

## CHRISTINE E. SCHNITZLER, Ph.D.

Associate Professor of Biology



I am a marine biologist with expertise in comparative genomics and molecular and cellular biology investigating the evolution and function of stem cells in homeostasis and regeneration using a cnidarian model organism. I have experience in functional genomics tool development, fluorescence microscopy, comparative genomics, transcriptomics, computational biology, bioinformatics, and phylogenetics techniques. I regularly generate and analyze next-generation sequence data including long and short-read genomic sequencing data, as well as bulk and single-cell RNA sequencing data. I also have a strong background in experimental molecular and cellular biology research, as well as field work experience involving spawning, rearing, and manipulating cnidarian embryos and larvae. For more than 20 years, I have worked with early-diverging animal phyla, specifically cnidarians and ctenophores. I am currently culturing multiple strains of the colonial hydrozoan cnidarian *Hydractinia symbiolongicarpus* in my lab, including several transgenic lines.

My research program is centered on two main areas: comparative evolutionary genomics of cnidarians, and stem-cell mediated regenerative biology. My group is using experimental and computational approaches to explore these research areas. My lab's main research organism is the colonial marine hydroid *Hydractinia*, chosen for its exaggerated ability to regenerate any tissue throughout its life, ability to spawn thousands of eggs each week, and small and translucent nature, which makes it great for imaging. In 2019, I was awarded a \$1.566 million NSF EDGE grant (lead PI) to continue to develop functional genomics tools for *Hydractinia*, and to share resources with community members. In 2020, I was awarded a \$1.786 million NIH MIRA grant for Early Stage Investigators to explore stem cells in *Hydractinia*. I maintain strong connections across the entire cnidarian community. I am a co-organizer of the biannual Cnidarian Model Systems Meeting ("Cnidofest") which brings together over 125 cnidarian biologists across all training levels. I have co-organized monthly Cnidofest Zoom seminars, initiated during the pandemic since our biannual meeting had to be postponed. I have also helped develop web-based genome portals for several species, including the ctenophore *Mnemiopsis leidyi*, the freshwater hydroid *Hydra vulgaris*, and currently for *Hydractinia*. I mentor high school and undergraduate summer interns, PhD students, and postdoctoral fellows in my group, and serve on thesis committees for several Whitney and UF Biology graduate students. I have a versatile and highly sought-after skillset that blends experimental and computational biology and, thus, I collaborate widely with other researchers on topics related to my areas of interest. Through my collaborations, I have contributed to the fields of cnidarian developmental biology, functional genomics tool development in cnidarians, gene family evolution, and cnidarian neural system development.

### Education:

2010	Ph.D. in Integrative Biology (formerly Zoology), Oregon State University
2005	M.S. in Marine Science, Moss Landing Marine Labs, California State University-Monterey Bay
1998	B.S. in Environmental Science, Northwestern University

### Professional Experience:

2022-present	Associate Professor, Whitney Laboratory for Marine Bioscience, University of Florida
2016-2022	Assistant Professor, Whitney Laboratory for Marine Bioscience, University of Florida
2016-present	Guest Researcher, National Human Genome Research Institute, National Institutes of Health

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### **Postgraduate Appointments:**

- 2015-2016 Research Fellow, Computational and Statistical Genomics Branch, National Human Genome Research Institute, National Institutes of Health  
PI: Andreas D. Baxevanis, Ph.D.
- 2010-2015 Intramural Research Training Award Postdoctoral Fellowship, Computational and Statistical Genomics Branch, National Human Genome Research Institute, National Institutes of Health  
PI: Andreas D. Baxevanis, Ph.D.

