

A. CONTACT INFORMATION

Dr. Alysia Cox
(406) 496-4185

alysia@mtech.edu

Montana Tech of the University of Montana

1300 W. Park St.

Butte, MT 59701

<http://www.mtech.edu/academics/clsp/chemistry/faculty/alysia-cox/>

<http://edgelab.weebly.com/>

B. PROJECT SUMMARY AND MAP

Title: “*Microbial Activity in Local Metal-Contaminated Sediments and Waters: Fostering Community Education Through Data Integration and Communication*”

Sponsor: The EDGE (Environmental Dynamics in Geobiochemical Engineering) Laboratory is the new research group headed by Assistant Professor Alysia Cox in the Department of Chemistry and Geochemistry at Montana Tech. Research with two new Geochemistry Masters students began this summer and the nascent lab has since recruited an undergraduate researcher with the start of the fall semester. Dr. Cox has a BS in Geological Sciences from Arizona State University and a PhD in Chemical Oceanography from the Massachusetts Institute of Technology and the Woods Hole Oceanographic Institution with extensive field research and data integration experience. The EDGE Masters students have strong backgrounds in chemistry and art history with interests in remediation. The EDGE undergraduate is pursuing a dual major in Chemistry and Biology and is applying for a Research Experience for Undergraduates Fellowship in Environmental Health entitled ‘The environmental quality of Silver Bow and Blacktail Creek: the microbial community’.

Project focus: This project will produce the first view of microbial diversity and activity in the Butte Area One, integrate existing geochemical data in the area, and provide the general public and children of Butte with an article and a book, respectively, addressing the nature of the damages to Butte Area One and steps the community is taking to remediate and restore the area. The article for the general public will cover integrated watershed data including the concepts of pH, dissolved and suspended chemistry, stormflow, and general ecosystem health of Butte Area One. The children’s book will cover a subset of these concepts and be illustrated by graduate student, Renee Schmidt. With the article and the book, we aim to educate the general public and children about the complex nature of Butte’s water resources in order to foster future awareness and stewardship of our resources in Butte.

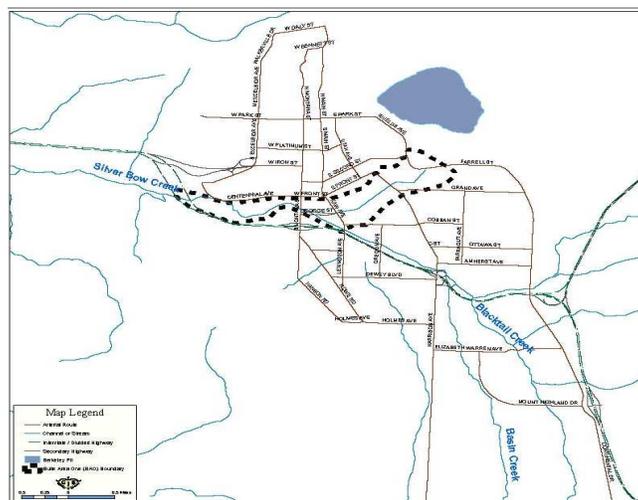
Partners and implementation:

Project location: The microbial identification and activity sampling will occur along Silver Bow Creek and Blacktail Creek in the Butte Area One with analyses being performed at Montana Tech. Integration of already existing geochemical data along and upstream of Butte Area One will occur at Montana Tech. The article for the general public will be published and circulated in Butte. The finished children's book will be debuted at the Science Mine (Dr. Cox recently joined the Science Mine Board of Directors) and the local bookstores.

Total dollar amount: The EDGE Lab requests \$77, 225 over a two-year period for the microbial identification and activity analysis, integration of already available data, public magazine article about the findings, and design and publishing of a children's book about the Butte Area One ecosystem.

