A Handbook for Geology Students

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Why study Geology?

Geology is the multi-disciplinary science that studies the earth and its history.
We live on a dynamic planet that is constantly changing. Our ability to survive as a civilization and as a species is intricately linked to the geologic processes that shape our earth, form its natural resources and allow it to recover from the abuse that our society heaps upon it. Geology is important because virtually all the natural materials our society needs such as oil, gas, metals, building materials, and so forth are found by geologists. Geologic engineers evaluate roads, buildings and dams for geologic stability and hazard potential. Environmental protection and remediation are important geologic issues faced by contemporary society.

Geology is an exciting profession that typically combines indoor and outdoor work. Students of geology encounter science in its broadest sense because geology incorporates those aspects of astronomy, biology, chemistry, engineering, mathematics and physics that are important to understanding the Earth and its interactions with the atmosphere, the biosphere, and the hydrosphere.

The rich history of the earth gives us our only window into the likely impacts of global climate in the future. As a science, Geology is unique in its focus on time, starting from the beginning of the Earth more than 4 billion years ago to the present. Combining a knowledge of fossils and environmental indicators, geologists reconstruct ancient climates, ecological systems, and geographies that reveal vanished tropical or polar oceans and eroded mountain ranges that once stretched across continents.

Geologists play a leading role in the utilization and management of natural resources, evaluating how natural processes impact all life on Earth, and how humans interact with the Earth. Geologists search the continents and sea floors for the minerals and fuels essential to modern society and look for fresh water used daily by the world's peoples. They work with engineers discovering pollution of the soil and groundwater, in developing plans for pollution control or remediation, in siting and developing waste disposal sites, in road and dam construction, and in evaluations of risk and planning designed to minimize the loss of life due to floods, volcanic eruptions, or earthquakes. Other geologists concern themselves with the history of the planet, unraveling the movements of continents, the distribution of climate-controlled rocks, and the evolution of species and ecosystems.

Geology requires problem solving, good 3D visualization and the ability to collect and process data accurately. Geologists are like detectives. Data that allow geologists to solve problems seldom arrive in a linear fashion. Geologists must be able to collect

fragments of information and develop interpretations based on those data. They must be able to separate important and trivial data and be able to adjust their interpretations as new data are collected. Developing models, either in their mind or on their computer, is essential. Once geologists have completed their work, they must be able to effectively communicate their results to others. Strong verbal and written communication skills are essential in geology. Most geologists work on practical problems that involve people. Those individuals, whether an individual landowner, an elected official, or the CEO of a Fortune 500 company, want answers communicated in a way they can understand.

Geologists work on every continent from the tropics to the poles and on and under the surface of the oceans. They work on foot or from ropes in high mountains, in submersibles and on ships, in mobile laboratories in trucks or aircraft, and in offices and labs in universities, research parks, urban offices, and high-rise offices buildings.
In these various settings, geologists use a wide range of equipment. The field geologist may use only a hammer, compass/pocket transit, notebook, pencil, and map or GPS unit.

On the other hand, geologists are the largest users of high performance computers and satellite technologies in the world outside the government's national intelligence network. The geophysicist uses technologically complex instruments such as computer-linked seismographs, used for recording earthquakes, and gravimeters (gravity meters) with which they can measure incredibly small gravitational attractions. Geochemists use sophisticated electronic instruments such as ion-beam microprobes to analyze parts of mineral grains that are microscopic in size, X-ray diffractometers to study crystal structures, and mass spectrometers to date earth materials. Mineralogists and crystal chemists, who study the nature of minerals, likewise use these instruments. Paleontologists, who study fossils, and petrologists, who study rocks, regularly depend on microscopes, including electron microscopes, as well as the tools of the geochemist to analyze the objects of their interest. Engineering geologists use instruments such as drills, inclinometers (to measure slope movements) and bore-hole shear devices (to measure the strength of materials).

As discussed earlier, geology is a broad multi-disciplinary science. As an undergraduate student in geology, your primary concern is to master the broad discipline of geology and its impact on society. If you pursue graduate study, you likely will specialize in one of the disciplines of geology listed below:

Crystallography: study of the chemistry and atomic arrangement of atoms in minerals

Earth System Science: study of the interaction of oceans, atmosphere, and the solid earth for the purpose of understanding past, present, and future environmental conditions

Economic Geology: genesis, location, and other aspects of economic materials; includes metallic, non-metallic (industrial rocks and minerals), and groundwater supplies (location and occurrence of subsurface water)

Environmental Geology: geological study of our natural environment; primarily concerned with depletion of natural resources, preservation of environmental quality, pollution problems, and natural hazards

Field Geology: collection, interpretation, and synthesis of geological data in the field (outside, in nature); generally consists, at least in part, of making geologic maps

Forensic Geology: interpretation of geological evidence at crime scenes

Geoarcheology: geological interpretation of archeological sites

Geochemistry: study of chemical processes within, upon and above the earth

Geochronology: study of the timing of geologic events; usually involves absolute age determinations

Geoinformatics: utilization of computers and data retrieval storage equipment for simulation, analysis and synthesis of geological data

Geomorphology: origin and description of land forms

Geomorphometry: the measurement of various rates of landscape-forming processes

Geophysics: "the study of the physics of the earth" - includes Seismology (study of earthquakes) and other studies of physical properties

Hydrogeology: the study of subsurface waters (groundwater) and the related geologic aspects of surface waters

Hydrology: study of the movement of water in and on the earth; flood hazard is a primary concern

Marine Geology: study of various aspects of the geology of the oceans and coastal areas

Mineralogy: study of crystal structure and chemistry, identification, classification and genesis of minerals

Optical Mineralogy: study of mineral properties through means of light transmitted through minerals; uses a petrographic microscope

Paleontology: the study of ancient life (fossils) - includes, paleobotany (plants); vertebrate paleontology (animals with backbones); invertebrate paleontology (animals without backbones); micropaleontology (microscopic-sized fossils); and palynology (spores and pollen)

Petrography: description of mineralogy, texture and structure of rocks

Petrology: study of rocks, including information on chemistry; classification; mineralogy, occurrence, shape and structure of rock masses (petrography), and rock origins (Petrogenesis)

Planetology: study of the planets, including the origin of their rocks and development of planetary structures, includes Lunar Geology, the geology of the moon

Photogeology: utilization of aerial photographs (and other indirect or remote sensing techniques) to determine various aspects of geology. Term now largely replaced by Remote Sensing

Sedimentology: study of the environmental factors controlling the origin of sediments and sedimentary rocks; development of depositional models

Stratigraphy: the study of layered (sedimentary) rocks, with emphasis on their relationships to each other with respect to time and origin

Structural Geology: the origin of geological features produced by stresses within the earth's crust (such as folds and faults)

Tectonics: large-scale or world-wide aspects of structural geology; generally involves origin of mountain ranges, ocean basins, continents, etc.

Job Prospects and Salaries

Outlook for employment in Geology and the environmental sciences is excellent because society needs you, and many individuals holding jobs in these fields are nearing retirement. Data on job prospects and salaries are often frustrating to students, because reliable data are difficult to obtain and generally reflect conditions two or more years in the past. More importantly, salaries significantly vary by geography, by specialty, and by employer. Finally, the "environmental sciences" include geologists as well as other disciplines. We encourage you to use the information below as a guide, but realize that job conditions can change dramatically as a function of the economy, public policy and the supply of qualified individuals. As an undergraduate student, your best prospects for a successful career are to develop strong science, math and communications skills which can be applied to a variety of job options.

The best avenue to a rewarding permanent job in geology, in most cases, is a graduate degree. Some students, however, choose to go to work when they complete their bachelor's degree. According to the National Science Foundation, about 125,000 geoscientists work in the United States. Currently, positions in environmental and engineering geology and the energy sector are abundant. Career opportunities in hydrogeology and geophysics are particularly abundant for those with graduate degrees. Graduates with special skills and high levels of ability continue to be in high demand.

In addition to these areas, geologists find employment in mining and public service - such as in state geological surveys and departments of transportation. State and local governments employ a variety of geologists and opportunities are relatively good. Jobs in the federal government, due to downsizing, are less available. Jobs in highway departments, museums, public health departments and other similar governmental agencies (rather than state geological surveys) may provide the best opportunities.

Data from this section were obtained from www.bls.gov/oco/ocos050.htm, the U.S. Department of Labor Bureau of Labor Statistics Occupational Outlook Handbook. In 2004, about 25 percent of geoscientists were employed in architectural, engineering, and related services, and 20 percent worked for oil and gas extraction companies. State agencies, such as State geological surveys and State departments of conservation, employed approximately 3,600 geoscientists. Another 2,900 worked for the Federal Government. About 5 percent of geoscientists were self-employed, most as consultants to industry or government.

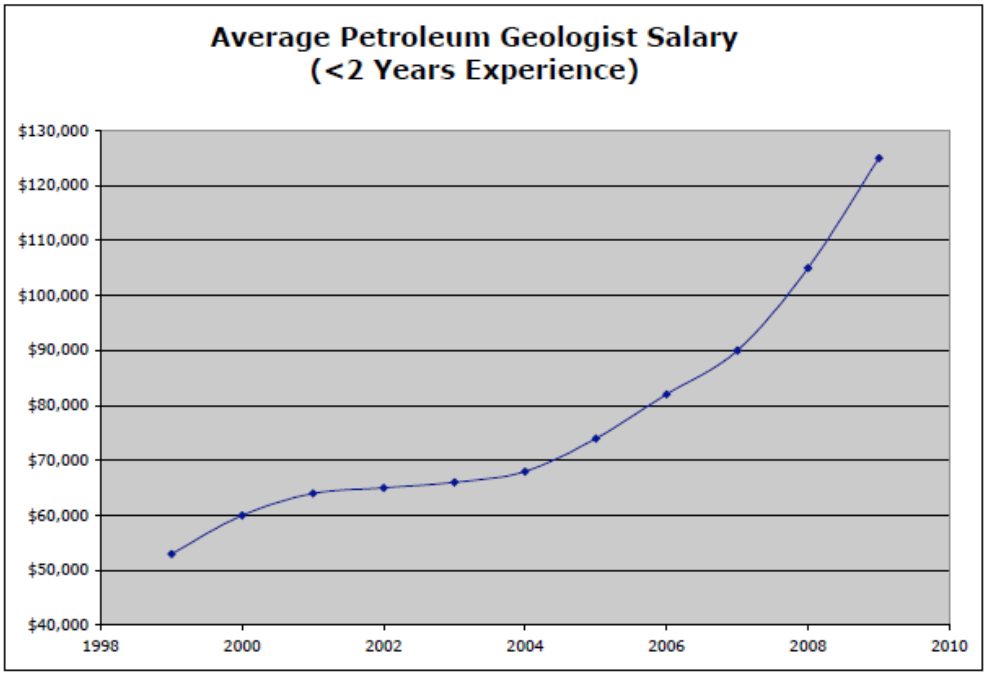
Environmental scientists and hydrologists held approximately 81,000 jobs in 2004. Jobs for hydrologists accounted for only 10 percent of the total. About 44 percent of environmental scientists were employed in State and local governments; 15 percent in management, scientific, and technical consulting services; 14 percent in architectural, engineering and related services; and 8 percent in the Federal Government. Nearly 5 percent were self-employed. Many more individuals held university level faculty positions in geology and environmental science, but they are classified as college and university faculty. Job opportunities for university faculty are discussed later in this section.

Employment of geologists and environmental scientists is expected to grow about as fast as the average for all occupations through 2014, while employment of hydrologists is expected to increase by 27 percent or more between 2004 and 2014. Job growth for environmental scientists and hydrologists should be strongest at private-sector consulting firms. Demand for environmental scientists and hydrologists will be spurred largely by public policy, which will oblige companies and organizations to comply with complex environmental laws and regulations, particularly those regarding ground-water decontamination, clean air, and ood control. Positions in the mining industry are more localized now than they have been, but a renewed appetite for precious and industrial metals has renewed interests in mining worldwide.

According to the National Association of Colleges and Employers, beginning salary offers in July 2005 for graduates with bachelors degrees in geology averaged $39,365 a year. The top 10 percent of geologists in all categories earned over $100,000 per year. Median annual earnings in the industries employing the largest number of geologists and environmental scientists in May 2004 were as follows (data from U.S. Department of Labor):

Employer	***Geologists***	***Environmental Scientists***
Federal Government	$87,000	$73,530
State Government	$49,000	$48,870
Consulting services	$75,000	$50,000

The petroleum industry is undergoing significant growth after a number of years of depressed hiring. The combination of near record prices for oil and gas, increasing demand for oil and gas across the world, and a workforce that is nearing retirement have led to increased demand and increasing salaries for geologists employed in the energy sector. Geologists with bachelor's degrees may find a few technician positions available, but the best jobs will be found by individuals with a master's or doctoral degree.



Science teachers with specialization in secondary education are in demand. Positions as science teachers in public schools are increasing dramatically, with some schools paying bonuses up to $15,000 to qualified individuals. In North Carolina, a new Earth Environmental Science requirement in the high schools has created a significant demand for geology teachers. Public school teachers in North Carolina average $44,000 for a ten month contract. Equivalent figures for science teachers are difficult to find, but the March 19, 2007 edition of the Raleigh News and Observer reported that beginning science and math teachers can earn $42,000 per year in some North Carolina school districts. Teachers with master's degrees can earn salary increases up to $10,000 per year in some school districts.

At the university level, tenure-track opportunities are highly competitive, but are expected to grow much faster than the average occupation through 2014. Opportunities are being fueled by the retirement of large numbers of current faculty members. At the university level, nearly all entry-level positions require a Ph.D. and are hired at the Assistant Professor level. Mean annual salaries for beginning geology faculty members are $50,000 to $55,000 per year for a 10 month contract (data from U.S. Department of Labor).

Summer jobs and internships in geology provide valuable experience for students preparing for graduate school or looking for a job. That experience may give the student new insight into geological principles, a better understanding of the profession, and an advantage in subsequent course work. In addition, when looking for permanent employment, a resume showing that you have had experience in geology is a valuable asset.

Job opportunities may come to the attention of geology majors through three channels. First, the aggressive student may attend professional geology meetings and make contacts with employers. Second, bulk mailings and emails of job openings by employers are posted in the department. Third, and most commonly, people who know faculty members personally call and ask the faculty member if they could recommend a student for a job. Because the faculty member's reputation and future relationships with the employer are at risk, faculty members often are selective about whom they recommend for such a position.

Employers remember where good and bad employees have been trained. Remember, you are a representative of the Appalachian Geology department. If you do poorly, the employer for whom you work may never again hire an Appalachian student. If you do well, future students may have the same or a better opportunity for summer or permanent employment.

Why Appalachian Geology?