### **Honors, Awards, and Fellowships:**

- 2019 Kavli Frontiers of Science Fellow, Invited Participant of 4<sup>th</sup> Israeli-American Symposium
- 2014 NHGRI Award to the Genomics and Evolution Team “For producing scientific advances that shook the tree of life from its shoots to its roots”
- 2013 NHGRI Intramural Research Award given to a post-doctoral fellow “In recognition of meritorious research accomplishments for a long-term body of work of exemplary quality and significance”
- 2013 NIH Community College Summer Enrichment Program Postdoctoral Mentor Award
- 2012 NHGRI Diversity and Community Outreach Award for helping to organize and teach a genomics course at the University of the District of Columbia
- 2012 Outstanding Service Award, Intramural Training Office, NHGRI/NIH
- 2010 Zoology Research Fund Award, Oregon State University
- 2009 Zoology Research Fund Award, Oregon State University
- 2008 Oregon Lottery Graduate Scholarship, Oregon State University
- 2008 Travel Award, Genomics of Coral Reefs, 11th International Coral Reef Symposium
- 2004 Martha Johnston Memorial Scholarship, Moss Landing Marine Laboratories

### **Teaching and Service:**

- 2022-present Co-Organizer, Cnidofest 2024 Meeting
- 2020-present Inclusion, Diversity, Equity, & Accessibility (IDEA) Committee Member, Whitney Lab, UF
- 2020-present Faculty Coordinator, Scientific Communication Group (SciComm), Whitney Lab, UF
- 2020-present Guest Lecturer, Stem Cell Course ZOO4926, University of Florida
- 2020-2022 Co-Organizer, monthly Cnidofest Zoom meetings
- 2019-2022 Organizing Committee Member, Cnidofest Meeting, UC-Davis, Sept 7-10, 2022
- 2019-present Graduate Admissions Committee Member, Department of Biology, UF
- 2019-2020 Search Committee Member, Tenure Track Wildlife Biologist, Whitney Lab
- 2018-present Grant Writing Workshop Co-Instructor (with Joe Ryan)
- 2018-2019 Search Committee Member, Tenure Track Marine Metabolomics and Proteomics Biologist, Department of Biology, UF
- 2017-2021 Lecturer for NSF REU program at Whitney Lab
- 2017- 2018 Co-Organizer, Cnidofest Meeting, Whitney Lab, Sept 6-9, 2018
- 2017-2018 Search Committee Member, Tenure Track Bioengineer/Neuroscientist, Whitney Lab
- 2017-2018 Search Committee Member, Tenure Track Molecular/Cellular Biologist, Department of Biology, UF
- 2016 Co-Organizer, Hydroidfest Meeting, Bodega Marine Lab, Sept 23-25, 2016
- 2015-2016 Co-Organizer, Ctenopalooza Meeting, Whitney Lab, March 14-15, 2016
- 2011-2014 Co-Coordinator, Genomics Course, University of the District of Columbia

## Patents Held:

2008

Haddock, S, **Schnitzler, C**, Keenan, R, McCord, R. Long-wavelength FPs. US Patent Number 7,326,771.

## Publications: (h-index = 26; i10-index = 40, total citations = 3777)

Huene, A.L., Sanders, S.M., Ma, Z., Nguyen, A-D., Koren, S., Michaca, M.H., Mullikin, J.C., Phillippy, A.M., **Schnitzler, C.E.**, Baxevanis, A.D., Nicotra, M.L. 2022. A family of unusual immunoglobulin superfamily genes in an invertebrate histocompatibility complex. *Proceedings of the National Academy of Sciences (PNAS)* 119(40): e2207374119. <https://www.pnas.org/doi/10.1073/pnas.2207374119>.

Quiroga-Artigas, G., de Jong, D., **Schnitzler, C.E.** 2022. GNL3 is an evolutionarily conserved stem cell gene influencing cell proliferation, animal growth and regeneration in the hydrozoan *Hydractinia*. *Open Biology* 12:220120. <https://doi.org/10.1098/rsob.220120>.

Chrysostomou, E., Flici, H., Gornik, S.G., Salinas-Saavedra, M., Gahan, J.M., McMahon, E.T., Thompson, K., Hanley, S., Kincoyne, M., **Schnitzler, C.E.**, Gonzalez, P., Baxevanis, A.D., Frank, U. 2022. A cellular and molecular analysis of SoxB-driven neurogenesis in a cnidarian. *eLife* 11:e78793. <https://elifesciences.org/articles/78793>.

