RECORD OF ACADEMIC ACHIEVEMENT

The Evergreen State College - Olympia, Washington 98505

OFFICIAL TRANSCRIPT DOCUMENT

Buechel, Andrew Jordan — A00232653

Last, First Middle — Student ID

DEGREES CONFERRED:

Bachelor of Arts and Bachelor of Science Awarded 10 Jun 2016

TRANSFER CREDIT:

Start	End	Credits	Title
09/2007	03/2010	52	**South Puget Sound Community College**
09/2007	03/2010	5	**South Puget Sound Community College**

EVERGREEN UNDERGRADUATE CREDIT:

Start	End	Credits	Title
01/2011	03/2011	12	**Russia and Eurasia: Empires and Enduring Legacies** *4 - Russian and Eurasian History* *4 - Russian Literature* *2 - Russian and Eurasian Cultural Studies* *2 - Geography of Russia and the Former Soviet Union*
09/2012	12/2012	14	**Political Economy and Social Movements: Race, Class and Gender** *3 - Political Economy* *4 - Economic Principles* *4 - Survey of United States History* *3 - Studies in Race, Class, and Gender*
04/2013	06/2013	16	**Ecology of Grazing and Grasslands in the Pacific Northwest** *4 - Animal Science* *4 - Plant Science* *4 - Ecology* **4 - Rangeland Management*
09/2013	03/2014	32	**Earth Matters: Geology and Chemistry** *15 - Introductory Chemistry with Laboratory* *6 - Physical Geology with Laboratory* *6 - Environmental Geology with Laboratory* *2 - Library Research and Scientific Presentation* *3 - Guided Undergraduate Research in Geology/Chemistry*
06/2014	09/2014	8	**General Biology** *8 - General Biology with Laboratory*

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EVERGREEN UNDERGRADUATE CREDIT:

Start	End	Credits	Title
09/2014	06/2015	48	**Environmental Analysis** **8 - Analytical Chemistry and Instrumentation with Laboratory* **3 - Aqueous Geochemistry* **3 - Biogeochemistry* **1 - Geographic Information Systems (GIS)* **3 - Freshwater Ecology* **3 - Ecosystem Ecology* **4 - Ecological Statistics* **4 - Advanced Field and Laboratory Methods in Terrestrial Biogeochemistry* **4 - Advanced Research in Terrestrial-Aquatic Interactions* **4 - Scientific Writing* **3 - Primary Literature Research in Biogeochemistry* **4 - Advanced Research in Analytical Chemistry* **4 - Applied Environmental Chemistry*
03/2015	06/2015	2	**Tutoring Math and Science For Social Justice** *2 - Education*
09/2015	03/2016	16	**Undergraduate Research in Scientific Inquiry with A. Biswas** **8 - Research Methods in Terrestrial Biogeochemistry* **8 - Independent Research in Terrestrial Biogeochemistry*
09/2015	12/2015	4	**Physics I** *4 - Algebra-based Physics: Dynamics*
01/2016	03/2016	4	**Physics II** *4 - Algebra-based Physics: Waves, Optics, and Light*
03/2016	06/2016	16	**Biogeochemistry: Microbes, Rocks, and Soils** **4 - Environmental Microbiology with Laboratory* **3 - Microbial Ecology with Laboratory* **6 - Terrestrial Biogeochemistry with Laboratory* **3 - Special Topics in Biogeochemistry: Seminar and Research Project*

Cumulative

229 Total Undergraduate Credits Earned

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March 2016 - June 2016: Biogeochemistry: Microbes, Rocks, and Soils

16 Credits

DESCRIPTION:
Faculty: Abir Biswas Ph.D., and Andrew D. Brabban Ph.D.

Biogeochemistry: Microbes, Rocks, and Soils was designed as a one quarter interdisciplinary science program that examined the biotic and abiotic controls on the cycling of important elements (specifically carbon, nitrogen, phosphorus, iron, etc., and elements we often consider toxic such as mercury, arsenic, and heavy metals) in both "pristine" and polluted systems, and in aerobic to anaerobic systems.

The program consisted of the following sections:

The microbiology component began by examining the roles microorganisms play in the environment, their metabolism and the broad diversity of ecosystems they occupy. Specifically we examined microbial metabolism and biogeochemical cycling, methods of measuring microbial numbers and microbial activity, chemolithotrophy and photosynthesis, and bioremediation. The laboratory component was structured to teach the basic techniques of microbiology required to manipulate microorganisms such as aseptic technique, making media, and growing cultures; methods to quantitatively examine real world samples using differentiating media, MPN, dilution series; and methods for qualitatively examine microorganisms such as the PCR. The textbook used was *Brock: Biology of Microorganisms* 14th Ed. Pearson/Benjamin Cummings. ISBN:978-0321897398. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock.