Timeline: The project will begin in January 2015 with overall planning occurring during the first half of 2015. Please see the following table for the project timeline. Sampling for microbial identification and activity will begin in earnest in late May or early June, 2016 as classes end and EDGE lab students are available full time for field work and analyses. Analyses will occur concurrently and carry on into fall 2016. Brochures describing our microbial findings will be put together and distributed in late fall and early winter, 2016. Pre-existing data will be integrated starting in Jun 2016. Careful and thoughtful integration will take from Jun 2016 through June 2017 and will contribute to the general public article and children’s book that will be designed, written, and illustrated from March 2017 to fall 2017. The article will be ready in September 2017 and the children’s book available in time for the holiday season in November 2017. A final report will be completed by December 2017.

Map: Five Butte Area One sites where microbial identification and activity will be determined at four different times (spring baseline, during stormflow, after the stormflow and summer baseline). Sites will be chosen in consultation with Joe Griffith (one each in Silver Bow and Blacktail Creek and three after the confluence). The article for the general public will be circulated throughout Butte and the children’s book will be debuted at the Science Mine on Granite Street in Butte.



Project Timeline

	2016												2017											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Overall Design & Planning	X	X	X	X																				
Microbial Identification																								
Planning			X	X	X																			
Sampling						X	X	X																
Analysis							X	X	X	X														
Public Brochure											X	X												
Microbial Activity																								
Planning			X	X	X																			
Sampling						X	X	X																
Analysis							X	X	X	X	X													
Public Brochure												X	X											
Data Integration																								
Planning	X	X	X	X	X	X																		
Analysis							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Publication aligns below																						X	X	
General Public Article																								
Planning												X	X	X										
Writing															X	X	X	X	X	X	X			
Publication																						X		
Children's Book																								
Planning												X	X	X										
Writing and Illustrating															X	X	X	X	X	X	X	X		
Publication																							X	

C. Project Goals and Objectives:

This project will achieve the three goals of 1) providing much-needed microbial identification and activity information to the Butte community in order to make better decisions about the Butte Area One remediation and restoration, 2) integrate pre-existing chemical data with microbial results and give a holistic view of the watershed encompassing Butte Area One, and 3) provide the general public and children with an article and book that contain simple, yet cognizant views of the extent of damage to Butte Area One and concepts vital to understanding its remediation and restoration.

Project implementation will occur over a two-year period while accomplishing the following objectives:

1. Create an overall detailed plan for successful orchestration of project.
2. Develop a specific field plan for microbial identification and activity.
3. Create a specific plan for data integration.
4. Determine microbial identifications and microbial activity.
5. Publish brochures about microbial identifications and activity.
6. Integrate data.
7. Create a specific plan for general public article and children's book and publish article and children's book.
8. Encourage knowledge and awareness of water resources through public education by distributing and promoting article and book.

D. Project Benefits:

This project aims to educate the general public and children about the water resources in and around Butte Area One so that decisions made in the future will be informed ones. This will be achieved by publishing and promoting brochures about the new microbial identification and activity data that we will produce and link to the chemistry, especially during and after a storm flow event.

This project also aims to integrate already existing chemical data on Butte Area One and the encompassing watershed in order to publish an article for the general public and a children's book. This integration and presentation of concepts will result in a better educated constituency able to make wise and protective decisions in the future.

E. Project Implementation:

Staff: The following individuals are the first members of the **EDGE (Environmental Dynamics in Geobiochemical Engineering) Lab** with the exception of environmental expert, Joe Griffin. Each will contribute to this project, detailed under 'Tasks'. Specific duties are listed below:

- **Dr. Alysia Cox**, assistant professor of Environmental Chemistry at Montana Tech, as the principal investigator and head of the EDGE Lab, will organize regular lab meetings to keep the project on track, will provide planning oversight and expertise, compose quarterly reports, prepare financial documentation, and be responsible for the

completion of the data integration, and final publication of brochures, general public article, and children's book.

- **Renee Schmidt**, chemist, artist, and Tech geochemistry masters student will contribute to field sampling and microbial identification analyses. She will be included in data integration and will produce the illustrations for the children's book and brochures (see examples of her work on page 9).
- **Georgia Dahlquist**, chemist and Tech geochemistry masters student, will contribute to field sampling and microbial activity analyses. She will be included in data integration and will help compose text for the general public article and brochures.
- **Jordan Foster**, Tech Chemistry and Biology undergraduate student, will be involved in field sampling and microbial identification analyses. He will be included in data integration and will help compose text for the various publications.
- **Joe Griffin**, local environmental and water chemistry expert and consultant.