The fundamental goal of the Department of Geology at Appalachian is to promote a scientific understanding of Earth systems - an awareness essential to an environmentally sound and sustainable future for the human race. Our specific goals are:

- To provide all students with the opportunity to learn about the nature of science and basic scientific principles through the study of geology.
- To introduce students to the many ways in which geology is interwoven into the fabric of modern civilization.
- To provide students with an understanding of the interrelationships of the basic parts of Earth systems.
- To provide students who seek a career in geology with the sound background for productive work in the profession and in graduate studies.
- To provide present and future teachers with the knowledge and methods necessary for competent instruction in earth and environmental sciences.
- To provide members of the public with the opportunity to gain a better understanding of the Earth systems of which they are a part.

The Appalachian State University Geology program provides students with a solid foundation on which to build a successful career in geology. Because we have no graduate program, we focus entirely on high quality undergraduate instruction. Appalachian's first geology major graduated in 1949. Since then, we have awarded more than 250 Bachelor degrees in Geology and Earth Science. An average of six Bachelor degrees per year is small compared to the large numbers typical of other disciplines, but we believe that a quality program is more important than one which churns out large numbers of students. We have been successful in establishing a program that is arguably among the best Bachelor degree programs in geology available in the Southeastern United States.

What is it that makes our graduates so successful? The answer is that our majors receive excellent preparation through the academic programs we offer. Faculty members are able to motivate students through rigorous courses that emphasize fundamentals and real world examples. Students who successfully complete our Bachelor degree programs learn to think

and function as professionals at an early stage in their careers. They learn that hard work is necessary to produce quality results. The "bottom line" is that Appalachian geology graduates receive academic and professional backgrounds that prepare them for life and a variety of career options beyond the short term.

One of the most effective ways to measure the quality of our program is to look at the record of successes that Appalachian Geology alumni have achieved. Approximately 30 percent of our alumni have attended graduate schools and nearly 5 percent of these have earned Ph.D. degrees. Appalachian Geology alumni have attended more than 35 different graduate schools including some of the finest in the United States, such as Duke, Wisconsin, Stanford, Chicago, and MIT. One or more of our graduates have also attended Alabama, Arizona, Arizona State, Colorado (Boulder), East Carolina University, Eastern Kentucky, Idaho, Maine, Missouri, North Carolina State, Northern Illinois, Penn State, Pittsburgh, Radford, South Dakota School of Mines, Southern Illinois, Southwestern Louisiana, Syracuse, Tennessee, Texas A&M, Tulane, Vanderbilt, Virginia Tech, UNLV, UNC-Chapel Hill and Wilmington, University of Texas El Paso, and others.

Ninety percent of our alumni who enter graduate programs complete requirements for at least the M. S. degree. Another measure of the quality of our graduates is found in the reputation and status of their employers. Current and past employers of Appalachian geologists include Texican Natural Gas Co., Gulf Mineral Reserves Co., Shell, Anadarko Petroleum, BP Amoco Exploration, Mobil, BHP Minerals, Samedan Oil Corp., Arco, Conoco, Chevron, Penzoil, Exxon Education Foundation, Phillips, Duke Power, Geological Surveys of Virginia, California, Mississippi, and Alabama, San Francisco Bay Regional Water Quality Control, Mine Health and Safety Administration, Virginia Division of Mineral Resources, MS Department of Environmental Quality, Geological Exploration, Inc., Atlanta Testing and Engineering and Triebold Paleontology, Inc. In addition, we are well represented by our alumni in many public and private schools of North Carolina, New York, and Tennessee. Two of our alumni are geology and geophysics professors in California and Idaho universities and another teaches at Earlham College in Indiana. One alumnus owns a coal mine and the largest insurance agency in a major southern city.

The geographic diversity of where our alumni live and work reveals that geology alumni are not afraid to leave the familiar surroundings of home to enter the profession. Yet, many of our alumni live in North Carolina. Other places of past and present employment include cities such as Denver, Houston, and New Orleans; states such as Alabama, California, Maine, Nebraska, Nevada, Oklahoma,

South Carolina, Virginia, Washington, and Wyoming; and the countries of England, China, Indonesia, Portugal, and Brazil. The variety of professional duties of our graduates ranges from presentation of geological evaluations of oil well drilling sites before groups of prospective Japanese investors, to exploration for mineral resources in the jungles of South America, and assessment of environmental problems in California and North Carolina. Several of our alumni operate their own geological consulting firms, while others perform jobs as geological technicians or professional geologists within major corporations.

Environments of working conditions for our alumni range from high-rise modern office buildings in Houston, New Orleans, and Denver to offshore drilling platforms in the Gulf of Mexico and small offices and laboratories in Raleigh, North Carolina and Casper, Wyoming. One of our graduates was a career officer in the U. S. Army. Several of our alumni work as curators in science museums. At least five of the alumni spend most of their time outside in the field studying and mapping rocks.

Many of our alumni are involved in basic scientific research projects. These projects include the study of evolutionary biology of several fossil groups, the petrographic history of Maine, the geologic evolution of the Appalachian Mountains in Alabama, and earthquake risk in California.

As described above, there is no stereotypical Appalachian geology graduate. Careers, places where they live, their graduate schools, employers, and personal goals are extremely varied. However, our graduates are quite successful in the profession. Even when the petroleum industry and the economy of the U. S. were somewhat depressed during the late 1980s, practically all of our alumni retained their jobs and prospered.

Appalachian geology alumni and faculty have worked diligently and successfully to establish an excellent reputation in the profession. Our standards are high. In order to maintain the program's reputation, we expect all of our majors to meet our standards so that future graduates will have excellent opportunities available to them.

Geology Faculty and Staff

Members of the Appalachian State University Department of Geology faculty have diverse interests, experiences, educations, and geographic origins, but they are all committed to undergraduate education. The faculty has grown and changed in the past four years as founding members of the Department faculty have retired and new faculty members have been hired. All of the geology faculty teach introductory courses, as well as courses for majors and minors, so majors may begin work with senior faculty early in their career. The photo below shows many of the faculty members of the Department of Geology for 2008-09.

Tenure Track Faculty

Dr. Johnny Waters, Chairperson (Ph.D., University of Indiana) came to Appalachian as Chair in 2004 after spending 28 years at the University of West Georgia. Trained as a paleontologist, his research centers on Paleozoic echinoderms, Carboniferous community structure, and rebounds from mass extinction events. For the past 20 years, he has conducted fieldwork in China with colleagues from Indiana University, the Nanjing Institute, and the Academy of Geological Sciences in Beijing. At West Georgia, Waters was twice recognized as the Regents Distinguished Professor.

Dr. Richard N. Abbott, Jr. (Ph.D., Harvard University) has been at Appalachian State University since 1979. His course offerings include introductory classes and Crystal Chemistry and Optical Mineralogy, but his interests extend into the fields of igneous and metamorphic petrology and environmental geology. He has traveled, studied geology, and/or taught in Nigeria, Jamaica, the Dominican Republic, Italy, and Nova Scotia. In 1995 he was a Fulbright Teaching Fellow at the University of the West Indies, Kingston, Jamaica. His research interests are in metamorphic petrology of rocks in the Appalachian Orogen, Jamaica and the Dominican Republic.

Dr. William Anderson (Ph.D., North Carolina State University) returned to the Appalachian faculty in 2004 as an Assistant Professor after having served the department as a temporary faculty member in 1998. In the intervening six years he taught as a tenure-track professor at Illinois State University and Radford University. He teaches Physical Geology, Environmental and Applied Geology, Hydrogeology, and Advanced Environmental and Engineering Geology. Dr. Anderson's research interests

focus primarily on hydrogeology and recharge: how it may be quantified with mathematical and modeling techniques and how it may be affected by natural cycles at annual, interannual, and decadal time scales. His data source for this study has been Hatteras Island, NC, where he has collected water-level data and other data since 1994. In addition to studying barrier-island aquifers, he is interested in the modeling of regional groundwater flow systems, groundwater flow within fractured bedrock aquifers, and groundwater-surface water interactions.

Dr. Sarah Carmichael (Ph.D., Johns Hopkins University) joined the department in 2007, after exploring the bottom of the ocean in the DSV Alvin and with the ROV Jason while a postdoc at the University of New Hampshire. Although a metamorphic petrologist by training, she does not conduct research on traditional metamorphic systems. Instead, she uses the methods commonly employed by traditional metamorphic petrologists (such as reactive transport theory) to model mineral replacement and crystallization in low-temperature fluid-rock systems, particularly in carbonates and supergene ore deposits. A lover of high tech lab equipment, her work heavily involves scanning and transmission electron microscopy, cathodoluminescence microscopy, and Fourier-transform infrared spectroscopy, mass spectrometry, and a variety of X-ray techniques. Her current research explores the geomicrobiology of cave mineral deposits, the role of microbes in ore formation, the mineralogy and petrogenesis of carbonatite and silica deficient volcanic rocks in east Africa, and geochemical and petrologic records of ancient fluid flow in Cambrian sediments and basalts in the Southern Appalachians.

Dr. Ellen A. Cowan (Ph.D., Northern Illinois University) joined the Appalachian faculty in 1988 and is a member of the College of Arts & Sciences Academy of Outstanding Teachers. She teaches Geomorphology and Geoarcheology, but does research in glacial-marine sedimentology. Dr. Cowan was the 1999 recipient of the College of Arts and Sciences Donald W. Sink Outstanding Scholar Award. Dr. Cowan spends her summers documenting modern sedimentation associated with glaciers. During four of her cruises examining tidewater glaciers in the fjords of southeastern Alaska, she included three students (each year) in various aspects of her research projects. In 1998, Dr. Cowan participated in the Ocean Drilling Project (ODP) in drilling glacimarine sediments off the coast of Antarctica, and returned to Antarctica for three months in 2007 as a part of the ANDRILL project.

Dr. Chuanhui Gu (Ph.D., University of Virginia) came to Appalachian in 2009 from the Berkeley Water Center at UC Berkeley. Dr. Gu earned his PhD in Environmental Sciences at the University of Virginia in 2007. His research focuses on the hydrological control on inorganic nitrogen loading to coastal streams. He also developed and conducted an experimental and modeling study to investigate the hillslope-scale nitrate reactive transport mechanisms across the multiple time scales from days to years. Dr. Gu will be active in the Environmental Science Program as well as in the Geology Department.

Dr. Steven J. Hageman (Ph.D., University of Illinois) joined the faculty of Appalachian State University in 1998. He teaches Historical Geology, Preparation of Geologic Reports and Paleontology. Dr. Hageman does research on bryozoan distribution and ecology, microevolution, quantitative paleobiology, evolutionary paleoecology, and carbonate sedimentology. Dr. Hageman has worked in Australia as a research scientist and came to Appalachian from the Field Museum of Natural History in Chicago. He

spent Fall Semester 2006 in Croatia studying bryozoan genetics as a Fulbright Research Fellow, and hosted the International Bryozoan Conference in Boone in 2008.

Dr. Andrew Heckert (Ph.D., University of New Mexico) joined the geology faculty in the Fall of 2005 as the Director of the McKinney teaching museum. After completing his Ph.D. he worked as the geoscience collections manager at the New Mexico Museum of Natural History, so he brings nearly a dozen years of museum experience to the Geology Department at Appalachian State University. Dr. Heckert is a vertebrate paleontologist specializing in Triassic terrestrial ecosystems and the reptiles the lived there. For the past two years, he has taken students to New Mexico, excavating Triassic reptiles in cooperation with the Friends of the New Mexico Museum of Natural History.

Dr. Cynthia Liutkus (Ph.D., Rutgers University) joined the Geology Department faculty in Fall 2005 after teaching for one year at Bucknell University as a Visiting Assistant Professor. She currently teaches Intro to Sedimentology and Stratigraphy, Evolution of the Earth, and several introductory courses and labs. Dr. Liutkus has three main areas of research interest. One aspect focuses on determining the origin, growth, and stable isotope signatures of non-pedogenic carbonates. This work studies plant casts that form in semi-arid playas in the western USA, called "phytocasts". Another aspect of her research uses techniques in sedimentology, stratigraphy, and stable isotope geochemistry to reconstruct rift basin systems in both the USA (in collaboration with the Virginia Museum of Natural History and the National Museums of Scotland) and in East Africa. Lastly, the third aspect of her research involves reconstructing hominin paleoenvironments in Africa, including several sites in Tanzania and Namibia that contain footprints of our early human ancestors. This work is being done in collaboration with several other institutions, including the Smithsonian Institute, George Washington University, Rutgers University, the University of the Witswatersrand, and the local governments of both countries.

Dr. Scott Marshall (Ph.D., University of Massachusetts) is a geophysicist who works on problems in structural geology and neotectonics. Dr. Marshall's dissertation modeled the mechanics of faults in the greater Los Angeles area. He has also studied similar processes in the Ventura Basin, in southeastern Nevada and on Europa. He is an accomplished mathematical modeler of geologic processes and builds his own computers. Dr. Marshall joined the faculty of Appalachian State University in August, 2008.

Lecturers

Mr. Joey Anderson (MS, University of South Carolina) obtained an undergraduate degree in geology from Appalachian State University and a master’s degree (also in geology) from the University of South Carolina. Prior to joining the faculty at Appalachian State, Joey worked in the environmental consulting industry for approximately a year and a half as a hydrogeologist focused in geologic/hydrogeologic investigation and remediation disciplines. His master’s degree investigated groundwater dynamics in coastal settings, primarily barrier islands. He developed a numerical model that simulated groundwater flow and salinity (calibrated from verified field data) at Sapelo Island, Georgia and used the model to forecast impacts from high-energy storms on various groundwater parameters. Joey's research interests include barrier island

groundwater dynamics and impacts from high-energy storms, surface-groundwater interactions within mountainous headwaters streams, and contaminant transport through porous and fractured media.

Mr. Gabriele Casale (ABD, University of Washington) joins the department this year from the University of Washington. His research interests are in the complex interplay between contemporaneous shortening and extension in active mountain belts from a field structural geology perspective. His research is centered around the Eocene-present tectonic evolution of the Adria continental block as it is consumed beneath Eurasia and the Apennines. He is currently constructing 2D geometric interpretations across the External Dinarides in Croatia and Bosnia to quantify the minimum amount of shortening that has taken place along the Eastern margin of Adria during mountain building in the Dinaric foreland, as well as investigating the timing and nature of mid-crustal exhumation in the Dinaric hinterland. On the Western margin of Adria, he is investigating the role of fluids in fabric development along low angle normal faults developed in the wake of the easterly migrating Apenninic subduction zone.

Ms. Laura Mallard (MS, University of Vermont) has taught at Appalachian since 2004. Laura teaches introductory geology courses and labs and is the department's liaison with the College of Education. Laura also advises students in the teaching concentration degree program in Geology. When she is not in the Geology Department, Laura runs River and Earth Adventures with her husband, Grant Seldomridge. Although her company is not affiliated with the department, it does occasionally hire other members of the department as guides and prides itself on eco-education.

