Learning from the Trees: Incorporating Project Budburst in an Introductory Biology Laboratory
Deborah A. Lichti*1 and Kristine Callis-Duehl1
1. Department of Biology, East Carolina University, Greenville, NC USA

**Introductory Lab (Pre-CUREs)**
- All freshmen biology majors take these courses and gain fundamental skills for course-based undergraduate research experience (CURE) courses
- Ecology is not required for all biology majors at East Carolina University
- 85% of students want to attend medical school

**Research Experience Importance:**
**Problem:** Undergraduates benefit from research experiences, but lack the skills (quantitative & communication) necessary to properly engage in research
**Solution:** Engage students early in pre-CURES or mini-CURES using large data research projects such as citizen science projects

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**Pathway of Growth during Ecology Section**

**Research Project with Budburst**

**First Step:**
Students determine
- Research question
- Choose Phenophase
- Tree species to study
- Abiotic Condition (Temperature, rainfall, etc)
**Done individually and then as a group**

**Second Step:**
After TA approval
- Students collect data on campus and from Budburst (4 weeks)
- Analyze data in R
- Produce group scientific poster
- Individual scientific papers

**Final Step:**
Peer Review Occurs
- Posters
- Individual Papers (ADI methods for peer review)
- Poster Presentation during last class

**Phenophase**
Observable phase in annual life cycle of trees.
Examples: Leaf fall, Color change, 1st Flower, Full Flower, Budburst, Full Leaf

**Foundational Subjects (Weekly Subjects)**
Citizen Science, Ecology, Tree Identification, Climate Change/Weather, Statistics, Learning to use R, Writing Scientific Papers, Designing Scientific Poster

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**Teaching Assistant Challenges**
- Not expert in statistics/tree identification
  - Detailed TA documents & study material
- Managing students and groups
  - Allow TAs to form groups
- First time teaching as TA and/or course
  - Support system from experienced TAs and lab managers
- Maintaining balance between teaching and graduate school
  - Realistic timeframe for preparing and grading assignments

**Undergraduate Challenges**
- Group Work
  - Not all students contribute the same or collect data for project
  - Peer Review self and others throughout project
  - Individual assignment
- Statistics and using RStudio
  - Use R markdown files
- Writing Scientific Papers
  - Examples and Peer Review
  - Use of the ECU Writing Center

**Citizen Science Pre-CURE Course**

**Vision and Change Core Competencies:**
- Ability to apply the process of science
- Ability to use quantitative reasoning
- Ability to communicate and collaborate with other disciplines
- Ability to understand the relationship between science and society

**Learning Objectives:**
1) Design an experiment to test a hypothesis by collecting data from the nature environment
2) Analyzing group data and data from Project Budburst using a statistical test, and developing and interpreting graphs
3) Presenting a group poster, and writing an individual scientific paper
4) Connect work to climate change

**Choosing a citizen science project**
- Project that can work across semesters with large number of students (360 students per semester)
- Has to be completed on campus

**Curriculum Development**
- Developed and validated rubrics, student documents, minimum requirements for projects
- TA documents and training (Semester & Weekly)

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