

EXPLORING OPPORTUNITIES:

Careers in the Minerals Industry

**A pre-college guide
for students,
parents and teachers**





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This career guidance booklet is presented as a public service to students, parents and teachers by the Society for Mining, Metallurgy, and Exploration (SME), Inc. The five divisions of SME—Coal, Environmental, Industrial Minerals, Mining and Exploration, and Mineral and Metallurgical Processing—are devoted to serving members who are involved in mineral resource exploration, mining, processing and reclamation.

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Is a Career in the Minerals Industry for You?

you may not know it, but minerals affect your life in almost every way. You may know that the minerals industry provides the materials that pave your roads or heat your home, but what about your stereo, your chewing gum, or the medicine your doctor prescribes? Minerals are used in all of them. Even in your own home, minerals are needed for everything from the carpet to the countertops. In fact, those in the minerals industry have a saying: if it can't be grown, it must be mined.

Today's minerals industry offers a wide range of exciting, rewarding careers for those who want to be a part of such a vital field. Careers in the minerals industry offer top salaries and benefits, variety, travel, the chance to work with advanced technology, continuous career training, opportunities for advancement, responsibility, challenge and leadership.

The minerals industry is constantly seeking creative and enthusiastic people who can tackle the many different facets of the resource-extraction process. This handbook provides a quick overview of some of the exciting careers in the minerals industry. For more information on this subject, please contact the Society for Mining, Metallurgy and Exploration (SME), Inc. at the address on the opposite page. For more information on how your academic goals can lead you to a career in the minerals industry, be sure to talk with your school guidance counselor.

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Top 10 Benefits *of a Career in the Minerals Industry*

1. Job Satisfaction. Studies have shown that job dissatisfaction is one of the top reasons for unhappiness among people in the United States. People in the minerals industry enjoy a high level of job satisfaction, and some of the reasons why are listed below.

2. Benefit to Society. A career in the minerals industry will allow you to work on projects that clearly benefit society. For example, you can be involved in minerals extraction projects that minimize impact on the environment, find new sources of energy, and increase the standard of living for people around the world.

3. Challenging Work. The minerals field has no shortage of challenging problems. In school, most problems have a single, correct answer. In the field, when finding solutions involving complex geologic materials, you must often work with incomplete and uncertain data. No professor can tell you that you are right or wrong. You must devise a creative solution and persuade others that your solution is the best one.

4. Opportunities for Career Advancement. As the world continues to develop and the global economy expands, the demand for minerals and mineral processing continues to increase. The world will always need minerals, and that means opportunities now and in the future.

5. Financial Benefits. The minerals industry is one of the highest paying of all industries. Because of the challenges and rewards involved in the minerals industry, companies offer excellent financial benefits in order to attract the very best people.

6. Variety of Work Environments. Do you like to work outdoors in the fresh air or do you prefer indoors? Would you like to work in a busy city skyscraper or would you rather be at a remote site? Is your goal to work in the United States or overseas? How about working underground or even on the ocean floor? Only the minerals industry offers such a wide variety of working environments.

7. Prestige. Your career in the minerals industry will contribute significantly to our nation's international competitiveness, ensure a strong national security, help maintain and improve our standard of living, and protect the environment. People understand that it takes hard work and strong technical skills to work in the minerals industry, and you will be recognized for that.

8. Variety of Work Experiences. The minerals industry is extremely diverse. Its activities include exploration for mineral deposits, developing new mine sites, underground or surface mines, processing minerals to extract the commodity, and the transportation and marketing of mineral products.

9. Safe and Professional Work Environment. The minerals industry has unique hazards and safety challenges, and working in mining you will find that management and workers agree that everyone has a personal commitment for the safety and well-being of fellow workers.

10. Creative Thinking. The infinite variety of occurrences and properties of natural materials that you will work with in the minerals industry requires creative thinking. You will be required to develop solutions to open-ended and unique problems that require the ability to think beyond the obvious and include requirements across many disciplines.

Questions about

Careers in the Minerals Industry

What is the minerals industry all about?

The minerals industry is about quality of life, both for today and tomorrow. The minerals industry produces the raw materials for a lot of the items you use each day: the house you live in, the foods you eat, the clothes you wear, and the cars you drive. Everything from lipstick to breakfast cereal—even your toothpaste—could not be made without the minerals industry.

