BIOGRAPHICAL SKETCH

NAME: **Amanda J.G. Dickinson**

eRA COMMONS USER NAME (credential, e.g., agency login): ajdickinson

POSITION TITLE: Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Mount Allison University, New Brunswick, Canada	BSc	05/95	Biology
Dalhousie University, Nova Scotia, Canada	MSc	05/97	Biology
Dalhousie University, Nova Scotia, Canada	PhD	05/03	Neuroscience
Whitehead Institute for Biomedical Research, MIT, Cambridge, MA	Postdoctoral Fellow	01/10	Developmental Biology

A. Personal Statement

From Biological Form to Human Birth Defects: I am a developmental biologist driven by a fascination with how complex biological form emerges and how its disruption leads to human birth defects. My research spans the fundamental mechanisms of morphogenesis and the genetic and environmental factors that underlie congenital craniofacial anomalies. My scientific training began in developmental neuroscience, where I studied the development, physiology, and evolution of simple invertebrate nervous systems under the mentorship of Dr. Croll at Dalhousie University Medical School. This work provided a strong comparative and evolutionary foundation that continues to shape my approach to developmental biology.

A Scientific Pivot: Establishing Xenopus as a Model for Orofacial Development: I later transitioned fields during my postdoctoral training with Dr. Hazel Sive at the Whitehead Institute at MIT, where I focused on the signaling pathways and developmental processes that direct oral cavity formation. During this time, I developed an independent research program and helped pioneer the use of Xenopus as a model system for studying orofacial development. I also gained extensive expertise in embryological and developmental biology techniques, ranging from advanced microscopy to large-scale gene expression analysis, which remain central to my research.

Building an Independent Research Program in Craniofacial Biology: In 2010, I established my laboratory at Virginia Commonwealth University, where I expanded my research program in craniofacial development. My group published the first report of an orofacial cleft in Xenopus, demonstrating the power of this system for modeling human craniofacial birth defects. I continue to use this developmental platform to dissect conserved pathways governing craniofacial morphogenesis. VCU recognized my early career success with the prestigious Eminent Scholar Award, and I now leverage the strengths of my laboratory to pursue new research questions and funding opportunities.

Integrating Teaching, Discovery, and Research Training: As a principal investigator in the Biology Department at VCU, I am deeply committed to teaching and the integration of research and training. I teach approximately 150 undergraduate students each year in a course I designed Development and Stem Cells. I developed both fully online and hybrid formats to ensure continuity and accessibility. I also teach the department's core graduate course, From Molecules to Organisms. I have developed three novel graduate-level courses and multiple CURE-based research classes in which students design and perform independent, original experiments that directly contribute to my research program. To date, I have mentored more than 50 undergraduate researchers, 10 graduate students, and 3 postdoctoral fellows. While this level of teachiung

engagement can slow short-term research productivity, I view the integration of teaching and discovery as essential to training the next generation of scientists. My commitment to this model was recognized with a prestigious NSF CAREER Award.

Resilience, Perspective, and Renewed Scientific Momentum: Since 2017, I have faced significant personal health challenges, including two separate diagnoses of stage IV cancer that required multiple surgeries, participation in clinical trials, and extensive treatment regimens. Throughout my health struggles I have worked to maintain my teaching and research programs at the highest level possible.

B. Positions, Scientific Appointments, and Honors

Positions and Appointments

2016-present Associate Professor, Department of Biology, Virginia Commonwealth University
2010-2016 Assistant Professor, Department of Biology, Virginia Commonwealth University
2015-present Affiliate Faculty, Department of Human and Molecular Genetics, VCU

Honors

2019 VCU Eminent Scholar, 25,000$ salary award in the College of Humanities and Sciences.
2003 Postdoctoral Fellowship. National Sciences and Engineering Research Council of Canada.
2001 Dalhousie President's Graduate Teaching Award, Dalhousie University.

