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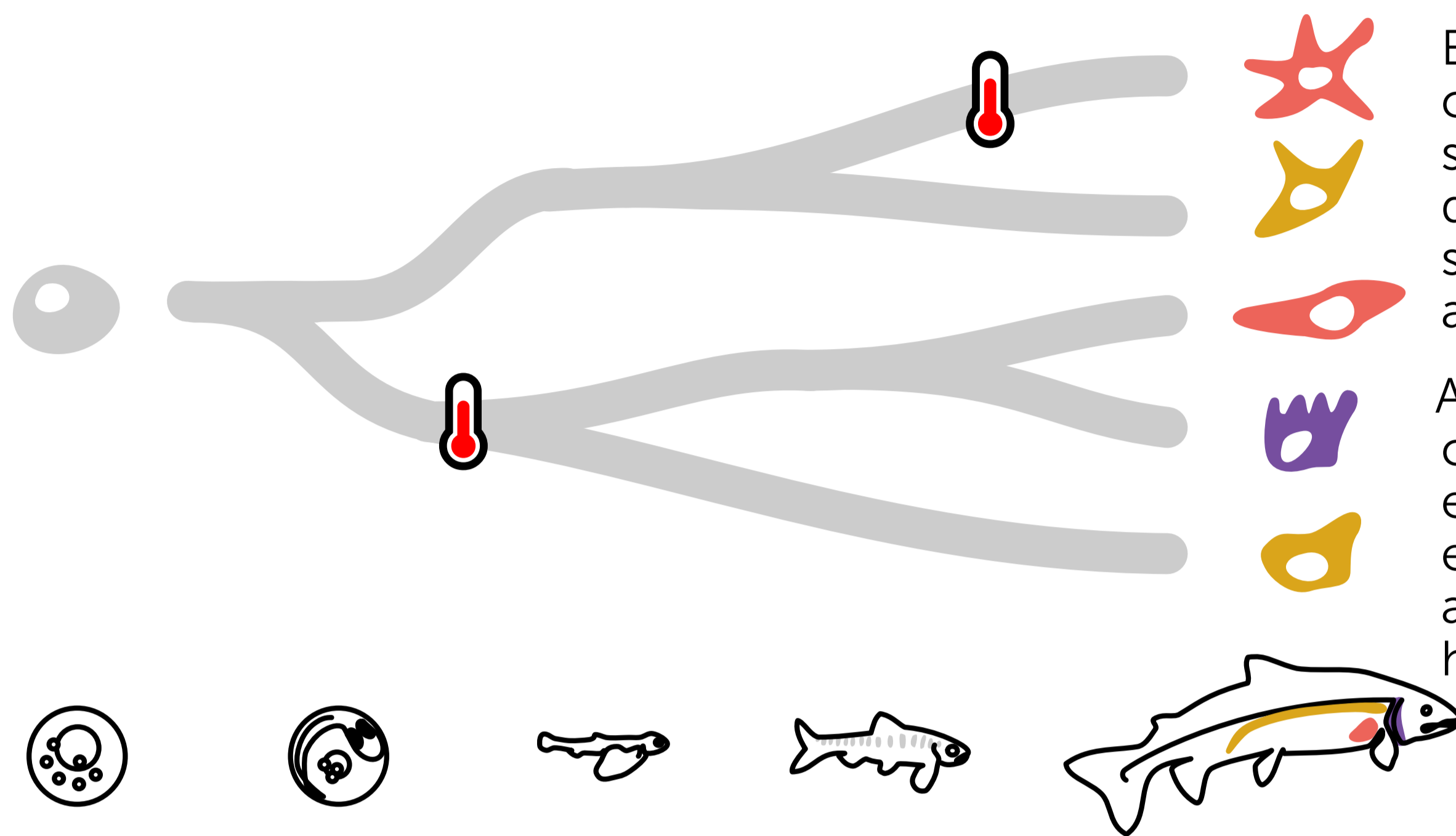
Towards a single-cell atlas of Atlantic salmon organogenesis

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Each animal consists of billions of cells, which are of hundreds of highly specialized types. These all emerge during early development from a single zygote through cell division and differentiation.

At different time points, different cellular lineages are vulnerable to environmental perturbations. For example, incubation of salmon eggs at elevated temperatures affects the health of specific organs (heart, immune system, etc.) in the adult fish.

SALMOCODE, the *Salmon Map of Organs and Cells for the Optimal Development of Embryos*, aims to tackle the problem of abnormal organ development by detecting its onset as early as possible.

