EARTH SCIENCE 11 / GEOLOGY 12
CAREER EXPLORATION
RESEARCH ACTIVITY

Name _____
Block _____

Website: earthsciencescanada.com/careers/

I. WHAT IS EARTH SCIENCE?

1. **What do Earth Scientists do?** BRIEFLY describe each of the following.

Create - _____

Explore - _____

Develop - _____

Track - _____

Help - _____

Search - _____

Discover - _____

Study - _____

Unlock - _____

Find - _____

2. **Who are Earth Scientists?** List the places where they are trained.

_____

_____

_____

3. **Where do Earth Scientists work?** Give at least 3 examples for each of the following.

In the Field:

_____

_____

_____

In the Lab:

_____

_____

_____

In the Office:

_____

_____

_____

Overseas:

_____

_____

_____

4. **What's in it for you?** BRIEFLY describe each of the following.

Opportunity - _____

Money - _____

Excitement - _____

Flexibility - _____

Development- _____

Satisfaction - _____

II. WHAT DO I NEED?

Refer to the “Admission Requirements” chart for most University/College Programs.

5. Which courses are you missing if you were interested in pursuing a geoscience career?

_____

_____

III. HOW MUCH CAN I MAKE?

Earth science jobs are some of the highest paying jobs out there. The minimum wage across Canada ranges from $9.50 to $11 per hour. But Earth science students graduating with a university degree, college diploma, or technical certificate can expect to earn around _____. With experience, training, and added job responsibility, their income quickly rises

In Canada, many Earth scientists are employed by the major _____ industries - energy (oil and gas), mining and minerals. These are some of the highest paying jobs out there

An Earth scientist may work for a company that pays them a _____ (a set annual income), and provides them with _____ (extended health care, a company vehicle, vacation pay), or they may work for themselves as independent _____, where they are employed by different clients. The value of the services they provide to their clients determines the amount of money they earn.

You are also very valuable to an employer if you can _____.

IV. WHAT CAN I BE?

Complete the following sections by filling in the missing word or phrase.

A. Energy

What's it all about?

Energy is essential for most everything we do - it lights and heats our homes and offices, cooks our food, and powers our cars, buses and trucks. Energy comes directly from the Sun, moving water, wind, and heat from within the Earth. Energy can be produced from _____, including oil, natural gas and coal, from uranium through radioactive decay, and from the Earth in the form of geothermal energy. Earth

scientists use their knowledge to search for and develop these important resources, all of which are abundant in Canada.

What kind of work is involved?

Geologists, geophysicists, and geochemists use their knowledge of physical geography, chemistry, physics, biology, and mathematics to locate reservoirs of oil and natural gas, coal seams, uranium deposits, and superheated bodies of water at shallow depth in Earth's crust. They:

- _____ rocks, sediments, minerals and fossils to determine the subsurface features of the Earth;
- perform _____ surveys and use interactive computer analysis to create 3D models of the subsurface;
- conduct field work and produce maps of potential mineral deposits and subsurface hydrocarbon reservoirs;
- interpret satellite data as well as other surface information, such as _____ features, that may reflect subsurface structures;
- study and map both the ocean floor and the rocks below it with remote sensing devices carried on ships and _____;
- use computers to simulate the movement and chemistry of water, mineral, or hydrocarbon-rich fluids below the surface.

What jobs are out there?

Canada has abundant _____, thus the energy sector is one of the largest sources of employment of Earth scientists in Canada. We also have some of the richest deposits of _____ in the world in northern Saskatchewan, and are the world's largest producer of hydroelectricity. In certain conditions, geothermal energy can be tapped to produce additional electricity.

Well trained geologists, geophysicists, and geochemists are required for exploration, development, and production. _____ are needed to install, operate, service, and monitor field equipment. Specialists are needed to program computers and process data. Lab specialists are required to record and analyze samples collected in the field. And _____ are required to monitor the impacts of exploration and production activities, as well as contribute to the reclamation of sites, and develop new technologies for sustainable energy in the long-term. The opportunities are endless - there is something for everyone in energy.