C. Contributions to Science

1. Using frog faces to understand human orofacial development.

In humans, the orofacial region serves as our gateway to the environment, permitting ingestion, taste, communication, and facial recognition. Therefore, birth defects affecting the mouth and face such as orofacial clefts can be devastating. Unfortunately, such deformities are also one of the most prevalent types of human birth defects. Despite the devastating effects of orofacial anomalies, the mechanisms that cause many of these types of malformations still remain poorly understood, in part due to their multifactorial nature and the complex morphogenesis of the region. My goals are to uncover the specific developmental mechanisms that underlie human orofacial defects. Most of the research on orofacial clefting is performed in mouse, chick and zebrafish. *Xenopus* has not historically been utilized for such craniofacial studies despite the fact that this species has several advantages. For example, there is no head flexure that obscures easy viewing of the face in these other species and of course, they do not have a beak. My lab was the first to create an orofacial cleft in *Xenopus* and I am among a few researchers that are now effectively using this model to quickly and more easily study mechanisms of orofacial development and disease. For example, we have validated novel human clefting genes as being important for developmental processes in the face, in collaboration with Dr. Manak and other geneticists at Iowa U**.** In particular we are interested in the role of epigenetic regulators in craniofacial development. We have uncovered mechanisms by which epigenetic modulators such as CHD1 (with Dr. Manak and Murray at Iowa) and RAI1 (with Dr. Elsea at Baylor) regulate processes in craniofacial development. We have also collaborated with Dr. Wang at VCU Massey Cancer Center on PRC1 gene repression and novel histone variants in the developing face. *These endeavors have been supported lab by R01DE023553 (NIDCR)*
Finally, we have become interested in the craniofacial defects associated with Down and DYRK1A Syndrome. Working with Dr. Litovchick in the VCU Scool of Medicine we have been identifying new mechanims by which the Down Syndrome associated gene DYRK1A regulates face formation in work supported by and internal VCU Children's hospital gratnt and *R21HD105144 (NICHD).*

Relevant Publications:

a. Kennedy, A.E. and **A.J. Dickinson**, Median facial clefts in Xenopus laevis: roles of retinoic acid signaling and homeobox genes. Dev Biol, 2012. 365(1): p. 229-40. PMID: 22405964
b. **Dickinson AJ.** Using frogs faces to dissect the mechanisms underlying human orofacial defects. Semin Cell Dev Biol. 2016 Jan 15. pii: S1084-9521(16)30016-7. PMCID: PMC4798872
c. Brent H. Wyatt, Thomas O. Raymond, Lisa A. Lansdon, Benjamin W. Darbro, Jeffrey C. Murray, J. Robert Manak, **A.J.G. Dickinson**. Using an aquatic model, Xenopus laevis, to uncover the role of Chromodomain 1 (CHD1) in craniofacial disorders. Genesis 2020 Sep 11;e23394. doi: 10.1002/dvg.23394.

d. Saeid Mohammad Parast , Deli Yu , Chunxu Chen, **Amanda J Dickinson**, Chenbei Chang, Hengbin Wang. Recognition of H2AK119ub plays an important role in RSF1-regulated early Xenopus development. Front Cell Dev Biol. 2023 Jul 17;11:1168643. doi: 10.3389/fcell.2023.1168643.
e. Johnson HK, Wahl SE, Sesay F, Litovchick L, **Dickinson AJ**. Dyrk1a is required for craniofacial development in Xenopus laevis. Dev Biol. 2024 Apr 15;511:63-75. doi: 10.1016/j.ydbio.2024.04.004. PMID: 38621649
f. Johnson HK, Litovchick LL, Dickinson AJG. The role of Goldilocks protein kinase DYRK1A in embryonic development. Dev Biol. 2025 Sep;525:216-228. doi: 10.1016/j.ydbio.2025.06.009.
g. Varsha Ananthapadmanabhan, Kathryn H Shows, **Amanda J Dickinson**, Larisa Litovchick. Insights from the protein interaction Universe of the multifunctional "Goldilocks" kinase DYRK1A. Front Cell Dev Biol. 2023 Oct 12:11:1277537. doi: 10.3389/fcell.2023.1277537. eCollection 2023. PMID: 37900285 PMCID: PMC10600473 DOI: 10.3389/fcell.2023.1277537

