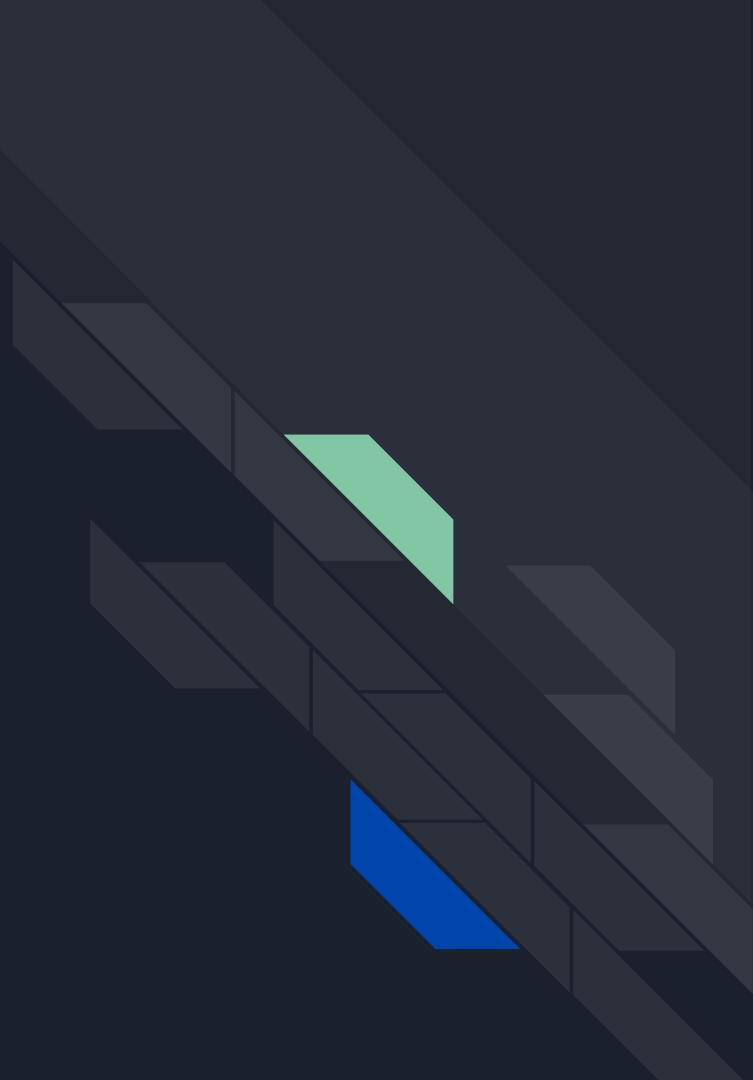




Scientific and Economic Applications of Tunicates

Jonathan Zhu

1. Research



Growing Back Lost Body Parts

- Not uncommon in animals
- Example: Note lizard breaking its tail
- What if humans could do this?
 - Organ donation
 - Prosthetic limbs
 - Hearing aids
 - Glasses
- How would we get there?



From petmd.com

The Axolotl

- *Ambystoma mexicanum*
- Exclusively native to Lake Xochimilco, Mexico
- Capable of regenerating entire body structures



From lithub.com

Problems with the Axolotl

1. Critically Endangered, almost all inbred
2. Long maturing time
3. Costly
4. Require extensive care and large aquaria

The hunt is on to find an other chordate model organism to study regeneration!

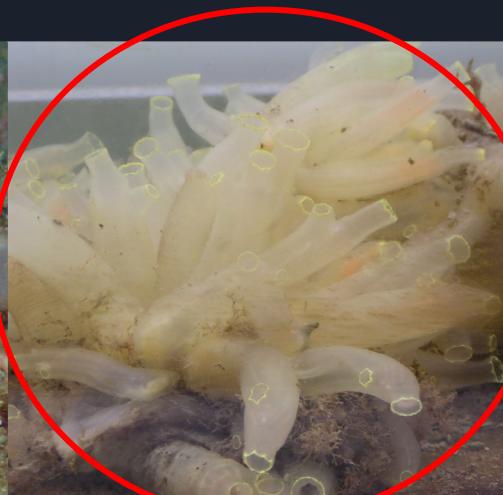


From dreamstime.com

Our Solution?