Why is the work important?

Today, a continuous supply of oil, natural gas, coal and uranium is essential to sustain our way of life. These resources enable us to operate our machines, travel the world, construct our buildings and roads, and manufacture our goods. Without these resources, we would return to the Stone Age. Earth scientists find these precious resources, and also work to minimize the imapct of their exploitation on our _____. As these energy sources become scarcer, they must work harder to find minerals and hydrocarbons that are deeper within the Earth and that are located in more difficult environments, such as Canada's Arctic and offshore. In

addition, Earth scientists are leaders in the development of _____ energy. We need a new generation of young, innovative, resourceful Earth scientists to ensure our future is bright.

Is it right for you?

If you enjoy discovery, computers, new technology, and finding solutions to the challenges that society faces, a career in energy may be right for you.

B. Education

What's it all about?

Everyone should have a fundamental understanding of the world in which they live so that they can make _____ decisions about how they live and understand their responsibilities to their community. Earth scientists share their knowledge of how our planet ticks, thus raising awareness and improving consumer, corporate, and government decisions that affect our lives. Earth science education is a full-time career for some (such as _____ and _____), while many other Earth scientists are involved in education as part of their job or as volunteers.

What kind of work is involved?

The job of an Earth science educator is to share the wonderful world of geology with students and the public. Many educators work with specialists to make technical information _____ to people with limited training in the Earth sciences.

Educators teach students, the public, and government. They produce _____, posters, books, magazines, websites, and displays for community events, conferences, museums, science centers, offices, parks, schools. They also organize courses, _____, lab experiments, field trips, and special events.

What jobs are out there?

Many Earth science educators have specialized knowledge of one aspect of science, for example _____, but all of them also have a broad understanding of the Earth, which they share with others. Government agencies, such as the Geological Survey of Canada, or Parks Canada, employ Earth scientists who work to educate the public. Earth scientists also work for science centers and _____, as curators and researchers. Museum curators, for example, collect, prepare, and archive fossils, rocks, and precious minerals. They create informative displays and exhibits, and arrange loans of rare specimens to other museums. Imagine rebuilding the _____ of a tyrannosaurus rex shipped from a museum in a foreign country!

Many Earth scientists choose to obtain an Education degree so that they can excite students from Kindergarten to Grade 12 about the wonders of the Earth. They teach them about the importance of our mineral and energy resources in their everyday lives, and about protecting the _____.

Earth science university and college instructors teach courses to students and mentor young people who are pursuing undergraduate and graduate degrees in science and other subjects. The teacher and students work as a detective team to reconstruct the _____ of the Earth, and their research is made public in reports, articles in science journals, and textbooks.

Why is Earth science education important?

Have you ever noticed that continents look like they fit together like jigsaw puzzle pieces? This observation was one the first that led to the theory of _____, which explains why earthquakes occur, why volcanoes erupt, and how mountains and ocean trenches form. If Earth scientists had not developed this theory and explained it to others, we'd still be scratching our heads and wondering if the world was _____! Those involved in education and outreach are important people.

Earth science education enhances our ability to make informed decisions about how to extract and use non-renewable resources, how to manage and protect the environment, and how to prepare for and respond to _____. Young people who gain this knowledge early in their lives can influence older generations of leaders and decision makers, and get involved in future trends and policies that will improve the long term health and safety of society.

We still have much to learn about our planet - new discoveries will be made, new technologies will come on stream that help Earth scientists decipher the 4.5 _____ of Earth history, and solutions will be found to the pressing environmental problems humanity faces. You can be part of this exciting future.

Is it right for you?

Do you enjoy challenges and working with others? If you get involved in Earth science education, you can be a leader, get involved in interesting projects, and discover new things. Best of all, you will excite others about the wonders of the Earth.

C. Environment & Water

What's it all about?

