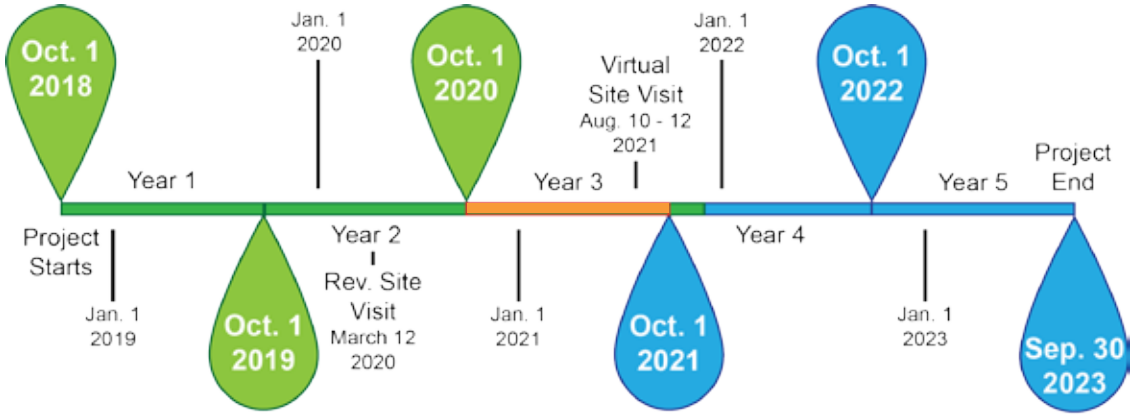
MONTANA NSF EPSCoR
NEWSLETTER

CREWS
YEAR 3
HIGHLIGHTS
2021

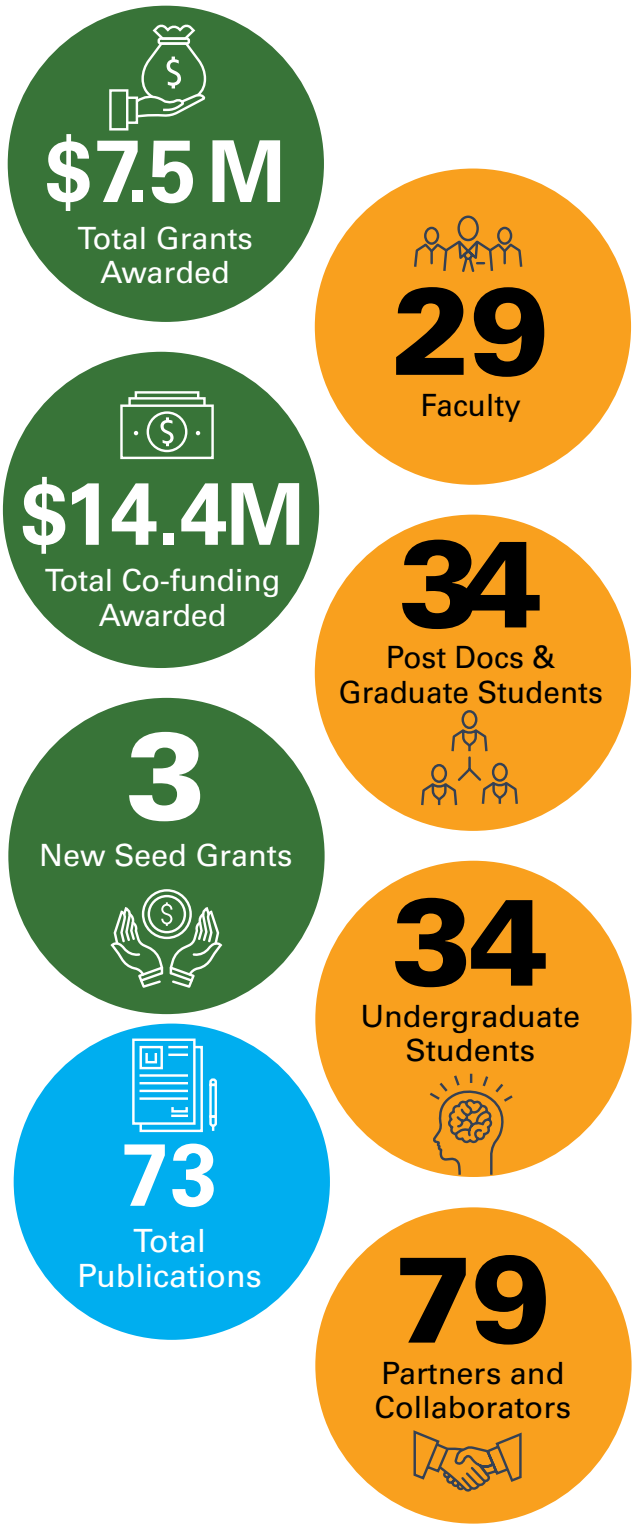
CREWS postdoctoral researcher Shelton Varapragasam prepares model iron oxide nano materials to evaluate photocatalytic activity of naturally-occurring minerals in the Judith River Watershed. *Photo credit: Adrian Sanchez Gonzalez*