Farrell, J.A.(g), Yetsko, K.(g), Whitmore, L.(g), Whilde, J., Eastman, C.B., Ramia, D.R., Thomas, R., Linser, P., Creer, S., Burkhalter, B., **Schnitzler, C.E.**, Duffy, D.J. 2021. Environmental (e)DNA-based monitoring of oncogenic viral shedding, and genomics of external, internal and post-surgical regrowth fibropapillomatosis tumors reveals unusual viral dynamics. *Communications Biology* 4, 565.

Yetsko, K., Farrell, J.A., Blackburn, N.B., Whitmore, L., Stammnitz, M.R., Whilde, J., Eastman, C.B., Ramia, D.R., Thomas, R., Krstic, A., Linser, P., Creer, S., Carvalho, G., Devlin, M.A., Nahvi, N., Leandro, A.C., deMaar, T.W., Burkhalter, B., Murchison, E.P., **Schnitzler, C.E.** and Duffy, D.J. 2021. Molecular characterization of a marine turtle tumor epizootic, profiling external, internal and post-surgical regrowth tumors. *Communications Biology* 4, 152.

Gahan, J.M., Rentzsch, F., **Schnitzler, C.E.** 2020. The genetic basis for PRC1 complex diversity emerged early in animal evolution. *PNAS* 117(37): 22880-22889.

Quiroga-Artigas, G., Duscher, A., Lundquist, K., Waletich, J., **Schnitzler, C.E.** 2020. Gene knockdown via electroporation of short hairpin RNAs in embryos of the marine hydroid *Hydractinia symbiolongicarpus*. *Scientific Reports* 10 (12806).

Newkirk, C.R., Frazer, T.K., Martindale, M.Q., **Schnitzler, C.E.** 2020. Adaptation to Bleaching: Are Thermotolerant Symbiodiniaceae Strains More Successful Than Other Strains Under Elevated Temperatures in a Model Symbiotic Cnidarian? *Frontiers in Microbiology* 11 (822).

Frank, U., Nicotra, M.L., **Schnitzler, C.E.** 2020. The colonial cnidarian *Hydractinia*. *EvoDevo* 11 (7).

DuBuc, T.Q., **Schnitzler, C.E.**, Chrysostomou, E., McMahon, E.T., Febrimarsa, Gahan, J.M., Buggie, T., Gornik, S.G., Hanley, S., Barreira, S.N., Gonzalez, P., Baxevanis, A.D., Frank, U. 2020. Transcription factor AP2 controls cnidarian germ cell induction. *Science* 367(6479): 757-762.

He, S., Grasis, J.A., Nicotra, M.L., Juliano, C.E., **Schnitzler, C.E.** 2019. Cnidofest 2018: the future is bright for cnidarian research. *EvoDevo* 10:20.

**Schnitzler, C.E.** 2019. What makes a jellyfish. *Nature Ecology and Evolution* 3: 724.

Siebert, S., Farrell, J.A., Cazet, J., Abeykoon, Y., Primack, A.S., **Schnitzler, C.E.**, Juliano, C.E. 2019. Stem cell differentiation trajectories in *Hydra* resolved at single-cell resolution. *Science* 365:eeav9314.

Sanders, S.M., Ma, Z., Hughes, J.M., Riscoe, B.M., Gibson, G.A., Watson, A.M., Flici, H., Frank, U., **Schnitzler, C.E.**, Baxevanis, A.D., Nicotra, M.L. 2018. CRISPR/Cas9-mediated gene knockin in the hydroid *Hydractinia symbiolongicarpus*. *BMC Genomics*. 19:649.

