

# SCIENCE EDUCATION (SCED)

## 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.

## 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 identity 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. 6.0 Semester Hrs.**

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 VS 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**

- 1. engage in appropriate scientific practices and support their students in doing the same.
- 2. 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

- 3. 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.
- 4. 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.
- 5. 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).
- 6. 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.
- 7. illustrate the value of a model in understanding composition and in science.
- 8. create a mini-unit (3 days or more) that explicitly teaches some aspect of scientific or engineering practice.
- 9. clearly articulate their scientific 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.
- 10. 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.

### SCED515. SCIENTIFIC PRACTICES VS 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

1. engage in appropriate scientific practices and support their students in doing the same.
2. 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
3. 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.
4. 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.
5. 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).
6. 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.
7. illustrate the value of a model in understanding composition and in science.

- 8. create a mini-unit (3 days or more) that explicitly teaches some aspect of scientific or engineering practice.
- 9. clearly articulate their scientific 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 claims.
- 10. 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, every-day 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.