

Regeneration

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**Every species is
capable of
regeneration...
but some
species can do
it better than
others**



Regeneration

“The process of **renewal, restoration, and tissue growth** that makes genomes, cells, organisms, and ecosystems resilient to natural fluctuations or events that cause disturbance or damage” -Wikipedia

We will only discuss limb and organ regeneration



Aves (Birds)

- Very limited regeneration
- Beak regeneration sometimes possible
- Some parts of limbs
- Liver regeneration, only mass is regained but not the shape
- Regenerate hair cells .. reverse hearing damage.
Maybe that's why birds are so loud?



Reptiles

- Well studied tail regeneration in lizards
- Used as defence mechanism
- Regenerate spinal cord, optic nerve, scales and parts of the brain



Osteichthyes (Bony fish and sharks)

- Zebrafish regeneration is well studied
- Some types of fish can regenerate fins, scales, retina, spinal cord, many internal organs such as pancreases, heart
- Liver regeneration, only mass is regained but not the shape
- Shark can regenerate teeth (average shark loses 30,000-40,000 teeth)



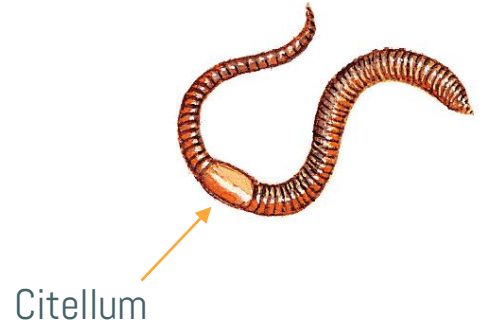
Arthropods (... basically insects)

- Regenerate appendages
- Restricted to molting
- Not so impressive?



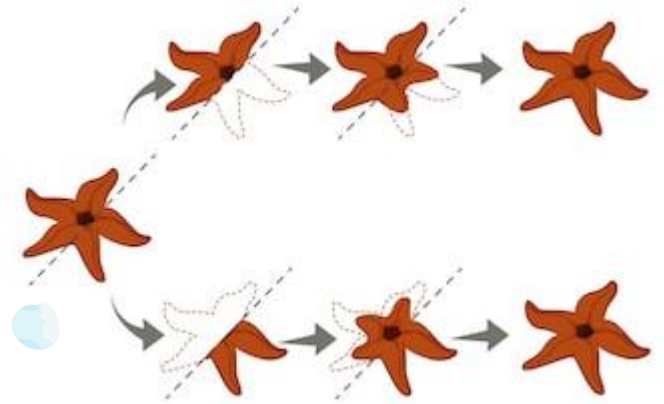
Annelids (... basically worms)

- Regenerate segments
- In earth worms the tail can't regenerate a head but the head can regenerate a tail
- For earth worms the "head cut" should include citellum



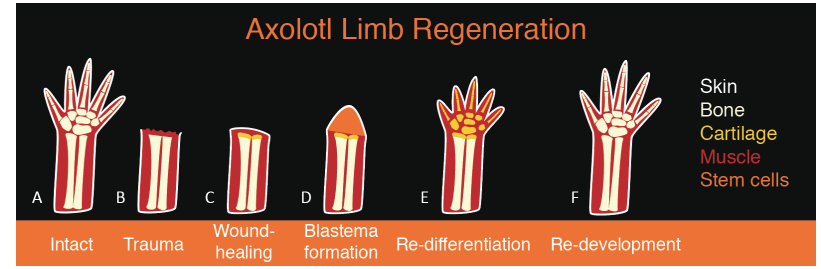
Echinoderms (... sea stars, sea cucumbers, sea urchins etc.)

