Developmental Biology Collaborative Specialization
Final Assessment Report & Implementation Plan
February 2020

Faculty / Affiliated University College	Schulich School of Medicine and Dentistry
Participating Programs	Biology – MSc, PhD Anatomy and Cell Biology – MSc, PhD Biochemistry – MSc, PhD Microbiology and Immunology – MSc, PhD Physiology and Pharmacology – MSc, PhD Pathology and Laboratory Medicine – MSc, PhD
Date of Last Review	First review since inception, 2006
External Consultants	None –desk audit
Internal Reviewer	Savita Dhanvantari, PhD Director of the Collaborative Graduate Specialization in Molecular Imaging; Director, Biomedical Imaging Research Centre
Date of Site Visit	November 1, 2019
Date Review Report Received	December 17, 2019
Date Faculty Response Received	February 13, 2020
Evaluation	**Good Quality**
Approval Dates	SUPR-G: April 13, 2020 SCAPA: April 29, 2020 Senate (FYI only): May 8, 2020
Year of Next Review	Year of next cyclical review - 2025-2026

Overview of Western's Cyclical Review Assessment Reporting Process

In accordance with Western's Institutional Quality Assurance Process (IQAP), adopted on May 11, 2011, and revised June 22, 2012, this Final Assessment Report (FAR) provides a summary of the first program review of the Developmental Biology Collaborative Graduate Specialization (delivered by the Schulich School of Medicine and Dentistry), assessment and Implementation Plan.

This Final Assessment Report (FAR) report considers the following documents:

- the self-study
- the internal consultant's report
- the response from the Director of the program

The FAR identifies the strengths of the specialization; opportunities for the Specialization's enhancement and improvement; and, lists the recommendations of the reviewer.

The Implementation Plan details the recommendations from the Final Assessment Report that are selected for implementation, identifies who is responsible for approving and acting on the recommendations, the follow-up that is required, and the timeline for completion.

The Final Assessment Report and Implementation Plan is sent for approval through SUPR-G and SCAPA, then for information to Senate and the Ontario Universities' Council on Quality Assurance and is made available on a publicly accessible location on Western's IQAP website

The Final Assessment Report which includes the Implementation Plan is the only document resulting from the graduate review process that is made public, all other documents are confidential to the Schulich School of Medicine and Dentistry, the program, the School of Graduate & Postdoctoral Studies, and SUPR-G.

Defining a Collaborative Specialization at Western[1]

A Collaborative Specialization is an intra-university graduate field of study that provides an additional multidisciplinary experience for students enrolled in and completing the degree requirements for one of a number of approved masters and/or PhD programs. Students meet the admission requirements of and register in the participating (or "home") program but complete, in addition to the degree requirements of that program, the additional requirements specified by the Collaborative Specialization. The degree conferred is that of the home program, and the completion of the collaborative program is indicated by a transcript notation and/or adjunct qualifications to the degree.

Students are registered in the participating degree program, meeting the requirements of the participating program as well as those of the collaborative program.

A Collaborative Specialization must have:
• At least one core one-semester course that is foundational to the specialization and does not form part of the course offerings of any of the partner programs.
This course must be completed by all students from partner programs registered in the specialization and provides an opportunity for students to appreciate the different disciplinary perspectives that can be brought to bear on the area of specialization. This course may serve as an elective in the student's home program.
• Clear and explicit requirements for each Collaborative Specialization.
In programs requiring a major research paper, essay, or thesis, the topic must be in the area of the collaborative specialization. In course-only Master's programs, at least 30% of the courses must be in the area of specialization including the core course described above. Courses in the area of specialization may be considered electives in the home program.
• core faculty who are the faculty members in the participating home programs who have an interest and expertise in the area of the collaborative specialization (this may include faculty appointed 100% to an interdisciplinary academic unit).
• appropriate administrative and academic oversight/governance in place to ensure requirements associated with the specialization are being met.

