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Waking Students up with Explorations of Metabolic Dormancy: A Pilot Study of the Killifish CURE

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Can we engage large numbers of biology undergraduates in a killifish research project that encourages student interest in science and yields novel scientific data?

To address this research question, we are piloting a course-based undergraduate research experience (CURE) in introductory biology labs, using the emerging model system, the Annual Killifish.

### Background: CURE

- Undergraduate research experiences increase retention and interest in STEM fields.
- Research positions in faculty labs are limited, but CUREs allow many undergraduates to participate in research.
- In a CURE classroom, students experience the following: 1) use of scientific practices, 2) discovery, 3) broader relevance or importance, 4) collaboration, and 5) iteration.

### Background: Killifish

- The annual killifish (Austrofundulus limnaeus) survives in temporary ponds found in Venezuela.
- Populations are able to survive by producing embryos that can enter into a state of metabolic dormancy (Diapause).
- Previous research in the lab has elucidated a possible mechanism for Diapause II.
- However, little is known about Diapause I (DI) in A. limnaeus, or what specific biotic factors cause embryos to enter DI in any species of annual killifish.

### Hypothesis: CURE

- Participation in the Killifish CURE will engage Portland State Principles of Biology students with principles of scientific research and increase student interest in research.

### Hypothesis: Killifish

- The presence of a biotic factor will induce Diapause I in A. limnaeus embryos, which may be a shared mechanism across all annual killifish species.

### Course timeline:

**Experimental outline: CURE**

<table>
<thead>
<tr>
<th>CURE Component</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Use of scientific practices</td>
<td>Experiment design; conducting experiments, data collection and analysis, student presentations</td>
</tr>
<tr>
<td>2 Discovery</td>
<td>Diapause I cues of interest have not previously been studied in A. limnaeus</td>
</tr>
<tr>
<td>3 Broad relevance</td>
<td>Experiment has ecological significance, and is novel, relevant work in the Podrabsky lab</td>
</tr>
<tr>
<td>4 Collaboration</td>
<td>Students work in groups and alongside the teaching assistants, and will have guidance from Dr. Podrabsky</td>
</tr>
<tr>
<td>5 Iteration</td>
<td>Students have opportunity to repeat or alter their experimental treatments, and their work builds on ongoing killifish research</td>
</tr>
</tbody>
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We will compare outcomes for students in the CURE pilots (n=77) to students in the non-CURE labs (n=302) through:

- The Laboratory Course Assessment Survey (LCAS), administered to students in Week 10, which tests if students perceive critical components of the CURE.
- Analysis of open-ended prompts, such as “What do you think it means to think like a scientist?”
- Pre- and post-course survey questions and focus groups/interviews for further insight about the impact of the CURE on students.

**Future Directions:**

- Use student-collected data to develop understanding of factors that impact killifish embryo entrance into DI, and potentially publish data.
- Collect student data and input to determine if CUREs are an effective tool to expose PSU’s specific student population to research.
- Scale-up CUREs across all Principles of Biology lab sections.

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### References:


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A course timeline of the CURE piloted in four sections of the Spring 2018 Principles of Biology laboratory series at Portland State University.

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### Experimental outline: Killifish

- Brainstorm treatments based off of scientific literature.
- Expose recently fertilized embryos to biotic factors.
- e.g., adult killifish (male and/or female) or any species of fish.
- Observe embryos to see if they continue developing or enter Diapause I.
- Repeat or alter experimental treatments to deduce what exactly is causing arrested development.
- Analyze results to produce robust and potentially publication-quality data as a foundation for Diapause I exploration.

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### Acknowledgements:

We would like to thank the biology department and Portland State University for allowing us to pilot our CURE. Special thanks to Emily Cornelius and Mike Wender for their help in designing and coordinating the CURE. Ultimately, none of this work would be possible without the Principles of Biology students and their excitement to participate in this novel research.

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