

### Syllabus – Mining Essentials Program

Department of Mining Engineering and Management South Dakota School of Mines and Technology Rapid City, South Dakota

 $\mathbf{2025}$ 



Class Hours: Wednesday 8:30AM Mountain Time

Course begins – August 20, 2025 Course concludes – January 28, 2026

Instructors: Dr. Andrea Brickey

Office: MI 231 - Office Hours (7:30am-5pm MT M-F) – email might be best to start, and we can then schedule a call or video conference.
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Course Description:

The Mining Essentials Program (MEP) is a professional development program focused on teaching professionals about mining from a practical industry point of view. It is delivered through South Dakota School of Mines and Technology's (SD Mines) Office for Professional Education and the Mining Engineering and Management Department.

Textbooks: Brickey, A., McBrayer, A., Guerin-Davey, K. (2024). *Mining Practitioner's Reference Guide* (Provided)

Dunbar, S. (2016). *How Mining Works*. Society of Mining, Metallurgy and Exploration. (Not required)

- Attendance Policy: Attendance is highly recommended during the live streaming of the lecture, but if unable to attend, participants are required to watch the missed lecture prior to the next class.
- Learning Outcomes: After completion of this course, participants will be able to demonstrate the following:
  - explain the operational processes and practices pivotal to the mining industry;
  - comprehend and utilize important mining-related terminology;
  - describe key mining concepts from a practical, applied learning perspective backed by a theoretical understanding of how and when to apply this mining knowledge.
  - communicate effectively when interacting with mining companies

Grading:

To complete the program, the participant must complete all 8 assignments. The assignments are not graded but participants will be



provided with feedback on their responses. To complete the program and receive the completion certificate, participants must submit all assignments by February 28, 2026.

### Late Homework Policy:

Assignments are due two weeks (typically) from the assigned date.

#### Computer Usage:

MS Teams, D2L, Internet Browser (Chrome *recommended*, Firefox, IE) Kahoot.it, MS Word, MS Excel.

### Internet Requirement:

Sufficient internet connection to live-stream audio and visual media.



# Schedule: (lecture topic subject to change depending on availability of guest speakers)

2025	Mining	Essentials	Program
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Date	Module - Lecture	
Wednesday, August 20, 2025	Module 1-1 Industry Overview	
Wednesday, August 27, 2025	Module 1-2 Industry Overview	
Wednesday, September 3, 2025	Module 2-1 Exploration & Geology	
Wednesday, September 10, 2025	Module 3-1 Feasibility & Design	
Wednesday, September 17, 2025	Module 3-2 Feasibility & Design	
Wednesday, September 24, 2025	Module 3-3 Feasibility & Design	
Wednesday, October 1, 2025	Module 4-1 Surface Mining	
Wednesday, October 8, 2025	Module 4-2 Surface Mining	
Wednesday, October 15, 2025	Module 4-3 Surface Mining	
Wednesday, October 22, 2025	Module 4-4 Surface Mining	
Wednesday, October 29, 2025	Module 5-1 Underground Mining	
Wednesday, November 5, 2025	Module 5-2 Underground Mining	
Wednesday, November 12, 2025	Module 5-3 Underground Mining	
Wednesday, November 19, 2025	Module 6-1 Mineral Processing	
Wednesday, November 26, 2025	No Class - Holiday Break	
Wednesday, December 3, 2025	Module 7-1 Mineral Economics	
Wednesday, December 10, 2025	Module 7-2 Mineral Economics	
Wednesday, December 17, 2025	No Class - Holiday Break	
Wednesday, December 24, 2025	No Class - Holiday Break	
Wednesday, December 31, 2025	No Class - Holiday Break	
Wednesday, January 7, 2026	Module 7-3 Mineral Economics	
Wednesday, January 14, 2026	Module 8-1 Environment	
Wednesday, January 21, 2026	Module 8-2 Environment	
Wednesday, January 28, 2026	Module 9-1 Industry Technology & Closeout	



The following course outline is intended to provide additional detail regarding the content of the Mining Essentials Program. The instructors will do their best to cover all the topics listed in the allotted time; however, the participants and instructors will have the ability to influence the content if a given topic requires additional detail or time. The instructors listed will manage the module, but additional instructors or guest speakers may be used to expand the content as appropriate.



