

Faculty Senate Minutes

02/15/2018

1:00-2:00 PM

Attendance: Scott Risser, Glen Southergill, Jason Parish, Leslie Dickerson, Phil Curtiss, Charie Faught, Atish Mitra, Matt Egloff, Stella Capoccia, Micah Gjeltema, Burt Todd, Miriam Young, Tony Patrick, Courtney Young, Brian Kukay, Dan Trudnowski, Rita Spear, Karen Weisenburg-Ward, Larry Smith, Bev Hartline, Doug Abbott, Jack Skinner, Jerry Downey, Katherine Zodrow, Laura Young, Marvin Speece, Ron White, Khalid Miah, Abhishek Choudhury, George Williams, Doug Abbott, Laurie Vandell, Carrie Vath, Sudhakar Vadiraja, Lorrie Burkenbuel,

I. Welcome and Minutes

- a. Draft Minutes found here: <http://www.mtech.edu/about/facultysenate/minutes/index.htm>
- b. Motion to approve seconded, passed with name spelling correction.

Action Items

II. Emeritus Rank Applications- Two applications (see attached documents)

- a. John Morrison- Faculty need to make a recommendation that goes to Chancellor and Board of Regents. Motion approved and seconded to recommend Emeritus Rank. Motion Passes.
- b. Hsin-Hsiung Huang- Motion to recommend seconded and approved.

III. CRC Recommendation

- a. Create Virology – BIOM 435 (course has been taught as a special topics)-

Changes from special topic and added to course inventory. The proposal to change the curriculum was presented at a subsequent meeting. Move to approve as an addition to the catalogue and seconded. Motion passes.

- b. Create a MS in Materials Science- see attached documents

CRC and Grad Council approved. Question regarding budget impact (response was that since it involves existing courses and faculty). Question regarding level II status. Followed the same format as the PhD program that was approved four years ago. Comment that looking at the CRC approval process. Question regarding enough faculty to teach, with response that core courses are same as PhD program. Lowest enrollment at Montana Tech in core courses has been 4-5. Offers opportunity to have an “off ramp” for PhD, and can also be umbrella to other programs. Has the potential to grow. Question regarding need for extra lab space. Realistically, will need research funding to cover cost, which requires research space, depending on projects. May need additional space, with a process that exists on campus. Will not reduce the need for research space that impacts many departments. Tried to be realistic with revenue based on experience. Right now have 18 PhD students, masters with less time will be a realistic estimate. Question regarding off campus learning and being prepared for PhD program. Will depend on the student and if they pursue the thesis option. Properly managed, students should be able to transition into PhD. A practicum may be able to help those who do not take the thesis option. Also accept people without a masters into the material science program. May have pushback from MSU, UM. Currently no other in the state. Is intended to go from masters to PhD. Comment that masters is very marketable. Question regarding UM or MSU PhD students being able to achieve degree. Comment that details have yet to be worked out. Comment about being in the department of Materials Science, which does not exist. Response that would be in school of mines and engineering, and the budget right now in the grad school. The department has not been created yet. Language enables Tech to create the department, but it is not required. Question about how to have an umbrella degree but in a department. Faculty in related departments can elect to affiliate with a department. Comment about seeking to add to catalogue without a department. Hope to have effective by next academic year. Similarly, the Mechanical and Civil degrees also had the language of adding new departments. Holding department is now the graduate school. Can make a motion to address issue of no department. Concern that no department and no budget addressed. Currently have program director for Materials Science PhD, plus assistance, is now in the grad school

budget (is now ad hoc). No incremental cost associated with the masters. Comment that not having a budget is not transparent. Concern that undergraduate labs will be squeezed, and currently lack space. Relying heavily on Mechanical and Chemistry (with comment that space will be in metallurgy). Labs will depend on who is the advisor. Response that will be needed lab space. Will need to communicate and coordinate. Concern that use of equipment and repairs will come out of other budgets. Move to approve recommendation seconded as written. CRC does not require a budget. Motion passes. Will forward to registrar and provost for next steps.

IV. GERC Recommendations- none at this time.

V. Research Integrity Policy- see attached documents. Research office reviewed previous document as well as any new federal requirements, and changed to two documents instead of one. Policy short, procedure addresses if misconduct is alleged. Also includes navigation between the two. Nothing of content has changed, just change of format and made less wieldy. Sent to Chris Danielson in terms of MEA/MFTA contract, with comment that no significant changes. Mostly impacts research faculty. Not necessarily required for faculty senate approval, but seeking input. Question regarding formatting of policies, such as adding a date, revision number, original author, etc. University policies typically has a signature line, which would need. Will need to be placed in Tech formatting. Future policy will require faculty senate approval. Question regarding faculty in inquiry phase, which is the same unless it was unclear. Question regarding who appoints committee for inquiry phase. The research committee has representation across campus, but the committee is appointed. Sexual misconduct is not considered research misconduct, falls into another category, and would take precedence. Faculty staff handbook defers to the policy. Motion to approve the recommended policy and seconded. Motion passes.

- a. Policy
- b. Procedures

Informational Items

VI. Committee updates:

- a. Program Prioritization Committee- Presented an overview of current status. Committee just getting started, with preliminary data on metrics based on themes taking place in the next meeting Commented that do appreciate updates and hope that updates continue.
- b. WIRE- Report that report will be sent to BOR in March. Goal is to have some kind of forum to campus to show what planning to say. Still trying to figure out final objectives. Focus on science and engineering, with graduate studies and applied research, and to add an interdisciplinary approach.
- c. Student Evaluations Sub-Committee- see attached presentation. Previous document reviewed, right now just an informational update. Subcommittee receiving feedback from multiple sources to evaluate process, including purpose. Statement of purpose and domains has been reviewed. One of the purposes is to enhance teaching and learning, but should not be the only measure (and may be at times contradictory). One of the changes would like to see is the mechanics of receiving the evals. Also considering how to separate learning experience such as room technology. Further, departments may outline different questions, so could select specific questions to isolate and evaluate. Question regarding ASMT involvement, have been contacted and will do so in the future. Question regarding link between CBA and evals. If change measure, may need to invoke CBA protocol to change. Question about questions taught completely online. Response that was raised as a discussion, with input from David Bentz, which will be included into the evaluation. No separate evaluation, as the questions were not contradictory. Would not add to the cost for printing. Can also add a few specific department questions. Question regarding length of current evaluations- should the number of questions be reduced or stay the same? Ask that faculty provide feedback.
- d. Teaching Community Leadership Team- Out of ten people, six have agreed to participate (four turned down). Would be helpful to have topics, questions, problems that can be addressed. Would like to have a list of topics for teaching and research. Would also like to have Dean's Council input and consideration. Still looking for ten individuals participate. Comment that others in the MUS system could also participate in future iterations.
- e. Research Mentors- see above (d).

VII. Textbook Proposals- See attached slides. Looking at a new program called "inclusive access". Should help to reduce the costs, and increase educational outcomes. Books and supplies at \$1100 on the website, see attachment.

Textbook costs rising higher than CPI and medical costs. Freight alone accounts for \$50,000 last year at Tech. Looking at e-textbooks. The information in inclusive access will integrate with LMS including Moodle. Required to have an opt out option. Is available with many publishers and texts used at Tech. Looking to pilot courses at the freshman level. Important to think about e-textbooks and how students read textbooks in a successful manner. Will need to educate faculty to use the tools as well. Comment that is the innovation of education. Question about adding material that is not from the publisher. Can be added with same analytics if OCR. Vendor is charging and taking from the publisher cost. Comment that UC Davis had an 85% satisfaction rate. Comment that some do not like digital products. In some cases will have access for 180 days. Can potentially have access for longer term for calculus series. Comment that book only lasts for a certain period of time. Based on generation that use internet research tools. Comment that instructor requires any textbook on the subject, concern that Google and online research is not reliable, and that price will increase once it has been established. Some students go without books and some purchase and never open. Comment that can purchase as a three ring binder or keep and print as a pdf. Comment that instructors can opt out (not looking at 100% use). Not a mandate, but hope that most will participate. Most students do have access to technology. Can have policy that requires utilization.

Discussion Items

VIII. Budget Discussion with VC Wright – postponed until a future meeting

IX. Proposed Revision to Transfer Language – returning to floor with guest L. Dickerson – language below. Concern that students finding path of least resistance to complete courses. Revised language based on students in certain areas that are transferring more credits. Concern about quality of courses. Propose a change that departments can choose to participate if they have a concern. Can also limit to a certain number of credits. Concern that lower level credits being transferred. If the catalogue description matches Techs, then we are required to transfer the credit. When a substitution, it is an exception to the rule, which can be denied. Will not be able to change all transfers, but will be helpful. Overall trying to limit “loophole” and not taking core credits at Tech, which typically is at the 300-400 level. Motion to recommend the language as presented, with changing XX to 30 credits and seconded. Question regarding 200 level courses. Way it is written is 300/400 level credits. Comment that XX should be 60, with additional comment that it may not be realistic. Comment that quality graduates come from 2 year institutions. Intent that solving upper division courses for transfer students. Clarification that faculty senate would be deciding body, and would be in catalogue if approved. Comment that some upper division in other departments. Does not change substitution. New motion to amend to XX to not exceed 60 credits. Comment that registrar does not approve 60 credits. Not saying that students have to take the class, saying that they have to take it at Tech. Do have agreements in place that includes 300. Call to question. Motion passes. Will have to go through CRC for departments.

X. Other Items – Discussion that we do not meet enough. Motion that we meet with Brant at a smaller meeting within a month seconded. Comment that to have the discussion when we have a quorum. Comment that once a month not enough. Motion passes.

Handout of appointments to a new contract, to be put before the next meeting. Motion to meet every two weeks, seconded for the semester. Motion passes.

VII. Physics, Math, and Chemistry service courses are looking at going with Cengage products so that students can save money with a Cengage Unlimited Subscription (<https://www.cengage.com/unlimited>)



Comparison of Current costs vs. Cengage Unlimited		
Course	Publisher	Bookstore New Retail
Phy 234/235/237	Cengage w/access	\$306.00
Math 171/172	Pearson w/access	\$284.00
CHEM 141/143	Norton w/access	\$166.25
	Total	\$756.25
	Cengage Unlimited Subscription includes etext & online homework system	\$119.99
	Savings	\$636.26

If students want a printed text they can rent one for only the shipping cost of 7.99 per semester. Cost of renting all 3 texts for duration of each course is \$55.93 - bringing total costs of using Cengage Unlimited with a printed text to \$175.92 for all courses.

Savings Total \$580.00 per student.

Total savings if each course is 200 students= \$116,000 per semester.

IX. Proposed revision to the BS requirements for transfer students. See italicized amendment below:

Replace in 2018-19 catalog:

“Bachelor of Science Degree

1. The student must meet all the requirements of one of the curricula listed for the Bachelor of Science degree. Students can choose to complete the degree requirements in the catalog they enter under or any subsequent catalog published while they are continuously enrolled, but they must complete those requirements within six years from the date of the chosen catalog.
2. At least 50% of the student’s upper division (3000/4000 level classes) credits must be completed through Montana Tech, including any Senior Design/Capstone course work required for the degree.
3. The student must achieve a minimum cumulative grade point average of 2.00 on all course work attempted (with repeats counted as indicated previously) as well as on all course work in the departmental major. No course below a “C-” will transfer or be acceptable toward degree requirements.”

With:

“Bachelor of Science Degree

1. The student must meet all the requirements of one of the curricula listed for the Bachelor of Science degree. Students can choose to complete the degree requirements in the catalog they enter under or any subsequent catalog published while they are continuously enrolled, but they must complete those requirements within six years from the date of the chosen catalog.
2. At least 50% of the student’s upper division (300/400 level classes) credits must be completed through Montana Tech, including *senior design/capstone courses and all core classes as determined by the department. If a department chooses to identify core courses, they will be specified in the catalog with the program curricula* *Core coursework will not exceed XX credits.*
3. The student must achieve a minimum cumulative grade point average of 2.00 on all course work attempted (with repeats counted as indicated previously) as well as on all course work in the departmental major. No course below a “C-” will transfer or be acceptable toward degree requirements.”

Professor Emeritus Status for Professor John Morrison; Montana Tech of The University of Montana

THAT: Upon the occasion of the retirement of Professor John Morrison from the faculty of Montana Tech of The University of Montana, the faculty wish to express their appreciation for his 17 years of dedicated and valued service to the Department of Electrical Engineering, Montana Tech, the Butte Community, and the State of Montana by recommending the rank of Professor Emeritus be conferred upon him by the Board of Regents of the Montana University System.

EXPLANATION: John L. Morrison earned his BS degree in 1967 and his MS degree in 1968, both from the University of Connecticut. Over two decades later in 1992, he earned the PhD in Electrical Engineering from the University of Idaho. Dr. Morrison joined the research staff at Idaho National Laboratory (INL) in 1973. Over the next 18 years, Dr. Morrison rose through the ranks at INL working a wide variety of electrical engineering research problems. In 2005 John was awarded the prestigious INL "Lifetime Achievement Award". Dr. Morrison joined Montana Tech in 2001 as an Assistant Professor of Electrical Engineering. He was promoted to Associate Professor in 2004, and was promoted to Full Professor with tenure in 2009.

John is one of the founding members of the current Electrical Engineering Department. He was critical in nurturing the program, having developed over half of the curriculum. These are some of the most difficult courses at Montana Tech. He is a rigorous teacher and demands hard work from his students. In return, Dr. Morrison goes to great lengths to help students succeed. For example, nearly every Sunday afternoon, he offers a help session (he calls them "workshops"). Because of the significant amount of time he spends outside of class helping students, he has developed a close mentoring relationship with many EE students. As one student told me: Dr. Morrison "will bend over backwards" to help a student. His dedication to excellence set a culture within the EE department that permeates the entire program. The program now has a national reputation for excellence that is rooted, in large part, in John's work ethic.

Dr. Morrison's research and scholarly activities at Tech are truly impressive. He is an international expert in battery diagnostics. Over his career at Tech, he has established close collaborative relationships with federal research institutions (INL, and NASA), and with private industry such as the Ford Motor Company. Since joining Tech, he has had many grants funded, advised several MS students, advised one PhD student, been awarded 12 patents, and over 20 refereed publications. In 2007, he was named the "Engineer of the Year" by the local section of IEEE. And most impressively, he was awarded an R&D 100 Award in 2011 for his innovations in battery diagnostics. An R&D 100 annually recognizes the top 100 innovations in the United States each year.

With this recommendation goes sincere gratitude for over 17 years of invaluable teaching, service and research. To Dr. Morrison: congratulations and best wishes for the future.

Professor Emeritus Status for Professor Hsin-Hsiung Huang; Montana Tech of The University of Montana

THAT: Upon the occasion of the retirement of Professor Hsin-Hsiung Huang from the faculty of Montana Tech of The University of Montana, the faculty wish to express their appreciation for his 40 years of dedicated and valued service to the Department of Metallurgical & Materials Engineering, Montana Tech, the Butte Community, and the State of Montana by recommending the rank of Professor Emeritus be conferred upon him by the Board of Regents of the Montana University System.

EXPLANATION: Hsin-Hsiung Huang was born and raised in Taipei, Taiwan. He prefers to simply be called “Huang” but fellow researchers including his students also call him, “H³”, his affectionate nickname. Huang earned his B.S. in Metallurgical Engineering at Cheng-Kung University, Taiwan, in June 1969. Afterwards, he promptly started Graduate School at Stanford University, California, where he completed his MS and PhD degrees in Chemical and Extractive Metallurgy in 1974 and 1975, respectively. Dr. Huang immediately joined the Metallurgical Engineering Department at The University of Utah as a Postdoctoral Researcher and remained there until 1978. H³ then became a Visiting Professor in the Metallurgical & Materials Engineering Department at Montana Tech, a position that he enjoyed until 1982 when he became Assistant Professor. Dr. Huang was promoted to Associate Professor in 1986, received tenure in 1989, and was promoted to Full Professor in 1992. In 1999, he became the Anaconda Professor of Metallurgical Engineering. He retains this title today.

Having been at Montana Tech for 40 years and spent nearly 3 years at University of Utah, Dr. Huang has over 4 decades in academia. At Montana Tech, he has been a mainstay with the Computer and Telecommunications Advisory Committee, Web Guidance Committee, Research Advisory Committee, and Graduate Council but has also served periodically on the Library, Traffic and Parking, Cultural Events and Curriculum Review Committees. He is a member of The Minerals, Metals and Materials Society (TMS), Sigma Xi (through the Stanford Chapter), and ASM International (formerly the American Society for Metals). He participates regularly with them as well as the Society of Mining, Metallurgy and Exploration (SME). With SME, he is not a member but is active by attending and presenting at their Annual Meeting approximately every other year. With TMS and SME, he has been active with the Aqueous Processing Committee and Mineral and Metallurgical Processing Division, respectively. It is through these societies that he has done most of his publishing and presenting. These efforts kept him professionally active and helped the M&ME Department and Montana Tech maintain accreditation.

Huang is best known for developing the thermodynamic equilibrium modeling program, StabCal, which is used internationally to calculate speciation/stability diagrams ranging from simple alpha plots to more complex mass-balanced E_H-pH figures. He has spent a lifetime developing the program and continues to increase its capabilities. His latest contributions to StabCal involve calculating 3-dimensional plots and applying it to non-hydrometallurgical processes including but not limited to mineral processing (sizing and flotation), pyrometallurgy (smelting and refining), electrometallurgy (rare earth elements),

and the environment (water remediation, recycling and waste treatment). He plans to continue adding to its capabilities as he phases into retirement and beyond.

Dr. Huang's research activities not only include thermodynamic modeling but also working in the lab or field to generate data to verify the models. While all of his work has been critical, it is his environmental research that has received the highest accolades. The four most prevalent include the titration simulation for treating Berkeley Pit water, formation of high density sludge from neutralization of acid mine water, removal of manganese from waste water, and speciation of arsenic and subsequent adsorption on precipitated ferrihydrite. In this regard, it is strongly noted that his work on Berkeley Pit water resulted in his proposed remediation being selected as the best demonstrated available treatment (BDAT). His process is specified in the EPA Record of Decision (ROD).