Our planet is incredibly complex and beautiful - everything on it is interconnected. We must understand these connections to maintain a healthy and sustainable world for future generations. Many Earth scientists are employed to protect the _____.

What kind of work is involved?

- **Unravel the past to understand the future!**

Earth scientists study _____, rock formations, sediments, and fossils to uncover the secrets of the past. This knowledge allows scientists to understand complex environmental issues, as well as the impacts humans are having on our planet. Earth scientists are able to predict what our planet will be like in the future.

- **Water, water everywhere**

Earth scientists study the movement and quality of surface and subsurface water. They manage wastewater, protect groundwater from _____, and produce electrical power from streams and rivers.

- **Mother Nature's violent side**

Earth scientists study earthquakes, tsunamis, floods, landslides, volcanic eruptions, and other hazardous natural phenomena. As you might imagine, their skills are in great demand. For example, they may be asked to advise authorities on what an _____ might do to buildings, roads, or bridges. They produce maps that identify areas at risk of flooding by rivers or streams, slope instability following forest fires, and debris flows or snow avalanches in mountainous terrain. Such _____ are highly sought after by planners to focus development into safer areas.

- **Observe and conserve**

Earth scientists work to protect environmentally sensitive areas. It is important that development in such areas have no lasting adverse impacts. Many Earth scientists are employed to provide environmental impact _____ in advance of development, as well as site remediation post-work.

What jobs are out there?

Career opportunities in the environment are limitless. The number of Earth scientists needed to work in environmental, _____, and geotechnical fields is large and growing as rising populations apply pressure on the natural world and its resources. Some environmental scientists and hydrologists work as independent _____ and consultants to clients who require geological expertise. Others are employed by companies that provide environmental services. Still others work for government agencies, like Natural Resources Canada and Environment Canada. Employment is also available with companies that provide us with oil, gas, minerals and _____. These companies strive to minimize their impact on the environment.

Opportunities for work in developing countries exist, as Earth scientists are involved in finding innovative solutions to problems concerning safe _____, areas threatened by natural hazards, and sanitary living conditions.

Why is the work important?

There are more than six billion people on Earth today, and in _____ years we will number _____ billion. The existence as a species requires that we wisely manage what

the Earth provides. We must use our resources carefully to keep our planet beautiful and healthy. Earth scientists have a vital role to play in finding solutions to the pressing environmental problems we face.

Is it right for you?

Whether you are interested in the intricacies of some small miracle of nature, or would like to work as part of a team to minimize the environmental impacts of a large development, there is a job for you.

D. Mining & Minerals

What's it all about?

Look around you - almost everything you see comes from the Earth. It is no exaggeration to say that life as we know it would not exist without _____ and _____, including hydrocarbons. They are used in everything from cars to computers. They are essential to countless industrial processes and fabricated materials that we use every day of our lives. Metals such as gold and minerals such as _____ and _____ are highly valued. Can you guess who locates and brings them into production? It's Earth scientists!

What kind of work is involved?

Geology determines where metal and mineral deposits occur. Where they are mined, however, depends on production costs, access to power and transportation, and environmental issues. Metals, minerals, and "aggregates" (sand, _____, and gravel) may be mined from large pits dug into the Earth or from underground workings. Earth scientists are involved in _____, development, and production of these resources, as well as environmental work throughout the process and reclamation post-work to return sites to the land.

We've come a long way since the early days of mineral exploration when prospectors ventured into the wilderness with pack horses to strike it rich with little more than a pick, shovel, and their own strength and determination. Today, Earth scientists use an arsenal of high-tech _____ to explore for and extract minerals and metals, from advanced computers to sophisticated geophysical instruments and _____ systems mounted in helicopters or fixed-wing aircraft that give us locations on the ground that are accurate to within centimeters. Earth scientists get where they need to go with helicopters, planes, _____, snowmobiles, and even _____. Exploration for metals and minerals is an exciting and rewarding career.

What jobs are out there?

