

# University Honors and Scholars Program

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## University Honors & Scholars Programs

University Honors and Scholars Programs (UHSP) cultivate a signature student experience beyond the traditional boundaries of the classroom and across learning communities. UHSP's mission is to offer curricular and co-curricular honors and scholars experiences for students seeking opportunities to shape a distinctive undergraduate pathway that will challenge them, help them grow, build connections, and develop adaptability beyond their technical degrees. UHS programs develop the professional and interpersonal skills engineers and scientists need to succeed in their professions and to make an impact in their various communities. By emboldening interdisciplinary collaboration and experiential learning, UHS programs foster critical thinking, leadership, creativity, and innovation. UHSP opportunities are open to all students and include: interdisciplinary honors pathways, immersive co-curricular scholars activities, distinct hands-on, curricular-based research and mentorship, and STEM-Ed teaching.

UHS Programs:

- Thorson First-Year Honors
- Grandey First-Year Honors
- McBride Honors Program in Public Affairs
- Grand Challenges Scholars Program
- Office of Undergraduate Research
- Teach@Mines
- Nationally Competitive Scholarships

Visit the University Honors and Scholars Programs webpage at <https://honors.mines.edu/>.

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## Thorson First-Year Honors Experience

The Thorson First-Year Honors Experience is a unique and collaborative approach to learning that uses lenses from the humanities to develop students' creativity and critical thinking in the face of complex problems. Thorson students enroll in a two-semester interdisciplinary course sequence called IDEAS – Innovation and Discovery in Engineering, Arts, and Sciences. In IDEAS, students explore design, communication, and ethical problem solving through open-ended projects that connect them with local communities. Working closely with some of the best teachers across the humanities and STEM, students in IDEAS develop a close-knit community that supports rigorous skill development and intellectual discovery.

The IDEAS course sequence fulfills core curriculum requirements for all majors by replacing two required core courses (HASS 100 Nature and Human Values and EDNS 151 Design I).

We believe a world of IDEAS is also a world worth exploring, and Thorson collaborates with the First-Year Semester Abroad Experience to offer an honors experience abroad. Students in the "Thorson-abroad" cohort take a hybrid-online version of IDEAS during fall semester, with course content that pushes them to explore and understand their study abroad location in greater depths. For Thorson students at Mines, each

year we offer new and different opportunities for exploration within and beyond the course. Co-curricular components of the program include local field trips, community events, and opportunities for education outside the classroom. Thorson and Grandey First-Year Honors collaborate to run a spring break trip each year for a tailored educational travel experience. Through all of these curricular and co-curricular experiences and interactions, learning extends beyond the classroom into the lasting friendships that students develop over the course of their first year.

**Courses:**

### **HNRS105. INNOVATION AND DISCOVERY IN ENGINEERING, ARTS, AND SCIENCES I. 3 Semester Hrs.**

(I) (WI) "Innovation and Discovery in Engineering, Arts, and Sciences" (IDEAS) applies honors pedagogies in a multidisciplinary, integrated environment that highlights the seamless boundaries between science and engineering, design, ethics, and the arts as a path toward making value-informed design decisions. In addition to developing foundational skills in engineering design and problem-solving, students examine place, identity, and community in various contexts as they learn what it means to be an engaged and mindful citizen and professional. IDEAS poses ethical problems and hands-on design challenges from a multitude of lenses. It incorporates experiential learning, team-based projects, and seminar discussions to encourage students to think both critically and creatively about their world. In order to move on to HNRS 115, HNRS 105 must be completed with a C- or better. Students must pass both HNRS 105 and HNRS 115 to meet degree requirements. If students drop either of these courses, they must take both HASS 100 and EDNS 151 or their equivalents in order to graduate. 2 hours studio; 1 hour seminar; 3 semester hours.

Course Learning Outcomes:

- Evaluate the roles of self, place, and community in ethical design innovation using multiple research modes.
- Analyze interconnected systems of communities through geographical, temporal, ethical, environmental, societal, and cultural lenses.
- Integrate written, visual, and oral communication techniques for different rhetorical purposes and situations.
- Develop innovative and thoughtful design solutions using principles, mindsets, and processes of engineering, sciences, design, and the arts.
- Apply professional techniques of team membership and project management in order to promote individual and team wellness.
- Reflect on educational and personal experiences to make meaning, discover connections, and identify opportunities for future growth.

### **HNRS115. INNOVATION AND DISCOVERY IN ENGINEERING, ARTS, AND SCIENCES II. 4 Semester Hrs.**

(II) (WI) "Innovation and Discovery in Engineering, Arts, and Sciences" (IDEAS) applies honors pedagogies in a multidisciplinary, integrated environment that highlights the seamless boundaries between science and engineering, design, ethics, and the arts as a path toward making value-informed design decisions. The second semester of IDEAS

expands on content and skills from HNRS 105 to pose problems of greater complexity and scope. Students must pass both HNRS 105 and HNRS 115 to meet degree requirements. If students drop either of these courses, they must take both HASS 100 and EDNS 151 or their equivalents in order to graduate. Prerequisites: HNRS 105. 3 hours studio; 1 hour seminar; 4 semester hours.

Course Learning Outcomes:

- Evaluate the roles of self, place, and community in ethical design innovation using multiple research modes.
- Analyze interconnected systems of communities through geographical, temporal, ethical, environmental, societal, and cultural lenses.
- Integrate written, visual, and oral communication techniques for different rhetorical purposes and situations.
- Develop innovative and thoughtful design solutions using principles, mindsets, and processes of engineering, sciences, design, and the arts.
- Apply professional techniques of team membership and project management in order to promote individual and team wellness.
- Reflect on educational and personal experiences to make meaning, discover connections, and identify opportunities for future growth

Visit the First-Year Honors website: [firstyearhonors.mines.edu](http://firstyearhonors.mines.edu)

### Grandey First-Year Honors

The Grandey First-Year Honors is a unique, collaborative, and interdisciplinary way to start building your capabilities to address the world's complex challenges through design, leadership, communication, ethics, and systems thinking. Curriculum for Grandey First-Year Honors focuses on helping you develop the creativity and capabilities to lead and design through a two-semester course sequence called Leadership by Design. Learning is centered on open-ended projects in which you choose your approach. Students experience a combination of experiential learning, interdisciplinary projects, seminar discussions, guest speakers, and design sprints. Coursework enables students to learn how to design for people and find their own way to lead, build communication abilities, ask better questions, develop professional skills, and cultivate creative mindsets.

The Leadership by Design course sequence is taught by interdisciplinary faculty teams, with core faculty members from University Honors & Scholars, and guests rotating in from departments all over campus. The sequence fulfills core curriculum requirements for all majors by replacing two required core courses (HASS 100 – Nature and Human Values; and EDNS 151 – Cornerstone Design I).

We believe that exploring the world beyond the classroom can be an effective and impactful way to learn and to develop your leadership, design, communication and systems-thinking skills. Therefore, Grandey collaborates with the First-Year Semester Abroad Experience to offer an honors experience abroad. Students in the “Grandey-abroad” cohort take a hybrid-online version of Leadership by Design during the spring semester, with course content that allows them to also explore and better understand their study abroad location. For Grandey students at

Mines, each year we offer new and different opportunities for exploration within and beyond the course. Co-curricular components of the program include local field trips, community events, leadership workshops, and opportunities for education outside the classroom. Grandey and Thorson First-Year Honors collaborate to run a spring break trip each year for a tailored educational travel experience. Through these curricular and co-curricular experiences and interactions, learning extends beyond the classroom and leads to lasting friendships that students develop over the course of their first year.

Visit the First-Year Honors website: [firstyearhonors.mines.edu](http://firstyearhonors.mines.edu)

Courses:

**HNRS 110. LEADERSHIP BY DESIGN I (I) (WI)** In the first of two semesters of this honors experience, students participate in an interdisciplinary, collaborative environment that blends design, leadership, communication, systems-thinking, and ethics in order to build the capabilities needed to lead and design as we address complex socio-technical challenges. Students will experience a combination of experiential learning, projects, seminar discussions, guest speakers, and design sprints as they spend time gaining foundational knowledge learning how to lead themselves through a project; crafting and building an object; thinking in systems; considering how design affects society; designing ways to communicate in multiple modes for multiple audiences; and discovering multiple perspectives.

In order to move on to HNRS 120, HNRS 110 must be completed with a C- or better. If students drop either HNRS 110 or HNRS 120, they must take both HASS 100 and EDNS 151 or their equivalents in order to graduate. 2 hours studio; 1 hour seminar; 3 semester hours. Students must pass both HNRS 110 and HNRS 120 to meet degree requirements.

Outcomes:

- Use design and leadership techniques, tools, methods, and principles to work, plan, create, reflect, and collaborate.
- Create and Deliver “Effective” Storytelling (through writing, CAD, tech drawing, modeling, “maps,” etc.)
- Gain agency and efficacy as a leader, thinker, and designer through finding connections between and within sociotechnical systems, and understanding the interplay of values and ethics.
- Cultivate perspectives in design and leadership through reading, watching, listening, observing, interviewing, research, small group communication, and reflective practices.
- Foster creativity and curiosity and build design and leadership skills by engaging in open-ended projects.
- Apply techniques of team membership and project management to promote “team health,” and to practice professional ways of designing and leading.

