

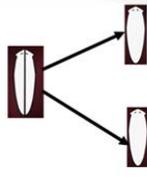
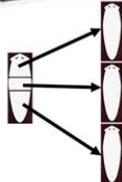
# Body pattern and regeneration of Hydra

Fejlődés- és molekuláris genetika 2021

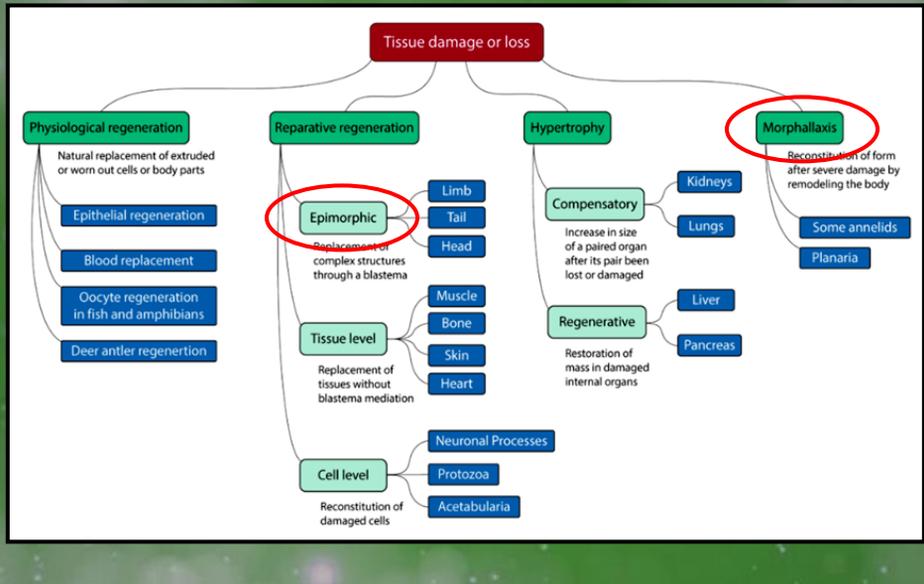
## Planarian regeneration: the Pioner



“The regenerative process is one of the fundamental attributes of living things...”  
Thomas Hunt Morgan (1901), from his book *Regeneration*.



## Types of regeneration



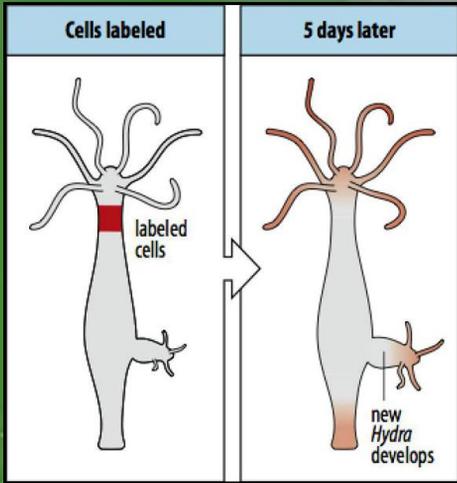
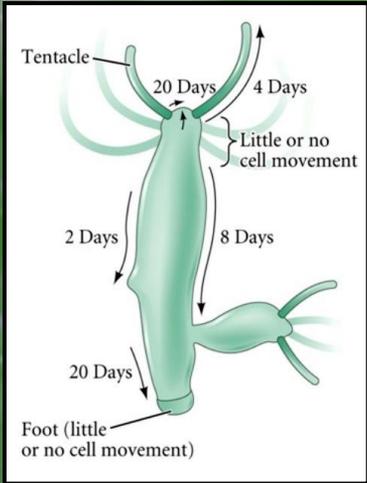
## Types of regeneration

**Epimorphosis** is defined as the regeneration of a specific part of an organism in a way that involves extensive cell proliferation of somatic stem cells, dedifferentiation, and reformation, as well as blastema formation. (limb regeneration)

