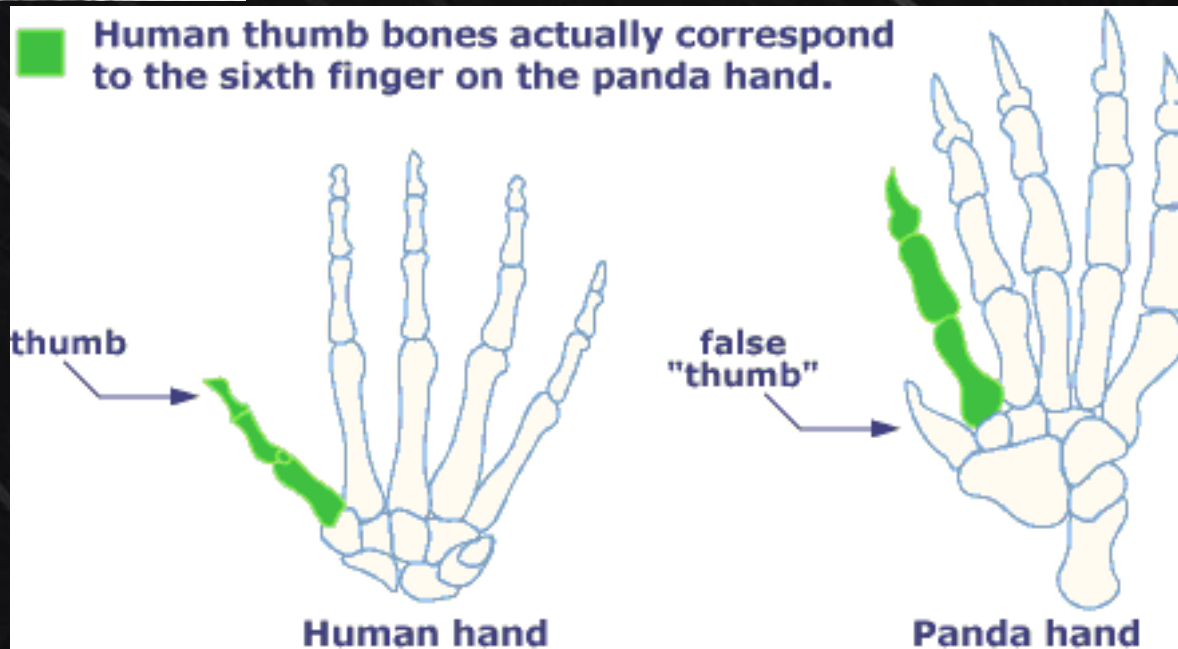
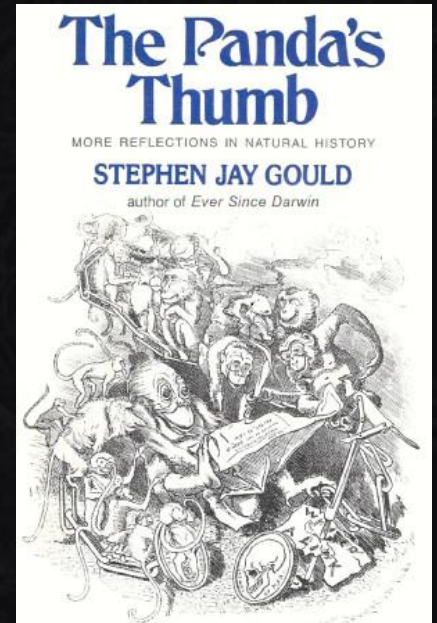


STEPHEN J GOULD



1941 – 2002. paleontologist, evolutionary biologist, and historian of science. Harvard University and American Museum of Natural History in New York.