**HNRS 120 – LEADERSHIP BY DESIGN II (I) (WI)** In the second of two semesters of this honors experience, students participate in an interdisciplinary, collaborative environment that blends leadership, design, communication, systems-thinking, and ethics in order to build the capabilities needed to lead and design as we address

socio-technical challenges. Students experience a combination of experiential learning, projects, seminar discussions, guest speakers, and design sprints. Students build on what they learn in HNRS 110 as they consider designing and leading for the future. Students design ways to share the “wicked stories” of complex challenges, and practice leading through design as they communicate their visions of the future through objects. They also create a portfolio to document their experience to best tell the story of their year in Leadership by Design.

Students must pass both HNRS110 and HNRS120 to meet degree requirements. 3 hours studio; 1 hour seminar; 4 semester hours.

Prerequisite: C- or better in HNRS110.

Outcomes:

- Use design and leadership techniques, tools, methods, and principles to work, plan, create, reflect, and collaborate.
- Create and Deliver “Effective” Storytelling (through writing, CAD, tech drawing, modeling, “maps,” etc.)
- Gain agency and efficacy as a leader, thinker, and designer through finding connections between and within sociotechnical systems, and understanding the interplay of values and ethics.
- Cultivate perspectives [in design and leadership] through reading, watching, listening, observing, interviewing, research, small group communication, and reflective practices.
- Foster creativity and curiosity and build design and leadership skills by engaging in open-ended projects.
- Apply techniques of team membership and project management to promote “team health,” and to practice professional ways of designing and leading.

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## Guy T. McBride, Jr. Honors Program in Public Affairs

The McBride Honors Program in Public Affairs offers a 21-credit minor consisting of seminars, courses, and co-curricular activities that provide a select number of students the opportunity to cross the boundaries of their technical expertise into the ethical, cultural, socio-political, and environmental dimensions of human life. Students will develop their skills in communication, critical thinking, and leadership through seminar-style classes that explore diverse aspects of the human experience. The seminars are designed to offer coherent perspectives across the curriculum, allowing for a maximum degree of discussion and debate on complex topics. Themes, approaches, and perspectives from the humanities and the social sciences are integrated with science and engineering perspectives to develop in students habits of thought necessary for a comprehensive understanding of societal and cultural issues that enhance critical thinking, social responsibility, and enlightened leadership.

Please see the Guy T. McBride, Jr. Honors Program in Interdisciplinary Minors for more details about this program.

Visit the McBride webpage at <https://mcbride.mines.edu/>.

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## Grand Challenges Scholars Program

The Grand Challenges Scholars Program (GCSP) prepares students to be world changers and impact makers. The GCSP offers a way to combine coursework, extracurricular activities, and experiences that prepare you to address complex socio-technical issues, such as the National Academy of Engineering (NAE) Grand Challenges and the United Nations Sustainable Development Goals, while receiving certification from the NAE and a scholars designation at graduation. As a scholar, you will have the chance to choose your own pathways to gain skills in interdisciplinary thinking, applying engineering and science in the service of entrepreneurship and innovation, and addressing problems through design, research, and creativity.

Visit the Grand Challenge Scholars Program webpage at <https://grandchallenges.mines.edu/>.

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## Office of Undergraduate Research

Office of Undergraduate Research (OUR) is a valuable resource for all undergraduate students interested in engaging in a research opportunity. OUR assists students in all the stages of the research life cycle—from identifying research projects to helping students share their work. A few focus areas of OUR include:

### Providing enhanced funding opportunities for undergraduate students:

OUR awards funding to undergraduate students through three signature programs: FIRST, MURF, and SURF. These opportunities are open to students of all disciplines. First-year Innovation and Research Scholar Training (FIRST) is designed to recruit incoming first-year students and transfer students to participate in research and support them throughout the first and second semesters on campus. FIRST scholars enroll in the 1-credit course HNRS 150: Entering Research in the fall semester. In this course, students will be introduced to various skills needed to be successful when conducting research. These skills include best practices to finding a research mentor, the roles and responsibilities of a researcher, developing relationships that make for a successful research experience, how to critically read and analyze scientific literature, lab safety, and disseminating research work. FIRST applications open in June, and students can apply through the undergraduate research website.

Mines Undergraduate Research Fellowship (MURF) provides an opportunity for any undergraduate student to work on a research project proposed by a faculty mentor during the fall and spring semesters. Applications open in April, and students can apply through the undergraduate research website.

Summer Undergraduate Research Fellowship (SURF) program at Mines seeks to provide funding for current Mines undergraduate students to participate in concentrated, full-time research under the mentorship of the Mines faculty during the summer semester.

In Vertically Integrated Projects for Experiential Research (VIPER), teams of undergraduate students from various years, disciplines, and backgrounds work with faculty and graduate students on their efforts in scholarship and exploration. The teams are multidisciplinary –

drawing students from the disciplines needed by each project; vertically integrated – maintaining a mix of undergraduate from different cohorts. Students can enroll in VIPER teams and earn academic credit for their engagement. The credit structure of VIPER is designed to allow students to participate for multiple semesters.

#### **Promoting and recognizing undergraduate research campus-wide:**

OUR helps showcase and celebrate undergraduate research by providing a platform for students to disseminate their research at the annual Undergraduate Research Symposium held on the Mines campus and the Mines Undergraduate Research Journal, Reuleaux.

#### **Providing professional development and networking opportunities for undergraduate researchers:**

OUR offers bi-weekly seminars on topics of interest to undergraduate researchers through the Emerging Scholar Seminar Series. In addition, undergraduate students with two or more semesters of research experience can apply to be an Undergraduate Research Ambassador and help guide other students interested in research.

Visit the Office of Undergraduate Research webpage at <https://mines.edu/undergraduate-research/>.

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## **Teach@Mines**

Teach@Mines offers courses, a Teaching Minor, a non-thesis masters of science in STEM education, advising, and information on certification pathways to help you explore and learn more about the teaching profession.

Teach@Mines is tailored specifically to the needs of Mines students and alumni, with nontraditional pathways toward licensure.

We offer curriculum and field experiences for students to both try out teaching and to prepare to teach (K-12 or college). A person can start on this path at any point in their Mines career as an undergraduate, graduate student, or as a Mines alumni. The earlier you begin, the more flexibility you have.

Please see the Teach@Mines Interdisciplinary Minor for more details about this program.

Visit the Teach@Mines webpage at <https://mines.edu/teacherprep/>.

#### **HNRS105. INNOVATION AND DISCOVERY IN ENGINEERING, ARTS, AND SCIENCES I. 3.0 Semester Hrs.**

(I) (WI) "Innovation and Discovery in Engineering, Arts, and Sciences" (IDEAS) applies honors pedagogies in a multidisciplinary, integrated environment that highlights the seamless boundaries between science and engineering, design, ethics, and the arts as a path toward making value-informed technical decisions. In addition to developing foundational skills in engineering design and problem-solving, students examine place, identity, citizenship, and community in various contexts as they learn what it means to be an engaged and mindful citizen and professional. IDEAS poses ethical problems and hands-on design challenges from a multitude of lenses. It incorporates experiential learning, team-based projects, and seminar discussions to encourage students to think both critically and creatively about their world. Students must pass both HNRS105 and HNRS 115 to meet degree requirements. If students drop either of these courses, they must take both HASS100 and EDNS151 or their equivalents in order to graduate.

#### **Course Learning Outcomes**

- Identify design problems that respond to needs of place, identity, citizen, and community.
- Recognize and utilize multiple perspectives in the problem-definition process.
- Analyze self and community through multidisciplinary techniques.
- Evaluate a place using ethical, environmental, societal, and cultural lenses.
- Utilize observational and ethnographic research methods.
- Engage in design charrettes, writing projects, and rapid prototyping activities that demonstrate user empathy, values-sensitive design, creativity, synthesis, and/or reflection.
- Give and receive feedback during peer review and portfolio development.
- Increase ethical sensitivity and add to ethical judgment.
- Visually communicate ideas through hand sketching.
- Use written, oral, and graphic communication as a means to discover and reconsider ideas through a process of drafting, collaborating, revising, and editing.

#### **HNRS110. LEADERSHIP BY DESIGN I. 3.0 Semester Hrs.**

In the first of two semesters of this honors experience, students participate in a multidisciplinary, integrated, collaborative environment that blends leadership, design, communication, innovation, and ethics in order to build the capabilities needed to lead and address grand challenges. Students will experience a combination of experiential learning, projects, seminar discussions, guest speakers, and design sprints as they spend time gaining foundational knowledge, learning how to think in systems, analyzing grand challenges, communicating "the story" in multiple ways to various audiences, and designing documents, presentations, objects, and exhibitions. Also, students will begin to develop their portfolio to document the story of their time in Leadership by Design. Students must pass both HNRS110 and HNRS120 to meet degree requirements.

#### **Course Learning Outcomes**

- Develop your Capabilities and Mindsets through these 10 C's, so that you Grow as a leader, communicator, thinker, designer, maker, innovator, and collaborator

#### **HNRS115. INNOVATION AND DISCOVERY IN ENGINEERING, ARTS, AND SCIENCES II. 4.0 Semester Hrs.**

(WI) "Innovation and Discovery in Engineering, Arts, and Sciences" (IDEAS) applies honors pedagogies in a multidisciplinary, integrated environment that highlights the seamless boundaries between science and engineering, design, ethics, and the arts as a path toward making value-informed technical decisions. Students examine place, identity, citizenship, and community in various contexts as they learn what it means to be an engaged and mindful citizen and professional. IDEAS poses ethical problems and hands-on design challenges from a multitude of lenses. It incorporates experiential learning, team-based projects, and seminar discussions to encourage students to think both critically and creatively about their world. Students must pass both HNRS105 and HNRS115 to meet degree requirements. If students drop either of these courses, they must take both HASS100 and EDNS151 or their equivalents in order to graduate. Prerequisite: HNRS105 with a grade of C- or higher.