For the last three decades, StabCal has been used by the Department, CAMP, and faculty across the campus, particularly by graduate students and their theses and dissertations as well as their publications and presentations. It has also been used around the world as a premiere tool by a number of universities (e.g., Colorado School of Mines, U of Utah, U of Arizona, U of New South Wales, Akita U, and Curtin U) and companies (e.g., Freeport McMoRan, Newmont, Barrick, Montana Resources/ARCO, Kennecott, Hecla, Montana Enviromet, and MSE-TA). In the end, StabCal served what Dr. Huang cared about most: undergraduates learning in the classroom and lab, graduate students receiving their advanced degrees, and companies saving thousands if not millions of dollars. Every step of the way, H³ was unselfish, always making himself available to help. StabCal has been a true labor of love.

Dr. Huang loves math and chemistry. In this regard, his enthusiasm was contagious in the classroom and lab, making him the perfect instructor for Metallurgical Kinetics, Phase Transformations, Heat and Momentum Transfer, Hydrometallurgy, Extractive Metallurgy Lab, Advanced Extractive Metallurgy I and II, and Computer Applications. His expertise, knowledge and insight in these subject areas, particularly when he applies StabCal to his lectures, has been invaluable and shared generously with everyone throughout the years.

With this recommendation goes sincere gratitude for over 40 years of invaluable teaching, service and research. To Dr. Hsin-Hsiung Huang: congratulations and best wishes for the future.

Protocol: The department requesting curriculum change holds a discussion at the departmental level, and if agreed upon by the department head, discuss with the Dean for approval. Forward the completed form along with supporting information to the CRC chair after approval from the department head, dean, and graduate council if necessary. Final changes are then made by the registrar after faculty senate approval. Guidance: <https://www.umt.edu/provost/faculty/curriculum/default.php>.

Date 12/13/17

Dept. Biological Sciences College CLSPS

Program: Biological Sciences/ Cell and Molecular track

to course inventory

Description of Request/Summary: We are adding an upper level virology class ~~as a required course to our~~ cellular/molecular track to meet the needs of our students. The course has been occasionally taught in the past as a "special topics course". At this time, we plan to offer this course every other fall semester starting in 2018.

Current Course Program Information: A virology course has been taught at Montana Tech from time to time as a special topics course with the most recent offering in the 2016 fall semester.

Proposed Change (Attach syllabus or curriculum for new course or curriculum changes.)

Course # Name	Credits	Pre-req.
BIOM 435 Virology	3	BIOB 160 and 161

Note: The course number is consistent with other MUS institutes including UM and MSU.

Course Description: Viruses represent a major category of human infectious diseases. This course will cover viral classification system, structural features, replication cycle variations, host-pathogen interactions, epidemiology, and relevant cellular biology. Specific important families of human viruses will be evaluated thoroughly. Additional topics will include plant viruses, bacterial viruses (bacteriophages), as well as non-viral pathogens prions and viroids.

List of supporting documentation attached:

1. Syllabus

Assessment Leading to Request

A number of our majors are focused on getting in to a professional health school (e.g. medical school, dental school, etc) and many of these programs required an undergraduate virology course. In addition this course will be of interest to biochemistry majors interested in professional health schools. We have offered this course as a special topics elective but want to make it a regular course required for our cellular/molecular track.

Anticipated Impacts to "Other" Programs

No anticipated impacts

Impact on Library: No consultation is required since changes are only in the course number, course name, or course pre-requisites.

Date to take effect: Fall 2018

do not ammend curr
at this time

LEVEL of Request

Please indicate the type of request(s) by selecting *all that apply*:

Faculty Approvals (directly to CRC, then Faculty Senate):

- Establish a new course for the catalog (please contact the Registrar of MUS CCN information)
- Changed course: addition, deletion or change of title, credit, course number, pre-req, description, or cross listing.
- Amend an existing degree program. Making changes to programs such as adding a writing course to a major, changing the list of accepted electives or removing a requirement of a minor

- New degree certification of 29 credits or less
- Other:

Campus Approvals (must be approved by the VCAA prior to CRC submission):

- Placing a postsecondary educational program into moratorium
- Withdrawing a postsecondary educational program from moratorium
- Establishing, re-titling, terminating or revising a campus certificate of 29 credits or more
- Establishing a B.A.S./A.A./A.S. area of study
- Offering an existing postsecondary educational program via distance or online delivery.
- Other:

OCHE Approvals (must be approved by the VCAA and Chancellor prior to CRC submission):

- Re-titling an existing postsecondary educational program
- Terminating an existing postsecondary educational program
- Consolidating existing postsecondary educational programs
- Establishing a new minor where there is a major or an option in a major
- Revising a postsecondary educational program
- Establishing a temporary C.A.S. or A.A.S. degree program Approval limited to 2 years
- Other:

Level II (must be approved by the VCAA and Chancellor prior to CRC submission):

- Establishing a new postsecondary educational program
- Exceeding the 120 credit maximum for baccalaureate degrees Exception to policy 301.11
- Forming, eliminating or consolidating an academic, administrative, or research unit
- Re-titling an academic, administrative, or research unit
- Other:

APPROVALS

Department Head Approval

Amy Kuen Date 1/16/18

Dean Approval

Doug Lee Date 1/16/18

VCAAR Approval (see above)

_____ Date _____

Chancellor Approval (see above)

_____ Date _____

Graduate Council Approval

_____ Date _____

CRC Approval

A Stack Date 1/24/18

Faculty Senate Approval

_____ Date _____

Virology

Classroom TBD, Time TBD (3 credits)

Textbook Human Virology, 5th Edition – by John Oxford, Paul Kellam, Leslie Collier

Instructor Joel Graff, PhD (jgraff@mtech.edu), CBB 212

Office hours Tuesday 9:00am to noon, or by appointment (send email)

Catalog description

Viruses represent a major category of human infectious diseases. This course will cover viral classification system, structural features, replication cycle variations, host-pathogen interactions, epidemiology, and relevant cellular biology. Specific important families of human viruses will be evaluated thoroughly. Additional topics will include plant viruses, bacterial viruses (bacteriophages), as well as non-viral pathogens prions and viroids.

Learning outcomes

- Familiarity with both the Baltimore and the International Committee on Virus Taxonomy (ICTV) classification systems
- An understanding of important events in virological research history
- In-depth knowledge of several important and diverse viruses such as poliovirus (enteroviruses), influenza viruses, various hepatitis viruses, herpesviruses, human immunodeficiency viruses, and poxviruses
- Make connections between oncogenic viruses and certain cancers
- An appreciation for non-mammalian viruses such as plant viruses and bacteriophages as well as an introduction to other infectious agents such as prions and viroids
- A deeper understanding of eukaryotic cell biology due to virus-related manipulations of normal cell biology
- Ability to communicate important aspects of a typical virus replication cycle such as cell attachment and entry, uncoating, genomic replication and gene expression regulation, as well as cell exit strategies
- Familiarity with virus structural features such as icosahedral symmetry, fibril virions, and viral envelopes
- An ability to explain virus-host interactions with a particular emphasis on host resistance via various immunological responses and pathology
- Awareness of epidemiology, viral evolution, laboratory diagnostic techniques, and current trends in virology research.

Additional information

Most information about the class will be available on the <http://lifeandbiology.com> website in "Virology" within the "Courses" tab. Some information, such as primary literature articles that are not open source, will be found on Moodle.

Expectations

We will cover a lot of information this semester. Be prepared for class by reading the textbook and turning in assignments on time.

Grades

1. **Be a teacher:** 20 points each
2. **Questions and prompts:** 10 points each
3. **Quizzes:** 10 points each
4. **Primary literature reports:** 40 points each

For the "General principles" and "Practical aspects" sections of the course:

Be a teacher: After reading the textbook assignment, write in your own words how you would explain the main concepts to someone else. I will be looking for personalization in these assignments. Prior to class, submit this assignment as a Word document of ~600-1000 words. (Suggestions: Make them entertaining. Come up with analogies. Break down a concept that you think might be difficult for some to grasp. Use and cite other sources of information.)

In-class questions and prompts: Questions and other writing prompts will be contemplated. We will talk through them as a class on our way to working toward a consensus. Written answers will be turned in at the end of class.

For the "Specific viruses" and "Odds and ends" sections of the course:

Quizzes: Daily quizzes will be given at the beginning of class following Q&A time to clear up any concepts or descriptions from the reading assignment.

Reports: We will be incorporating primary literature into the section of class describing individual viral families. The articles will be the focus of most of our class time. Once we have finished each primary literature article, you will be assigned to write up a report.

This report should be written as if you were explaining the results as well as the rationale for the experimental design. Why did they initiate this research? What was the purpose of each figure and what was their experimental and logical rationale as they transition from one experiment to the next? What were some of their interesting insights in the discussion section? What are some paths forward with the research? What was the significance of the research?

The reports should each be between 800 and 1200 words in length. Drawings are encouraged and do not count against your word limit. (Take pictures of your drawings and insert them into your Word document.)

Grade scale

	From	Up To
A	93	100
A-	90	93
B+	86	90
B	83	86
B-	80	83
C+	76	80
C	73	76
C-	70	73
D+	66	70
D	63	66
D-	60	63
F	0	60

Cheating

Cheating/Plagiarism will not be tolerated. Please see the student handbook for Montana Tech's Cheating/Plagiarism policy.

Disabilities

Students with disabilities who believe they may need accommodations in this class are encouraged to contact Montana Tech's Disability Services Coordinators at either 496-4429 (North campus) or 496-3730 (South campus).

Disclaimer

This syllabus is subject to modification during the semester. Any changes will be announced during class and/or posted to the Moodle page.

Schedule

		Chapter
General principles	Virology: how it all began and where it will go next	1
	General properties of viruses	2
	Viral replication and genetics	3
	How viruses cause disease	4
	Resistance of the human body to virus infections	5
	Viruses and the community: epidemiology	6
Group 1	Picornaviruses: polio, hep A, enteroviruses, common cold	7
	Astroviruses: gastroenteritis agents	8
	Caliciviruses: norovirus causing vomiting and diarrhea	9
	Hepatitis E	10
	Togaviruses: mosquito-borne Chikungunya, teratogenic rubella	11
	Flaviviruses: yellow fever, dengue fever, hep C	12
	Coronaviruses: SARS, MERS, etc.	13
Group 2	Orthomyxoviruses: influenza A, B, C	14
	Arenaviruses: Lassa and hemorrhagic fevers	15
	Bunyaviruses: Hanta, phlebo, and nairo	16
	Paramyxoviruses: measles, RSV, mumps, parainfluenza, etc.	17
	Filoviruses: zoonotic Marburg and Ebola	18
	Rabies: zoonotic rabies	19
Group 3	Reoviruses: diarrhea-causing rotaviruses	20
Group 4	Polyomaviruses	21
	Papillomaviruses	22
	Herpesviruses: herpetic lesions, zoster, cancer, and encephalitis	23
	Smallpox: human disease eradication but zoonotic infections still	24
	Adenovirus: respiratory, eye, and gastroenteritis viruses	25
Group 5	Parvoviruses	26
Group 6	Retroviruses	27
Group 7	Hepadnaviruses: hep B and D	28
Practical aspects (lectures)	The clinical virology laboratory	29
	Control of viral diseases by immunization	30
	Antiviral chemotherapy	31
Odds and ends (not covered in your book)	Bacteriophages	
	Plant viruses	
	Viroids and satellite viruses	
	"Big" viruses: Mimivirus, Megavirus, etc.	
	Prions	

Protocol: The department requesting curriculum change holds a discussion at the departmental level, and if agreed upon by the department head, discuss with the Dean for approval. Forward the completed form along with supporting information to the CRC chair after approval from the department head, dean, and graduate council if necessary. Final changes are then made by the registrar after faculty senate approval. Guidance: <https://www.umt.edu/provost/faculty/curriculum/default.php>.

Date: 02/05/18

Dept.: Materials Science

College: Graduate School

Program: Master of Science in Materials Science and Engineering

Description of Request/Summary: We propose to offer a Master of Science program in Materials Science and Engineering. There is no other Master of Science in Materials Science & Engineering in the MUS or at other institutions in Montana. The program will be available to students enrolled on campus and to working professionals seeking professional advancement via distance learning. It will be structured to complement and bridge between several engineering and science bachelor's degree programs and the growing MUS Collaborative Materials Science Ph.D. program, and to position its graduates for numerous career pathways in materials, manufacturing, and high tech industries.

Current Course Program Information: The interdisciplinary Master of Science in Materials Science and Engineering degree program will include thesis and non-thesis tracks to enable students to customize their studies to fit their career goals and objectives. Thesis-track students are required to complete a minimum of 30 semester credit hours and they must prepare and submit a research-based thesis and pass a formal thesis defense examination, which will be conducted by the student's research advisor and committee. Non-thesis track students are required to complete a minimum of 36 semester credit hours. In the final year of their program, non-thesis track students complete a culminating experience or "practicum." Additional details are available in the supporting documentation.

Proposed Change

MS/MSE Minimums	Thesis Track	Non-thesis Track	Required Core Courses and Seminars: MTSI 501-- Bonding, Structure, and Defects (4 Cr-h) MTSI 511-- Thermodynamics of Materials (3 Cr-h) MTSI 512-- Kinetics and Phase Transformations (3 Cr-h) ENGR 5940-- Graduate Seminar (1 Cr-h) TC 5160-- Writing Seminar (1 Cr-h) Prerequisites: graduate student standing with a bachelor's degree in a physical science or engineering discipline.
Core	10	10	
Adv. Mathematics/Modeling	3	3	
Technical Electives	9	15	
Independent Study/Practicum	0	6	
Seminar	1	1	
Writing Seminar	1	1	
Thesis	6	0	
Total Credit Requirement	30	36	

List of supporting documentation attached:

1. Montana University System Intent to Plan Form
2. Montana Board of Regents Curriculum Proposal

Assessment Leading to Request

This proposal was developed in summer and fall 2017 by faculty representatives from the Metallurgical and Materials Engineering Department and the Mechanical Engineering Department with oversight and approval from the Graduate School Dean, the Dean of the School of Mines and Engineering, the Dean of the College of Letters, Sciences, and Professional Studies, and the Graduate Council.

Anticipated Impacts to "Other" Programs

The impact on the resources of existing programs will be negligible because no new faculty, administrative, or support personnel are required to implement the MS/MSE program. The program can be implemented with existing basic sciences and engineering faculty and without affecting their respective class schedules. The MS/MSE curriculum is predominantly based on graduate-level courses that are offered annually in the Materials Science Ph.D. program, the M.S. in the Project Engineering Management (MPEM) program,

and the individual basic science and engineering departments No existing programs will be adversely affected, new resource requirements are negligible, and start-up is expected to be seamless because the requisite faculty, classrooms, courses, and laboratories are already in place and the program will conform to existing faculty assignments and projected class schedules.

Impact on Library: Dr. Jerry Downey consulted with Montana Tech Library Director Mr. Scott Juskiwicz (02/01/18) to ensure needed materials and media are available. The library and information resources are sufficient to support the proposed MS/MSE program. To date, these resources have proved adequate to sustain the Materials Science Ph.D. program, which is currently in its fourth year of active student engagement. MS/MSE research is expected to focus on the same areas as does the Ph.D. program, so additional resources are not necessary.

Date to take effect: 08/20/18

LEVEL of Request

Please indicate the type of request(s) by selecting *all that apply*:

Faculty Approvals (directly to CRC, then Faculty Senate):

- Establish a new course for the catalog (please contact the Registrar of MUS CCN information)
- Changed course: addition, deletion or change of title, credit, course number, pre-req, description, or cross listing.
- Amend an existing degree program. Making changes to programs such as adding a writing course to a major, changing the list of accepted electives or removing a requirement of a minor
- New degree certification of 29 credits or less
- Other:

Campus Approvals (must be approved by the VCAA prior to CRC submission):

- Placing a postsecondary educational program into moratorium
- Withdrawing a postsecondary educational program from moratorium
- Establishing, re-titling, terminating or revising a campus certificate of 29 credits or more
- Establishing a B.A.S./A.A./A.S. area of study
- Offering an existing postsecondary educational program via distance or online delivery
- Other:

OCHE Approvals (must be approved by the VCAA and Chancellor prior to CRC submission):

- Re-titling an existing postsecondary educational program
- Terminating an existing postsecondary educational program
- Consolidating existing postsecondary educational programs
- Establishing a new minor where there is a major or an option in a major
- Revising a postsecondary educational program
- Establishing a temporary C.A.S. or A.A.S. degree program Approval limited to 2 years
- Other:

Level II (must be approved by the VCAA and Chancellor prior to CRC submission):

- Establishing a new postsecondary educational program
- Exceeding the 120 credit maximum for baccalaureate degrees Exception to policy 301.11
- Forming, eliminating or consolidating an academic, administrative, or research unit
- Re-titling an academic, administrative, or research unit
- Other:

APPROVALS

Department Head Approval

James P. Doney Date 5-Feb-18

Dean Approval

Bill K Hartle Date 2/5/18

VCAA Approval (see above)

_____ Date _____

Chancellor Approval (see above)

_____ Date _____

Graduate Council Approval

Bill K Hartle Date 2/5/18

CRC Approval

_____ Date _____

Faculty Senate Approval

_____ Date _____

Montana University System
INTENT TO PLAN FORM

Program/Center/Institute Title: Master of Science in Materials Science & Engineering (MS/MSE)

Campus, School/Department: Montana Tech Graduate School

Expected Submission Date: May 2018

Contact Name/Info: Dr. Jerry Downey, jdowney@mtech.edu;

To increase communication, collaboration, and problem solving opportunities throughout the MUS in the program/center/institute development process, please complete this form not more than 18 months in advance of the anticipated date of submission of the proposed program/center/institute to the Board of Regents for approval. The completed form should not be more than 2-3 pages. For more information regarding the Intent to Plan process, please visit <http://mus.edu/che/arsa/preparingacademicproposals.asp>.

1) Provide a description of the program/center/institute.

The interdisciplinary Master of Science in Materials Science and Engineering (MS/MSE) degree program will include thesis (30 credit-hour) and non-thesis (36 credit-hour) tracks to enable students to customize their studies to fit their career goals and objectives. It will be available to students enrolled on campus and to working professionals seeking professional advancement via distance learning. It will be structured to complement and bridge between several engineering and science bachelor's degree programs and the growing MUS Collaborative Materials Science Ph.D. program, and to position its graduates for numerous career pathways in materials, manufacturing, and high tech industries.

2) Describe the need for the program/center/institute. Specifically, how the program/center/institute meets current student and workforce demands. (Please cite sources).