What is my career outlook in the minerals industry?

The career outlook for the minerals industry remains positive. Although somewhat cyclic, the overall use of minerals and metals is increasing every year due

to the improvement of living conditions in the developing world, increased human longevity, and new uses. As a result, new sources of these minerals must be found and produced worldwide.

How open is the minerals industry to women and minorities?

The industry is open to women and minorities. In fact, a few well-known chief executive officers and several executives in the mining industry are women. In increasing numbers, women and minorities are pursuing careers in the minerals industry and filling positions without question of gender, race or nationality.

Exploring Opportunities: In Geology

What is geology?

Geology is the scientific study of the nature, formation, origin and development of the planet Earth, including its raw materials, natural processes and resulting products.

Why is geology important to the mining industry?

The knowledge of the Earth, its processes, and its materials are used to aid in the discovery of metals, minerals and fuels, to identify geological conditions, hazards and stability of mine sites, and to remediate and reclaim mine and mill sites.

What geological specialists are used by the mining industry?

There are many specialties in the field of geology. These include mineralogy, petrology, paleontology, geophysics, geochemistry, hydrology, engineering geology, economic geology and environmental geology.

Where are the jobs for geoscientists and geological engineers?

Geoscientists and geological engineers work for mining and exploration companies and consulting and geotechnical firms that provide technical expertise to the mining industry, government agencies such as the United States Geological Survey and state geological surveys, and universities. Companies that employ geoscience professionals range in size from Fortune 500 corporations that employ hundreds to small consulting firms that may employ only a few individuals.



FOCUS ON: Specialities in Geology

Geologist. Geologists study the materials and processes of the Earth to explain how, when and why events occurred in the formation of the Earth's rock record. Economic geologists apply geology to explore for and develop the metal, mineral, and coal resources that are used as the foundation of our standard of living and modern society. Structural geologists analyze the Earth's forces by studying deformation, fracturing and folding of the Earth's crust.

Geochemist. Geochemists use physical, organic and inorganic chemistry to investigate the type and distribution of major and trace elements and organic compounds in rocks, soils and waters.

Mineralogist. Mineralogists study mineral formation, crystal structure, chemistry and properties to understand ore genesis, to develop process strategies for mineral liberation and beneficiation, and to develop and modify mineral-based products for industrial and consumer use.

Geophysicist. Geophysicists apply the principles of physics to studies of the Earth's interior and inves-

tigate Earth's magnetic, electrical and gravitational properties.

Geophysical Engineer. Geophysical engineers apply geophysical techniques to understand and plan for geologic conditions that affect mines.

Geological Engineer. Geological engineers apply geological data, techniques and principles to study rocks, soils and groundwater, and to understand and plan for geologic conditions that affect structures such as mines, bridges, buildings and dams.



Profile in Geology:

Name: Jason McCuiston

Education: B.S. 1993 and M.S. 1995 in Geology from Indiana University-Bloomington

Position: Geologist/Director, Raw Materials Management, for H.C. Spinks Clay Company at Paris, Tennessee

“I work as a geologist for a company that mines and processes clay. The first of my responsibilities is directing the drilling program and applying geologic interpretation to the results. From this information I make computerized maps of our clay deposits both to use for detailed mine plans and for long-term reserve planning. The second of my responsibilities involves applying that information and geologic interpretation directly to the mining, processing, and better understanding the characteristics of the clays. This part of the job involves coordinating the mining group, the processing group, and the research and development groups. In order to do this it is necessary to be in the mines with the mining superintendent and heavy equipment operators, it is necessary to be in the processing plants and storage sheds with the plant managers, and it is also necessary to spend time in the R&D center to gather data to distribute and use in the mines and plants.

“The best thing about this job is its variety. On a given day, I may be hiking through the woods or a pasture looking for a suitable place to prospect for clay, in an open mine 60 to 100 feet below the surface, in a processing plant, in a laboratory setting, or in front of a computer making maps or interpreting data. It is also fun to find fossilized leaves that fell into these clay deposits 55 million years ago. Through finds such as these I can focus on the industrial aspects of mining, and I can learn about how these deposits came to be where they are and how they fit into the historical picture of the Earth.”

Exploring Opportunities: In Mining

What is mining today?