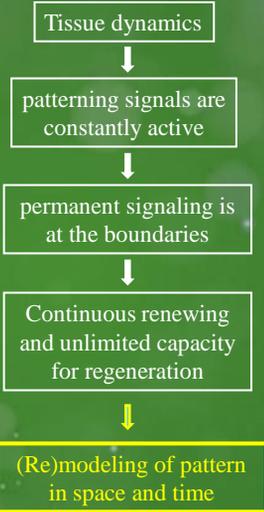
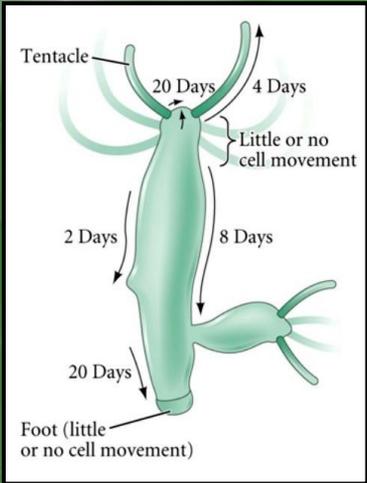
**Morphallaxis** is the regeneration of specific tissue in a variety of organisms due to loss or death of the existing tissue. Not a blastema is formed after wound healing. (Hydra regeneration)

Planaria regeneration: partly epimorphosis, partly morphallaxis. Sometimes it is called epimorphallaxis.

# Hydra's body is a dynamic structure

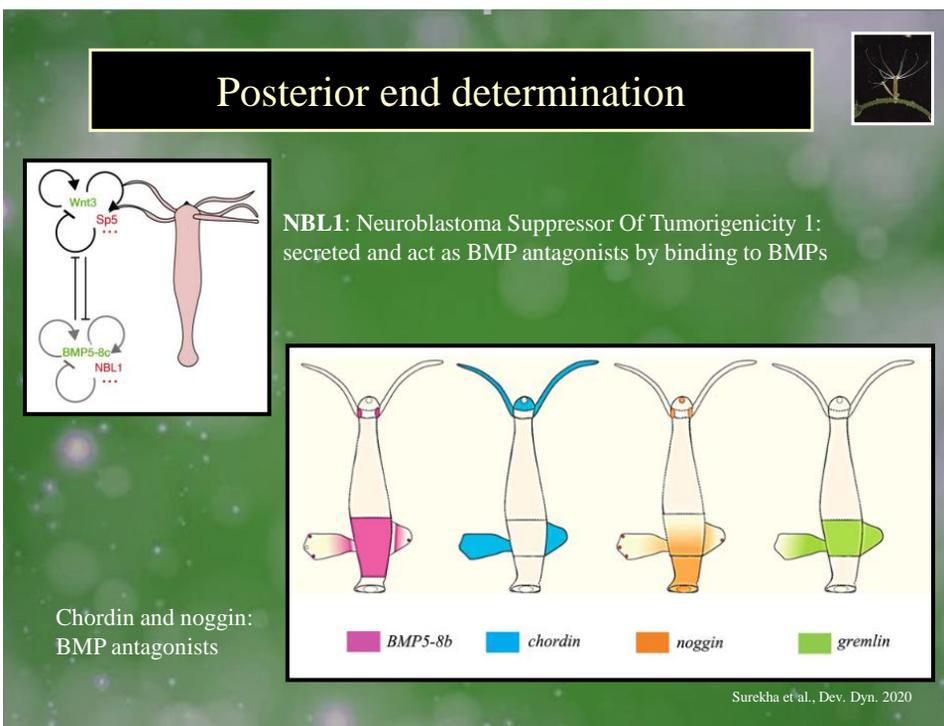
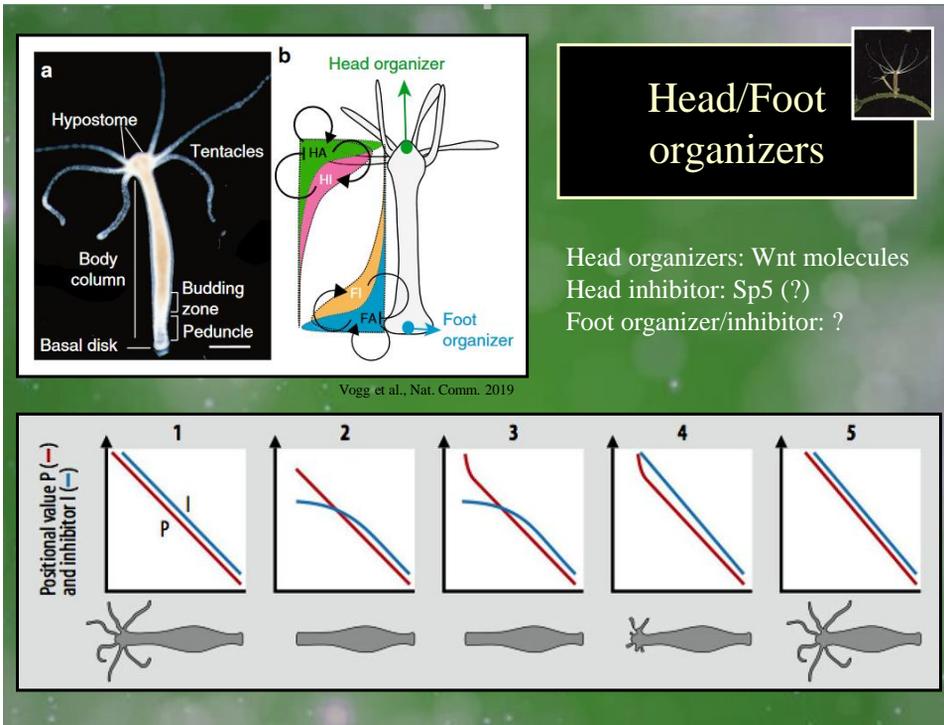