### Module 1 – Mining Industry Overview – Dr. Andrea Brickey

- a) A 3-hour module that will provide participants with a general overview of the mining industry. The learning objectives will include:
  - i) Global perspective of mining, economic impact of mining, location of mines, major mining companies;
    - (1) What is mining?
    - (2) Why do we mine and how does it impacts our world?
  - ii) Commodities that are mined and what is produced;
    - (1) Major commodities and where significant deposits are located throughout the world.
  - iii) Basic mining terminology (terminology will also be discussed throughout the program)
    - (1) Students will receive a copy of *Mining Practitioner's Reference Guide*.
  - iv) Mining methods, how the method is selected, and application of equipment;
    - (1) Surface vs. Underground (dredging, hydraulic, supported and unsupported methods) presented at a high level initially.
    - (2) Truck-shovel, dragline, continuous miner, longwall, etc.
  - v) Mining technology and its evolution;
    - (1) How did we get from *De Re Metallica* to fully autonomous equipment?
    - (2) What has changed, what hasn't changed, and what might change in the near future?
  - vi) Mining business model and the current impacts to that model including cyclical pricing, regulations, and supply/demand.
    - (1) How are different commodities bought and sold
    - (2) Factors that impact commodity prices
    - (3) Evaluation of major commodities' price performance over the previous 5-10 years.
    - (4) Discussion on how global currencies impact commodity prices and mining companies.
- b) The learning outcomes from this module will include:
  - i) Understanding the importance of mining and its impact on our daily lives;
  - ii) Ability to differentiate between the various mining methods and the application of equipment between each method;
  - iii) Ability to understand how mining technology has evolved and will continue to evolve in the future.



### Module 2 – Mining Exploration and Basic Geology – Dr. Kelli McCormick

- a) A 1.5-hour module that will provide participants with a basic understanding of geology and how exploration of the geology can be used in a feasibility assessment for a mining operation. The learning objectives will include:
  - i) Types of basic geology and locations of major deposits;
    - (1) Basic rock classifications
    - (2) Geologic environments and process
    - (3) Major deposits (global) by commodity
  - ii) How geology impacts deposit grade, location, amount of waste;
    - (1) Dilution
    - (2) Recovery rates
    - (3) Regulatory requirements
  - iii) Exploration process and how this leads to the type of mining operation;
    - (1) Greenfield vs brownfield exploration
    - (2) Arial survey methods and mapping
    - (3) Sampling methods Drilling
    - (4) Assaying and data collection
  - iv) Resource Modeling;
    - (1) Resource Classifications
    - (2) US, Canadian and other global codes regulating classifications
    - (3) Basic statistics and geostatistical overview
  - v) Other impacts of geology on the mining operation.
    - (1) Geologic structure
    - (2) Rock strength
    - (3) Acid mine drainage
    - (4) Cultural or paleontological findings
- b) The learning outcomes from this module will include:
  - i) Understanding basic geology and how the geology dictates the type of mining operation;
  - ii) Understanding how the extraction and handling of ore and waste is affected by geology, rock fragmentation, and mining method;
  - iii) Understanding what data gathered during the exploration process is essential for making mining and processing related decisions.