#### **Course Learning Outcomes**

- Model and communicate formalized design ideas through the use of standardized engineering graphics conventions and computer-aided design/solid modeling software.
- Apply the professional techniques of leadership and team membership in the context of project management.
- Research and analyze an engineered or natural system through multidisciplinary techniques.
- Analyze and evaluate the needs, values, and perspectives of human and non-human stakeholders.
- Design solutions through an iterative testing, refining, and feedback process based on bibliographic research, analysis of technical requirements, environmental risks, user empathy, and stakeholder engagement.
- Develop written and oral arguments that meet the needs of varying rhetorical situations.
- Recognize the need for engineering solutions that are responsive to a multicultural and globalized world.
- Apply ethical reasoning in support of an engineering design solution.

#### **HNRS120. LEADERSHIP BY DESIGN II. 3.0 Semester Hrs.**

In the second of two semesters of this honors experience, students participate in a multidisciplinary, integrated, collaborative environment that blends leadership, design, communication, innovation, and ethics in order to build the capabilities needed to lead and address grand challenges. Students will experience a combination of experiential learning, projects, seminar discussions, professional development workshops, guest speakers, and design sprints. Students build on the first semester as they build leadership skills and work to be better designers, creators, thinkers, innovators, and communicators. They will address the questions "What is good design?" "What is good leadership?" "What is innovation?" and "How do I best tell the story?" Students design documents, presentations, and objects. They investigate ways to create impact and value as they define problems, pose solutions for grand challenges, and create a portfolio to document their experience to best tell the story of their time in Leadership by Design. Students must pass both HNRS110 and HNRS120 to meet degree requirements. Prerequisite: HNRS110 with a grade of C- or better.

#### **Course Learning Outcomes**

- Develop your Capabilities and Mindsets through these 10 C's, so that you Grow as a leader, communicator, thinker, designer, maker, innovator, and collaborator

#### **HNRS150. ENTERING RESEARCH. 1.0 Semester Hr.**

In this course, students will be introduced to various skills needed to be successful when conducting research. These skills include best practices to finding a research mentor, the roles and responsibilities of a researcher, developing relationships that make for a successful research experience, how to critically read and analyze scientific literature, lab safety, and disseminating research work.

#### **Course Learning Outcomes**

- Student Learning Outcomes

#### **HNRS155. VERTICALLY INTEGRATED PROJECTS FOR EXPERIENTIAL RESEARCH. 1-3 Semester Hr.**

The Vertically Integrated Projects for Experiential Research (VIPER) courses are designed to allow select students to participate in ongoing research, innovation, design, and entrepreneurial projects within student teams, under the direction of faculty from within Colorado School of Mines. These courses are open to students from the first to senior

years, and students must apply to engage in a specific project in a given semester. Decisions on acceptance will be made by the faculty advisors for the project, in consultation with the Co-Directors of the VIPER Program. Students must commit to at least three semesters of participation. Students should check with their departments regarding the counting of VIP credits towards their degree program.

#### **Course Learning Outcomes**

- Work on and make substantial contributions to a significant team research project
- Apply methods of engineering research and carrying such research out to fruition.
- Learn and practice professional skills.
- Experience different roles on a large, multidisciplinary team.
- Keep a project notebook and document activities and progress.
- Contribute to team activities and rely on other team members for effective collaboration.
- Students will learn to support others' work, generate and follow-up ideas, and simulate and construct prototypes.

#### **HNRS198. SPECIAL TOPICS. 0-6 Semester Hr.**

Equivalent with HASS100,

A Special Topics course will be a pilot course in the UHSP curriculum or will be offered as an enhancement to regularly-scheduled UHSP seminars. Special Topics courses in the UHSP curriculum will not be offered more than twice. Variable credit: 1 - 6 semester hours. Repeatable for credit under different titles.

#### **HNRS198. SPECIAL TOPICS. 1-6 Semester Hr.**

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#### **HNRS199. INDEPENDENT STUDY. 1-6 Semester Hr.**

Under special circumstances, a UHSP student may use this course number to register for an independent study project which substitutes for or enhances the regularly-scheduled UHSP curriculum seminars. Variable credit: 1 - 6 semester hours. Repeatable for credit.

#### **HNRS255. VERTICALLY INTEGRATED PROJECTS FOR EXPERIENTIAL RESEARCH. 1-3 Semester Hr.**

The Vertically Integrated Projects for Experiential Research (VIPER) courses are designed to allow select students to participate in ongoing research, innovation, design, and entrepreneurial projects within student teams, under the direction of faculty from within Colorado School of Mines. These courses are open to students from the first to senior years, and students must apply to engage in a specific project in a given semester. Decisions on acceptance will be made by the faculty advisors for the project, in consultation with the Co-Directors of the VIPER Program. Students must commit to at least three semesters of participation. Students should check with their departments regarding the counting of VIP credits towards their degree program.

#### **Course Learning Outcomes**

- Work on and make substantial contributions to a significant
- Apply methods of engineering research and carrying such research out to fruition.
- Learn and practice professional skills
- Experience different roles on a large, multidisciplinary team.
- Keep a project notebook and document activities and progress.
- Contribute to team activities and rely on other team members for effective collaboration.

- Students will learn to support others' work, generate and follow-up ideas, and simulate and construct prototypes.

**HNRS298. SPECIAL TOPICS. 1-6 Semester Hr.**

A Special Topics course will be a pilot course in the UHSP curriculum or will be offered as an enhancement to regularly-scheduled UHSP seminars. Special Topics courses in the UHSP curriculum will not be offered more than twice. Variable credit: 1 - 6 semester hours. Repeatable for credit under different titles.

**HNRS299. INDEPENDENT STUDY. 1-6 Semester Hr.**

Under special circumstances, a UHSP student may use this course number to register for an independent study project which substitutes for or enhances the regularly-scheduled UHSP curriculum seminars. Variable credit: 1 - 6 semester hours. Repeatable for credit.

**HNRS305. EXPLORATIONS IN MODERN AMERICA. 3.0 Semester Hrs.**

(WI) Honors core course that develops student skills in reading, writing, critical thinking, and oral communication. skills through the exploration of selected topics related to the social, cultural, and political ideas and events that have shaped the development of the modern United States and its role in the world. 3 lecture hours, 3 credit hours. Prerequisite: HASS100 or HNRS105, HNRS115 or HNRS110, HNRS120 or HNRS198A.

**HNRS315. EXPLORATIONS IN THE MODERN WORLD. 3.0 Semester Hrs.**

(WI) Honors core course that develops student writing skills and critical thinking abilities through the exploration of selected topics related to the social, cultural, and political ideas and developments that have shaped the modern world. 3 lecture hours, 3 credit hours. Prerequisite: HASS100 or HNRS105, HNRS115 or HNRS110, HNRS120 or HNRS198A.

**HNRS355. VERTICALLY INTEGRATED PROJECTS FOR EXPERIENTIAL RESEARCH. 1-3 Semester Hr.**

The Vertically Integrated Projects for Experiential Research (VIPER) courses are designed to allow select students to participate in ongoing research, innovation, design, and entrepreneurial projects within student teams, under the direction of faculty from within Colorado School of Mines. These courses are open to students from the first to senior years, and students must apply to engage in a specific project in a given semester. Decisions on acceptance will be made by the faculty advisors for the project, in consultation with the Co-Directors of the VIPER Program. Students must commit to at least three semesters of participation. Students should check with their departments regarding the counting of VIP credits towards their degree program.

**Course Learning Outcomes**

- Work on and make substantial contributions to a significant team research project.
- Apply methods of engineering research and carrying such research out to fruition.
- Learn and practice professional skills.
- Experience different roles on a large, multidisciplinary team.
- Keep a project notebook and document activities and progress.
- Contribute to team activities and rely on other team members for effective collaboration.
- Students will learn to support others' work, generate and follow-up ideas, and simulate and construct prototypes.

**HNRS398. SPECIAL TOPICS IN THE UNIVERSITY HONORS AND SCHOLARS PROGRAM. 1-6 Semester Hr.**

A Special Topics course will be a pilot course in the University Honors & Scholars Programs curriculum or will be offered as an enhancement to regularly-scheduled UHSP seminars. Special Topics courses in the UHSP curriculum will not be offered more than twice.

**HNRS399. INDEPENDENT STUDY. 1-6 Semester Hr.**

Under special circumstances, a UHSP student may use this course number to register for an independent study project which substitutes for or enhances the regularly-scheduled UHSP curriculum seminars. Variable credit: 1 - 6 semester hours. Repeatable for credit.

**HNRS405. MCBRIDE PRACTICUM. 1-3 Semester Hr.**

(I, II) (WI) With approval of the Program, a McBride student may enroll in an individualized study project which substitutes for or enhances the regularly-scheduled McBride curriculum seminars. This option may be used to pursue an approved foreign study program, service learning program, international internship, undergraduate research project, or other authorized experiential learning program of study. Students must also prepare a faculty-guided major research paper that integrates the experience with the goals, objectives, and focus of the Honors Program in Public Affairs. 1-3 semester hours. Repeatable up to 6 hours.