Joe Griffin is willing to provide preexisting data for this project and contribute 80 hours of expertise to the planning and execution of the project (personal communication). All microbial identification (DNA) and activity (protein) extractions will be performed in the EDGE lab and sent to previous collaborators for analysis, (DNA sequencing - Dr. Marissa Pedulla of Tech uses Functional Biosciences and protein analysis - Dr. Cox collaborates with Dr. Brian Bothner, the director of Proteomics, Metabolomics, and Mass Spectrometry at Montana State University)(personal communications). Concurrent water samples will be analyzed at the Montana Bureau of Mines and Geology. Additional Tech and Bureau faculty will be able to participate and contribute as appropriate.

Tasks: Individual tasks required to complete this project will be undertaken according to the previously listed objectives. Specific tasks vital to each objective are listed below:

- **Objective #1** - develop a detailed plan for project orchestration with EDGE members and Joe Griffin including sampling, data integration, and brochure, article and children's book ideas.
- **Objective #2** - create a detailed plan for microbial identification and activity analysis at five locations in Butte Area One over four time points in conjunction with Joe Griffin.
- **Objective #3** - compose a data integration plan that includes EDGE members, Joe Griffin, and other interested faculty members at Tech and the Bureau. This will involve organizing meetings with people and sharing information.
- **Objective #4** - execute the sampling plan taking advantage of our consultations and gained expertise as well as storm flow events. Samples will be extracted for DNA (identification) by Renee Schmidt and Jordan Foster and protein (activity) by Georgia Dahlquist and sent for analysis. Water samples will be analyzed at the Bureau.
- **Objective #5** - produce brief brochures with our results from microbial identification and activity analyses for the general public.
- **Objective #6** - integrate known data about the system according to the developed plan and incorporate microbial findings. This will define the topic of the article for the general public and the children's book.

- **Objective #7** - brainstorm concise topics for article and children's book. This will result in iterating drafts between participants until the two products are deemed publishable. Renee Schmidt will illustrate the children's book (see pg. 9).
- **Objective #8** - promote distribution and reading of brochures, article, and children's book in Butte at the Science Mine, local bookstores, and schools. This will result in greater dissemination and digestion of our contribution and hopefully garner positive public interest.

Preliminary product descriptions:

- **What Microbes Live in Butte? (brochure):** This brochure will address the following questions about microbes that live around us. What is a microbe? How do we identify microbes? How are they contributing to our environment? What microbes do we find in and around Butte Ares One? Do they change during storm flow? If so, why do they change?
- **What Are Microbes Doing in Silver Bow Creek? (brochure):** Are the microbes helping us remove contaminants? If so, how? Can we use microbes to increase our success at remediation and restoration?
- **The Dynamics of Butte Area One (general public article):** How has the area been changed by mining procedures? How healthy is the area? How has the surface water chemistry changed with time? How does storm flow influence the system? How do microbes contribute to the dynamics of the area? Why does the system change? What do I, the reader, need to know about the system and how can I contribute to remediation and restoration?
- **Along the Silver Bow (children's book):** The story will likely be narrated by an anthropomorphized rabbit. The rabbit will describe the area as she travels through looking for an ideal spot to nest. Throughout the story, she learns from the various creatures and plants she encounters and with whom she interacts. She will experience storm conditions and describe the changes.

F. Project Schedule:

The project will begin in January 2016 with overall design and planning for the four months of the year (see table on page 3). Planning for data integration will begin immediately and integration will begin in the second half of the year, continuing throughout the duration of the project and producing the backbone for the general public article and children's book. Sampling plans will be developed beginning in March. Sampling will occur when students are available full time starting in June. Analyses will be performed during the summer and into fall. Results will be distilled into brochures and published at the end of 2016 and early 2017. Planning for the general public article and children's book will commence at the end of 2016/beginning of 2017, using the information from the ongoing data integration. The writing and illustration will begin in March 2017 with the final progress occurring in summer of 2017 for publication in the fall.