## Module 3 – Mine Feasibility, Mining Design and Planning – Dr. Andrea Brickey and Guests

- a) A 4.5-hour module that will provide participants with an understanding of the mining design and planning process. The learning objectives will include:
  - i) Stages of a mine and how they impact one another;
    - (1) Prospecting, exploration, development, mining, reclamation.
    - (2) Various studies preliminary assessment, scoping, prefeasibility, and feasibility studies
    - (3) Handout Minimum Requirements for Engineering Studies by RPM
  - ii) Transition from mine feasibility to mine design and planning for an operation;
    - (1) Components of a surface mine design benches, slope angles, ramps, etc.
    - (2) Components of an underground mine design shafts, declines, drifts, ramps, stopes, pillars, etc.
    - (3) Strategic vs. tactical planning
    - (4) Resource and Reserves
    - (5) Optimization methods and software overview
  - iii) Mine planning process and understanding of the iterative nature of designing and developing a mining operation;
    - (1) Initial production rate and costing estimations.
    - $(2) \ Model \ analysis Geologic \ and \ resource \ model$
  - iv) Basic understanding of block modeling, why it is important, and how geology affects the model;
    - (1) Selective Mining Unit (SMU)
    - (2) Block model benefits and potential errors
    - (3) Discussion of tools used in modeling
  - v) Effect of changing economies of pre-operational and operational mines;
    - (1) Fixed and variable costs
    - (2) Initial introduction to the time-value of money
  - vi) Importance of proper equipment selection and sizing;
    - (1) Safety
    - (2) Mining method factors
    - (3) Operational efficiencies
    - (4) Economies of scale
    - (5) Density
  - vii) Unit operations and production metrics.
    - (1) Drill Blast Load Haul (various surface and underground mining method equivalencies)
    - (2) Tonnage, volume
    - (3) Production metrics annual production, fleet production, resource capacities and limitations, corporate objectives,



marketing objectives, cost per unit of production, cost per unit of commodity produced, etc.

- b) The learning outcomes from this module will include:
  - i) Understanding the transition from feasibility to operation and the methods used in mine design and planning;
  - ii) Understanding of the mine design and planning process and key decisions made in that process;
  - iii) Understanding the stages in the life of a mine and what effects the mine life.



### Module 4 – Surface Mining Operations – Dr. Andrea Brickey and Guests

- a) A 6-hour module that will provide participants with an understanding of surface mining operations. The learning objectives will include:
  - i) A comprehensive overview of surface mining methods, limitations of surface mines, and advantages and disadvantages of surface mining;
    - (1) Open Pit
    - (2) Area Mining
    - (3) Quarrying
    - (4) Aqueous methods dredging, hydraulic
  - ii) Surface mining activities;
    - (1) Drilling
    - (2) Blasting
    - (3) Loading
    - (4) Haulage
  - iii) Surface mine design components;
    - (1) Ultimate pit and phase design
    - (2) Haulage and ramp systems
    - (3) Waste dumps
    - (4) Infrastructure
    - (5) Leach pads, processing facilities
    - (6) Transportation
  - iv) Type, selection, and use of equipment for the surface mining method;
    - (1) Loading equipment
    - (2) Haulage equipment
    - (3) Ancillary equipment
  - v) Material handling aspects of surface mining;
    - (1) Conveyor systems
    - (2) Trains, Trolley systems
  - vi) Introduction to various software packages for surface mine design.
    - (1) Geologic modeling
    - (2) Design
    - (3) Planning and optimization
    - (4) Operational
- b) The learning outcomes from this module will include:
  - i) Understanding the basic reasons and methods for surface mining including use of equipment and materials handling;
  - ii) Understanding the factors that can affect production in a surface mine and how these factors may also affect equipment selection and use.



### Module 5 – Underground Mining Operations – Dr. Andrea Brickey

A 4.5-hour module that will provide participants with an understanding of underground mining operations. The learning objectives will include:

- i) A comprehensive overview of underground mining methods, limitations, and advantages and disadvantages of underground mining;
  - (1) Naturally supported
  - (2) Artificially supported
  - (3) Caving
- ii) Major factors that dictate that a mine should be located underground;
- iii) Access to underground mines
- iv) Underground mining activities;
  - (1) Drilling
  - (2) Blasting
  - (3) Loading
  - (4) Haulage
- v) Underground mine design components;
  - (1) Development
  - (2) Production and access components stopes, rooms, pillars, panels
  - (3) Hoisting system
  - (4) Ventilation
  - (5) Infrastructure
  - (6) Transportation
  - (7) Processing facilities
- vi) Type, selection, and use of equipment for the underground mining method;
  - (1) Loading equipment
  - (2) Haulage equipment
  - (3) Ancillary equipment
- vii) Material handling aspects of underground mining;
  - (1) Conveyor systems
  - (2) Trains, Trolley systems
  - (3) Truck Haulage
  - (4) Crushing
- b) The learning outcomes from this module will include:
  - i) Understanding the basic reasons and methods for underground mining, including the use of equipment and materials handling;
  - ii) Understanding the factors that can affect production in an underground mine and how these factors may also affect equipment selection and use.