**HNRS425. EXPLORATIONS IN POLITICS, POLICY, AND LEADERSHIP. 3.0 Semester Hrs.**

(WI) Study of selected topics related to policy, politics, and/or leadership through case studies, readings, research, and writing. Prerequisites: HNRS305: Explorations in Modern America and HNRS315: Explorations in The Modern World. Repeatable for credit up to a maximum of 6 hours. 3 lecture hours, 3 credit hours.

**HNRS430. EXPLORATIONS IN IDEAS, ETHICS, AND RELIGION. 3.0 Semester Hrs.**

(WI) Study of selected topics related to ideas, ethics, and/or religion through case studies, readings, research, and writing. Prerequisites: HNRS305: Explorations in Modern America and HNRS315: Explorations in the Modern World. Repeatable for credit up to a maximum of 6 hours. 3 lecture hours, 3 credit hours.

**HNRS435. EXPLORATIONS IN CULTURE, SOCIETY, AND CREATIVE ARTS. 3.0 Semester Hrs.**

(WI) Study of selected topics related to culture, society, and/or the creative arts through case studies, readings, research, and writing. Prerequisites: HNRS305: Explorations in Modern America and HNRS315: Explorations in the Modern World. Repeatable for credit up to a maximum of 6 hours. 3 lecture hours, 3 credit hours.

**HNRS440. EXPLORATIONS IN INTERNATIONAL STUDIES & GLOBAL AFFAIRS. 3.0 Semester Hrs.**

(WI) Study of selected topics related to international studies and/or global affairs through case studies, readings, research, and writing. Prerequisites: HNRS305: Explorations in Modern America and HNRS315: Explorations in the Modern World. Repeatable for credit up to a maximum of 6 hours. 3 lecture hours, 3 credit hours.

**HNRS445. EXPLORATIONS IN SCIENCE, TECHNOLOGY, AND SOCIETY. 3.0 Semester Hrs.**

(WI) Study of selected topics related to the relationships between science, technology, and society through case studies, readings, research, and writing. Prerequisites: HNRS305: Explorations in Modern America and HNRS315: Explorations in the Modern World. Repeatable for credit up to a maximum of 6 hours. 3 lecture hours, 3 credit hours.

**HNRS450. EXPLORATIONS IN EARTH, ENERGY, AND ENVIRONMENT. 3.0 Semester Hrs.**

(WI) Study of selected topics related to earth, energy, and/or the environment through case studies, readings, research, and writing. This course may focus on the human dimensions or broader impacts of science, technology, engineering, or mathematics. Prerequisites: HNRS305: Explorations in Modern America and HNRS315: Explorations in the Modern World. Repeatable for credit up to a maximum of 6 hours. 3 lecture hours, 3 credit hours.

**HNRS455. VERTICALLY INTEGRATED PROJECTS FOR EXPERIENTIAL RESEARCH. 1-3 Semester Hr.**

The Vertically Integrated Projects for Experiential Research (VIPER) courses are designed to allow select students to participate in ongoing research, innovation, design, and entrepreneurial projects within student teams, under the direction of faculty from within Colorado School of Mines. These courses are open to students from the first to senior years, and students must apply to engage in a specific project in a given semester. Decisions on acceptance will be made by the faculty advisors for the project, in consultation with the Co-Directors of the VIPER Program. Students must commit to at least three semesters of participation. Students should check with their departments regarding the counting of VIP credits towards their degree program.

**Course Learning Outcomes**

- Work on and make substantial contributions to a significant team research project.
- Apply methods of engineering research and carrying such research out to fruition.
- Learn and practice professional skills.
- Experience different roles on a large, multidisciplinary team.
- Keep a project notebook and document activities and progress.
- Contribute to team activities and rely on other team members for effective collaboration.
- Students will learn to support others' work, generate and follow-up ideas, and simulate and construct prototypes.

**HNRS476. COMMUNITY ENGAGEMENT THROUGH SERVICE LEARNING. 3.0 Semester Hrs.**

(II) Community Engagement through Service Learning combines a traditional classroom environment with an off campus learning experience with a local non-profit or community organization. Students spend 3-4 hours per week serving the organization they choose and meet in class once per week to discuss reading assignments, present research findings, and share experiences and insights about the course material. Instructors may choose to focus on a particular topic or social issue, such as poverty and privilege, or may engage with community issues more broadly. The course focuses on several aspects of a student's learning, including intra- and interpersonal learning, discovering community, and developing communication skills and critical and interdisciplinary approaches. Course work will focus on critical reading, group discussion and deliberation, oral presentations of research, and writing assignments. Prerequisites: none. 2 hours lecture; 3-4 hours lab; 3.0 semester hours.

**HNRS496. PAYNE SCHOLARS PROGRAM. 1.0 Semester Hr.**

Mines graduates often go on to become corporate leaders and are responsible for many of the innovations and changes seen across industries. In much the same way, the research done at Mines has far reaching implications for many of the social, economic, and environmental challenges faced around the world. To develop these relationships, and to prepare students for future roles, the Payne Institute partnered with students to develop a public policy community that uses all

the School of Mines' resources to be both physical and social engineers of the world around them. One of the most prominent ways we do this is through the Payne Scholars program. This one-credit course helps students perform research, collaborate across campus, and engage with a broad network of international experts on global policy challenges. Students are taught how to write academic papers on the important issues we are facing today, and once the students finish the course, the papers they write can be published as Payne Commentaries on our website. We often sponsor students for internships, or offer student worker positions to continue their work. This often means that they get to be co-authors on peer-reviewed academic papers or help us build world-shaping policy.

**HNRS497. SUMMER COURSE. 0-6 Semester Hr.****HNRS497. SUMMER COURSE. 0-6 Semester Hr.****HNRS498. SPECIAL TOPICS IN THE MCBRIDE HONORS PROGRAM IN PUBLIC AFFAIRS. 1-6 Semester Hr.**

A Special Topics course will be a pilot course in the McBride curriculum or will be offered as an enhancement to regularly-scheduled McBride seminars. Special Topics courses in the McBride curriculum will not be offered more than twice. Variable credit: 1 - 6 semester hours. Repeatable for credit under different titles.

**HNRS498. SPECIAL TOPICS. 1-6 Semester Hr.****HNRS498. SPECIAL TOPICS. 1-6 Semester Hr.****HNRS498. SPECIAL TOPICS. 1-6 Semester Hr.****HNRS498. SPECIAL TOPICS. 1-6 Semester Hr.****HNRS499. INDEPENDENT STUDY. 1-6 Semester Hr.**

Under special circumstances, a McBride student may use this course number to register for an independent study project which substitutes for or enhances the regularly-scheduled McBride curriculum seminars. Variable credit: 1 - 6 semester hours. Repeatable for credit.

**Course Learning Outcomes**

- See above

**HNRS499. INDEPENDENT STUDY. 1-6 Semester Hr.****HNRS499. INDEPENDENT STUDY. 1-6 Semester Hr.****MAED262. K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS. 1.0 Semester Hr.**

This course is designed to provide Mines students with opportunities to participate in, analyze, and reflect on issues in a mathematics or computer science K-12 school classroom setting. The overall goal is for Mines students to understand who their students are, build relationships, and begin exploring learner development and learner differences. Specifically, the course will focus on developing Mines students' ability to identify and practice basic classroom management, differentiate instruction, ask probing questions, mathematics or computer science content preconceptions, language/activities that promote a growth

mindset, and professional language. Furthermore, Mines students will begin exploring the factors that shape school norms and culture. In addition to an on-campus seminar, there is a 25-hour field experience requirement in the student's assigned partner school.

#### Course Learning Outcomes

- identify and provide examples of differentiated instruction.
- identify and provide examples of formative-assessment techniques used to evaluate what students are thinking during classroom activities
- articulate the value of reflecting on their practice.
- explain different levels of questioning and how to ask probing questions as well as provide examples of how to use these types of questioning.
- articulate reasons for, ways to, and examples of how they built relationships with each and every student in their classroom.
- articulate and document the mathematics or computer science content specific preconceptions that they observed students demonstrate during the field placement.
- identify the school policies and practices of their field placement.
- identify factors that shaped the culture and norms of the school they experienced.
- communicate effectively, model appropriate use of language (e.g., use of proper grammar, use of professional language, and use of discipline-specific vocabulary), and identify unprofessional language.
- articulate the critical role of high ethical standards, including a belief in being committed to displaying ethical conduct towards students, performance and the profession, colleagues, and parents and the community.
- recognize that with quality instruction and hard work, all students are capable of learning science and mathematics; use language, activities and feedback that is consistent with a growth mindset.

#### MAED405. MATHEMATICAL PRACTICES AND THE SOCIAL CONTEXT OF MATHEMATICS. 3.0 Semester Hrs.

This course provides teacher candidates an opportunity to develop the skills to promote students mathematical identity and their understanding of mathematical practices and processes - mathematics is a community of inquiry-as articulated in the Colorado Academic Standards and Common Core. These skills will be modeled, practiced and mastered in the context of authentic mathematical practices (eg. the formation of the quadratic equation through maximization of orange production). Teacher candidates will engage as learners, reflect as practitioners, and finally develop their own 3-day mini-unit. To promote candidates awareness of the social context of mathematics, candidates will explore the historical development of content and perspectives from diverse cultures. In addition this course will prepare students to be able to communicate effectively in a variety of mediums (written, oral, and digital) as educators about mathematical processes and practices.