YEAR 3 HIGHLIGHTS

This Special Issue of the Montana NSF EPSCoR newsletter provides a summary of the Year 3 activities and progress for the RII Track-1 Consortium for Research on Environmental Water Systems (CREWS) project. CREWS, supported by the National Science Foundation under Award OIA-1757351, is a five-year $20M project that explores how changing compositions and levels of nutrients and contaminants affect water quality from soils to rivers to local communities that rely on clean water. The project focuses on three Montana landscapes where water and economy are inextricably linked and creates opportunities in workforce development, innovation, and entrepreneurship. See the timeline below for an overview of where activities described in this newsletter sit on the project timeline (highlighted below) as well as other major project milestones and dates.



Timeline of the Montana NSF EPSCoR RII Track-1 CREWS project illustrating the major dates and milestones. This Special Issue newsletter highlights activities that occurred in Year 3 of the project, noted in orange on the timeline.



CREWS BY THE NUMBERS

YEAR 3 OUTCOMES OF MONTANA'S NSF EPSCOR RII TRACK-1 PROJECT

29 total faculty, **34** postdocs and graduate students, and **34** undergraduate students involved with the CREWS project in Year 3

$7.5 MILLION IN GRANTS AWARDED – Cumulative total amount of grant funding awarded to CREWS researchers by the end of Year 3

3 SEED GRANTS - Total number of seed grants awarded in Year 3. *For more information about these seed grants, see Page 3.*

73 PUBLICATIONS – Cumulative total number of publications released by CREWS researchers by the end of Year 3

79 PARTNERS AND COLLABORATORS – Total number of CREWS external partners and collaborating institutions in Year 3. *For the full list of external partners and collaborating institutions see Page 12.*

$14.4 MILLION IN CO-FUNDING - Total NSF EPSCoR co-funding awarded to Montana in Year 3

DIRECTORS UPDATE

It is hard to believe that we are several months into Year 4 of the CREWS project! We are delighted with how well all of the research, education, and related activities are going. Compiling our Year 3 Annual Report for the National Science Foundation with team accomplishments and scholarship was astonishing – this statewide group is an innovative and productive bunch. We also would like to single out another success originating from the bottom up, CREWS & BREWS. We received feedback from many across the CREWS team about wanting to hear more about project wide activities, which has been a very real problem during the pandemic. Thus, CREWS & BREWS was designed to be an informal, once-a-month, virtual gathering in which we could hear about the pursuits, interests, and successes at different sites and different disciplinary foci. Anyone attending these meetings has had the pleasure of exceptional cross-disciplinary updates on the Powder River, the Judith Basin and the Upper Clark Fork. A heart-felt thank you to all the students and faculty that worked exceptionally hard on these updates. Future CREWS & BREWS meetings will be a combination of project wide updates and brainstorming ideas for new integrative activities. On another subject, we are still thinking hard about when to safely meet in person. Later in the spring is an outside possibility, but there will probably still be quite a bit of hesitancy among us. The most likely in-person meeting target will be early in the fall, with invitation extended broadly to our partners. We are looking forward to completing Year 4 and powering into Year 5!