Ms. Elizabeth Rhenberg (ABD, West Virginia University) joins us this year. Her masters research at Kent State included looking at biotic interactions involving the bivalves found in the type section of the Coon Creek Formation in southwest Tennessee. Her PhD research involves camerate crinoids of the Lake Valley Formation in south-central New Mexico, using a combination of systematic work (correctly identifying species, combining redundant species, and naming five new species) with a paleogeographical component (comparing crinoids of the lower Burlington Limestone in Iowa, the Redwall Limestone in Arizona, and the Anchor Limestone in Nevada to the Lake Valley to see how similar the faunas are). She would eventually like to expand this study to include western Europe to see if the same patterns stretch farther than just the North American continent.

Ms. Lauren H. Waterworth (JD, Tulane University Law School) graduated from the Appalachian State Geology Department in 2001. She received her Master's Degree in 2004 from Texas A&M University where she studied active mountain-building processes by examining the evolution of the Chaochou fault system in Southern Taiwan. In 2007, Lauren earned her Juris Doctorate from Tulane University Law School with a Certificate in Environmental Law. She is a practicing attorney and is currently involved in litigation in the coal country of Eastern Kentucky that aims to enforce Clean Water Act permit requirements.

Ms. Crystal Wilson (MS, University of Tennessee) joined the faculty in Geology at Appalachian in August 2006 following completion of her Master's Degree in Structural Geology and Tectonics from the University of Tennessee. Ms. Wilson teaches Geology 1101 and Geology 1103 and the labs associated with these courses. Her interests include the formation and evolution of mountain belts, particularly the southern Appalachian Mountains. This research involves detailed geologic mapping at the

1:24,000-scale coupled with petrographic analyses to determine the deformational and metamorphic history of the region. She is also interested in pluton origin and emplacement, as well as metamorphic geochemistry.

Mr. Brian Zimmer (MS, Northern Arizona University) has been with the Geology Department since 2008 and has taught a myriad of labs, introductory lectures, and freshman seminar. He researches volcanoes and volcanic deposits and is currently working, in conjunction with Dr. Cynthia Liutkus, on a set of ancient human footprints preserved in volcanic ash in northern Tanzania. In addition, Brian is currently directing the geology cluster of Appalachian State's Research Academy where undergraduates get experience performing a wide range of different experiments.

Emeritus Faculty

Dr. Frank K. McKinney (Ph.D., University of North Carolina) has been at Appalachian State since 1968, is now Professor Emeritus, having retired in 1998. Dr. McKinney has traveled extensively in Europe and has conducted research in England, Ireland, Germany, Denmark, Russia, France, Italy, Czechoslovakia, and Croatia, as well as the southern Appalachians. He has been a Fulbright Research Fellow in England. Dr. McKinney continues his research in the ecology, morphology, and evolution of colonial marine animals, particularly the bryozoans. His many publications include the co-authored book, Bryozoan Evolution, and the laboratory manual, Exercises in Invertebrate Paleontology. In 1984, Dr. McKinney was the first professor at Appalachian to be awarded the College of Arts & Sciences Outstanding Scholar Award. Ken's newest book "The Northern Adriatic Ecosystem: Deep Time in a Shallow Sea" has recently been published by Columbia University press.

Dr. John E. Callahan (Ph.D., Queens University, Kingston, Ontario) served the department as a professor prior to his retirement in 2004. He specialized in economic geology but conducted extensive studies on the Queen Anne's Revenge, a ship tied to the notorious pirate Blackbeard late in his career. For many years, Dr. Callahan was the department's liaison with the College of Education and worked extensively to further the cause of teacher education at Appalachian.

Dr. Loren Raymond (Ph.D., University of California, Davis) first joined the faculty of Appalachian State University in 1972. Prior to his retirement in 2007, Dr. Raymond taught Earth Materials, Petrology, and the introductory geology courses and was the Chairperson of the Department in 1982-83 and 1994-2000. He was the first recipient of Appalachian's College of Arts and Sciences Outstanding teacher of the Year Award in 1990 and was a charter member of the Academy of Outstanding Teachers. Dr Raymond's specialty is Petrotectonics, the use of rocks to decipher the history of mountain belts. He is a licensed geologist in North Carolina and has written and graded the N.C. State Licensing examination. Dr. Raymond edited a Geological Society of America volume on melanges and authored the text "Petrology: The Study of Igneous, Sedimentary, and Metamorphic Rocks" (now in its second edition) and Petrography Laboratory Manual.

Dr. Fred Webb, Jr. (Ph.D., Virginia Polytechnic Institute and State University) taught at Appalachian State University from 1968 until his retirement in 2004. He served as

Department Chairperson in the Department of Geography and Geology before becoming the first chairperson of the Department of Geology at its inception. Dr. Webb served as Chairperson for twenty-two years. Dr. Webb is a member of the Academy of Outstanding Teachers and the 1977 Teacher of the Year. He is particularly interested in stratigraphic and sedimentological problems in Southwestern Virginia and China. He led the Appalachian Summer Field Camp in Italy before his retirement. He and Dr. Raymond are currently compiling the geology in SW Virginia for the Virginia Division of Geology/ USGS State Map Project.

Adjunct Faculty

The Department of geology also has associated with it additional temporary faculty, adjunct faculty, and research associates. These individuals may work with students and faculty on research projects, give lectures, teach classes, and/or participate in field trips. Adjunct faculty include:

- Ryan Emanuel, NC State
- Gregg Marland, RIEEE – Appalachian State University
- Arthur Merschat, USGS
- Cara Santelli, Smithsonian National Museum of Natural History
- Keith Seramur, Appalachian State University

Staff

Ms. Lauri Miller joined the department in 2005 and is the Department Administrative Assistant. Ms. Miller maintains the department's budget, assists students and faculty in a variety of ways, and is one of the few people in the department who understands the new Banner student information system.

Mr. Anthony Love (B.S., Appalachian State University) the Laboratory Manager, joined the Department in 1999 and provides technical help to faculty and students, public school lectures and laboratory instruction, and a diverse array of services in support of instruction and research. Anthony is an ardent rock climber and works closely with a number of local climbing groups.

Geology Students

The top ten reasons you should be a geology student are:

- You are concerned about the environment.
- You wonder why the Earth appears as it does.
- You like the outdoors.
- You don't want a desk job.
- You have a sense of adventure and a spirit of discovery.
- You enjoy solving puzzles and problems.
- You enjoy using computer technology to solve practical problems.
- You desire a lucrative career doing something you actually like doing.
- You enjoy travel.
- You can immediately recognize the San Andreas Fault in this photo:

What's your excuse for not being a geology major?

This handbook is designed to give geology majors information on how to be successful in the Geology program, details about the program, and guidelines for use in the path to a Bachelor degree. This guide also provides information for prospective majors about the program and attributes needed for success in Geology at Appalachian. Rewarding careers and success in Appalachian's Geology programs come to those who are hard working, conscientious, learn from their mistakes, and get involved in the life of the department.

The education of geologists generally parallels that of other students of the natural sciences. Because an understanding of the Earth requires an understanding of the principles of physics, chemistry, and biology, a fundamental background in these subjects is necessary, as is an understanding of mathematics and computer science. The education of geologists and other scientists differs in the emphasis on field work in order to study the Earth and its changes over time. Like chemists or physicists, some geologists conduct experiments in the laboratory under controlled conditions, but they focus on Earth materials. In many cases, however, nature has already conducted the experiment (that is, a natural event like an earthquake or a period of glaciation has occurred in the past) and the geologist is faced with discovering the conditions under which the experiment (the event) occurred. While this can sometimes be done in the laboratory, it commonly requires investigation in the field. Here, geologists often use modern day processes or conditions as keys to understanding past events.

Active geologists continue to seek new knowledge about the Earth, that is, they do research. Thus, it is essential that students of geology develop an understanding of the research process and all of its facets, from data collection in the field, laboratory and library, to data analysis and hypothesis testing. Objectivity and complete honesty are essential to this process. Communication, too, is essential for the advancement of science; hence students learn to write and speak publicly about their discoveries. At Appalachian State University, such opportunities are provided, and good students find that they can contribute new discoveries through original research and publication of their findings at meetings of professional scientists.

The Appalachian Geology program provides strong training in the fundamentals of geology necessary for a successful career as a technician, scientist, or consultant at the Bachelor's level, or for successful pursuit of a graduate education. We encourage students to pursue a graduate education, because greater career opportunities and opportunities for contributing to the scientific foundation of society are made possible.

If you are either majoring or seriously considering a major in Geology at Appalachian State University, the following advice will be helpful. If you have questions about the courses you need to take, consult the University Catalog, this Handbook, or the following academic advisors:

- Dr. William Anderson (RSS 115)
- Dr. Sarah Carmichael (RSS 113)
- Dr. Ellen Cowan (RSS 102A)
- Dr. Steve Hageman (RSS 116)
- Dr. Andrew Heckert (RSW 041)
- Dr. Cynthia Liutkus (RSS 117)
- Dr. Scott Marshall (RSS 111)
- Ms. Laura Mallard (RSW 025) (for questions concerning the B.S. in Geoscience Education)

You should take Geology 1101 or 1510 as soon as possible (your freshman year, preferably). GLY 2250, Evolution of the Earth, marks the transition from courses taken for General Education credit and those required for the major. Depending on the program you are following, other courses such as Preparation of Geologic Reports (GLY 2745), and Fundamentals of Mineralogy (GLY 3220) follow in turn. Checksheets for individual degree programs are provided later in the handbook. Because many jobs with good futures in geology generally require a Master's degree, you should concentrate on getting high grades while you are at Appalachian in order to get into graduate school and (or) receive the best possible job offer when you graduate. Job opportunities are almost always good for good geologists. However, in order to become a good geologist, you will need to learn as much geology as possible.

The best way to determine whether geology is really the major for you and the profession you want to live with for the next 50 years is to become involved with your fellow geology majors, the geology professors, geology courses, and geology field trips. The best geologists are those who have seen the most geology and can think critically. Field trip notices and sign-up sheets are normally posted in the halls of Rankin Science building. Watch for these notices and join with us on our trips and

meetings. Attend Appalachian Geological Society (club) meetings and take an active part in club activities.

Geology is complex, and it can be intellectually challenging. It requires hard work and dedication. It can also be incredibly fun with opportunities to travel widely, interacting with geologists around the world. Geologists worldwide share a feeling of collegiality that is rare in many professions. The faculty invite you to join us in the hard work and good times as we study geology together.

The following words of wisdom have been passed on to you from the alumni who preceded you through the Geology Programs at Appalachian State University. These folks have been where you are now and give their perspectives from their geological professions. Consider their advice.

The following advice is from alumni working in Minerals and Fuels Exploration:

- Get an MS if you want to work in geology.
- Take a course in economics.
- Take and participate in as many field trips as possible.
- Take more business and economics courses.
- Minor in business, particularly finance, if you are going into the petroleum industry.
- Try to get summer jobs in geology related fields.
- Do not major in Geology unless you really like it.
- Take as many stratigraphy courses as possible.
- Take computer courses, more chemistry, more physics, and as much geology as possible.
- Study as hard as you can, and learn how to do your structure labs, especially three point problems.

Alumni who are Environmental and Engineering Geologists and Hydrologists gave us the following feedback:

- Take computer science courses.
- Specialization is good, but well-rounded is better.
- Physics, math, and computer science are becoming more necessary.
- Take courses in computer modeling...and geophysics.
- Live geology if you hope to become a good geologist.

The following quotes come from alumni who are teachers and professors:

- Geology majors who expect to teach should make collections for the classroom.
- Collect plenty of fossils for the kids....
- Take more statistics and computer science courses.

Financial Support in the Department

Undergraduate Research Assistantships (URAs)

The Geology Department offers undergraduate research assistantships to bona fide geology majors on a competitive basis. We currently support five URAs and typically offer at least one new award per year. The value of the award typically is $500 - $750 per semester or $1000 - $1500 per year. URAs are awarded primarily on the basis of superior academic performance and promise as a professional. Financial need is not a major criterion. Departmental URAs are research awards, meaning that the recipient must work with a faculty member on a research project for 4-6 hours per week.

URAs are renewable for a maximum of $6000, must be renewed each semester, and are renewable by returning students who have a GPA in geology courses of at least 3.0 and an overall GPA of at least 2.75, maintained while taking a full-time course load and making normal progress towards a degree. Students holding URAs are expected to be active participants in departmental functions.

The deadline for submission of all application materials is March 15. Application materials include a formal letter of application, a personal resume, and academic records. Academic records for new freshmen include SAT scores, letters of recommendation from at least one high school teacher and two other persons who are personally acquainted with the performance and character of the applicant. Academic records of students who have previously attended Appalachian consist of permission for the scholarship committee to access all transcripts of the applicant.

For additional information about a Undergraduate Research Assistantship, contact the Geology Department office in 031 Rankin Science West or call 828-262-3049.

DeBroder Scholarship

Founded by Glen DeBroder in memory of his son, Mark, who opened the Espresso News coffee shop near campus. Geology faculty, staff, and students have been such regulars at Espresso News since it opened in 1994 that Mark was named an honorary member of the department. The scholarship typically is awarded to a rising senior Geology major.

Lloyd L. Hobbs Memorial Scholarship for the Physical Sciences

The Lloyd L. Hobbs Scholarships are given to rising juniors or seniors at Appalachian State University majoring in an area of the physical sciences within the College of Arts and Sciences. Applicants must demonstrate and maintain satisfactory academic progress (3.0 GPA) and have a verifiable need for financial aid. The amount of the scholarship will vary with in accordance with investment performance, current conditions and Foundation policy. In recent years, the scholarship has ranged from $750 to $1700 per year. Information concerning other scholarships is available from the Appalachian State University Financial Aid Office at 828-262-2190.

The Jonathan K. Perryman Memorial Scholarship for the Sciences

This endowed scholarship was established in memory of Jonathan K. Perryman by family members, friends and colleagues.

Applicants must be full time students, rising juniors and seniors and majoring in either Biology, Chemistry, Geology, Physics and Astronomy, Mathematics or Computer Science. Applicants must demonstrate satisfactory performance of at least a 3.0 grade point average.

The award is renewable based upon reapplication and reselection. The Office of the Dean of the College of Arts and Sciences collects applications and nominations, then conducts the selection process according to established guidelines. For additional information, please contact Dr. Dru Henson (hensonda@appstate.edu), Assistant Dean, College of Arts and Sciences at (828) 262-3078.

The Richard A. Thomas Memorial Scholarship for Arts and Sciences

This endowed scholarship is established as a memorial to Richard A. Thomas. The scholarship guidelines specify that applicants must demonstrate a verifiable need for financial support and that a financial aid form must be on file. Applicants must have completed the freshman year at Appalachian and must be pursuing a major within the College of Arts and Sciences. In addition, applicants must display success and progress in academics, leadership potential, and co-curricular activities. The award is directed to be renewable based upon reapplication and reselection. Mrs. Alice T. Thomas, the donor who established this scholarship endowment, would genuinely appreciate a letter from scholarship recipients detailing their background and ambitions. The Office of the Dean of the College of Arts and Sciences collects applications and nominations and then conducts the selection process in accordance with established guidelines. For additional information, please contact Dr. Dru Henson (hensonda@appstate.edu), Assistant Dean, College of Arts and Sciences at (828) 262-3078.