The mining industry offers a wide variety of challenging jobs to trained Earth scientists within many different stages of development:

- Exploration, including prospecting, _____, and sampling
- _____ assessment and permitting (mineral rights acquisition)
- Construction of mine sites and access roads
- Corporate _____ and financing; regulations and stakeholder relations
- Mine planning, development and operation
- Mine site _____ and monitoring
- Because minerals and metals are such an important part of our lives, knowledgeable and skilled workers are in _____ demand.

Why is the work important?

The mining industry has made an enormous contribution to Canada's prosperity. Not only does this industry provide employment to large numbers of people, it is a leader in sustainable development. The Canadian _____ was the first to develop and adopt a national environmental policy, and Canada is recognized around the world as a leader in technological innovation. Canada is a much richer country thanks to the contributions of the mineral industry.

Is it right for you?

Are you interested in _____ and making new discoveries? Would you like to be part of an industry that is a leader in technology and that is helping improve the quality of life in Canada? A career in mining means a future of opportunity.

V. A – Z List Of Jobs

Briefly describe at least 4 of the 51 jobs listed and provide a sketch or an interpretation of the symbols for that job (along the right-hand side).

1. Job: _____ Symbols _____

_____

_____

_____

_____

_____

2. Job: _____ Symbols _____

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3. Job: _____ Symbols _____

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4. Job: _____ Symbols _____

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VI. Where Can I Learn?

Earth Science has no boundaries! Study in Canada and travel the world! An education makes the impossible possible. List at least 5 locations across Canada where you can study, learn about and train for a career in earth science.

_____

_____

_____

_____

_____

VII. What is it like?

Select a province to see profiles from some of Canada's Earth scientists in action. Choose at least TWO profiles and give a brief description of that person's job.

Name _____

Province _____

Job Profile _____

_____

_____

_____

_____

Name _____

Province _____

Job Profile _____

_____

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TEACHER REFERENCE: A – Z List of Jobs

1. Aerial Photograph Interpreters
Identify and interpret geology geomorphology, and geography features using 3-D photographs taken from specialized helicopters and small airplanes.

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2. Archeologists
Study the evidence of ancient people, societies, and cultures by analyzing their artifacts at historic sites through excavation and careful examination.

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3. Atmospheric Scientists
Study weather processes, global and regional climate, solar radiation and its effects, and the role of atmospheric chemistry in ozone depletion, climate change, and pollution.

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4. Avalanche Specialists
Assess snowpack stability, monitor avalanche hazards and risk, study snow properties and snowpack profiles, assess terrain and weather conditions, and spend a lot of time in mountains skiing.

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5. Chemical Oceanographers/Marine Geochemists
Investigate the chemical composition of seawater and its interaction with the atmosphere and the sea floor. Their study of trace chemicals in seawater helps us understand different processes within the marine environment and living systems, how ocean currents move seawater and pollutants around the globe, and how the ocean affects climate.

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6. Computer Programmers
Develop and run complex programs, models and machines used in earth sciences. They are essential at all levels of operation, from administration to research and development.

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7. Conservation Officers
Enforce federal, provincial, and territorial regulations governing the protection of wildlife, fisheries, and natural resources. They run conservation programs and raise public awareness of conservation laws.

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8. Cosmochemists
Study the occurrence and distribution of material matter in the universe, understanding its chemistry and behaviour, impacts, and roles.

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9. Economic/Exploration Geologists
Study, explore for, and develop mineral resources. They determine the history of mineral deposits, including gold, diamonds, and copper, and find environmentally safe ways of disposing waste materials generated by mining activities.

10. Engineering Geologists
Apply geological data, techniques, and principles to the study of rock, surficial materials, and surface and ground water. They investigate geologic factors and natural hazards that affect structures such as bridges, buildings, airports, roads and dams.

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11. Environmental Auditors
Do inspections to assess the performance of commercial and industrial operations. They collect and document evidence to evaluate compliance with environmental laws and regulations.

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12. Environmental Education Specialists
Develop educational programs that promote environmental awareness. They ensure that environmental objectives are included in corporate strategies, government laws and regulations, and consumer decisions.