(1980) collection of 31 essays



CUTE ANIMAL



SEAN B. CARROLL



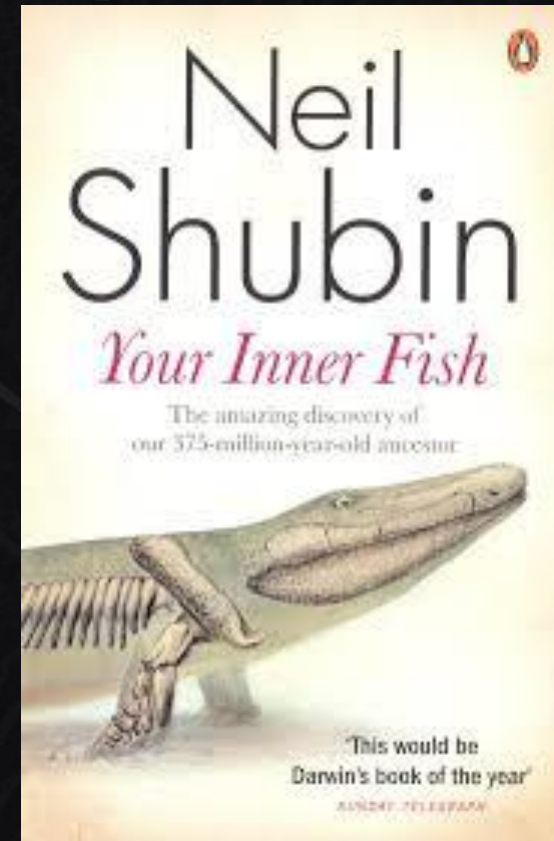
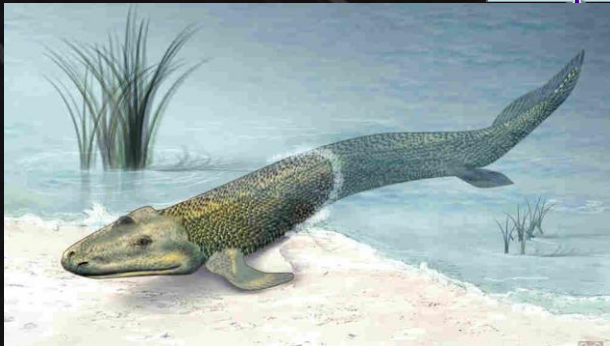
Professor in the Department of Organismal Biology and Anatomy and the Committee on Evolutionary Biology at the University of Chicago.

2008

<https://tiktaalik.uchicago.edu/book-tools.html>

PBS Doc 2014

<http://www.pbs.org/your-inner-fish/>

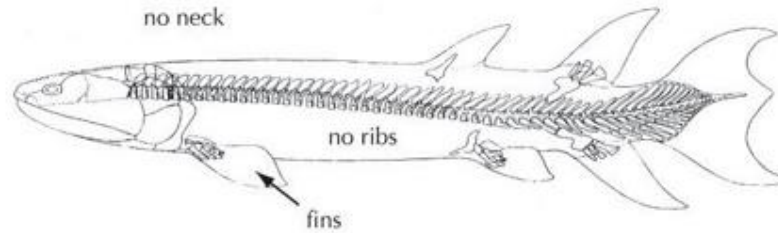


from Neil Shubin's
Your Inner Fish
A Journey into the 3.5-Billion-Year History of the Human Body