Rhopalea crassa



Ciona intestinalis



Clavelina moluccensis

All images from wikipedia.com

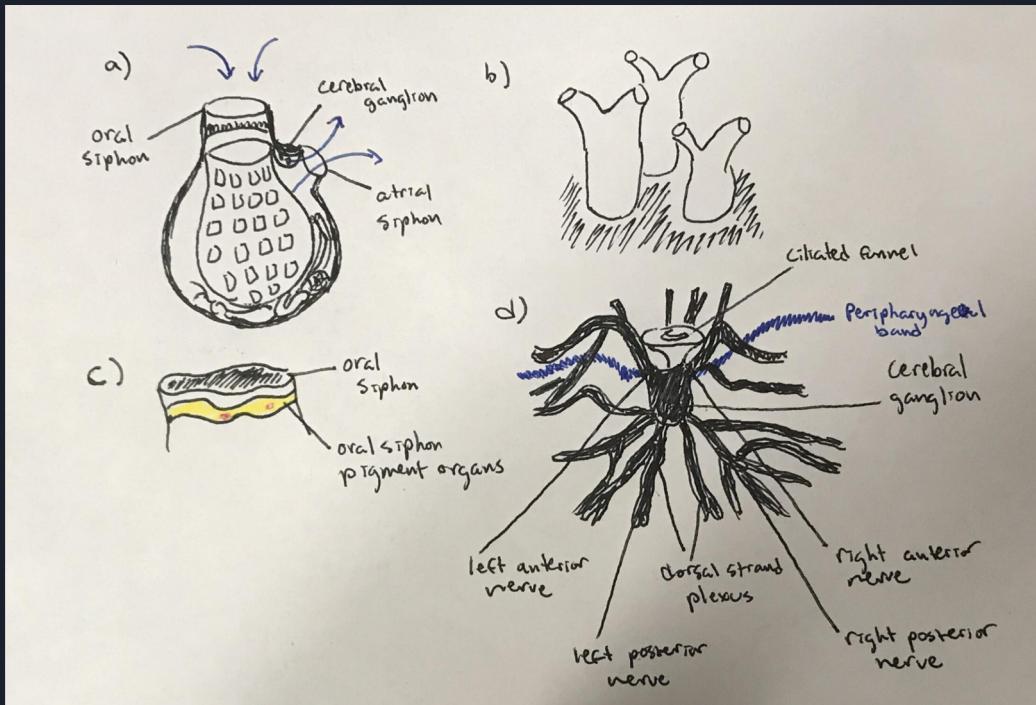
Advantages of the Tunicate Model Organism

1. Plentiful in the wild and are even invasive, eliminating the need for inbred organisms
2. Short development time
3. Can easily be cultured in a laboratory en masse with little volume per organism
4. Are taxonomically close to humans, unlike other widely used invertebrate models



From britannica.com

Areas of Interest



Areas of Interest





The Papers

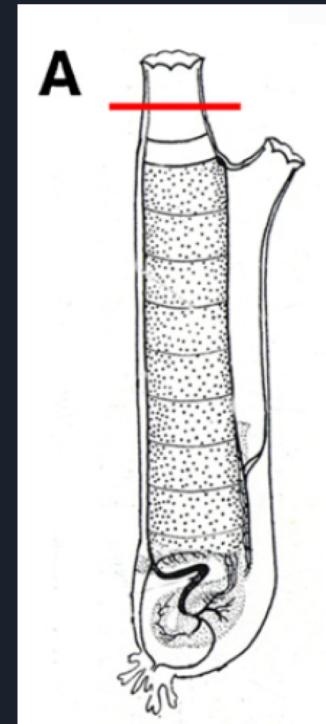
Regeneration of oral siphon pigment
organs in the ascidian *Ciona intestinalis*.
Hélène Auger, Yasunori Sasakura, Jean-
Stéphane Joly, William R. Jeffery. (2009)

Siphon regeneration capacity is
compromised during aging in the
ascidian *Ciona intestinalis*. William R.
Jeffery. (2012)