#### Course Learning Outcomes

- nurture development of mathematical processes and practices. They anticipate how students' use of mathematical practices will look and sound within specific grade-band mathematical topics, knowing that over years of experience, their knowledge of students' ways of using mathematical practices will expand to more mathematical topics.
- identify, adapt, or develop lessons that explicitly teach mathematical process and practices demonstrating these as tools use to solve problems and communicate ideas.

- demonstrate that doing mathematics is a sense-making activity that promotes perseverance, problem posing, and problem solving.
- provide examples and connections for students to see that mathematics is a human endeavor that is practice in and out of school, across many facets of life.
- integrate the history of mathematics into content and share contributions from people with different gender and cultural, linguistic, religious, and racial/ethnic backgrounds.
- articulate how mathematics is based on constructed conventions and agreements about the meanings of words and symbols, and these conventions vary; algorithms considered as standard in the United States different from algorithms used in other countries.
- cultivate their students' mathematical identity by helping students realize the usefulness of mathematics by providing connections to students' everyday lives and building their students mathematics self-efficacy by encouraging hard work from every student and demonstrating the belief that every student is capable of learning and using mathematics
- identify and implement practices that draw on students' mathematical, cultural, and linguistic resources/strengths and challenge practices grounded in deficit-based thinking.
- select, adapt, or develop lessons that explicitly engage students the mathematical practices defined in the Colorado Academic Standards and Common Core in mathematics.
- identify, adapt, or develop lessons that reflect the interconnectedness of content areas/disciplines to help erase the disciplinary lines and reflect authentic situations.
- create a mini-unit (3 days or more) that explicitly teaches some aspect of mathematical practices or the social context of mathematics.
- clearly articulate their mathematical ideas in writing.
  - o analyze text based on occasion, audience, form and function.
  - o compose one page reflections with an awareness about introductions, conclusions and topic sentences.
  - o articulate the process of and compose with an awareness about the composing process which is an iterative process of formulation, composition and revision.
  - o incorporate and cite correctly all evidence used to support a text's claim/s.
- clearly articulate their mathematical ideas verbally.
  - o delineate effective characteristics of multi-media presentations.
  - o articulate mathematical practices in a way that secondary students can understand and be motivated to explore these practices.
  - o collaborate with others towards giving and receiving feedback on both oral and written work about teaching mathematics as a community of inquiry.

#### MAED425. PRE-ALGEBRA AND ALGEBRA TEACHING TECHNIQUES. 3.0 Semester Hrs.

In this course teacher candidates will be exposed to evidence-based instructional practices to support students learning of pre-algebra and algebra and model meaningful learning opportunities, common misconceptions and ways of thinking, and students learning progressions (i.e., content trajectory). The goal of this course is for teacher candidates is to develop an awareness of 1) the common misconceptions and learning progressions associated with pre-algebra and algebra; 2) students learning progressions in pre-algebra and algebra, and 3) evidence-based and meaningful instructional strategies for pre-algebra and algebra. The teacher candidate analyzes conceptual algebra underpinnings, common misconceptions, and students' ways of thinking to create opportunities to learn.

### Course Learning Outcomes

- plan at least the first month of instruction for a middle or high school pre-algebra or algebra course using standards-based lessons experienced in this course.
- construct and evaluate mathematical conjectures and argument to validate one's own mathematical thinking.
- identify and develop lessons that are designed to build students knowledge as defined in the Colorado Academic Standards in mathematics and literacy. Candidates will be able to
- articulate the scope of the above standards related to the content knowledge necessary for teaching 7-12 students.
- describe mathematical ideas, using every day and mathematical language, in both verbal and written formats.

### MAED464. CAPSTONE CURRICULUM DESIGN I. 3.0 Semester Hrs.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 100-hour field experience requirement in the students assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisite: Completed/concurrent 3 credits of SCED 262; completed/concurrent with MAED 405 or MAED 425. Corequisite: Completed/concurrent 3 credits of SCED 262; completed/concurrent with MAED 405 or MAED 425.

### Course Learning Outcomes

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.

- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.
- reflect on their practice and use this reflection to set goals for further growth.
- write standards-based lesson plans that include measurable learning objectives, applicable Colorado Content Standards, required materials, safety considerations, an outline of the lesson scaffolded with the five E's (engage, explore, explain, elaborate and evaluate) or other learning cycle model, accommodations, formative assessment and subject integration.

### MAED465. CAPSTONE CURRICULUM DESIGN II. 6-12 Semester Hr.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 32-hour per credit hour enrolled field experience requirement in the students assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction for each 3 credit hours enrolled as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisite: Completed MAED 464; completed/concurrent with SCED 333, SCED 363, MAED 405, and MAED 425. Corequisite: Completed/concurrent with SCED 333, SCED 363, MAED 405, and MAED 425.

### Course Learning Outcomes

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations,

asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.

- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics or computer science which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including
  - o appropriate dress,
  - o attendance and professional commitments,
  - o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend),
  - o respectful collaboration (even if do not agree),
  - o professional initiative, and
  - o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.

#### **MAED498. SPECIAL TOPICS. 0-6 Semester Hr.**

#### **MAED505. MATHEMATICAL PRACTICES AND THE SOCIAL CONTEXT OF MATHEMATICS. 3.0 Semester Hrs.**

n/a.

#### **Course Learning Outcomes**

- nurture development of mathematical processes and practices. They anticipate how students' use of mathematical practices will look and sound within specific grade-band mathematical topics, knowing that

over years of experience, their knowledge of students' ways of using mathematical practices will expand to more mathematical topics.

- identify, adapt, or develop lessons that explicitly teach mathematical process and practices demonstrating these as tools use to solve problems and communicate ideas.
- demonstrate that doing mathematics is a sense-making activity that promotes perseverance, problem posing, and problem solving.
- provide examples and connections for students to see that mathematics is a human endeavor that is practice in and out of school, across many facets of life.
- integrate the history of mathematics into content and share contributions from people with different gender and cultural, linguistic, religious, and racial/ethnic backgrounds.
- articulate how mathematics is based on constructed conventions and agreements about the meanings of words and symbols, and these conventions vary; algorithms considered as standard in the United States different from algorithms used in other countries.
- cultivate their students' mathematical identity by helping students realize the usefulness of mathematics by providing connections to students' everyday lives and building their students mathematics self-efficacy by encouraging hard work from every student and demonstrating the belief that every student is capable of learning and using mathematics
- identify and implement practices that draw on students' mathematical, cultural, and linguistic resources/strengths and challenge practices grounded in deficit-based thinking.
- select, adapt, or develop lessons that explicitly engage students the mathematical practices defined in the Colorado Academic Standards and Common Core in mathematics.
- identify, adapt, or develop lessons that reflect the interconnectedness of content areas/disciplines to help erase the disciplinary lines and reflect authentic situations.
- create a mini-unit (3 days or more) that explicitly teaches some aspect of mathematical practices or the social context of mathematics.
- clearly articulate their mathematical ideas in writing.
  - o analyze text based on occasion, audience, form and function.
  - o compose one page reflections with an awareness about introductions, conclusions and topic sentences.
  - o articulate the process of and compose with an awareness about the composing process which is an iterative process of formulation, composition and revision.
  - o incorporate and cite correctly all evidence used to support a text's claim/s.
- clearly articulate their mathematical ideas verbally.
  - o delineate effective characteristics of multi-media presentations.
  - o articulate mathematical practices in a way that secondary students can understand and be motivated to explore these practices.
  - o collaborate with others towards giving and receiving feedback on both oral and written work about teaching mathematics as a community of inquiry.

#### **MAED525. PRE-ALGEBRA AND ALGEBRA TEACHING TECHNIQUES. 3.0 Semester Hrs.**

In this course teacher candidates will be exposed to evidence-based instructional practices to support students' learning of pre-algebra and algebra and model meaningful learning opportunities, common misconceptions and ways of thinking, and students' learning progressions (i.e., content trajectory). The goal of this course is for teacher candidates is to develop an awareness of 1) the common misconceptions and learning progressions associated with pre-algebra and algebra; 2) students learning progressions in pre-algebra and algebra, and 3)

evidence-based and meaningful instructional strategies for pre-algebra and algebra. The teacher candidate analyzes conceptual algebra underpinnings, common misconceptions, and students' ways of thinking to create opportunities to learn.

#### Course Learning Outcomes

- plan at least the first month of instruction for a middle or high school pre-algebra or algebra course using standards-based lessons experienced in this course.
- construct and evaluate mathematical conjectures and argument to validate one's own mathematical thinking.
- identify and develop lessons that are designed to build students knowledge as defined in the Colorado Academic Standards in mathematics and literacy. Candidates will be able to articulate the scope of the above standards related to the content knowledge necessary for teaching 7-12 students.
- describe mathematical ideas, using every day and mathematical language, in both verbal and written formats.

#### MAED562. K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS. 1-3 Semester Hr.

This course is designed to provide Mines students with opportunities to participate in, analyze, and reflect on issues in a mathematics or computer science K-12 school classroom setting. The overall goal is for Mines students to understand who their students are, build relationships, and begin exploring learner development and learner differences. Specifically, the course will focus on developing Mines students' ability to identify and practice basic classroom management, differentiate instruction, ask probing questions, mathematics or computer science content preconceptions, language/activities that promote a growth mindset, and professional language. Furthermore, Mines students will begin exploring the factors that shape school norms and culture. In addition to an on-campus seminar, there is a 25-hour field experience requirement in the student's assigned partner school.