Duffy, D, **Schnitzler C.E.**, Karpinski, L, Thomas, R, Whilde, J, Eastman, C, Yang, C, Krstic, A, Rollinson, D, Zirkelbach, B, Yetsko, K, Burkhalter, B, Martindale, MQ. 2018. Sea turtle fibropapilloma tumors share genomic drivers and therapeutic vulnerabilities with human cancers. *Communications Biology* 1:63.

Haddock, S.H.D., Christianson, L.M., Francis, W.R., Martini, S., Powers, M.L., Dunn, C.W., Pugh, P.R., Mills, C.E., Osborn, K.J., Seibel, B.A., Choy, C.A., **Schnitzler, C.E.**, Matsumoto, G.I., Messié, M., Schultz, D.T., Winnikoff, J.R., Gasca, R., Browne, W.E., Johnsen, S., Schlining, K.L., von Thun, S., Erwin, B.E., Ryan, J.F., Thuesen, E.V. 2017. Insights into the biodiversity, behavior, and bioluminescence of deep-sea organisms using molecular and maritime technology. *Oceanography* 30(4):38-47.

Davidson, P.L., Koch, B.J., **Schnitzler, C.E.**, Henry, J.Q., Martindale, M.Q., Browne, W.E. 2017. The maternal-zygotic transition and zygotic activation of the *Mnemiopsis leidyi* genome occurs within the first three cleavage cycles. *Molecular Reproduction and Development* 84: 1218-1229.

Berthelie, J., **Schnitzler, C.E.**, Wood-Charlson, E.M., Poole, A.Z., Weis, V.M., Detournay, O. 2017. Implication of the host TGF $\beta$  pathway in the onset of symbiosis between larvae of the coral *Fungia scutaria* and the dinoflagellate *Symbiodinium* sp. (clade C1f). *Coral Reefs* 36: 1263-1268.

Gahan, J.M., **Schnitzler, C.E.**, DuBuc, T.Q., Doonan, L.B., Kanska, J., Gornik, S.G., Barreira, S., Thompson, K., Schiffer, P., Baxevanis, A.D., Frank, U. 2017. Functional studies on the role of Notch signaling in *Hydractinia* development. *Developmental Biology*. 1:224-231.

Dupre, C., Grasis, J.A., Steele, R.E., **Schnitzler, C.E.**, Juliano, C.E. 2017. Hydroidfest 2016: celebrating a renaissance in hydrozoan research. *EvoDevo* 8:7.

Voolstra, C., GIGA Community of Scientists (COS), Worheide, G., Lopez, J. 2017. Advancing genomics through the Global Invertebrate Genomics Alliance (GIGA). *Invertebrate Systematics* 31: 1–7. [I was part of the GIGA Community of Scientists group.]

Flici, H., **Schnitzler, C.E.**, Millane, R.C., Govinden, G., Houlihan, A., Boomkamp, S.D., Shen, S., Baxevanis, A.D., Frank, U. 2017. An evolutionarily conserved SoxB-Hdac2 crosstalk regulates neurogenesis in a cnidarian. *Cell Reports* 18:1395-1409. PMID: PMC5312794.

Török, A, Schiffer, P.H., **Schnitzler, C.E.**, Ford, K, Mullikin, J.C., Baxevanis, A.D., Bacic, A, Frank, U, Gornik, S.G. 2016. The cnidarian *Hydractinia echinata* employs canonical and highly adapted histones to pack its DNA. *Epigenetics & Chromatin* 9:36. PMID: PMC5011920

Francis, W.R., Christianson, L.M., Powers, M.L., **Schnitzler, C.E.**, Haddock, S.H.D. 2016. Nonexcitable fluorescent protein orthologs found in ctenophores. *BMC Evolutionary Biology* 16:167. PMID: PMC4997694.

Ryan, J.F., **Schnitzler, C.E.**, Tamm, S.L. 2016. Meeting report of Ctenopalooza: the first international meeting of ctenophorologists. *EvoDevo* 7:19.

Presnell, J.S., **Schnitzler, C.E.**, Browne, W.E. 2015. KLF/SP transcription factor family evolution: expansion, diversification, and innovation in eukaryotes. *Genome Biology and Evolution* 7:2289-2309. PMID: 26232396.