FISH



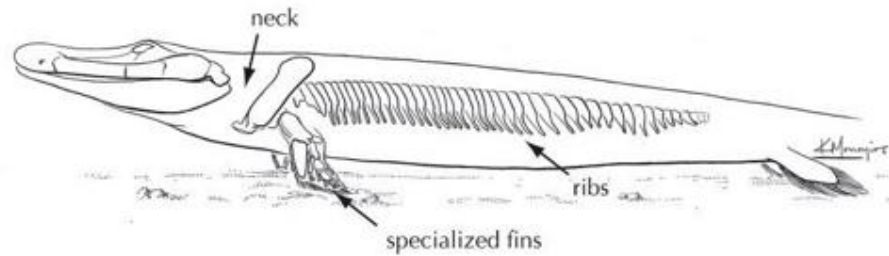
round head
eyes on side



TIKTAALIK



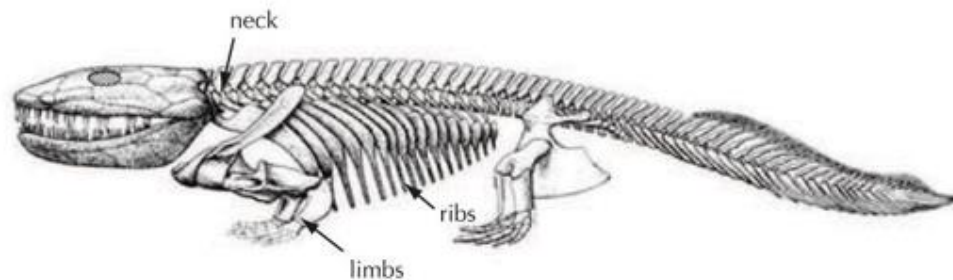
flat head
eyes on top



TETRAPOD



flat head
eyes on top



This figure says it all. *Tiktaalik* is intermediate between fish and primitive land-living animal.

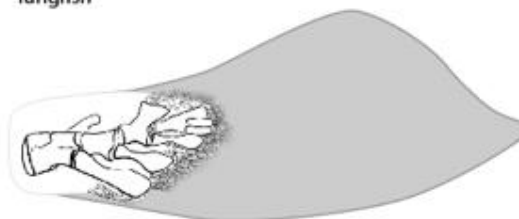
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zebrafish



