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## Measuring is believing: quantifying adaptation behaviour of *Hydra*

# Info sheet: *Hydra*

When you go to a pond, lake, or creek, you rarely think of the alien species that lie within its waters. However, lift up a rock and look underneath. There, you will likely find a *Hydra:* a few mm long, brainless and spineless critter with incredible powers to regenerate (figure 1a).[1] Because *Hydra* have no backbone, they belong to the invertebrates. We humans and other animals, such as dogs, fish, and birds have a backbone, and thus belong to the vertebrates.

*Hydra* looks a bit like a cactus, but it is an animal. *Hydra* is a hollow cylinder with a sticky foot at one end and a head that consists of a pointed tip (the hypostome), surrounded by a ring of tentacles at the other end (figure 1b).[2] *Hydra* 's body is composed of two cell layers or tissues, called the ectoderm and endoderm. The names come from Greek, with "*ecto*" meaning "outside", "*endo*" meaning "inside", and "*derm*" meaning "skin".[3]

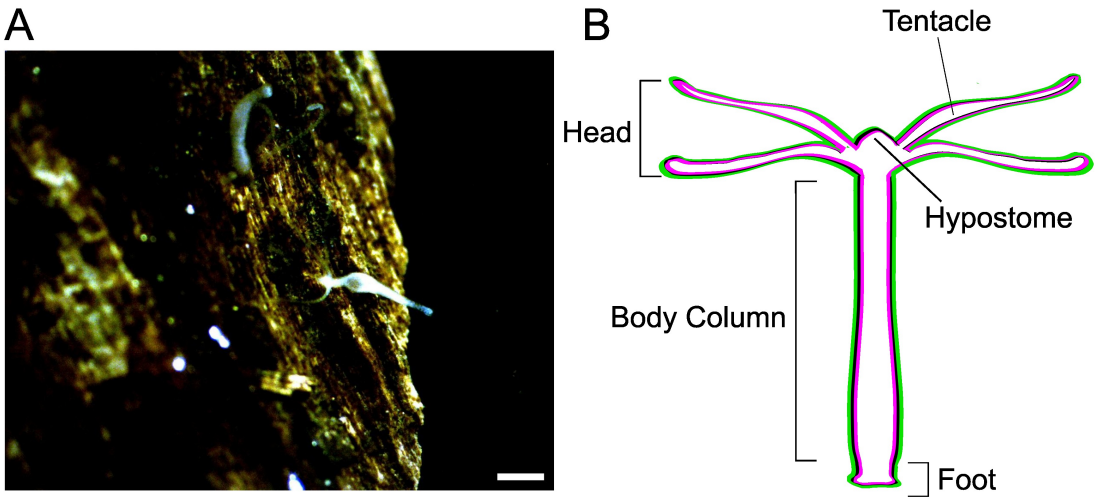


Figure 1: a) *Hydra* in the natural environment. Scale bar: 1 mm. b) The anatomy of a *Hydra:* the endoderm (inner layer) is shown in pink and the ectoderm (outer layer) is shown in green.

*Image courtesy of the authors*

*Hydra* uses its head for eating: the tentacles sense its environment using nerve cells and catch living organisms with specialized stingy cells (called nematocytes) that immobilise their prey. The tentacles then push the food into the mouth that opens in the hypostome.[4] The suction foot attaches to a substrate. *Hydra* can move from one location to another by going head-over-foot using somersaults (figure 2).[2] When you observe a *Hydra* for a few minutes, you will see that it changes shape: it may bend, contract, stretch out (elongate), or wave its head (figure 2a). Just like our nervous system controls how we feel and respond to our environment, a network of nerve cells – the "nerve net"– controls *Hydra*'s behaviours (figure 2b).

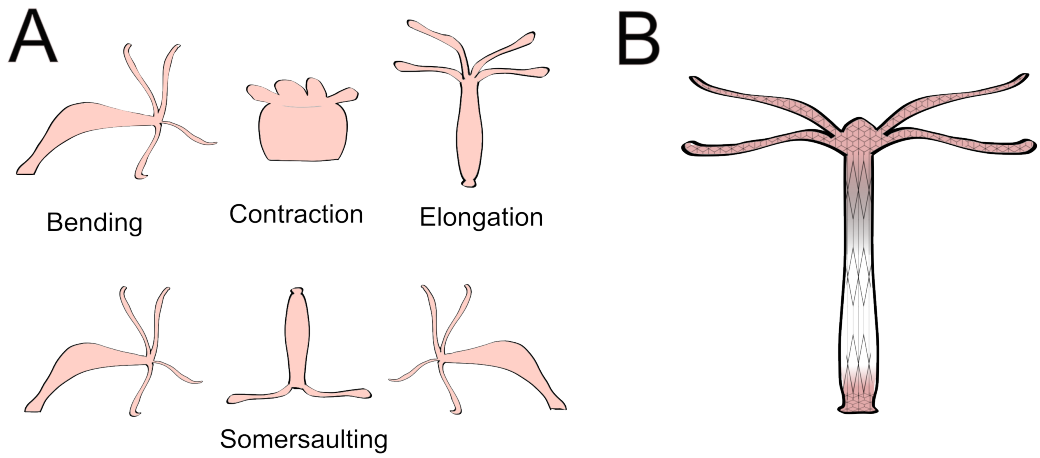


Figure 2: a) Characteristic behaviours of *Hydra*. b) Schematic of the nerve net with which *Hydra* senses its environment. Coloured areas indicate regions of higher sensitivity.

*Image courtesy of the authors*

When disturbed, *Hydra* will react to the disturbance. For example, *Hydra* can contract in response to sudden changes in water movement, possibly as a mechanism to protect itself from predators[5] or to prevent detachment from the substrate. If the water movement continues for an extended time, the *Hydra* will elongate again,[6] because contraction costs energy and contracted tentacles cannot catch food easily. This change in behaviour reflects the *Hydra's* adaptability to changes in its environment.

## References

[1] A short video on the biology of *Hydra*: https://www.youtube.com/watch?v=ITVfXHrfudw

[2] A brief description on *Hydra's* name, habitat, food and life cycle: https://mdc.mo.gov/discover-nature/field-guide/hydras

[3] Terms in Embryology: https://embryology.med.unsw.edu.au/embryology/index.php?title=Foundations_Practical_-_Week_3_and_4

[4] A video on *Hydra's* mouth: https://www.youtube.com/watch?v=uaSJdcXlp-o

[5] Swain TD et al. (2015) Evolution of anthozoan polyp retraction mechanisms: convergent functional morphology and evolutionary allometry of the marginal musculature in order Zoanthidea (Cnidaria: Anthozoa: Hexacorallia). *BMC Evol. Biol.* **15**: 123. doi: 10.1186/s12862-015-0406-1

[6] Wagner G (1905) On some movements and reactions of hydra. *J. Cell Sci.* **48**: 585–622. doi: 10.1242/jcs.s2-48.192.585