Nationally, materials science and engineering are rapidly growing, economically vital fields, in increasing demand for graduate credentials both by students and employers (National Science Foundation, *Science & Engineering Indicators 2018*). The MS/MSE program will fill an educational gap in Montana, which currently has no master's-level degree programs in materials science or engineering, and this lack contributes to a shortfall in expertise and skilled workforce that remains a major barrier in Montana to launching, attracting, and expanding manufacturing and high tech firms with the associated rapid growth in jobs (2016 & 2018 *Montana Economic Reports*, University of Montana, Bureau of Business and Economic Research (BBER)). Industry sectors supported and enabled by the proposed degree program include biotechnology, energy, aerospace, photonics, automotive, chemicals, metals, ceramics, composites, defense, and telecommunications.

3) Describe how the program/center/institute fits with the institutional mission, strategic plan, and existing institutional program array.

The proposed interdisciplinary MS/MSE will fit Montana Tech's mission by providing exemplary graduate education and research, blending theory with practice and building on Montana Tech's strong heritage and special focus on engineering, science, and technology and supporting the responsible and sustainable use of natural resources. It supports all four themes (quality education, achieving students, engaged faculty, and service to the community) and numerous strategic goals and objectives in the institutional strategic plan. It fills a gap between bachelor's degree programs in Metallurgical and Materials Engineering, Mechanical Engineering, Geological Engineering, Environmental Engineering, Electrical Engineering, Petroleum Engineering, Mining Engineering, and Chemistry and the collaborative MUS Ph.D. program in Materials Science. It complements existing Master of Science degree programs in Metallurgical and Mineral Processing

Montana University System
INTENT TO PLAN FORM

Engineering, General Engineering (especially the mechanical- and welding-focused options), Geoscience, Environmental Engineering, Electrical Engineering, Mining Engineering, Project Engineering Management, and Petroleum Engineering. No new courses would be needed and no schedule or teaching changes would be required, because the MS/MSE curriculum will utilize as core courses and as electives courses that are already offered for one or more of those programs and the Materials Science Ph.D. program. Thus, the existence of the MS/MSE will increase enrollment, instructional efficiency, and peer-learning in graduate-level courses in the Materials Science Ph.D. program and the listed materials-related M.S. programs. No changes will be needed in the existing programs.

- 4) Describe how the program/center/institute overlaps, complements, or duplicates existing efforts in the MUS. Describe efforts that will be made to collaborate with similar programs at other institutions. If no efforts will be made, please explain why.

There is no other Master of Science in Materials Science & Engineering in the MUS or at other institutions in Montana. The proposed program will complement and fill a gap for the collaborative MUS Ph.D. program in Materials Science, which currently lacks any matched Master of Science program that would allow students who leave that program prior to completion to achieve a completion that would position them well for numerous career opportunities in materials science and/or engineering—where there are many master’s-requiring positions available. Active coordination and collaboration with UM-Missoula and MSU-Bozeman will be continued as part of the ongoing routine coordination and collaboration via near-weekly phone calls involving the faculty leaders of the Materials Science Ph.D. program on the three campuses, and the occasional phone calls and face-to-face meetings involving the faculty leaders and the three graduate deans. The core courses for the MS/MSE are some of the core courses for the Materials Science Ph.D. program, which are taught by faculty on the three campuses. As is the case for the Materials Science Ph.D. students, the MS/MSE students would be allowed to take courses from UM-Missoula or MSU-Bozeman, where the topics would be valuable to their curriculum and aspirations. In addition, some MS/MSE students may decide they are interested in continuing for the Ph.D. in the MUS collaborative program. They would be mentored and encouraged to apply and enroll at whichever campus best matches their interests and career aspirations.

Signature/Date

College/School Dean:

Chief Academic Officer:

Chief Executive Officer:

Flagship Provost*:

Flagship President*:

*Not applicable to the Community Colleges.

Date of Final Review:

Original signed and submitted to OCTE

When submitting the proposal to the BOR, include this signed form with the Level II request.

Montana Board of Regents
Curriculum Proposal
February 2, 2018

1. Overview

Montana Tech hereby proposes to create and offer a Master of Science program in Materials Science and Engineering (MS/MSE). At present, no MS-level materials science or materials engineering degree program exists in the Montana University System (MUS). Montana Tech does offer a Bachelor of Science degree in Metallurgical and Materials Engineering and participates, along with Montana State University and the University of Montana, in the MUS collaborative Materials Science Ph.D. program. Thus, the proposed MS/MSE program will bridge the void between the undergraduate and the Ph.D. programs. The proposed program includes thesis and non-thesis options with provisions to serve both on-campus and off-campus (distance-learning) students.

Materials Science and Engineering is a rapidly growing discipline and opportunities exist for graduates at all levels. The graph in Figure 1 compares the number of MSE graduates (combined B.S., M.S., and Ph.D.) from 2006 to 2015 with those of other specialty engineering disciplines. The positive enrollment trend illustrates the increased interest in the field that is primarily fueled by industrial demand. Master of Science degrees have become increasingly popular and represent approximately one-third of the MSE degrees conferred in recent years.

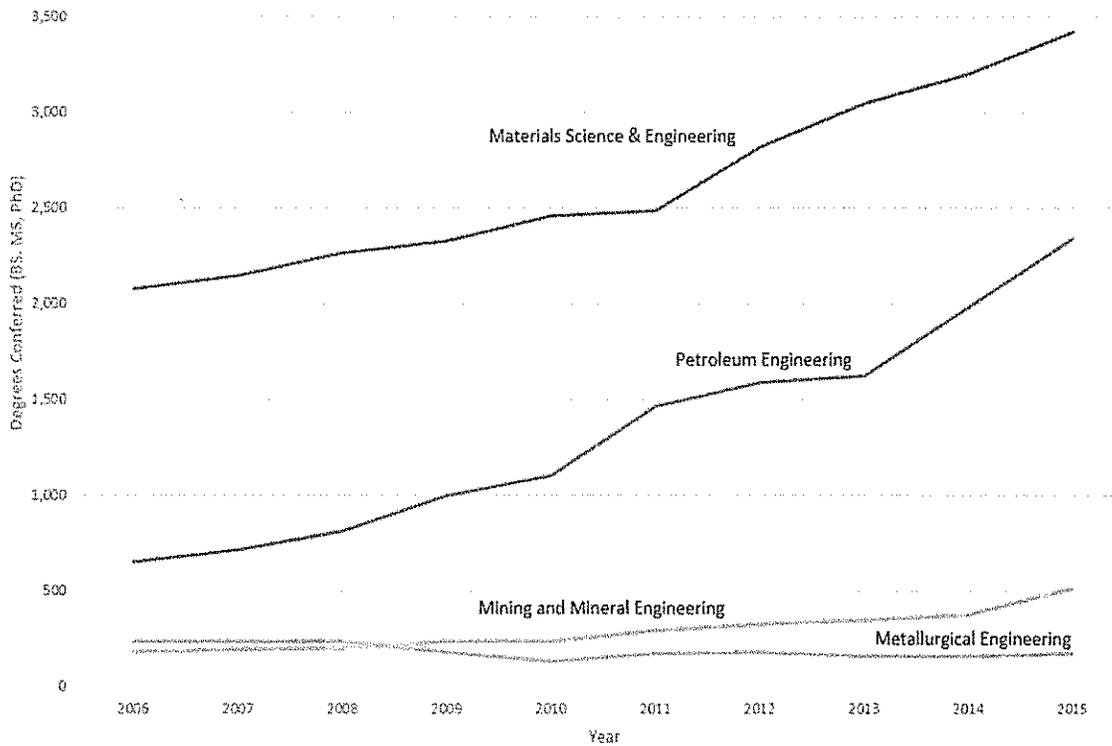


Figure 1 – Degrees conferred in the U.S. for selected engineering specialties, 2006 to 2015.

The materials science and engineering discipline serves multiple industrial sectors, including those critical to the Montana economy, specifically agriculture, energy, high-technology, health care, manufacturing, industrial minerals, and metals. Highly educated materials scientists and engineers are essential to sustaining the growth and competitiveness of these industries. The MS/MSE program will prepare students for careers in research and development, operations, and technical management. Although the proposed program will be closely affiliated with the Mechanical Engineering and the Metallurgical and Materials Engineering Departments at Montana Tech, students will enjoy access to faculty, courses, and research in all of the basic science and engineering departments. Thus, the students will have the opportunity to tailor their studies to enhance their intellectual development while attaining the depth of knowledge required to specialize in the materials industry of their choice.

The proposed MS/MSE program is structured to complement and facilitate student matriculation in the MUS Collaborative Material Science Ph.D. program. Graduate course credits earned in pursuit of the MS/MSE will be transferable to the Ph.D. program, which will attract students who decide to continue their education beyond the M.S. The program also stands to benefit students who enter the Ph.D. program without an M.S. degree and must exit the Ph.D. program due to life circumstances, qualifying or candidacy exam failure, or other reasons; the MS/MSE program will afford such students the opportunity to complete their educational experience by earning a graduate degree that will position them for career opportunities.

The MS/MSE program will follow the integration model successfully established by the MUS Collaborative Ph.D. program. No existing programs will be adversely affected, new resource requirements are negligible, and start-up is expected to be seamless because the requisite faculty, classrooms, courses, and laboratories are already in place and the program will conform to existing faculty assignments and projected class schedules. As the program grows, existing MS/MSE core courses will realize significant enrollment increases as will graduate elective courses that are available via distance learning technology to off-campus students. The Master of Science in Project Engineering Management (MPEM) program serves as a case in point and there will be a degree of reciprocity because MPEM students, as well as graduate students in other departments, will have the option of enrolling in the MSE offerings. Productivity in the relevant graduate courses will improve as a consequence of the enrollment increases and the presence of MS/MSE students is expected to elevate the quality of these courses by giving the students exposure to and experience in multidisciplinary interaction.

2. One Paragraph Description

Provide a one paragraph description of the proposed program. Be specific about what degree, major, minor, or option is sought.

The MS/MSE program will include thesis (30 credit-hour) and non-thesis (36 credit-hour) tracks to enable students to customize their studies to fit their career goals and objectives. Students who will study on-campus may elect to follow either track upon acceptance into the program. Off-campus (distance-learning) students will be initially admitted to the coursework-intensive non-thesis track, which is primarily viewed as a terminal degree for working professionals. At the invitation of a research-active participating faculty member (advisor), off-campus students, who demonstrate an interest and aptitude for scientific research, may petition the Graduate School for transfer to the thesis track. These students may fulfill the thesis requirements either through research conducted on the Montana Tech campus (in most cases requiring a leave of absence from the place of employment) or, where circumstances permit, through research conducted by the student at the place of employment.

3. Need

A. To what specific need is the institution responding in developing the proposed program?

Materials science and engineering are well-established fields that serve multiple industrial sectors with significant strategic and economic importance. In 2016, the U.S. Council on Competitiveness declared “advanced materials key to elevating the U.S. economy.” As examples of the economic significance of advanced materials, the U.S. consumer electronics industry annual revenues exceeded \$218 billion in 2015 and sources project that annual global demand for biomaterials will reach \$149 billion by 2021. Other major industries that depend on advanced materials technology to remain globally competitive are aerospace, automotive, chemicals, energy, metals, and telecommunications. The availability of highly educated materials scientists and engineers is vital to maintain national manufacturing competitiveness and ensure sustained industrial growth.

In the years ahead, the development and application of advanced materials promises to be one of the largest sources of technological and economic growth in Montana. A 2016 report by the University of Montana’s Bureau of Business and Economic Research (BBER) projected high-tech and manufacturing companies (within the State) will grow *seven times faster than the overall Montana economy*. The 2016 Montana Economic Report produced by the BBER asserted that “finding enough talent remains the No. 1 barrier to growth for Montana high-tech firms.” The MS/MSE program will produce graduates needed to fill high-paying positions in these new and fast-growing companies.

B. How will students and any other affected constituencies be served by the proposed program?

Students will benefit from the expanded research opportunities and access to state-of-the art techniques and technologies. The program features substantial on-line coursework to attract and be conducive to the schedules of working professionals and others whose life circumstances prohibit them from conducting their studies on the Montana Tech campus. Upon completion of the MS/MSE program, students will be able to:

- demonstrate a command of the appropriate breadth and depth of fundamental knowledge in materials science and engineering
- create new knowledge by performing theoretical, computational, and/or experimental research at the graduate level (design new materials)
- employ the highest ethical and professional standards, sound and safe laboratory practices
- effectively communicate new knowledge through journal articles, theses, and archived publications
- apply their engineering knowledge to critically evaluate relevant literature and new technologies or systems; review and critically analyze the ideas of other scientists and engineers
- solve advanced materials engineering problems and defend their recommendations by applying engineering, science, and mathematic principles
- understand and evaluate the impact of their work in the context of sustainability, including societal, ethical, economic, and environmental aspects
- become leaders capable of working in diverse environments

C. What is the anticipated demand for the program? How was this determined?

Demand can be viewed as student-oriented and market-oriented. Student-oriented demand was assessed through recent career preference surveys of undergraduate students (sophomores, juniors, and seniors) in the M&ME department; approximately half of the students indicated a preference for a materials-related career and some opined that the availability of such a program would increase the likelihood of attending graduate school.

The market-oriented demand for MS/MSE graduates was partly addressed in the response to 3A –Need. Indeed, materials science and engineering serve multiple industrial sectors, including aerospace, agriculture, automotive, biomaterials, chemicals, electronics, energy, metals, and telecommunications. The demand for qualified materials scientists and engineers in Montana and throughout the nation is only expected to intensify. The continued availability of highly educated materials scientists and engineers is essential to sustaining the growth and of these industries. The MS/MSE program is designed to prepare students for careers in research and development, operations, and technical management in these industries. Materials-based corporate investment in the forms of new entrepreneurial ventures, start-up companies, and relocation of facilities to sites in Montana are anticipated to provide full-time employment opportunities for program graduates as well as invaluable internship experience for students.

4. Institutional and System Fit

A. What is the connection between the proposed program and existing programs at the institution?

No similar M.S.-level materials science or materials engineering degree programs exist within the MUS or within the private colleges in Montana. Montana Tech offers a Bachelor of Science degree in Metallurgical and Materials Engineering and a M.S. degree in Metallurgical and Mineral Processing Engineering. Montana Tech participates, along with Montana State University and the University of Montana, in the MUS collaborative Materials Science Ph.D. program. Thus, the proposed MS/MSE program will bridge an educational void between the undergraduate science and engineering programs and the Materials Science Ph.D. program.

B. Will approval of the proposed program require changes to any existing programs at the institution? If so, please describe.

No, approval of the proposed program will not require changes to any existing programs at the institution. The impact on the quality and productivity of existing programs is expected to be wholly positive. Productivity will improve as a consequence of the enrollment increases in the relevant graduate courses, and the presence of MS/MSE students will improve quality of these courses by giving students the exposure to and experience in multidisciplinary interaction. Significant enrollment increases will occur in the existing MS/MSE core courses and in those graduate courses that are available to off-campus students via distance learning.

C. Describe what differentiates this program from other, closely related programs at the institution (if appropriate).

The program will be the only Master of Science degree in Materials Science and Engineering available in the State.

D. How does the proposed program serve to advance the strategic goals of the institution?

The proposed MS/MSE program is consistent Montana Tech's stated mission and is expected to advance the following strategic goals:

- Be a national leader in providing education and in transforming undergraduate and graduate education.
- Support and grow research, scholarship, and technology transfer.
- Be responsive to the needs of industry, our community, and State.
- Improve the visibility, recognition, and reputation of Montana Tech in the State, nation, and world.
- Secure resources that support excellence.
- Create a culture and workplace environment that embraces excellence.

The MS/MSE program is consistent with Montana Tech's designation as a "Special Focus Institution" within the MUS. The program is designed to leverage existing faculty and infrastructure to cost-effectively provide more accessible educational opportunities, expand materials research within the State, and foster regional economic development.

E. Describe the relationship between the proposed program and any similar programs within the Montana University System. In cases of substantial duplication, explain the need for the proposed program at an additional institution. Describe any efforts that were made to collaborate with these similar programs; and if no efforts were made, explain why. If articulation or transfer agreements have been developed for the substantially duplicated programs, please include the agreement(s) as part of the documentation.

The MS/MSE program is structured to complement and facilitate student matriculation in the MUS Collaborative Material Science Ph.D. program. Graduate course credits earned in pursuit of the MS/MSE are transferable to the Ph.D. program and, with judicious selection of technical electives, MS/MSE graduates accepted into the Ph.D. program could be eligible to sit for the Qualifying Examination at the start of their first semester because of the common core course requirements in the two programs. Of course, many students enter the Ph.D. program without an M.S. degree. For various reasons (life circumstances, qualifying or candidacy exam failure, etc.) some of these students will exit the Ph.D. program before obtaining their degree; the MS/MSE program will afford such students the opportunity to complete their educational experience with a graduate degree.

5. Program Details

A. Provide a detailed description of the proposed curriculum. Where possible, present the information in the form intended to appear in the catalog or other publications. NOTE: In the case of two-year degree programs and certificates of applied science, the curriculum should include enough detail to determine if the characteristics set out in Regents' Policy 301.12 have been met.

The MS/MSE program adheres to all MUS Montana Tech Graduate School Policies and Procedures as described under the Graduate School heading in the Montana Tech catalog. The catalog provides salient details regarding application and admission, academic regulations, and master's program procedures.

The Master of Science in MSE program offers thesis track and non-thesis track alternatives. Both alternatives will be available to conventional on-campus students and to off-campus students through distance-learning. However, all incoming off-campus students are initially admitted to the non-thesis track. At the invitation of

a research-active participating faculty member (advisor), students, who demonstrate an interest and aptitude for scientific research, may petition the Graduate School for transfer to the thesis track.

To graduate with the MS/MSE degree, a student on the non-thesis track is required to complete a minimum of 36 semester credit hours. In the final year of their program, non-thesis track students complete a culminating experience or "practicum." To fulfill the practicum requirements, students must undertake and complete a substantial materials-related project of approximately six months duration. As part of the practicum, students must participate in a one-week summer laboratory session at Montana Tech. The project selection, scope, and objectives must be approved in advance by the student's academic advisor, the MS/MSE program director, and the Montana Tech graduate school. At the conclusion of the project, the student must submit a detailed comprehensive technical report and deliver a presentation to an audience of MSE faculty and students.

Thesis-track students are required to complete a minimum of 30 semester credit hours. Thesis track students must prepare and submit a research-based thesis and pass a formal thesis defense examination, which will be conducted by the student's research advisor and committee. The thesis and defense examination must conform to established Montana Tech Graduate School and department policies and guidelines.