lungfish



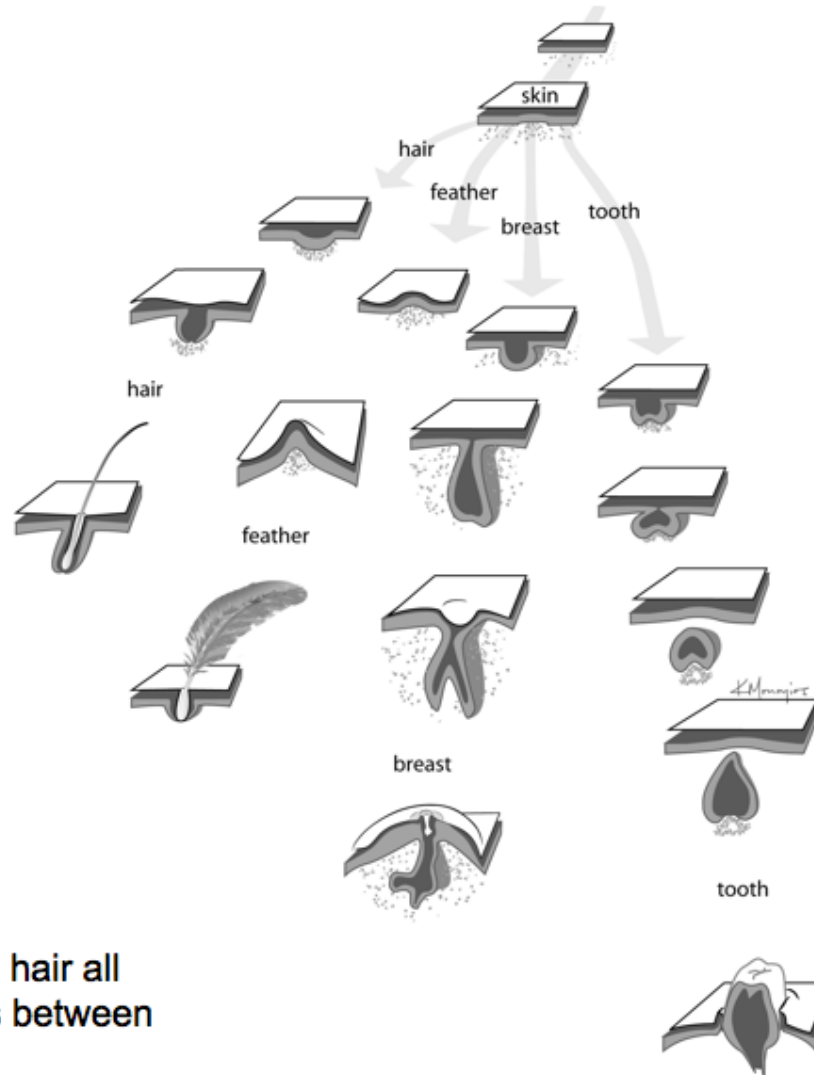
Eusthenopteron



Acanthostega

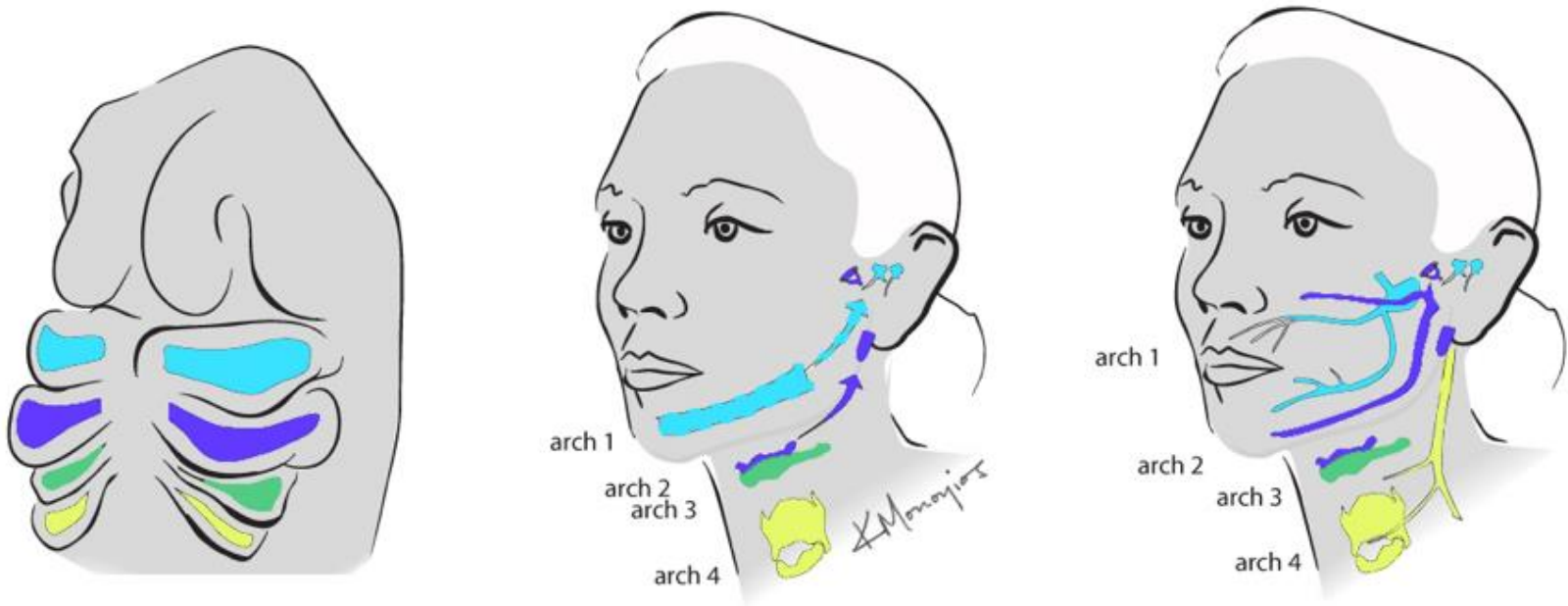
The fins of most fish - for example, a zebrafish (top) - have large amounts of fin webbing and many bones at the base. Lungfish captured people's interest because like us they have a single bone at the base of the appendage. *Eusthenopteron* (middle) showed how fossils begin to fill the gap; it has bones that compare to our upper arm and forearm. *Acanthostega* (bottom) shares *Eusthenopteron*'s pattern of arm bones with the addition of fully formed digits.