- Regenerate appendages, internal organs, nervous system
- Some starfish species need mouth parts to regenerate
- But some species can regenerate from 1cm fragments



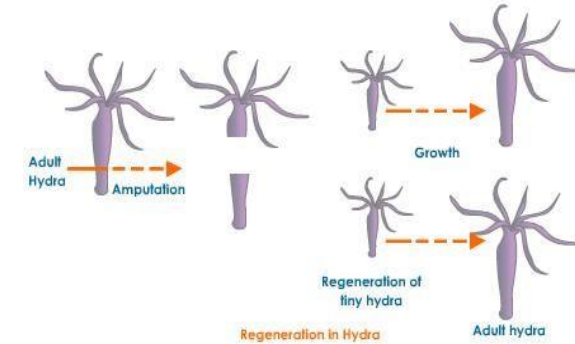
Amphibians

- Many amphibians have the ability to regenerate
- Extensive research on limb regeneration in axolotl
- Axolotl is a model genetic organism
- Axolotl can regenerate limbs, tail, jaws, spinal cord with no scarring
- 1000x more resistant to cancer
- <https://youtu.be/Eo50cto0TWs?t=117>



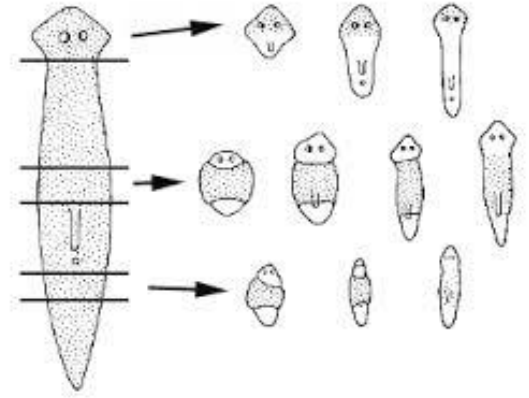
Cnidaria (... jellyfish and cousins)

- Many jellyfish have the ability to regenerate
- Regeneration in Hydra is studied extensively
- Hydra can regenerate their entire body from a few hundred cells
- Morphallaxis: the piece that was cut will form a smaller hydra, there is no cellular proliferation (growth) only cell rearrangement
- Only require 3-4 days for cell rearrangement
- Basically immortal?

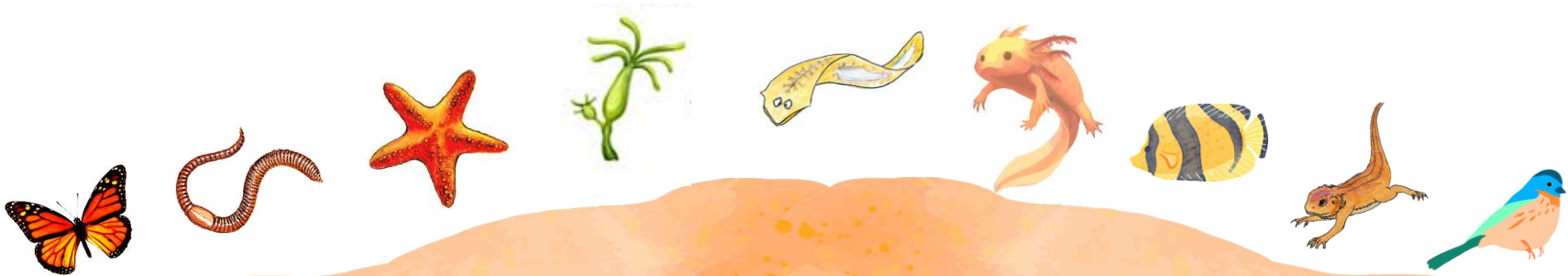


Tricladida (Planarians)

- Planarians is another model genetic organism
- 1/279th of a planarian can become a new planarian (10,000 cells)
- Only requires 1-2 weeks to form a complete organism
- What happens if we starve a planarian?
- “Immortal under the edge of the knife”
- Memory retrieval after regeneration of head