Executive Summary

This FAR examines the review of the Collaborative Graduate Specialization in Developmental Biology, formed in 2006. Developmental Biology (DevBio) is the field of biological and biomedical science that explores mechanisms of spatially and temporally programmed change in developing organisms. It encompasses the full range of organisms, from microbes through plants and animals, including humans. Like other fields of biology, developmental biology has been revitalized by the genomics and stem cell revolution, necessitating continuous upgrading of research technologies. This has had an impact on graduate and postdoctoral training programs because a critical mass of active researchers is required to generate sufficient funding to acquire and maintain such expertise. Western has at least 34 researchers working in this area and is only one of three programs in Canada to offer this program, the other two

[1] Description retrieved from http://oucqa.ca/framework/1-6-definitions/.

being at UBC and Toronto. Both institutional and public awareness has enhanced the program's ability to attract top quality graduate students and postdoctoral fellows, especially from other institutions, and to garner internal and external research funding to support their training.

In its self-study, the faculty described the program in detail, outlined its perceived strengths and weaknesses, and discussed plans for future modifications, including a joint training symposium with the University of Toronto, inviting additional, appropriate departments/faculties at Western to join the program, developing a communication plan for the specialization, and exploring the possibility of creating a Collaborative Graduate Specialization in Children's Health Research.

Reviews of Collaborative Graduate Specialization are carried out on a cyclical basis by one informed internal reviewer from the University. This program was reviewed in November 2019 by Dr. Savita Dhanvantari, PhD, a faculty member in Medical Biophysics as well as Pathology and Laboratory Medicine. Dr. Dhanvantari, the former Director of the Collaborative Graduate Specialization in Molecular Imaging and current Director of the Biomedical Imaging Research Centre has significant expertise and experience in another Collaborative Graduate Specialization to carry out this review effectively.

Dr. Dhanvantari outlined the strengths and weaknesses of the specialization as a result of the reading the self-study and after the onsite visit. In her report, she outlines the strengths of the program and suggestions for further development. This FAR document provides a comprehensive overview of the process, findings, recommendations and implementation plans.

The review finds that the Collaborative Graduate Specialization in Developmental Biology is progressive in nature. The faculty involved are self-reflective and committed to moving forward in positive directions. Most of the recommendations – actually labelled as suggestions by the reviewer – were already acknowledged prior to the review in the self-study and are under active discussion.

Summary of the Self-Study – Volume 1

Developmental Biology is the field of biological and biomedical science that explores mechanisms of spatially and temporally programmed change in developing organisms. It encompasses the full range of organisms, from microbes through plants and animals, including humans. Knowledge of developmental mechanisms is being applied to a vast array of societal problems including, but not limited to, the following:

- Improving our food supply (through better understanding of mechanisms of plant flowering and seed/fruit development, and through assisted reproduction techniques to improve livestock quality)
- Developing new diagnostic tests for congenital diseases (through identification of genes involved in normal/abnormal embryonic and fetal development)
- Developing new therapies, including pharmaceuticals, for treating developmental disabilities and cancer (through better understanding of cellular and molecular mechanisms of normal tissue homeostasis, stem cells and organ development)
- Providing better approaches for contraception and for alleviating infertility (through discoveries that illuminate molecules and mechanisms involved in gamete formation, fertilization, and embryo implantation)
- Acquiring a better understanding of the evolution of life on Earth (through comparisons of the genes and processes governing the development of diverse organisms)
- Developing animal and cellular models of human disease through gene-targeting and gene editing approaches and in the production of induced pluripotent stem cells from patient-derived cells

Like other fields of biology, developmental biology has been revitalized by the genomics and stem cell revolution, necessitating continuous upgrading of research technologies. This has had an impact on graduate and postdoctoral training programs because a critical mass of active researchers is required to generate sufficient funding to acquire and maintain such expertise. Western has been very fortunate during the past few decades in having recruited a number of highly trained scientists working in the

developmental biology field. There is currently a critical mass of more than 34 faculty members who devote all or part of their research to solving fundamental or applied problems in organismal development. In fact, this is one of the largest academic focus groups in the UWO scientific community. These faculty members oversee research programs affiliated with numerous Departments in the Faculties of Science and the Schulich School of Medicine & Dentistry. Their laboratories are located throughout the city of London including the UWO campus, St. Joseph's Health Care, the London Health Sciences Centre, the Lawson Health Research Institute, the Victoria Research Laboratories, (including the Children's Health Research Institute [CHRI] and the London Regional Cancer Program), and the Robarts Research Institute. Their collective expertise in developmental biology is unequalled in Ontario outside the University of Toronto. Through extensive research collaboration and monthly developmental biology research seminars, Western faculty have been linked informally for over 20 years.