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13. Environmental Engineers
Develop solutions for environmental problems, such as air or groundwater pollution and wastewater disposal. They make new advancements in environmental protection and conservation, and may work for consulting firms, universities, and government agencies.

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14. Environmental Geologists
Study the interaction between humans and the solid Earth, hydrosphere, atmosphere, and biosphere. They solve problems associated with pollution, waste management, urbanization, and natural hazards, such as flooding, earthquakes, and landslides.

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15. Exploration Geophysicists (Petroleum)
Study and interpret data on sediments, mineral and rock compositions and geologic structure to determine where oil and gas deposits are most likely to occur. They collect data from seismic operations and from gravity, magnetic, satellite or LiDAR (light detecting and ranging) surveys. Mineral exploration geophysicists often use electrical and electromagnetic techniques to search for ore deposits below the Earth's surface.

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16. Geochemists
Study the distribution of major and trace elements in rocks, minerals, soils, water, the atmosphere, and fossil fuels (oil, gas, and coal). They apply their knowledge of chemistry to determine how the Earth formed and how it might change in the future.

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17. Geochronologists
Use state-of-the-art instruments to determine the ages of rocks, minerals, and fossils and piece together the sequence of events that have shaped the Earth.

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18. Geodynamacists
Study dynamic forces and processes within the Earth. They look at how mountains are made and track the size and movement of Earth's plates throughout geologic time.

19. Geographers
Study the Earth's surface, the multitude of processes that shape it, and the interaction between humans and the physical environment. They design and create maps using computers.

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20. Geological Information Systems (GIS) Analysts
Develop and maintain large electronic databases used in studying the Earth and its resources. Geographic Information Systems are used in natural resource management, computer modeling, urban planning, mineral exploration, and environmental studies and decision making.

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21. Geological Technicians
Assist exploration geologists and geological engineers with field work. They log cores extracted from the Earth, take and analyze samples of rock and sediments, and monitor daily mining work. Work is at mine and building sites, sometimes in remote locations.

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22. Geologists
Study the materials, processes, and history of the Earth. They help locate and develop natural resources, and study hazardous natural phenomena such as earthquakes, tsunamis, landslides, and volcanoes.

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23. Geomorphologists
Study the age and origin of landforms and land surfaces to understand the geologic and climatic processes that have formed them.

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24. Geophysicists
Study Earth's interior by measuring responses to sound and electromagnetic waves, and gravity, magnetic, and electric fields. Using the principles of physics and sophisticated instruments and computers, these responses are processed and interpreted to provide an image of the subsurface. This is done to find deposits of minerals, oil, gas, and water, and to assess sites proposed for dams and other large structures.

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25. Geotechnical Consultants
Provide forestry, aggregate, mining and energy companies with geological data from the field & office with applicable recommendations and solutions to development projects. They perform terrain stability, erosion, hydrological, and avalanche assessments to evaluate hazards and risks associated with proposed projects, and to keep the surrounding elements safe from harm.

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26. Geotechnical Engineers
Apply the principles of geology and engineering to evaluate the suitability of sites for different types of development, such as roads, utility corridors, mine sites, bridges and more.

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27. Glaciologists
Study glaciers and ice sheets. They investigate the nature and impact of past and future climates on glaciers in the Arctic, western Canada, Greenland, Antarctica, and elsewhere.

28. Hydrogeologists
Study the occurrence, movement, and quality of surface and subsurface waters. They are concerned with sustainability and contamination of groundwater, and provide consultation in waste management, environmental impact assessment, and site remediation.

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29. Hydrologists
Study streams and rivers, aquatic ecosystems, and flood hazards and risk.

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30. Marine and Ocean Engineers
Design instruments to measure ocean processes and build structures that can withstand currents, waves, and severe storms. They use highly specialized computers and instruments, and work both indoors and outdoors.

