

# 2021\_SSP Faculty Projects

Row 2

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**Research Group** Robic

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**Project Title** **Exploring fruit fly metabolic pathways through comparative genomic analysis**

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**Research Question, Hypothesis, or Conjecture** How do evolutionary changes to metabolic pathways affect regulation of these pathways in different species?

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**Project Description** Genomics is an exciting, relatively new, area of biology which focuses on using computational tools to understand how the sequence of our genes encodes the mechanisms of cells and organisms. In this project, we will annotate genes (determine their start, end, structure and regulatory regions) with focus on trying to understand biochemical pathways. Pathway is a sequence of regulatory and enzymatic reactions which result in important biological outcomes, such as regulation of blood sugar levels or defense against pathogens. In addition to annotating genes, we will use network analysis to try to understand function and evolution of such pathways. We will focus on pathways related to metabolic homeostasis by analyzing sequences from multiple fruit fly (*Drosophila*) species. Your research project will be an original analysis of genomic data, and your contribution, if significant enough, will likely lead to a publication in collaboration with Genomics Education Partnership (GEP) (<https://thegep.org/>). Previously ASC students who carried out GEP-related research presented their work at national conferences and some even became co-authors on prestigious peer-reviewed journals. The long-term goal of the *Drosophila* Pathways Project is to analyze how the regulatory regions of genes evolve in the context of their positions within a network. This type of work helps us understand mechanisms of regulation of important biological processes, and has fundamental implications relevant to other species, including understanding human health.

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**Introductory References** 1.S. Williams, K. Dew-Budd, K. Davis, J. Anderson, R. Bishop, K. Freeman, D. Davis, K. Bray, L. Perkins, J. Hubickey, L.K. Reed, 2015 "Metabolomic and gene expression profiles exhibit modular genetic and dietary structure linking metabolic syndrome phenotypes in *Drosophila*" G3: GENES, GENOMES, GENETICS December 1, 2015 vol. 5 no. 12 2817-2829; 2.Elgin CR, ...,Robic S, ...,Leatherman, J. 2017. The GEP: Crown-Sourcing Big Data Analysis with Undergraduates. Trends in Genetics 33(2) 81-85

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**Project Timeline (weekly), during June 1 - July 31** Wk1: Lit review, set the expectations, work on understanding genes training modules Wk2: Complete genome browser training, claim annotation project Wk3-4 Work on annotating genes from the project, submit to the database by end of week 4, write up the annotation portion of the project Wk 5-6 Pathway analysis: lit review, start working on analysis Wk 7-8 Complete pathway analysis, write up the pathway analysis portion of the project

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**Expected Learning Outcomes** 1. Students will become skilled in using tools such as genome browser 2. Students will be able to independently annotate genes 3. Students will understand limitations of annotation process 4. Students will use different lines of evidence (experimental, computational, evolutionary) when building their gene models, and critically reflect on their choices 5. Students will develop a pathway model based on evidence they collected during gene annotation

<b>Research Team &amp; Environment</b>	Our research team will the undergraduate students and me. However, we will be interacting with the broader Genomics Education Partnership community by participating in some virtual meetings and accessing help form GEP virtual "TAs" as needed.
<b>Department</b>	Biology
<b>4 or 8 Week Project</b>	8 weeks
<b># of full-time student positions requested (1-3)</b>	Two students: one novice one who took my bioinformatics class (but I would consider two novices too)
<b>Minimum Requirements (for research novices)</b>	BIO 110-111
<b>Requirements for Advanced students</b>	NA
<b>Recommended Preparation (but not required)</b>	
<b>Modification for Remote Research (IF needed)</b>	The research I am proposing this summer is computational and can easily be adopted to a virtual setting. If needed, our individual and group meetings can be on zoom. All students will need for their research is a computer and access to the internet. The computational tools we are using are free and available through internet browser access and via the Genomics Education Partnership portal. Another exciting feature of this project is its collaborative nature. Since the start of the pandemic, the GEP has started offering virtual "TAs" available to all the students doing GEP-related research. This means, that my students will have access to additional research support from more advanced undergraduate and graduate research assistants with experience in genomics. This will be especially helpful if we encounter technology-related issues or complicated data analysis challenges.