Quarterly reports will be submitted in coordination with achievement of objectives described as follows: Objectives #1 and 2 will be completed by the end of the 2nd quarter of 2016. Objectives

#3 and 4 will be completed by the end of the 3rd quarter of 2016. Objective # 5 will be completed by the 1st quarter of 2017. Objective #6 will be completed by the 3rd quarter of 2017. Objective # 7 will be completed by the end of the 4th quarter of 2017. Objective # 8 will be ongoing throughout 2017. A final report will be submitted at the end of 2017.

G. Monitoring Activities:

Progress and effectiveness will be measured by filling out checklists for the completion of the tasks required to complete each objective. These checklists are an inherent part of the project progression and will be completed and turned in with the quarterly reports.

The efficacy of the general public article and the children's book will be increased if we interact with these populations before final publications. Drafts will be tested at the Science Mine with a short questionnaire for adults and observations of children's reactions. Arrangements will be made to take a draft of the children's book to a local classroom and reactions observed. These comments and observations will allow us to temper the publications to increase effectiveness.

H. Project Budget

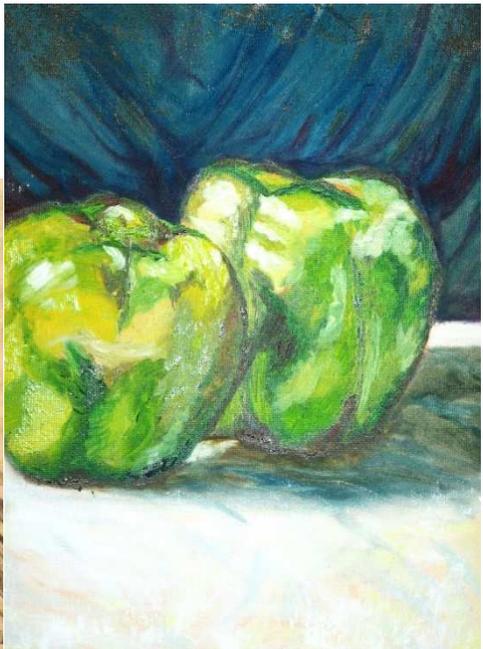
The budget narrative below shows the details and calculations for entries in the summary budget (pg. 10). Montana Tech's budget summary follows. In-kind match is provided through Tech by Dr. Cox's time during the academic year, which includes benefits and indirect costs. Joe Griffin has also offered his consulting time as match.

Budget Narrative:

- **Overall Project Design & Planning:** In-kind match for Dr. Cox and Joe Griffin's time; 0.75 months x \$9,553/month (\$7165) + 40 hours x \$110/hr (\$4400) = \$11,565
- **Microbial Identification:**
 1. Planning time – Dr. Cox; approximately 0.25 months x \$9,553/month = \$2388 in-kind
 2. Materials – sampling vials, sampling materials, dry ice or liquid nitrogen, DNA extraction kits, DNA extraction consumables = \$2000
 3. Sample Analysis – sent to Functional Biosciences for sequencing (20 samples x \$100) and the Montana Bureau of Mines and Geology for water chemistry (20 samples x \$30) = \$2600
 4. Labor – Renee Schmidt graduate student 2.5 month salary x \$2400/month (\$6000) + Jordan Foster undergraduate 0.5 month x \$1600/month (\$800) = \$6800
 5. Subtotal = \$11,400 cost & \$2388 in-kind
- **Microbial Activity:**
 1. Planning time – Dr. Cox; approximately 0.25 months x \$9,553/month = \$2388 in-kind
 2. Materials – sampling vials, sampling materials, dry ice or liquid nitrogen, protein extraction reagents, protein extraction consumables = \$2000
 3. Sample Analysis – sent to MSU for analysis (20 samples x \$150) = \$3000
 4. Labor – Georgia Dahlquist graduate student 2.5 month salary x \$2400/month = \$6,000
 5. Subtotal = \$11,000 cost & \$2388 in-kind

