Careers in Mining

Level: MS
Facilitator Guide

LESSON DETAILS

Objective: Students will explore careers involved in each step of the mining process and will learn how their personal interests align with specific roles within those careers.

Standards

NVACSS and NGSS

- **MS-ESS3-1:** Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- **MS-ESS3-4:** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- **DCI:** Human Impacts on Earth Systems
- **SEP:** Obtaining, Evaluating, and Communicating Information
- **CCC:** Interdependence of Science, Engineering, and Technology

Career Readiness

- **1.1.3:** Demonstrate teamwork skills by contributing to the success of the team, assisting others, and requesting help when needed.
- **1.2.3:** Demonstrate critical-thinking and problem-solving skills by analyzing and resolving problems that arise in completing assigned tasks.

Materials

- mini pom-poms or other small objects
- tools or bowls for **Engage** activity (optional)
- glue sticks
- scissors
- blank paper
- copies of "The Mining Process Icons" handout
- copies of "Career Skills and Roles" handout
- copies of "Investment and Profit Icons" handout (cut apart)
- copies of "Mining Careers" handouts

Lesson Summary

Students will work in teams to locate items in a designated "mine" in the classroom, then discuss the skills needed to address and solve problems. Students then match career-related skills with steps of the mining process to show how different jobs and roles work together to run a successful mine. A discussion of the steps of the mining process will help students refine how they matched career-related skills to each step. Students then consider their own skill sets and interests to relate to mining careers they could pursue. Finally, students revisit the initial activity to apply what they learned about mining careers to more efficiently "mine" for items.

Preparation

Before **Explore** and **Explain**, review the **stages of mining** and determine the level of detail you want to address with your students.

For **Engage**, clear two spaces in the classroom where you can scatter mini pom-poms or other small objects that will represent a mineral resource. You may want these areas to differ in size, shape, accessibility, or "terrain" to mimic challenges a mining company might face when locating new mineral deposits. Randomly spread the objects throughout each area to mimic how mineral resources are not evenly distributed in the environment. Consider if you want to have tools (e.g., scoops, tongs) and/or containers for students to use in collecting the pom-poms.

Engage

1. Tell students that their groups have the opportunity to compete for the development of a mining site.

2. Allow students to make observations of at least two potential mine sites, then work in groups to make a plan for how they can collect as many pom-poms as possible from one of the sites. Tell students:

   a. They need to justify their site choice.

   b. They have only 20 seconds to collect the mineral resource and transport it to a designated area (e.g., a bowl or a specific desk).

   c. They need to follow safety rules, such as not running.

   d. You are the investor who will choose which plans will be used for collecting the resources. Share some key factors that you will consider in your selection, such as:

   - **Teamwork:** teams in which students specify how they will work together to collect the pom-poms.
   - **Roles:** teams in which students will assume different responsibilities to collect the pom-poms.
   - **Tools:** teams that use available resources in the classroom to improve efficiency.
   - **Innovations:** teams that have the most unique approach.

3. Have each group share their plan and decide which groups will execute their plans. You might have all groups to carry out their plans, or select specific groups depending on time.

4. Discuss how successful each group was and why some plans were more successful than others, relating to many factors, including the uneven distribution of the mineral at each site.

Explore

1. Give each student group a copy of "The Mining Process Icons" handout and allow students time to make observations of the icons.

2. Ask students to identify which steps they took part in during **Engage** (such as planning, production, and distribution), and to explain their choices with evidence from the activity.

3. Discuss the rest of the terms to review their meanings, as needed, and to relate them to the process of mining.

4. Have students cut out the icons and arrange them on a blank sheet of paper in the order they think the steps occur in the mining process.

   a. Have students **read about mining for gold** to help them arrange the icons.

   b. Have students get into their groups to discuss their order.

   c. Facilitate a class discussion on the order students chose. Show Figure 1 that has the icons in the order in which the steps of mining most frequently occur. Ask students:

   - *Why do you think the icons are in a circle?*
   - *When might mining companies need to revisit or redo a step?*
   - *When might some steps of the mining process overlap?*

5. Provide each group a copy of the "Career Skills and Roles" handout.

6. In groups, have students discuss the list on the "Career Skills and Roles" handout to decide which steps of the mining process each skill or role applies to.

   a. They should write the roles next to each step on "The Mining Process" handout where they apply.

   b. You may want to do one or two as an example, especially noting that each skill or role may apply to more than one step of the mining process.

7. As groups finish, discuss some of their choices and why different skills and roles are needed at each step of the process.

8. Have each group then consider other potential steps related to financial careers, namely "Investment" and "Profit."

a. First discuss the skills and roles that could be used to describe financial careers in addition to the list that is provided, such as: math skills (calculating costs, profits, budgets, and forecasts), negotiating (prices and contracts), and the specific knowledge these careers might need (tax and financial laws and rules).

b. Discuss with students where they would place "Investment" and "Profit" icons.

c. Provide each group with 6 Investment and 1 Profit icons to add where financial careers are most involved to "The Mining Process" handout (see Figure 2).

