe. If a dolphin ever goes unconscious it will suffocate and drown. The position of the blowhole allows dolphins to go to the surface and only expose a small region of the head into the air to breathe. This allows the *Tursiops truncatus* to swim and breathe at the same time. The blowhole is the outer component of their respiratory system and it contains muscles that surround it which allows for the skin at the top of their blowhole to open and close, it is known as the nasal plug. The nasal plug helps prevent water from coming in when the *Tursiops truncatus* is underwater. Also, their respiratory system is completely separate from the digestive tract, therefore; only air gets into the lungs and it doesn't get obstructed by food or water. The lungs of dolphins are not bigger than the lungs other land mammals, which mean that their lung size doesn't play a role in how much oxygen is absorbed.

On the contrary, *Chelonia mydas* breathe through their mouth. Their respiratory system is composed of the right and left lungs; they also contain a glottis, a bronchus, and a trachea. The glottis is positioned right after the tongue. It opens when the turtle is breathing and it closes when the turtle holds its breath. The trachea is situated after the glottis and splits into the two bronchi. The two bronchi extend to the lungs. The bronchi serve as a passage which allows for air to enter the lungs and exit the same way. The bronchi continue to split throughout the lungs giving rise to the alveoli. In the alveoli sacs is where most of the process of gas exchange takes place. Turtles don't have a diaphragm to help them with ventilation of the lungs and instead they use ventral muscles which are located at the pelvic and pectoral girdles area. The lungs of *Chelonia mydas* are complex since they

are multi-chambered; this increases their pulmonary resistance, thus allowing them to stay submerged under water for many hours. The pressure of being underwater helps turtles breathe out and the ventral muscles help them breathe in.

Further, even though there is a difference in the physiology of the respiratory system of the *Tursiops truncatus* and the *Chelonia mydas*, their lung capacity shows some similarities. *Tursiops truncatus* have very efficient lungs because they have a great amount of tidal volume due to the amount of alveoli cells that they contain in their lungs. They also have very elastic tissues in their lungs, and this elasticity accounts for their great lung capacity. *Tursiops truncatus* can exchange more than three fourths of their air volume in a single breath. They can dive for periods of about 15 minutes at a time but their lungs cannot retain great amounts of oxygen and therefore they cannot stay underwater for prolonged periods of time. In addition, *Tursiops truncatus* can dive deep into the ocean for more than 150 meters. Around this depth their lungs subside causing an increase in blood pressure, which is fatal to humans, but *Tursiops truncatus* manage to slow the pressure before it gets to the brain. Also, after diving big depths and going to the surface to breathe immediately one would expect *Tursiops truncatus* to feel sick after such decrease in pressure but they experience no side effects because they hold their breath while diving.

Chelonia mydas also have tidal volume which helps them breathe faster and exchange gas in a more effective manner. They can exchange about half their air volume in a single breath. Additionally, they can stay under water for many hours. This adaptation is possible due to the fact that they are cold

blooded and have a slow metabolism which slows their heart rate for about seven heart beats per minute allowing them to be able to conserve more oxygen. However the lungs become compressed as they move down and as a result they also lose buoyancy. To account for this the *Chelonia mydas* become naturally buoyant at certain depth thus allowing the lungs to be able to retain more oxygen. As a result, the deeper that *Chelonia mydas* dive the more their oxygen storing capacity increases,

Further, the gas exchange of the *Tursiops truncatus* and *Chelonia mydas* has some similarities and differences. First, the *Tursiops truncatus* have made adaptations to their circulatory system which has allowed them to store oxygen more efficiently and to use it more effectively. *Tursiops truncates* have lungs that contain many alveoli, which are air cells, thus making gas exchange in them occur much faster. *Tursiops truncates* store oxygen in their blood and muscles because during long dives the oxygen can be accessed easily.

Additionally, *Chelonia mydas* have made adaptations to be able to withstand long periods of dives under water. The major mechanism for gas exchange in the *Chelonia mydas* is the lung, however; the ability of their blood to uptake large amounts of oxygen is also very important for gas exchange. *Chelonia mydas* can tolerate high amounts of carbon dioxide in their blood.

In conclusion, *Tursiops truncates* and *Chelonia mydas* share certain characteristics and differences when it comes to their respiratory system. The physiology of their respiratory systems is very different from each other since *Tursiops truncates* don't breathe through their mouth and *Chelonia*

mydas do. However, their lung capacity and gas exchange mechanisms can be said to be fairly similar. *Tursiops truncatus* and *Chelonia mydas* store oxygen in their blood to use during periods of long dives. Also, they can effectively exchange more than half of their air volume in a single breath (Reynolds, et. al., 2000; Spotila, 2004). It is important to learn about the respiratory system of these animals because knowing how they live will help ensure their survival and give us a better understanding of their needs.