#### Course Learning Outcomes

- identify and provide examples of differentiated instruction.
- identify and provide examples of formative-assessment techniques used to evaluate what students are thinking during classroom activities
- articulate the value of reflecting on their practice.
- explain different levels of questioning and how to ask probing questions as well as provide examples of how to use these types of questioning.
- articulate reasons for, ways to, and examples of how they built relationships with each and every student in their classroom.
- articulate and document the mathematics or computer science content specific preconceptions that they observed students demonstrate during the field placement.
- identify the school policies and practices of their field placement.
- identify factors that shaped the culture and norms of the school they experienced.
- communicate effectively, model appropriate use of language (e.g., use of proper grammar, use of professional language, and use of discipline-specific vocabulary), and identify unprofessional language.
- articulate the critical role of high ethical standards, including a belief in being committed to displaying ethical conduct towards students, performance and the profession, colleagues, and parents and the community.

- recognize that with quality instruction and hard work, all students are capable of learning science and mathematics; use language, activities and feedback that is consistent with a growth mindset.

#### MAED564. CAPSTONE CURRICULUM DESIGN I. 3.0 Semester Hrs.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is an approximately 6 hours per week (100-hours total) field experience requirement in the student's assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection).. Prerequisites: Completed/concurrent 3 credits of SCED 562; completed/concurrent with MAED 505 or MAED 525. Corequisites: Completed/concurrent 3 credits of SCED 562; completed/concurrent with MAED 505 or MAED 525.

#### Course Learning Outcomes

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.

- engage in professional behavior expected of new teachers including
  - o appropriate dress, o attendance and professional commitments,
  - o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.
- reflect on their practice and use this reflection to set goals for further growth.
- write standards-based lesson plans that include measurable learning objectives, applicable Colorado Content Standards, required materials, safety considerations, an outline of the lesson scaffolded with the five E's (engage, explore, explain, elaborate and evaluate) or other learning cycle model, accommodations, formative assessment and subject integration.

#### **MAED565. CAPSTONE CURRICULUM DESIGN II. 6-12 Semester Hr.**

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 2 hours per week (32-hours total) per credit hour enrolled field experience requirement in the student's assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction for each 3 credit hours enrolled as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisites: Completed MAED 564; completed/concurrent with SCED 333, SCED 363, MAED 505, and MAED 425. Corequisites: Completed/concurrent with SCED 333, SCED 363, MAED 505, and MAED 425.

#### **Course Learning Outcomes**

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics or computer science which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including
  - o appropriate dress, o attendance and professional commitments,
  - o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.

#### **MAED598. SPECIAL TOPICS. 0-6 Semester Hr.**

#### **MAED599. INDEPENDENT STUDY. 0.5-6 Semester Hr.**

#### **SCED199. INDEPENDENT STUDY. 1-6 Semester Hr.**

#### **SCED262. K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS. 1-3 Semester Hr.**

This course is designed to provide Mines students with opportunities to participate in, analyze, and reflect on issues in a science K-12 school classroom setting. The overall goal is for Mines students to understand who their students are, build relationships, and begin exploring learner development and learner differences. Specifically, the course will focus on developing Mines students ability to identify and practice basic classroom management, differentiate instruction, ask probing questions, science content preconceptions, language/activities that promote a growth mindset, and professional language. Furthermore, Mines students will begin exploring the factors that shape school norms and culture. In addition to an on-campus seminar, there is a 25-hour field experience requirement in the students assigned partner school.

#### **Course Learning Outcomes**

- identify and provide examples of differentiated instruction.
- identify and provide examples of formative-assessment techniques used to evaluate what students are thinking during classroom activities
- articulate the value of reflecting on their practice.
- explain different levels of questioning and how to ask probing questions as well as provide examples of how to use these types of questioning.
- articulate reasons for, ways to, and examples of how they built relationships with each and every student in their classroom.
- articulate and document the science content specific preconceptions that they observed students demonstrate during the field placement.
- identify the school policies and practices of their field placement.
- identify factors that shaped the culture and norms of the school they experienced.
- communicate effectively, model appropriate use of language (e.g., use of proper grammar, use of professional language, and use of discipline-specific vocabulary), and identify unprofessional language.
- articulate the critical role of high ethical standards, including a belief in being committed to displaying ethical conduct towards students, performance and the profession, colleagues, and parents and the community.
- recognize that with quality instruction and hard work, all students are capable of learning science and mathematics; use language, activities and feedback that is consistent with a growth mindset.

#### **SCED299. INDEPENDENT STUDY. 1-6 Semester Hr.**

#### **SCED333. EDUCATIONAL PSYCHOLOGY AND ASSESSMENT. 3.0 Semester Hrs.**

An explosive growth in research on how people learn has revealed many ways to improve teaching and catalyze learning at all ages. The purpose of this course is to present this new science of learning so that educators can creatively translate the science into exceptional practice. This course covers field-defining learning theories ranging from behaviorism to cognitive psychology to social psychology and some lesser-known theories exceptionally relevant to practice, such as arousal theory. Together the theories, evidence, and strategies can be combined endlessly to create original and effective learning plans and the means to know if they succeed.

#### **Course Learning Outcomes**

- Describe in general what cognitive science has learned about how the brain works related to the topics of conceptual understanding, memory, motivation, expertise, study skills, sense of inclusion, problem solving, collaboration, and discovery.
- Analyze various effective teaching practices in math and the sciences and provide examples of how the above topics in cognitive science inform these practices.
- utilize research based methods of instruction that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, repeatedly alternating solved and unsolved problems, distributed practice, and assessment to boost retention.
- effectively integrate technology into instructional and assessment strategies, as appropriate to science and mathematical education and the learner including but not limited to the use of a variety of resources (e.g., manipulative materials, graphing calculators, everyday hands-on materials, probe ware, and computers).
- Explain the value of embedding disciplinary research into the high school classroom and provide an example in science or math of how this can be done.
- Define data driven instruction, brain plasticity, and individual differences.
- Utilize formative assessment daily to adjust to students' needs as they are teaching and to determine where instruction can be improved next time.
- Utilize pre/post-tests as a form of formative assessment on a unit basis to determine change, learning gains, and effect size by group; Then, use the results to modify their future instruction.
- Use summative assessment to determine student level of mastery
- Provide accurate information about the teaching profession related to salary, benefits, and teacher satisfaction.
- Provide evidence for the nations' science and math teacher shortage and describe some research-based actions that can help change the direction of this trend.
- continuously improve their knowledge and understanding of the ever-changing knowledge base of both content, and science/mathematics pedagogy, including approaches for addressing inequities and inclusion for all students in science and math.

#### **SCED363. DYNAMIC TEACHING: MOTIVATION, CLASSROOM MANAGEMENT, AND DIFFERENTIATION OF INSTRUCTION. 3.0 Semester Hrs.**

Effective teaching is a dynamic process that requires the instructor to motivate, manage, and vary instruction for all learners in the classroom. The purpose of this course is to prepare future educators to be able to motivate students, manage classroom behavior, and differentiate their instruction so that all students can learn. This course will cover the field-defining theories of motivation, classroom management, and differentiation. Additionally, this course will introduce research-based practices that can be used to create learning environments where students are motivated and given the tools to be successful in their individual learning.

#### **Course Learning Outcomes**

- Describe theories of motivation and how classroom practices connect to those theories.
- Describe classroom management theories and how practices connect to those theories.
- Describe how differentiation techniques can be used to assist students with various exceptionalities.
- Create effective lesson plans that differentiate instruction for students in a classroom.
- Evaluate learning environments to recognize effective and ineffective motivation, management, and differentiation techniques in practice.
- cultivate students' scientific/mathematics identify and confidence in learning science/math by connecting their instruction and content to students' background, providing ample opportunities for students to experience and reflect on success in learning science/mathematics content and practices, making their instruction and content relevant to students' lives, and helping students to contextualize the information being taught.
- use classroom management, motivation, and differentiation practices to plan for and set the conditions of an effective learning environment.
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards,

consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).

- demonstrate a commitment to and respect for diversity, while working toward common goals as a community and as a country.

#### **SCED398. SPECIAL TOPICS. 0-6 Semester Hr.**

Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

#### **SCED415. SCIENTIFIC PRACTICES AND ENGINEERING DESIGN AND THE NATURE OF SCIENCE. 3.0 Semester Hrs.**

The goal of this course is to prepare students to integrate knowledge of scientific and engineering practices into their teaching as articulated in the Colorado Academic Standards and the Next Generation Science Standards, including asking questions, defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, obtaining, evaluating and communicating information. These skills will be modeled, practiced and mastered in the context of science, specifically: 1) earthquakes and waves, 2) mitosis, meiosis, and reproduction, 4) periodic table of the elements, 5) energy conservation, and 6) forces in static equilibrium. In addition this course will prepare students to be able to communicate effectively in a variety of mediums (written, oral, and digital) as educators about scientific and engineering practices.