We are creating a 'roadmap' of Atlantic salmon development based on single-cell transcriptomics. By combining snapshots at many time points between gastrulation to hatching, the emergence of all cellular lineages can be traced. Subsequently, we will use diagnostic single-cell transcriptomics to identify when, and in which cell types, early life conditions negatively affect organ development.
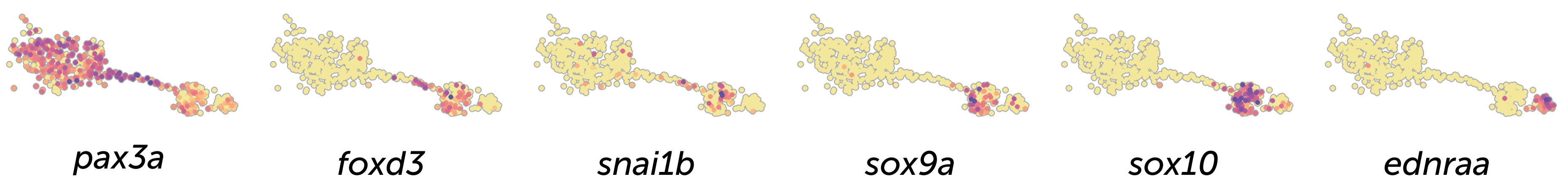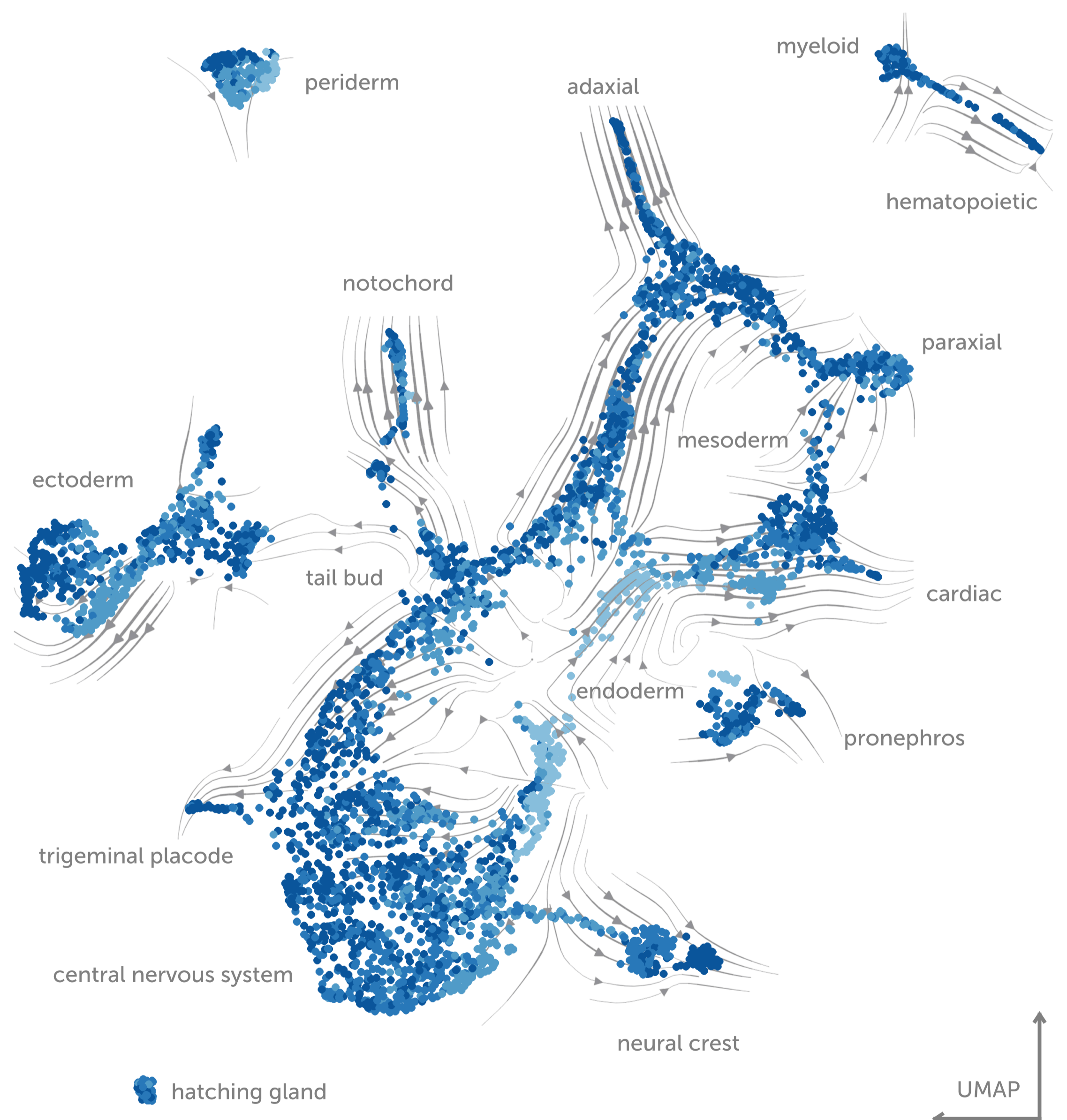
This preliminary map combines 4780 single-cell gene expression profiles from four embryonic stages ⟶

- At gastrulation (88 day-degrees) only limited differentiation is apparent.
- At 110 dd (100% epiboly) the germ layers (endo-, meso-, and ecto-derm) have been established.
- After 126 dd (20 somites) developmental trajectories leading to specialized cells and organs start to appear.
- At 148 dd (40 somites) functional organs have started to form.

The vector field indicates the direction of cellular differentiation trajectories.

The final atlas will contain >100000 cells for >30 stages.

The map also reveals the gene expression patterns that lead to cell fate commitment, for example for the neural crest lineage.

periderm
adaxial
myeloid
hematopoietic
notochord
paraxial
ectoderm
mesoderm
tail bud
cardiac
endoderm
pronephros
trigeminal placode
central nervous system
neural crest
hatching gland
UMAP

pax3a *foxd3* *snai1b* *sox9a* *sox10* *ednraa*