9. Ask students:

- *Are there any roles that relate to mining that could be added to the diagram? What are they and where would you add them?*
- *Do you think there are any steps or details that are missing from "The Mining Process" diagram? What are they? What other roles or skills might they require?*

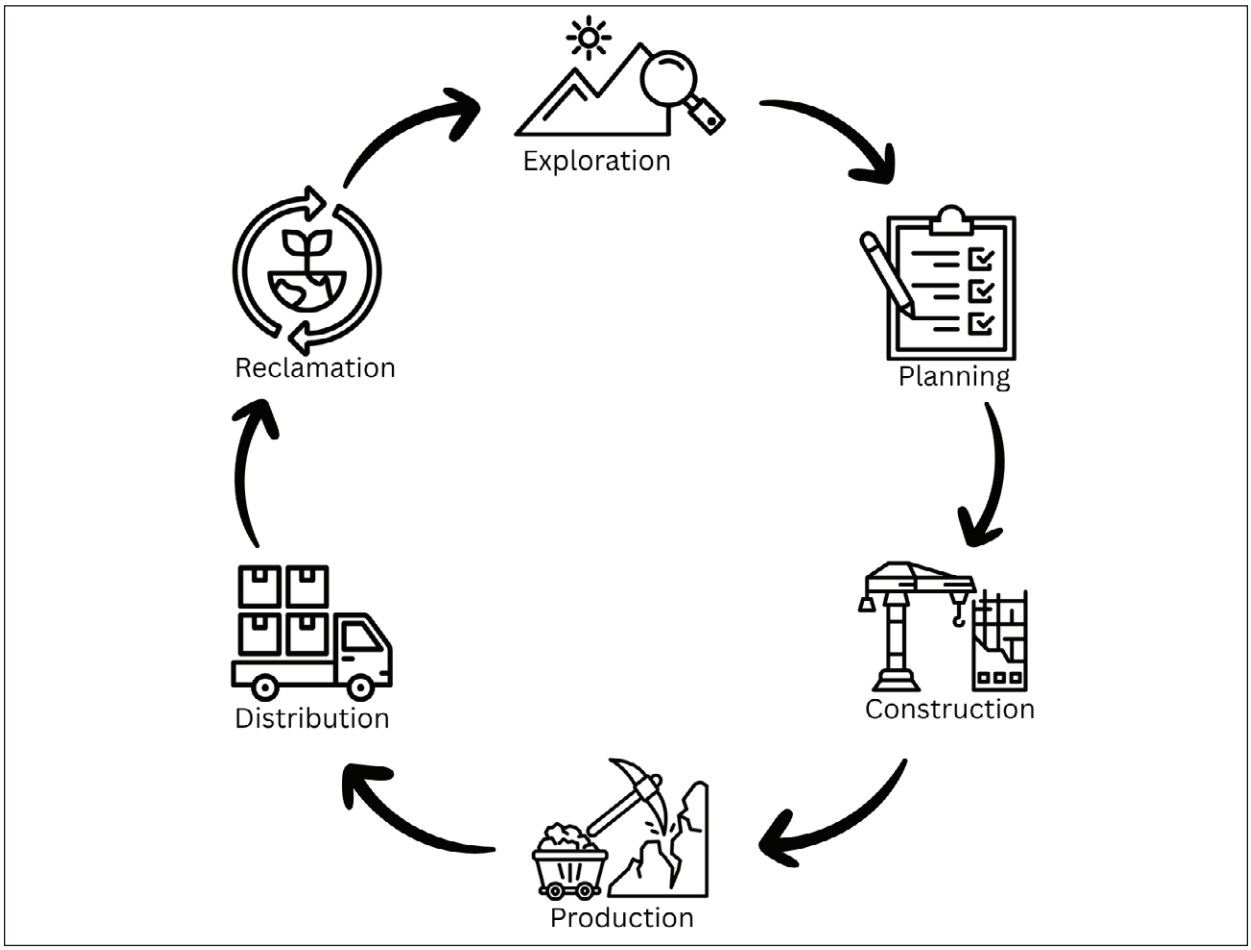


FIGURE 1. THE MINING PROCESS

Credit: Created using icons from The Noun Project, CC BY 3.0.