# Hydra's body is a dynamic structure



Expression pattern of Wnt gene(s)

Lengfeld et al., Dev. Biol., 2009



## Regeneration of the Hydra

**A piece of region 1 fails to induce a secondary axis when grafted into an intact Hydra**

**When the host's head is removed, grafting a region 1 induces a secondary axis**

**A piece of region 1 successfully induces a secondary axis when grafted further away from the head of an intact host**

**Hydra**

## Head activator: Wnt molecules

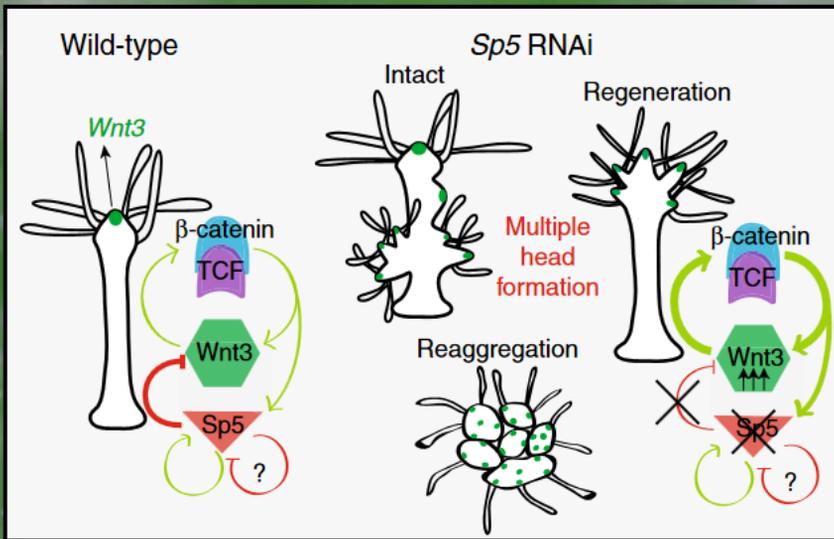
Nakamura, PNAS, 2011

**TCF: T-cell factor**  
**APC: Adenomatous polyposis coli**

### Partners competing for the binding site on the ARM domain

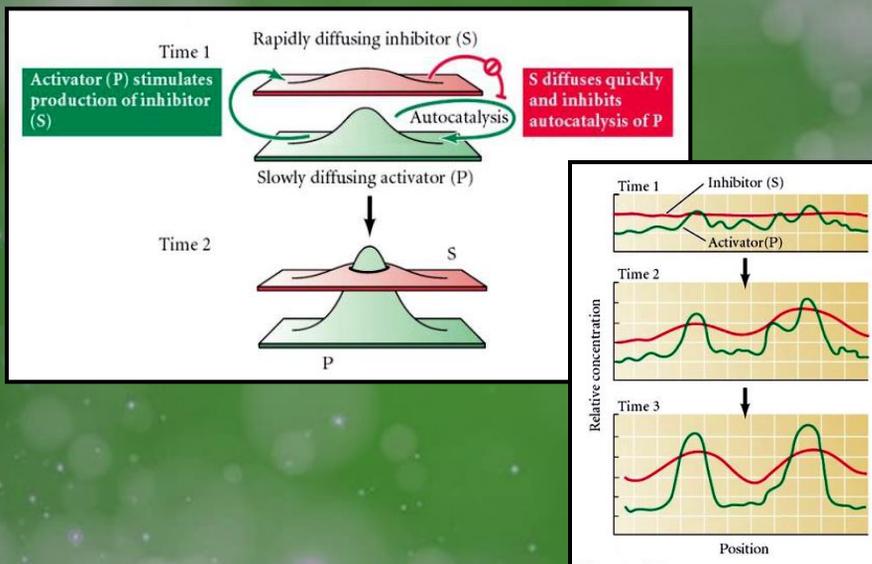
- E-cadherin (cell adhesion)**: β-catenin binding motif, Cadherin repeats, Transmembrane segment.