from Neil Shubin's
Your Inner Fish
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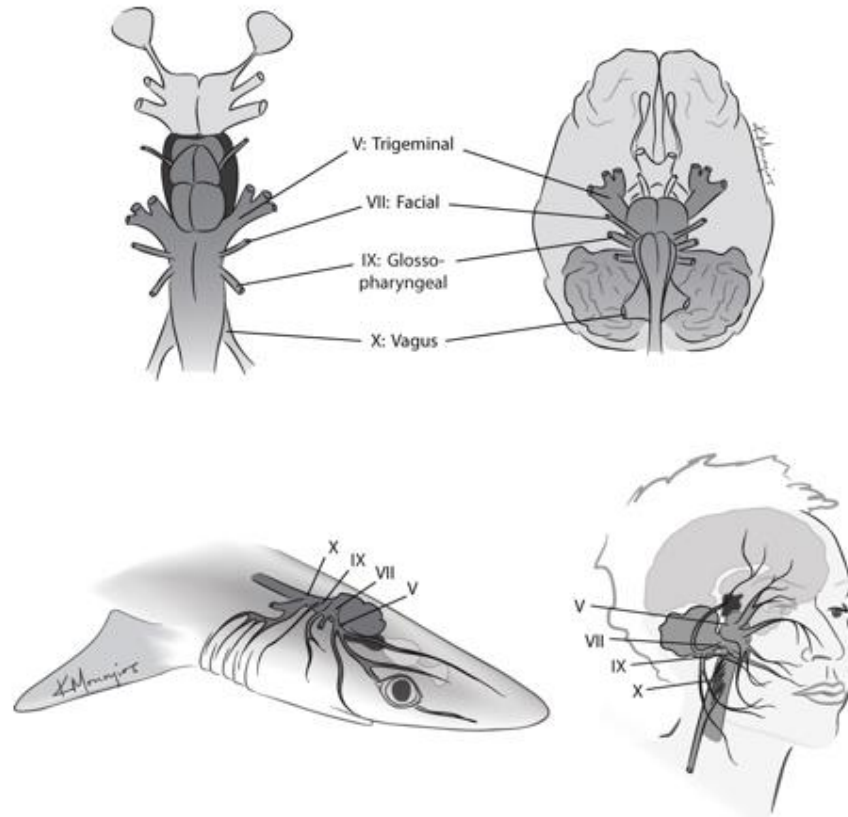
Teeth, breasts, feathers, and hair all develop from the interactions between layers of skin.

from Neil Shubin's
Your Inner Fish
A Journey into the 3.5-Billion-Year History of the Human Body



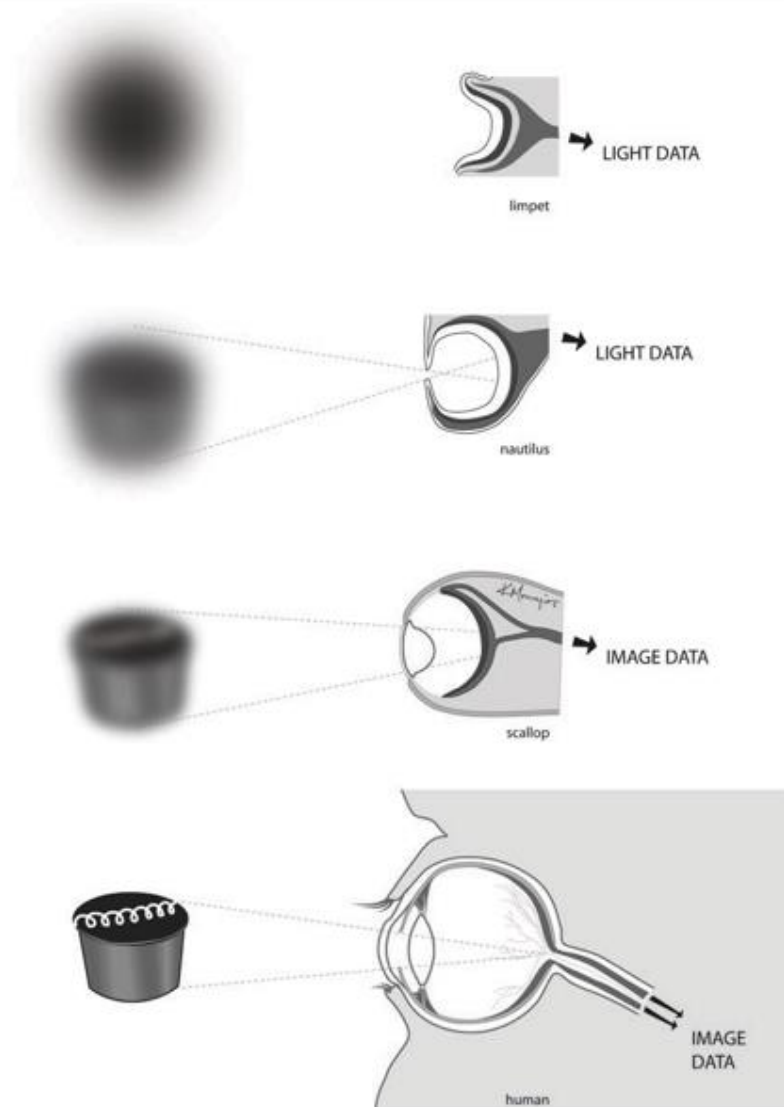
If we follow the gill arches from an embryo to an adult, we can trace the origins of jaws, ears, larynx, and throat. Bones, muscles, nerves, and arteries all develop inside these gill arches.