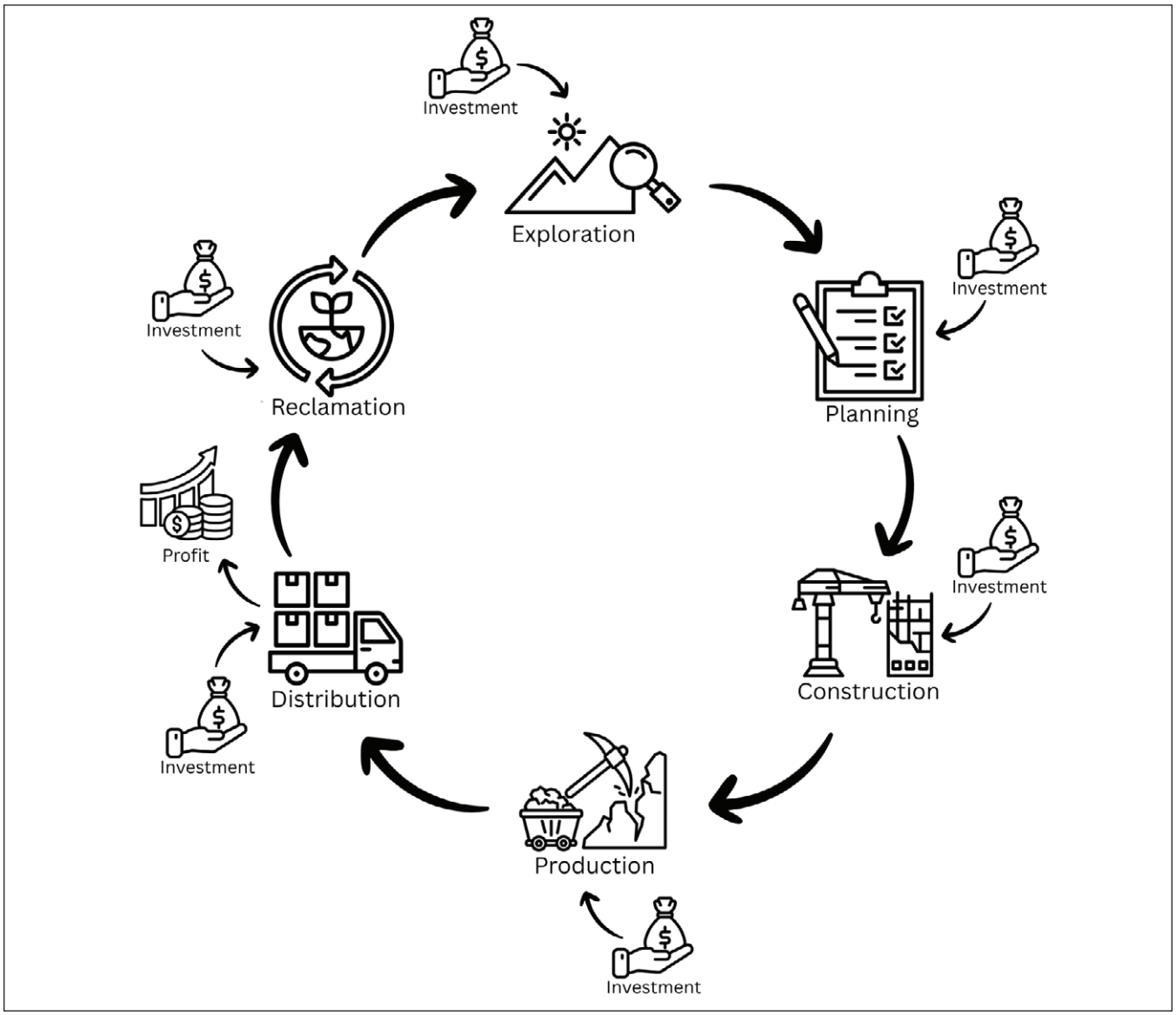


FIGURE 2. SAMPLE MINING PROCESS DIAGRAM WITH INVESTMENT AND PROFIT ICONS ADDED

Credit: Created using icons from The Noun Project, CC BY 3.0.

Explain

1. Have students watch a **video about the mining process in Nevada**.

2. Pause the video to discuss the steps of the mining process and to allow students to review the skills and roles they related to each step. Sections of the video include:

   a. Introduction to mining and the Nevada Mining Association (0:00–2:54)

   b. Skills and roles related to the mining industry (2:54–4:12 and 7:47–8:54)

c. Why mining careers are important (4:12–6:20)

d. How people's interests can relate to mining careers (6:20–7:47)

e. Ways to learn more about mining careers and related skills (8:54–9:43)

3. Discuss each group's diagram, addressing questions they might have about which steps of the mining process align with different skills or roles. Discuss that there is not one correct answer, but they should be able to justify the placement of skills within the steps.

Elaborate

1. Have students choose 2–5 interests and/or skills from the "Career Skills and Roles" handout that they identify with or that describe what they like to do.

2. Then, have students try to identify which step of the mining process their interests and skills best align with.

   a. Give students the "Mining Careers" handout that matches the step of the mining process they identified. Tell students that the careers described on these handouts represent only a few jobs within each step of the mining process.

   b. Have students read the career descriptions on these cards to identify which career is of most interest to them. If students do not find a career that interests them, provide access to the other handouts so they can find a career that suits their interests.

   c. Optionally, group students by their career choices to discuss what interests them about their choice.

   d. Have some students share about their career choice and how it matches their interests.

3. Have students access a course catalog or a list of courses offered by the high school they will attend.

   a. Have students identify at least 2 classes that they think would help prepare them for the mining career in which they are most interested.

   b. Students should describe why they think each course will help them prepare for the chosen career.

   c. Have a few students who have chosen different careers to share the courses they think they should take. Note similarities or differences.

   d. Have a class discussion on how courses align with different careers to reinforce that the mining process relies on a wide range of skills and knowledge bases, from science and engineering to communication and finance.

Evaluate

1. Revisit the activity from **Engage**. Have students return to their initial groups.

2. Groups should discuss what they have learned about the mining process and how they would change the activity or their approach to collecting the resource.