The program requirements are summarized in Table 1. Courses are categorized as "Core Courses", "Advanced Graduate Courses", and "Seminar", and, depending on whether the student selects the thesis or the non-thesis track. All students must complete the following mandatory Core Courses:

- MTSI 501 – Bonding, Structure, and defects (4 credit-hours)
- MTSI 511 – Thermodynamics of materials (3 credit-hours)
- MTSI 512 – Kinetics and phase transformations (3 credit-hours)

Table 1. Program Requirements for the Proposed MS/MSE Degree

MS/MSE Minimums	Thesis Track	Non-thesis Track
Core	10	10
Adv. Mathematics/Modeling	3	3
Technical Electives	9	15
Independent Study/Practicum	0	6
Seminar	1	1
Writing Seminar	1	1
Thesis	6	0
Total Credit Requirement	30	36

Beyond the core courses, the general curricular requirements are summarized in the following points:

- A total of 30 credit-hours (credits) are required to earn the M.S. degree under the thesis track, and 36 credit-hours are required to earn the degree under the non-thesis track option.
- Students in each track are required to take one 3-credit-hour graduate-level course in advanced mathematics, computer applications, or experimental design.

- A minimum of nine technical elective credits are required for the thesis track and 15 for the non-thesis track. The technical electives must be in STEM disciplines and are accepted at the advisor's discretion. Courses are typically at the 500 level but, subject to committee approval, as many as six credits in 400 level courses may count toward the M.S. degree requirement. Students may take a maximum of three approved courses (9 credits) from the Master of Science in Project Engineering Management (MPEM) program as technical electives.
- Two 1-credit seminar courses (ENGR 5940 and TC 5160) are required.
- Thesis track students are required to earn a minimum of 6 thesis credits while performing research and writing/defending a M.S. thesis.
- Non-thesis track students are required earn a minimum of 6 independent study credits to complete their practicum requirement.
- Thesis and practicum credits may not substitute for elective credits.

More than thirty materials-oriented graduate courses are available and eighteen of these courses are available through distance learning, and many are delivered in real time via the existing synchronous delivery system. A list of the currently available courses is provided as Appendix A but, in addition to the courses listed, several departments offer 400- and 500-level courses that students could take as electives to fulfill their degree requirements.

Applicants are expected to have earned a bachelor of science degree in a physical science or engineering discipline with a minimum GPA of 3.0 (4.0 maximum basis) or equivalent. Undergraduate studies normally include mathematics at least through differential equations, at least one year each of general physics and chemistry, a course in physical chemistry or modern physics, an elementary course in properties of materials (such as EGEN 213 or EMAT 251), and engineering coursework (including prerequisites) equivalent to:

- EGEN 201 – Engineering Mechanics/Statics
- EELE 201 – Circuits for Engineers
- EGEN 335 – Fluid Mechanics
- EGEN 305 – Mechanics of Materials

Applicants may be admitted with deficiencies but, to the extent possible, such courses are expected to be made up during the student's first year in the program.

Off-campus M.S./Distance Learning

It is possible for students to earn the MS/MSE degree almost entirely via distance learning. The degree requirements for the non-thesis and thesis alternatives are essentially the same as those previously described for students in residence at Montana Tech.

Off-campus research is encouraged for qualified students. This alternative enables off-campus students to enter the thesis-track and conduct their M.S. research at their place of employment. Student participation is subject to the following stipulations:

- The student must be employed by a company, national laboratory, or government agency or department (the Employer) prior to admission to the program and, to enter the thesis track, the proposed research

must be approved in writing by an authorized representative of the Employer, the student's academic advisor, and the Vice Chancellor of Research and Dean of the Graduate School.

- The thesis research project must be well defined and acceptable to the graduate student's advisory committee. The thesis may be based on either fundamental or applied research that involves (original) computational and/or experimental research to investigate a current problem of interest to the field of materials science and engineering.
- Where possible, a qualified representative of the Employer will serve as an on-site thesis committee member; to qualify as a committee member, the individual must be a professional with an M.S. or Ph.D. degree in materials science and engineering or a closely related field.
- The student must follow the published Montana Tech guidelines for thesis content, format, preparation, and defense.
- The student must be on-campus in person for the thesis defense.
- The student must register every semester that he or she is working toward fulfillment of the degree requirements.

B. Describe the planned implementation of the proposed program, including estimates of numbers of students at each stage.

Montana Tech is prepared to launch the MS/MSE program at the start of the semester immediately following receipt of approval by the Board of Regents or as early as the Fall 2018 semester. Recruiting efforts will focus on enrollment of the initial student cohort, including online and resident students. Program start-up will be seamless and stage-wise implementation is not deemed necessary because the requisite faculty, classrooms, courses, and laboratories are already in place and the program will conform to existing faculty assignments and projected class schedules.

A conservative estimate of the ten-year projected enrollment and graduation figures for the proposed program are shown in Table 2. In the early years, enrollment projections rely on recruitment of students as they graduate with Bachelor of Science degrees from on-campus science and engineering programs. As the program expands and gains notoriety, recruitment of on-campus and off-campus students, who earned B.S. degrees at other institutions, is expected to increase. With allowances for attrition, the program is projected to enroll twelve new students and produce ten graduates each year. It was assumed that half of the incoming students will be off-campus distance learning students.

Table 2. Projected enrollment and graduation figures for the proposed MS/MSE program

Year	New Students		Total Enrollment	Graduates	Revenue
	On campus	Off campus			
1	3	0	3	0	\$ 12,600
2	3	3	6	3	\$ 23,400
3	4	3	12	3	\$ 44,700
4	5	4	17	6	\$ 63,300
5	5	5	19	7	\$ 70,500
6	6	6	23	8	\$ 85,800
7	6	6	25	10	\$ 94,050
8	6	6	25	10	\$ 96,150
9	6	6	25	10	\$ 96,150
10	6	6	25	10	\$ 96,150

Based on the current tuition and mandatory fee schedule and the assumptions used to construct Table 2, the MS/MSE program will reach steady-state after seven years with projected annual revenues of approximately \$96,000. The incremental costs of program implementation are expected to be negligible because no new faculty or other resources are needed, no new course development is required, and the video communications system is already functional and proven successful with the Materials Science Ph.D. program. Further, the MS/MSE program will not require any new course, classroom, laboratory, or program fees.

6. Resources

Will additional faculty resources be required to implement this program? If yes, please describe the need and indicate the plan for meeting this need.

No additional faculty resources will be required to implement the program. The program can be implemented with existing basic sciences and engineering faculty and without affecting their respective class schedules. The MS/MSE curriculum is predominantly based on graduate-level courses that are offered annually in the Materials Science Ph.D. program, the M.S. in the Project Engineering Management (MPEM) program, and the individual basic science and engineering departments. As previously stated, classroom space and faculty availability to teach the courses are not concerns because excess capacity exists in the relevant graduate courses. Appendix A contains a partial listing of the available courses; at least 18 of the 30 courses will be available via existing distance learning facilities.

The impact on the resources of existing programs will be negligible because no new faculty, administrative, or support personnel are required to implement the MS/MSE program. The Montana Tech Campus Director of the Materials Science Ph.D. program will direct and coordinate the new program under the supervision of the Dean of Graduate School.

Are other, additional resources required to ensure the success of the proposed program? If yes, please describe the need and indicate the plan for meeting this need.

No new facilities, equipment, space, laboratory instruments or other scientific paraphernalia are needed for the proposed MS/MSE program. Extensive physical resources in the basic science and engineering laboratories at Montana Tech are sufficient to support the program implementation. For example, the Metallurgical and Materials Engineering Department has laboratories dedicated to Materials Thermochemistry, Metallography, Scanning Electron Microscopy, and Materials Testing. Mechanical Engineering has a well-equipped Nanotechnology Laboratory and a plethora of materials testing devices. The labs are supported by an array of characterization equipment including: x-ray fluorescence and x-ray diffraction spectroscopy, Raman spectrometry, micro-hardness, and strength testing, and various types of thermo-analysis. Other available resources include the Center for Advanced Minerals, Metals, and Materials Processing (CAMP), the Library, the High Performance Computing Center and powerful analytical capabilities at the Montana Bureau of Mines and Geology.

Instead of imposing strain, the proposed program will contribute to maximum effective resource utilization because most of these resources are subject to intermittent use by faculty and graduate students. As needs for additional resources emerge, they will be met through grant-funded project budgets of the Principal Investigator/advisor.

The Montana Tech library and information resources are sufficient to support the proposed MS/MSE program. To date, these resources have proved adequate to sustain the Materials Science Ph.D. program,

which is currently in its fourth year of active student engagement. MS/MSE research is expected to focus on the same areas as does the Ph.D. program, so new resources are unnecessary. Further, the MS/MSE program, while rigorous, will not require resources at as high of a level as the Ph.D. program.

Existing student services have the capacity to accommodate the proposed program. As a graduate program, enrollment will be low compared to most undergraduate programs and therefore unlikely to overwhelm existing student services. With two possible exceptions, the implications of the new program on services for the rest of the student body will be practically negligible. The first exception is the influx of MSE students could affect certain laboratory-based courses, where enrollment is necessarily limited by space and safety constraints. The second exception is the provision of adequate laboratory space for the MS/MSE students to conduct their research. Both exceptions can be managed by mindful advising and scheduling.

7. Assessment

How will the success of the program be measured?

Program success will be measured by collecting relevant data and comparing factors considered critical to the program progress. The results will be used to guide the program development to maximize quality, enable growth in enrollment, and produce graduates who are in demand to enhance the intellectual, cultural, and economic development of Montana and beyond.

In the short term, critical assessment factors include: enrollment growth, student retention and graduation rates, student placement following graduation, research funding and productivity, and program reputation/recognition. These measures will be placed in effect for immediate annual assessment but it is expected that the program must exist for at least five years to develop an adequate database for meaningful trend analyses.

In the longer term, the quality and value of the program will be assessed by periodically surveying program graduates to measure their career progress, commitment to life-long education.

8. Process leading to submission.

This proposal was developed in summer and fall 2017 by faculty representatives from the Metallurgical and Materials Engineering Department and the Mechanical Engineering Department with oversight from the Montana Tech Provost, the Vice Chancellor of Research and Graduate School Dean, the Dean of the School of Mines and Engineering, the Dean of the College of Letters, Sciences, and Professional Studies, and the Graduate Council. This proposal has been reviewed and approved by the following Deans and Faculty Governance on the dates listed:

Director of Libraries	<date>
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Dean of School of Mines and Engineering	<date>
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Curriculum Review Committee	<date>
Faculty Senate	<date>
Provost & Vice Chancellor for Academic Affairs	<date>

Appendix A – Courses available for the MS/MSE Program

Required Core Courses and Seminars

(* = available for distance learning; ** = available via synchronous delivery)

MTSI 501**	– Bonding, Structure, and Defects (4 Cr-h)
MTSI 511**	– Thermodynamics of Materials (3 Cr-h)
MTSI 512**	– Kinetics and Phase Transformations (3 Cr-h)
ENGR 5940	– Graduate Seminar (1 Cr-h)
TC 5160	– Writing Seminar (1 Cr-h)

Partial List of Technical Electives

(* = available for distance learning; ** = available via synchronous delivery)

MTSI 502**	– (Materials) Function and Application (3 Cr-h)
MTSI 551**	– Advance Materials Characterization Techniques I (2 Cr-h)
MTSI 552**	– Advanced Materials Characterization Techniques II (3 Cr-h)
EGEN xxx	– Fundamentals of Additive manufacturing
EGEN 574	-- Intro to Micro- and Nano-mechanical Systems
EGEN 591	-- Special Topics in Fluid Mechanics
EMAT 530	-- Energy Issues & Analysis (cross-listed as EGEN 530)
EMAT 534	– Processing of Primary and Secondary Resources
EMAT 544**	– Casting and Solidification
EMAT 555**	– Biomaterials
EMAT 569	– Failure Analysis and Design Life of Materials
EMAT 570**	– Mechanical Behavior of Materials
EMET 501	– Advanced Extractive Metallurgy I
EMET 502	– Advanced Extractive Metallurgy II
EMET 511	– Materials Handling Design
EMET 520*	– Physical Chemistry of Iron and Steelmaking
EMET 525	-- Computer Applications for Metallurgical Processes
EMET 526	-- Thermodynamic Modeling of Aqueous Systems
EMET 583	– Processing of Precious Metal Resources
EMAT 597	– M&ME Problems
EMAT 697	– Special Problems
EMET xxx	– Advanced Pyro-processing
EMET xxx	– Remediation & Recycling of Process Wastes and Byproducts
EWLD 488	– Metallurgy of Welds
EWLD 476	– Nondestructive Evaluation
MPEM 5020*	– Project and Engineering Management
MPEM 5100*	– Pollution Prevention
MPEM 5110*	– Technology for Energy Conversion
MPEM 5120*	– Application & Design of Industrial Experiments
MPEM 5130*	– Hazardous Waste Engineering
MPEM 5170*	– Technology for Renewable Energy
MPEM 5180*	– Energy for Sustainability

**Montana Board of Regents
Curriculum Proposal
February 7, 2018**

1. Overview

Montana Tech hereby proposes to create and offer a Master of Science program in Materials Science and Engineering (MS/MSE). At present, no MS-level materials science or materials engineering degree program exists in the Montana University System (MUS). Montana Tech does participate, along with Montana State University and the University of Montana, in the MUS collaborative Materials Science Ph.D. program. Thus, the proposed MS/MSE program will bridge the void between the undergraduate and the Ph.D. programs. The proposed program includes thesis and non-thesis options with provisions to serve both on-campus and off-campus (distance-learning) students. The MS/MSE program will operate in conjunction with the Materials Science Ph.D. program in a new Department of Materials Science and Engineering.

Materials Science and Engineering is a rapidly growing discipline and opportunities exist for graduates at all levels. The graph in Figure 1 compares the number of MSE graduates (combined B.S., M.S., and Ph.D.) from 2006 to 2015 with those of other specialty engineering disciplines. The positive enrollment trend illustrates the increased interest in the field that is primarily fueled by industrial demand. Master of Science degrees have become increasingly popular and represent approximately one-third of the MSE degrees conferred in recent years.

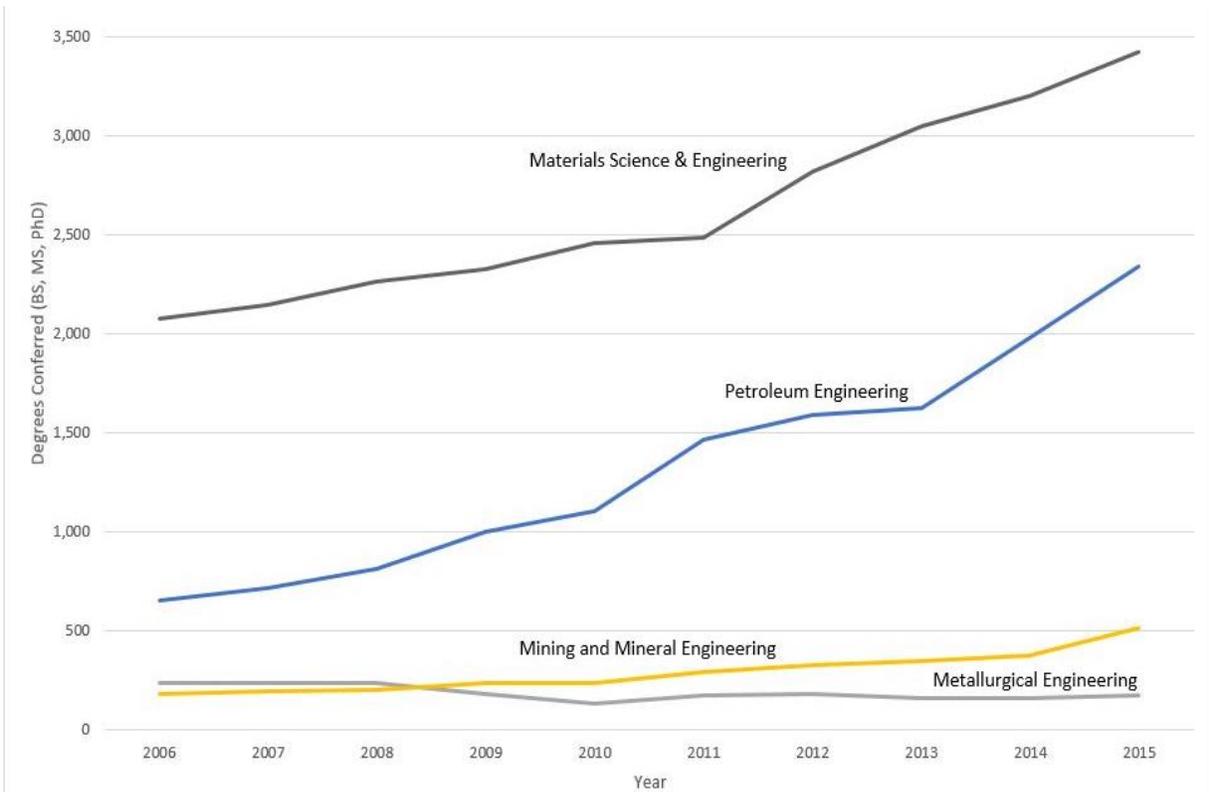


Figure 1 – Degrees conferred in the U.S. for selected engineering specialties, 2006 to 2015.

The materials science and engineering discipline serves multiple industrial sectors, including those critical to the Montana economy, specifically agriculture, energy, high-technology, health care, manufacturing, industrial minerals, and metals. Highly educated materials scientists and engineers are essential to sustaining the growth and competitiveness of these industries. The MS/MSE program will prepare students for careers in research and development, operations, and technical management. Although the proposed program will be closely affiliated with the Mechanical Engineering and the Metallurgical and Materials Engineering Departments at Montana Tech, students will enjoy access to faculty, courses, and research in all of the basic science and engineering departments. Thus, the students will have the opportunity to tailor their studies to enhance their intellectual development while attaining the depth of knowledge required to specialize in the materials industry of their choice.

The proposed MS/MSE program is structured to complement and facilitate student matriculation in the MUS Collaborative Material Science Ph.D. program. Graduate course credits earned in pursuit of the MS/MSE will be transferable to the Ph.D. program, which will attract students who decide to continue their education beyond the M.S. The program also stands to benefit students who enter the Ph.D. program without an M.S. degree and must exit the Ph.D. program due to life circumstances, qualifying or candidacy exam failure, or other reasons; the MS/MSE program will afford such students the opportunity to complete their educational experience by earning a graduate degree that will position them for career opportunities.