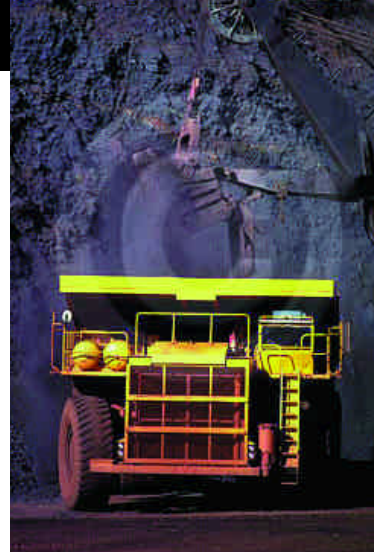
Mining is varied in its application, but consists of extracting the desired mineral resources that are found naturally deposited within the earth. This requires an understanding of the market for the particular mineral or minerals, the economics associated with the actual operation and maintenance of the mining facility, and coordination with other mineral scientists to convert the mineral resource into a salable product. It also requires the implementation of sound engineering practices, good equipment operation and maintenance procedures, and compliance with safety and environmental regulations.

Why is mining engineering important to the minerals industry?

Mining is the first step toward extracting the mineral resource. Mining is the initial selection process where the material that is desired is separated from the nondesired material. Engineering is required to identify the resource and to finally optimize the extraction of the mineral resource.

Where are the jobs for mining engineers?

Mining engineers work all over the world. They are located at corporate offices or consulting services offices that are typically located in major cities throughout the world. They are also located at operating properties that may be near urban areas such as sand and gravel operations. But typically mining engineers are located in more remote locations.



FOCUS ON: Specialities in Mining Engineering

Mine Valuation. Mine valuation is the process of determining the worth of a specific mineral deposit. This is necessary to determine the viability of extracting the mineral resource and making a return on the investment.

Mine Design. After a mineral resource is located and defined, the approach to mining the deposit must be engineered. The method of mining must be established, typically defined as surface or underground mining. The selection of which method to use must consider many factors, which will be specific to the site and location of the deposit.

Materials Handling. Mining is the process of selecting the resource material from other materials. Generally, depending on the nature of the mine, the volume of the materials that must be handled is quite large, whether the resource itself, the surrounding materials, or the combination of both.

Rock Excavation. The most common method of extracting the resource is rock excavation. The method of excavating the rock will vary dramatically depending on the physical properties of the rock. Rock excavation may be accomplished by simple scraping or gouging practices, in the case of soft

materials such as coal. Or it may require intense drilling followed by loading explosives in the drill holes and blasting.

Ventilation. In underground operations, special consideration must be given to the condition of the air. Emissions from underground equipment, combustion gases from blasting operations, and moisture and heat from rock surfaces affect the quality of the air. If not addressed, this will result in an unsafe or an unproductive work environment. Even if emissions are not a safety issue, in the case of

certain mine locations, worker productivity and the premature onset of fatigue can be an issue due to higher humidity and temperatures.

Rock Mechanics. The physical properties of the resources and nonresource materials are key considerations when designing and operating a mine. How well the rock holds together, how it responds to different stresses, and how that response is affected by the moisture content of the material will greatly influence the overall mine design and the approach to mining.



Profile in Mining:

Name: Dayan J. Anderson

Education: B.S. 1997 in Mining Engineering, Colorado School of Mines

Position: Mining Engineer for Cleveland-Cliffs Inc. (Empire Iron Mining Partnership)

“Everything we use today, if not grown from the Earth, is mined from the Earth. Each year the average American uses about 40,000 pounds of newly-mined minerals: from the coal we use to generate electricity and the salt we find on the kitchen table, to the aluminum we use to make Pepsi cans and more. In fact, it takes as many as 42 different minerals just to build a telephone! It is the challenge of every mine engineer to determine the best way to remove these valuable resources from the Earth while minimizing the removal of material that isn't valuable. In doing this, mining engineers help reduce the impact of mining on the Earth's surface. The idea of being part of something so basic and yet so important is exciting. Ensuring that mining is done in an environmentally responsible manner is even more exciting.

"I love the variety of my career so far. When I worked in a copper mine in New Mexico, I surveyed the pit to determine how much material had been moved by trucks the size of a two-story house. In the coal mines of Wyoming, I worked with environmental engineers and reclamation specialists to ensure that all environmental rules and regulations were met. Today, I work in an iron mine in Michigan identifying which material is valuable enough to be eventually processed into steel. My career has only just begun, and I know that I will soon have the opportunity to work and travel all over the world: from South America to Africa to India and beyond."