Loren A. Raymond Student Research Grant

In honor of Dr. Raymond's service to the department, friends, alumni, and faculty have endowed a fund to support the Loren A. Raymond Student Research Grant. The grant will consist of an award to support field-based research by a Junior or Senior student, in the broad fields of petrology, structural geology, stratigraphy and geologic mapping. To receive the award, the student will be expected to apply for it with a brief proposal describing the project and its anticipated expenditures, along with a letter of support from a faculty member who will be the student's research advisor. The recipient of the award will be announced at the annual spring banquet, and a report will be expected at the end of the next academic year.

Fred Webb, Jr. and Barbara Haynes Webb Endowed Scholarship for Summer Field Course

The Fred Webb, Jr. and Barbara Haynes Webb Endowed Scholarship for Summer Field Course is designated for a junior or senior Geology major at Appalachian State University who is enrolled in a summer field geology course taught outside of North or South America. To qualify for this scholarship, in addition to enrolling in a summer field geology course taught outside of North or South America, the applicant must have a GPA of 2.8 or more, have significant academic potential, and have demonstrated sustained dedication to the profession of Geology. The amount of this scholarship is currently $500, but the amount is dependent on the return on the endowment.
To apply, submit a letter of application with a description of how you meet each of the above requirements, a list of memberships in professional organizations and other pertinent activities to the Chairperson, Department of Geology, Appalachian State University. The application deadline is March 1st of the year in which you plan to attend field camp.

McKinney Paleontology Scholarship

The McKinney Paleontology Scholarship was established in 2011, in honor of Dr. F. Kenneth “Ken” McKinney's contributions to Paleontology and to the Department of Geology at Appalachian.

Undergraduate Teaching Assistantships

Undergraduate Teaching Assistantships (UTAs) are competitive awards available to geology majors who have completed Geology 2215 with a C or better. These awards of $300/semester provide majors with the opportunity to gain experience in assisting professors in teaching introductory geology laboratories. Service required of recipients consists of approximately two (2) hours per week during laboratory and 0.5 to 1 hour of preparation. Duties include answering students' questions, aid in test administration, and other tasks associated with preparation of and teaching laboratories.

Answersphere

The Answersphere is the in-house tutoring system in the Department of Geology and the McKinney Teaching Museum. The Department hires Geology majors to assist students in introductory geology classes with funding from the College of Arts and Sciences. All sessions are held in the McKinney Teaching Museum located on the first floor of Rankin Science South. Working in the Answersphere is excellent experience for Geology majors planning to attend graduate school, planning a career in secondary education, or polishing those interpersonal communication skills that are so important.

Geology Department Awards and Honors

Departmental awards are presented by the faculty at the Geology department's Annual Award Banquet in April. To be eligible for these merit-based awards, a student must be taking a normal load of geology courses and be making reasonable progress toward graduation. Substantial factors in determination of recipients for all awards are enthusiasm, academic achievement, and promise as a professional. Definitions of academic class (i.e. freshman, junior, etc.) are those specified in the Appalachian General Bulletin.

Outstanding Geology Senior

The Outstanding Geology Senior receives a Brunton ® compass and case as well as having his/her name mounted on the granite wall plaque in the hall. Only those senior geology majors (non-teaching track) who have graduated in December prior to the banquet, will graduate in May, or will graduate at the end of the summer after completion of only one remaining requirement (field camp) are eligible for this award. The typical award recipient will have: an overall GPA above 3.0, taken an average of 14 hours per term, placed higher priority on geological rather than on other activities, participated in extra-curricular geology activities such as spring field trips and/or professional meetings, demonstrated a level of interest in the profession beyond that expected in formal classes, and plans to continue their study of the geosciences after graduation (either in graduate school or in a geoscience-related career).

Academic Achievement Award

The Academic Achievement Award is given to the graduating senior who, at Appalachian State University, has 1) completed at least 40 s.h. of science and mathematics courses, 2) taken a load of at least 12 s.h. in each semester in which science or mathematics courses were completed, 3) completed 12 or more hours of geology courses above the 1000 level, 4) earned a GPA of greater than 3.00 in science and mathematics courses, and 5) earned the highest GPA among his or her classmates in science and mathematics courses.

Outstanding Geology Teaching Degree Senior

The award for the Outstanding Geology Teaching Degree Senior will be determined on the basis of GPA, enthusiasm, performance as a student teacher, and promise as a professional. In general, the criteria for selection are similar to those for Outstanding Geology Senior as described above. This award, if given, generally is a gift certificate for purchase of geology equipment, books, or specimens.

Distinguished Senior Award

The Distinguished Senior Award is given each year at the College of Arts & Sciences Awards ceremony. The award is given to the senior (or seniors) who has (have) distinguished herself or himself through academic achievement, service to student colleagues and the department, or other meritorious activities in his or her career as a Geology major in Appalachian's Geology department.

Outstanding Field Student

The Outstanding Field Student award goes to a student with a geology GPA greater than 2.7. The award recipient will be awarded a scholarship to help defray the cost of attending the geology summer field course. Performance in field work in Geology 2745, 3150, and 3800 is a major criterion on which this award is based. In recent years, the amount of the scholarship has been $250.

Quantitative Geoscience Award

The Quantitative Geoscience Award goes to a student in any Geology degree program with a geology GPA greater than 2.7. Performance in 3160, 4630, 4705, and/or other quantitative science courses (including independent research), will be the criterion on which this award is based.

Early Academic Achievement in Geology Award

This award goes to a new major who has completed 2250 and who shows promise of being a successful major in the Geology Department. An overall GPA greater than 2.7, and performance in 110X, 2250, and/or other science courses (including independent research) will be the criterion on which this award is based.

Promising Freshman Awards

Freshmen majors who show promise of successful work in geology are awarded free dinners at the geology awards banquet. These awards are normally made only to those students who attain above average grades and demonstrate an interest in geology beyond class attendance.

Opportunities and Requirements

Geology majors have the advantage of working with one another and the faculty in one of the smallest departments at Appalachian State University. The close personal contact provides opportunities for independent research and a feeling of belonging to a close knit group. Special privileges, such as keys to labs and study areas and student lockers, are among the benefits of our small program. Students learn that the faculty have high standards for their own and their students' performance.

Appalachian's Geology Department requires courses, including summer field geology, that the faculty consider to be essential for a solid foundation in fundamentals necessary for a broad range of geological jobs and graduate work. A recent study indicates that more than 90% of Geology graduate schools require or recommend Physical Geology, Historical Geology, Structural Geology, and Earth Materials; more than 80% require or recommend Optical Mineralogy, Paleontology, Stratigraphy and Sedimentology, and Sedimentary Petrology. In addition, 89% require six or more hours of Chemistry, 81% require calculus based Physics, 77% require six or more hours of Calculus, and 73% require or recommend at least one semester of computer programming. Students in the Environmental Geology concentration should consider taking, as electives, as many of these courses as possible, in order to strengthen their backgrounds.

No course required by any major, either by title or area can be taken as pass/fail. Students with less than a C- grade in any particular geology course and/or less than a B average in geology may not take Independent or Individual studies. Students who have received poor grades in regular courses may not repeat those courses as either independent or individual studies. If you are a geology major you should plan to purchase your geology textbooks and keep them permanently. You should also keep your class notes and may wish to make copies of all material that may not be returned to you. For example, if an instructor plans to keep the original of a project report or term paper, you should make a personal copy. Any serious geology student should try to purchase the following items as soon as possible after becoming a major. You will use this equipment frequently, not only as a student, but also as a working geologist.

- hand lens (triplet)
- rock hammer
- straight edge and scale
- protractor
- set of colored pencils
- magnet
- field notebook
- Glossary of Geology (paperback version)

As a matter of practice, you should make copies of letters. It is also helpful to record your academic honors and accomplishments and to keep an updated resume. You should keep a work experience record, particularly your geological work experience. This record should include dates employed; name, address, and phone number of employer; kind of business or organization; your title; work location, name and phone number of supervisor; nature of work; your duties and accomplishments; salary; and reason for leaving. This information will be extremely useful for resumes and job applications.

Senior Comprehensive Examination

Colleges and Universities increasingly are being held accountable for student performance after completing their academic career. Developing procedures and metrics to measure student performance is a hot topic in university administrations these days. You should not fear the outcome of the deliberations.

The Department of Geology at Appalachian has administered a comprehensive examination to BA and BS degree students for the past twenty years. These exams assure the department that students have retained an acceptable content base. For students, the senior exams serve as a comprehensive review of their geology coursework in preparation for graduate school or their first job. Teaching concentration students are required to take part 2 of the Praxis exam in lieu of the senior exams. Students take a 45 minute examination on each geology course required for their degree and concentration. Advisors work with students to insure that students are aware of the exams they must take. Typically, the senior examination is administered in the early portion of the semester in which the student is completing geology course requirements. The examination for each course is developed and graded by the faculty member who taught the course. This faculty member will provide a study sheet to students to facilitate preparation for the exams. Each exam is graded independently. Students will have three opportunities to take or retake parts or all of the exam during the semester in an effort to pass all parts. Students who do not pass the senior exams will not graduate with a degree in Geology.

Student Research

One of the benefits of a small department with faculty who are committed to undergraduate education is the opportunity to conduct independent research with one or more faculty members in the department. These opportunities are invaluable to students applying to graduate schools or to those attempting to convince potential employers that they have the capacity to work independently. Students should recognize that tenure track faculty are under signifi cant pressure to conduct original research. Unless they meet minimum standards of scholarship, they will not be promoted and tenured in the department, and will be asked to seek employment elsewhere. As a result, research opportunities are accorded to students who can demonstrate to individual faculty members that they are hard working, dedicated and intellectually curious.

Faculty members with external funding who take on research students may have independent funding to support student travel and other research expenses. Students should be aware that funding for scientific projects is extremely competitive, with funding rates usually in the range of 15% to 20%. Students who are fortunate enough to take advantage of these opportunities should be committed to insuring that the project gets value for their expenditure.

Other faculty members who lack external funding to support students can point students to university-wide sources of funding. Geology students can apply to the Office of Student Research at Appalachian for research grants up to $500 and travel grants up to $300 to attend conferences where they are presenting their results. Projects with an international focus are eligible for awards up to $1500.

This summer the alumni of the department honored Dr. Loren Raymond for his many years of service to the department by endowing a fund that will provide geology students with grants to support field work. These grants require that the students study some aspect of petrology and conduct field work to support their research objectives. The department will announce a call for proposals during the current academic year.

Senior Honors Thesis

In order to take advantage of these opportunities, majors must meet the criterion of a minimum G.P.A. of 3.25 to be eligible to apply. In addition to the GPA requirement, the research topic must be selected and formally discussed with a faculty member who has agreed to supervise the research. Prior to the end of the Spring term of the Junior year, the student who seeks permission to register for research must also have: (1) completed courses deemed necessary by the research advisor, (2) submitted and have approved a proposal that describes the nature of the project, procedures, and other aspects deemed appropriate by the advisor, and (3) demonstrated an appropriate level of knowledge and interest in the selected topic through prior data collection or field work or reading. If progress in the research project (GLY 4501) is unsatisfactory, the student will not be permitted to write a thesis (i.e., register for GLY 4510). A copy of the official form for submission of a research proposal for consideration for GLY 4501 is available in the department office. After the form is completed and all necessary approvals have been obtained, it will serve as a contract to be kept on file in the department office.

The URL and Other Research Labs

Because the Department of Geology is committed to excellence in undergraduate education and has high expectations for its students, we have allocated space to enable you to work quietly and effectively. During the Fall 2006 departmental picnic, we unveiled the new Undergraduate Research Lab (The URL) in Rankin Science West room 023. The main function of the room is to be a quiet, academic atmosphere where students can work on class projects and research, study, and hold group review sessions. We believe the URL is the finest student research space dedicated to undergraduate use at Appalachian and we need your help to keep it that way. Behavior that negatively impacts the ability of others to effectively use this room will be dealt with accordingly. If you are really bad, we will call your Mom.

The URL houses eight high performance Dell gaming workstations, two MacPro computers, a large conference table and leather chairs, as well as a large-format printer (for poster presentations) and a ceiling-mounted LCD projector that students can use to practice presentations. The computers have a complete suite of software including MatLab, GIS software, Google Earth, NASA World Wind, Adobe Creative Suite, and Microsoft O_ce Suite. The introduction of unauthorized software programs on URL computers is strictly forbidden. If you have special software needs that are not met by the installed software, please contact Dr. Johnny Waters. When you use these computers, please remember that they are owned by the State of North Carolina and

have appropriate use restrictions. We will investigate incidents of inappropriate use, and will restrict access to guilty parties.

The computers are connected to a laser printer in the URL, to the Phaser color printer in the Department office, and to the HP 800PS large format printer also located in the URL. Your primary printer option should be the laser printer. In special cases where you need color for geology class projects or research, you should choose the Phaser. Large format printing to the HP 800PS will normally be supervised by a faculty member, who can help you with the myriad of choices needed to produce a quality poster.

As a rule, only geology majors and minors, with permission, are authorized to use the URL. Authorized students may check out and assume responsibility for keys that unlock the outside door to Rankin Science West, and the URL. Keys may be checked out from the department office manager. A signed affidavit must be completed before a key will be issued. Key holders should not loan departmental keys to anyone who is not a geology major for any reason. Persons who abuse this privilege will forfeit their keys and the opportunity for after hours work in the department. All department keys must be returned in a timely fashion in order to avoid costly financial and other penalties. Failure to abide by conditions stated on the check out form will result in penalties including loss of entry privileges.

Other undergraduate research laboratories designed specifically for geology majors include the Rock Preparations Lab, the Optical Mineralogy and Petrography lab, the X-Ray Diffraction lab, and the Paleontology Preparation portion of the Geology Repository. Only geology majors, geology minors currently enrolled in Geology classes, students assigned by faculty to work in the lab, and students given special permission to use these laboratories by the chairperson, are permitted to use these facilities. Access to the laboratories should be coordinated with Mr. Anthony Love, laboratories manager and/or the faculty member with whom you are working. Rock cutting and polishing equipment may only be used for course or research purposes. Laboratory equipment must not be used by anyone who has not received formal instruction in proper use of the equipment.

Liability

All persons using University property may be held liable for damage to or destruction of such property caused by their intentional acts or negligence. The cost of repair or replacement will be charged to the account of the responsible person or deducted from the responsible employee's payroll disbursement.

This policy does not apply to normal wear in the laboratories. In the case of problems, students should immediately contact Mr. Anthony Love (who acts as the Departmental safety officer), the Chairperson, or a faculty member.