### Module 6 – Mineral Processing – Dr. Jon Kellar

- a) A 1.5-hour module that will provide participants with an understanding of the different methods used to process and extract minerals from rock. The learning objectives will include:
  - i) Overview of mineral types, mineral processing methods and terminology, including mass balances and the need for metallurgical accounting;
  - ii) Comminution, including machines used and particle sizing and mineral liberation;
  - iii) Discussion of specific mineral processing unit operations including gravity, electrostatic, magnetic and froth flotation separation methods;
  - iv) Physical and chemical factors that dictate the method of processing selected;
  - v) Environmental and safety issues associated with the various processing techniques;
  - vi) Flowsheet analysis;
  - vii)Handling and processing of tailings.
- b) The learning outcomes from this module will include:
  - i) Understanding the various mineral beneficiation methods, the physical and chemical factors that dictate the type of method for separation, and preparation of the ore for downstream extraction (hydrometallurgy, pyrometallurgy);



### Module 7 - Mineral Economics and Metrics - Dr. Ray Sheldon

- a) A 4.5-hour module that will provide participants with an understanding of the economics within the mining process and the metrics used for production. The learning objectives will include:
  - i) How to assess the economics of mining, commodity prices, and cost per unit operation;
  - ii) Key terminology and key steps in the economic process;
  - iii) Understanding of a cash flow analysis and associated metrics (NPV, ROI, ROC);
  - iv) Factors that affect mining economics, both internal and external, including operations, equipment performance, regulations, commodity prices, logistics, and emerging countries;
  - v) Additional factors, environmental, strategic, etc., considerations and effects on mineral economics.
  - vi) Government's role in the development and exploitation of mineral resources.

vii)Productivity metrics and effect on mining economics;

viii) Key financial decisions during the various stages of a mine.

- b) The learning outcomes from this module will include:
  - i) Understanding the various factors that affect the economics of the mining operation;
  - ii) Understanding the metrics used to assess the economics of a mine;
  - iii) Understanding the mineral cycles and how companies prepare or don't for the swings in commodity prices.



### Module 8 - Environment and Sustainability - Mr. Ross Conner

- a) A three-hour module that will provide participants with an understanding of the permitting, reclamation, regulation, and sustainability processes. The learning objectives will include:
  - i) How mineral and surface ownership will determine which laws and regulations apply;
  - ii) How the permitting process works and how government regulations and public involvement shape the process;
  - iii) The planning process for reclamation and how it affects the mining operation;
  - iv) Discussion of environmental compliance and how sustainability is implemented during the various mining stages;
  - v) Economics of the permitting and reclamation efforts;
    - (1) Bonds
    - (2) Long-term monitoring
- vi) Current social/political influence on the social license to operate a mine.
- b) The learning outcomes from this module will include:
  - i) Understanding the permitting process and the effect of government regulations and public involvement;
  - ii) Understanding the reclamation process and the planning necessary to ensure sustainability;
  - iii) Understanding the cost of permitting and the implementation of environmental protections.



### Module 9 – Industry Technology – Dr. Andrea Brickey

- a) A 1.5 module that will provide participants with an understanding of technology used in the mining industry. The learning objectives will include:
  - i) What technology is currently used in the mining industry and how it has changed with time;
    - (1) Computers and software
    - (2) Satellites and UAV's
    - (3) Algorithms and artificial intelligence
    - (4) Virtual and augmented reality
  - ii) How big data is used in the mine operation, planning processes, and continuous improvement;
    - (1) Analytics
    - (2) Predicative methods
    - (3) QA/AC
  - iii) How technology is used in equipment management;
    - (1) GPS
    - (2) Monitoring systems
  - iv) How technology is used to collect information and provide feedback to evaluate and operation;
    - (1) Database management
    - (2) Useful metrics
  - v) How technology is used to improve the health and safety of miners;
  - vi) How technology is used across mine support services and contractors; vii)Technology for the mine of the future.
    - (1) Autonomous mining
    - (2) Robotics
    - (3) Extraterrestrial mining
- b) The learning outcomes from this module will include:
  - i) Understanding of the role of technology and big data in mine planning, design, operations, and health and safety;
  - ii) Understanding how technology has evolved and what technologies will be important in the future of mining.