Exploring Opportunities: In Mineral Processing

What is mineral processing?

Mineral processing is a broad field that involves the production of both metallic and nonmetallic industrial materials. Metallic products include copper, iron, zinc and gold. Nonmetallic products include silica, kaolin, gypsum and aggregates. Mineral processing engineers have a background in the crushing, grinding and separation of the mineral from the host rock.

What is the role of science in mineral processing?

Materials engineers, or physical metallurgists, investigate the roles and uses of materials or metals and determine their use for new applications. This includes the production of raw materials for metal alloys, ceramics, glasses, and other products. For example, the tiles used to protect the space shuttle from the heat of re-entering the Earth's atmosphere are produced from industrial minerals.

What is the role of engineering in mineral processing?

Engineers develop, or direct, the mining and processing of ores to produce the raw materials used in a wide range of products. This includes the design of mines, utilities, equipment ergonomics, equipment used in the mining or production of the minerals, and the processes used to produce the mineral.

Where are the jobs in mineral processing?

Worldwide. For example, large-scale metals mining occurs in North America, South America, Australia, Asia and Africa.



FOCUS ON: Specialities in Mineral Processing

Materials Scientist. Materials scientists create new products for existing uses or new uses for existing products.

Process Chemist. Process chemists investigate or develop processes used in the production of metals or materials. Process chemists work with the process plants to reduce costs, increase production recovery, purify the metal or material, or develop new processes.

Mineral Processing Engineer. Mineral Processing Engineer. Mineral processing engineers develop and direct the processes that separate minerals from other materials. These processes include crushing, grinding and treatment with chemicals, heat, water, microbes and electrolysis.

Metallurgical Engineer. Metallurgical engineers deal primarily with the separation of the metals or materials from the ore. This specialty includes the research metallurgist, who is involved with laboratory testing to evaluate existing or new processes or equipment; the mineral processing plant metallurgist, who oversees the separation of the product

from the ore; the pyrometallurgist, who employs high-temperature processes to produce metals and

alloys; and the hydrometallurgist, who uses solvents and other solutions to extract valuable minerals.



Profile in Mineral Processing:

Name: Steve Brown

Education: B.S. 1995, Metallurgical Engineering, Mackay School of Mines, University of Nevada-Reno

Position: Metallurgical and Environmental Engineer for Unocal Molycorp's Mountain Pass Operations and part-time graduate student pursuing an M.S. in Environmental Engineering from the University of Nevada, Las Vegas

“I enjoy the people I work with and know several of their families. We consider our professions to be in one of the best industries to work in; we are outdoors, we see wildlife, plants, and can see what our work achieves from an ore to a finished product. I work with miners, mill and separations plant operators, engineers, chemists, and the public every day. Our compounds allow the world to see clearer, breathe cleaner air, and enjoy color television. The one use that I am most grateful for is the use in MRI inks which caught a medical problem of a close friend that may have gone undetected otherwise.

“Overall, this is a fast-paced industry where the planning, operations, and other demands are continually in a state of change. Some days are rough and filled with strife, others are peaceful and spent in the company of a great collection of personalities doing pro-

jects or manufacturing product. I wouldn't trade any of what I've done here and enjoy the camaraderie that has been built through the sharing of responsibility, pride, or grief in our everyday life both inside and outside of the workplace.”



Exploring Opportunities: In Environment

Why is the environment important to the mining industry?

Many people moved West in the 1800s in search of a new life. They helped open up the frontier. Mining was one of the industries that provided jobs and wealth for a country that was growing and expanding every day. At first, and for many years into the 20th century, a mine was built and the ore extracted without regard to its effect on the surrounding environment. But this practice no longer exists. The mining industry today is responsible and dedicated to compliance with all local, state and federal regulations required by environmental law. It usually takes years for a mining company to have all of the environmental permits approved before the mine is allowed to open. The mining industry has learned from its history and strives to be a good neighbor and do the right thing for the environment. Every mine today has a staff of environmental professionals to ensure that the mine meets or exceeds all environmental regulations.

What is the role of environmental specialists in the mining industry?