Pope, W.H., Bowman, C.A., Russell, D.A., Jacobs-Sera, D., Asai, D.J., Cresawn, S.G., Jacobs, W.R. Jr, Hendrix, R.W., Lawrence, J.G., Hatfull, G.F., Science Education Alliance Phage Hunters Advancing Genomics and Evolutionary Science, Phage Hunters Integrating Research and Education, Mycobacterial Genetics Course. 2015. Whole genome comparison of a large collection of mycobacteriophages reveals a continuum of phage genetic diversity. *eLife* 4:e06416. PMID: 25919952. [I was part of the Science Education Alliance Phage Hunters Advancing Genomics and Evolutionary Science group.]

Maxwell, E.K., **Schnitzler, C.E.**, Havlak, P., Putnam, N.H., Nguyen, A.D., Moreland, R.T., Baxevanis, A.D. 2014. Evolutionary profiling reveals the heterogeneous origins of classes of human disease genes: implications for modeling disease genetics in animals. *BMC Evolutionary Biology* 14:212. PMID: 25281000.

**Schnitzler, C.E.**, Simmons D.K., Pang, K., Martindale, M.Q., Baxevanis, A.D. 2014. Expression of multiple *Sox* genes through embryonic development in the ctenophore *Mnemiopsis leidyi* is spatially restricted to zones of cell proliferation. *EvoDevo* 5:15. PMID: 24834317.

Moreland, R.T., Nguyen, A.D., Ryan, J.F., **Schnitzler, C.E.**, Koch, B.J.\*, Siewert, K.\*, Wolfsberg, T.G., Baxevanis, A.D. 2014. A customized Web portal for the genome of the ctenophore *Mnemiopsis leidyi*. *BMC Genomics* 15:316. PMID: 24773765.

Ryan, J.F., Pang, K., **Schnitzler, C.E.**, Nguyen, A-D, Moreland, R.T., Simmons, D.K., Koch, B.J.\*, Francis, W.R., Havlak, P., NISC Comparative Sequencing Program, Smith, S.A., Putnam, N.H., Haddock, S.H.D., Dunn, C.W., Wolfsberg, T.G., Mullikin, J.C., Martindale, M.Q., Baxevanis, A.D. 2013. The genome of the ctenophore *Mnemiopsis leidyi* and its implications for cell type evolution. *Science* 342:1242592. PMCID: PMC3920664.

**Schnitzler, C.E.**, Pang, K., Powers, M., Reitzel, A.M., Ryan, J.F., Simmons, D., Tada, T., Park, M., Gupta, J., Brooks, S.Y., Blakesley, R.W., Yokoyama, S., Haddock, S.H.D., Martindale, M.Q., Baxevanis, A.D. 2012. Genomic organization, evolution, and expression of photoprotein and opsin genes in *Mnemiopsis leidyi*: a new view of ctenophore photocytes. *BMC Biology* 10:107. PMCID: PMC3570280.

Maxwell, E.K., Ryan, J.F., **Schnitzler, C.E.**, Browne, W.E., Baxevanis, A.D. 2012. MicroRNAs and microRNA processing machinery are absent in the genome of the ctenophore *Mnemiopsis leidyi*. *BMC Genomics* 13:714. PMCID: PMC3563456.

Detournay, O.\*, **Schnitzler C.E.\***, Poole, A., Weis V.M. 2012. Regulation of cnidarian-dinoflagellate mutualisms: Evidence that activation of a host TGF $\beta$  innate immune pathway promotes tolerance of the symbiont. *Developmental and Comparative Immunology* 38:525-537. \*Co-first author. PMID: 23010490.

**Schnitzler, C.E.**, Hollingsworth, L.L., Krupp, D.A., Weis, V.M. 2012. Elevated temperature impairs onset of symbiosis and reduces survivorship in larvae of the Hawaiian coral, *Fungia scutaria*. *Marine Biology* 159:633-642.