##### **Course Learning Outcomes**

- Engage in appropriate scientific practices and support their students in doing the same.
- Identify, adapt or develop lessons specifically designed to engage students in scientific and engineering practices, including but not limited to, asking questions (for science) and defining problems (for engineering); analyzing and interpreting data; engaging in argument from evidence; constructing explanations (for science) and designing solutions (for engineering); developing and using models; planning and carrying out investigations; obtaining, evaluating, and communicating information; and using mathematics and computational thinking.
  - o compare and contrast "Scientific Practice" with "Engineering Design"
  - o judge a student's abilities to do design practices in an informed way.
  - o describe an engineering design cycle and how to apply it to design challenges
  - o define and provide examples of design criteria and design constraints.
- Effectively instruct students about and model the basic understandings about the nature of science: science as a way of knowing, scientists use a variety of methods, science is based on evidence, science is open to revision, scientists use models, laws, mechanisms, and theories, science assumes order and consistency in natural systems, science is a human endeavor, and science addresses questions about the natural and material world.
  - o articulate how scientific knowledge is acquired in a way that secondary students can comprehend.
  - o describe the practices that brought about at least one major breakthrough in each of the four primary disciplines of science and how this contributed to our modern understanding of science.
  - o analyze differences in the process of scientific discovery as described in the course text.
  - o formulate a generalization and assess the evidence used to support a generalization or scientific theory.
  - o provide examples that demonstrate the necessity for observations and characterization of patterns to understand the invisible.

- Integrate current issues and events related to science, and age-/grade-appropriate controversial topics presented from multiple science perspectives into lessons using an analytical approach without bias.
- Select, adapt, or develop lessons that explicitly engage students in scientific and engineering practices defined by the Colorado Academic Standards in science, and the Next Generation Science Standards (NGSS).
- Identify, adapt or develop lessons that reflect the interconnectedness of content areas/disciplines to help erase the disciplinary lines and reflect authentic situations; for example through cross-cutting concepts defined in NGSS.
- Illustrate the value of a model in understanding composition and in science.
- Create a mini-unit (3 days or more) that explicitly teaches some aspect of scientific or engineering practice.
- Clearly articulate their scientific ideas in writing. Analyze text based on occasion, audience, form and function.
  - o compose one page reflections with an awareness about introductions, conclusions and topic sentences.
  - o articulate the process of and compose with an awareness about the composing process which is an iterative process of formulation, composition and revision.
  - o incorporate and cite correctly all evidence used to support a text's claim/s.
- Clearly articulate their scientific ideas verbally.
  - o delineate effective characteristics of multi-media presentations.
  - o articulate scientific practices in a way that secondary students can understand and be motivated to explore these practices.
  - o collaborate with others towards giving and receiving feedback on both oral and written work about teaching science as a way of knowing.

#### **SCED445. PHYSICS AND CHEMISTRY TEACHING TECHNIQUES. 3.0 Semester Hrs.**

In this course students will engage as learners of physics and chemistry through evidence-based teaching strategies. After each unit of instruction, students will reflect on the practices used during the unit and why these practices are effective techniques for teaching science. The goal of this course is for teacher candidates to develop an awareness of 1) the common misconceptions and learning progressions associated with physics and chemistry; 2) evidence-based teaching strategies for physics and chemistry; and 3) the importance of and techniques for placing all content within a context that is familiar to and interesting to your specific student body. Students will leave this course with a minimum of a full month of curriculum annotated and ready to deliver to middle or high school physical science and high school physics courses.

##### **Course Learning Outcomes**

- plan at least the first month of instruction for a middle or high school physics or chemistry course using standards-based lessons experienced in this course.
- identify lessons that are designed to build students knowledge as defined in the Colorado Academic Standards in science, mathematics, and literacy and the Next Generation Science Standards (NGSS),
- articulate and offer recommendations for addressing the common student preconceptions associated with all of the topics listed above for physical science and physics.
- integrate content within identified student personal interest to build student engagement and connections to the world around them.
- utilize Just in Time Teaching to plan lessons that meet students current interests and background knowledge.

- articulate the scope of the above standards related to the content knowledge necessary for teaching 7-12 students.
- articulate and engage students in investigation of the major concepts, principles, theories, laws, and interrelationships in science that underlie what they encounter in teaching.

#### **SCED464. CAPSTONE CURRICULUM DESIGN I. 3.0 Semester Hrs.**

This course provides Mines students an intensive teaching experience in a K-12 science, engineering, or STEM classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 100-hour field experience requirement in the students assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisite: Completed/concurrent 3 credits of SCED 262; completed/concurrent with SCED 415 or SCED 445. Co-requisite: Completed/concurrent 3 credits of SCED 262; completed/concurrent with SCED 415 or SCED 445.

#### **Course Learning Outcomes**

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a variety of active learning techniques based on how all students learn science, including lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, and identify relationships and natural patterns. Applications of science-specific technology are included in the lessons when appropriate.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.

- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.
- reflect on their practice and use this reflection to set goals for further growth.
- write standards-based lesson plans that include measurable learning objectives, applicable Colorado Content Standards, required materials, safety considerations, an outline of the lesson scaffolded with the five E's (engage, explore, explain, elaborate and evaluate) or other learning cycle model, accommodations, formative assessment and subject integration.

#### **SCED465. CAPSTONE CURRICULUM DESIGN II. 6-12 Semester Hr.**

This course provides Mines students an immersive student teaching experience in a K-12 science, engineering, or STEM classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 32-hour per credit hour enrolled field experience requirement in the students assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction for each 3 credit hours enrolled as well as participate in other school related professional roles and will develop a work sample (unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisite: Completed SCED 464; completed/concurrent with SCED 333, SCED 363, SCED 415, and SCED 445. Corequisites: Completed/concurrent with SCED 333, SCED 363, SCED 415, and SCED 445.

#### **Course Learning Outcomes**

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a variety of active learning techniques based on how all students learn science or engineering, including lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, and identify relationships and natural patterns. Applications of science-specific technology are included in the lessons when appropriate.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the

formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.

- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.

#### **SCED499. INDEPENDENT STUDY. 0.5-6 Semester Hr.**

#### **SCED515. SCIENTIFIC PRACTICES AND ENGINEERING DESIGN AND THE NATURE OF SCIENTIFIC KNOWLEDGE. 3.0 Semester Hrs.**

The goal of this course is to prepare students to integrate knowledge of scientific and engineering practices into their teaching as articulated in the Colorado Academic Standards and the Next Generation Science Standards, including asking questions, defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, obtaining, evaluating and communicating information. These skills will be modeled, practiced and mastered in the context of science, specifically: 1) earthquakes and waves, 2) mitosis, meiosis, and reproduction, 4) periodic table of the elements, 5) energy conservation, and 6) forces in static equilibrium. In addition this course will prepare students to be able to communicate effectively in a variety of mediums (written, oral, and digital) as educators about scientific and engineering practices.

#### **Course Learning Outcomes**

- Engage in appropriate scientific practices and support their students in doing the same.
- Identify, adapt or develop lessons specifically designed to engage students in scientific and engineering practices, including but not limited to, asking questions (for science) and defining problems (for engineering); analyzing and interpreting data; engaging in argument from evidence; constructing explanations (for science) and designing solutions (for engineering); developing and using models; planning and carrying out investigations; obtaining, evaluating,

and communicating information; and using mathematics and computational thinking. o compare and contrast "Scientific Practice" with "Engineering Design" o judge a student's abilities to do design practices in an informed way. o describe an engineering design cycle and how to apply it to design challenges o define and provide examples of design criteria and design constraints compare and contrast "Scientific Practice" with "Engineering Design"; judge a student's abilities to do design practices in an informed way; describe an engineering design cycle and how to apply it to design challenges; define and provide examples of design criteria and design constraints.

- Effectively instruct students about and model the basic understandings about the nature of science: science as a way of knowing, scientists use a variety of methods, science is based on evidence, science is open to revision, scientists use models, laws, mechanisms, and theories, science assumes order and consistency in natural systems, science is a human endeavor, and science addresses questions about the natural and material world. o articulate how scientific knowledge is acquired in a way that secondary students can comprehend. o describe the practices that brought about at least one major breakthrough in each of the four primary disciplines of science and how this contributed to our modern understanding of science. o analyze differences in the process of scientific discovery as described in the course text. o formulate a generalization and assess the evidence used to support a generalization or scientific theory. o provide examples that demonstrate the necessity for observations and characterization of patterns to understand the invisible.
- Integrate current issues and events related to science, and age-/ grade-appropriate controversial topics presented from multiple science perspectives into lessons using an analytical approach without bias.
- Select, adapt, or develop lessons that explicitly engage students in scientific and engineering practices defined by the Colorado Academic Standards in science, and the Next Generation Science Standards (NGSS).
- Identify, adapt or develop lessons that reflect the interconnectedness of content areas/disciplines to help erase the disciplinary lines and reflect authentic situations; for example through cross-cutting concepts defined in NGSS.
- Illustrate the value of a model in understanding composition and in science.
- Create a mini-unit (3 days or more) that explicitly teaches some aspect of scientific or engineering practice.
- Clearly articulate their scientific ideas in writing. Analyze text based on occasion, audience, form and function. o compose one page reflections with an awareness about introductions, conclusions and topic sentences. o articulate the process of and compose with an awareness about the composing process which is an iterative process of formulation, composition and revision. o incorporate and cite correctly all evidence used to support a text's claims.
- Clearly articulate their scientific ideas verbally. o delineate effective characteristics of multi-media presentations. o articulate scientific practices in a way that secondary students can understand and be motivated to explore these practices. o collaborate with others towards giving and receiving feedback on both oral and written work about teaching science as a way of knowing.

