

A short-term (4 months) summer research position is available in the Zandstra Stem Cell Bioengineering laboratory, which is in the School of Biomedical Engineering located within the Biomedical Research Centre, and is affiliated with the Michael Smith Laboratories, at the University of British Columbia's Vancouver campus. The successful candidates will join our world-class research team to **compute a mathematical model of morphogen transport**. Our highly successful multidisciplinary program integrates researchers in stem cell biology, biological computation, microfabrication, developmental biology, and regenerative medicine, with the goal of developing in vitro and in silico representations of complex tissue and organ development. Our research program is based on understanding how individual cells form complex functional tissues and organs by studying multiscale interactions between cells, their internal regulatory networks, and the external microenvironment, and then mobilizing our findings to generate therapeutically relevant blood cells from stem cells.

Details on the project and position:

Title: Scaling and growth control in embryonic organoids

During development, morphogens can direct cellular patterning and growth by forming dynamic, long-range concentration profiles in tissues. How tissues *know* when to stop growing is still to be understood. Examples of growth control mechanisms have been proposed in some model systems, where morphogen concentration profiles scale with tissue size. Achieving scalable control of pattern formation in embryonic organoids can lead to the design of cellular domains with specific size for particular purposes, e.g. regeneration of tissues, expansion of stem cells and specific progenitor cells. Building up from ongoing research on pattern formation in embryonic organoids in the Zandstra Lab, in this project we will design mathematical models in the form of spatiotemporal regulatory networks that can lead to the scaling of molecular patterns with the size of embryonic organoids. In future, we aim to design synthetic circuits, to test the theory and move forward on both theory and experiments. Ultimately we will apply this circuit to human pluripotent stem cells (PSC) e.g. using our micropatterning culture approaches, whose behavior will feed back on to the mathematical model to refine conditions.

The candidate will compute a mathematical model of morphogen transport in a growing domain, with partial differential equations (PDE). They will solve this model numerically, with some analytical work as well (using Matlab, Python, Mathematica, Maple). They will find conditions for scaling and determine relations between variables and parameters that can potentially lead to the control of tissue growth. If time permits, the student may also contribute to synthetic circuit design and/or human PSC culture experimental work.

Relevant literature:

- <https://www.ncbi.nlm.nih.gov/pubmed/23533171>
- <https://www.ncbi.nlm.nih.gov/pubmed/31862792>
- <https://www.ncbi.nlm.nih.gov/pubmed/26108346>
- <https://www.ncbi.nlm.nih.gov/pubmed/29799239>

- <https://www.ncbi.nlm.nih.gov/pubmed/25884138>
- <https://www.ncbi.nlm.nih.gov/pubmed/28870989>

- 1) This position is suitable for an independent, resourceful, highly self-motivated candidate with some experience in computational biology.
- 2) Position will be 4 months duration, to start May 1st 2020, and end Aug 31, 2020.
- 3) No vacation time is provided as vacation pay is provided in lieu; however if the candidate wishes to minimally alter the start or end dates, please discuss with us
- 4) We encourage successful applicants to also apply for external award funding as appropriate e.g. an NSERC undergraduate summer research award (USRA) (<https://students.ubc.ca/career/campus-experiences/nserc-undergraduate-student-research-awards>) and/or a Centre for Blood Research-School of Biomedical Engineering USRA (<https://www.bme.ubc.ca/research/funding-opportunities/>); either one of these awards can be held at one time concurrent with a co-op position. Note that the NSERC USRA program requires a minimum 16 week continuous duration of work.
- 5) The salary will be \$2500/month full-time (based on 40 hours work/week), pro-rated if any partial months worked; inclusive of any award funding received.

Ideal candidates would have experience in some or all of the below:

- Computational biology
- Numerical/analytical solution of PDEs
- Strong programming skills (using Matlab, Python, Mathematica)

Individuals must also:

- Work well in a goal-oriented team environment;
- Be highly self-motivated and engaged in research
- Possess excellent communication skills – both verbal and written;
- be open to instruction and constructive criticism on the project and their capabilities
- Have the ability to work semi-independently and organize own workload under supervision
- keep meticulous records of experiments and data, report on research progress and outcomes openly
- Demonstrate an ability to design and analyze experiments, review experimental methodologies in response to feedback
- Have the ability to acquire and update knowledge in their specialized area and implement relevant technologies to advance the project

For further information about these projects and to apply, please also send us your application package *as one PDF file* via email at zandstra.lab@ubc.ca to include

- Email subject line: “Scaling and growth control in embryonic organoids” 2020 summer student application

- cover letter
- dates of your availability (if not May 1-Aug 31 2020)
- CV
- copy of all university transcripts (require English translations where applicable; originals must sent prior to acceptance of offer)
- contact information for 3 references

For further information on our research and team, please visit our website and Twitter account:

<https://www.stemcellbioengineering.ca/>

<https://twitter.com/StemCellBioEng>

We will consider applications on a rolling basis until the position is filled, at which time we will note this on the job posting on our lab website here - <https://www.stemcellbioengineering.ca/careers/>

We regret that we can only contact those applicants who are selected for further consideration.