The official establishment of Western's Collaborative Graduate Specialization in Developmental Biology in 2006 granted formal recognition to this strength. Greater institutional and public awareness has enhanced our ability to attract top quality graduate students and postdoctoral fellows, especially from other institutions, and to garner internal and external research funding to support their training. This Specialization has provided a formal network that along with the Children's Health Research Institute, whose Scientists make up the majority of our faculty, help facilitate communication between faculty and students engaged in developmental biology research throughout the city. This unique partnership has facilitated participating faculty members to pool their time, expertise, and resources in establishing novel interdisciplinary graduate courses, to support innovative research and trainee seminars series and help fund student stipends, workshops, and travel grants that are tailored to the needs and interests of this specific cadre of graduate students.

The administrative home of the program is in the Victoria Research Laboratories in offices shared with Children's Health Research Institute. Participating Degree Programs include: Biology – MSc, PhD; Anatomy and Cell Biology – MSc, PhD; Biochemistry – MSc, PhD; Microbiology and Immunology – MSc, PhD; Physiology and Pharmacology – MSc, PhD; Pathology and Laboratory Medicine – MSc, PhD. Oversight of the Program is provided by the Steering Committee, consisting of five members from the Faculty of Science (Department of Biology) and the Schulich School of Medicine & Dentistry represented by at least one member from each faculty, two student members and the course coordinators for the Developmental Biology Course. The program has enrolment-based finding that supports the operations. To support findings in this self-study, the program conducted online surveys with current and former graduate students about students' perceptions of the program, noting good satisfaction levels with the coursework.

In addition, the faculty identified a number of innovative features of the program in that it is one of only three such programs in Canada and is the largest. The program admits excellent students and offers ongoing, excellent opportunities for professional development. It is recognized as being interdisciplinary, interactive, comprehensive and the research work is supported by the University and the key research institutes.

In the future, the program is investigating the possibility of some modifications to the program including:

- a joint training symposium with the University of Toronto
- inviting additional, appropriate departments/faculties at Western to join the program
- developing a communication plan for the specialization, and exploring the possibility of creating a Collaborative Graduate Specialization in Children's Health Research.

Review Process

For a Graduate Collaborative Specialization, an internal review is required consisting of a knowledgeable arm's-length reviewer from within the University. The reviewer reads the Program Self-Study and then engages in a one-day onsite review.

Over the course of day, the internal reviewer met with

- the Director of Collaborative Specialization
- Graduate Chairs of Microbiology & Immunology, Anatomy & Cell Biology, and Biology
- a PhD Student and MSc student
- the Graduate Associate Dean, Schulich School of Medicine and Dentistry, and
- Chair of Physiology/Pharmacology, Chair, Dept of Biology and the Course Director for DevBio 9100 by telephone.

Following the onsite review, the reviewer submitted a comprehensive report of the findings which was sent to the Program Director for review and response.

These formative documents, including Volumes I and II of the Self-Study, the Internal Report, and the Program Response have formed the basis of this summative assessment report of the Developmental Biology Colaborative Graduate Specialization.

Strengths of the Specialization Identified

- Clear curriculum mapping of the program
- Learning Outcomes for the program are clearly stated and differentiated between the MSc and PhD students
- Extensive competence in breadth and depth of the graduate faculty
- Curriculum content is comprehensive and covers subject matter of the discipline as well as such topics as academic integrity, research ethics, professional development
- Strong partnerships with various research institutes
- Strong administrative support
- Library support (noting a concern that with dwindling resources, library materials could be affected in future)
- Student completion times are satisfactory and not substantially different from students not enrolled in the Specialization. Therefore, students are receiving an enhanced education with "Developmental Biology" on their transcripts and diplomas (seen as a strength by the students) in the same amount of time.

Areas of Concern Identified

- Extent of collaboration between and among individual graduate faculty is unclear
- The Memorandum of Understanding for the specialization needs to be shared widely with the graduate chairs of students' home programs as they seemed to have little awareness of the MOU and expectations
- Noticeable lack of capacity in super-resolution microscopy, bioinformatics, and single cell transcriptomics that has been addressed
- Financial support for graduate students: The Development Biology Specialization does not provide meaningful financial support directly to students and student funding comes from their supervisor's grants as well as internal and external scholarships. As a result, only those faculty members with substantial external funding can offer research projects to students and have them enroll in the Developmental Biology specialization.