Methodology

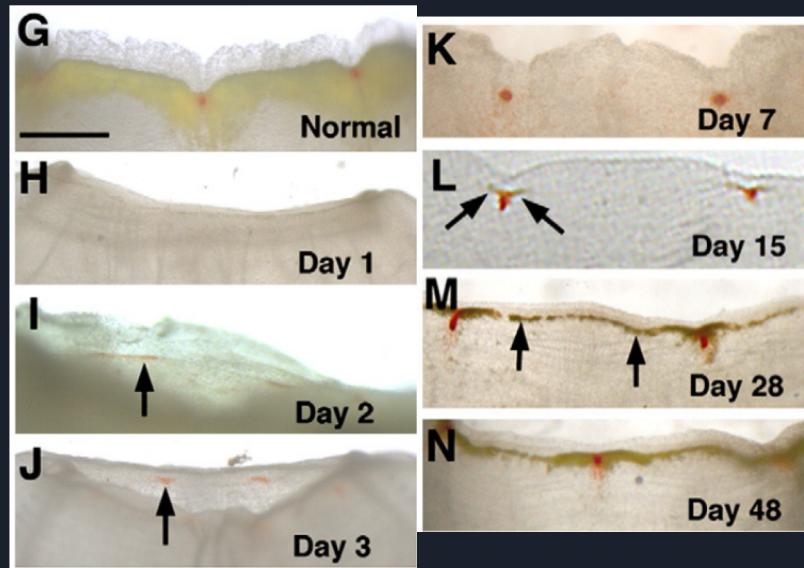
- Anesthetization
- Severing
- Looking for regrowth, comparing it with tunicate length

Why was this done?



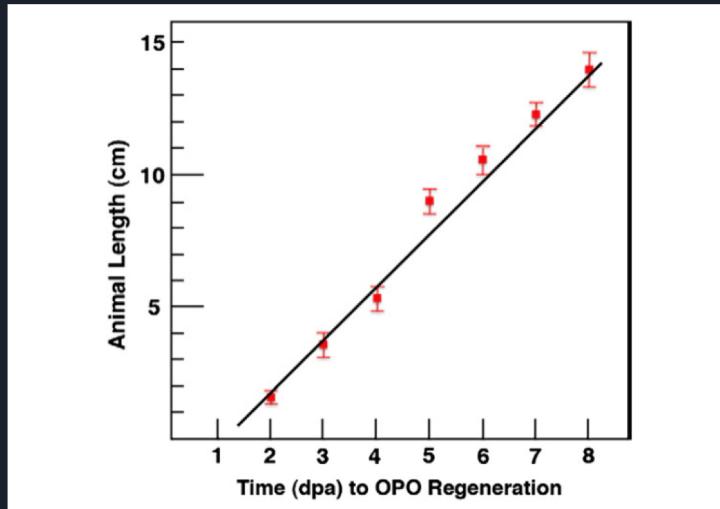
From Fig. 2 in Jeffery (2012)

Results



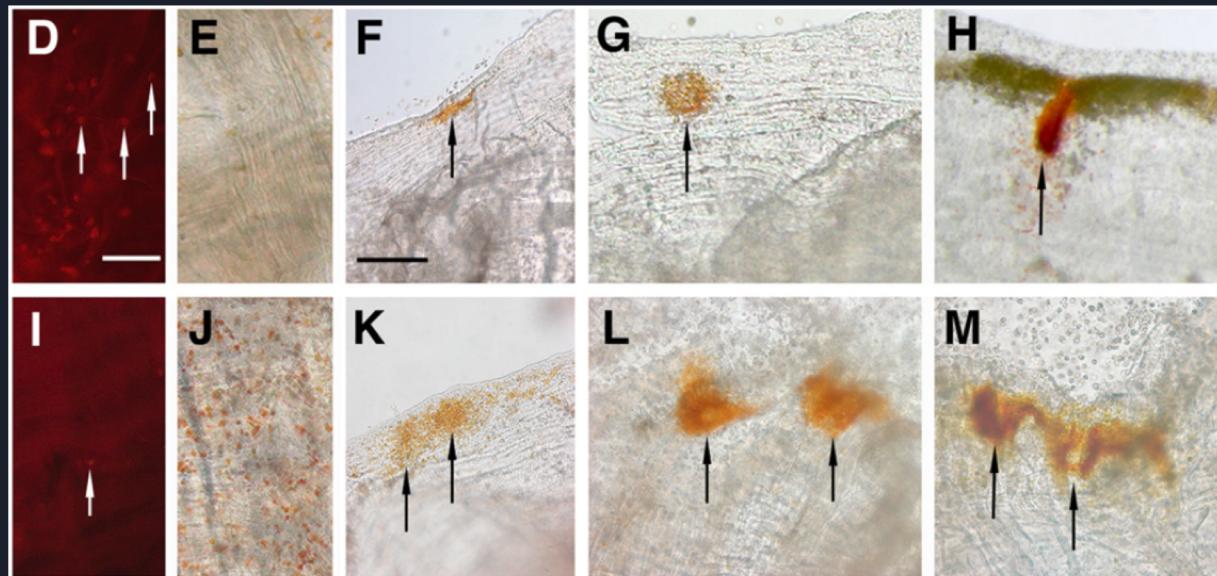
From Figure 2 in Auger et al. (2010)

