SOAR Research Proposal - Summer 2014

Project title — Characterization of a novel bang-sensitive gene in *Drosophila melanogaster*
Faculty — Christopher Jones, Associate Professor of Biological Sciences
Student — Ghazal Stity
Project duration — 10 weeks, Monday June 16 through Friday August 22

[Ghazal will be out of the country until mid-June; she and I have discussed this, and I have no objection to working with her beyond the normal end of the SOAR program to enable her to have a full 10-week project.]

Description of the project —

Studying bang-sensitive mutations in the fruit fly *Drosophila melanogaster* has been a long-term focus of my laboratory. Any one of these mutations results in the fly displaying seizures and paralysis upon violent stimulation (e.g. "banging" the container it's held in, thus the name of the mutant class). Although researchers are still at an early stage in the study of these genetic lesions, they hold promise for better understanding human seizure disorders such as epilepsy.

Only a half-dozen of these mutations have been identified at the level of the gene, a necessary step in understanding the mechanism by which they act. Or perhaps "mechanisms" is more appropriate; the genes that have been identified so far code for proteins with no obvious connecting functional roles; these include citrate synthase (essentially ubiquitous in cells, necessary for energy metabolism), ethanolamine kinase (involved in lipid metabolism), and a structural protein comprising part of the ribosome (crucial for building proteins). Expanding the catalog of these bang-sensitive mutants and identifying the affected genes seems necessary to eventually understanding how these mutations exert their effects.

I recently acquired a new, as-yet-uncharacterized bang-sensitive mutant from a colleague at the Bloomington Drosophila Stock Center. Preliminary testing has confirmed that it is on the X chromosome, and that it is not in any of the known bang-sensitive genes. Ghazal's goal will be to characterize this new mutation as much as is possible over the course of the summer: recombination mapping to confirm its general location, deletion mapping to narrow the list of candidate genes, transgenic rescue and genome sequencing to confirm the identity of the gene, and characterization of the bang-sensitive phenotype (temperature sensitivity, refractory period, suppressibility, and interactions with other bang-sensitive mutations).

Roles and responsibilities —

Ghazal has acquired an extensive background in the necessary knowledge and skills to succeed with this project: she has taken both Genetics and Genomics with me, served as a TA in Genetics

this past semester, and is currently enrolled in Molecular Genetics. This SOAR project will enable her to synthesize much of what she's learned and apply her various skills to a single project, an increasingly common skill in modern molecular genetic research. She will be responsible for background research

(reviewing the basic molecular genetics she has learned as well as specifics of the bang-sensitive mutants characterized to date), determining and ordering the additional mutant stocks needed for mapping the mutation, identifying and/or creating the necessary molecular reagents for rescue experiments, and conducting a range of experiments to better characterize the phenotype of this mutant.

My role will be to guide Ghazal's background research, coordinate the various aspects of the project, guide her in her initial forays into the various databases she will need to access, and to make suggestions as we discuss strategies, to help her hone her abilities to think and work like a molecular geneticist.

Weeks 1–2: Literature research and review; decide on mapping strategy; order the necessary mapping stocks.
Weeks 3–8: Carry out mapping crosses.
Weeks 8-10: Begin making rescue constructs if possible; begin to prepare for presentation at Scholars Day, the NCUR conference, and the Drosophila Research Conference (if appropriate).

Note that because of the 10-day life cycle of the fruit fly, there will be a number of days of "downtime" throughout the project, during which Ghazal will be waiting for cross progeny. On these days she will be carrying out the phenotypic characterization experiments.

Student engagement —

The strategies, techniques, and experimental goals of this project are all considered fundamental in *Drosophila* genetics, and indeed are essentially identical to those in genetic studies using other model organisms. Her involvement in all phases of the project, from planning the crosses to carry out to acquiring the data to analyzing them with an eye toward the next step toward our goal, will further strengthen her command of the research process. Given her interest in pursuing biomedical research, whether as a clinician or a research scientist, this project will prove invaluable to her development as a professional.

Student contributions —

Assuming that this proves to be a new bang-sensitive gene (and my preliminary results indicate strongly that it is), we will ultimately publish our findings. I hesitate to say that we will accumulate enough data over the course of the summer to do this, but this project will certainly lay the groundwork for future research, either conducted by Ghazal next year or by another student, which will qualify as publishable.

