**PROJECT TITLE: *Carbon on Campus: Connecting students to Minnesota ecosystems***

1. **PROJECT STATEMENT**

Direct engagement with ecosystems – in urban contexts or preserved forests - can enhance student understanding and personal connection to the environment. In the spirit of Minnesota’s commitment to environmental education and sustaining its natural history legacy, we aim to engage students in ecological studies through field data collection of biodiversity, biomass, and carbon on their schools’ campuses. This direct examination of ecological concepts will support LCCMR’s priority, “to restore and maintain a healthy and biodiverse natural environment” and directly address the Environmental Education goals to “involve broad-based partnerships, engage diverse and changing demographics, …provide outdoor experiences” and “enhance existing curriculum”.

We seek to challenge the notion that ecology must be studied and measured in undeveloped, pristine ecosystems. By emphasizing that significant ecological research can occur in developed areas, including school campuses, we aim to broaden access and participation in the study of field ecology to students whose schools are more likely to exist near agricultural fields or urban grids than conserved, intact forests. Through this approach, we hope for students to develop a more expansive view of nature and what types of nature are valued by measuring and analyzing ecological processes and patterns that occur on their own campuses.

Our project will establish a network of ecological scientists representing 10 collaborating colleges and universities (Collaborators). Collaborators will work with students to measure biodiversity, biomass, and carbon in the plants and soils on their campuses, train students in field methods and analyses, and create an accessible online database and website to be used in the teaching of sustainability, ecosystem monitoring, and ecology. We will develop measurement protocols that will be applied at campuses representing a diversity of Minnesota climates and ecosystems, annually providing ~400-800 undergraduate students a unique opportunity to be involved in this state-wide ecosystem monitoring program. Students and faculty will quantify biodiversity of tree species on campuses and in nearby forested field sites, measure trees for size, and collect soil cores, gaining hands-on training experience in approaches used by foresters and natural resource managers. Students will collect leaf and soil samples – allowing for calculations of carbon storage on and across campuses in Minnesota. All data will be stored, managed, and made publicly available through a website hosted by Macalester College to digitally connect student projects among institutions and establish a database for the public and secondary-school teaching purposes.

A parallel goal is for Collaborators to develop educational partnerships with secondary school teachers and to train undergraduates to facilitate educational sessions for students at partner schools. Measuring biodiversity and biomass of the ecosystems of their campuses connects middle and high school students to ecological processes and patterns that are too often thought of as occurring in distant locations. Outdoor activities enhance biology and environmental science classes and allow secondary school students to connect to measurements being made by students at colleges and universities in Minnesota. Collectively, we will create a statewide dataset of local and regional biodiversity, biomass, and carbon across secondary and higher education campuses. The website will host the cross-site datasets, as well as local weather data, and informative, educational videos made by the collaborating scientists and students on measurement techniques and local ecosystems. The website will allow students and others to quantitatively explore relationships of biodiversity, biomass, soil type, and carbon content of leaves and soils within and across campuses.

Our project creates a statewide, openly-accessible database and website of Minnesota’s ecosystems, integrating student-driven environmental fieldwork, data analysis, web-based educational tools, and engagement with middle- and high-school science classes. On a broader scale, this project’s associated partnerships form the basis for long-term ecological research, allowing collaborators to evaluate and monitor impacts of habitat modifications and changing climate regimes, as well as to assess variability across Minnesota’s ecoregions.