Environmental specialists make certain that mine management is aware of new laws and regulations that can affect the mine operation. The mine management team includes environmental professionals from various speciality fields. They work closely together to ensure the mine operates efficiently and without a mishap that could endanger the mine operations. Environmental specialists constantly

monitor the air and groundwater at the mine so that public and private lands surrounding the mine property are protected. Environmental specialists can be found working outdoors with special tools and instruments to take measurements, indoors in laboratories analyzing data and designing and planning environmental processes.

Where are the environmental jobs in the mining industry?

Environmental professionals are found in the mining industry at all levels of employment throughout the world. If you like travel and adventure, you could find yourself working at a mine in a jungle in South America. Some mines are near large towns and cities. You might like planning new environmental projects and work in an office. You could find yourself eventually working at the corporate headquarters of a mining company.

FOCUS ON: Specialities in Environment

Hydrologist. Hydrologists study the properties, distribution and effects of water in the atmosphere, on the earth's surface, and in soil and rocks.



Biologist. Biologists study the science of living organisms and life processes, including the structure, functioning, growth, origin, evolution, and distribution of living organisms.

Environmental Engineer. Environmental engineers are certified professionals who apply math, science and engineering principles to the design, construction and operation of economical and efficient structures, equipment and systems in the natural environment.



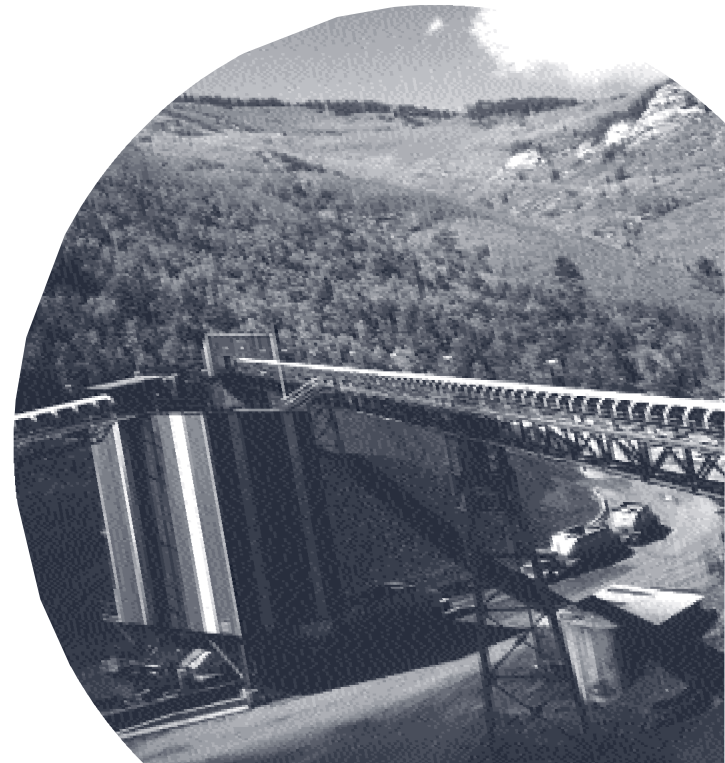
Profile in Environment:

Name: Barbara Filas

Education: B.S. in Mining Engineering from the University of Arizona, 1978

Position: Vice President of Mining and Environment at Knight Piesold Services, Inc., in Denver, Colorado.

“As a third-generation miner, I’ve grown up loving the mines: from old abandoned dog-holes to huge, contemporary operations. I’ve always loved traveling, too, seeing new places and meeting new people. I never dreamed that there was a ‘job’ that could combine the two, but the environmental work I do for the mining industry requires me to travel all over the world visiting all kinds of mines; supplies me with tour guides like biologists, geologists, archaeologists and socioeconomists who make sure I understand the ecological, human interest and historical aspects of those sites; and as unbelievable as it may seem, they actually pay me.”



Exploring Opportunities: In Health & Safety

Why is health and safety important in the minerals industry?

During the 19th century, mining methods and equipment were crude and did not improve until modern times. Miners often worked in very hazardous conditions deep in underground mines. There were many fires, accidents, serious injuries, illnesses and fatalities in the mines. Miners' unions were formed and demanded safer work conditions. The financial loss of valuable employees and equipment caused mining industry leaders to rethink how they did business. So they joined with the unions to improve working conditions. Today, mine safety and health is regarded as the top priority for the mining industry. Every mine has a staff of safety professionals to ensure that miners are knowledgeable about the equipment they use and are aware at all times about their working conditions.