3. Discuss students' suggested changes and why they would make them. Ask students:

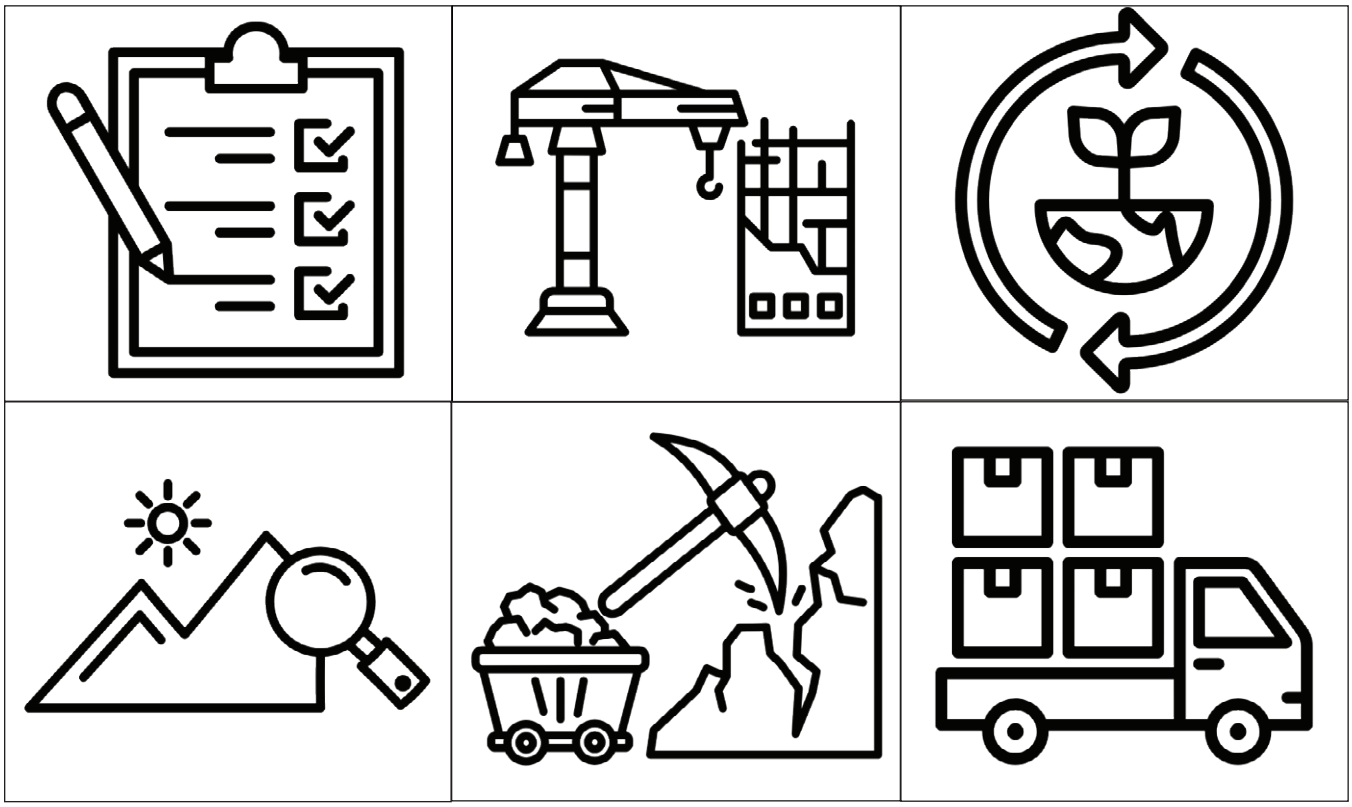
   - *Which step of the mining process was the most difficult to add to your plan? Why do you think this is?*

   - *Were there any steps you were not able to add or represent in your plan? Why is this? What further changes could you make so this activity is more like actual mining?* Examples include adding financial steps and the exchange of money; construction of buildings to support the mining operation; or reclamation and rebuilding of the land if they did not have to disturb anything to get to the resources.

4. Have students repeat the activity with some of their changes incorporated. Discuss how the activity has changed and how it is more like the actual mining process.