Pope, W.H., Jacobs-Sera D., Russell D.A., Peebles C.L., Al-Atrache Z... **Schnitzler, C.E.**...et al. (192 authors) 2011. Expanding the diversity of mycobacteriophages: Insights into genome architecture and evolution. *PLoS ONE* 6(1):e16329. PMID: PMC3029335.

**Schnitzler, C.E.**, Weis, V.M. 2010. Coral larvae exhibit few measurable transcriptional changes during the onset of coral-dinoflagellate endosymbiosis. *Marine Genomics* 3:107-116. PMID: 21798204.

Richier, S., Rodriguez-Lanetty, M., **Schnitzler, C.E.**, Weis, V.M. 2008. Response of the symbiotic cnidarian *Anthopleura elegantissima* transcriptome to temperature and UV increase. *Comparative Biochemistry and Physiology D: Genomics and Proteomics* 3:283-289. PMID: 20494848.

**Schnitzler, C.E.**, Keenan, R.J., McCord, R., Matysik, A., Christianson, L.M., Haddock, S.H.D. 2008. Spectral diversity of fluorescent proteins from the anthozoan *Corynactis californica*. *Marine Biotechnology* 10:328-342. Cover photo. PMID: 18330643.

Dunn, S.R., **Schnitzler, C.E.**, Weis, V.M. 2007. Apoptosis and autophagy as mechanisms of dinoflagellate symbiont release during cnidarian bleaching: every which way you lose. *Proceedings of the Royal Society of London Series B*. 274:3079-3085. PMID: PMC2293937.

Haddock, S.H.D., Dunn, C.W., Pugh, P.R., **Schnitzler, C.E.** 2005. Use of bioluminescent and redfluorescent lures in deep-sea fish-eating siphonophores. *Science* 309:263. PMID: 16002609.

Farzan, M., Chung, S., Li, W., Vasilieva, N., Wright, P., **Schnitzler, C.E.**, Marchione, RJ, Gerard, C, Gerard, NP, Sodroski, J, Choe, H. 2002. Tyrosine-sulfated peptides functionally reconstitute a CCR5 variant lacking a critical amino-terminal region. *Journal of Biological Chemistry* 277(43):40397-40402. PMID: 12183462.

Farzan, M., **Schnitzler, C.E.**, Vasilieva, N., Leung, D., Kuhn, J., Gerard, C., Gerard, N., Choe, H. 2001. Sulfated tyrosines contribute to the formation of the C5a docking site of the human C5a anaphylatoxin receptor. *Journal of Experimental Medicine* 193(9):1059-66. PMID: PMC2193433.

Farzan, M., Vasilieva, N., **Schnitzler, C.E.**, Chung, S., Robinson, J., Gerard, N.P., Gerard, C., Choe, H., Sodroski, J. 2000. A tyrosine-sulfated peptide based on the N-terminus of CCR5 interacts with a CD4-enhanced epitope of the HIV-1 gp120 envelope glycoprotein and Inhibits HIV-1 entry. *Journal of Biological Chemistry* 275 (43):33516-33521. PMID: 10938094.

Farzan, M., **Schnitzler, C.E.**, Vasilieva, N., Leung, D., Choe, H. 2000. BACE2, a  $\beta$ -secretase homologue, cleaves at the  $\beta$ -site and within the amyloid- $\beta$  region of the amyloid- $\beta$  precursor protein. *Proceedings of the National Academy of Sciences* 97(17):9712-9717. PMID: PMC16930.

#### **Research Support:**

NSF IOS: EDGE: Enabling cell-specific functional genomics in a colonial animal (\$1,566,223 Total Costs). Role: Lead PI.

NIH R35 MIRA for Early Stage Investigators (ESIs): Characterizing the molecular regulators of stem cell populations during homeostasis and regeneration in *Hydractinia*, an emerging cnidarian research organism. (\$1,786,642 Total Costs). Role: PI.