The MS/MSE program will follow the integration model successfully established by the MUS Collaborative Ph.D. program. No existing programs will be adversely affected, new resource requirements are negligible, and start-up is expected to be seamless because the requisite faculty, classrooms, courses, and laboratories are already in place and the program will conform to existing faculty assignments and projected class schedules. As the program grows, existing MS/MSE core courses will realize significant enrollment increases as will graduate elective courses that are available via distance learning technology to off-campus students. The Master of Science in Project Engineering Management (MPEM) program serves as a case in point and there will be a degree of reciprocity because MPEM students, as well as graduate students in other departments, will have the option of enrolling in the MSE offerings. Productivity in the relevant graduate courses will improve as a consequence of the enrollment increases and the presence of MS/MSE students is expected to elevate the quality of these courses by giving the students exposure to and experience in multidisciplinary interaction.

2. One Paragraph Description

Provide a one paragraph description of the proposed program. Be specific about what degree, major, minor, or option is sought.

The MS/MSE program will include thesis (30 credit-hour) and non-thesis (36 credit-hour) tracks to enable students to customize their studies to fit their career goals and objectives. Students who will study on-campus may elect to follow either track upon acceptance into the program. Off-campus (distance-learning) students will be initially admitted to the coursework-intensive non-thesis track, which is primarily viewed as a terminal degree for working professionals. At the invitation of a research-active participating faculty member (advisor), off-campus students, who demonstrate an interest and aptitude for scientific research, may petition the Graduate School for transfer to the thesis track. These students may fulfill the thesis requirements either through research conducted on the Montana Tech campus (in

most cases requiring a leave of absence from the place of employment) or, where circumstances permit, through research conducted by the student at the place of employment.

3. Need

A. To what specific need is the institution responding in developing the proposed program?

Materials science and engineering are well-established fields that serve multiple industrial sectors with significant strategic and economic importance. In 2016, the U.S. Council on Competitiveness declared “advanced materials key to elevating the U.S. economy.” As examples of the economic significance of advanced materials, the U.S. consumer electronics industry annual revenues exceeded \$218 billion in 2015 and sources project that annual global demand for biomaterials will reach \$149 billion by 2021. Other major industries that depend on advanced materials technology to remain globally competitive are aerospace, automotive, chemicals, energy, metals, and telecommunications. The availability of highly educated materials scientists and engineers is vital to maintain national manufacturing competitiveness and ensure sustained industrial growth.

In the years ahead, the development and application of advanced materials promises to be one of the largest sources of technological and economic growth in Montana. A 2016 report by the University of Montana’s Bureau of Business and Economic Research (BBER) projected high-tech and manufacturing companies (within the State) will grow *seven times faster than the overall Montana economy*. The 2016 Montana Economic Report produced by the BBER asserted that “finding enough talent remains the No. 1 barrier to growth for Montana high-tech firms.” The MS/MSE program will produce graduates needed to fill high-paying positions in these new and fast-growing companies.

B. How will students and any other affected constituencies be served by the proposed program?

Students will benefit from the expanded research opportunities and access to state-of-the-art techniques and technologies. The program features substantial on-line coursework to attract and be conducive to the schedules of working professionals and others whose life circumstances prohibit them from conducting their studies on the Montana Tech campus. Upon completion of the MS/MSE program, students will be able to:

- demonstrate a command of the appropriate breadth and depth of fundamental knowledge in materials science and engineering
- create new knowledge by performing theoretical, computational, and/or experimental research at the graduate level (design new materials)
- employ the highest ethical and professional standards, sound and safe laboratory practices
- effectively communicate new knowledge through journal articles, theses, and archived publications
- apply their engineering knowledge to critically evaluate relevant literature and new technologies or systems; review and critically analyze the ideas of other scientists and engineers
- solve advanced materials engineering problems and defend their recommendations by applying engineering, science, and mathematic principles
- understand and evaluate the impact of their work in the context of sustainability, including societal, ethical, economic, and environmental aspects

- become leaders capable of working in diverse environments

C. What is the anticipated demand for the program? How was this determined?

Demand can be viewed as student-oriented and market-oriented. Student-oriented demand was assessed through recent career preference surveys of undergraduate students (sophomores, juniors, and seniors) in the M&ME department; approximately half of the students indicated a preference for a materials-related career and some opined that the availability of such a program would increase the likelihood of attending graduate school.

The market-oriented demand for MS/MSE graduates was partly addressed in the response to 3A –Need. Indeed, materials science and engineering serve multiple industrial sectors, including aerospace, agriculture, automotive, biomaterials, chemicals, electronics, energy, metals, and telecommunications. The demand for qualified materials scientists and engineers in Montana and throughout the nation is only expected to intensify. The continued availability of highly educated materials scientists and engineers is essential to sustaining the growth and of these industries. The MS/MSE program is designed to prepare students for careers in research and development, operations, and technical management in these industries. Materials-based corporate investment in the forms of new entrepreneurial ventures, start-up companies, and relocation of facilities to sites in Montana are anticipated to provide full-time employment opportunities for program graduates as well as invaluable internship experience for students.

4. Institutional and System Fit

A. What is the connection between the proposed program and existing programs at the institution?

No similar M.S.-level materials science or materials engineering degree programs exist within the MUS or within the private colleges in Montana. Montana Tech offers a Bachelor of Science degree in Metallurgical and Materials Engineering and a M.S. degree in Metallurgical and Mineral Processing Engineering. Montana Tech participates, along with Montana State University and the University of Montana, in the MUS collaborative Materials Science Ph.D. program. Thus, the proposed MS/MSE program will bridge an educational void between the undergraduate science and engineering programs and the Materials Science Ph.D. program.

B. Will approval of the proposed program require changes to any existing programs at the institution? If so, please describe.

No, approval of the proposed program will not require changes to any existing programs at the institution. The impact on the quality and productivity of existing programs is expected to be wholly positive. Productivity will improve as a consequence of the enrollment increases in the relevant graduate courses, and the presence of MS/MSE students will improve quality of these courses by giving students the exposure to and experience in multidisciplinary interaction. Significant enrollment increases will occur in the existing MS/MSE core courses and in those graduate courses that are available to off-campus students via distance learning.

C. Describe what differentiates this program from other, closely related programs at the institution (if appropriate).

The program will be the only Master of Science degree in Materials Science and Engineering available in the State.

D. How does the proposed program serve to advance the strategic goals of the institution?

The proposed MS/MSE program is consistent Montana Tech's stated mission and is expected to advance the following strategic goals:

- Be a national leader in providing education and in transforming undergraduate and graduate education.
- Support and grow research, scholarship, and technology transfer.
- Be responsive to the needs of industry, our community, and State.
- Improve the visibility, recognition, and reputation of Montana Tech in the State, nation, and world.
- Secure resources that support excellence.
- Create a culture and workplace environment that embraces excellence.

The MS/MSE program is consistent with Montana Tech's designation as a "Special Focus Institution" within the MUS. The program is designed to leverage existing faculty and infrastructure to cost-effectively provide more accessible educational opportunities, expand materials research within the State, and foster regional economic development.

E. Describe the relationship between the proposed program and any similar programs within the Montana University System. In cases of substantial duplication, explain the need for the proposed program at an additional institution. Describe any efforts that were made to collaborate with these similar programs; and if no efforts were made, explain why. If articulation or transfer agreements have been developed for the substantially duplicated programs, please include the agreement(s) as part of the documentation.

The MS/MSE program is structured to complement and facilitate student matriculation in the MUS Collaborative Material Science Ph.D. program. Graduate course credits earned in pursuit of the MS/MSE are transferable to the Ph.D. program and, with judicious selection of technical electives, MS/MSE graduates accepted into the Ph.D. program could be eligible to sit for the Qualifying Examination at the start of their first semester because of the common core course requirements in the two programs. Of course, many students enter the Ph.D. program without an M.S. degree. For various reasons (life circumstances, qualifying or candidacy exam failure, etc.) some of these students will exit the Ph.D. program before obtaining their degree; the MS/MSE program will afford such students the opportunity to complete their educational experience with a graduate degree.

5. Program Details

A. Provide a detailed description of the proposed curriculum. Where possible, present the information in the form intended to appear in the catalog or other publications. NOTE: In the case of two-year degree programs and certificates of applied science, the curriculum should include enough detail to determine if the characteristics set out in Regents' Policy 301.12 have been met.

The MS/MSE program adheres to all MUS Montana Tech Graduate School Policies and Procedures as described under the Graduate School heading in the Montana Tech catalog. The catalog provides salient details regarding application and admission, academic regulations, and master's program procedures.

The Master of Science in MSE program offers thesis track and non-thesis track alternatives. Both alternatives will be available to conventional on-campus students and to off-campus students through distance-learning. However, all incoming off-campus students are initially admitted to the non-thesis track. At the invitation of a research-active participating faculty member (advisor), students, who demonstrate an interest and aptitude for scientific research, may petition the Graduate School for transfer to the thesis track.

To graduate with the MS/MSE degree, a student on the non-thesis track is required to complete a minimum of 36 semester credit hours. In the final year of their program, non-thesis track students complete a culminating experience or “practicum.” To fulfill the practicum requirements, students must undertake and complete a substantial materials-related project of approximately six months duration. As part of the practicum, students must participate in a one-week summer laboratory session at Montana Tech. The project selection, scope, and objectives must be approved in advance by the student’s academic advisor, the MS/MSE program director, and the Montana Tech graduate school. At the conclusion of the project, the student must submit a detailed comprehensive technical report and deliver a presentation to an audience of MSE faculty and students.

Thesis-track students are required to complete a minimum of 30 semester credit hours. Thesis track students must prepare and submit a research-based thesis and pass a formal thesis defense examination, which will be conducted by the student’s research advisor and committee. The thesis and defense examination must conform to established Montana Tech Graduate School and department policies and guidelines.

The program requirements are summarized in Table 1. Courses are categorized as "Core Courses", "Advanced Graduate Courses", and "Seminar", and, depending on whether the student selects the thesis or the non-thesis track. All students must complete the following mandatory Core Courses:

- MTSI 501 – Bonding, Structure, and defects (4 credit-hours)
- MTSI 511 – Thermodynamics of materials (3 credit-hours)
- MTSI 512 – Kinetics and phase transformations (3 credit-hours)

Table 1. Program Requirements for the Proposed MS/MSE Degree

MS/MSE Minimums	Thesis Track	Non-thesis Track
Core	10	10
Adv. Mathematics/Modeling	3	3
Technical Electives	9	15
Independent Study/Practicum	0	6
Seminar	1	1
Writing Seminar	1	1
Thesis	6	0
Total Credit Requirement	30	36

Beyond the core courses, the general curricular requirements are summarized in the following points:

- A total of 30 credit-hours (credits) are required to earn the M.S. degree under the thesis track, and 36 credit-hours are required to earn the degree under the non-thesis track option.
- Students in each track are required to take one 3-credit-hour graduate-level course in advanced mathematics, computer applications, or experimental design.
- A minimum of nine technical elective credits are required for the thesis track and 15 for the non-thesis track. The technical electives must be in STEM disciplines and are accepted at the advisor's discretion. Courses are typically at the 500 level but, subject to committee approval, as many as six credits in 400 level courses may count toward the M.S. degree requirement. Students may take a maximum of three approved courses (9 credits) from the Master of Science in Project Engineering Management (MPEM) program as technical electives.
- Two 1-credit seminar courses (ENGR 5940 and TC 5160) are required.
- Thesis track students are required to earn a minimum of 6 thesis credits while performing research and writing/defending a M.S. thesis.
- Non-thesis track students are required earn a minimum of 6 independent study credits to complete their practicum requirement.
- Thesis and practicum credits may not substitute for elective credits.

More than thirty materials-oriented graduate courses are available and eighteen of these courses are available through distance learning, and many are delivered in real time via the existing synchronous delivery system. A list of the currently available courses is provided as Appendix A but, in addition to the courses listed, several departments offer 400- and 500-level courses that students could take as electives to fulfill their degree requirements.

Applicants are expected to have earned a bachelor of science degree in a physical science or engineering discipline with a minimum GPA of 3.0 (4.0 maximum basis) or equivalent. Undergraduate studies normally include mathematics at least through differential equations, at least one year each of general physics and chemistry, a course in physical chemistry or modern physics, an elementary course in properties of materials (such as EGEN 213 or EMAT 251), and engineering coursework (including prerequisites) equivalent to:

- EGEN 201 – Engineering Mechanics/Statics
- EELE 201 – Circuits for Engineers
- EGEN 335 – Fluid Mechanics
- EGEN 305 – Mechanics of Materials

Applicants may be admitted with deficiencies but, to the extent possible, such courses are expected to be made up during the student's first year in the program.

Off-campus M.S./Distance Learning

It is possible for students to earn the MS/MSE degree almost entirely via distance learning. The degree requirements for the non-thesis and thesis alternatives are essentially the same as those previously described for students in residence at Montana Tech.

Off-campus research is encouraged for qualified students. This alternative enables off-campus students to enter the thesis-track and conduct their M.S. research at their place of employment. Student participation is subject to the following stipulations:

- The student must be employed by a company, national laboratory, or government agency or department (the Employer) prior to admission to the program and, to enter the thesis track, the proposed research must be approved in writing by an authorized representative of the Employer, the student's academic advisor, and the Vice Chancellor of Research and Dean of the Graduate School.
- The thesis research project must be well defined and acceptable to the graduate student's advisory committee. The thesis may be based on either fundamental or applied research that involves (original) computational and/or experimental research to investigate a current problem of interest to the field of materials science and engineering.
- Where possible, a qualified representative of the Employer will serve as an on-site thesis committee member; to qualify as a committee member, the individual must be a professional with an M.S. or Ph.D. degree in materials science and engineering or a closely related field.
- The student must follow the published Montana Tech guidelines for thesis content, format, preparation, and defense.
- The student must be on-campus in person for the thesis defense.
- The student must register every semester that he or she is working toward fulfillment of the degree requirements.

B. Describe the planned implementation of the proposed program, including estimates of numbers of students at each stage.

Montana Tech is prepared to launch the MS/MSE program at the start of the semester immediately following receipt of approval by the Board of Regents or as early as the Fall 2018 semester. Recruiting efforts will focus on enrollment of the initial student cohort, including online and resident students. Program start-up will be seamless and stage-wise implementation is not deemed necessary because the requisite faculty, classrooms, courses, and laboratories are already in place and the program will conform to existing faculty assignments and projected class schedules.

Conservative estimates of the ten-year projected enrollment and graduation figures for the proposed program are shown in Table 2. In the early years, enrollment projections rely on recruitment of students as they graduate with Bachelor of Science degrees from on-campus science and engineering programs. As the program expands and gains notoriety, recruitment of on-campus and off-campus students, who earned B.S. degrees at other institutions, is expected to increase. With allowances for attrition, the program is projected to enroll twelve new students and produce ten graduates each year. It was assumed that half of the incoming students will be off-campus distance learning students.

Table 2. Projected enrollment and graduation figures for the proposed MS/MSE program

Year	New Students		Total Enrollment	Graduates	Revenue
	On campus	Off campus			
1	3	0	3	0	\$ 12,600
2	3	3	6	3	\$ 23,400
3	4	3	12	3	\$ 44,700
4	5	4	17	6	\$ 63,300
5	5	5	19	7	\$ 70,500
6	6	6	23	8	\$ 85,800
7	6	6	25	10	\$ 94,050
8	6	6	25	10	\$ 96,150
9	6	6	25	10	\$ 96,150
10	6	6	25	10	\$ 96,150

Based on the current tuition and mandatory fee schedule and the assumptions used to construct Table 2, the MS/MSE program will reach steady-state after seven years with projected annual revenues of approximately \$96,000. The incremental costs of program implementation are expected to be negligible because no new faculty or other resources are needed, no new course development is required, and the video communications system is already functional and proven successful with the Materials Science Ph.D. program. Further, the MS/MSE program will not require any new course, classroom, laboratory, or program fees.

6. Resources

Will additional faculty resources be required to implement this program? If yes, please describe the need and indicate the plan for meeting this need.

No additional faculty resources will be required to implement the program. The program can be implemented with existing basic sciences and engineering faculty and without affecting their respective class schedules. The MS/MSE curriculum is predominantly based on graduate-level courses that are offered annually in the Materials Science Ph.D. program, the M.S. in the Project Engineering Management (MPEM) program, and the individual basic science and engineering departments. As previously stated, classroom space and faculty availability to teach the courses are not concerns because excess capacity exists in the relevant graduate courses. Appendix A contains a partial listing of the available courses; at least 18 of the 30 courses will be available via existing distance learning facilities.

The impact on the resources of existing programs will be negligible because no new faculty, administrative, or support personnel are required to implement the MS/MSE program. A Materials Science and Engineering Department will be created to house both of the highly interdisciplinary materials-focused graduate programs.

Are other, additional resources required to ensure the success of the proposed program? If yes, please describe the need and indicate the plan for meeting this need.

No new facilities, equipment, space, laboratory instruments or other scientific paraphernalia are needed for the proposed MS/MSE program. Extensive physical resources in the basic science and engineering laboratories at Montana Tech are sufficient to support the program implementation. For example, the Metallurgical and Materials Engineering Department has laboratories dedicated to Materials Thermochemistry, Metallography, Scanning Electron Microscopy, and Materials Testing. Mechanical Engineering has a well-equipped Nanotechnology Laboratory and a plethora of materials testing devices.

The labs are supported by an array of characterization equipment including: x-ray fluorescence and x-ray diffraction spectroscopy, Raman spectrometry, micro-hardness, and strength testing, and various types of thermo-analysis. Other available resources include the Center for Advanced Minerals, Metals, and Materials Processing (CAMP), the Library, the High Performance Computing Center and powerful analytical capabilities at the Montana Bureau of Mines and Geology.

Instead of imposing strain, the proposed program will contribute to maximum effective resource utilization because most of these resources are subject to intermittent use by faculty and graduate students. As needs for additional resources emerge, they will be met through grant-funded project budgets of the Principal Investigator/advisor.

The Montana Tech library and information resources are sufficient to support the proposed MS/MSE program. To date, these resources have proved adequate to sustain the Materials Science Ph.D. program, which is currently in its fourth year of active student engagement. MS/MSE research is expected to focus on the same areas as does the Ph.D. program, so new resources are unnecessary. Further, the MS/MSE program, while rigorous, will not require resources at as high of a level as the Ph.D. program.