Field Trips

Field trips are an integral part of the geology curriculum at Appalachian State University. You may find that you will have several trips scheduled during any given semester. Those field trips must be high on your list of priorities; juggle your social calendar accordingly. When you're on a field trip and arrive at a locality, do not disperse until you have been given instructions and explanations by your field trip leader. Be sure to read the Appalachian field trip policy and the British statement on field trips below. In addition

to sanctions contained in the Student Code of Conduct, anyone who violates the Appalachian Geology field trip policies will not be permitted to participate in future field trips with the department. To insure that you have a safe and productive field experience, the following policies must be observed:

- We prohibit the transportation and/or use of illegal drugs in state-owned vehicles on any field trips with which we are associated.
- No alcoholic beverage may be consumed by anyone under the age of 21.
- No alcoholic beverages may be transported or consumed in state-owned vehicles by anyone at any time.
- The field trip leader or professor in the vehicle has authority to enforce all safety regulations during the trip.
- All applicable traffic and safety regulations of the University, the State of North Carolina, and the locality of the trip are in effect and should be observed at all times.
- Only departmentally approved drivers are to be permitted to drive.
- No driver is to continue to drive when, in the judgment of the field trip leader, operation of the vehicle is being conducted in a dangerous manner, loss of concentration has occurred, the driver is fatigued, or road conditions are unsafe.
- On long trips, officially approved and capable relief drivers should be rotated.
- Seat belts must be worn by everyone. North Carolina and most other state laws require use of seat belts by passengers seated in the front seat of any vehicle while it is moving.
- Neither horseplay nor disruptive behavior is permitted.
- There should always be at least two persons awake and alert. The driver is responsible for safety (taking all aspects of road conditions, vehicle characteristics, weather, etc. into account) and the "co-pilot" is responsible for navigation and keeping the driver alert (e.g. by engaging the driver in conversation).
- Rest stops of at least 10 minutes in length should be made at regular intervals.
- Students and faculty should remove trash from vehicles upon return from the field.
- Smoking is not permitted in vans or cars used for field trips.

A Code for Geological Field Work

A geological 'code of conduct' has become essential if opportunities for field work in the future are to be preserved. The rapid increase in field studies in recent years has tended to concentrate attention upon a limited number of localities, so that sheer collecting pressure is destroying the scientific value of irreplaceable sites. At the same time the volume of field work is causing concern to many site owners. This code is one that many geologists in Great Britain follow. Changes in wording have been made to take the US into account.

Geologists must be seen to use the countryside with responsibility. To achieve this, the following general points should be observed:

- Obey the country code, and observe local laws. Remember to shut gates and leave no litter.
- Always seek prior permission before entering private land.
- Don't interfere with machinery.
- Don't litter fields or roads with rock fragments that might cause injury to livestock, or be a hazard to pedestrians or vehicles.
- Avoid undue disturbance to wildlife. Plants and animals may inadvertently be displaced or destroyed by careless actions.
- On coastal sections, be sure you know the local tide conditions.
- When working in mountainous or remote areas, follow the advice given in the pamphlet, "Mountain Safety," issued by the Central Council for Physical Education, and, in particular, inform someone of your intended route.
- When exploring underground, be sure to have the proper equipment, and the necessary experience. Never go alone. Report to someone your departure, location, estimated time underground, and your actual return.
- Don't take risks on insecure cliffs or rock faces. Take care not to dislodge rocks, since other people may be below.
- Be considerate. By your actions in collecting, do not render an exposure untidy or dangerous for those who follow you.

Quarries and other active construction sites offer unparalleled opportunities for geologists to see fresh exposures of rocks. By their very nature, quarries are inherently dangerous places and special care must be taken. When visiting quarries the following guidelines should be considered:

- An individual, or leader of the party, should have obtained prior permission to visit.

- The leader of a party should have made himself familiar with the current state of the quarry. He should have consulted with the Manager as to where visitors may go, and what local hazards should be avoided.

- On each visit, both arrival and departure must be reported.

- In the quarry, the wearing of safety hats and stout boots is recommended.

- Keep clear of vehicles and machinery.

- Be sure that blast warning procedures are understood.

- Beware of rock falls. Quarry faces may be highly dangerous and liable to collapse without warning.

- Beware of sludge lagoons.

Geologists and geology students who are collecting rocks, minerals, and fossils or who are organized into field parties should remember the following:

- Students should be encouraged to observe and record, but not to hammer indiscriminately.

- Keep collecting to a minimum. Avoid removing fossils, rocks or minerals unless they are genuinely needed for serious study.

- For teaching, the use of replicas is recommended. The collecting of actual specimens should be restricted to those localities where there is a plentiful supply, or to scree, fallen blocks and wastetips.

- Never collect from walls or buildings. Take care not to undermine fences, walls, bridges or other structures.

Degree Programs in Geology

All majors in geology require a minimum of 122 semester hours for the degree.
The Bachelor of Arts degree requires a minor. In addition to core curriculum, major and minor requirements, electives must be taken to meet the total required minimum hours. Two semester hours of free electives outside the major discipline are required. A major in geology leading to either the Bachelor of Arts degree or the Bachelor of Science (non-teaching) degree is appropriate for those students who intend to pursue graduate studies in Geology. The Bachelor of Science (non-teaching) degree is recommended for students who seek a career at the Bachelor degree level. The programs consist of the following, in addition to general requirements for B.A. and B.S. (non-teaching) degrees in this college as stated in the University Bulletin.

Bachelor of Arts degree in Geology

Students pursuing the B.A. degree in geology (non-teaching) must complete a minimum of 37 semester hours of geology courses. Required courses include GLY 1101 (or GLY 1510), GLY 2250, GLY 2745, GLY 3150, GLY 3220, GLY 3715, GLY 3800, GLY 4210, and an approved six semester hour geology summer field course. Students are required to take a total of 6 semester hours of geology electives at or above the 3000-level (exclusive of GLY 3520). In addition, students must complete the following cognate courses: MAT 1110, MAT 1120; CHE 1101, CHE 1110, CHE 1102, CHE 1120; PHY 1150 and PHY 1151. Additional courses include another course in mathematics or computer science, six semester hours of a foreign language at the intermediate or higher level, and enough courses (12-20 s.h.) to satisfy requirements in a minor.

A candidate for the Bachelor of Arts degree may count not more than a total of 40 hours above core curriculum requirements in geology. During the senior year, the B.A. in geology student must take and achieve a satisfactory score on a comprehensive examination covering theoretical and practical aspects of areas of geology. Students who are unsuccessful on any portion or all of the examination may retake the appropriate portion(s) up to two additional times before graduation.

Bachelor of Science degree in Geology

Students pursing the B.S. degree in Geology (non-teaching) must complete a minimum of 33 semester hours of geology courses above the 1000 level. Required courses include GLY 1101 (or GLY 1510), GLY 2250, GLY 2745, GLY 3150, GLY 3220, GLY 3715, GLY 3800, GLY 4210 and an approved six semester hour geology summer field course. Students are also required to take a total of 6 semester hours of geology courses at or above the 3000 level. In addition, students must complete the following cognate courses: MAT 1110, MAT 1120; CHE 1101, CHE 1110, CHE 1102, CHE 1120; PHY 1150 and PHY 1151. Additional courses (as speci_ed on the degree checksheet) include six semester hours of statistics OR six semester hours of advisor approved computing courses. The degree also requires at least eight semester hours of appropriate non-geology courses that must be approved by the department advisor.

During the senior year, the B.S. in Geology student must take and achieve a satisfactory score on a comprehensive examination covering theoretical and practical aspects of areas of geology. Students who are unsuccessful on any portion or all of the examination may retake the appropriate portion(s) up to two additional times before graduation.

B.S. degree with an Environmental Geology concentration

The Bachelor of Science degree in Geology (non-teaching) with a concentration in Environmental Geology will provide a background for students who seek a career or graduate work in which they apply geological principles to the solution of environmental problems. This 122 semester hour degree consists of a minimum of 39 semester hours of geology courses, in addition to supporting courses in biology, chemistry, geography, mathematics, physics, social sciences, and business. Required courses include: GLY 1101 (or GLY 1510), GLY 2250, GLY 2745, GLY 3150, GLY 3220, GLY 3715, GLY 3703, GLY 3800, GLY 4630, GLY 4705. Students are also required to take a total of 6 semester hours of elective geology courses at or above the 3000 level, in addition to the following required courses: MAT 1110; BIO 1110; CS 1425, three semester hours of advisor-approved, computer- intensive courses; CHE 1101, CHE 1110, CHE 1102, CHE 1120; PHY 1103; ECO 2030; LAW 2150; GHY 3100, GHY 4820; PS 2130; STT 2810; and either GHY 2310 and GHY 3812 or FIN 3010 and MGT 3010. General requirements for the B.S. (non- teaching) degree in this college must also be met.

During the senior year, candidates for the B.S. in geology with an environmental geology concentration degree must take and achieve a satisfactory score on a comprehensive examination covering theoretical and practical aspects of areas of geology. Students who are unsuccessful on any portion or all of the examination may retake the appropriate portion(s) up to two additional times before graduation.

B.S. degree with a Paleontology concentration

The Bachelor of Science degree in Geology (non-teaching) with a concentration in Paleontology will provide a background for students who seek graduate work in various fields of paleontology, paleobiology or the oil and gas industry. Students pursuing this concentration must complete a minimum of 33 semester hours of geology courses above the 1000 level. Required courses include: GLY 1101 (or GLY 1510), GLY 2250, GLY 2745, GLY 3150, GLY 3220, GLY 3715, GLY 3800, GLY 4025, GLY 4210, and an approved six semester hour geology summer field course. Students are required to take a total of three semester hours from GLY 3333, GLY 3703, GLY 3415, GLY 4630, GLY 4705, GLY 4501, GLY 4510, and GLY 3530-3549. The biological component of this degree program consists of 18 semester hours of biology courses including BIO 1110, and either BIO 2000 or BIO 2001, plus an additional 10 s.h. of biology courses at the 2000-4000 level. The student will work with an advisor to determine the courses taken, but the following BIO courses are specifically not allowed: BIO 2800, BIO 3318, BIO 3520, BIO 4550 and BIO 4563. In addition, students must complete the following cognate courses: MAT 1110, MAT 1120; CHE 1101, CHE 1110, CHE 1102, CHE 1120; PHY 1151 and PHY 1152. Additional courses (as specified on the degree checksheet) include six semester hours of computer science, GIS or statistics.

During the senior year, the B.S. in geology with a paleontology concentration student must take and achieve a satisfactory score on a comprehensive examination covering theoretical and practical aspects of geology. Students who are unsuccessful on any portion or all of the examination may retake the appropriate portion(s) up to two additional times before graduation.

B.S. degree with a Quantitative Geoscience concentration

A major in Geology leading to the Bachelor of Science (non-teaching) degree with a Quantitative Geoscience concentration will provide a background for students interested in pursuing professional careers or graduate study in areas that demand rigorous quantitative and numerical skills. These areas may include, but are not limited to: geophysics, hydrology/hydrogeology, tectonics/seismology and paleontology. This 122 semester hour degree consists of a 31 semester hours of essential geology courses, and an additional complement of geology courses emphasizing quantitative analyses and numerical methods.

Required courses include: GLY 1101 (or GLY 1510), GLY 2250, GLY 2745, GLY 3150, GLY 3220, GLY 3715, GLY 3800, GLY 4210, and GLY 4835; quantitative courses GLY 4630, GLY 4705, and GLY 3160; a three s.h. Geology course at the 3000 or 4000 level; required courses MAT 1110, MAT 1120, MAT 2130, MAT 2240 (or MAT 3130), CHE 1101, CHE 1110, CHE 1102, CHE 1120, PHY 1150, PHY 1151; and six s.h. from among the following courses: GHY 3820, STT 2810, STT 3820, CS 1400, CS 1425, and CS 1440. General requirements for the B.S. (non-teaching) degree in this college must also be met.

During the senior year, the B.S. in Geology with a Quantitative Geoscience concentration student must take and achieve a satisfactory score on a comprehensive examination covering theoretical and practical aspects of areas of geology. Students who are unsuccessful on any portion or all of the examination may retake the appropriate portion(s) up to two additional times before graduation.

B.S. degree and teacher licensure

A major in Geology leading to the B.S. degree and teacher licensure requires GLY 1101 (or GLY 1510), GLY 1103, GLY 2250, GLY 3220, GLY 3333, GLY 3480, GLY 3521, three semester hours of geology electives, and GLY 3520 for two semester hours (one hour each of instructional assistance in GLY 1101 and GLY 1102 labs). Also required are GHY 3100; BIO 1110 or BIO 1101 and BIO 1102; AST 1001 and AST 1002; MAT 1110; at least 12 semester hours selected from CHE 1101, CHE 1110 and CHE 1102, CHE 1120; PHY 1103 and PHY 1104; and GS 4403; RE 4630 (minimum grade of C required in GS 4403 and RE 4630). For information on necessary professional education requirements for secondary education licensures, see the section for the Department of Curriculum and Instruction in the University course catalog.

During the senior year, the B.S. in Geology Teaching Licensure degree student must take the Praxis II subject area exam: Earth/Space Science (0570) portion. The score should be reported to Appalachian State University.

Minor in Geology

A minor in Geology will consist of 17 semester hours of geology, including GLY 1101 and GLY 2250, plus five semester hours of additional geology courses at the 2000-level or above (excluding GLY 3520).

2011-2012

Bachelor of Arts (BA) **Checksheet for Geology Majors**
Degree Code 244A

I. GENERAL EDUCATION CURRICULUM 44
Chemistry 1101/1110 & 1102/1120 will fulfill Science Inquiry perspective. MAT 1110 fulfills the Quantitative Literacy requirement.

II. FOREIGN LANGUAGE (Completion of 6 semester hours at the *intermediate level, or higher) 6

_____1040 ____ and 1050 ____ or 1060 ____; or higher level courses _____
**NOTE: Foreign language 1010 and 1020 (or 1030) are prerequisites for the intermediate level courses.*

III. MAJOR REQUIREMENTS (not including 12 s.h. from Area I, above) **..... 54**
2.0 major GPA is required for graduation. Major GPA calculation will include <u>all</u> courses taken in the major department, plus any other courses under III. No more than 46 semester hours of Geology courses may be counted toward the BA Degree. Minimum of 18 semester hours of courses taken to fulfill major requirements must be courses offered by Appalachian. *Since many upper level Geology courses require GLY 1101 as a prerequisite, it is highly recommended that students complete this course during their freshman year.*

A. Geology (37 semester hours):

GLY 1101	_____ (4)	Introduction to Physical Geology	**OR** GLY 1510_____ (4) Geological Science Honors
GLY 2250	_____ (4)	Evolution of the Earth *(Pre: GLY 1101, 1102, 1103, 1104, or 1105)*	
GLY 2745	_____ (4)	Preparation of Geologic Reports **[WID]** *(Pre: ENG 2001; GLY 2250)*	
GLY 3150	_____ (3)	Principles of Structural Geology and Tectonics *(Pre: GLY 2250, 2745)*	
GLY 3220	_____ (3)	Fundamentals of Mineralogy *(Pre: GLY 2250)*	
GLY 3715	_____ (3)	Petrology and Petrography *(Pre: CHE 1101/1110; GLY 2250, 2745, 3220)*	
GLY 3800	_____ (3)	Introduction to Stratigraphy & Sedimentology *(Pre: GLY 2250)*	
GLY 4210	_____ (1)	Geology Seminar **[CAP]**	
GLY 4835	_____ (6)	Summer Field Geology or other approved field course *(Pre: GLY 3150, 3715, 3800)*	

6 semester hours GLY electives at or above 3000 level (excluding GLY 3520):

_____

B. Mathematics/Chemistry/Physics (29 semester hours)

MAT 1110	_____ (4)	Calculus with Analytic Geometry I *(Pre: MAT 1025)*
MAT 1120	_____ (4)	Calculus with Analytic Geometry II *(Pre: MAT 1110)*
Elective	_____ (3)	Math or Computer Science Elective _____
CHE 1101	_____ (3)	Introductory Chemistry I *(Co: CHE 1110)*
CHE 1110	_____ (1)	Introductory Chemistry I Lab *(Co: CHE 1101)*
CHE 1102	_____ (3)	Introductory Chemistry II *(Pre: CHE 1101; Co: CHE 1120)*
CHE 1120	_____ (1)	Introductory Chemistry II Lab *(Co: CHE 1102)*
PHY 1150	_____ (5)	Analytical Physics I *(Co: MAT 1110)*
PHY 1151	_____ (5)	Analytical Physics II *(Co: MAT 1120)*

Major Requirements that count in Gen Education:

Science Inquiry
CHE 1101/1110 4 s.h.
CHE 1102/1120 4 s.h.