The biogeochemistry component focused on the cycling of carbon, nitrogen, and phosphorus, as well as other biogeochemically important elements at the ecosystem scale, from accumulation in ecosystems, to movement within ecosystem pools (incl. biota, vegetation, and soil horizons) via production and decomposition, and nutrient use and cycling in food webs and at the global scale. Laboratory was structured to develop connections between field work, geochemical analyses of samples, and data interpretation in the environmental sciences; starting with soil sample collection in the field, processing samples to quantify carbon and to isolate elements from the cation exchange pool of soils, preparing samples for quantification of nutrients and trace metals by inductively coupled plasma mass spectrometry (ICP-MS) and interpreting ICP-MS data to quantify nutrients in soil profiles. The textbook used was *Principles of Terrestrial Ecosystem Ecology*. Springer. 2nd Ed. Springer. ISBN 978-1-4419-9504-9 Chapin III, F. Stuart, Matson, Pamela A., Vitousek, Peter. (2012).

Students developed skills in reading and interpreting biogeochemical studies through weekly seminars reading the primary literature (Nature, Science, PNAS, Environmental Science & Technology, Applied and Environmental Microbiology, and Archives of Microbiology), in addition to a group primary literature research project, which culminated in a research poster presentation.

Students were evaluated through course work, participation, seminar, laboratory work and reports, and seven examinations. Examinations were designed to test the qualitative and quantitative reasoning of the students and their ability to apply to solve experimental problems.

EVALUATION:
Written by: Abir Biswas Ph.D., and Andrew D. Brabban Ph.D.

Andrew had a successful spring quarter in Biogeochemistry. He joined the program with an extensive background in both chemistry and geology having recently taken the upper division program Environmental Analysis. He hoped through this program to further enhance his current skills and develop further his knowledge of microbiology in support of this future career plans in the environmental sciences.

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During this one quarter study of microbes and the environment Andrew took responsibility for his education, always attending class and laboratory sessions, and submitting all assignments complete and on time. Microbiology is obviously a subject Andrew finds interesting and this showed in all aspects of this part of the program. He made very good progress all quarter demonstrating his comfort with this new subject material, and this was evidenced in his submitted homework, lab reports and often excellent examinations. Andrew has shown he can solve both quantitative and qualitative problems in environmental microbiology and microbial ecology. During the quarter he was an active participant in class demonstrating his interest in the subject and his ability to solve problems as part of a team. He would often answer questions posed by the faculty during lecture. In lab Andrew is capable, organized and skilled; he is well on his way to being a very good lab scientist with continued application and commitment. He has demonstrated an aptitude for science and is prepared to do more advanced work.

Andrew was an outstanding student in the biogeochemistry component of the program. He had excellent attendance and consistently completed the assigned reading before class. He was very engaged and was an important contributor to class discussions. Andrew's homework assignments were consistently on time and very well done. During group activities, Andrew was a leader in working with his fellow students to discuss and understand the material. Through an in-class examination including topics of soil development, productivity, nutrient inputs to ecosystems and plant nutrient budgets, as well as several related articles from the primary literature, Andrew demonstrated an excellent understanding of the material. Andrew continued to work hard through the quarter and again demonstrated an excellent understanding of topics related to decomposition and carbon cycling in ecosystems, plant nutrient use, and nutrient cycling during an in-class examination. Andrew was an excellent contributor in laboratory activities and his lab group benefited from this effort and attention to detail. Andrew's lab notebook was well-organized and provided a good record of his laboratory work though it could be enhanced by additional details and labeling.

Andrew was very engaged and integral to group discussions during weekly seminars based on articles from the primary literature, and consistently demonstrated an excellent grasp of these studies. Through an examination based a new article, Andrew demonstrated a very good to excellent ability to independently interpret a study on his own.

Working as part of a team of three, Andrew carried out a primary literature research study entitled "Ancient Halophilic Microorganisms: Their Environment, Survival, and Why We Care About Them." Over the course of seven weeks Andrew worked well with his team to collect and read the required twenty primary literature papers. Andrew's teammates commented on his high level of involvement, ability to lead the group and his organizational skills. The final presentation of this research was at a poster session. This poster was well conceived and produced with good mixture and interplay between the text and figures (photographs, electronmicrographs and graphs). The poster clearly showed the depth of their research. During the course of the group's presentation Andrew gave a clear and detailed description of the microorganisms involved. He also answered a number of questions from both the faculty and other students with confidence and enthusiasm. As a group they had ownership of the project, the limitations of the studies cited and what the key take away message was.