### **SCED533. EDUCATIONAL PSYCHOLOGY AND ASSESSMENT. 3.0 Semester Hrs.**

An explosive growth in research on how people learn has revealed many ways to improve teaching and catalyze learning at all ages. The purpose of this course is to present this new science of learning so that educators can creatively translate the science into exceptional practice. This course covers field-defining learning theories ranging from behaviorism to cognitive psychology to social psychology and some lesser-known theories exceptionally relevant to practice, such as arousal theory. Together the theories, evidence, and strategies can be combined endlessly to create original and effective learning plans and the means to know if they succeed.

#### **Course Learning Outcomes**

- Describe in general what cognitive science has learned about how the brain works related to the topics of conceptual understanding, memory, motivation, expertise, study skills, sense of inclusion, problem solving, collaboration, and discovery.
- Analyze various effective teaching practices in math and the sciences and provide examples of how the above topics in cognitive science inform these practices.
- utilize research based methods of instruction that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, repeatedly alternating solved and unsolved problems, distributed practice, and assessment to boost retention.
- effectively integrate technology into instructional and assessment strategies, as appropriate to science and mathematical education and the learner including but not limited to the use of a variety of resources (e.g., manipulative materials, graphing calculators, everyday hands-on materials, probe ware, and computers).
- Explain the value of embedding disciplinary research into the high school classroom and provide an example in science or math of how this can be done.
- Define data driven instruction, brain plasticity, and individual differences.
- Utilize formative assessment daily to adjust to students' needs as they are teaching and to determine where instruction can be improved next time.
- Utilize pre/post-tests as a form of formative assessment on a unit basis to determine change, learning gains, and effect size by group; Then, use the results to modify their future instruction.
- Use summative assessment to determine student level of mastery
- Provide accurate information about the teaching profession related to salary, benefits, and teacher satisfaction.
- Provide evidence for the nations' science and math teacher shortage and describe some research-based actions that can help change the direction of this trend.
- continuously improve their knowledge and understanding of the ever-changing knowledge base of both content, and science/mathematics pedagogy, including approaches for addressing inequities and inclusion for all students in science and math.

### **SCED545. PHYSICS AND CHEMISTRY TEACHING TECHNIQUES. 3.0 Semester Hrs.**

In this course students will engage as learners of physics and chemistry through evidence-based teaching strategies. After each unit of instruction, students will reflect on the practices used during the unit and why these practices are effective techniques for teaching science. The goal of this course is for teacher candidates to develop an awareness

of 1) the common misconceptions and learning progressions associated with physics and chemistry; 2) evidence-based teaching strategies for physics and chemistry; and 3) the importance of and techniques for placing all content within a context that is familiar to and interesting to your specific student body. Students will leave this course with a minimum of a full month of curriculum annotated and ready to deliver to middle or high school physical science and high school physics courses.

#### **Course Learning Outcomes**

- Plan at least the first month of instruction for a middle or high school physics or chemistry course using standards-based lessons experienced in this course.
- Identify lessons that are designed to build students knowledge as defined in the Colorado Academic Standards in science, mathematics, and literacy and the Next Generation Science Standards (NGSS)
- Articulate and offer recommendations for addressing the common student preconceptions associated with all of the topics listed above for physical science and physics.
- Integrate content within identified student personal interest to build student engagement and connections to the world around them.
- Utilize Just in Time Teaching to plan lessons that meet students current interests and background knowledge.
- Articulate the scope of the above standards related to the content knowledge necessary for teaching 7-12 students.
- Articulate and engage students in investigation of the major concepts, principles, theories, laws, and interrelationships in science that underlie what they encounter in teaching.

### **SCED562. K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS. 1-3 Semester Hr.**

This course is designed to provide Mines students with opportunities to participate in, analyze, and reflect on issues in a science K-12 school classroom setting. The overall goal is for Mines students to understand who their students are, build relationships, and begin exploring learner development and learner differences. Specifically, the course will focus on developing Mines students' ability to identify and practice basic classroom management, differentiate instruction, ask probing questions, science content preconceptions, language/activities that promote a growth mindset, and professional language. Furthermore, Mines students will begin exploring the factors that shape school norms and culture. In addition to an on-campus seminar, there is a 25-hour field experience requirement in the student's assigned partner school.

#### **Course Learning Outcomes**

- Identify and provide examples of differentiated instruction.
- Identify and provide examples of formative-assessment techniques used to evaluate what students are thinking during classroom activities
- Articulate the value of reflecting on their practice.
- Explain different levels of questioning and how to ask probing questions as well as provide examples of how to use these types of questioning.
- Articulate reasons for, ways to, and examples of how they built relationships with each and every student in their classroom.
- Articulate and document the science content specific preconceptions that they observed students demonstrate during the field placement.
- Identify the school policies and practices of their field placement.
- Identify factors that shaped the culture and norms of the school they experienced.

- Communicate effectively, model appropriate use of language (e.g., use of proper grammar, use of professional language, and use of discipline-specific vocabulary), and identify unprofessional language.
- Articulate the critical role of high ethical standards, including a belief in being committed to displaying ethical conduct towards students, performance and the profession, colleagues, and parents and the community.
- Recognize that with quality instruction and hard work, all students are capable of learning science and mathematics; use language, activities and feedback that is consistent with a growth mindset.

**SCED563. DYNAMIC TEACHING: MOTIVATION, CLASSROOM MANAGEMENT, AND DIFFERENTIATION OF INSTRUCTION. 3.0 Semester Hrs.**

Effective teaching is a dynamic process that requires the instructor to motivate, manage, and vary instruction for all learners in the classroom. The purpose of this course is to prepare future educators to be able to motivate students, manage classroom behavior, and differentiate their instruction so that all students can learn. This course will cover the field-defining theories of motivation, classroom management, and differentiation. Additionally, this course will introduce research-based practices that can be used to create learning environments where students are motivated and given the tools to be successful in their individual learning.

**Course Learning Outcomes**

- Describe theories of motivation and how classroom practices connect to those theories.
- Describe classroom management theories and how practices connect to those theories.
- Describe how differentiation techniques can be used to assist students with various exceptionalities.
- Create effective lesson plans that differentiate instruction for students in a classroom.
- Evaluate learning environments to recognize effective and ineffective motivation, management, and differentiation techniques in practice.
- Cultivate students' scientific/mathematics identify and confidence in learning science/math by connecting their instruction and content to students' background, providing ample opportunities for students to experience and reflect on success in learning science/mathematics content and practices, making their instruction and content relevant to students' lives, and helping students to contextualize the information being taught.
- Use classroom management, motivation, and differentiation practices to plan for and set the conditions of an effective learning environment.
- Apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- Demonstrate a commitment to and respect for diversity, while working toward common goals as a community and as a country.

**SCED564. CAPSTONE CURRICULUM DESIGN I. 3.0 Semester Hrs.**

This course provides Mines students an intensive teaching experience in a K-12 science, engineering, or STEM classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition

to a total of 15 hours of seminars (on campus and teacher professional development), there is an approximately 6 hours per week (100-hours total) field experience requirement in the student's assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisite: Completed/concurrent 3 credits of SCED 562; completed/concurrent with SCED 515 or SCED 545. Co-requisite: Completed/concurrent 3 credits of SCED 562; completed/concurrent with SCED 515 or SCED 545.

**Course Learning Outcomes**

- Utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- Identify, adapt, or develop lessons using a variety of active learning techniques based on how all students learn science, including lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, and identify relationships and natural patterns. Applications of science-specific technology are included in the lessons when appropriate.
- Use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills
- Apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- Create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- Identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- Engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- Learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- Provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work

collaboratively with the families and significant adults in the lives of their students.

- Reflect on their practice and use this reflection to set goals for further growth.
- Write standards-based lesson plans that include measurable learning objectives, applicable Colorado Content Standards, required materials, safety considerations, an outline of the lesson scaffolded with the five E's (engage, explore, explain, elaborate and evaluate) or other learning cycle model, accommodations, formative assessment and subject integration.

#### **SCED565. CAPSTONE CURRICULUM DESIGN II. 6-12 Semester Hr.**

This course provides Mines students an immersive student teaching experience in a K-12 science, engineering, or STEM classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 32-hour per credit hour enrolled field experience requirement in the student's assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction for each 3 credit hours enrolled as well as participate in other school related professional roles and will develop a work sample (unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisites: Completed SCED 564; completed/concurrent with SCED 333, SCED 363, SCED 515, and SCED 545. Corequisites: Completed/concurrent with SCED 333, SCED 363, SCED 515, and SCED 545.

#### **Course Learning Outcomes**

- Utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- Identify, adapt, or develop lessons using a variety of active learning techniques based on how all students learn science or engineering, including lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, and identify relationships and natural patterns. Applications of science-specific technology are included in the lessons when appropriate.
- Use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- Apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- Create engaging learning environments that are effective for all students by providing access, support, and challenge for every

student as well as differentiating instruction to meet the needs of all students.

- Identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- Engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- Learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- Provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.

#### **SCED598. SPECIAL TOPICS. 0-6 Semester Hr.**

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#### **SCED599. INDEPENDENT STUDY. 0.5-6 Semester Hr.**

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### **Executive Director**

Toni Lefton, Executive Director, University Honors & Scholars Programs and Assistant Provost for Signature Student Experience, Teaching Professor

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Melanie Brandt, Director, McBride Honors Program

### **Teaching Associate Professors**

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