All the best,

Ray Callaway & Todd Kipfer

CREWS YEAR 3 SEED GRANTS

WORKFORCE DEVELOPMENT AWARDS

Improving Wetland Characterization Using Remote Sensing Tools and Environmental DNA, SKC PI Georgia Smies

Learn to Operate a Water Treatment Facility in Virtual Reality, MSU-B PI Andrew Sullivan

Next-Gen Sequencing-Based CURE for Undergraduate Research, Carroll College PI Ashley Beck, UM co-PI Maury Valett and MSU co-PI Stephanie Ewing

A map illustrating CREWS partner institutions. CREWS was developed as a partnership between the University of Montana (UM), Montana State University (MSU), Montana Technological University (MTU), Salish Kootenai College (SKC), and Little Big Horn College (LBHC). Through competitive seed funding opportunities, new higher education partners include Carroll College, University of Montana Western (UM-W), Montana State University-Billings (MSU-B), and Rocky Mountain College (RMC).

UPPER CLARK FORK RIVER

A picture of a Hydropsychid nymph, a type of caddisfly, taken under a microscope. This nymph was caught by Adam Hensley during macroinvertebrate sampling along Gold Creek, a tributary of the Upper Clark Fork River. Adam and four other undergraduate students conducted research in the Valett Lab at the University of Montana over the summer through the NSF-funded Research Experience for Undergraduates (REU) program. *Photo credit: Adam Hensley.*

The Upper Clark Fork River (UCFR) team pursued their objectives to understand the interactions between nutrients and metals, how metals and contaminants propagate across trophic levels, and the contaminant character and efficacy of technical solutions. The team added a highly effective monitoring program along the river that focused on water-borne nutrients, metals, and assessment of food webs. This program, which employed unique autonomous sensors to generate measures of river metabolism, addressed suspended, colloidal, and dissolved metal loads in the river, improving understanding of water quality over space and time. The UCFR team includes many CREWS graduate students from MSU and UM who collaboratively established food web studies that couple measurements of productivity, trophic exchange, and metal propagation for macroinvertebrates and fish in the UCFR. One of the highlights of the Year 3 efforts for UCFR was the excellent work by undergraduates in the Valett Lab at UM. In collaboration with the NSF Long Term Research in Environmental Biology (LTREB) program, these students engaged in the NSF-funded Research Experience for Undergraduates (REU) program and partnered with CREWS graduate students and postdoctoral researchers to execute ten-week research projects.

Team members at MTU completed identification and selection of a viable sorbent, magnetite, for the Continuous Flow Metal Recovery (CFMR) system in Year 3. The material will continue to be scrutinized moving forward to look for any technical issues. In addition, researchers and students from MTU collaborated with a CREWS seed grant recipient to develop an alternative coating for magnetite nanoparticles, an effort that appears to be highly promising. The UCFR team continued to focus on improving and refining its data management protocols. They entered around 40 data products into the public domain in Year 3, and supported data management cultural shifts via policy reform, automated metadata generation, and training. The team released several exciting publications during Year 3. Two of these papers have the potential to substantially influence our understanding of river biogeochemistry, and a third publication focused on the fate and impacts of copper contaminants in artificial wetlands. The team will address nitrogen-fixation associated with bloom progression, link remote sensing assessment to bloom monitoring, expand metals assessment, and more in the future.

Members of the Upper Clark Fork Working Group survey a section of the Upper Clark Fork River as part of an August field workshop. The workshop was hosted to help improve the group's collective understanding of ecosystem components that are present or lacking within reaches that have been remediated and reaches that have not been remediated, thereby informing future restoration work. *Photo credit: Taylor Gold Quiros.*

UCFR team members continued to engage with external partners during Year 3. CREWS researchers from UM worked with a local GIS company, GCS, on river data visualization. From this partnership, GCS will develop a movie that can be used as a basis of other river visualizations, a tool for river managers, and for educational outreach. Finally, graduate students from MTU mentored local high school students in Butte in conjunction with the Upward Bound program. The Upper Clark Fork Working Group (UCFWG), with support from CREWS, grew substantially and now has over 130 members. The UCFWG held eight virtual presentation meetings with an average attendance of 65 participants, and hosted two workshops on water quality and floodplain restoration. To learn more about the UCFWG, visit **www.ucfwg.org.**