Existing student services have the capacity to accommodate the proposed program. As a graduate program, enrollment will be low compared to most undergraduate programs and therefore unlikely to overwhelm existing student services. With two possible exceptions, the implications of the new program on services for the rest of the student body will be practically negligible. The first exception is the influx of MSE students could affect certain laboratory-based courses, where enrollment is necessarily limited by space and safety constraints. The second exception is the provision of adequate laboratory space for the MS/MSE students to conduct their research. Both exceptions can be managed by mindful advising and scheduling.

7. Assessment

How will the success of the program be measured?

Program success will be measured by collecting relevant data and comparing factors considered critical to the program progress. The results will be used to guide the program development to maximize quality, enable growth in enrollment, and produce graduates who are in demand to enhance the intellectual, cultural, and economic development of Montana and beyond.

In the short term, critical assessment factors include: enrollment growth, student retention and graduation rates, student placement following graduation, research funding and productivity, and program reputation/recognition. These measures will be placed in effect for immediate annual assessment but it is expected that the program must exist for at least five years to develop an adequate database for meaningful trend analyses.

In the longer term, the quality and value of the program will be assessed by periodically surveying program graduates to measure their career progress and commitment to life-long education.

8. Process leading to submission.

This proposal was developed in summer and fall 2017 by faculty representatives from the Metallurgical and Materials Engineering Department and the Mechanical Engineering Department with oversight from the Montana Tech Provost, the Vice Chancellor of Research and Graduate School Dean, the Dean of the School of Mines and Engineering, the Dean of the College of Letters, Sciences, and Professional Studies,

and the Graduate Council. This proposal has been reviewed and approved by the following Deans and Faculty Governance on the dates listed:

Director of Libraries	February 2, 2018
Dean of College of Letters, Sciences, and Professional Studies	<date>
Dean of School of Mines and Engineering	<date>
Graduate Council	February 5, 2018
Dean of Graduate School	February 5, 2018
Curriculum Review Committee	February 7, 2018
Faculty Senate	<date>
Provost & Vice Chancellor for Academic Affairs	<date>

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(* = available for distance learning; ** = available via synchronous delivery)

MTSI 502**	– (Materials) Function and Application (3 Cr-h)
MTSI 551**	– Advance Materials Characterization Techniques I (2 Cr-h)
MTSI 552**	– Advanced Materials Characterization Techniques II (3 Cr-h)
EGEN xxx	– Fundamentals of Additive manufacturing
EGEN 574	-- Intro to Micro- and Nano-mechanical Systems
EGEN 591	-- Special Topics in Fluid Mechanics
EMAT 530	-- Energy Issues & Analysis (cross-listed as EGEN 530)
EMAT 534	– Processing of Primary and Secondary Resources
EMAT 544**	– Casting and Solidification
EMAT 555**	– Biomaterials
EMAT 569	– Failure Analysis and Design Life of Materials
EMAT 570**	– Mechanical Behavior of Materials
EMET 501	– Advanced Extractive Metallurgy I
EMET 502	– Advanced Extractive Metallurgy II
EMET 511	– Materials Handling Design
EMET 520*	– Physical Chemistry of Iron and Steelmaking
EMET 525	– Computer Applications for Metallurgical Processes
EMET 526	– Thermodynamic Modeling of Aqueous Systems
EMET 583	– Processing of Precious Metal Resources
EMAT 597	– M&ME Problems
EMAT 697	– Special Problems
EMET xxx	– Advanced Pyro-processing
EMET xxx	– Remediation & Recycling of Process Wastes and Byproducts
EWLD 488	– Metallurgy of Welds
EWLD 476	– Nondestructive Evaluation
MPEM 5020*	– Project and Engineering Management
MPEM 5100*	– Pollution Prevention
MPEM 5110*	– Technology for Energy Conversion
MPEM 5120*	– Application & Design of Industrial Experiments
MPEM 5130*	– Hazardous Waste Engineering
MPEM 5170*	– Technology for Renewable Energy
MPEM 5180*	– Energy for Sustainability

***MONTANA TECH
PROCEDURES SUPPORTING THE POLICY TO ASSURE THE INTEGRITY OF RESEARCH
AND SCHOLARLY ACTIVITY***

I. Purpose

The purpose of this document is to describe the procedures and process used at Montana Tech to assure the integrity of research and scholarly activity conducted at Montana Tech and by Montana Tech employees and students.

II. Policy and Definition of Research Misconduct

Policy Statement: Research and scholarly activity by and at Montana Tech must be conducted responsibly, ethically, and in a manner consistent with the highest standards and commonly accepted practices within the scientific, engineering, and academic communities. Allegations of research misconduct will be investigated promptly, systematically, and in a way that protects both the person providing notification of the alleged misconduct and the person whose research practices are being questioned from undue publicity and impairment of reputation until the matter has been fully investigated and resolved.

Summary Definition of Research Misconduct: Research misconduct is significant misbehavior that improperly appropriates the intellectual property or contributions of others, that intentionally impedes the progress of research, or that risks corrupting the scientific record or compromising the integrity of scientific practices. Such behaviors are unethical and unacceptable in proposing, conducting, or reporting research, or in reviewing the proposals or research reports of others.

Research misconduct includes fabrication, falsification, and plagiarism associated with planning, proposing, performing, analyzing, reporting, and reviewing research and other scholarly activity, along with other willful violations of accepted research practices or administrative requirements or regulations associated with research. It does not include differences of opinion, interpretation or honest error. Violation of criminal or civil law in the course of conducting or reporting research is a crime and would normally be handled as such, rather than as research misconduct. The full definition can be found in the Policy.

III. Responsibilities and Requirements

The Vice Chancellor for Research (VCR) is Montana Tech's Research Integrity Officer (RIO).

All employees, students, and other individuals associated with Montana Tech are responsible for reporting observed, suspected, or apparent misconduct in research to the VCR/RIO. If an individual is unsure whether a suspected incident falls within the definition of research misconduct, he or she should contact the VCR to discuss the suspected misconduct informally.

As the RIO, the VCR is responsible for ensuring that Montana Tech:

- a. Fosters a research environment that promotes the responsible conduct of research.
- b. Provides responsible research training, discourages research misconduct, and deals promptly and fairly with allegations or suspicions of possible research misconduct.
- c. Interprets and complies with this Research Integrity Policy and files the required annual reports on research integrity with the National Institutes of Health (NIH) Office of Research Integrity (ORI).

- d. Confidentially hears any individual who comes forward with an allegation of research misconduct.
- e. Takes appropriate action in response to allegations or suspicions of research misconduct to protect the person reporting the allegation; to protect the person whose research practices are being questioned; to investigate the allegation or suspicion fairly and promptly; to protect public health, sponsor funds and equipment, and the integrity of the research process; to document the investigation and its results; and to provide the required reports to sponsor(s), if any, on the questioned research.
- f. In the case of an anonymous allegation of research misconduct, conducts a “Pre-Inquiry” to determine if there is sufficient evidence of alleged misconduct to warrant initiation of an Inquiry with no named complainant.
- g. If warranted, appoints an impartial Inquiry Committee and serves as its non-voting chair to oversee its fair and prompt Inquiry to determine within 60 days whether a full investigation is warranted.
- h. If warranted, appoints an impartial Investigation Committee and serves as its non-voting chairperson to oversee its fair and prompt Investigation to determine within 120 days whether the “preponderance of the evidence” indicates that misconduct occurred, considering both action and intent. For misconduct to be confirmed, the preponderance of the evidence must support the conclusion that the acts or practices in question were serious deviations from those commonly employed in the United States for proposing, conducting or reporting research and other creative activities.

The Provost and Vice Chancellor for Academic Affairs (VCAA) is responsible for serving as the RIO in a situation where the VCR is associated with the questioned research.

IV. PROCEDURES

1. Procedures for Filing a Complaint Alleging Misconduct

- A. Complainant reports the allegation of research misconduct to the VCR/RIO. If the VCR is associated with the research in question, report the allegation to the Provost/Vice Chancellor for Academic Affairs (VCAA). The RIO will inform the complainant about the process, described below, for investigating the alleged misconduct. If the alleged act(s) do not fall within the scope of this policy, the RIO may assist the complainant in a resolution, using whatever institutional channels best fit the situation, such as referral to a department chair, a dean, the Office of Human Resources or a grievance committee
- B. If the complainant chooses to make a formal allegation, he/she must submit a formal written report of the alleged misconduct to the RIO. If the complainant chooses not to make a formal allegation, the RIO may pursue the matter at his or her discretion, by initiating a Pre-Inquiry with no named complainant.
- C. The RIO shall explain to the complainant any limits to confidentiality that may be imposed by law, such as the obligation to respond to external subpoenas. If substantial evidence is readily available, further involvement of the complainant may not be necessary. It may not be possible to pursue the allegation without the participation of the complainant. If the case depends specifically on eyewitness accounts or other evidence which necessitates open participation of the complainant, the complainant must comply.
- D. In the event the RIO receives an anonymous allegation of research misconduct, he or she must initiate a Pre-Inquiry Phase to investigate the allegation to the fullest extent possible. The intent of the Pre-Inquiry Phase is to determine if there is sufficient evidence of alleged misconduct to warrant initiation of an Inquiry Phase with no named complainant. The RIO has the option of requesting conferences with anyone, who may help to clarify the anonymous allegation.

2. Procedures for Investigating an Allegation of Research Misconduct

A. The Pre-Inquiry Phase. Upon receiving an allegation of research misconduct, the RIO shall conduct an informal, preliminary review of the facts to determine if there is a reasonable basis for initiating the formal process of inquiry.

B. The Inquiry Phase. The Inquiry Phase determines if a full-scale investigation of a complaint is warranted. The Inquiry Phase shall include limited formal gathering of information, the review of evidence, a careful review of the allegation, and interviews with the complainant (if there is one) and the respondent.

a) *Committee Structure.* The Inquiry Committee shall consist of the RIO (as non-voting chairperson); the Dean of the College in which the alleged misconduct occurred or the Director of the Montana Bureau of Mines and Geology (Bureau) if the inquiry involves a Bureau employee or the Center Director if the inquiry involves a researcher in the Center; and three faculty members appointed by the VCAA. If a member of the Student Affairs or Administrative Affairs staff conducted the questioned research, appropriate peer representation will be appointed to this Committee by the VCR. If a student conducted the questioned work, the Dean of Students will be a member of the Inquiry Committee. The Chairperson will vote in the case of a tie. Decisions of the Inquiry Committee require a majority vote. Appointees to the Inquiry Committee must have no conflicts of interest with the respondent or the complainant and shall be relieved of their appointments to the Inquiry Committee at the outset if they believe that their personal or professional relationships with the principal(s) in the case may affect their judgment. Membership in the same academic unit is not automatically considered to be a conflict of interest within the context of this policy. The Inquiry Committee shall be informed of its responsibilities and the processes, including the requirement for the inquiry to be conducted in a strictly confidential manner.

b) *Inquiry Process.* Upon the initiation of the Inquiry Phase, the respondent shall receive from the RIO written confidential notification of the inquiry, of the allegations, and of the policies and procedures for investigating the allegation. The Committee shall have the authority to request and the respondent shall be obligated to provide evidence including, but not limited to lab notebooks, computer printouts and codes, electronic data storage, magnetic and voice-recorded tapes, notes, manuscripts, publications, tours of the research area, and any other item, evidence, or activity, which will assist the investigation and enhance or expedite the inquiry and its decision process. "Failure to cooperate" on the part of the respondent, including refusal to comply with requests of the Inquiry Committee, shall result in immediate transition to the Investigation Phase, and possibly to disciplinary actions, which could be recommended by the Inquiry Committee to the VCAA (or to the Chancellor, if the respondent is a Vice Chancellor). Montana Tech reserves the right to exercise mandatory processes, such as seizure and protection of physical evidence (e.g. laboratory notes and research materials) when necessary. If the respondent leaves Montana Tech prior to the close of the inquiry, the Committee shall complete the Inquiry Phase.

c) *Inquiry Timetable.* The Inquiry Phase must be completed within 60 days from the date of the written notification to the respondent that an inquiry will be conducted.

d) *Inquiry Committee Report(s).* A written report of the findings shall be completed by the Inquiry Committee at or before the end of the Inquiry Period. The RIO shall notify the respondent and the complainant of the Inquiry Committee's decision in writing and send them each and the VCAA (or Chancellor) a copy of the report. If the Inquiry Phase

exceeds the 60-day deadline, the Inquiry Committee must prepare and submit to the VCAA (or Chancellor) an interim report prior to the deadline, describing the progress of the inquiry, the reasons for the delay, and a proposed completion date.

- e) *Following Action(s)*. If the decision of the Inquiry Committee is that the allegations are unfounded (see Section VII Unfounded Allegations). If the Decision of the Inquiry Committee is that sufficient evidence exists to proceed to the Investigation Phase, the complainant, the respondent, and the witnesses shall be notified in writing by the RIO of the date the Investigation Phase will begin. If the research was funded by a sponsor, the RIO shall notify the appropriate official(s) of the sponsor of the allegation on or before the day the Investigation Phase is initiated (or on the timing required by the sponsor, if different). The decision by the Committee to proceed to the Investigation Phase shall be final.

C. The Investigation Phase. The Investigation Phase formally examines the allegations of misconduct, which were found to be worthy of closer scrutiny in the Inquiry Phase, and to determine if the evidence gathered supports the conclusion that scientific misconduct has occurred. All persons involved are obligated to cooperate fully by providing all information pertaining to the case. The Investigation Phase must be initiated within 30 days of the completion of the Inquiry Phase (e.g. the submission of the final report from the Inquiry Committee). There are four aspects to the Investigation Phase: gathering and reviewing evidence; convening a hearing; drawing conclusions; and preparing a report.

- a) *Committee Structure*. The Inquiry Committee shall consist of the Inquiry Committee, with two additional, preferably senior faculty, appointed by the VCAA, ideally with applicable research expertise. If special expertise is needed, additional non-voting members may be appointed who are not affiliated with Montana Tech. The RIO serves as non-voting chairperson, who will vote in the case of a tie. Decisions of the Investigation Committee require a majority vote. Appointees to the Investigation Committee must have no conflicts of interest with the respondent or the complainant, with the same criteria as for the Inquiry Committee. Committee members will be informed of the process and their responsibility to honor its confidentiality.
- b) *Four Aspects of the Investigation Committee's Work*
- i. Gathering and reviewing evidence/testimony-This activity includes collecting and examining raw research materials and records and receiving and documenting testimony from all relevant sources, including that from the respondent. All relevant evidence shall be considered in the Investigation Phase. "Evidence" includes all items requested during the Inquiry Phase, plus additional notes, journals, letters, computer printouts, equipment printouts, publications, manuscripts, tours of the laboratory or other research area, witness testimony, testimony of the accused, and any other item which is reasonably requested for examination by the Investigation Committee. All items pertaining to the case are to be carefully documented in written form by the Committee including the statements by the respondent, the complainant, and witnesses made during the hearing. At the discretion of the Vice Chancellor for Research and Graduate Studies, a court reporter may be retained for this purpose.
 - ii. Convening a hearing- The hearing is a formal procedure during which the respondent has an adequate opportunity to hear and question witnesses, to examine other evidence, and to present testimony and evidence on his /her own behalf.
 - iii. Drawing conclusions-After review of the evidence, the Investigation Committee shall draw conclusions about whether the evidence persuasively supports a finding that scientific misconduct took place, about the nature of deeds engaged in, and about who is responsible.
 - iv. Preparing a report- A report shall be prepared setting forth and documenting

- evidence received, conclusions drawn, and actions recommended.
- c) *Investigation Process.* To initiate the process, the RIO sends written notification of the investigation to those involved. The respondent will be provided with a complete statement of the allegations and must prepare and submit to the RIO a written response within 10 working days of receiving the statement of allegations. The respondent and the complainant have the right to legal counsel at their own expense. Counsel shall be permitted to attend the hearing(s). However, attorneys for the respondent and the complainant shall not be permitted to testify, cross-examine witnesses, or otherwise take an active role in the proceedings. If a respondent leaves Montana Tech prior to the completion of the Investigation, Montana Tech will still complete the investigation.
- i. Strict Confidentiality. The proceedings of the Investigation Phase shall be strictly confidential. Only members of the Investigation Committee, persons called as witnesses by the Investigation Committee, the complainant, the respondent, and their legal counsels, if any, shall be allowed in the hearing. Any member of the Committee or other affiliated person who breaches the confidentiality of the reports and paperwork shall be subject to disciplinary action, including removal from the Committee.
 - ii. Protection of Research Subjects, Students, Property. If it is deemed necessary by the Investigation Committee, interim administrative action may be taken to protect the health and safety of research subjects, the best interests of students and colleagues, and Montana Tech and community property. This action may range from requiring alterations in the research activities of the respondent to full suspension of his or her research activities. The Committee's recommendations shall be made to the VCAA.
 - iii. Timetable. The Investigation Phase shall be completed no later than 120 days after it was opened.
 - iv. Report(s). The findings of the Investigation Committee and recommended actions shall be submitted in written form to the VCAA (to the Chancellor, if a vice chancellor is the respondent) for implementation. The respondent shall be provided with a complete copy of the recommendations. If the investigation involves more than one person, only the portion of the report that pertains to each person will be provided to her or him. If the Investigation Phase cannot be completed in 120 days, the Committee shall submit an interim report to the VCAA describing the progress of the investigation, the reason(s) for the delay, and a proposed completion date. In addition, the RIO shall submit a request for an extension to the funding agency(ies), if any, and include an interim report on the progress and an estimated completion date.
- d. *Following Action(s) if Research Misconduct Did Not Occur.* If the Investigation Committee determines that research misconduct did not occur, all pertinent agencies and individuals will be notified as quickly as possible by the RIO (see Section VII Unfounded Allegations). If the scientific record needs to be corrected, the RIO shall ensure that the corrections to the scientific record are made. If the research needing correction has already been published, the Investigation Committee may recommend specific actions(s), if any, appropriate to the circumstances of the case.
- e. *Following Action(s) if Research Misconduct Has Occurred.* The RIO will inform the involved funding agencies, the complainant, the respondent, and other appropriate individuals of the results of the investigation as quickly as possible after the period during which an appeal may be initiated has lapsed. If there is an appeal, the notice will be communicated after the appeal has been resolved. If applicable, notification will be provided to:
- Affected offices within Montana Tech;

- Co-authors, co-investigators, and collaborators for the affected work;
 - Editors of journals in which the accused or, in the case of a collaborator (albeit unknowingly), published fraudulent research;
 - State professional licensing boards;
 - Editors of other journals, or publications, other institutions, sponsoring agencies, and funding sources with which the accused has been affiliated;
 - Applicable professional societies;
 - Criminal authorities, if appropriate;
 - Others who might be affected.
- f. *Disciplinary Action(s)*. Disciplinary action shall be recommended by the Investigation to the VCAA (if a faculty member or academic staff member), to the MBMG Director (if a Bureau researcher), to the appropriate vice chancellor (if a non-academic staff member), or to the Chancellor (if a vice chancellor). If the accused is a currently enrolled student, the Student Disciplinary Appeals Committee shall meet with the Investigation Committee and shall jointly recommend appropriate action to the VCAA. Recommended disciplinary action shall be in accordance with appropriate, established University policies and procedures. Disciplinary actions may include, but are not limited to, letter of reprimand, removal of chair holder or administrative position, reduction in salary, dismissal, and termination of employment. If the individual is a student, credit hours and the grade for the course in question may be withdrawn and the student may be suspended or expelled. If the research in question was the basis of a graduate thesis or dissertation or played a significant role in the award of an undergraduate, graduate or professional degree, Montana Tech reserves the right to withdraw the degree awarded. The student's transcript shall be amended and Montana Tech will notify professional societies, licensing boards and other pertinent parties of the decision. In the case of termination of employment, expulsion, or in the case of the respondent's decision to resign or withdraw from Montana Tech, the Director of Human Resources or the Registrar shall place the findings of the Investigation Committee in the respondent's personnel or student file

V. RECORDS RETENTION

The written report from the Inquiry Phase and all records pertaining to the Investigation Phase, including the final report written at the completion of the investigation, shall be kept in a locked file in the Research Office. The records shall be retained for a minimum of 7 years for Official University purposes and to enable the agency(ies) funding the research to obtain information regarding the case. At the discretion of the VCR, original notebooks, printouts and other original materials that were submitted by the respondent in response to the request of the Inquiry and/or Investigation Committees, shall be returned to the respondent after copies are made for the file. Only appropriate officials, based on the judgment of the VCR shall be permitted access to these files.

