

## The basis of yawning

© Gary S. Tong 2010

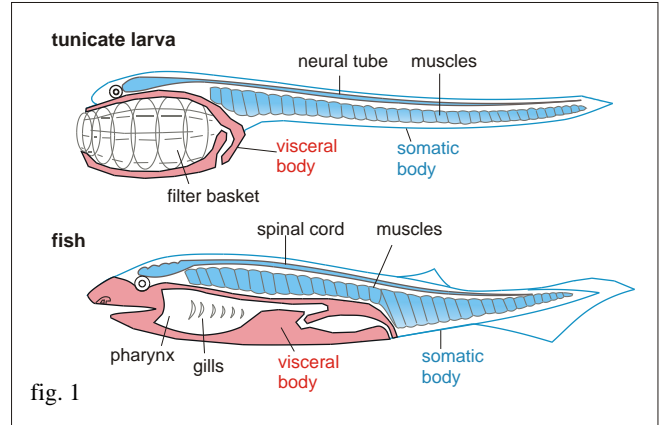
### The two-bodies system of Romer

The question of why we yawn is effectively clarified by the two-bodies principle that was advanced by the noted vertebrate anatomist Alfred S. Romer. Observing the development of the tunicate sea-squirt he stated that there are two distinct, incompletely integrated bodies in vertebrates: (a) the ancestral visceral feeding and respiratory tract to which the later evolving (b) somatic musculoskeleton became fused: \*

"In many regards the vertebrate organism, whether fish or mammal, is a well-knit unit structure. But in other respects there seems to be a somewhat imperfect welding, functionally and structurally, of two somewhat distinct beings:

(1) an external, "somatic", animal, including most of the flesh and bone of our body, with a well organized nervous system and sense organs, in charge, so to speak, of external affairs, and

(2) an internal, "visceral" , animal, basically consisting of the digestive tract and it's appendages, which, to a considerable degree, conducts it's own affairs, and over which the somatic animal exerts but incomplete control."



This diagram illustrates the invertebrate tunicate larva with gill basket and ancestral notochord and muscles of movement and compares it to the vertebrate fish which has complex visceral and somatic structures. The tunicate larval model is theoretical: it combines the extant tunicate (sea-squirt) larva, which has somatic muscles plus a notocord with the sessile adult that only has feeding organs (diagram adapted from A. S. Romer, *The Vertebrate Body* [Philadelphia: W. B. Saunders, 1970]).

---

\* Romer, Alfred Sherwood. 1972. "The Vertebrate as a Dual Organism: The Somato-Visceral Animal." *Evolutionary Biology* 6:121-156.

Commonly, "visceral" refers to the digestive tract, but in the evolutionary perspective of terrestrial vertebrates, the term denotes the entire feeding-respiratory tract. This tract extends from the mouth to the diaphragm, and is best termed the "upper visceral body or tract". It consists of all bones and muscles derived from the ancestral fish gills (branchials), and of the muscles from under the gills (hypobranchials), fig. 2. These include the tongue, hyoid, larynx, pharynx, esophagus, inner ear, jaw, and all of their associated musculatures, plus the facial muscles and those on the sides and back of the head, the outer ear muscles, and those of the upper chest and upper back, fig. 3. This anatomic development is a fundamental principle of comparative vertebrate anatomy.

It is the entire respiratory tract and its own and associated musculature that forms the upper visceral body. The diaphragm and the respiratory muscles of the thorax are also part of this group simply because they are the agents of breathing movement.

**Yawning**

Considering the above, the two-bodies system explains the old puzzle: why do we yawn?

The general explanation cites increase in oxygen intake or, what seems obvious, a stretching of muscles. The latter is the correct notion, but it can be made more precise in physiologically convincing terms if Romer's concept of the two-bodies is taken into account.

If muscle stretching is an innate behavior of the somatic body, then the muscular components of the upper visceral system may also need to perform this function. Yawning is precisely that: it is the upper visceral tract, namely the musculatures of the facial and head sheet, mandible, external and internal ear, lingual, oral, pharyngeal, laryngeal, thoracic and diaphragmatic regions that engage in stretching. Further support comes from the fact that body stretching is typically associated with yawning and both functions, unless consciously produced, are involuntary and either one can initiate the other.