What is the role of health and safety specialists in the minerals industry?

Health and safety specialists keep mine management informed about all new and applicable safety laws and regulations for the safe operation of the mine. The safety department is an important part of the management team. Mines are very proud of their safety records that result in no loss of time or injuries. Safety professionals monitor working conditions throughout the mine, mill, shops, and laboratories to ensure that all employees use personal pro-

TECTIVE equipment and are proactive about health and safety in their respective work areas. Health and safety specialists can be found working indoors and out with a wide variety of instruments and tools for taking measurements and analyzing data.

Where are the jobs for health and safety specialists?

Health and safety professionals work in the mining industry throughout the world and at all levels of employment based on their knowledge and experience. Mines are where the minerals, coal, sand, gravel or any economically extractable material is located. This can be in a jungle, desert, in the mountains or near a big city. You could also find yourself working in the corporate offices of a mining company.

FOCUS ON: Specialities in Health and Safety

Industrial Hygienist. Industrial hygienists study the science of health, prevention of disease and illness, and the conditions and practices that promote or preserve health.



Occupational Safety and Health Specialist.

Occupational safety and health specialists, through education and experience, demonstrate a thorough knowledge of safety principles, laws and regulations and apply them in the workplace.

Safety Engineer. Safety engineers are certified professionals who apply math, science, and engineering principles to the design of systems with inherent safety and fail-safe features.



Profile in Health & Safety:

Name: Robert "Larry" Grayson

Education: B.A. in mathematics, California University, PA, 1974; B.S. in Engineering of Mines, West Virginia University, 1978; M.S. in Engineering of Mines, W.V.U., 1981; Ph.D. in Mining Engineering, W.V.U., 1986

Position: Associate Director for Mine Health and Safety Research, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Department of Health and Human Services

“After graduating with a mathematics degree, I sought employment in the coal industry to pay for a baby and because most of my wife’s family worked there. In just a few weeks, I knew I wanted to dedicate my career to help improve underground mine operations; the work environment; interactions among management, labor, and government; and fulfill my personal academic goals. I have a deep-rooted respect for the often unpredictable challenges of mining and admire the ability of miners to overcome them.”



Academics:

Making the Right Choices

Selecting the right school is an important first step in pursuing a career in the minerals industry. Schools differ in academic, social, and financial demands and opportunities. Given below are the most important criteria for selecting a school for a minerals career:

- Type of school
- Academic programs
- Faculty
- Cost and financial aid

Type of school. Most mineral schools are located either in a university, an institute of technology or a polytechnic institute. One should also consider related factors, such as professional societies, student body, school size and campus facilities such as housing, sports facilities, cultural and leisure activities. It is always wise to tour the institution you are considering attending to see if they have the facilities important to you.

Academic programs. Many minerals engineering programs in the United States have been accredited by the Accreditation Board for Engineering and Technology (ABET). This organization follows national standards of quality for faculty, curricula, students, administration, facilities and institutional commitment. Be sure to check the accreditation of the particular program of interest to you. Once you've narrowed your choices, look through each school's catalog and browse through its homepage on the Internet.

You should also check out a school's academic approach—whether the programs take a theoretical approach or also provide practical experience. A school that offers an interdisciplinary approach is highly preferable.

Other items to be considered are internship and co-op programs with the minerals industry and research opportunities. It is a good idea to talk to students currently enrolled in the program.

Faculty. An ABET-accredited program meets certain national standards in maintaining the faculty. Examine whether the faculty has an established reputation for teaching or research. Also, a diverse faculty prepares you to work with people from different cultures, a strength when considering the global nature of the minerals industry.

Finally, check out the academic resources, such as library facilities, computer facilities, laboratory equipment, and types of counseling and tutorial services available on the campus.

Cost and financial aid. Cost sometimes becomes a primary factor in selecting a school. Remember, public institutions offer excellent engineering programs and are less expensive than private institutions. In most of the mineral schools, scholarships, grants, part-time employment, and co-op and work-study programs are available.

Notes:





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Today's minerals industry offers a wide range of rewarding careers that feature top salaries, travel, and the chance to work with advanced technology. This handbook provides a quick overview of these opportunities and could put you on the path to an exciting career in the minerals industry.

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