It will also add to our understanding of this interesting class of genes, which may someday contribute to improved therapies for human seizure disorders.

Although I don't know whether this SOAR project will produce directly publishable results, I anticipate that they will be more than sufficient to merit presentation at regional and national conferences. In years past my SOAR students have presented their work at the regional Beta Beta Beta convention (Tri-Beta is the undergraduate biology honor society), the National Council for Undergraduate Research conference, and at the national Drosophila Research Conference. Next spring the "Fly Meeting" will be held in Chicago, a relatively accessible city from Bethlehem, so I foresee no problem with Ghazal's participation there, should we be as successful as I hope.

Application, Part 4: Expense Proposal

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Budget items — mapping stocks

It is impossible to know in advance how many additional stocks will be necessary for this project; it will depend on initial results and luck. Assuming a total of 20 stocks are needed (a not-unreasonable number for this sort of work), that will cost $190.00.

Additional expenses (e.g. routinely-used laboratory supplies, fly food ingredients, additional reagents) will be covered by the Department of Biological Sciences.

SOAR Student Statement of Purpose –Summer 2014

Mapping a New "Bang Sensitive" Gene in *Drosophila melanogaster*

Name: Ghazal Stity
Major: Biochemistry
Graduation: May 2015
On- campus housing request: Yes

Faculty Mentors: Professor Christopher Jones

I felt my perspective begin to shift markedly when I first skimmed a chapter on molecular biology and genetics in a biology high school textbook. I was completely captivated by the notion of DNA, and how it holds within it the blueprint for biological life. The concepts of DNA, proteins, enzymes and gene behavior were all illuminated after the various genetics courses I took at Moravian.

At the onset of my undergraduate endeavors, I concentrated solely on the ultimate goal of medical school. However, after gleaning experience in a laboratory setting, I found myself completely enraptured by the power of research. I did not want to stray from my original goals, but found my interests had begun to evolve, and that my educational commitments should reflect this. As a result, my academic focus has shifted to include not only medicine, but the research and innovation that lie behind the scenes.

My journey with genetics began in fall 2012 when I had my first Genetics course at Moravian which I absolutely loved. I have gained great experience and insight with respect to genetic linkage and recombination through my lab work with *Drosophila melanogaster*. This encouraged me to enroll in a genomics course (spring 2013) to learn more about the world of DNA sequencing. In this course, we worked on the finishing and annotation of the genomic DNA sequence of *Drosophila ananassae*. I, then, worked as a laboratory teaching assistant to Dr.

Jones for his genetics course in the fall semester of 2013 and I am currently taking a molecular genetics course. My experiences in this field made me very passionate about the subject and so eager to actively participate in such a project.

The research I wish to tackle with the supervision and guidance of Dr. Jones would aim to narrow down the location of a new "bang sensitive" gene. "Bang sensitive" mutations express a seizure-like phenotype when exposed to vigorous physical shock. The possible relation between this family of mutations and nervous system maladies in humans, such as epilepsy is very interesting and appealing to me. Previous complementation and mapping tests done by Dr. Jones suggested that the gene in question is on the X-chromosome and is novel. The next task will be to perform several molecular genetics techniques such as deletion mapping, cloning, etc. to further narrow down the location or hopefully pinpoint it. The results I hope to achieve may carry the project a step closer to publication and reveal another enciphered secret of well-being.

The SOAR program will be an enriching opportunity for me to utilize the skills I have developed through my laboratory work and especially the ones I am currently studying in my molecular genetics class. My SOAR work with Drs. Shari and Stephen Dunham for ten days over winter break 2014 was very fruitful and encouraged me to participate in an over summer research. A summer SOAR will allow me to spend more time focusing on a topic I am mainly interested in. By engaging in this project with Dr. Jones, I expect to apply and enhance my knowledge about forward and reverse genetics techniques widely used in scientific research. As a premedical student, I believe that this experience will be an invaluable contributor in my future career. Immersing myself in research for ten weeks will feed my appreciation for science and will definitely make me a more knowledgeable physician in the future.