

Environment and Natural Resources Trust Fund 2020 Request for Proposals (RFP)

Project Title:

ENRTF ID: 147-CH

Carbon on Campus: Connecting Students to Minnesota Ecosystems

Category: H. Proposals seeking \$200,000 or less in funding

Sub-Category: C. Environmental Education

Total Project Budget: \$ 134,577

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

We aim to create 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.

Name: Mary Hesel

Sponsoring Organization: Macalester College

Job Title:

Department: Biology

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Location:

Region: Statewide

County Name: Beltrami, Blue Earth, Clay, Dakota, Lyon, Ramsey, Rice, St. Louis, Stearns

City / Township: Bemidji, Collegeville, Duluth, Inver Grove Heights, Mankato, Marshall, Moorhead, Northfield

Alternate Text for Visual:

The collaborating scientists represent northern, central and southern MN and urban and rural regions. Students use non-destructive methods to measure tree biomass.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity	_____ Readiness	_____ Leverage	_____ TOTAL _____%



Environment and Natural Resources Trust Fund (ENRTF)

2020 Main Proposal

Project Title: *Carbon on Campus: Connecting students to Minnesota ecosystems*

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I. 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.

II. 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



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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

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 Heskell 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

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

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

III. 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 Heskell (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.

IV. 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.

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet

Legal Citation:

Project Manager: Mary Heskell

Project Title: Carbon on Campus: Connecting students to Minnesotan ecosystems

Organization: Macalester College

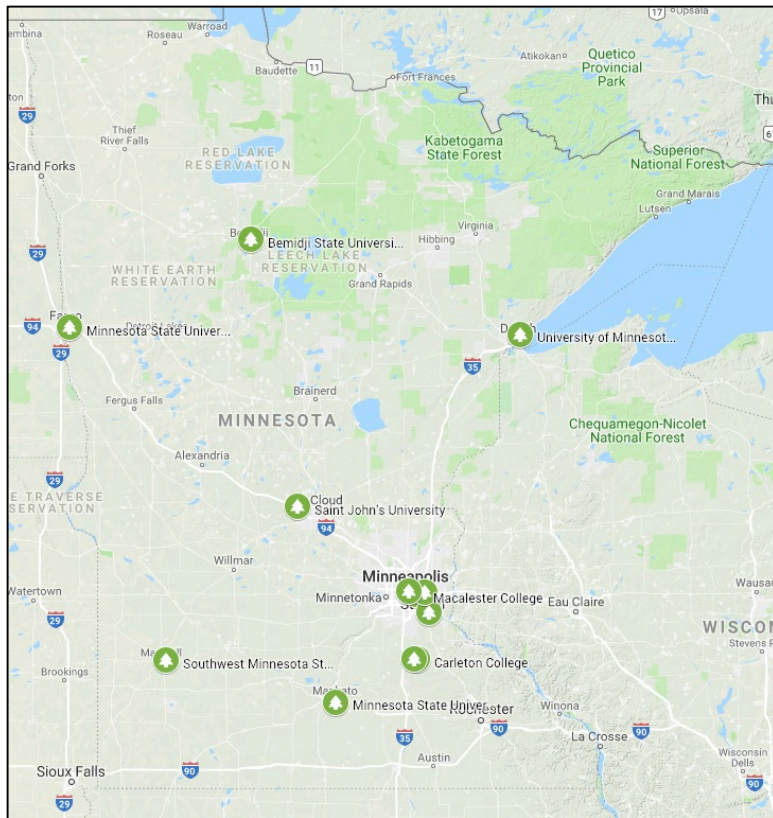
Project Budget: \$134,577

Project Length and Completion Date: 2 years 1 month; August 31, 2022

Today's Date: April 12, 2019



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Budget	Amount Spent	Balance
BUDGET ITEM				
Personnel (Wages and Benefits)		\$ 57,417	\$ -	\$ 57,417
Activity 1: Summer 2020: Mary Heskell .5 month salary; Jerald Dosch .5 month salary; both at 10% fringe.				
Activity 2: Summer 2021: Mary Heskell 1.5 month summer salary; Summer student researcher stipends for two students for 10 weeks; both at 10% fringe.				
Activity 3: Summer 2022: Mary Heskell .5 month summer salary; Stipends for 10 collaborating secondary school partners; Summer student researcher stipends for two students for 10 weeks; both at 10% fringe.				
Professor Mary Heskell, Project Manager, \$23,609 (90% salary;10% fringe). Equates to .5 month salary Activity 1; 1.5 month summer salary Activity 2; and .5 month summer salary Activity 3.				
Professor Jerald Dosch, \$4,608 (90% salary;10% fringe), .5 month salary.				
Summer student researchers 2021: Two students, 10 weeks at \$550 per week with 10% fringe, \$12,100 (90% stipend;10% fringe). Students have option for free campus housing during the summer.				
Summer student researchers 2022: Two students, 10 weeks at \$550 per week with 10% fringe, \$12,100 (90% stipend;10% fringe). Students have option for free campus housing during the summer.				
Stipends for 10 collaborating secondary school partners, \$5,000.				
Professional/Technical/Service Contracts				
		\$ -	\$ -	\$ -
Equipment/Tools/Supplies				
		\$ 8,600	\$ -	\$ 8,600
Activity 1 & 3: DBH tape, \$4,000, (\$20 per tape*10 tapes per group*10 groups, for two years).				
Activity 2: Soil Corers, \$1,600, (\$40 per core*2 cores per group*10 groups for one year).				
Activity 1 & 3: Tree ID books, \$3,000, (for outreach activities and secondary school partners for two years).				
Capital Expenditures Over \$5,000				
		\$ 65,000	\$ -	\$ 65,000
One Elemental Analyzer at \$65,000.			\$ -	
Fee Title Acquisition				
		\$ -	\$ -	\$ -
Easement Acquisition				
		\$ -	\$ -	\$ -
Professional Services for Acquisition				
		\$ -	\$ -	\$ -
Printing				
		\$ -	\$ -	\$ -
Travel expenses in Minnesota				
		\$ 2,660	\$ -	\$ 2,660
Travel to Ordway from 10 different non-local locations at a Federal IRS mileage reimbursement rate of 0.58/mile, assuming an average travel distance of 250 miles in accordance with Section 15 of Commissioners Plan.				
Hotel for five people for one night (\$210 per person) in accordance with Section 15 of Commissioners Plan.				
Reimbursable expenses for meals (10 people at \$16 per) in accordance with Section 15 of Commissioners Plan.				
Other				
Shipping: Equipment for Activity 1 and 3 (\$400) and 50 samples for Activity 2 (\$500)		\$ 900	\$ -	\$ 900
COLUMN TOTAL		\$ 134,577	\$ -	\$ 134,577
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT				
	Status (secured or pending)	Budget	Spent	Balance
Non-State: Overhead costs during grant period covered by Macalester.		\$ 30,735	\$ -	\$ 30,735
State:		\$ -	\$ -	\$ -
In kind:			\$ -	\$ -
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS				
	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -



Participating Collaborators & Measurement Sites:

The collaborating scientists are based in institutes that represent (1) Northern, Central, and Southern Minnesota and (2) urban and rural regions. This representation will add coverage and diversity to better understand the natural history of Minnesota, and also extend the project to all corners of the state, reaching a broad range of students.



Measuring biomass and carbon in campus trees and soils:

Students use non-destructive methods to measure tree biomass and soils. Data from these collections will be publicly available via a website geared toward secondary schools and introductory courses in colleges and universities, and emphasize sustainability, ecosystem diversity, and career applications.

At left, an undergraduate, Sonja Helgeson (St. Olaf College) measures tree diameter at breast height (DBH), a common metric for tree size and biomass.

Photo: Prof. Kathy Shea

Project Manager Qualifications: Prof. Mary Heskel

Prof. Mary Heskel recently joined the faculty of Macalester College as a plant and ecosystem ecologist in the Biology Department. Prior to this appointment, Dr. Heskel worked as a postdoctoral scientist at The Ecosystems Center of the Marine Biological Laboratory in Woods Hole, Massachusetts, the Department of Forestry and Natural Resources of the University of Minnesota, and the Division of Plant Sciences of Australian National University. She was awarded a PhD in Ecology, Evolution, and Environmental Biology in 2013 from Columbia University in New York, a Masters in Secondary School Education from the City College of New York in 2008, and a BA in Biology from the University of Pennsylvania in 2006. Dr. Heskel worked as a high school teacher in an under-resourced school for two years prior to earning her doctorate, and aims to engage local teachers and students at the secondary level in hands-on environmental education. She was recently awarded a “Transforming Education in Plant Biology” award from the American Society of Plant Biologists based on her plans to enhance undergraduate teaching styles, and regularly participated in “Planting Science”, an online mentoring program connecting scientists to K12 classrooms. Dr. Heskel has authored over 25 peer-reviewed articles, serves as the Section Chief Editor of the journal *Annals of Botany – Plants*, and her work has been cited over 800 times. Over the past decade, Dr. Heskel worked in large collaborative teams that include students and senior scientists, managed large datasets, and strives to make scientific data more accessible and understandable for K12 students and their teachers.

Macalester College Organizational Description

Macalester College is a nationally prominent liberal arts college located in St. Paul, Minnesota, whose mission is to be a “preeminent liberal arts college with an educational program known for its high standards for scholarship and its special emphasis on internationalism, multiculturalism, and service to society.” Pursuit of excellence has been a constant at Macalester since it was founded in 1874 by the Rev. Edward Duffield Neill and funded by Charles Macalester, a prominent Philadelphia businessman and philanthropist. The college admitted its first class in 1885. Macalester’s 30 academic departments offer 38 majors and 63 areas of study. To ensure that students from all backgrounds can attend, Macalester meets the full financial need of admitted students. Two-thirds of our students receive need-based financial aid, with an average award of \$47,816 for full-time students in 2018. More than 60% of Macalester students take advantage of study away programs, and 96% participate in community-based learning, service, or applied research by the time they graduate. A 10:1 student/faculty ratio ensures that Macalester’s 2,174 students receive intensive instruction both in and out of the classroom. U.S. students of color comprise 26% of the Macalester student body. Consistent with broader trends in higher education, the majority of our students are female (59% in Fall 2018). In addition, 16% of Macalester students are international, representing 75 countries by citizenship.