Members of the CREWS Upper Clark Fork River team pose for a picture during the "Big Diel," a research campaign in which twelve researchers and students continuously sampled for 48-hours on the Clark Fork River. The goal of this campaign was to characterize diel cycles of nutrients and carbon dioxide alongside metals and arsenic in the river. *Photo credit: Ben Colman.*

JUDITH RIVER WATERSHED

In Year 3, the Judith River Watershed (JRW) team expanded their research on molecular and environmental controls of nitrate in riparian systems. The contaminant source, transport, and reactivity datasets created in Years 1 and 2 of the project informed the team's work in Year 3. Field data collection intensified as the team conducted ongoing spatiotemporal surveys of riparian corridor water chemistry in the three study reaches. The team also perfected their field design and approach to continuous sensor measurements and expanded upstream-downstream sensor deployments to late winter through spring. All of this resulted in exciting work for four CREWS graduate students, who are focused on the emerging story of how riparian systems attenuate nitrate loading in agricultural systems. These students made substantial progress in Year 3 on surface water and groundwater sensing, drone-based imaging, and reactive transport modeling. Team members collaborated with the NASA SnowEx project and Montana Mesonet as well, which expanded understanding of how snowmelt contributes to reactive transport in soils and groundwater.

JRW social science researchers and students completed their community interviews and analyzed these data in Year 3 to better understand the constraints communities in the region face when making decisions about water infrastructure. In the lab, members of the JRW team at MSU established, documented, and published on the molecular interactions between pesticides and biological membranes. They also demonstrated that various synthetic engineering materials contribute to the photocatalytic reduction of nitrate in the lab. Team members at MTU continued their work on biofilm formation in reverse osmosis (RO) systems and began testing polydopamine-copper polypropylene spacers with RO membranes. Exciting preliminary results from this benchtop RO system show that polydopamine, copper, and hydrogen peroxide effectively mitigate biofilm formation.

Modeling and data management remained an important research focus for the JRW team. Members applied coupled solute transport models to an analysis of how upland loading and riparian processing influences nitrogen concentration changes. They are also developing an upland soil water model to quantify snow contributions to cereal production during drought. In addition, under NSF Award 2034430, JRW researchers received a grant for a project called Signals in the Soil. This grant will focus on sensor design concepts and reactive transport in soils. The team meets on a monthly basis to provide a forum for research. The Judith River Watershed Working Group (JRWWG) met twice in Year 3 to discuss research progress, and CREWS staff developed a Working Group website to help facilitate communication. To learn more about the JRWWG visit **www.jrwwg.org.**

CREWS graduate students Caitlin Mitchell and Skye Keeshin and undergraduate research intern Zoe Durkin use a YSI multiparameter water quality meter to measure conductivity, temperature, dissolved oxygen, and pH in Louse Creek, a study site in the Judith River Watershed. They are also filling sample bottles using a peristaltic pump and filter, which will be analyzed for water isotope ratios, nitrogen, and carbon. *Photo credit: Madison Boone*

CREWS graduate student Madison Foster loads JRW water sample vials into the Shimadzu TOC-V for analysis of dissolved carbon species and total nitrogen. *Photo credit: Adrian Sanchez Gonzalez*

POWDER RIVER BASIN

The Powder River Basin (PRB) team made substantial progress in Year 3. In August 2020, researchers from the Montana Bureau of Mines and Geology (MBMG) drilled five wells on drainages emptying into Rosebud Creek, south of Colstrip, MT. Three of these wells allow sampling of groundwater originating from land that was actively mined for coal in the 1960s and 1970s and reclaimed in the 1980s. The two other wells sample groundwater from undisturbed land and will provide important comparative data for samples taken from the impacted sites. As part of this effort, an undergraduate student from MTU participated in the installation of one of the monitoring wells and assisted with flow measurements on Rosebud Creek. The flow and other surface water measurements taken in Year 3, when combined with groundwater data, will help the team establish the groundwater-surface water relationships that impact sulfate concentrations in aquatic systems. A large wildfire swept through the team's research sites in August 2021, but thankfully the groundwater wells and other research infrastructure was unharmed. The PRB team continued their work in the lab with a focus on conditions that impact calcium sulfate, or gypsum, dissolution. The initial findings from this work imply that surfactant-gypsum affinity may disrupt interfacial water structure and inhibit gypsum dissolution that increases water contamination. The team also examined how carbon particulate composition changes the adsorption distribution in water-air interfaces and becomes solvated in bulk solution.