HANDOUT

The Mining Process



HANDOUT

Career Skills and Roles

Operating large equipment

Following safety rules

Working outdoors

Testing mineral samples

Works with computers

Collecting and analyzing data

Using or making maps

Testing water or air quality

Focusing on details

Doing physical tasks and/or using tools

Organized

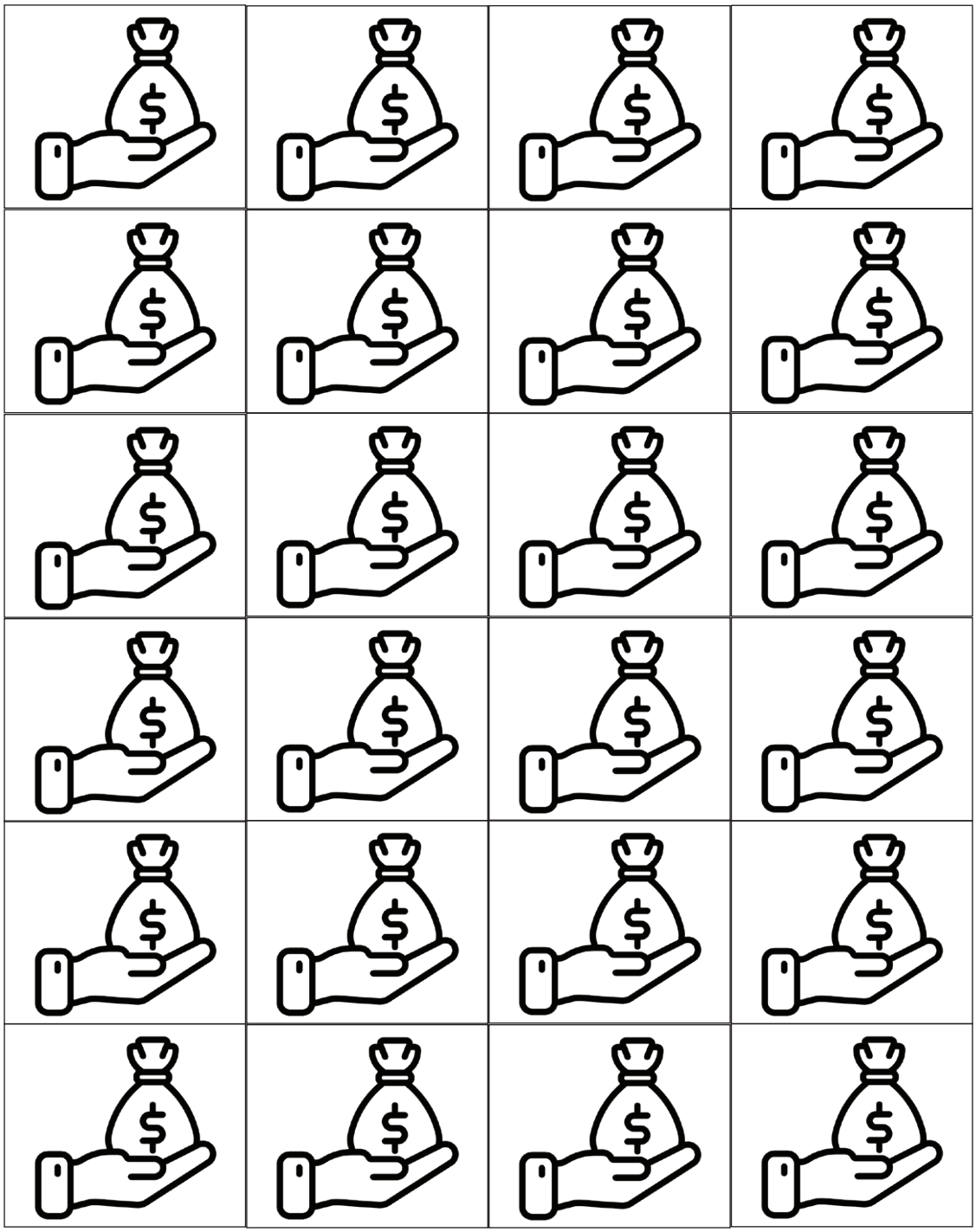
Problem-solving

Making decisions

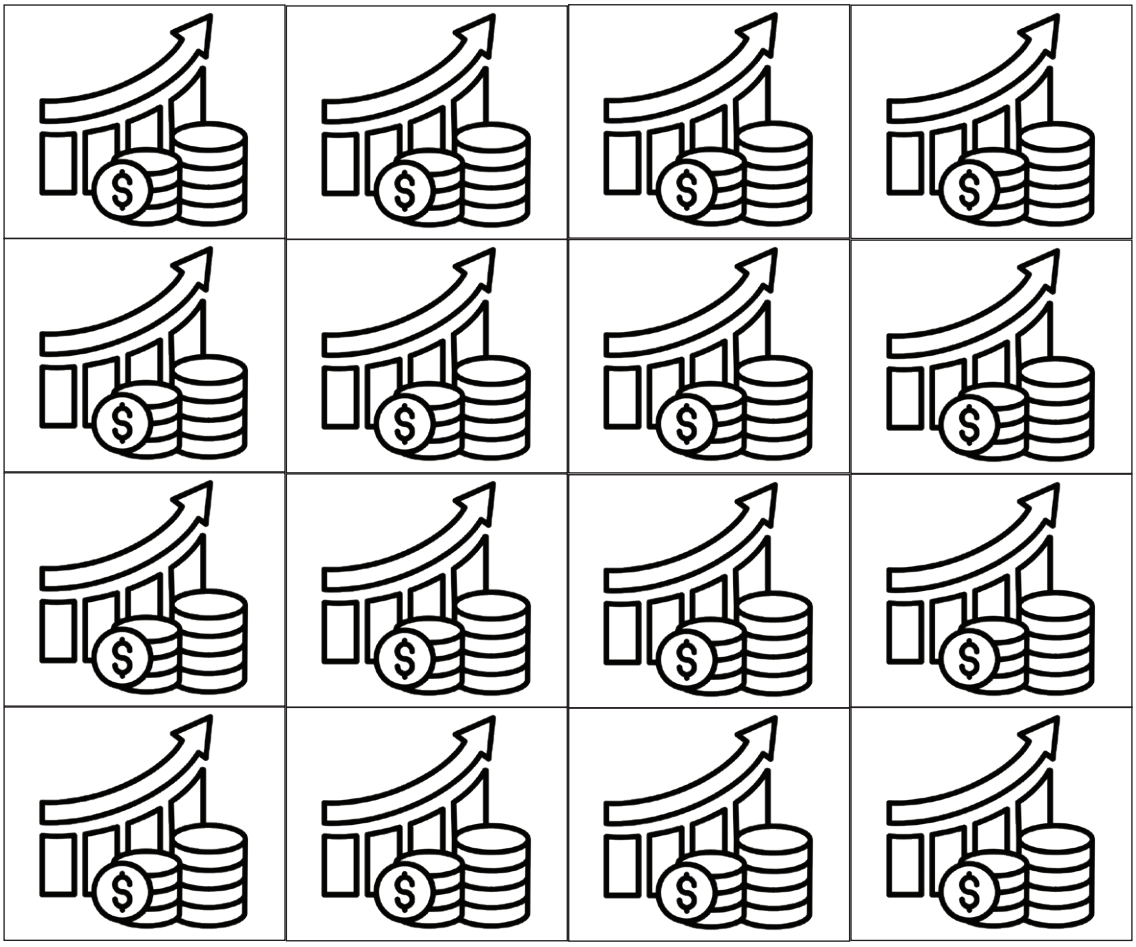
Working in a team

Writing reports

Investment Icons



Profit Icons



HANDOUT

Mining Careers: Exploration

Exploration: Mine Surveyor

Do you like spending time outdoors? Do you like both physical and mental work (like math problems)? Would you like to learn how to make maps? If so, then consider becoming a **Mine Surveyor**.

A mine surveyor provides all sorts of information to people planning and working at a mine site. This information may include the location of mineral resources, buildings, fences or power lines. As a mine surveyor, you may be called upon to provide elevations or to locate underground areas to be explored for minerals. You may also be required to supervise others.

Mine surveyors need to have a degree in surveying (2 years) from a college certified by the Accreditation Board for Engineering & Technology (ABET), or you may have an engineering degree with a surveying focus. You will also need two to five years experience working on a mine survey crew.

Exploration: Exploration (Mine) Geologist

Do you love exploring the Earth's surface or digging to find out what lies beneath it? Do you want to know where mineral resources occur? Do you enjoy challenges? If so, a career as an **Exploration Geologist** might be perfect for you.

As an Exploration or Mine Geologist, you will use your understanding of the relationship of geology (faults, rock types, structures, etc.) to ore formation to identify potential mine sites. You will also conduct fieldwork to locate mineral deposits, study rock formations, and analyze geological data. You will work with various tools and techniques such as mapping, drilling, and sampling to guide the decision to develop new mines. You will also help inform the mining process so resources are extracted sustainably.

Exploration Geologists need a college degree in Geology, Earth Science, or a related field.

Exploration: Geophysical Technician

