Zebrafish, Extracellular Vesicle Biology & Safe-by-Design RNA Origami

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What we do

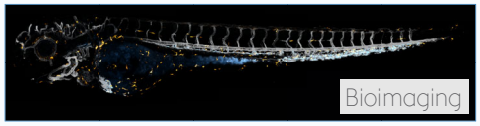
Seeing is believing. We use zebrafish as a model organism to "visualize" unsolved mysteries in biology – the role of extracellular vesicles (EVs) in health and disease.

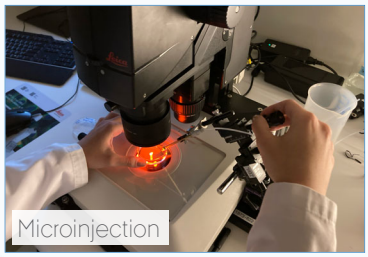
Our specific interest lies in the molecular mechanisms underlying how EVs facilitate cell-to-cell communication in tissue injury, inflammation and regeneration.

What messages are delivered to regulate the recipient cells? How can we translate the EV biology into novel therapeutics? With zebrafish as our little partners, we seek answers to these questions by nanoscience approaches, genetic engineering, bioinformatics and live imaging of transgenic embryos.

So, what is our goal? We aim to redefine today's knowledge about cell signalling and to advance the nanomedicine field by *learning*, *manipulating* and *mimicking* nature's smart biomolecular architecture, EVs.

Project Opportunities





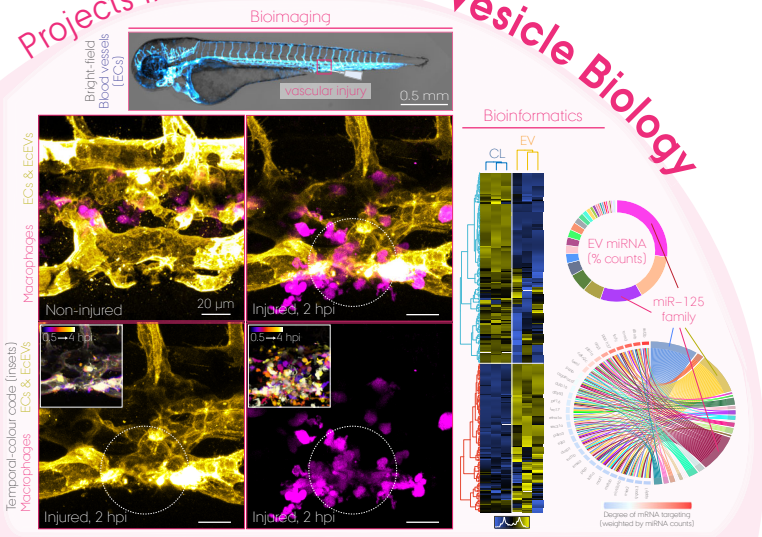
For your project, we offer training in modern molecular & cell biology techniques for experiments using zebrafish embryos or cell cultures.

For example:

- Zebrafish embryo handling and screening
- Mammalian cell culturing
- Microinjection of nucleic acids/proteins/nanoparticles
- Plasmid construction (design, PCR, and DNA assembly)
- Transformation, transfection and transgenesis
- Gene and miRNA expression profiling (qPCR)
- SDS-PAGE and Western blotting
- Bioimaging of zebrafish embryos and image analysis

...and also thesis writing skills!

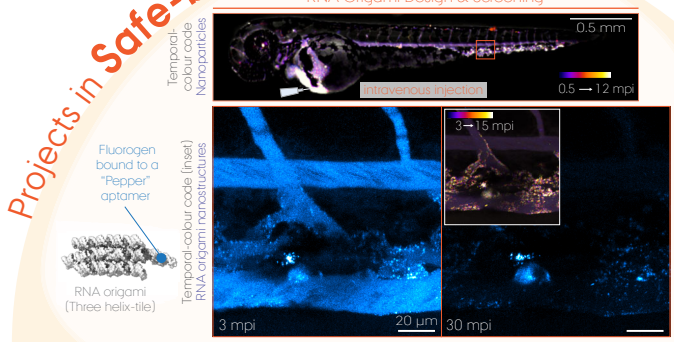
Projects in Extracellular Vesicle Biology



Extracellular vesicles (EVs) were once believed to be just waste released from cells. Today, we know they are indeed bags filled with secret messages. Using zebrafish as an *in vivo* model, we study EVs of various origins on their dynamic behaviour in a living organism and how they are trapped by cells. We have also developed a method to profile the biomolecular cargo of EVs "in transit" from donor cells.

Our aim is to capture snapshots of the conversation between cells and thus to identify novel therapeutic targets e.g. miRNA that can be delivered or silenced by RNA origami approaches (see the right bubble).

Projects in Safe-by-Design RNA Origami



RNA origami uses RNA as molecular building blocks that self-assemble into programmable 3D nanostructures. We focus on its biomedical application using zebrafish as a screening model to develop a multi-functional RNA origami without undesired antiviral responses. In particular, we look at key determinants of nucleic acid sensing and inflammation to unravel how life "sees" artificial RNA architectures. Our goal is thus to pave the road for a safe-by-design approach.

Main collaboration partners @ iNANO
Assist. Prof. Julián Valero Moreno
Assoc. Prof. Ebbe Sloth Andersen
Prof. Jørgen Kjems

Other projects in collaboration with Dept. of Biomedicine are also available!

Recent publications from the group

1. "Differential Nanoparticle Sequestration by Macrophages and Scavenger Endothelial Cells Visualized in Vivo in Real-Time and at Ultrastructural Resolution" in **ACS Nano** (2020) doi: 10.1021/acsnano.9b07233
2. "Tracing the In Vivo Fate of Nanoparticles with a Non-Self Biological Identity" in **ACS Nano** (2020) doi: 0.1021/acsnano.0c05178

Visit our group webpage (QR on the right) to find more about the student projects and techniques you can learn with us.
You can also watch fancy movies of cells capturing EVs from the bloodstream!