VI. APPEALS PROCESS

The respondent may appeal the decision of the Investigation Committee by submitting in writing a Statement of Appeal to the Chancellor within fifteen (15) working days of the notification to the respondent by the RIO of the Investigation Committee's decision. The appeal shall not constitute a new fact-finding process, but shall rather be a review of the record previously compiled. The appeal must be based on a contention that improper procedures were followed during the Inquiry or Investigation Phase; that the decision of the Investigation Committee, when taken as a whole,

was not based upon sufficient evidence; or that the decision of the Investigation Committee was reached in an arbitrary and capricious manner.

The respondent must set forth in his or her written Statement of Appeal a summary of the facts of the case, the investigative procedures which have taken place, the dates of hearing(s), the witnesses present, a brief summary of the relevant testimony and evidence presented at the hearings, and the particular bases or grounds for the appeal. The RIO shall make available to the respondent for his/her use in preparing the appeal the entire record of the case. The respondent must deliver a copy of the Statement of Appeal to the Chancellor and to the RIO. The RIO shall then deliver the entire record of the case, including the transcript of the hearing and all exhibits and documentary evidence, to the Chancellor. The RIO may make a written response to the Statement of Appeal in which he or she sets forth facts and arguments in support of the Investigation Committee's decision, with a copy provided to the respondent.

The Chancellor's review shall be completed within 30 calendar days. The decision of the Chancellor shall be final.

VII. UNFOUNDED ALLEGATIONS AND MALICIOUS ALLEGATIONS AND RETALIATION

1. Unfounded Allegations

If the Inquiry or Investigation Committee finds the allegations are not justified, but the complainant submitted the allegations in good faith, the case shall be dismissed and no further action will be taken except to inform the complainant, the accused and any witnesses of the decision. If necessary, the pertinent funding agencies shall be notified that during the course of the Investigation Phase, the allegations were found to be unjustified.

2. Malicious Allegations and Retaliation

If in the Pre-Inquiry, the Inquiry or the Investigation Phases, the allegations are found to have not been made in good faith and the complainant is found to have been maliciously motivated, the complainant shall be subject to disciplinary action.

Montana Tech will make every effort to protect the complainant against retaliation. If the complainant requests a transfer, Montana Tech shall act 'in good faith to help him or her to find a position of comparable responsibility and salary.

The RIO shall caution the respondent that engaging in acts of retaliation toward the complainant, members of an Inquiry or Investigation Committee, or other members of Montana Tech, shall be subject to disciplinary action, independent of the outcome of the inquiry and investigation.

3. Disciplinary Action

The disciplinary actions possible for both malicious allegations and retaliatory acts may range from a letter of reprimand to dismissal and termination of employment. The disciplinary action to be taken shall be recommended by either the Inquiry or the Investigation Committee to the VCAA. If the claimant or respondent, respectively, is a student, the Student Disciplinary Appeals Committee shall meet with the Inquiry or Investigation Committee, and the Committee and the Council shall jointly recommend appropriate action to the VCAA.

VIII MODIFICATIONS TO THESE PROCEDURES

Proposed modifications to these procedures shall be submitted to the Research Advisory Committee

(RAC) for consideration and recommended to the VCR and RIO for approval.

VIII. DEFINITIONS

Allegation—notice to the responsible official either in writing or orally that wrongdoing is suspected or known to have occurred. The individual who makes the allegation will be hereinafter referred to as the complainant. The individual against whom the allegation has been brought will be termed the respondent.

Appeal—an opportunity afforded by the institution for review of the final determination. Permissible bases for an appeal are limited to assertions that improper procedures were followed during the Inquiry or Investigation phase; that the decision of the Investigation Committee, when taken as a whole, was not based upon sufficient evidence; or that the decision of the Investigation Committee was reached in an arbitrary and capricious manner. An appeal shall only be on the record.

Complainant—a person who makes an allegation of scientific misconduct.

Conflict of Interest—real or apparent interference of one person's interests with the interests of another person, where potential bias may occur due to prior or existing personal or professional relationships.

Failure to cooperate—the failure to produce requested documents, data, research results, publications, audio or video tapes, or other materials in a timely manner; the failure to respond to questions, either orally or in writing, the refusal to permit members of the Inquiry or Investigation Committee or other authorized persons to enter the research area or laboratory; and other actions deemed by the Inquiry or Investigation Committee to be unsatisfactory in response to requests made to expedite the inquiry or investigation procedure.

Federal support—federal grants, contracts, or cooperative agreements or applications.

Final determination—the institutional conclusion concerning the extent of possible wrongdoing and culpability of the respondent, which occurs after the investigation. In deciding a case, the standard for weighing the evidence is “preponderance of the evidence,” in which a simple majority of the evidence must weigh in favor of the decision. A presumption of innocence should prevail until a final determination concerning guilt has been made.

Good faith allegation—an allegation made with the honest belief that scientific or other misconduct may have occurred. An allegation is not in good faith if it is made with reckless disregard for or willful ignorance of facts that would disprove the allegation.

Hearing—a formal procedure during which the respondent has an adequate opportunity to hear and question witnesses, to examine other evidence, and to present testimony and evidence on his /her own behalf.

Inquiry—gathering information and initial fact-finding to determine whether an allegation or apparent instance of misconduct warrants an investigation.

Investigation—the formal examination and evaluation of all relevant facts to determine if misconduct has occurred, and if so, to determine the responsible person and the seriousness of the misconduct.

Misconduct in science or scholarly activity—research misconduct, professional misconduct, or other practices that seriously deviate from those commonly accepted within the scientific and academic community for proposing, conducting, or reporting research and other creative activities. It does not

include honest error or honest differences in interpretations or judgments of data.

NSF—National Science Foundation

NSF Regulation—The NSF responsible research regulation is 45 CFR Part 689. The Office responsible for research integrity is the Office of the Inspector General.

ORI—Office of Research Integrity, the office within the U.S. Department of Health and Human Services (DHHS) that is responsible for the scientific misconduct and research integrity activities of the U.S. Public Health Service. In the case of the National Science Foundation (NSF), the appropriate office is the Office of the Inspector General. In the case of other federal agencies, an appropriate office of the involved federal agency will be identified.

PHS—U.S. Public Health Service, an operating component of the DHHS.

PHS regulation—Public Health Service regulation establishing standards for institutional inquiries and investigations into allegations of scientific misconduct, which is set forth at 42 C.F.R. Part 93, entitled "Public Health Service Policies on Research Misconduct."

Research record—any data, document, electronic file, e-mail, or any other written or non-written account or object that reasonably may be expected to provide evidence or information regarding the proposed, conducted, or reported research that constitutes the subject of an allegation of scientific misconduct. A research record includes, but is not limited to, grant or contract applications, funded or unfunded; grant or contract progress and other reports; laboratory notebooks; notes; correspondence; videos; photographs; X-ray film; slides; biological materials; computer files and printouts; manuscripts and publications; equipment use logs; laboratory procurement records; animal facility records; human and animal subject protocols; consent forms; medical charts; and patient research files.

Respondent—the person against whom an allegation of scientific misconduct is directed or the person whose actions are the subject of the inquiry or investigation. There can be more than one respondent in any inquiry or investigation.

Retaliation—any action that adversely affects the employment or other institutional status of an individual that is taken by an institution or an employee because the individual has in good faith, made an allegation of scientific misconduct or of inadequate institutional response thereto or has cooperated in good faith with an investigation of such allegation.

RIO—Research Integrity Officer

Scientific Record—any documentation or presentation of research, oral or written, published or unpublished. Scientific record includes the results of engineering studies, humanities, and other research and creative scholarship.

VCAA—Provost and Vice Chancellor for Academic Affairs

VCR—Vice Chancellor for Research

MONTANA TECH

POLICY TO ASSURE THE INTEGRITY OF RESEARCH AND SCHOLARLY ACTIVITY

I. Purpose

The purpose of this policy is to assure the integrity of research and scholarly activity conducted at Montana Tech and by Montana Tech employees and students, to protect both the person alleging research misconduct and the person whose research practices are being questioned, and to comply with federal regulations for institutional management and oversight of research.

II. Policy

Research and scholarly activity by and at Montana Tech must be conducted responsibly, ethically, and in a manner consistent with the highest standards and commonly accepted practices within the scientific, engineering, and academic communities. Allegations of research misconduct will be investigated promptly, systematically, and in a way that protects both the person providing notification of the alleged misconduct and the person whose research practices are being questioned from undue publicity and impairment of reputation until the matter has been fully investigated and resolved.

III. Scope and Application

This policy and the referenced [procedures](#) apply to all individuals at Montana Tech engaged in research or other creative activities whether or not their work is supported by federal funding. This policy defines research misconduct and provides guidelines for evaluating allegations expeditiously and responsibly.

This policy applies to activities associated with the collection, analysis, and reporting of all types of research: theoretical, computational, experimental, field-based, basic, and/or applied, being done by researchers employed by, enrolled at, or utilizing facilities of Montana Tech. “Researchers” include faculty; research personnel; individuals holding postdoctoral, affiliate, or adjunct appointments; graduate students; undergraduate students; high-school students and teachers; and any other individuals who are doing research at Montana Tech. This policy does not apply to other areas or types of academic integrity or misconduct.

IV. Definition of Research Misconduct

Research misconduct is significant misbehavior that improperly appropriates the intellectual property or contributions of others, that intentionally impedes the progress of research, or that risks corrupting the scientific record or compromising the integrity of scientific practices. Such behaviors are unethical and unacceptable in proposing, conducting, or reporting research, or in reviewing the proposals or research reports of others.

Research misconduct includes fabrication, falsification, and plagiarism associated with planning, proposing, performing, analyzing, reporting, and reviewing research and other scholarly activity, along with other willful violations of accepted research practices or administrative requirements or regulations associated with research. It does not include differences of opinion, interpretation or honest error. Violation of criminal or civil law in the course of conducting or reporting research is a crime and would normally be handled as such, rather than as research misconduct.

- a. Fabrication is inventing or making up any research data or reporting on experiments that were never performed.
- b. Falsification is manipulating research materials, equipment, or processes; adjusting data or measurements; or selectively choosing data to report, such that the research is not accurately represented in the research record.
- c. Plagiarism is the act of taking ideas, results, processes, analyses, words, or interpretation from another person and presenting them as one's own.
- d. Violation of administrative requirements, such as:
 - i. Applying for federal funding while under federal suspension or debarment, or knowingly utilizing as a co-principal investigator, investigator, technician, or consultant a person, who is suspended or debarred.
 - ii. Failure to maintain a record of primary data with the intent to deceive, e.g. destroying laboratory notebooks, survey forms, microscope reference slides, computer or other machine printouts with the intent to deceive.
 - iii. Failure to report known or suspected acts of misconduct or knowingly withholding or destroying evidence crucial in an investigation of misconduct.
 - iv. Abuse of confidentiality when gathering or reporting data, e.g., releasing data gathered during privileged communication.
 - v. Use of honorary authorships, without the person's consent, and/or with the intent to deceive.
 - vi. Being in a position of authority over a researcher and demanding to be listed as an author of a publication without having contributed to the research covered by the publication.

V. Responsibilities and Requirements

The Vice Chancellor for Research (VCR) is Montana Tech's Research Integrity Officer (RIO) responsible for ensuring that Montana Tech:

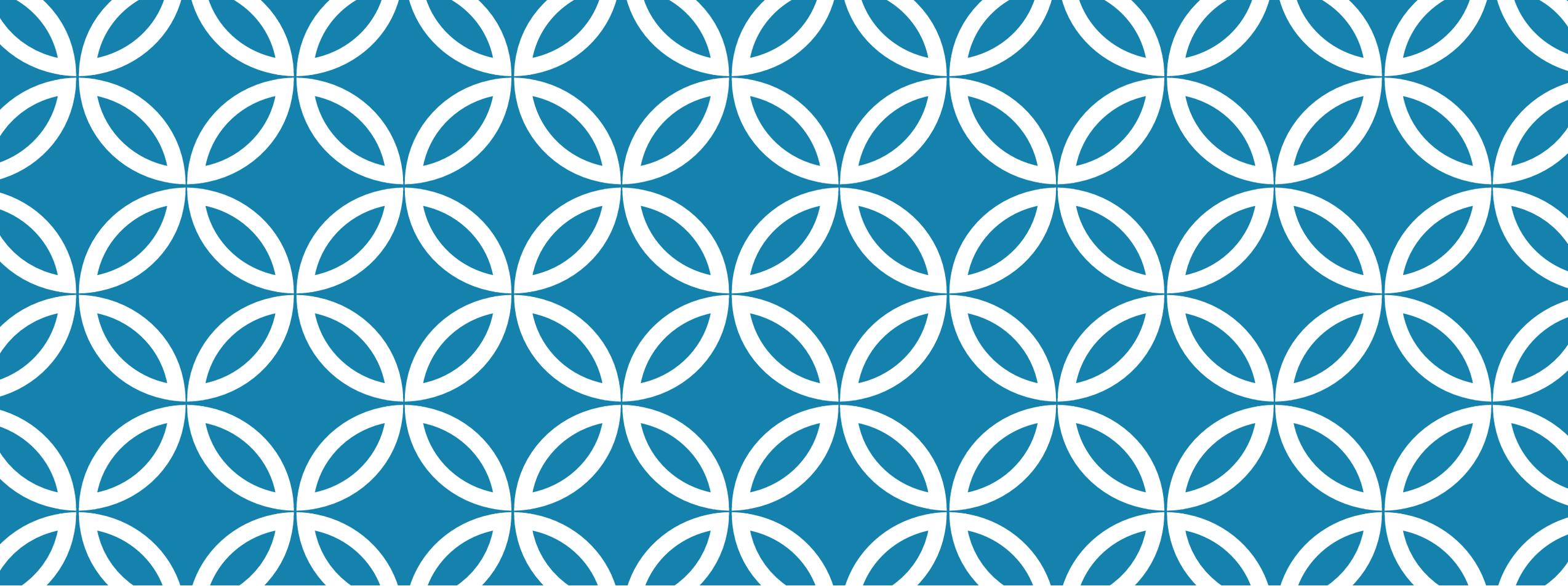
- a. Fosters a research environment that promotes the responsible conduct of research.
- b. Provides responsible research training, discourages research misconduct, and deals promptly and fairly with allegations or suspicions of possible research misconduct.
- c. Complies with this Research Integrity Policy and files the required annual reports on research integrity with the National Institutes of Health (NIH) Office of Research Integrity (ORI).
- d. Takes appropriate action in response to allegations or suspicions of research misconduct to protect the person reporting the allegation; to protect the person whose research practices are being questioned; to investigate the allegation or suspicion fairly and promptly; to protect public health, sponsor funds and equipment, and the integrity of the research process; to document the investigation and its results; and to provide the required reports to sponsor(s), if any, on the questioned research.
- e. In the case of an anonymous allegation of research misconduct, conducts a "Pre-inquiry" to determine if there is sufficient evidence of alleged misconduct to warrant initiation of an Inquiry with no named complainant.
- f. If warranted, appoints an impartial committee and oversees its fair and prompt Inquiry to determine within 60 days whether a full investigation is warranted.
- g. If warranted, appoints an impartial committee and oversees its fair and prompt Investigation to determine within 120 days whether the "preponderance of the evidence" indicates that misconduct occurred, considering both action and intent. For misconduct to be confirmed, the preponderance of the evidence must support the conclusion that the acts or practices in question were serious deviations from those

commonly employed in the United States for proposing, conducting or reporting research and other creative activities.

All employees, students, and other individuals associated with Montana Tech are responsible for reporting observed, suspected, or apparent misconduct in research to the VCR/RIO. If an individual is unsure whether a suspected incident falls within the definition of research misconduct, he or she should contact the VCR to discuss the suspected misconduct informally.

VI. MODIFICATIONS TO THIS POLICY

Any proposed modifications to this policy shall be submitted to the Research Advisory Committee (RAC) for their consideration. Changes proposed by the RAC will be forwarded to the Faculty Senate for review and approval, and finally to the Chancellor for his/her approval.



EVALUATION OF EVALUATIONS



UPDATES

Subcommittee has met several times this semester, and found it necessary to “step back” in order to address Faculty Senate, Dean’s Council, and scholarly feedback (specifically peer reviewed scholarship, and Iowa State University’s Center for Excellence and Teaching’s published position statements on Student Evaluation of Teaching (SET) best practices).

We generated two things for discussion today: a statement of purpose, and five domains that we feel can be productively measured. We wish to update the Senate on this progress, solicit any feedback, and discuss upcoming steps.

Our next meeting: this coming Tuesday.



BUT FIRST: WELCOME ABOARD!!