Are you fascinated by technology and enjoy working with data and equipment? Are you curious about what is beneath Earth’s surface? Do you like problem-solving and contributing to discoveries? If so, a career as a **Geophysical Technician** in mining might be a great fit for you.

As a Geophysical Technician, you will use technical instruments to conduct surveys that help locate mineral deposits, like seismic, magnetic, and electrical resistivity surveys. By analyzing the data, you’ll help geologists and engineers determine the best locations for drilling and mineral extraction. Your role is essential in guiding exploration teams and ensuring efficient resource discovery.

To become a Geophysical Technician, you will need a degree or certification in Geophysics, Geology, or a related field, along with experience working with geophysical equipment.

HANDOUT

Mining Careers: Planning

Planning: Administrative Assistant

Do you enjoy working with and helping others? Do you like to stay organized and work on a computer? If so, you might like to be an **Administrative Assistant**.

In this role at a mining company, you will assist various departments with maintaining schedules, routing mail, typing reports, and organizing files. In addition, you will screen and route phone calls and visitors. You will work with computers, copy machines, and other office equipment.

To be an Administrative Assistant you will need a high school diploma or equivalent and know basic office machines.

Planning: Environmental Manager

Do you love being outdoors and want to see the environment managed carefully? Do you like solving complex problems? If you are self-motivated with good negotiating skills, then you might enjoy the job of **Environmental Manager**.

In this position you will work with all kinds of people on a mine site as well as State and Federal Environmental workers. As environmental manager, you would be responsible for water, soil and air monitoring procedures and reports, implementing environmental programs that would include guiding on-site environmental tours and inspections before, during, and after mining.

To become an Environmental Manager a college degree in Environmental Science, Engineering, Geohydrology, Metallurgy, Geology, Chemistry or Resource Management is required. In addition, you will also need one to 2 years experience in the mining industry.