One of the most significant COVID-19 impacts was the shutdown of home-well sampling on the Crow Reservation. However, in Year 3, they resumed this sampling. The researchers reviewed and sorted initial well data based on arsenic and high sulfate concentrations, and then contacted well owners to expand water sampling. With help from a Crow undergraduate intern, home wells were sampled in summer 2021. In addition, Montana NSF EPSCoR contributed to the cost of a new Water Resource Management course at LBHC that was initially taught over the summer, with plans to continue offering it in the future.

Finally, the PRB team arranged a tour of the Rosebud Coal Mine and invited members of the full CREWS team. Attendees, with the help of Rosebud employees, were able to learn about the history of the mine, view its active, on-the-ground operations, and see and discuss the various reclamation efforts. The field trip culminated with a visit to the team's research sites located in the area and around Rosebud Creek. An outstanding outcome of the trip was to broadly inform the CREWS team about work in the PRB and promote integration across research sites.

Student Tennison Big Day inspects the torch and nebulizer plumbing of the Environmental Analytical Lab's SpectroBlue ICP-OES. *Photo credit: Adrian Sanchez Gonzalez*

Allie Wolverton, a former CREWS undergraduate researcher from Rocky Mountain College and now graduate student at the University of Wyoming, collects a groundwater sample from a dedicated monitoring well in the Powder River Basin study site. *Photo credit: Elizabeth Meredith.*

NATURAL RESOURCE SOCIAL SCIENCE

The CREWS Natural Resource Social Science (NRSS) team maintained their robust collaborations and research during Year 3. The team completed qualitative interviews in the JRW and UCFR and coded and analyzed data from these interviews. Researchers and students from MSU and UM focused on forming a conceptual model from their data. The model links perceived water quality, perceived community resilience, economic and future outlook, and trust in institutions. As a result of these insights, the team published three papers. These findings also informed the development of a survey instrument and protocol, which will be a cornerstone of data collection in the JRW and UCFR in Year 4. NRSS team members from Salish Kootenai College (SKC) partnered with researchers at the University of Minnesota to continue development of an interactive assessment tool that began in Years 1 and 2 of the project. This tool, which will focus on how youth value water resources, will help SKC researchers measure how outreach activities impact youth.

CREWS NRSS team members from the JRW and UCFR as they work on their survey this summer, which is set to go out to the public in early 2022. Individuals pictured include (clockwise from upper left): Jen Dunn, Ph.D. Candidate, History; Julia Haggerty, Associate Professor, Resource Geography; Libby Metcalf, Associate Professor, Human Dimensions of Natural Resource Management; Amanda Bailey, Postdoctoral Researcher, Anthropology; Grete Gansauer, Ph.D. Student, Resource Geography; Megan Moore, Ph.D. Candidate, Conservation Social Science.

ENVIRONMENTAL SENSORS, SYNOPTICS, AND SIGNALS

The Environmental Sensors, Synoptics, and Signals (ESSS) team continued their successful field data collection campaign and worked on data calibration and analysis.

As part of the summer field campaign, researchers and students from MSU flew drone-mounted hyperspectral and RGB imagers. This group compiled an outstanding dataset for the UCFR after flying both Summer 2020 and 2021 and focused Year 3 activities on expanding their dataset for the JRW. Members of the ESSS team from UM collaborated with Sunburst Sensors to develop a Deployable Underwater Chemical Sampler (DUCS) and tested the DUCS with three deployments in the UCFR. The ESSS team also partnered with a local GIS company, GCS, to create a dissolved O_2 movie that will be used to develop other river visualizations. The ESSS team also worked on evolving and improving their code base for processing data. They made the code publicly accessible on GitHub, and through it continued to gain an understanding of the joint use of oxygen, inorganic carbon, and nitrate data for integrated river metabolism analyses.

From left to right, CREWS graduate student Riley Logan and undergraduate students Maddie Torrey and Shannon Hamp begin the process of packing up the drone after a flight on the Upper Clark Fork River in July 2021. The pictured drone carries the research team's hyperspectral imaging system, which is used to identify algal blooms and estimate water quality parameters. *Photo credit: Joe Shaw.*

The team also collaborated with computer science and machine learning researchers in their work, and as a result of this collaboration published two journal papers and two conference papers in Year 3.