- **Data Integration:**
 1. In-kind match for Dr. Cox and Joe Griffin's time; 0.75 months x \$9,553/month (\$7165) + 40 hours x \$110/hr (\$4400) = \$11,565 in-kind
 2. Materials – none = \$0
 3. Sample Analysis – none = \$0
 4. Labor – Assistant Professor 2 month summer salary x \$6,056 = \$12,112
 5. Subtotal = \$12,112 cost & \$11,565 in-kind
- **General Public Article:**
 1. Planning time – Dr. Cox; approximately 0.75 months x \$9,553/month = \$4777 in-kind
 2. Materials – none = \$0
 3. Publishing Cost – local publisher TBD = \$2000
 4. Labor – Georgia Dahlquist - Graduate Student 3 month salary x \$2400/month (\$7200) + Jordan Foster undergraduate 1 month x \$1600/month (\$1600) = \$8800
 5. Subtotal = \$10,800 cost & \$4,777 in-kind
- **Children's Book:**
 1. Planning time – Dr. Cox; approximately 0.75 months x \$9,553/month = \$4777 in-kind
 2. Materials – none = \$0
 3. Publishing Cost – local publisher TBD = \$2000
 4. Labor – Renee Schmidt - Graduate Student 3 month salary x \$2400/month (\$7200) + Jordan Foster undergraduate 1 month x \$1600/month (\$1600) = \$8800
 5. Subtotal = \$10,800 cost & \$4,777 in-kind

Grant Total: Amount Requested = \$77,225 In-kind Match = \$37,188
The total amount requested includes 10% benefits for graduate students and 25% indirect costs for Montana Tech.



Selected portfolio in varied media for Renee Schmidt - EDGE masters student and illustrator for the children's book.

Budget Summary

Activities	Category	Cost (in dollars)	In-kind Match (in dollars)
Overall planning & design	Planning time		8942*
Microbial Identification	Planning time		1514*
What organisms are there?	Materials	2000	
	Sample Analysis	2600	
	Labor	6800	
	Subtotal	11400	1514*
Microbial Activity	Planning time		1514*
What are they doing?	Materials	2000	
	Sample Analysis	3000	
	Labor	6000	
	Subtotal	11000	1514*
Data Integration	Planning time		8942*
What are the data that we already have telling us?	Materials		
	Sample Analysis		
	Labor	12112	
	Subtotal	12112	8942*
General Public Article	Planning time		3028*
Butte general public article	Materials		
	Publishing Cost	2000	
	Labor	8800	
	Subtotal	10800	3028*
Children's Book	Planning time		3028*
Illustrated short story	Materials		
	Publishing Cost	2000	
	Labor	8800	
	Subtotal	10800	3028*
GRANT TOTAL		77,225*	37,188*

*Indicates includes Tech benefits and indirect costs of 25%. Benefits and indirect costs were not applied to the outside consultant, \$8,800 in-kind match.

October 15, 2015

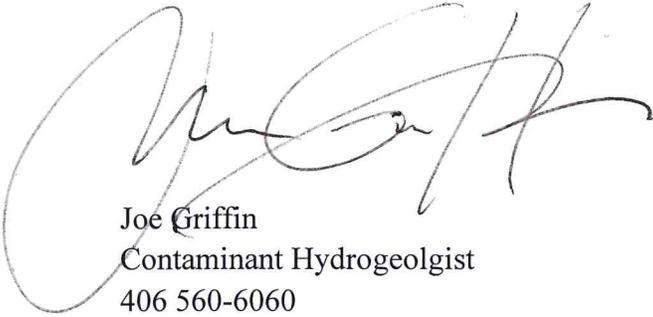
Alysia Cox, PhD
Assistant Professor, Department of Chemistry & Geochemistry
Montana Tech of the University of Montana
1300 W. Park St.
Butte, MT 59701
Office: CBB 217
(406) 496-4185

RE: Technical Support for the Study - *Microbial Activity in Local Metal-Contaminated Sediments and Waters: Fostering Community Education Through Data Integration and Communication*

Dear Alysia,

I will consult 40 hours on the overall planning and design of the above project including the exact location of sampling sites and 40 hours on data integration for a total of 80 hours at my consulting rate of \$110/ for a total in-kind match of \$8,800.

Best of Luck,



Joe Griffin
Contaminant Hydrogeologist
406 560-6060