Planning: Systems Manager

Do you like using computers to do complex tasks (like coding)? Do you enjoy finding patterns in data? Do you like working with people to help them work more efficiently and safely? If so, you might want to consider becoming a **Systems Manager** at a mine.

As a Systems Manager you will be responsible for the operation of all computer hardware and software on the mine site to inform planning, track production, and manage the movement of large equipment. In addition, you will provide new or updated programming via development or purchase, as well as training and troubleshooting on hardware and software. You will need to be able to work with all types of people and good at solving problems.

As a Systems Manager, you will need a college degree in Computer Science or a related field.

HANDOUT

Mining Careers: Construction

Construction: Electrician

Do you like installing or taking apart electronics? Do you prefer to do tasks that require the use of tools? Are you willing to follow safety rules? If you answered yes, you might want to become an **Electrician**.

As an Electrician at a mine site, you would work on electrical construction, instrumentation, and all electrical repairs on mine equipment. You will also be required to use hand and power tools, plus electrical test equipment. In addition, you must know how to read complex diagrams and have a working knowledge of electrical currents and their potential hazards.

To be an Electrician you will need a high school diploma or equivalent and two (2) years experience in maintenance, electrical construction, instrumentation, or other associated electrical fields. Trade schools and U. S. Military branches provide excellent technical training for this field. You will also be required to pass a written test to become a certified Electrician.

Construction: Safety Technician

Do you like doing presentations? Do you enjoy helping others learn new skills or rules? Are you organized? Then consider becoming a **Safety Technician**.

A Safety Technician trains all mining staff on safety rules, maintains records, and works with the Mine Safety and Health Administration (MSHA) and State Mine Inspectors to ensure the mine is being operated safely. In addition, a technician collects data and prepares written reports on potential safety hazards or issues that occur throughout a mine's operation. This job can lead to a Safety Coordinator position, who is in charge of a mine's safety department.

As a Safety Technician, you would need a high school diploma, one year experience in surface mining, computer knowledge, certification as an MSHA Instructor and as a First Responder.

Construction: Mine Engineer

Do you like to develop plans and work with numbers? Do you enjoy supervising and working with others? Do you pay attention to detail? A career as a **Mine Engineer** may be for you.

As a Mine Engineer you will work with all kinds of people to optimize mine operations to reduce costs. This can be achieved through mine design and planning, equipment selection and production reporting. You will need to have knowledge of geology, engineering principles, and mining methods to prepare plans on mine development and to write reports on mine operations.

A Mine Engineer requires a college degree in Mine, Geological, or Civil Engineering.

HANDOUT

Mining Careers: Production

Production: Welder

Do you enjoy working with your hands? Does the idea that you can fix heavy equipment appeal to you? If this is your interest and you want a skill-based career, then consider becoming a **Welder**.

As a Welder in the Minerals Industry, you could work on many types of equipment from light vehicles to large crushers. You will be required to identify and document the majority of welding-related problems and communicate about any issues so they can be addressed. You must be able to perform welding repair jobs and use all tools and equipment properly. You may have the opportunity to be trained in operating the equipment as well.

Mine welders need a high school diploma andone to two years experience with welding.

Production: Blaster or Driller

Would you like to work with equipment and explosives to break apart rocks? Are you good at thinking on your feet? Are you willing to follow safety protocols? Maybe you would like a career as a **Blaster** or **Driller**.

As a Blaster, you will learn how to safely handle explosives, load and tie in blast patterns, and calculate the tons of rock broken and quantities of explosives used. As a Driller, you will perform equipment inspections, drill holes, collect cutting samples to the proper specifications, and change bits and hammers on the drill to keep it operational. In both roles, you will be required to operate equipment safely and efficiently,fill out all required reports, and communicate effectively both verbally and in writing.

To be a Blaster or Driller, you will need a high school diploma or equivalent and a minimum of one to two years experience working as a laborer. Additionally, Blasters are expected to attend any required blasting schools and may be required to obtain a State Certified Blasting License.

Production: Assayer or Metallurgist

Are you curious about what materials are made up of? Do you enjoy math problems and science labs? If so, maybe you would like to be an **Assayer** or **Metallurgist**.

As an Assayer, you would prepare samples of minerals, test them for purity, and estimate the amount of minerals within the rocks removed from the mine. As a Metallurgist, you would test metal minerals for their properties and help design extraction methods to remove metals from rock. In both roles, you would work in a lab, running tests on mineral samples, do calculations, and fill out daily reports that inform the process of extraction and refining.

To be an Assayer, you will need a high school diploma and a minimum of six months experience related to fire assaying and sample preparation. You must also pass written and hands on tests for

basic assay calculations, techniques, and safety policies. A metallurgist needs a college degree in Metallurgical Engineering.

HANDOUT

Mining Careers: Distribution

Distribution: Mechanic

Do you like using tools and working with your hands? Do you think you would enjoy diagnosing and repairing faulty equipment? If so, then you could consider a career as a **Mechanic**.

As a mechanic, you will check equipment and vehicles for problems, as well as document and repair all mobile equipment on the mine site, which includes loaders, trucks, graders, dozers, pickups, cranes, forklifts, and more. You will need to be knowledgeable about the proper use of tools and equipment for repair operations and also potentially do some minor welding.