from Neil Shubin's
Your Inner Fish
A Journey into the 3.5-Billion-Year History of the Human Body



At first glance, our cranial nerves appear different from those of a shark. But look closely and you will find profound similarities. Virtually all of our nerves are present in sharks. The parallels go deeper still: equivalent nerves in sharks and humans supply similar structures, and they even exit the brain in the same order.

from Neil Shubin's
Your Inner Fish
A Journey into the 3.5-Billion-Year History of the Human Body



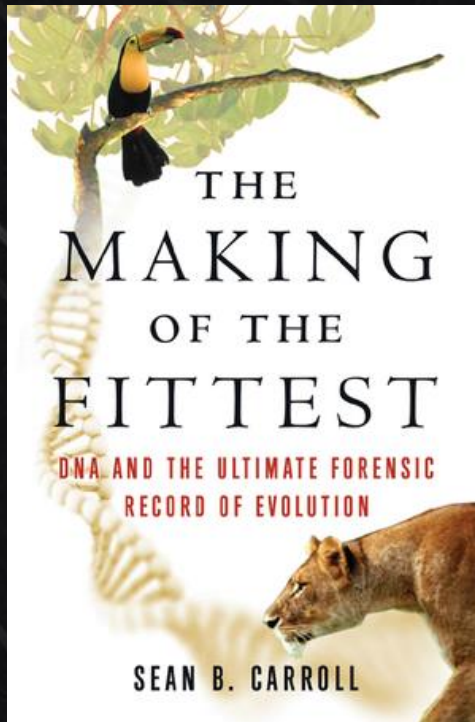
Eyes come into focus: from primitive light-capturing devices in invertebrates to our camera-type eye with a lens. As eyes evolve, visual acuity increases.

SEAN B. CARROLL



scientist, author, and educator. Chair Department of Science Education of the Howard Hughes Medical Institute, Andrew and Mary Balo and Nicholas and Susan Simon Endowed Chair of Biology at the University of Maryland.

<http://seanbcarroll.com/>
<http://www.26supdcsiloff.com/>



2007 “Fossil Genes: Broken Pieces of Yesterday’s Life”