1. **PROJECT ACTIVITIES AND OUTCOMES**

**Activity 1 Title:** *Collaborators meeting and establishment of distributed measurement protocols*

**Description:**All 10 Collaborators will assemble for a meeting at Macalester College’s Katharine Ordway Natural History Study Area in Inver Grove Heights. We will establish standardized protocols, distribute equipment required for measurements, and plan field activities. The initial meeting will occur prior to Fall 2020, so measurements can be implemented in courses the following Fall and Spring.  **BUDGET: $16,352**

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| **Outcome** | **Completion Date** |
| *1. Collaborators meeting to establish standardized methods for measuring biomass, biodiversity, and soil sampling* | *August 2020* |
| *2. Create ‘Carbon on Campus’ website for methods-based videos and data-portal*  | *September 2020* |

**Activity 2 Title:** *Distributed biodiversity, biomass, and carbon measurements across Minnesota campuses*

**Description:**Collaborators will lead courses with field components that integrate the measurements established in Activity 1. Students will contribute data from their campuses to the data portal. Samples of leaves and soils will be sent to Macalester College where Dr. Mary Heskel and undergraduate students will measure carbon using an elemental analyzer. Campus data will be made public for teaching and outreach purposes, along with a web-based app that facilitates student exploration of ecological relationships for student learning. **BUDGET: $91,763**

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| **Outcome** | **Completion Date** |
| *1. Distributed data collection of biomass, biodiversity, and carbon by ~400-800 students at collaborating campuses representing a range of ecosystems in MN* | *May 2021* |
| *2. Publicly available dataset and educational videos on MN ecosystems via the website*  | *June 2021* |

**Activity 3 Title:***Student-centered Outreach and Engagement through Secondary School Partnerships (SSP)*

**Description:** Collaborators and undergraduates will develop outreach activities for local middle and high school students in their communities. Outreach and engagement activities will leverage existing partnerships when possible, such as the BLAST program at Carleton College that partners with Northfield Middle School that collaborator Dr. Dan Hernández is involved with. Partnerships aim for Collaborators and undergraduates to train secondary school students and teachers in field data collection to provide hands-on outdoor experiences to enhance existing curricula on biodiversity and ecosystems. Measurements led by SSP teachers and students will first occur during 2021-2022. Data collected across all campuses will contribute to the online data portal. Videos will be produced to distribute educational content to learners of all ages across Minnesota. During the 2021-2022 academic year, Collaborators and students will also collect and share data. **BUDGET: $26,462**

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| **Outcome** | **Completion Date** |
| *1. Identifying and establishing Secondary School Partnerships and methods training* | *November 2021* |
| *2. Student-led Data Collection with Secondary School Partners & Collaborators* | *November 2021 - June 2022* |
| *3. Video production of SSPs measuring their campuses and modeling measurements* | *July 2022* |
| *4. Collected data added to public data portal and website*  | *August 2022* |

1. **PROJECT PARTNERS AND COLLABORATORS:** The strength of this proposal lies in the network of collaborating scientists and educators who represent widespread regions and ecosystems of Minnesota. The network includes: Dr. Mary Heskel (lead network organizer) and Dr. Jerald Dosch of **Macalester College**; Dr. Dan Hernández of **Carleton College**; Dr. William Sea of **Bemidji State University**; Dr. Kathleen Shea of **St. Olaf College**; Dr. Jessica Savage of **University of Minnesota-Duluth**; Dr. Chris Ruhland of **Minnesota State University-Mankato**; Dr. Troy Knight of **College of St Benedict/St John’s University**; Dr. Virginia Card of **Metropolitan State University**; Dr. Alyssa Anderson of **Southwest Minnesota State University**; and Dr. Chris Merkord of **Minnesota State University-Moorhead**. Collaborators will lead teaching, field measurements, and SSPs in their respective locations, including Bemidji, Collegeville, Duluth, Mankato, Marshall, Moorhead, Northfield, and Saint Paul.
2. **LONG-TERM IMPLEMENTATION AND FUNDING:** Field-based activities at colleges and partnering secondary schools should not require additional support after equipment purchases have been made. Web-hosting and data-sharing will be provided by Macalester College’s servers. We aim for this network and its partnerships to be sustainable beyond the scope of LCCMR funding at minimal costs while providing long-term student-led data collection on the trees and soils of campuses and ecosystems in Minnesota.