

Short Course Descriptions

Session 1A: Constructing the Rock Cycle

Dean Moosavi, Geologist, Department of Science, Rochester Community Technical College

Grade Level: Middle School and High School; Adaptation Possible for Elementary School

In Constructing the Rock Cycle you will identify common rock samples and place them on a diagram outlining the tectonic environments in which they form. The short course will focus on linking the identified rocks to the locations where, and processes by which, they form and how these earth materials are moved from one place and form to another in the natural cycles of Earth's surface and crust. The activity will be demonstrated at the middle school to high school level, but it can in principle be used with students of all ages by adjusting the number and complexity of samples. Participants are encouraged to bring rocks of their own to add to the activity (not required).

Session 1B: Mining and Geology 101

Karl D. Everett, PE, PG; Environmental Consultant, KEA Associates

Grade Level: Elementary School, Middle School, and High School

What non-living creature has a face, back and ribs and exists deep underground? Answer: An underground mine. This course will cover basic geology, mining terms, and environmental aspects of mining in Minnesota. The geology of Minnesota will be discussed related to the formation of mineral resources and the mining of iron ore, silica sand, fossil resources, copper-nickel, gold, platinum, palladium, manganese, and rare earth minerals. Instructor will explain some basic mining terms, e.g. ore reserves, resources, footwall, hanging wall, heads, middlings, and tails. Course will cover the formation of ore deposits and the evaluation of resources, including some Minnesota mining history and practices; mining processes of drilling, blasting, haulage and mining processing equipment. Environmental compliance aspects will be reviewed including practices associated with controlling air emissions, land disturbance, stormwater, groundwater, water discharge, tailings ponds, and the final reclamation of mine sites. Participants will study and identify ore and mineral samples.

Session 1C: Benefits of Beneficiation

Ted Anderson, Engineering & Mineral Operations manager, Minnesota Department of Natural Resources

Grade Level: Middle School; Adaptation Possible for Elementary School and High School

Have you ever wondered what it takes to turn a chunk of rock into a toaster, smartphone, or a car? In this course we will take a look at the first steps needed to turn rocky mineral ore into the appliances in your home. Using edible specimens, this course will run a series of hands-on experiments to demonstrate how mineral ores can be processed through grinding, screening, concentration, and drying. In addition, you will learn why some methods will work for some ores but not for others and how the steps work together to create a useful mineral product that can

be used in factories. Participants will receive instructions for replicating these experiments in their class and video clips of industry examples.

Session 1D: The BIG PICTURE: Continental Drift and Plate Tectonics

Dr. Richard Ojakangas, Professor Emeritus, University of Minnesota Duluth

Grade Level: Middle School and High School

This PowerPoint presentation describes how the idea that the continents had moved (drifted) relative to each other, as proposed by Alfred Wegener (a German meteorologist) in 1912, was ridiculed by nearly all American geologists. A half-century later, new oceanographic discoveries provided essential information that led not only to the acceptance of "continental drift", but greatly expanded upon it. Today "Plate Tectonic Theory" is a geologic concept that explains the major Earth processes and the resultant features: volcanoes, mountain belts, large faults, ocean trenches, island arcs and ridges, many ore deposits, and more.

Session 2A: Surficial Geology of Minnesota

Kate Kleiter, PG, CPG; Environmental Scientist/Consultant, Retired

Grade Level: Middle School and High School

This course will skim the surface of Minnesota's geology. There will be an overall summary of the historical formation of the solid rock mass below the land surface followed by Minnesota's glacial history. The surficial geology of Minnesota is mostly composed of glacial sediments deposited from the last retreating glaciers approximately 10 to 12 thousand years ago. The geology of Minnesota can be divided into five different regions and they uniquely impact the surface topography and type of drainage patterns seen in the soils and wetlands. During this talk and power point presentation I will include describing the formation of Minnesota's more interesting rocks such as agates or pipestone. Samples of Minnesota rocks and glacial sediment cores will be passed around for identification and discussion after the summary presentation. Handouts and a worksheet will be provided.