Quantitative Literacy
MAT 1110 4 s.h.

Perspectives
(depends on choices)
FL 1050 3 s.h.

Total Major hrs: 66
Gen Ed-up to 15 hrs: - 15
Net Major hrs: 51

During the senior year the B.A. student must take and achieve a satisfactory score on a COMPREHENSIVE EXAMINATION covering theoretical and practical aspects in areas of geology. Students who are unsuccessful on portions or all of the examination may retake appropriate portions up to two additional times prior to graduation.

IV. MINOR REQUIRED 12-18
Minimum of 9 semester hours of courses taken to fulfill minor requirements must be courses offered by Appalachian.

V. ELECTIVES (taken to total 122 hours for the degree) ..... 2-<u>6</u>
2 semester hours of free electives must be outside the major discipline. **122**

2011-2012

Bachelor of Science (BS) Non-Teaching **Checksheet for Geology Majors**
Degree Code 244A

I. GENERAL EDUCATION CURRICULUM 44

CHE 1101/1110 and 1102/1120 fulfills the Science Inquiry perspective.

II. MAJOR REQUIREMENTS (not including 8 hours counted in Area I, above) 69

2.0 major GPA is required for graduation. Major GPA calculation will include all courses taken in the major department, plus any other courses under II. Minimum of 18 semester hours of courses taken to fulfill major requirements must be courses offered by Appalachian. ***Since many upper level Geology courses require GLY 1101 as a prerequisite, it is highly recommended that students complete this course during their freshman year.***

A. Geology (37 semester hours):

GLY 1101 _____ (4) Introduction to Physical Geology **OR** GLY 1510 _____ (4) Geological Science Honors
GLY 2250 _____ (4) Evolution of the Earth *(Pre: GLY 1101, 1102, 1103, 1104, or 1105)*
GLY 2745 _____ (4) Preparation of Geologic Reports **[WID]** *(Pre: ENG 2001, GLY 2250)*
GLY 3150 _____ (3) Principles of Structural Geology and Tectonics *(Pre: GLY 2250, 2745)*
GLY 3220 _____ (3) Fundamentals of Mineralogy *(Pre: GLY 2250)*
GLY 3715 _____ (3) Petrology and Petrography *(Pre: CHE 1101/1110; GLY 2250, 2745, 3220)*
GLY 3800 _____ (3) Introduction to Stratigraphy and Sedimentology *(Pre: GLY 2250)*
GLY 4210 _____ (1) Geology Seminar **[CAP]**
GLY 4835 _____ (6) Summer Field Geology or other approved field course *(Pre: GLY 3150, 3715, 3800)*
6 s.h. GLY electives at or above 3000 level (excluding GLY 3520) _____

B. 8 semester hours Advisor Approved Non-Geology Courses _____

C. Mathematics/Chemistry/Physics (26 hours)

MAT 1110 _____ (4) Calculus with Analytic Geometry I *(Pre: MAT 1025)*
MAT 1120 _____ (4) Calculus with Analytic Geometry II *(Pre: MAT 1110)*
CHE 1101 _____ (3) Introductory Chemistry I *(Co: CHE 1110)*
CHE 1110 _____ (1) Introductory Chemistry I Lab *(Co: CHE 1101)*
CHE 1102 _____ (3) Introductory Chemistry II *(Pre: CHE 1101; Co: 1120)*
CHE 1120 _____ (1) Introductory Chemistry II Lab *(Co: CHE 1102)*
PHY 1150 _____ (5) Analytical Physics I *(Co: MAT 1110)*
PHY 1151 _____ (5) Analytical Physics II *(Co: MAT 1120)*

Major Requirements that count in Gen Education:

Science Inquiry
CHE 1101/1110 4 s.h.
CHE 1102/1120 4 s.h.
Quantitative Literacy
MAT 1110 4 s.h.

Total Major hrs: 77
Gen Ed hrs: - 12
Net Major hrs: 65

D. Six semester hours of statistics, such as

STT 2810 _____ (3) Introduction to Statistics *(Pre: MAT 1010)*
STT 3820 _____ (3) Statistical Methods I *(Pre: STT 2810)*
Or other Geology advisor approved courses based on statistical applications _____

OR 6 semester hours of geology advisor-approved computer science or computing courses

CS 1425 _____ (3) Overview of Computer Science *(Co: MAT 1020 or 1025)*
CS 1440 _____ (4) Computer Science I *(Pre: MAT 1020/1025 w/minimum grade "C-")*
GHY 2310 _____ (3) Cartographic Design & Analysis
GHY 3812 _____ (3) Introduction to GIS *(Pre: GHY 2310, 2812)*
GHY 4812 _____ (3) Advanced GIS *(Pre: GHY 3812)*

Other _____

During the senior year the B.S. (non-teaching) student must take and achieve a satisfactory score on a COMPREHENSIVE EXAMINATION covering theoretical and practical aspects in areas of geology. Students who are unsuccessful on portions or all of the examination may retake appropriate portions up to two additional times prior to graduation.

III. MINOR (optional)

IV. ELECTIVES (taken to total 122 hours for the degree).....9

2 semester hours of free electives must be outside the major discipline. **122**

2011-2012

Bachelor of Science (BS)
Degree Code 259*
Concentration Code 259C

Checksheet for Geology Majors
ENVIRONMENTAL GEOLOGY CONCENTRATION

I. GENERAL EDUCATION CURRICULUM 44
CHE 1101/1110 & CHE 1102/1120 fulfill Science Inquiry perspective and MAT 1110 fulfills Quantitative Literacy in general education.

II. MAJOR REQUIREMENTS (not including 12 hours counted in Area I, or 3 hours in Area II. C below) **..... 74**
2.0 major GPA is required for graduation. Major GPA calculation will include <u>all</u> courses taken in the major department, plus any other courses under II. Minimum of 18 semester hours of courses taken to fulfill major requirements must be courses offered by Appalachian. *Since many upper level Geology courses require GLY 1101 as a prerequisite, it is highly recommended that students complete this course during their freshman year.*

A. Required Geology courses (33 semester hours)

GLY 1101	_____ (4)	Intro to Physical Geology	**<u>or</u>** GLY 1510_____(4) Geo. Sci. Honors-Physical
GLY 2250	_____ (4)	Evolution of the Earth *(Pre: GLY 1101,1102,1103,1104, or 1105)*	
GLY 2745	_____ (4)	Preparation of Geologic Reports **[WID]** *(Pre: ENG 2001, GLY 2250)*	
GLY 3150	_____ (3)	Principles of Structural Geology and Tectonics *(Pre: GLY 2250, 2745)*	
GLY 3220	_____ (3)	Fundamentals of Mineralogy *(Pre: GLY 2250)*	
GLY 3703	_____ (3)	Issues in Environmental Geology *(Pre: Science Inquiry met)*	
GLY 3715	_____ (3)	Petrology and Petrography *(Pre: CHE 1101/1110; GLY 2250, 2745, 3220)*	
GLY 3800	_____ (3)	Introduction to Stratigraphy & Sedimentology *(Pre: GLY 2250)*	
GLY 4630	_____ (3)	Hydrogeology *(Pre: 6 s.h. GLY)*	
GLY 4705	_____ (3)	Advanced Environmental and Engineering Geology **[CAP]** *(Pre: 6 s.h. GLY)*	

B. Geology electives--choose 6 semester hours at or above the 3000 level (excluding 3520):

_____

C. Environmental Geology concentration (50 semester hours) (ECO 2030 can count in gen ed)

BIO 1801	_____ (4)	Biological Concepts I *(Co: CHE 1101)*
CHE 1101	_____ (3)	Introductory Chemistry I *(Co: CHE 1110)*
CHE 1110	_____ (1)	Introductory Chemistry I Lab *(Co: CHE 1101)*
CHE 1102	_____ (3)	Introductory Chemistry II *(Pre: CHE 1101; Co: 1120)*
CHE 1120	_____ (1)	Introductory Chemistry II Lab *(Co: CHE 1102)*
C S 1425	_____ (3)	Overview of Computer Science *(Co: MAT 1020/1025)*
PHY 1103	_____ (4)	General Physics I *(Co: MAT 1020/1025)*
MAT 1110	_____ (4)	Calculus with Analytic Geometry I *(Pre: MAT 1025)*
STT 2810	_____ (3)	Introduction to Statistics *(Pre: MAT 1010)*
ECO 2030	_____ (3)	Principles of Economics-Price Theory
LAW 2150	_____ (3)	Legal Environment of Business
GHY 3100	_____ (3)	Weather and Climate *(Pre: GHY 1010)*
GHY 4820	_____ (3)	Geographical Hydrology *(Pre: GHY 1010, 3100, 3110)*
P S 2130	_____ (3)	State and Local Government
Elective	_____ (3)	Advisor approved, computer intensive course _____

Choose one series (of two courses):

FIN 3010	_____ (3)	Survey of Finance	**<u>and</u>**	MGT 3010 (3) ___ Survey of Management
<u>OR</u> GHY 2310	_____ (3)	Cartographic Design & Analysis	**<u>and</u>**	GHY 3812 (3) ___ Intro to GIS *(Pre: GHY 2310, 2812)*

During the senior year, the B.S. Geology with an Environmental Geology concentration student must take and achieve a satisfactory score on a comprehensive examination covering theoretical and practical aspects of areas of geology. Students who are unsuccessful on any portion or all of the examination may retake the appropriate portion(s) up to two additional times before graduation.

III. MINOR (optional)

IV. ELECTIVES (taken to total 122 hours for the degree)..... <u>4</u>
2 semester hours of free electives must be outside the major discipline. **122**

Major Requirements that count in Gen Education:

Science Inquiry
CHE 1101/1110 4 s.h.
CHE 1102/1120 4 s.h.
Quantitative Literacy
MAT 1110 4 s.h.
Perspectives
ECO 2030 3 s.h.

Total Major hrs: 89
Gen Ed hrs: - 15
Net Major hrs: 74

2011-2012

Bachelor of Science (BS) Non-Teaching **Checksheet for Geology Majors**
Degree Code 259D **PALEONTOLOGY**

I. GENERAL EDUCATION CURRICULUM 44

Chemistry 1101/1110 & 1102/1120 fulfill the Science Inquiry perspective. MAT 1110 fulfills the Quantitative Literacy requirement.

II. MAJOR REQUIREMENTS (not including 12 hours counted in Area I, above)**.....75**

2.0 major GPA required for graduation. Major GPA calculation includes all courses taken in the major department, plus any other courses under II. Minimum of 18 semester hours of courses taken to fulfill major requirements must be courses offered by Appalachian.

A. Geology (37 semester hours):

GLY 1101 _____ (4) Introduction to Physical Geology **OR** GLY 1510 _____ (4) Geological Science Honors
GLY 2250 _____ (4) Evolution of the Earth *(Pre: GLY 1101,1102,1103,1104,or 1105)*
GLY 2745 _____ (4) Preparation of Geologic Reports **[WID]** *(Pre: ENG 2001, GLY 2250)*
GLY 3150 _____ (3) Principles of Structural Geology and Tectonics *(Pre: GLY 2250, 2745)*
GLY 3220 _____ (3) Fundamentals of Mineralogy *(Pre: GLY 2250)*
GLY 3715 _____ (3) Petrology and Petrography *(Pre: CHE 1101/1110; GLY 2250, 2745, 3220)*
GLY 3800 _____ (3) Introduction to Stratigraphy and Sedimentology *(Pre: GLY 2250)*
GLY 4025 _____ (3) Principles of Paleontology *(Pre: GLY 2250 or GLY 1101 & BIO 3436/ANT 3405)*
GLY 4210 _____ (1) Geology Seminar **[CAP]**
GLY 4835 _____ (6) Summer Field Geology or other approved field course *(Pre: GLY 3150, 3715, 3800)*

And choose 3 semester hours geology electives at or above 3000 level

GLY 3333 _____ (3) Geomorphology *(Pre: 6 s.h. GLY)*
GLY 4501 _____ (1) Senior Research
GLY 4630 _____ (3) Hydrogeology *(Pre: 6 s.h. GLY)*
GLY 3530-49 _____ (3) Special Topics
GLY 3703 _____ (3) Issues in Env'l Gly (*Pre: Science Literacy met)*
GLY 4510 _____ (3) Senior Honors Thesis
GLY 4705 _____ (3) Advanced Env & Eng Gly *(Pre: 6 s.h. GLY)*

B. Biological Component (18 semester hours Biology)

BIO 1801 _____ (4) Biological Concepts I *(Co: CHE 1101)* **And either** BIO 2000 _____ (4) Introduction to Botany *(Pre: BIO 1801)*
OR BIO 2001 _____ (4) Introduction to Zoology *(Pre: BIO 1801)*

And 10 semester hours of BIO at or above the 2000 level (excluding 2800, 3520, 4550, 4563):

_____ _____ _____ _____
_____ _____ _____ _____

C. Mathematics/Chemistry/Physics (26 semester hours)

MAT 1110_____ (4) Calculus with Analytic Geometry I *(Pre: MAT 1025)*
MAT 1120_____ (4) Calculus with Analytic Geometry II *(Pre: MAT 1110)*
CHE 1101/1110 _____ (4) Introductory Chemistry I & Lab
CHE 1102/1120 _____ (4) Introductory Chemistry II & Lab *(Pre: CHE 1101/1110)*
PHY 1150 _____ (5) Analytical Physics I *(Co: MAT 1110)*
PHY 1151 _____ (5) Analytical Physics II *(Co: MAT 1120)*

D. Computer science/programming, GIS, or statistics courses (Choose 6 semester hours)

C S 1425 _____ (3) Overview of Computer Science *(Co: MAT 1020/1025)*
GHY 2310 _____ (3) Cartographic Design & Analysis
GHY 3310 _____ (3) Environmental Remote Sensing
GHY 3812 _____ (3) Introduction to GIS *(Pre: GHY 2310, 2812)*
STT 2810 _____ (3) Introduction to Statistics *(Pre: MAT 1010)*
STT 3820 _____ (3) Statistical Methods I *(Pre: STT 2810)*

Major Requirements that count in Gen Education:

Science Inquiry
CHE 1101/1110 4 s.h.
CHE 1102/1120 4 s.h.