2. Pioneering work on determining how the embryonic mouth is formed.

The mouth forms from a complex series of growth and fusions of the embryonic facial tissues. Its formation creates an opening to the digestive system in all metazoa, without it, animals cannot eat. The digestive tube is initially covered by a structure called the buccopharyngeal membrane. This structure ruptures and an initial opening between the gut and the external environment is formed called the embryonic or primary mouth. Remarkably, before I started my postdoc there were only a very few antiquated studies that focused on embryonic mouth formation. Further, the embryonic mouth is not often considered in studies of orofacial evolution, development, and birth defects, and is rarely mentioned in developmental or anatomical textbooks. This was surprising as one can imagine that abnormalities in the development of this structure could have devastating effects on the formation of the adult mouth. In fact, we have evidence that a persistent buccopharyngeal membrane could be a cause for Choanal Atresia which is present in as many as 80 human syndromes affecting the face. Therefore, my broad goals have been to fill a major knowledge gap in our understanding of how the embryonic mouth is formed in vertebrates. Over the past several years we have developed a model where jaw muscles, via connections to the oral epithelium, generate forces across the buccopharyngeal membrane. This force, in conjunction with localized cell death and junctional remodeling, results in the perforation of the structure and the formation of the embryonic mouth. This model was made possible by *support from a NSF Career Award (IOS-1349668) and R03 RAR065583A (NIAMS).*

Relevant Publications:

a. **Dickinson, A.J.** and H. Sive, Development of the primary mouth in Xenopus laevis. Dev Biol, 2006. 295: p.700-13. PMID: 16678148
b. N.S. Houssin, N.K. Bharathan, S.D. Turner, **Amanda J.G Dickinson**. The role of JNK during buccopharyngeal membrane perforation, the last step of embryonic mouth formation. Dev Dyn. 2017 Feb;246(2):100-115. PMCID: PMC5261731
c. Bharathan, N. and **Dickinson AJG**. Desmoplakin is required for epidermal integrity and morphogenesis in Xenopus. Dev Biol. 2019 Jun 15;450(2):115-131. PMCID: PMC6659752
d. **Amanda J. G. Dickinson.** Jak2 and Jaw Muscles Are Required for Buccopharyngeal Membrane Perforation during Mouth Development. J. Dev. Biol. 2023, 11(2), 24. PMCID: PMC10298892

3. Establishing methods for the analysis of orofacial development in Xenopus

Xenopus laevis has emerged as a new tool for dissecting the mechanisms governing craniofacial development. Therefore, I have developed a quantitative method to analyze size and shape changes during the development of the head and face in this species. Such a method has and will continue to allow us and other researchers to quantify facial phenotypes, but also distinguish between the subtle differences. The analysis of craniofacial defects arising from the synergistic effects of genes and/or environmental factors will be greatly improved by this method. As a postdoc, I established a *Xenopus* face transplant method with the guidance of my mentor Hazel Sive. The face transplant technique provides a major leap forward in our ability to study the complexity of orofacial development since it allows for region-specific loss or gain of function in all the cell types in the orofacial region. This has not been possible with promoter-driven gene expression in mammals and zebrafish since no single gene is expressed in all the tissues at the same time in the face. Importantly, face transplants also allow us to examine the roles of proteins in the orofacial region without worrying about non-specific effects or viability problems in the whole embryo. I did not have time to publish this as a technique at the end of my postdoc or

when starting my own lab. Therefore, a graduate student in the Sive lab, that I trained in the technique, helped me co-author a video techniques publication. My lab continues to develop and adapt methodology to better analyze and quantify *Xenopus* development. We have developed simple assays to test the mechanical strength of the epidermis and are currently working to standardize cranial cartilage measurements.