Results



From Figure 4 in Auger et al. (2010)

Results



From Figure 2 in Jeffery (2012).



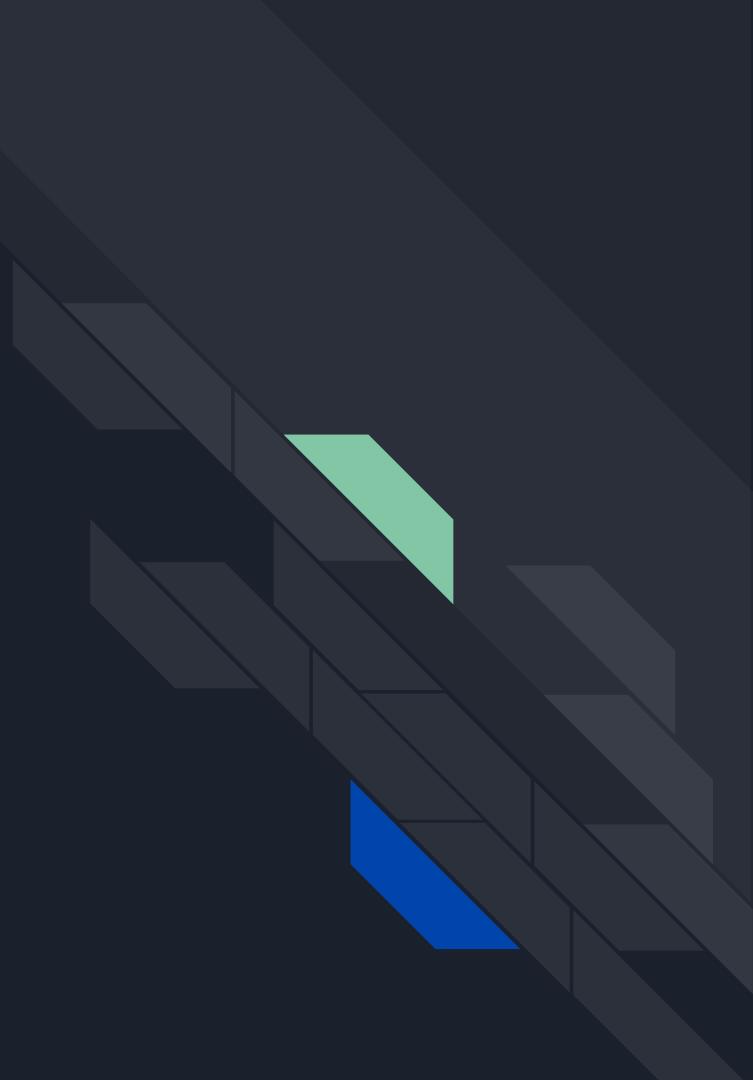
Implications on Humans

So can we regenerate a kidney? We're not quite there yet.

But, it gives us insight into elderly struggles.