Quantitative Literacy
MAT 1110 4 s.h.

Total Major hrs: 87
Gen Ed hrs: - 12
Net Major hrs: 75

During the senior year the B.S. (non-teaching) student must take and achieve a satisfactory score on a COMPREHENSIVE EXAMINATION covering theoretical and practical aspects in areas of geology. Students who are unsuccessful on portions or all of the examination may retake appropriate portions up to two additional times prior to graduation.

III. MINOR (optional)

IV. ELECTIVES (taken to total 125 hours for the degree).....6

2 semester hours of free electives must be outside the major discipline. Total hours must equal 125

2011-2012

Bachelor of Science (BS) Non-Teaching **Checksheet for Geology Majors**
Degree Code 259* **QUANTITATIVE GEOSCIENCE**
Concentration Code 259E

I. GENERAL EDUCATION CURRICULUM 44

Chemistry 1101/1110 & 1102/1120 fulfill the Science Inquiry perspective. MAT 1110 fulfills Quantitative Literacy.

II. MAJOR REQUIREMENTS (not including 12 hours counted in Area I, above)**.....70**

2.0 major GPA is required for graduation. Major GPA calculation will include <u>all</u> courses taken in the major department, plus any other courses under II. Minimum of 18 semester hours of courses taken to fulfill major requirements must be courses offered by Appalachian. ***Since many upper level Geology courses require GLY 1101 as a prerequisite, it is highly recommended that students complete this course during their freshman year.***

A. Geology (31 semester hours):

GLY 1101 _____ (4) Introduction to Physical Geology **OR** GLY 1510 _____ (4) Geological Science Honors
GLY 2250 _____ (4) Evolution of the Earth *(Pre: GLY 1101)*
GLY 2745 _____ (4) Preparation of Geologic Reports **[WID]** *(Pre: ENG 2001; GLY 2250)*
GLY 3150 _____ (3) Principles of Structural Geology and Tectonics *(Pre: GLY 2250, 2745)*
GLY 3220 _____ (3) Fundamentals of Mineralogy *(Pre: GLY 2250)*
GLY 3715 _____ (3) Petrology and Petrography *(Pre: CHE 1101/1110; GLY 2250, 2745, 3220)*
GLY 3800 _____ (3) Introduction to Stratigraphy and Sedimentology *(Pre: GLY 2250)*
GLY 4210 _____ (1) Geology Seminar *(Pre: Senior Standing)*
GLY 4835 _____ (6) Summer Field Geology or other approved field course *(Pre: GLY 3150, 3715, 3800)*

Major Requirements that count in Gen Education:

Science Inquiry
CHE 1101/1110 4 s.h.
CHE 1102/1120 4 s.h.

Quantitative Literacy
MAT 1110 4 s.h.

Total Major hrs: 82
Gen Ed hrs: - 12
Net Major hrs: 70

B. Quantitative Courses (12 semester hours)

PHY/GLY 3160 _____ (3) Introduction to Geophysics *(Pre: 1 intro GLY; PHY 1101; MAT 1110)*
GLY 4630 _____ (3) Hydrogeology *(Pre: 6 s.h. GLY)*
GLY 4705 _____ (3) Advanced Environmental & Engineering Geology **[CAP]** *(Pre: 6 s.h. GLY)*

3 semester hours of geology courses at or above 3000 level _____

C. Mathematics/Chemistry/Physics (33 hours)

MAT 1110 _____ (4) Calculus with Analytic Geometry I *(Pre: MAT 1025)*
MAT 1120 _____ (4) Calculus with Analytic Geometry II *(Pre: MAT 1110)*
MAT 2130 _____ (4) Calculus with Analytic Geometry III *(Pre: MAT 1120)*
MAT 2240 _____ (3) Intro to Linear Algebra *(Pre: MAT 1120)* **OR** MAT 3130___ (3) Intro to Differential Equations *(Pre: MAT 2130)*
CHE 1101 _____ (3) Introductory Chemistry I *(Co: CHE 1110)*
CHE 1110 _____ (1) Introductory Chemistry I Lab *(Co: CHE 1101)*
CHE 1102 _____ (3) Introductory Chemistry II *(Pre: CHE 1101/1110; Co: CHE 1120)*
CHE 1120 _____ (1) Introductory Chemistry II Lab *(Co: CHE 1102)*
PHY 1150 _____ (5) Analytical Physics I *(Co: MAT 1110)*
PHY 1151 _____ (5) Analytical Physics II *(Co: MAT 1120)*

D. Six semester hours from the following:

STT 2810 _____ (3) Introduction to Statistics (*Pre: MAT 1010)*
STT 3820 _____ (3) Statistical Methods I (*Pre: STT 2810)*
Or other Geology advisor approved courses based on statistical applications _____
CS 1425 _____ (3) Overview of Computer Science (*Co: MAT 1020/1025)*
CS 1440 _____ (4) Computer Science I *(Pre: MAT 1020/1025 w/minimum grade "C-")*
GHY 3820 _____ (3) GIS for Social and Environmental Sciences

During the senior year the B.S. (non-teaching) student must take and achieve a satisfactory score on a COMPREHENSIVE EXAMINATION covering theoretical and practical aspects in areas of geology. Students who are unsuccessful on portions or all of the examination may retake appropriate portions up to two additional times prior to graduation.

III. MINOR (optional)

IV. ELECTIVES (taken to total 122 hours for the degree).....<u>8</u>

2 semester hours of free electives must be outside the major discipline. **122**

2011-2012

Bachelor of Science (BS) Teaching **Checksheet for Geology Majors**
Degree Code 243A

I. GENERAL EDUCATION CURRICULUM 44
Geology 1101 and 1103 fulfill Science Inquiry perspective in general education. MAT 1110 fulfills the Quantitative Literacy requirement.

II. PROFESSIONAL EDUCATION REQUIREMENTS 24
A minimum grade of C is required in each professional education course. CI 2300 & FDN 2400 are required prior to admission to Teacher Educ.

CI 2300 _____ (2) Teaching and Learning in the Digital Age *(Entry course to teacher education)*
FDN 2400 _____ (2) Critical Perspectives on Teaching and Learning *(Pre or Co: CI 2300) (Entry course to teacher education)*
PSY 3010 _____ (3) Psychology Applied to Teaching *(Pre or Co: CI 2300)*
SPE 3300* _____ (3) Creating Inclusive Learning Communities *(Pre: CI 2300, FDN 2400, PSY 3010)*
C I 3400* _____ (2) Policies and Practice in Educational Assessment *(Pre: CI 2300, FDN 2400, PSY 3010)*
C I 4900 _____ (12) Student Teaching **[CAP]** *(All courses in professional core must be completed with grades of C (2.0) or higher prior to student teaching, along with other courses (including methods and reading) identified within the major.*

PROFICIENCIES:
Reading _____
English _____
Speech _____

*Admission to Teacher Education required.

NOTE: To be admitted to the Teacher Education Program students must take and satisfy testing requirements for Reading, Writing and Math areas of the PRAXIS (PPST or CBT). The PRAXIS II Area Exams are required for student teaching.

III. MAJOR REQUIREMENTS (not including 12 hours counted in Area I, above) **..... 52**
2.0 major GPA is required for graduation. Major GPA calculation will include <u>all</u> courses taken in the major department, plus any other courses under III. Minimum of 18 semester hours of courses taken to fulfill major requirements must be courses offered by Appalachian. *Since many upper level Geology courses require GLY 1101 as a prerequisite, it is highly recommended that students complete this course during their freshman year.*

A. Geology Courses (28 hours)

GLY 1101 _____ (4) Introduction to Physical Geology
<u>or</u> GLY 1510 _____ (4) Geological Science Honors-Physical
GLY 1103 _____ (4) Introduction to Environmental and Applied Geology
GLY 1105 _____ (4) Oceanography
GLY 2250 _____ (4) Evolution of the Earth *(Pre: GLY 1101, 1102, 1103, 1104, or 1105)*
GLY 2745 _____ (4) Preparation of Geologic Reports **[WID]** *(Pre: ENG 2001, GLY 2250)*
GLY 3220 _____ (3) Fundamentals of Mineralogy *(Pre: GLY 2250)*
GLY 3333 _____ (3) Geomorphology *(Pre: 6 s.h. GLY)*
GLY 3520 _____ (1) Instructional Asst for GLY 1101
GLY 3521 _____ (1) Secondary Science Field Experience

Major Requirements that count in Gen Education:

Science Inquiry
GLY 1101 4 s.h.
GLY 1103 4 s.h.
Quantitative Literacy
MAT 1110 4 s.h.

Total Major hrs: 64
Gen Ed hrs: - 12
Net Major hrs: 52

B. At least 12 semester hours selected from the following:

CHE 1101 _____ (3) Introductory Chemistry I *(Co: CHE 1110)*
CHE 1110 _____ (1) Introductory Chemistry I Lab *(Co: CHE 1101)*
CHE 1102 _____ (3) Introductory Chemistry II *(Pre: CHE 1101; Co: 1120)*
CHE 1120 _____ (1) Introductory Chemistry II Lab *(Co: CHE 1102)*
PHY 1103 _____ (4) General Physics I *(Co: MAT 1020 or 1025)*
PHY 1104 _____ (4) General Physics II *(Pre: PHY 1103)*

C. Also required (24 hours):

G S 4403 _____ (3) Teaching Science in the Middle and High Schools **[WID]** *(minimum "C" grade required) (Pre: ENG 2001)*
R E 4630 _____ (2) Reading in the Content Areas *(minimum "C" grade required)*
AST 1001 _____ (4) Introductory Astronomy I – The Solar System
AST 1002 _____ (4) Introductory Astronomy II – Stars and Galaxies
BIO 1801 _____ (4) Biological Concepts I *(Co: CHE 1101)*
GHY 3100 _____ (3) Weather and Climate *(Pre: GHY 1010)*
MAT 1110 _____ (4) Calculus with Analytic Geometry I *(Pre: MAT 1025)*

During the senior year, the B.S. Geology Teaching Licensure degree student must take the Praxis II subject area exam: Earth/Space Science (#0570) portion. The score should be reported to Appalachian State University.

IV. MINOR (optional)

V. ELECTIVES (taken to total 122 hours for the degree) ..... <u>2</u>
2 semester hours of free electives must be outside the major discipline **122**

Geology Courses

Introductory Courses

Introduction to Physical Geology (GLY-1101)
Introduction to the composition, origin, and modification of Earth materials through the study of the Earth's interacting dynamic systems; study and application of the scientific method with reference to the principles of geology as demonstrated through use of case histories and laboratory material. Lecture three hours, laboratory two hours. (NUMERICAL DATA) (CORE: NATURAL SCIENCES) (ND prerequisite: passing the math placement test or successful completion of MAT 0010.)

Introduction to Historical Geology (GLY-1102)
A study of the historical and biological aspects of the science of geology - tectonic models for understanding earth structure and lithospheric history, the physical and paleontological bases for understanding geologic time and dating rocks, biological principles relating to the evolution of organisms revealed in the fossil record, facts and theories of biological evolution, a survey of the evolution of organisms through time, the geologic history of North America, and discussion of the scientific aspects of the scientific-religious controversy of evolution vs. creationism. Lecture three hours, laboratory two hours. (CROSS-DISCIPLINARY; NUMERICAL DATA) (CORE: NATURAL SCIENCES) (ND prerequisite: passing the math placement test or successful completion of MAT 0010.)

Introduction to Environmental and Applied Geology (GLY-1103)
A survey of the chemical and physical processes that change the Earth's crust and surface creating geologic hazards and environmental problems for people; human perturbations of the environment that directly and indirectly affect geological change and human life, such as mining, waste disposal, and agricultural practices; and the principles of origin, distribution, availability, environmental consequences of use, and exploration of the Earth's mineral and water resources. Lecture three hours, laboratory two hours. (NUMERICAL DATA) (CORE: NATURAL SCIENCES) (ND prerequisite: passing the math placement test or successful completion of MAT 0010.)

Water: Mountains to Sea (GLY-1104)
A study of the interaction between terrestrial water and geological phenomena. The course applies the scientific method to the study of the continental components of the hydrologic cycle. It also focuses on the interaction of water with the rock and plate tectonic cycles. Lecture three hours, laboratory two hours.

Introduction to Oceanography (GLY-1105)
A study of physical, chemical, biological, and geological oceanography and their interrelationships. Lecture three hours, laboratory two hours. (WRITING; NUMERICAL DATA) (ND prerequisite: passing the math placement test or successful completion of MAT 0010.)

The History of Coal from the Pennsylvanian to the Present (GLY/AS-2301)
Coal has played a critical role in the history of the southern Appalachians. The geologic processes that formed coal and shaped the landscape into the steep ridges and hollows of the Appalachian coalfields have directly affected the human history of the region - from hunting in pre-colonial times, to settlement and subsistence farming in the 1800s, to mining and unionization in the 1900s, to mountaintop removal and natural gas/coalbed methane extraction in the last decade. This course covers the physical and chemical processes that form coal as well as the tectonic and geomorphologic processes that formed the landscape of the coalfields and shaped the agricultural practices of the early settlers. It examines the cultural history of coal mining and life in the company-owned coal camps and the political history of unionization through literature and film. The economics and environmental consequences of coal-fired power plants are discussed, and the environmental and occupational hazards associated with both underground and surface coal mining are analyzed from both a scientific and a sociological perspective. (Same as AS 2301)

Advanced Courses

GLY 2250. Evolution of the Earth (4)
This course consists of the integrated study of the physicochemical and biological systems of the earth and their evolution over time, including investigation of the persistent linkage of geologic and biologic systems over earth's history. This course provides a basis for understanding the stratigraphic, geochemical, geophysical, and paleontological data utilized to reconstruct earth history, including a survey of the 4.5 billion years of earth system history, with special emphasis on the tectonic history of North America as observed in the Appalachian Mountains. The course also provides a survey of the evolution of life over earth history and an introduction to the paleontological principles utilized in understanding the fossil record of evolution. Introduction to advanced methods of rock and mineral identification and classification. Lecture three hours, laboratory three hours.
Prerequisite: GLY 1101.