Relevant Publications:

a. Kennedy, A.E. and **A.J. Dickinson**, Quantification of orofacial phenotypes in Xenopus. J Vis Exp, 2014(93): p. e52062.
b. Kennedy, A.E. and **A.J. Dickinson**, Quantitative analysis of orofacial development and median clefts in Xenopus laevis. Anat Rec (Hoboken), 2014. 297(5): p. 834-55.
c. Jacox, L.A., A.J. Dickinson, and H. Sive, Facial transplants in Xenopus laevis embryos. J Vis Exp, 2014(85).
d. Desmoplakin is required for epidermal integrity and morphogenesis in Xenopus. Bharathan, N. and **Dickinson AJG**. Dev Biol. 2019 Jun 15;450(2):115-131.

4. Testing the effects of e-cigarettes on craniofacial development

ECIGs are battery-powered nicotine delivery systems that are increasing in popularity globally especially in young people. In fact, from 2017 to 2018, there was a 78 percent increase in current e-cigarette use among high school students and many of these are regular users. This rise in use can be reasoned by the fact that ECIGs are advertised as "a safer alternative" to cigarette smoke. In addition, ECIGs appeal to the younger population and women because the liquids can contain yummy flavors invoking ice cream and fruity cereals delivered by sleek stylish devices. However, adequate testing of these e-liquids is still in its infancy. Since ECIGS are so new we have no information yet about its effects in human pregnancy. In addition, testing in mammalian models is slow and labor-intensive and so I am using a novel approach with Xenopus to test quickly whether ECIGs could affect embryonic development. My lab was the first to report the possible dangers since some e-liquid flavors can cause median clefts accompanied by reductions in jaw and muscle cartilage as well as blood supply to the face. This work was covered in the **Atlantic Magazine**. More recently, we have shown that vanillin containing e-liquids and vanillin flavoring itself can affect retinoic acid signaling and this represents a possible gene-environment interaction. *These studies were supported by an R56 RDE026024A (NIDCR).*

Relevant Publications:

a. Kennedy AE, Kandalam S, Olivares-Navarrete R, **Dickinson AJG**. E-cigarette aerosol exposure can cause craniofacial defects in Xenopus laevis embryos and mammalian neural crest cells. PLoS One. 2017 Sep 28;12(9):e0185729.
b. **Amanda J. G. Dickinson**[1]*, Stephen D Turner[2,3], Stacey Wahl[4], Allyson E Kennedy[5], Brent H Wyatt[6], Deborah A Pridgen[1] E-liquids and vanillin flavoring disrupts retinoic acid signaling and causes craniofacial defects in *Xenopus* embryos. Dev Biol. 2021 Sep 17;481:14-29. doi: 10.1016/j.ydbio.2021.09.004. PMID: 34543654
c. James E Black, Thomas O Raymond, **Amanda J G Dickinson**. E-Cigarette and Vanillin Exposure Disrupts Cardiovascular Development in Xenopus laevis. Birth Defects Res. 2025 Oct;117(10):e2535. doi: 10.1002/bdr2.2535.

5. Evo-devo studies of molluscan larval nervous systems.

As a graduate student in the lab of Roger Croll, I helped to revitalize the use of molluscan species such as *Ilyanassa, Crepidula*, and *Aplysia* in developmental studies. Such species were originally well studied at the turn of the century by scientists such as Edwin Conklin or later by Nobel Prize winner Eric Kandel. I was the first to map the development and function of the larval nervous systems in these species. This has contributed to our understanding of the development, function, and evolution of molluscan neural development. My best cited paper describes *Ilyanassa* larval neural development and subsequently, this species has become a new model for evo-devo research. Therefore, my graduate work has provided a useful foundation to those studying the molecular evolution in this and other molluscan species. While I am no longer working in this field, I feel that this work gave me a solid training in evolutionary developmental biology, classical embryology, and neural function that influences many of my current projects.