Summary Statement

"Overall, the Graduate Collaborative Specialization in Developmental Biology is one of the most successful interdisciplinary educational programs at Western University. It has a sustained record of research excellence, and the graduate student experience is significantly enriched compared to their home programs. The strengths of the specialization lie in the strong partnership with CHRI and the innovations in the delivery of the curriculum, which makes this Specialization a model for all others."

Reviewer's Recommendations

The following are recommendations "suggested for consideration" by the internal reviewer, with the program's response in the right column.

INTERNAL REVIEWER'S RECOMMENDATIONS	**PROGRAM'S RESPONSE** Prepared by the Director of the Collaborative Graduate Specialization in Developmental Biology. (abbreviated)
Integrate a professional development program such as Own Your Future (OYF) into the Professional Capacity outcomes as an option for PhD students.	*We will continue to strongly encourage our PhD trainees to enroll in OYF, while still enhancing our students' professional development skills such as communication abilities and problem-solving skills through the assignments and group interactions within our graduate courses (DEV 9000 and DEV 9100).*
Offer different learning outcomes than a traditional grad program, such as an emphasis on convergent thinking— e.g., how to take a complex problem and get groups of students to use multiple ways of solving them, instead of the standard journal club format. Develop ways of minimizing the didactic lectures and evolve towards a more problem-based learning approach for DevBio 9000.	*We plan to maintain and enhance our interdisciplinary didactic lecture offerings in our courses by increasing faculty member participation from existing departmental participants along with increasing faculty membership by enlisting newly appointed faculty and incorporating new departments (e.g. Biomedical Engineering) within our Specialization (Summer 2020-2021). To enhance the active learning aspect of our courses we will utilize Western's WALS classrooms to encourage group discussions and problem-based learning. This innovative classroom space will be employed for the 2020-21 academic year, applying novel assignments such as having graduate students prepare and present Three Minute Thesis (3MT) lay talks on their thesis projects.*
Given that most MSc and PhD students do not pursue a career in academia, formal evaluation could include communication of their project to a lay (patient advocates, high school students) or corporate (patent office, CEO) audiences.	*No response*
Include the Department of Medical Biophysics as a participating department and seek out more collaborations with Imaging researchers.	*We will continually seek out new faculty member involvement from participating departments and we plan to engage with other Schulich Departments (e.g. Medical Biophysics) and the faculties of Health Sciences and the School of Biomedical Engineering to assess their suitability with partnering with our graduate specialization and if deemed beneficial to then establish MOUs and recruit faculty members from these disciplines to further enhance the interdisciplinary nature of our graduate specialization (2020-2022).*
Increase the awareness of the Developmental Biology Specialization amongst the participating departments' faculty by having the Director make regular presentations at the departmental Grad committee meetings, and by actively encouraging individual faculty from all participating	*We agree that Grad Chairs of participating graduate programs may not be aware of the MOUs. In addition, we are aware that a number of these MOUs are dated and need to be updated. Updated MOUs between the DevBio specialization and the participating departments*