Mechanics need a high school diploma and at least two years experience in mobile equipment repairs.

Distribution: Equipment Operator

Are you interested in operating large vehicles? Are you concerned with safety? Are you good at staying focused for long periods of time? Then you should consider the job of **Equipment Operator**.

As an Equipment Operator you will learn how to safely operate any one or more of the large pieces of equipment used on a mine site (dozers, loaders, graders, shovels, off-road haul trucks). Additionally, you will be required to perform the safety and mechanical inspections of the equipment you operate. You will need to be able to remain alert during a shift, climb a 10-foot ladder to get on the equipment, and communicate effectively, even in loud or distracting conditions.

Equipment Operators receive training either on-the-job or from a heavy equipment trade school.

You will also be required to have a high school diploma or equivalent and a minimum of one year mining experience before being considered for training.

Distribution: Refiner

Do you like working in small groups? Do you like the idea of being the first to see a final product? Are you good at following detailed instructions? If this sounds good, then consider the job of **Refiner**.

As a Refiner, you would be responsible for the operation of all equipment used to separate minerals from rocks extracted during mining and then purify the minerals. You would be expected to troubleshoot any problems that arise, keep accurate records of production, and be able to do some physical manual labor. You will need to work with minimal supervision, be self-motivated, and communicate effectively.

To become a Refiner, you will need a high school diploma and receive on-the-job training. You would also need to satisfactorily complete a stringent background check.

HANDOUT

Mining Careers: Reclamation

Reclamation: Hydrologist

Do you enjoy solving problems related to water quality? Are you curious about how water affects ecosystems? If so, a career as a **Hydrologist** in mine reclamation could be right for you.

As a Hydrologist, you will study flow patterns of groundwater and surface water at and around mine sites. You will monitor water quality, design water management plans, ensure compliance with environmental regulations, and could help in constructing wetlands that help improve water quality. Your work will help prevent or reduce contamination and the spread of pollution into bodies of water and groundwater.

To become a Hydrologist, you will need a college degree in Hydrology, Environmental Science, or a related field.

Reclamation: Community Relations Coordinator

Are you passionate about communication and helping communities understand the importance of sustainable practices? Do you enjoy building strong relationships with people and advocating for environmental responsibility? If so, a career as a **Community Relations Coordinator** in mine reclamation might be a perfect fit.

As a Community Relations Coordinator, you will engage with local communities and government agencies to ensure clear communication about mine reclamation efforts. You will be responsible for addressing community concerns, organizing public meetings, and promoting transparency about the progress and impact of the reclamation project.

To pursue this role, you will need a degree in Communications, Public Relations, or a related field. A strong background in Environmental Science is also recommended.

Reclamation: Environmental Technician

Do you like working outdoors and contributing to the protection of the environment? Are you detail-oriented and enjoy collecting and analyzing data? If so, you might consider becoming an **Environmental Technician** in mine reclamation.

As an Environmental Technician, you will assist in monitoring soil, water, and air quality on mine sites. You will collect samples, conduct field tests, and ensure that reclamation efforts align with environmental standards. You will also help implement and maintain reclamation plans to restore habitats and prevent environmental damage.

To become an Environmental Technician, you will need a degree or certification in Environmental Science, Ecology, or a related field.

HANDOUT

Mining Careers: Financial

Financial: Accountant

Do you enjoy working with money and doing calculations? Do you like to work by yourself? Are you organized? Then, a career as an **Accountant** may work for you.

An Accountant provides all the cost and profit information for the mine site. This includes maintaining accurate records of all money spent and received, reviewing payroll records, performing internal audits to check for errors, providing all financial reports and assisting in preparing annual budgets.

As an Accountant, you must have a bachelors degree in accounting or business administration. In addition you may be required to obtain a CPA (Certified Professional Accountant) certificate.

Financial: Purchasing Agent

Do you like shopping for others? Do you like dealing with people and negotiating prices? If so you might like to become a **Purchasing Agent**.

As a Purchasing Agent, you will be responsible for researching purchasing options, organizing the delivery of all goods and services, and making sure that a good relationship is maintained between the mining company and its suppliers. You must also be familiar with all the phases of mine operation and the vendor supplied equipment and parts that match the mining company's systems.

To be a purchasing agent you will need a high school diploma and must have a minimum of five to ten years experience in purchasing. It will also be beneficial to have contract negotiation experience and be able to communicate with all types of people.

Financial: Analyst

Do you have a keen eye for numbers? Do you like the idea of balancing risks with rewards? Are you interested in how investments and market trends affect the mining industry? If so, a career as a **Mining Financial Analyst** might be the perfect fit for you.

As a Mining Financial Analyst, you will assess if proposed mining projects will be profitable by conducting cost-benefit analyses. You will review market conditions, evaluate resource prices, and provide data-driven recommendations to senior management who approve financial decisions. Your work will directly influence the financial strategy and investment decisions of the company.

To become a Mining Financial Analyst, you will need a degree in Finance, Economics, or a related field. Additional certifications in financial analysis or investment may be beneficial.