- As people age, their voices become less engaging and more slow (Rojas et al., 2020)
- Due to language processing slowing and voice muscles weakening
- Leads to difficulty in the workplace

2. Consumption

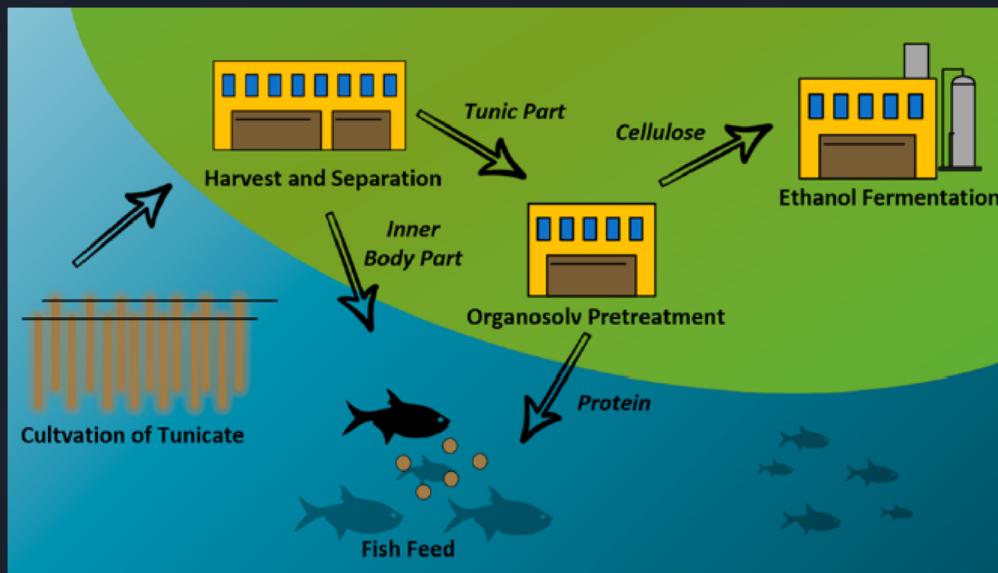


Food



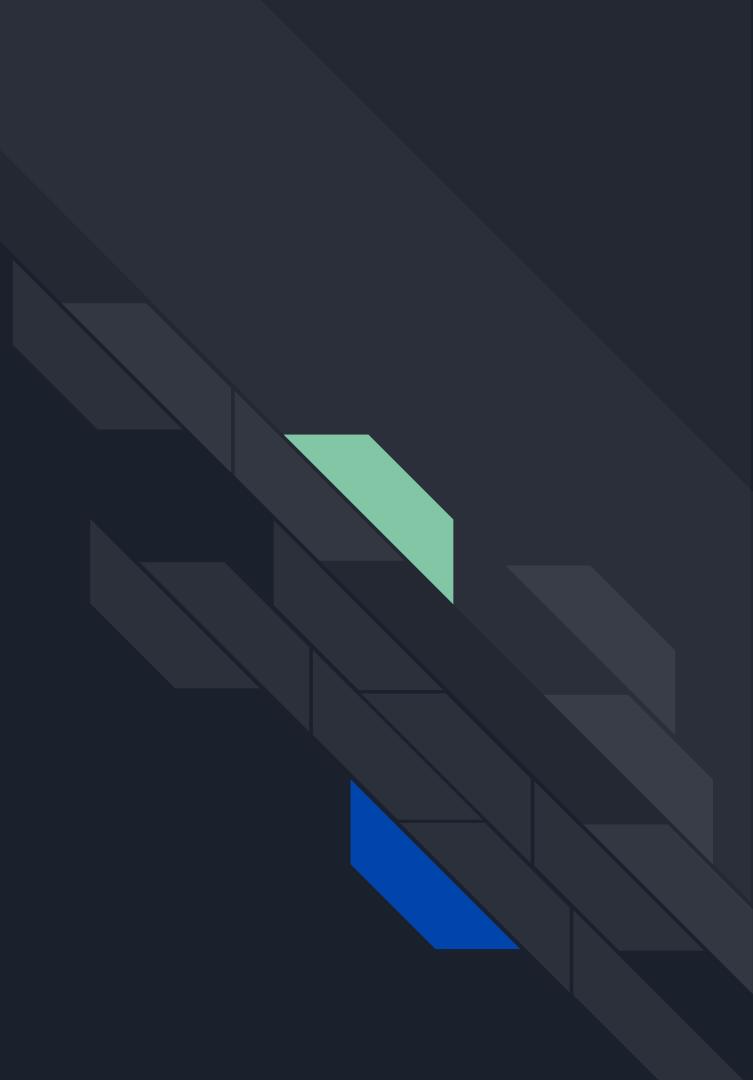
Halocynthia roretzi, or sea pineapple
Image from wikipedia.com

