**Course Title:** BIOL 102: Introductory Biology, section 557

**CURE Project Title:** Determining genetic relationships of plant pollinator traits in Maryland wildflowers

**Primary Investigator(s):** Mary Glover

**Research Assistant(s), if applicable:**

**CURE Project Abstract (250 words or less):**

In this project, students will determine the genetic relationships between flowering plants found in Prince George’s county, using the *RBCL* gene. Students will explore the species of flowering plants in PG county using iNaturalist, which includes a database of organisms observed through citizen science. Students will collect sequences from plants that of their choosing from publicly available databases build a phylogenetic tree. They will then map two pollinator traits onto the phylogenetic tree to see if the traits are conserved in the clades or if the traits evolve independently.

**Research Goals (Please include at least 2-3 research goals for the CURE Project):**

1. Determine the phylogenetic relationships for wildflower plant species
2. Compare genetic relationships to the plant pollinator traits

**Student Goals (Please include at least 3-4 learning objectives for the students in the CURE Project):**

1. Analyze DNA sequence data using various computer programs
2. Maintain accurate and complete notes during a scientific project
3. Manage their data throughout the experiment
4. Create data figures and interpret
5. Present results in a scientific poster

**Context for the Research (Is this part of larger project or is it a stand-alone project? What is the relevance of the research to the scientific community?)**

This is a stand-alone project. As a part of the project students determine the species of flowers that are most abundant in PG county as observed through citizen science, in the process learning the role that the community plays in building scientific knowledge. Students will also learn the important role of pollinator in the ecosystem, specifically in their own backyard.

**Target Audience for the CURE Project: (Major, Non-Major, Upper Level Students, etc. Please identify all categories that define your target audience.)**

Major or non-major lower level undergraduates.

**CURE Project Duration: (Full Semester, Half Semester, Number of Weeks)**

Half semester (~8 weeks); the first half of the semester students will learn about bench skills and the experiments that make up DNA barcoding through virtual labs. The second half of the experiment will focus on their project, analyzing publicly available data that has been collected through DNA barcoding.

**CURE Design (Elaborate on the focus of the project and its overall goals)**

In this project, students will build off of what they learn in the first half of the semester, detailing the process of DNA barcoding. The project will demonstrate the application of DNA barcoding and how to analyze and work with DNA sequences. Special focus will be given on managing data, record keeping, and general organizational skills needed to be successful in the lab. Students will determine the evolutionary pattern of a specific pollinator trait in plants, such as plant shape. They will ask, do similar traits cluster together on a phylogenetic tree or did the traits evolve independently? By doing so, they will apply what they have learned in the lecture class about the process of evolution and how to make phylogenetic trees to look at phylogenetic signal in flowering plants. They will also explore plants found in Prince George County to add connection to the question. Lastly, they will summarize and present their findings in a poster, learning how to interpret data and effectively present their work.

**Tasks that Align Student and Research Goals (We use examples before for two separate projects. Student goal 1 and research goal 1 are for a separate project; student goal 2 and research goal 2 are for a separate project)**

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| --- | --- | --- |
|  | **Research Goal 1**  Determine the phylogenetic relationships for wildflower plant species | **Research Goal 2**  Compare genetic relationships to the plant pollinator traits |
| **Student Goal 1**  Analyze DNA sequence data using various computer programs | 1. Collect DNA sequences for plants 2. Complete a phylogenetic analysis to determine the relationships between species | 1. Determine pollinator traits of plants |
| **Student Goal 2**  Maintain accurate and complete notes during a scientific project | 1. Complete lab notebook after each part of the project to keep track of how the analysis was done. | 1. Complete lab notebook after each part of the project to keep track of how the analysis was done. |
| **Student Goal 3**  Manage their data throughout the experiment | 1. Store and manage all data in Microsoft Office. | 1. Store and manage all data in Microsoft Office. |
| **Student Goal 4** Create data figures and interpret | 1. Make phylogenetic tree based on species they choose using RBCL gene. | 1. Map plant traits onto the phylogenetic tree to show evolutionary pattern using PowerPoint |
| **Student Goal 5**  Effectively present results in a scientific poster | 1. Summarize methods and results on a poster | 1. Summarize methods and results on a poster |

**Instructional Materials (Overview of Lab Experiments):**

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Date | Topic | Assignments due |
| 8 | 10/19 – 10/23 | Introduction to pollination | DNA barcoding lab quiz Pollination introduction questions |
| 9 | 10/26 -10/30 | Assessing pollinators in Prince George County with excel | Lab 9 lab notebook Excel lab |
| 10 | 11/2 – 11/6 | Collecting DNA sequences and plant pollinator traits | Lab 10 lab notebook Plant trait table DNA sequence FASTA file Pollination infographic |
| 11 | 11/9 – 11/13 | Phylogenetic analysis | Lab 11 lab notebook Phylogenetic tree |
| 12 | 11/16 – 11/20 | Interpreting analysis and phylogenetic signal | Results summary assignment Poster set up file |
| 13 | 11/23 – 11/27 | Designing scientific posters | Poster rough draft |
| 14 | 11/30 – 12/4 | Poster peer review | Poster peer review Scientific virtues reflection |
| 15 | 12/7 – 12/11 | Semester project wrap up | Poster final draft Video summary of project |
| 16 | 12/14 – 12/18 | Graphing in excel | Pollinators in Maryland graph |

**Assessment:**

Lab notebooks and assignments (10% of total course grade). Lab notebook entries due each week to summarize what was done and for students to keep notes. Students will complete virtual labs using assignments in Microsoft Office. They will complete the lab tasks and answer questions, submit results, and receive feedback through Microsoft office.

Lab poster (10% of total course grade) Students will summarize their results in a poster format. Students will work on the poster throughout the project.

**Course surveys will be designed and given to each student in the CURE Project before and after the project.**

**Advice for Implementation (Please offer advice on potential pitfalls or ways to improve on similar CURE projects, based on your expertise and experience.)**

Because of the nature of CUREs, weekly assignments build on each other so it is important that students complete the work each week AND go back and correct errors in labs. Therefore it is important to provide frequent and specific feedback to make sure students are ready for the next step in the process.

I have found that having assignments throughout the semester that build to the poster is helpful. For example, at the start of the project, students submit their powerpoint slide of the poster. They also practice concisely writing up the methods or making graphically representations of methodology. This helps make the final poster less daunting and students have had chances for feedback before the final high stakes assignment.

**Using CURE Data (How do you plan to use the results from your CURE Project – manuscript, poster, conference presentation, all the above, etc? How do you plan to recognize student efforts and complete projects that were not finished, if needed?)**

Students will create posters of their results. They will also make an infographic of pollinated plants in PG county and their importance which may be interesting to the public!

**Resources (Are there any resources you can offer or source literature on your topic?)**

Students will use the following websites for data analysis:

* [GenBank](https://www.ncbi.nlm.nih.gov/genbank/): collecting sequences
* [NC State Garden toolkit](https://plants.ces.ncsu.edu/): learning about plant traits
* [DNA subway](https://dnasubway.cyverse.org/): phylogenetic analysis
* [Phylogeny.fr:](http://www.phylogeny.fr/index.cgi) backup for phylogenetic analysis.

<https://www.fs.fed.us/wildflowers/pollinators/> This website provides useful information about coevolution of plants and their pollinators

**For more examples of CURE Projects in the sciences, view the CUREnet Collection at: <https://serc.carleton.edu/curenet/collection/220515.html>.**