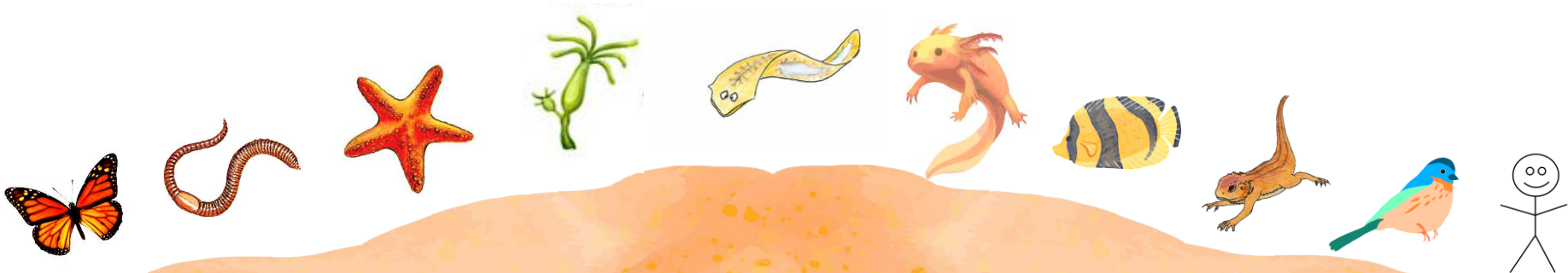


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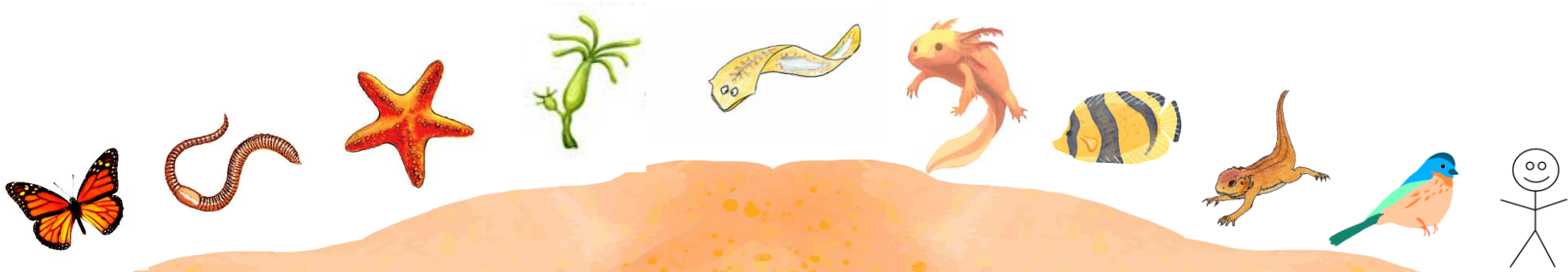
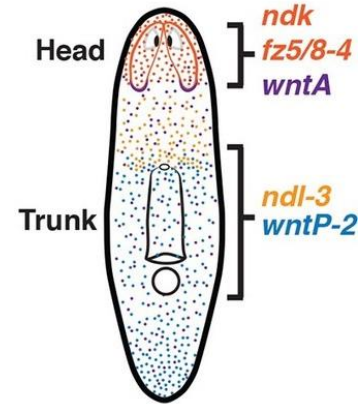
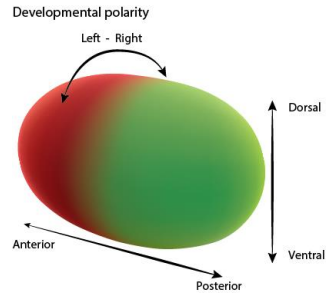
Mammals

- Humans can regenerate fingertips (depending on where it is cut)
- Rib regeneration
- Liver regeneration, only mass is regained but not the shape



How do the cells know what they need to do?

- Wnt signaling pathway determines body axis (Ant-Post)



**Thank you!
Questions?**