MOLECULAR ENGINEERING AND ENVIRONMENTAL SCIENCE

The Molecular Engineering and Environmental Science (MEES) team established flourishing cross-project collaborations and made substantial progress on their activities in Year 3. MEES team members at UM improved their understanding of the transformation, persistence, and transport of contaminants and nutrients in natural water systems. Researchers designed and built an artificial stream prototype to experimentally explore bioaccumulation of pollutants, with an emphasis on metals. UM researchers also collaborated with USGS scientists to set up a mesocosm facility in Helena. This facility will allow the team to test the interaction of biofilms with metals and nutrients in different size fractions. Finally, the UM researchers accumulated data on the distribution of metals, arsenic, and phosphorus among size fractions in the UCFR using cascade filtration and ICP-MS/ICP-OES. As a next step, they will build a model that investigates the drivers of these data.

At MSU, MEES researchers continued to examine forms of nutrient, metal, and synthetic organic contaminants in surface waters in Year 3. The team examined the effects of hydrophobic and hydrophilic carbon particulates on lipid monolayer properties, which shed light on mechanisms driving toxicity of targeted pollutants. They also trained several graduate students to build and operate time-resolved spectroscopy tools and analyze these data.

At MTU, researchers developed and made available three benchtop systems to enable detailed evaluation of reverse osmosis, photocatalysis, and metal and nutrient ion capture to reduce water pollution. Researchers at MTU also collaborated with the MSU team to characterize and synthesize nanoparticles. These data guided the synthesis of engineered nanoparticles to provide photocatalytic reduction of aqueous nitrate and globally important water pollutants. MEES researchers at MTU also collaborated with a CREWS seed grant recipient to develop an alternate coating for magnetite nanoparticles, an effort that appears highly promising due to the coating's relatively high adsorption capacity and low toxicity.

Teagan Leitzke, a Ph.D. student at Montana Tech, pours a slurry of magnetite and water into the continuous flow metal recovery system. The slurry flows through the static mixer column to a magnet, where the magnetite is collected, and water continues to flow out of the system. *Photo credit: Amanda Badovinac*

SYSTEMS ECOLOGY AND EARTH SCIENCES

In response to the Year 2 Reverse Site Visit, Systems Ecology and Earth Sciences (SEES) researchers developed a framework in Year 3 for addressing flowpaths as physical templates. These templates help address controls over water quality and for scaling up both spatially and temporally. They also allow comparison of system function across different landscape domains including unsaturated soil water, groundwater flow through riparian zones, and channel flow in streams and rivers. The SEES team then used these data integrated with Damkohler analysis to develop a simulation model. Progress was made in Year 3 toward determining rates of specific biogeochemical processes.

Families play at spectrUM's water tables and explore the watershed. P*hoto credit: Wake Up Montana*

OUTREACH

Despite the challenges COVID-19 presented to holding in-person events, CREWS outreach leads were able to accomplish a great deal in Year 3. At MSU, team members from the Science Math Resource Center (SMRC) celebrated Citizen Science Month by creating small kits featuring several water-based citizen science projects. They then disseminated these kits to Lewistown Public Library and the MSU campus library. A CREWS seed grant recipient at MSU developed an acid mine drainage activity and held two outreach activities with local high schools that focused on this activity.

CREWS project researchers from the UCFR and JRW contributed data to the Datasets for Teachers course, a free class developed and taught by two K-12 teachers and hosted by the Montana Office of Public Instruction. SMRC also finalized the outcomes report for its Educator Needs Assessment and made it publicly available. The report features questions specifically related to EPSCoR education, outreach, and diversity, including questions on how university researchers can best support classroom teachers. This information will be invaluable for Broader Impacts in future proposals.