Relevant Publications:

a. **Dickinson, A.J.G**. and R.P. Croll, *Development of the larval nervous system of the gastropod Ilyanassa obsoleta.* Journal of Comparative Neurology, 2003. 466(2): p. 197-218. PMID: 14528448

b. **Dickinson, A.J.G**. and R.P. Croll, *Early development and cell fate specification of the larval nervous system and musculature of the prosobranch mollusc Ilyanassa obsoleta.* American Zoologist, 2001. 41(6): p. 1427-1428.
c. **Dickinson, A.J.G**., R.P. Croll, and E.E. Voronezhskaya, *Development of embryonic cells containing serotonin, catecholamines, and FMRFamide-related peptides in Aplysia.* Biological Bulletin, 2000.199(3): p.305-15.
d. **Dickinson, A.J.G**., J. Nason, and R.P. Croll, *Histochemical localization of FMRFamide, serotonin, and catecholamines in embryonic Crepidula fornicata (Gastropoda, Prosobranchia).* Zoomorphology, 1999. 119(1): p. 49-62.

D. Summary of Achievements

Research Funding and Scholarly Leadership: I have secured over $2.3 million in external research funding as principal investigator or multi-PI, including a prestigious NSF CAREER Award and multiple NIH awards (R01, R03, R56) spanning developmental biology, craniofacial birth defects, gene–environment interactions, and DYRK1A biology in development and disease. My funding portfolio reflects sustained NIH competitiveness, with multiple R01 submissions scoring in or near the funding range and ongoing support through NICHD and institutional mechanisms. My early independence and research vision were recognized by a Canadian NSERC Postdoctoral Fellowship and later by designation as a CHS Eminent Scholar.

Teaching Excellence and Curricular Innovation: I have taught undergraduate and graduate students continuously for more than 15 years, designing and leading core and advanced courses in developmental, cell, and molecular biology. I have instructed or co-instructed more than 500 undergraduate students and over 100 graduate students, across in-person, hybrid, and fully online formats. I designed and repeatedly taught a high-enrollment course, *Development and Stem Cells*, integrating authentic research experiences, CURE-based lab modules, data analysis using primary datasets from my laboratory, and inclusive pedagogical practices that measurably improved student performance. At the graduate level, I lead or co-lead core and advanced courses emphasizing proposal writing, critical thinking, and experimental design, often using my own funded research as instructional material.

Mentorship and Training Impact: I have mentored more than 60 undergraduate researchers, over 15 graduate students, and 5 postdoctoral fellows directly in my laboratory, many through multi-year research experiences. In addition, I have served on over 20 graduate thesis and dissertation committees across biology, genetics, and interdisciplinary programs. My trainees have participated in funded research, presented at conferences, and progressed into advanced training or professional careers. I maintain a strong commitment to structured mentoring, having intensive CIMER training and developed a workshop for the College of Humanities and Sciences as well as compiled mentoring resources now used broadly within my department and college.

Professional Service and National Visibility: I am an active contributor to the scientific community through NIH and NSF service, including repeated service as an NSF Developmental Systems panel reviewer and ad hoc reviewer for U.S. and international funding agencies. I have reviewed manuscripts for over 25 journals, including high-impact venues such as *Nature Communications*, *Cell Reports*, *Science Signaling*, and *Human Molecular Genetics*. I served as Guest Editor for a special issue of *Seminars in Cell and Developmental Biology* and currently serve on the **editorial advisory board of the Journal of Developmental Biology*. My expertise has been recognized through numerous invited talks and plenary presentations at national and international meetings.

Institutional Leadership, Mentoring, and Outreach: Within my institution, I have held several integral roles, including chairing faculty promotion and tenure committees, research groups, and departmental communications efforts. I have led mentoring initiatives for faculty and students, organized research seminar programs, and contributed to graduate training infrastructure. My outreach activities include long-standing engagement with K–12 education, childcare centers, community science programs, and cancer research advocacy, extending the impact of my research and training mission beyond the university.