Session 2B: The Last Big Push: Ice and the Mesabi Range

Carrie Jennings, Research and Policy Director, Freshwater

Grade Level: Middle School and High School

In this short course we will explore: 1) how the Giant's Range may have protected the deeply weathered Banded Iron Formation from glacial erosion; 2) how the last push of ice paired deep lakes with the Siseebakwet and Sugar Hills to produce almost 300' of total relief, and 3) review the evidence for subglacial water movement. Glacial features in the region are large and span tens to hundreds of miles and are best viewed initially on elevation maps like those available using [MnTOPO](#). A potential field trip route that helps check hypotheses for formation will be developed by the participants. In this course:

- Participants will learn how to distinguish glacial landforms from rock features in the area and how to interpret the texture of glacial sediment from slope.

- Participants will gain an understanding of how glacier erosion revealed the resources of the Range, created lakes, and built some pretty fine ski hills.
- Participants will look at map examples and descriptions of outcrops and landforms to build understanding of the type and scale of glacial landforms in the area of Grand Rapids and the Mesabi Range. These examples could be used in class as a virtual field trip or as stops on a real field trip.

Session 2C: Minnesota's Lakes: Laboratories for Mineral Genesis

Chad Wittkop, Associate Professor, Department of Chemistry and Geology, Minnesota State University

Grade Level: Middle School and High School

This course will explore the intersection of limnology (the science of lakes) and mineralogy (the science of minerals) using case studies from lakes in Minnesota and nearby states. We will examine the chemistry, microbiology, and physical structure of lakes and explore how processes operating within lakes lead to the formation of minerals, with a focus on carbonates and oxides. We will then use these concepts to develop our understanding of the conditions that led to the formation of Minnesota's iron ore deposits. The consequences of road salt pollution in lakes will also be discussed. Handouts with notes and ideas for demonstrations, lab activities, and short field trips will be provided.

Session 2D: Using the On-Line Minnesota Natural Resource Atlas in the Classroom

*Cindy Hagley, Environmental Quality Extension Educator, MN Sea Grant
Will Bartsch, Watershed Scientist, Natural Resources Research Institute*

Grade Level: Middle School and High School

In this interactive class, you will learn how to design lesson plans for middle and high school students that utilize the publically available Minnesota Natural Resource Atlas (www.mnnaturalresourceatlas.org). The Atlas includes a multidisciplinary database and an interactive mapping tool, and you will receive training on how to use it for spatial data exploration, mapping, and analysis. The course will be held in a computer lab. Training materials and lesson plan guidelines will be provided.

Session 3A: Raw Materials and Iron Production

Dr. Donald R. Fosnacht, Associate Director, Natural Resources Research Institute

Grade Level: High School

This lecture- and discussion-based course will describe the evolution of the iron production process over time and illustrate the raw materials used to produce iron and steel. It will highlight the various iron ore conversion processes as well as the need for various alloys and other ingredients that lead to steel products with a variety of end uses. Participants will receive a copy of the lecture notes.

Session 3B: Minnesota Iron Mining & the Classroom

Kelsey Johnson, Iron Mining Association of Minnesota, President

Katy Lofquist, Iron Mining Association of Minnesota, Director of Operations

Julie Marinucci, Minnesota Section of the Society for Mining, Metallurgy, and Exploration

Kurt Doran, Minnesota Section of the Society for Mining, Metallurgy, and Exploration

Grade Level: Middle School; Adaptation Possible for Elementary School and High School

Minnesota has been mining iron ore for more than 130 years and contributes 1/3 of the GRP in Northeast Minnesota. The Iron Mining Association will present its 6th grade curriculum, *Taconite Rocks!*, and hand out corresponding classroom materials. The Minnesota Section of the Society for Mining, Metallurgy, and Exploration will present mining and mineral education tools and resources available for your classroom no matter what grade level you teach. Presentation will conclude with a Q&A about the current state of Minnesota's iron mining industry.

Session 3C: American Peat Technology and the Five Challenges of Harvesting Peat

Peggy Jones, Vice-President of Research and Sales, American Peat Technology

Grade Level: Elementary School and Middle School

American Peat Technology (APT) has been harvesting reed-sedge peat in Aitkin, MN since 2003. At first glance, the business of peat harvest would seem to be simple: just dig it out of the ground. The reality, though, is that the harvest and processing of peat into value-added products is burdened with complexities of agriculture, manufacturing and transportation. This course explains what peat is, what products APT makes, how those products have supported the company through fifteen years of expansion, and how APT has met and overcome some of the challenges of producing peat products for the agricultural and water remediation industries. The course will include a mix of power point presentation and hands-on activities and is geared toward the elementary-to-middle school level.