Welcome Dr. Stella Capoccia! The sub-committee now consists of Drs. Capoccia, Faught, Kukay, Choudbury, and Southergill.

Current Focus Areas

Reconsider Goals: What do we want to measure, and why?

Revise Survey Design (topics/questions): Are we capturing what we want and need?

Discuss Utility: How can these results be productively interpreted?

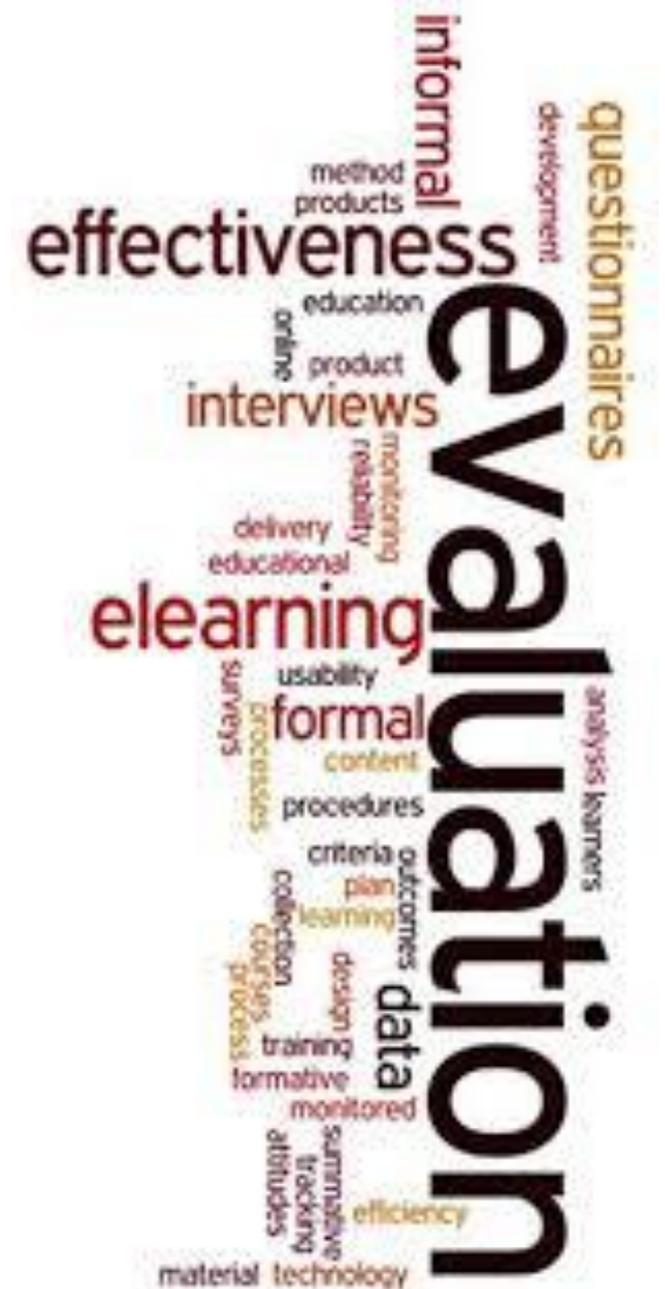
Leveraging Analytics and Functionalities: What can give instructors, departments, etc. more meaningful interactions with the data?

METHODS TOWARDS IMPROVEMENT

BASIC STRUCTURE/OUTCOME

Define Purpose of Evaluations:

Working Statement: the purpose of the forthcoming proposed revisions to the Student Evaluation of Teaching are to produce **a meaningful measure of student's self-perceptions of learning** that support departmental decision-making, recognize excellence in instruction, provide feedback to Teaching Circles and/or other institutional improvement efforts, and support employment related decisions consistently with the CBA and Iowa State University's Center for Excellence in Teaching and Learning's guidelines and recommendations for effective practice in SET.



SURVEY INSTRUMENT (TOPICS/QUESTIONS)



5 Topic Areas (Not all are usable for instructor evaluation protocols)

Student self-assessment & reporting

Course organization, instructional materials, learner resources

Activities & learner interaction

Assessment & feedback

Classroom, Facilities, and Learner Support.

3-5 questions/Topic Area

Quantifiable questions within each topic area (1-5 point scale)

Retain (but simplify) open ended questions at survey's end

Department and program specific questions may be added

UPCOMING STEPS

- Review questions for each domain for validity and reliability.
- Collaborate with internal programmers to set schedule for building functionalities and testing (note: some of the more complicated functions may take at least one year to generate, but will incur no projected costs).
- Encourage departmental conversations on potential revisions to standards consistent with the CBA.
- Obtain faculty feedback, test/analyze SET tool, and generate final recommendations for faculty administrative consideration.
- Timeline: increasingly, we anticipate this work will require at least some of AY18-19.



CONVERSATION AND QUESTIONS

We're all ears.



Montana Tech Advantage

Key Features

- Feature 1
- Feature 2
- Feature 3

Key Features

- Feature 1
- Feature 2
- Feature 3

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- Feature 1
- Feature 2
- Feature 3



Check it Out for Yourself

Industry System

Industry System

Key Features

- Feature 1
- Feature 2
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MONTANA TECH

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THE UNIVERSITY OF MONTANA



The Cost of Education

MontanaTech

ADMISSIONS

FIRST YEAR | TRANSFER | INTERNATIONAL | GRADUATE | HIGHLANDS COLLEGE

APPLY

RS

LIFE

ENDANCE

PS

ADUATE

GE (WUE)

ED STUDENTS

VETERANS



APPLY NOW



PAYING FOR COLLEGE

LISA WAREHAM PHOTOGRAPHY

ESTIMATED COST OF ATTENDANCE

A college education is one of the most important investments you will make in your life. Make sure you are financially prepared by knowing the types of expenses you may incur while attending Montana Tech. Use the table below to help budget for a year's worth of living and learning expenses.

RESOURCES

NET PRICE CALCULATOR

SAF/SMART ABOUT COLLEGE

Montana Tech 2017/18 Estimated Expenses

	MT Resident	Non-Resident	WUE/Advantage
Tuition & Fees	\$7,139	\$21,969	\$9,936
Room & Board	\$9,828	\$9,828	\$9,828
Books & Supplies	\$1,100	\$1,100	\$1,100
Transportation	\$1,700	\$1,900	\$1,900
Miscellaneous	\$1,650	\$1,650	\$1,650
Academic Year Total	\$21,417	\$36,447	\$24,414

IMPORTANT: Tuition costs are subject to change by the Montana Board of Regents without prior notice. Actual costs can be found on the [Business Office Tuition Schedules Page](#).

Books & Supplies
\$1100

A Closer Look

Comparing student costs across programs

Engineering Student, Freshman Year Book Costs

- All new textbooks (based on 17 cr./sem.):
 - \$1054 per semester
- All used textbooks (based on 17 cr./sem.):
 - \$796 per semester
- Average price per credit for textbooks:
 - \$62 new
 - \$46.83 used

Business Management Student, Freshman Year Book Costs

- All new textbooks (based on 18 cr./sem.):
 - \$1100.75 per semester
- All used textbooks (based on 18 cr./sem.):
 - \$827 per semester
- Average price per credit for textbooks:
 - \$61.16 new
 - \$45.95 used

A.A.S. Network Technology Student, Freshman Year Book Costs

- All new textbooks (based on 17 cr./sem.):
 - \$467 per semester
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 - \$337.75 per semester
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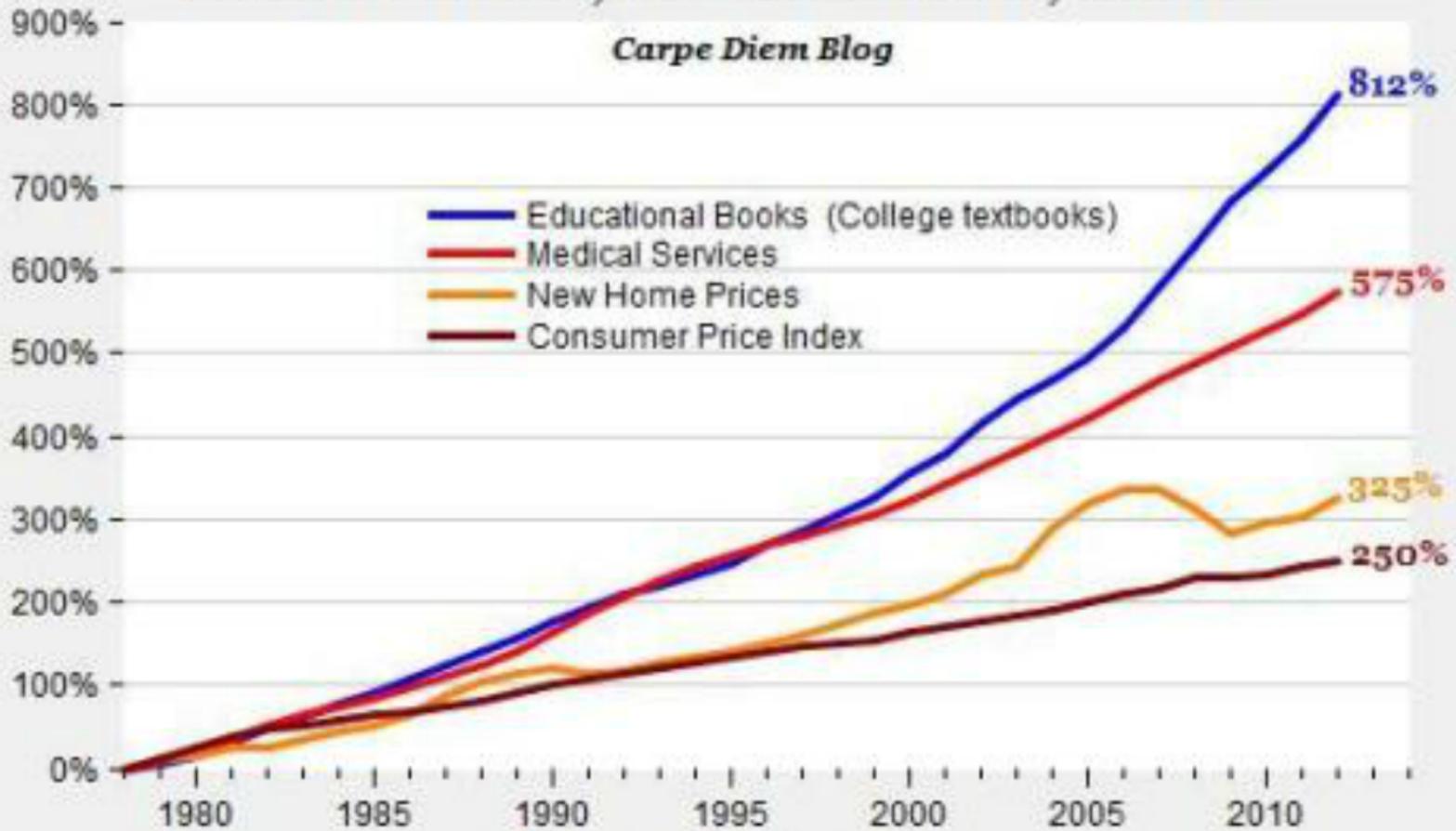
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The Cost of Doing Business

Percent Change Since 1978 for Educational Books, Medical Services, New Home Prices, and CPI



Sources: BLS, Census Bureau

By the Numbers

- **<10%:** The proportion of textbooks sold through independent college bookstores vs. online retailers or chain-stores.
- **53-60%:** The effective discount Amazon receives from publishers on their textbooks.
- **7-10%:** The effective discount Montana Tech Bookstore receives from publishers (with freight calculated).
- **30%:** The proportion of E-Textbooks to physical textbooks sold in the US (up from 5% just two-years ago).

References:

<https://www.nacs.org/research/HigherEdRetailMarketFactsFigures.aspx>

<https://www.forbes.com/sites/jeffbercovici/2014/02/10/amazon-vs-book-publishers-by-the-numbers/#56a40cd4ef9d>

Montana Tech
Advantage

Imagine Montana Tech

- ...if skyrocketing textbook prices were a thing of the past
- ...if every student had full access to all their required course materials on day 1
- ...if you could know who has actually read their assignment
- ...if you could pinpoint problem areas well in advance of an exam

Imagine the Advantage

Inclusive Access

- The solution to rising textbook prices
- Connects students with discounted eTextbooks and other digital course materials
- Integrates seamlessly with Moodle and other LMS
- Day 1 access
- Direct partnership with 400+ publishers for course material needs

Indiana University

- Began piloting eText Initiative in 2009
- Initial offering of 15 courses
- 2017 Indiana University distributed more than 100,000 eTextbooks in 2,500 class sections



Reference: Association of American Publishers, <http://www.aapublishers.org/pa1.pdf>

University of California - Davis

- UC Davis piloted Inclusive Access in 2014 with two goals in mind:
 - Reduce cost of course materials
 - Improve educational outcomes for students
- In the past three years, their award-winning program has helped 17,000 students save more than \$2.3 million



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Southern Illinois University - Edwardsville

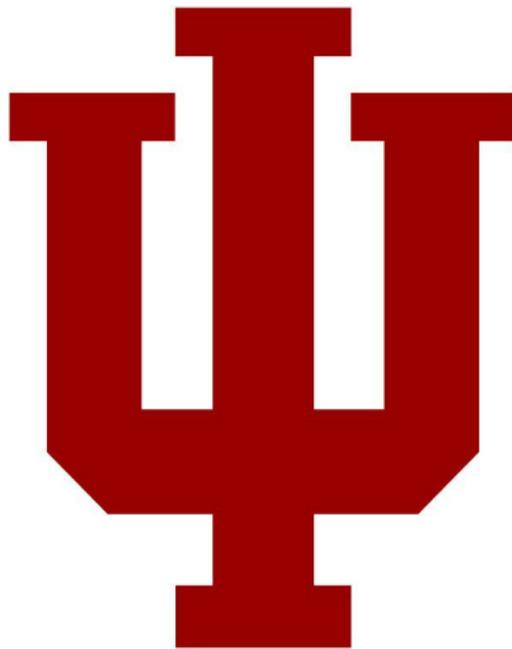
- Began using Inclusive Access in Fall of 2014
- Faculty participation has quadrupled since piloting: 8 instructors originally to 38 in 2017
- Students are paying an average of 60% less than if they were to purchase traditional textbooks



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The Advantages

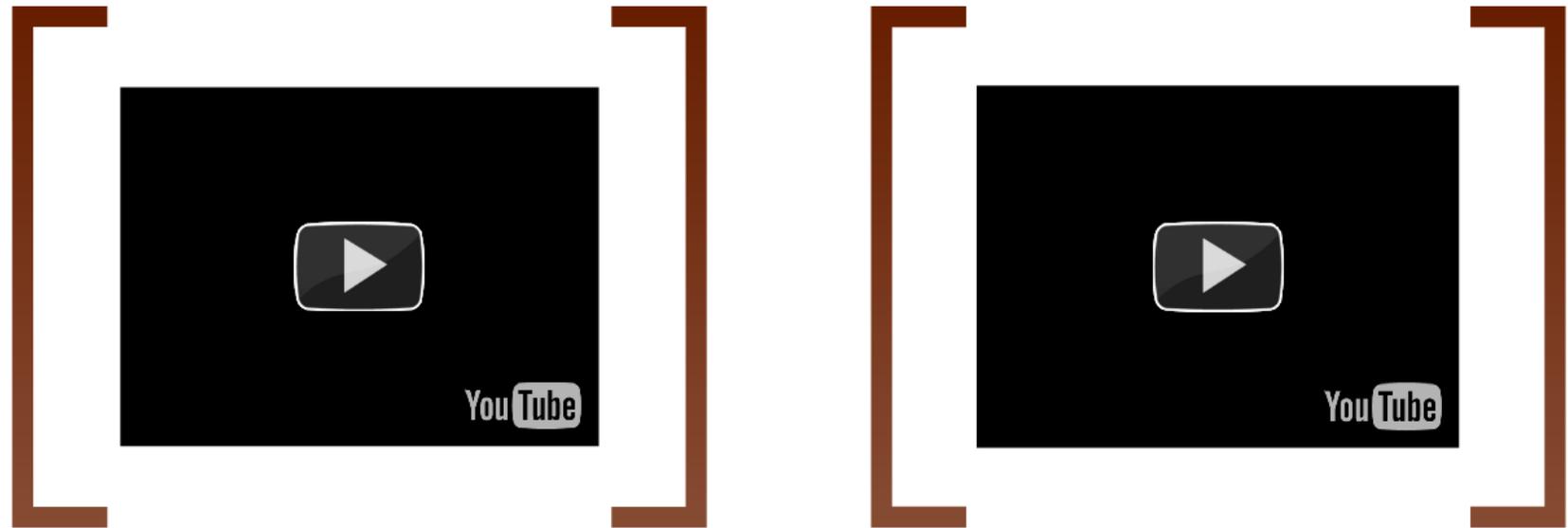
Student Benefits

- Students can save 40% to 74% off the new (print) price of textbooks
- ADA and Section 508 compliance for accessibility
- Navigation, tools, and reading environment are optimized to focus on student needs
- Study tools promote interaction with the content
- Students are able to see with which material they are struggling

Faculty Benefits

- Increased student retention, performance, and graduation rates
- Access material before classes start; instant access to desk copies
- Single sign-on through LMS; automated course roster exchange
- Metrics on students' usage and identification of at-risk students

Check It Out for Yourself





You Tube



You Tube

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Availability

- 400+ publishers
- More than 5000 textbooks immediately accessible
- 87% of Montana Tech's 2017 fall course list available as inclusive access
- All major eLearning tools ready to integrate
- Easy to use
- Turn-key

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Prospective Timeline

Fall 2018

Pilot Program:

- 12-15 Freshman Level Courses

Fall 2020

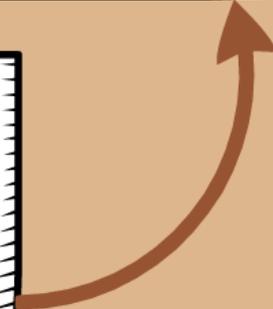
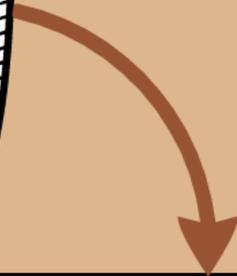
- 65% of All Montana Tech Courses Offered as Inclusive Access

Fall 2019

- 75% Freshman Level Courses Offered as Inclusive Access

Fall 2021

- 80+% of All Montana Tech Courses Offered as Inclusive Access



Montana Tech
Advantage