- Axin (scaffold/degradation)**: GSK3 kinase binding motif, RGS domain (binds APC), β-catenin binding motif, DIX domain.
- APC (scaffold/degradation)**: Colloid, β-catenin binding motifs, ARM domain, Axin binding motifs.
- TCF/LEF (transcription)**: Transactivator motifs, HMG-box domain, β-catenin binding motif, DNA binding.

# Head inhibitor Sp5

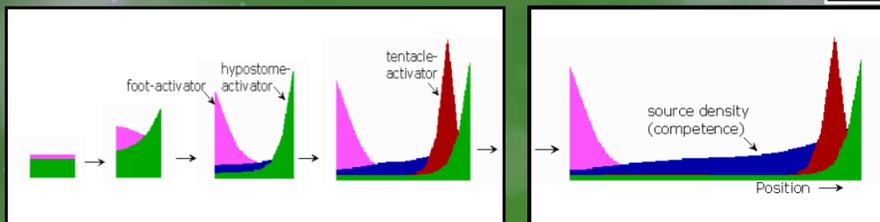


Vogg et al. Nat. Comm. 2019

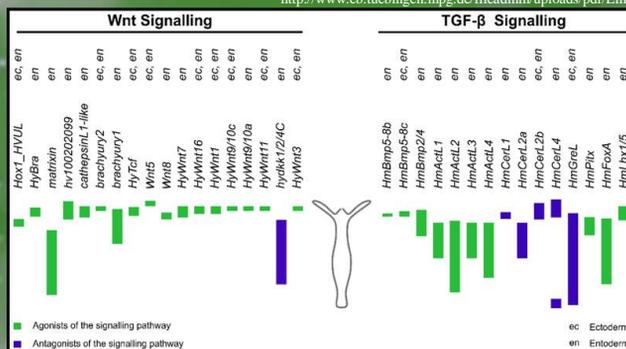
# Crosstalk between the head activator and inhibitor



# The model and the reality



[http://www.eb.tuebingen.mpg.de/fileadmin/uploads/pdf/Emeriti/Hans\\_Meinhardt/](http://www.eb.tuebingen.mpg.de/fileadmin/uploads/pdf/Emeriti/Hans_Meinhardt/)



Reddy et al., Res. Probl. Cell Differ. 2020

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