Session 3D: Life-Cycle/Circular Economy Concepts: Potential Applications to Minnesota's Mineral Resources

Dr. George J. Hudak, P. Geo., P.G.; Initiative Director, Minerals - Metallurgy - Mining, Natural Resources Research Institute

Grade Level: Middle School and High School

With a few exceptions, mineral deposits are rarely "sustainable" as they represent finite quantities of mineral-based resources. Yet, over the past few decades, the concept of "sustainable development" in the minerals industry has become increasingly important. A key component in developing "sustainable" mineral resources includes a change from "use it once and dispose of it" practices (linear economy) to developing products that can be utilized and repurposed and/or recycled (circular economy). Such a change will require new ways of thinking about our mineral resources to include not only the commodity being extracted, but also potential development of by-products from "waste" materials and reutilization of mining infrastructure for other purposes. This short course will discuss concepts related to the linear

economy, life-cycle assessment, and the circular economy, focusing on applications of these concepts to potentially increase the “sustainability” of mineral resources. Minnesota examples will be presented. Classroom handouts will be provided.

Session 4A: Minnesota Caves: History and Lore

Greg Brick, Minnesota Department of Natural Resources, Retired

Grade Level: Middle School and High School

The instructor will present a PowerPoint tour of Minnesota caves highlighting caves with significant narrative history, illustrated with historic images, never before published, from the National Cave Museum in Kentucky, based on the book of the same name (Arcadia Publishing, 2017). While most of the caves still exist, many are not publicly accessible, and some never did exist except in the minds of explorers.

On the practical side, the instructor will describe the Banshee Cave Subterranean Laboratory (circa 1990) and the author’s “classroom cave” in Hastings, MN, where he taught SPELEOLOGY 101 courses and the lessons learned from these experiences. Having led cave and geology tours for years, he will share some useful practical advice.

Session 4B: Lakes and Ground Water – A Single Resource?

Scott C. Alexander, Senior Scientist, University of Minnesota

Grade Level: Middle School and High School; Adaptation Possible for Elementary School

Water resources have been traditionally managed as if ground water and surface water were completely different things. As demands increase on our water resources it is becoming apparent that surface resources and the subsurface are strongly interconnected. Changes at the surface often adversely affect ground water. Likewise, increasing pumping of ground water can alter surface waters. We will explore this inter-relation with examples from Minnesota lakes, rivers, streams, and underlying ground water aquifers.

Session 4C: Protecting Ground Water in Aggregate Mining Areas

Bruce Olsen, Minnesota Geological Survey and Minnesota Department of Health, Retired

Grade Level: Middle School; Adaptation Possible for Elementary School and High School

Mining is an essential sector of Minnesota’s economy and iron mining is often thought of as the principle type of mining that occurs in the state. However, iron mining is limited to portions of northeastern Minnesota whereas aggregate mining occurs virtually everywhere. Often, the same geologic materials that are mined for aggregate also serve as aquifers. Ensuring that the development and reclamation of aggregate mines does not adversely impact the quality or quantity of groundwater resources is important to managing Minnesota’s groundwater resource. This course provides a basic understanding of the impacts that historical land and water uses relating to aggregate mining have on groundwater resources as well as what can be done to prevent future mistakes. Hands-on activities that use low cost materials are used to demonstrate how aggregate mining could impact groundwater and what measures should be

considered to offset these possible impacts. Participants may take a set of classroom materials with them at no cost.

Session 4D: Mining and Water – An Essential Partnership

Maggie Durenberger, Geologist, Twin Cities Section of the Society for Mining, Metallurgy, and Exploration

Grade Level: Middle School

This course will present real world examples of how mining companies are now recognizing [United Nations Sustainability goals](#) and [Circular Economy](#) principles with regard to water management practice - both within and external to the mine operation (surrounding communities). Placed into smaller groups, students will participate in a role-playing exercise to learn how to manage water issues while balancing the interests of all parties involved (e.g., Mine Sustainability Officer, Stakeholders, and Government). This course is aimed at middle school students. Basic earth/water cycle diagrams will be used together with examples.