The University of Montana's spectrUM Discovery Area continued to develop and distribute science kits across the state in Year 3. These kits ranged in topic from "Sensing for Science" to "Water Chemistry," and to date, spectrUM has distributed over 18,000 kits to students in Montana. Although the spectrUM Discovery Area was closed for much of Year 3, it successfully relocated to the new Missoula Public Library in May 2021 and in its first month after opening had over 3,500 visitors. As part of this new space, spectrUM and its partners developed the Watershed Experience, an interactive activity that allows students to gain an appreciation and deeper understanding of watersheds and ecosystems. spectrUM also hosted a series of in-person programs in Year 3 including summer camps and school programs as well as virtual science programs, and it continued to highlight CREWS researchers as STEM role models via digital and physical mediums.

COMMERCIALIZATION INTERNSHIP PROGRAM

CREWS, in partnership with the University of Montana's NSF I-Corps Site, supported four commercialization interns in Year 3. One graduate student at UM will develop a report over the fall and winter for the community of Anaconda, MT, based on previous research interviews they conducted with residents. The goal of this report will be to help residents learn more about their community and act as an informative document moving into the future. The other graduate student, at MSU, worked with CREWS partner Resonon over the summer to look at how hyperspectral imagers respond to different polarization states of light. Both undergraduate interns were located at MSU. One worked with CREWS researchers to address the inefficiency of invertebrate separation, an ecological studies method, while the other student worked with a CREWS education, outreach, and diversity lead to research how "Small Town STEM" could be commercialized and serve educators in rural Montana communities.

Group photo of MT AIMS students on their final day of the 2021 MT AIMS Gatherings Program; Photo credit: Stephan Chase

DIVERSITY

In Year 3, CREWS continued to provide opportunities for Tribal College faculty and students through the Native Research Network. COVID affected the ability of UM's Indigenous Research and STEM Education (IRSE) program to provide in-person tutoring, but they were able to assist science and math subjects through hybrid tutoring platforms. IRSE, through its Montana American Indian in Math and Science (MT-AIMS) program and with funding from the UM Department of Education and donors, hosted around 65 middle school students from Montana's reservations to participate in informal STEM learning in Year 3.

CREWS, in partnership with MSU Empower, supported two Native American students and one Latino student in research projects related to water quality. Empower provided tutoring support and seminars to 30 Native American students on co-academic skills, and CREWS, in collaboration with Empower and the Norm Asbjornson College of Engineering (NACOE), hosted its first Empower Academic Success Program for underrepresented students interested in STEM undergraduate research. As part of this program, twelve students received weekly one-on-one mentoring sessions, spent time with researchers in labs, and studied with their peers. CREWS also collaborated with Empower and NACOE faculty on a water quality project in Three Forks, MT, and with the National Institute of Health (NIH)'s Bridges to Baccalaureate program to host a two-week seminar on community-based participatory research.

The Montana Girls STEM Collaborative continued to support youth that are underrepresented in STEM. The Collaborative was accepted into three national programs that will bring NSF EPSCoR-leveraged STEM resources to Montana. These include Leap into Science, a curriculum program that combines early literacy with STEM, and the IF/THEN Collection, which showcases women role models in STEM. The Collaborative maintained its quarterly newsletter releases that featured CREWS women researchers as well as other news and opportunities from external organizations. Collaborative leads from CREWS also participated in various presentations and training, including one presentation on "Why Should We Care if Girls Like Math?" and leadership training for Leap into Science. The Collaborative team also distributed OSMO Creative Kits to youth organizations, with an emphasis on reaching those that serve girls and other underserved populations.

The Montana Girls STEM Collaborative – an outreach program of Montana NSF EPSCoR – recently disseminated eight $1,000 mini-grants to organizations across Montana in order to showcase STEM role models from the IF/THEN Collection, an online multimedia database. One of the funded projects was called "Coding Through Dance," hosted by the University of Montana Department of Teaching and Learning. The one-day camp helped girls learn the intersection of robots and dance. The camp, hosted on Nov. 14, used the IF/THEN Collection of STEM professionals featuring Goldie Blox's Fast Forward Girls video with teen Nicole Laeno, who works alongside L.A. professional dancer and mechanical engineer Catie Cuan to choreograph and perform a dance with robots. Girls learned to code robots to perform dances with the assistance of UM K-8 education majors. For the full list of IF/THEN mini-grant recipients, including more information about their projects, please see the table and caption below.

