ÉCOLE NORMALE SUPÉRIEURE DE LYON

Offre de stage de Master 2 / Master 2 Internship offer

Date of the offer: May 2024

Internship supervisor and Host laboratory:

Lab : Newly-formed team 'Developmental and Evolutionary Histories of Vertebrates' that will start at the IGFL (CNRS UMR5242, ENS Lyon) in September 2024

Supervisor for the internship:
Dr. Eglantine Heude, Team Leader, permanent CNRS researcher (CR CNRS)
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Address of the internship:
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Team Website :
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https://igfl.ens-lyon.fr/news/arrival-of-eglantine-heude-at-igfl?set_language=en&cl=en

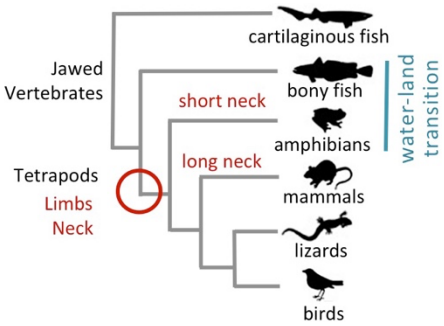
Languages spoken in the lab: French / English

Research project title:

Characterization of molecular actors of tetrapod neck formation

Keywords : evo-devo, vertebrates, organogenesis, neck, mesoderm, neural crest, molecular biology, transcriptomics, *in situ* hybridization, fluorescent imaging

Description du projet / Project description:



The neck, specific to tetrapods, emerged congruent with limbs during the vertebrate water-to-land transition. This morphological innovation resulted from the adaptation of the musculoskeletal system and required profound developmental rearrangements.

In vertebrates, the musculoskeletal systems of the head and trunk have different embryonic origins and their formation depends on distinct molecular mechanisms. The neck region constitutes a transition zone of mixed embryonic origin at the head-trunk interface and the molecular actors regulating its formation remain elusive.

The project will aim to characterize the genetic determinants of neck morphogenesis by comparative analysis of key vertebrate organisms. We are currently investigating the developmental processes involved in neck formation by functional analysis and transcriptome profiling in the mouse embryo.

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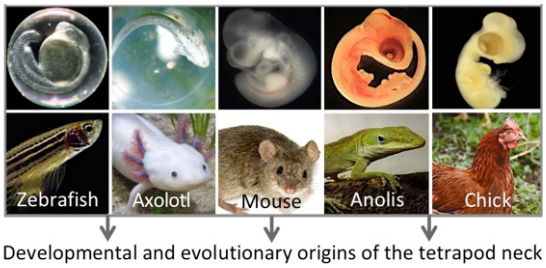
Our study seeks to identify molecular actors specifically implicated in the establishment of the mammalian neck. The present project will analyze and compare the spatiotemporal expression of genes of interest in key representatives of major jawed vertebrate taxa: the zebrafish (bony fish), the axolotl (amphibian), the mouse (mammal), the anolis lizard (reptile) and the chick (bird).



The student will generate and collect embryos of target species at different stages to complete our already established developmental time series. The comparative expression analysis of selected homologous genes will be mainly performed by *in situ* hybridization (ISH) on sections or in toto on cleared embryos to access both cellular and spatial resolution. The student will use cDNA libraries from total RNA embryonic extracts to produce ISH probes routinely by Polymerase Chain Reaction (PCR). We will take advantage of the recent accessibility to genome/transcriptome sequences of the axolotl and anolis unconventional models. Our different model organisms present very distinct sizes and tissue characteristics. Whole-mount labelling procedures will thus necessitate optimization depending the stages and the species analyzed. Some developmental-stage series for mouse, zebrafish, axolotl and anolis species are already treated for long-term storage to start experimental optimization of whole-mount labellings. Analysis will also be completed by qPCR after microdissection or by immunofluorescent stainings and high resolution confocal or light-sheet microscopy. The student will also be involved in the optimization of high-throughput (single cell/spatial) transcriptomic approaches that are currently being developed at the IGFL.

The study will aim to determine conservation and divergence in genetic programs taking place at the head-trunk interface in our strategic model organisms to elucidate the developmental determinants and evolutionary origins of the tetrapod neck. Our data will also bring new insights for the understanding of some human congenital disorders in which the neck musculoskeletal system is specifically affected.

Candidates must have a strong background in molecular and cellular biology, and interest for developmental and evolutionary biology. The internship would ideally start in January 2025 (negotiable).

Lab publications or recommended review on the subject:

1. Comai G*, **Heude E*** *et al.* (2019) A distinct cardiopharyngeal mesoderm genetic hierarchy establishes antero-posterior patterning of esophagus striated muscle. *eLife.* Sep 19;8. pii: e47460. (*co-first authors)

2. **Heude E** *et al.* (2018) Unique morphogenetic signatures define mammalian neck muscles and associated connective tissues. *eLife.* Nov 19;7. pii: e40179.

3. **Ericsson R** *et al.* (2013) Evolution and development of the vertebrate neck. *J. Anat.* Jan; 222(1): 67–78.

4. **Heude E**, *et al.* (2010) Jaw muscularization requires *Dlx* expression by cranial neural crest cells. *Proc. Natl. Acad. Sci. (U.S.A.)* June 22;107(25):11441-6.

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