INTERNAL REVIEWER'S RECOMMENDATIONS	**PROGRAM'S RESPONSE** Prepared by the Director of the Collaborative Graduate Specialization in Developmental Biology. (abbreviated)
departments to teach and supervise students in the Dev Bio Specialization.	*will be revised and signed immediately (Summer 2020) and reassessed every 2-3 years.* *The Director or a participating DevBio faculty member gives annual presentations about the DevBio Specialization to some of the Departmental Grad programs (Biology, Physiol/Pharm), but we agree that we can do a better job of this and ensure that we (i.e. Director or nominated faculty member) visits every participating home department to present what our Specialization offers and to encourage individual faculty member to participate in the teaching and/or supervision of graduate students through the Collaborative Specialization in DevBio.*
Expand the mandate of the Specialization to include Children's Health Research or Biomedical Engineering.	*Expanding the mandate of the Specialization to include Children's Health Research is an early idea that needs further exploring (over the next 2-3 years) to determine if it's the right fit for our Specialization. …In addition, we plan to engage with other Schulich Departments (e.g. Medical Biophysics) and the faculties and Health Sciences and Engineering over the next year (2020-2021) to recruit faculty members from these disciplines who conduct developmental biology related research to further enhance the interdisciplinary nature of our graduate specialization.*
The University needs to formally recognize the contributions of Collaborative Specializations to graduate education and provide long-term and meaningful funding to successful programs such as Developmental Biology. If Western wishes to break down departmental silos, encourage the growth of interdisciplinary programs and offer unique educational opportunities in recruiting graduate students that are competitive nationally and internationally, it must commit meaningful funding to enable further expansion of collaborative programs.	*We profoundly agree. Through strong support from Schulich's Graduate Studies and Postdoctoral Affairs office we have been able to maintain our funding from Schulich's Administration. The funds and administration support we have been able to receive from both Schulich and CHRI have been just enough to maintain the operations of our Graduate Specialization. However, we are under constant (yearly) threat of losing this funding. We are also limited in our capacity to enhance our program further from its current prodigious state. A fair and formalized funding structure approved at the Faculty or Institutional level would provide us the impetus to seek new Departmental/Faculty partners to expand and enhance the interdisciplinary nature of our Collaborative Specialization.*
Noticeable lack of capacity in super-resolution microscopy, bioinformatics, and single cell transcriptomics	*This is primarily an issue for the departments to solve. However, as a point of information currently there are currently a number of equipment proposals under review by / in preparation for various organizations (e.g. NSERC RTI, CFI) that are attempting to fill this infrastructure need. A single cell transcriptomics facility is currently*

INTERNAL REVIEWER'S RECOMMENDATIONS	**PROGRAM'S RESPONSE** Prepared by the Director of the Collaborative Graduate Specialization in Developmental Biology. (abbreviated)
	being set up at the Lawson Health Research Institute that DevBio participants will have access to including operational funding for a dedicated technician provided by the CHRI. In addition, CHRI/Western has recently hired a new bioinformatician faculty member, Dr. Parisa Shooshtari, who has just begun her tenure (summer 2019) and will become a member of this graduate specialization.
	Summary Statement from Program: A half-day retreat for the Collaborative Graduate Specialization in Developmental Biology with participating faculty members and selected graduate students will be organized for the Summer semester of 2020. During this retreat we will construct a strategic plan to address the recommendations and implement the responses/action points outlined in this document. This strategic plan will be implemented with short- and long-term goals over the next few years.

Implementation Plan

The Implementation Plan provides a summary of the recommendations that require action and/or follow-up, in this case, with the Graduate Program Director, in consultation with SGPS and the Associate Dean, Graduate, of the Schulich School of Medicine and Dentistry. The program is responsible for enacting and monitoring the actions noted in Implementation Plan. The details of progress made will be presented in the Dean's Annual Planning Document.

Recommendation requiring action	Proposed Action and Follow-up	Responsibility
Include the Department of Medical Biophysics as a participating department and seek out more collaborations with Imaging researchers.	Director will call meetings for discussion and potential collaboration/inclusion.	Director, DevBio -Graduate Program Chairs involved, -ADG Schulich
Increase the awareness of the Developmental Biology Specialization amongst the participating departments' faculty by having the Director make regular presentations at the departmental Grad committee meetings, and by actively encouraging individual faculty from all participating departments to teach and supervise students in the Dev Bio Specialization.	-MOUs between the DevBio specialization and the participating departments will be revised (Summer 2020) and reassessed every 2-3 years. -Director or nominated faculty member) will visit every participating home department to present what our Specialization offers and to encourage individual faculty members to participate in the teaching and/or supervision of graduate students through the Collaborative Specialization in DevBio.	Director and Graduate faculty
Expand the mandate of the Specialization to include Children's Health Research and Biomedical Engineering.	Continue discussions amongst appropriate faculty and chairs to facilitate this expansion.	-Director, DevBio -Graduate Program Chairs involved, including Biomedical Engineering -CHRI -ADGs (Schulich and Engineering)
The University needs to have a conversation and recognize the financial contributions of Collaborative Specializations to graduate education and provide long-term and meaningful funding to successful programs such as Developmental Biology.	Discussions to be held amongst senior administrators to determine if this is an issue, and if so, what redress is required. This funding should not be confused with the primary source of funding for graduate students which comes from their program/supervisor not the Collaborative Specialization.	-SGPS -Deans of Collaborative Graduate Specializations -ADGs of Collaborative Graduate Specializations