Photo credit: Suzi Taylor

YOUTH ORGANIZATION	LOCATION	OUTREACH ACTIVITIES
Ingenium (a non-profit game studio in Great Falls)	Great Falls, Browning, Helena, Pryor, Power	Presentation to students about inclusion and diversity in STEM, especially computer science and video game design
Code Girls United	Anaconda, Browning, Chinook, Columbia Falls, Evergreen, Havre, Joliet, Kalispell, Polson, Red Lodge, Ronan, and Sidney	Summer camp for girls focused on coding and technology. Girls will develop an app to solve a community problem.
George McCone Memorial Library	Circle	Building a "maker space" in the library with STEM classes and materials.
Wise Wonders Children's Museum	Billings	Billboards that showcase girls and women engaged in STEM and that encourage people to visit the museum.
Upward Bound	Missoula, Browning	Astronomy events that feature STEM role models, telescope viewing and "star stories" from Native scholars.
Boys & Girls Club of Richland County	Sidney	Curricula to promote STEM training and occupations for women and girls.
UMontana Dept. of Teaching & Learning	Missoula	One-day STEM mini-camp for girls that combines robotics, coding and dance.
SAE International	Statewide	Highlighting Myra Blanco, a Hispanic woman in autonomous vehicle development.

The Montana Girls STEM Collaborative, an outreach program of Montana NSF EPSCoR, received $10,000 in mini-grant funding from Lyda Hill Philanthropies to support Montana youth organizations in advancing STEM equity. The proposal was written and administered by Girls STEM intern Sierra Fisher-Dykman, who graduated from MSU on Dec. 17, 2021 and will become an elementary/special education teacher. All projects feature imagery or activities from the IF/THEN Collection, a multimedia database of 125 female STEM ambassadors.

CREWS PARTNERS AND COLLABORATORS

BROADER ENGAGEMENT

American Computer and Robotics Museum
Bitterroot College
Bitterroot Public Library
Blackstone LaunchPad
Boys and Girls Club of Flathead Reservation and Lake County
Boys and Girls Club of Missoula County
City of Missoula Parks and Recreation
Clark Fork Watershed Education Program
Corvallis School District
Families First Learning Lab
Hamilton School District
Lewistown Boys & Girls Club
Lewistown Public Library
Montana Afterschool Alliance
Missoula Butterfly House and Insectarium
Missoula Community Access Television
Missoula Food Bank & Community Center
Montana Outdoor Science School
Missoula Public Library
Missoula Water
MSU Academic Technology and Outreach
MSU Empower
MSU Science Math Resource Center
North Lake County Public Library
Ravalli County Museum and Historical Society
Rosebud Conservation District
School Services of Montana
SciNation on the Flathead Reservation
spectrUM Discovery Area
UM Broader Impacts Group
UM Indigenous Research and STEM Education

RESEARCH

Clark Fork Coalition
Crow Environmental Health Steering Committee
GCS
Geum Environmental Consulting
Internet2
Jackson State University
Montana Bureau of Mines and Geology
Montana Department of Agriculture
Montana Department of Environmental Quality
Montana Fish Wildlife and Parks
Montana Natural Resources Conservation Service
Montana Natural Resource Damage Program
Montana Rural Water Systems
Missoula Department of Public Works
Montana Climate Office
Montana Institute on Ecosystems
Montana Water Center
MSU Central Agricultural Research Center
MSU Environmental Analytical Laboratory
MSU Extension
Resonon
RESPEC Consulting
Rithron Associates, Inc.
Sandia National Laboratories
Semper Cogito Consulting
Sunburst Sensors
Trout Unlimited
UM Bird Ecology Lab
UM Environmental Biogeochemistry Laboratory
UM Flathead Lake Biological Station
University of Alaska Fairbanks
University of Hawaii
University of Minnesota
University of New Mexico
University of Nevada Reno
US Fish and Wildlife Service
University of Vienna
US Geological Survey
Water & Environmental Technologies
Western Washington University
York College

LAND ACCESS

Thank you to the following landowners for providing access for our field work: Clark Fork Veterinary Hospital, Greenleaf Land and Livestock, Hegglund Ranch, Kelley Ranch, Lambert Ranch, Mike Morse, Ueland Ranch.

CREWS PROJECT LEADS

Ragan Callaway, UM, Project Director/Principal Investigator
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*** CREWS Seed Grant Recipient**

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