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31. Marine Geologists
Investigate the seafloor from the coast to the abyssal depths. They also study the processes by which sediments are deposited in oceans. Their work provides valuable information on past climate and sea-level change and on Earth history back more than 100 million years.

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32. Meteorologists
Study climate and atmospheric phenomena. They try to accurately predict the weather, monitor storms, and track climate change. They issue forecasts of weather, air quality, and sun intensity.

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33. Mineralogists
Study the chemistry, atomic structure, and physical properties of minerals to understand the processes of mineral formation and alteration. Some mineralogists become gemologists who focus on precious and semi-precious stones, such as sapphires, emeralds, and diamonds.

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34. Mining Engineers
Design mines and plan mining operations. They apply their knowledge of soil and rock mechanics, transportation systems, and machinery to ensure that mines function efficiently.

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35. Museum Curators
Prepare, archive, and care for paleontological (fossil) specimens. They create informative displays and exhibits for the public, arrange loans of rare fossils, and prepare publicity material for museums and websites.

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36. Oceanographers
Study the physical, chemical, and biological aspects of oceans. They spend many hours at sea or under water, as well as in laboratories and using computers. Physical Oceanographers focus on ocean temperature, density, and turbulence, and on waves, tides, currents, and ice conditions,

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37. Paleoclimatologists
Study rocks, sediments, and glaciers to understand past climates. They use their knowledge to predict future climate change.

38. Paleoecologists
Study fossils preserved in sediments and rocks to reconstruct past environments and climates.
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39. Paleontologists
Study fossils to understand past life forms and their changes through time (evolution). Paleontology is the biological part of geology.
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40. Petroleum Geologists
Explore for and are involved in the development of oil and natural gas resources. Petroleum Engineers develop techniques and equipment to recover and process oil and natural gas. They may work on offshore drilling platforms and travel to all corners of the world.
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41. Petrologists
Determine the origin, structure, and history of rocks by analyzing their minerals, chemical composition, and physical properties.
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42. Petrophysicists
Determine the potential quality and performance of a petroleum resource by estimating how much hydrocarbon is present and whether it can be produced economically. They have experience in well logging, and related geophysical, geological, engineering and computer applications.
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43. Planetary Geologists
Study planets and their moons in order to understand the evolution of the solar system.
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44. Professors
Teach courses at universities and colleges, and mentor undergraduate and graduate students. They lead field trips to beautiful & interesting places, teach in the classroom and laboratory, write scientific papers and reports, conduct research, and travel worldwide to participate in conferences and workshops.
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45. Researchers
Conduct scientific studies on specific topics to improve understanding in that field. Research positions are available in universities, colleges, the private sector, and government agencies. Positions may involve laboratory work, field work, office work, or commonly a combination of all three.
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46. Science Teachers
Teach science to secondary and junior-secondary students. They teach daily lessons, grade assignments and exams, design and supervise lab experiments, and take students on field trips.
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47. Sedimentologists
Study the properties, structure, distribution, and origin of sediments and sedimentary rocks. Oil, gas, coal and many mineral deposits occur in these materials.

48. Seismologists
Study earthquakes and analyze the behavior of earthquake waves to understand seismic hazards and to interpret the structure of the Earth.

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49. Soil Scientists
Study the thin soil layer at the boundary between the Earth's crust and the atmosphere to determine how to sustain agricultural productivity, to detect and remediate contaminated soils, and to understand soil-forming processes.

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50. Stratigraphers
Investigate the three-dimensional form, physical properties, and age of sedimentary rocks, on local, regional, and global scales.

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51. Structural Geologists
Analyze rocks that have been folded and faulted by Earth forces. They help search for oil, gas and mineral deposits by mapping out rock formations.

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52. Volcanologists
Study active, dormant and dead volcanoes to understand the processes involved in their formation & eruptions. They work to determine how, why and when volcanoes erupt, and the effects eruptions can have on the environment.

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53. Water and Wastewater Laboratory Technicians
Manage water purification and wastewater disposal facilities. They ensure that the facilities are environmentally safe and meet industry standards.