GENE RELICS *PSEUDOGENES*

Number and kinds of opsin genes affects how your diversity of color detection

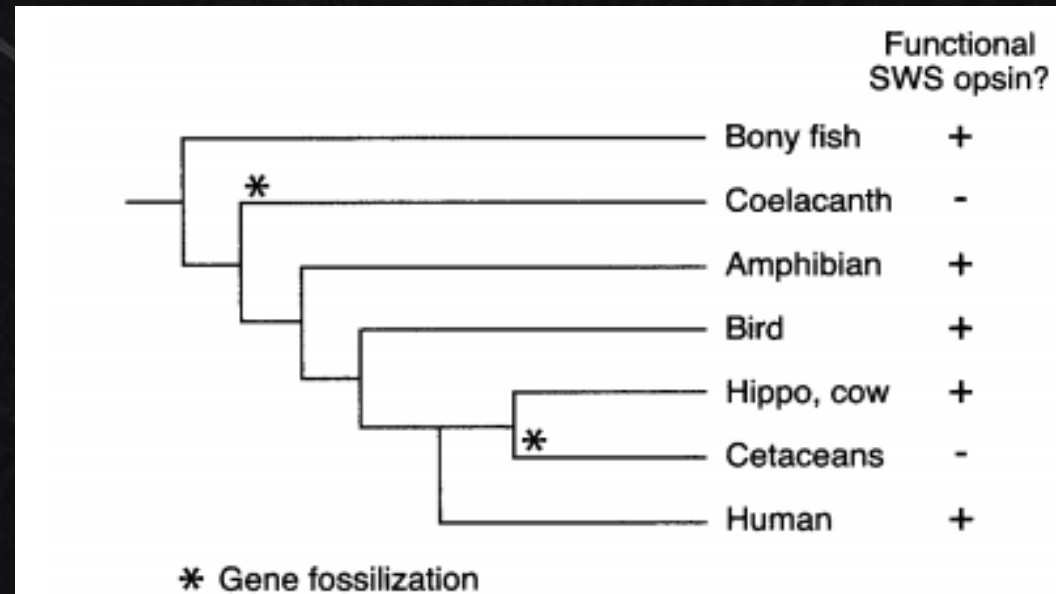
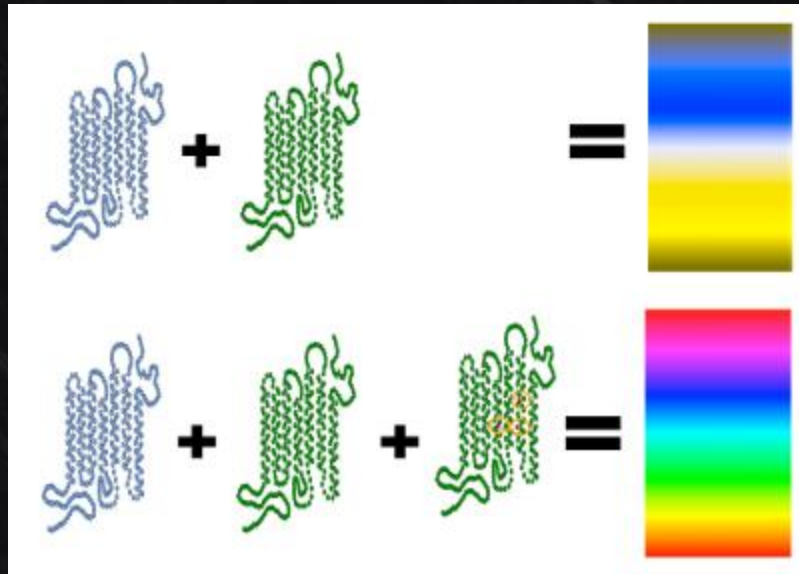


FIG. 5.2. The same opsin gene has been fossilized twice. The distribution of different mutations found in the coelacanth and cetacean SWS opsins and the evolutionary relationship of these species indicates that the SWS opsin was fossilized at least twice (asterisk). *Figure by Jamie Carroll.*

OWL MONKEY



RESOURCES AND MORE

https://en.wikipedia.org/wiki/Stephen_Jay_Gould

http://www.stephenjaygould.org/books/Panda%27s_Thumb/

<http://s-f->

walker.org.uk/pubsebooks/pdfs/Gould_Sтивен_Jay_The_Panda's_Thumb.pdf#page=15

https://evolution.berkeley.edu/evolibrary/article/analogy_06

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<https://tiktaalik.uchicago.edu/book-tools.html>

<http://www.pbs.org/your-inner-fish/>

<http://seanbcarroll.com/>

<http://www.evo-ed.org/Pages/primates/genetics.html>