Source of Biofuel

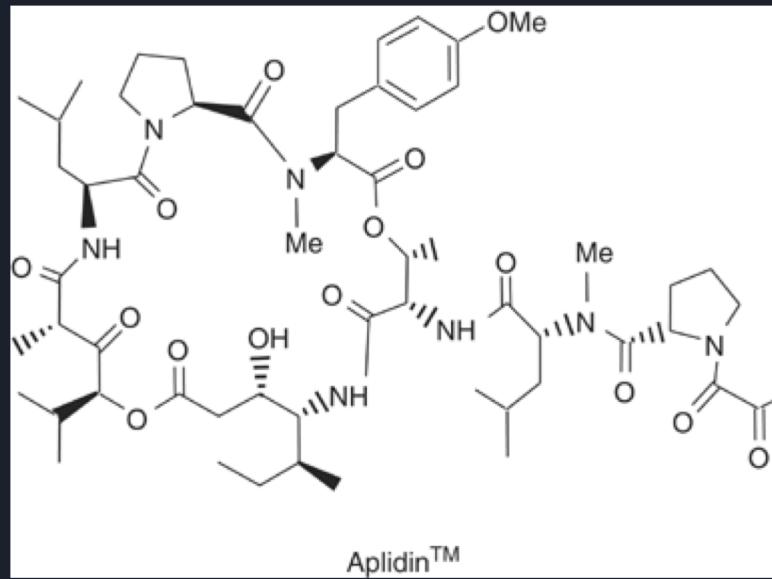


From abstract in Hružová et al. (2020)

3. Drugs



A COVID-19 Treatment



From wikipedia.com



References

- Auger, H., Sasakura, Y., Joly, J.-S., & Jeffery, W. R. (2010). Regeneration of oral siphon pigment organs in the ascidian *Ciona intestinalis*. *Developmental Biology*, 339, 374-389. doi:10.1016/j.ydbio.2009.12.040
- Bollner, T., Howalt, S., Thorndyke, M.C., & Beesley, P.W. (1995). Regeneration and post-metamorphic development of the central nervous system in the protostome *Ciona intestinalis*: a study with monoclonal antibodies. *Cell and Tissue Research*, 279, 421-432. doi:10.1007/BF00318500
- Hružová, K., Matsakas, L., Karnaouri, A., Norén, F., Rova, U., & Christakopoulos, P. (2020). Second-Generation Biofuel Production from the Marine Filter Feeder *Ciona intestinalis*. *ACS Sustainable Chemistry & Engineering*, 8, 8373-8380. doi:10.1021/acssuschemeng.0c02417
- Jeffery, W. R. (2012). Siphon regeneration capacity is compromised during aging in the ascidian *Ciona intestinalis*. *Mechanisms of Aging and Development*, 133, 629-636. doi:10.1016/j.mad.2012.08.030.
- Jeffery, W. R. (2015). The tunicate *Ciona*: a model system for understanding the relationship between regeneration and aging. *Invertebrate Reproduction and Development*, 59, 17-22. doi:10.1080/07924259.2014.925515
- Joly, J.-S., Kano, S., Matsuoka, T., Auger, H., Hirayama, K., Satoh, N., Awazu, S., Legendre, L., & Sasakura, Y. (2007). Culture of *Ciona intestinalis* in Closed Systems. *Developmental Dynamics*, 236, 1832-1840. doi:10.1002/dvdy.21124
- Rojas, S., Kefalianos, E., & Vogel, A. (2020). How Does Our Voice Change as We Age? A Systematic Review and Meta-Analysis of Acoustic and Perceptual Voice Data From Healthy Adults Over 50 Years of Age. *Journal of Speech, Language, and Hearing Research*, 63, 533-551. doi:10.1044/2019_JSLHR-19-00099
- Tagliafata-Scafati, O. (2021). New Hopes for Drugs against COVID-19 Come from the Sea. *Marine Drugs*, 19. doi:10.3390/md19020104
- Tsonis, P. A. (2000). Regeneration in Vertebrates. *Developmental Biology*, 221, 273-284. doi:10.1006/dbio.2000.9667