GLY 2500. Independent Study (1-4)

GLY 2745. Preparation of Geologic Reports (4)
GEN ED: Junior Writing
This course provides instruction in various aspects of data collection, quantitative and qualitative analysis, and the preparation and presentation of written and oral geologic reports to standards of the profession. Topics include: survey of geologic literature and digital information retrieval services, research design, data management, ethics and safety. Data collection and mapping in the field is a major component of the course and vigorous hiking is required. Lecture three hours, laboratory three hours.
Prerequisites: GLY 1101 (or GLY 1510) and GLY 2250. Open only to Geology majors and minors. (WRITING; SPEAKING; COMPUTER)

GLY 3150. Principles of Structural Geology and Tectonics (3)
The nature, classification, genesis, and quantification of microscopic and mesoscopic geologic structures, plus the history and fundamentals of tectonic theory, are the subjects of this course.
Prerequisites: GLY 2250 and GLY 2745. Lecture two hours, laboratory three hours. (NUMERICAL DATA; COMPUTER)
(ND Prerequisite: passing the math placement test or successful completion of MAT 0010.)

GLY 3160. Introduction to Geophysics (3)
(Same as PHY 3160.)
An introductory survey of whole earth geophysics through theory and practice. The theory portion of the course covers seismology (techniques in reflection and refraction seismology), geothermics, radioactive dating, surface processes, tectonics, orogenics, gravity and gravimetric techniques, electrical and magnetic surveys, and borehole logging. The practical component of the course includes the utilization of several of these methods to study subsurface environments. Lecture two hours, laboratory two hours.
Prerequisites OR Corequisites: GLY 1101 (or GLY 1510), PHY 1103 (or PHY 1150), and MAT 1110, or permission of the instructor.

GLY 3220. Fundamentals of Mineralogy (3)
The course focuses on (1) mineral identification and classification, (2) crystal chemistry, (3) X-ray diffraction, (4) analytical electron microscopy (SEM-EDS), and (5) the petrographic microscope. Lecture two hours, laboratory three hours.
Prerequisite: GLY 1101 or consent of the instructor.

GLY 3333. Geomorphology (3)
This course includes a study of the nature of landforms. Qualitative and quantitative aspects of landform analysis in the field and laboratory using maps and aerial photographs are introduced. Prerequisites: at least six hours of geology courses or consent of the instructor. Lecture two hours, laboratory three hours. (WRITING; NUMERICAL DATA)
(ND Prerequisite: passing the math placement test or successful completion of MAT 0010.)

GLY 3500. Independent Study (1-4)

GLY 3520. Instructional Assistance (1)
A supervised experience in the instructional process on the University level through direct participation in a classroom situation. Graded on an S/U basis.
Prerequisite: junior or senior standing. May be repeated for a total credit of three semester hours. (SPEAKING)

GLY 3521. Secondary Science Field Experience (1)
A supervised experience in the instructional process at the secondary school level through direct participation in a classroom situation. Graded on an S/U basis.
Prerequisite: junior or senior standing. May be repeated for a total credit of three semester hours. Required of all teacher-licensure candidates in geology.

GLY 3530-3549. Selected Topics (1-4)
On Demand.

GLY 3680. Geoarchaeology (3)
The course focuses on fundamental concepts in geoarchaeology and covers the application of earth science concepts, techniques and knowledge to the study of artifacts and the processes involved in the formation of the archaeological record. Preservation of paleoclimate signals in the geological record is considered. Case studies will consider specific North American and global examples.
Prerequisite: GLY 2250 or permission of the instructor.

GLY 3703. Issues in Environmental Geology (3)
An in-depth study of critical issues in environmental geology on a regional and global scale. Topics to be covered include: natural hazards, water, mineral and energy resources, and related waste disposal problems under pressures of increasing human population and changing climate. This course will make use of case studies to illustrate specific examples. Lecture three hours.
Prerequisite: one year sequence in natural science, e.g., BIO 1101 and BIO 1102; GLY 1101-GLY 1102; PHY 1103-PHY 1104; CHE 1101, CHE 1110 and CHE 1102, CHE 1120; or GSP 1010-GSC 1020-GSG 1030-GSB 1040.

GLY 3715. Petrology and Petrography (3)
This course includes a study of the microscopic, mesoscopic, and macroscopic features; the mineralogy, and the chemistry of rocks; and the study of petrogenetic theory.
Prerequisites: CHE 1101 and CHE 1110; GLY 2250, GLY 2745, and GLY 3220. Lecture two hours, laboratory three hours. (WRITING)

GLY 3800. Introduction to Stratigraphy and Sedimentology (3)
Properties, classification, and depositional models of sedimentary rocks. Principles of collection and interpretation of stratigraphic data; emphasis on field relationships.
Prerequisites: GLY 1102 and GLY 2250. Lecture two hours, laboratory three hours.

GLY 4025. Principles of Paleontology (3)
Morphology, phylogeny, temporal distribution, and paleoecology of fossils, with emphasis on applying invertebrates to the recognition of ancient environments and environmental change through geologic time. Biological evolution is studied in the scope of the history of the earth. Lecture two hours, laboratory three hours.
Prerequisite(s): GLY 2250 OR (GLY 1101 and either BIO 3436 or ANT 3405).
(WRITING; CROSS-DISCIPLINARY; NUMERICAL DATA)
(ND Prerequisite: passing the math placement test or successful completion of MAT 0010.)

GLY 4210. Geology Seminar (1)
GEN ED: Capstone Experience
Presentation and discussion of current topics, with emphasis on student projects, petrology, and surficial processes.
Prerequisite: senior standing geology major.

GLY 4501. Senior Research (1)
Initiation of a laboratory or field research project under supervision of a geology faculty member. At least one semester prior to the start of the research project, the student must formally confer with a thesis advisor, submit and have approved a formal research proposal.
Prerequisite: open only to senior geology majors with a minimum GPA of 3.25 in geology courses.

GLY 4510. Senior Honors Thesis (3)
Work, under supervision of a geology faculty member, on the project begun in GLY 4501. An oral report on the project will be presented in the spring geology seminar. Minimum of five hours laboratory or field work per week. A written thesis will be presented to the department. A student who completes the thesis with a grade of B or better and who graduates with a GPA of 3.5 in geology courses will be graduated with honors in geology; with a grade of A and a geology GPA of at least 3.7, the student will be graduated with highest honors in geology.
Prerequisite: GLY 4501; senior geology majors with minimum of 3.25 GPA in geology courses. (WRITING)

GLY 4630. Hydrogeology (3)
The occurrence of groundwater resources, factors governing groundwater movement through aquifers, and an analysis of techniques for measuring a water resource are the focus of this course. Groundwater contamination and remediation methods will be introduced. Lecture two hours, laboratory three hours.
Prerequisites: at least junior standing and a minimum of six semester hours of geology courses above the 1000 level, or permission of the instructor. (NUMERICAL DATA)
(ND Prerequisite: passing the math placementtest or successful completion of MAT 0010.) Dual-listed with GLY 5630.

GLY 4705. Advanced Environmental and Engineering Geology (3)
GEN ED: Capstone Experience
Field and laboratory analysis of problems arising from interactions between humans and Earth and application of geologic knowledge to the mitigation of these problems. Lecture two hours, laboratory three hours.
Prerequisites: at least junior standing and a minimum of six semester hours of geology courses above the 1000 level, or permission of the instructor. Dual-listed with GLY 5705.

GLY 4835. Summer Field Geology (6)
An intensive five to six week practicum in making geologic maps, measuring sections, and using other field techniques.
Prerequisites: GLY 3150, GLY 3715, and GLY 3800. [Dual-listed with GLY 5835.]

Proficiency in Communications / Writing in the Discipline

The Department of Geology will certify proficiency in communications via the following methods. For proficiency in writing, a student will be certified as proficient upon receiving a grade of D or better in GLY 2735 – Preparation of Geologic Reports. For proficiency in speaking, a student will be certified as proficient by earning a passing grade on the second of the two required speeches given in GLY 2735 - Preparation of Geologic Reports. Students in the BS-Teaching degree program will be judged to be proficient by satisfactory presentation of a laboratory exercise in GLY 3520.

Special Designators

(Core Curriculum and checksheets prior to 2009)

Students should recall that they must attain special designators as follows:
6 W Writing courses, including two courses in the major
4 MC Multi-Cultural courses (includes two in History)
2 ND Numerical Data courses
2 C Computer courses
1 S Speaking course (taken in the major; GLY 2735 meets this requirement)
1 CD Cross Disciplinary course

Many geology courses above the sophomore level carry writing designators and require a term paper. We know of no substitute for term papers insofar as it permits you to study in depth some aspect of the course you are taking and gives you practice in library research and writing. Whenever you write a term paper: a) turn it in on time, and b) remember that plagiarism is not tolerated in the department. We have found that term papers are loathed by some, tolerated by others, and loved by a fortunate few. Try to become one of the latter.

Strong oral communication skills are a major asset for the well-trained geologist. You will have opportunities to develop this skill during your time in the department, and we encourage you to work hard to develop these skills. A talk is not a paper. The success of your speech will depend to a great extent on how well you recognize this fact. The reader can go back over a point that was missed, but the listener cannot. The reader may scan the paper and then go back for details, but the listener must be introduced to the subject and brought along, step by step, with the speaker's argument. Therefore, introduce the subject of your talk, not the entire field, use short sentences, use repetition, pause for the digestion of facts, present only the highlights. Since a visual impact is more effective than an oral one, use visual images to help convey your ideas. Before

you prepare an image for presentation as a visual aid, follow this simple rule of thumb: Look at the original illustration from as many feet away as it is inches wide and you will see it as it will look to the audience when projected as a slide on the screen. Recognize also that visual images must use heavy lines and large letters, must be uncomplicated, and should be attractive. Uncomplicated images, which are simply constructed and present a discernible amount of information, are a welcome sight. Images, expertly drafted but crowded, are difficult to read and are of less value. Swashes of color for contrast are soothing to the eye and may be used instead of basic black against a glaring white backdrop. Another word to the wise: Don't use too many images.

Helpful suggestions for speakers, young and old, include the following:
(source: Anonymous, A guide to how to prepare your SME-AIME meeting paper)

- Time your talk in a rehearsal. You are a busy person, but so are the people in your audience.

- Pause. Use short sentences and pause between ideas so that your audience will have time to digest the facts.

- Speak. Glance down at your notes once in a while, but don't read your paper to the audience. For novices, it will help to memorize your introduction.

- This will enable your butteries to subside. At the same time it familiarizes you with your audience and surroundings.

- Stop. If you have to stop to think, do so. "Ers" and "Ahs" are much more distracting.

- Modulate. Regulate the modulation in your voice. Don't be tabbed a mumbling monotone, that's all your audience will remember about your talk.

- Don't rush to make a point. You may lose the crowd.

- Don't lose voice contact with your audience when turning to point to the screen. Always face your audience while speaking.

- Don't fix your attention to a specific point.

- Posture and eye contact are important.

- Don't overrun your time.

Field Camp

Geology majors in the B.S. and B.A. Geology, Paleontology, and Quantitative Geoscience degree programs are required to complete an approved geology summer field course that carries at least 6 semester hours of credit. Typically, students taking field camp have completed courses in petrology, structural geology, stratigraphy and sedimentology, and Preparation of Geologic Reports, but you should check the prerequisites for the course you intend to take. Most students take the course between their Junior and Senior years, although it is permissible to take it at the end of the Senior year. Additional field course possibilities are available in the AGI Directory of Geoscience Departments held in the Geology Department office as well as on the web.

Many universities offer field camps that fulfill this requirement. Names of the schools offering field courses that have been approved in the past include the following:

- North Carolina System-wide course
- University of Tennessee
- Georgia State University
- Idaho State University
- Northern Illinois University
- University of Kentucky
- University of Missouri, Rolla
- University of Montana
- University of Missouri
- Columbia Purdue University
- Ohio University
- Athens University of Wyoming
- University of Alabama
- University of Oregon
- University of Texas, San Antonio
- Oregon State University
- Fort Lewis College, Colorado
- Indiana University
- South Dakota School of Mines

Early during the fall semester of each year, a meeting of majors is held during which you will be instructed about how to choose a summer field course.

Regardless of the course you choose, it must be approved by the chairperson before you enroll in it. You should obtain information about course content, costs, etc. and then apply to several appropriate schools no later than mid-November. **Don't apply to any school unless its course is approved by the chair at Appalachian.**

After you have been officially accepted by an approved school, you must request the chairperson of the Geology Department at Appalachian to write a memorandum to the Dean of Arts & Sciences notifying him/her that you have departmental permission to register for the course and receive credit for it by transfer to Appalachian State University. This must be done before the end of the spring semester preceding the summer field course.

Before you complete the summer field course at another school, you must fill out and submit to that school's registrar a request for an official transcript of your summer field course to be sent to the

Registrar's Office
Appalachian State University,
P.O. Box 32009, Boone, NC 28608-2009.

Unless this is done, you will not receive credit for the summer field course and will not be able to graduate. It is generally advisable to apply to several different schools in order to assure yourself of a good chance of acceptance. If you do not get accepted by the middle of the Spring term, contact the chairperson for help.

When you write directors of summer field courses in which you have an interest, you should ask questions such as the following:

1. Does the course accept students other than its own?
2. What is the total cost of the camp including weekend meals, out-of-state tuition, equipment, supplies, transportation, and optional trips (if any)?
3. If the camp is located at a great distance from North Carolina, is it possible to travel there with an official group or other students to reduce travel expenses?
4. How many students will be there? How many professors?
5. What are sleeping, eating, and study facilities like?
6. How many hours per day are actually spent in the field?
7. What are the main types of field work done?
8. How many projects are done in Field Camp and what is the length of each project? Is there a final report? If so, how long is it and when is it due? When will grades be available?
9. What are the prerequisites?
10. When will I be notified that I have been accepted?
11. Will you send me application materials?

The steps below constitute a checklist for applying to field camp and receiving permission to count the field camp toward your degree requirements.

1. Attend meetings about field courses in the fall semester.
2. Select names of approved field courses in the fall semester (Chairperson approved).
3. Write letters to field camp directors at selected schools in the fall semester.
4. Receive responses from field camp directors at schools selected.
5. Select schools to send formal applications and reservation fees.
6. Mail formal applications and reservation fees (early Spring).
7. Receive formal acceptance from school(s).
8. Request chairperson of Appalachian Geology Department to send approval memo to dean of Arts and Sciences.
9. Follow-up letter, payment, etc. to school of choice.
10. Attend the summer field course.
11. Request an official transcript of summer field course be sent by the Registrar at the host school to the Appalachian Registrar before leaving the field camp.

A student desiring to substitute any activity such as summer work, independent study, etc. for the standard geology summer field course requirement must submit a written petition to the faculty for consideration. The petition must be submitted no later than the beginning of November immediately before the summer during which field work is to be

undertaken. The petition should include a detailed description of the nature of the substitution work, etc. including criteria for grading, name and background information on supervisor/teacher (if not an Appalachian professor), and reasons why the substitution is either equal to or superior to the normal geology summer field course. The departmental chairperson can provide information concerning criteria that summer work must meet in order to qualify for field course substitution. In general, substitutions are not approved, as the purpose of the summer field course requirement is to insure that our majors are competent in basic field techniques that are more varied and different in scope and purpose than what is normally provided by summer jobs or non-field mapping summer experience.