Andrew concluded the program by submitting all of his work in a complete and organized portfolio, which included all the required assignments, his lecture notes and both of his lab notebooks. A further demonstration of the diligent approach he has to his education.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 16

*4 - Environmental Microbiology with Laboratory
*3 - Microbial Ecology with Laboratory
*6 - Terrestrial Biogeochemistry with Laboratory

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*3 - Special Topics in Biogeochemistry: Seminar and Research Project

* indicates upper-division science credit

Buechel, Andrew Jordan — A00232653
Last, First Middle — Student ID

January 2016 - March 2016: Physics II

4 Credits

DESCRIPTION:
Faculty: Allen Olson

This course provides a standard introduction to the physics of waves, optics, and light. Mathematical approaches to problem solving focus on conceptual understanding and algebraic manipulation. Laboratory activities include introductory verification labs with minimal work on experimental design.

EVALUATION:
Written by: Allen Olson

By the end of this course, Andrew Buechel was able to identify and use standard vocabulary to describe rotational motion, wave motion, optical phenomena, the properties of light, and atomic models of the hydrogen atom. The course began with simple harmonic motion and, by the end, Andrew was able to describe evidence for both the wave nature and the particle nature of light and discuss how electrons also exhibit wave and particle aspects. Several related topics and experiments were covered along the way. Andrew was able to use concepts such as diffraction, interference, reflection, and refraction to describe situations and solve formulaic problems. Optical properties of mirrors and thin lenses were studied through formulas, ray diagrams, and hands-on investigations.

Andrew was a strong participant in this course. The course included weekly homework assignments that involved both reading and problem solving as well as occasional quizzes, a midterm, a take-home final, and an in-class final exam. Andrew demonstrated a strong familiarity with the vocabulary and the units of measurement used with the course concepts, good skill in completing computational exercises, and generally a solid level of understanding of course topics. He and a partner gave an informative presentation on the Earth's magnetic field and the evidence for changes in that field that show up in data related to tectonic plates. Overall, Andrew has consistently shown that he is able to learn the material and that he is prepared for further work in physics and related disciplines.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 4

4 - Algebra-based Physics: Waves, Optics, and Light

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September 2015 - December 2015: Physics I

4 Credits

DESCRIPTION:
Faculty: Allen Olson

This course provides a standard introduction to the physics of motion. Mathematical approaches to problem solving focus on conceptual understanding and algebraic manipulation. Laboratory activities include introductory verification labs with minimal work on experimental design.

EVALUATION:
Written by: Allen Olson

By the end of this course, Andrew Buechel was able to describe the background and effects of Special Relativity; describe motion by properly using terms such as position, velocity, acceleration, and force; and describe motion in terms of momentum and energy. Andrew was also able to independently solve standard introductory algebra-based physics motion problems involving length contraction and time dilation as well as forces and accelerations. He struggled more with problems involving Newton's laws of motion, momentum and energy. These were the final topics in the course, and I am confident that Andrew is capable of improving his level of competence in these areas with more time and practice.

Andrew was a valuable participant in this course. He stayed on top of his own work and helped peers when appropriate. He also gave an informative presentation on the formation of elements in the universe.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 4

4 - Algebra-based Physics: Dynamics

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September 2015 - March 2016: Undergraduate Research in Scientific Inquiry with A. Biswas

16 Credits

DESCRIPTION:
Faculty: Abir Biswas, Ph.D.

The student contributed to several research projects over the fall and winter quarters, all of which were grounded in the study of primary literature, independent research in the laboratory, and developing skills that would prepare the student well for advanced work in the bio-geo-sciences, at the graduate level if he chooses.

The student conducted an undergraduate research project investigating cycling of mercury (Hg) in forest ecosystems in the Pacific Northwest. He joined a faculty-directed research project, in collaboration with biogeochemistry and ecology faculty at The Evergreen State College, focused on studying mercury cycling Mt St Helens forests soils. The samples for this project had been collected and preserved by collaborators during previous sampling seasons. The student contributed to sample processing including soil drying, sieving, and determination of carbon content (by loss-on-ignition). The student operated a Nippon MA-3000 mercury analyzer to conduct analyses of his own samples and conducted his own QAQC. The student wrote a final research paper that included analysis of his data supported by statistical analyses in the format of a peer-reviewed study.

The student also contributed to an additional project studying the cycling of mercury (Hg) in forest ecosystems in the Pacific Northwest. Specifically, he joined another faculty-directed student-research project, in collaboration with biogeochemistry and ecology faculty at The Evergreen State College, focused on quantifying mercury inputs via litterfall to 2^{nd} order streams in a 2nd growth temperate rainforest in the Pacific Northwest. The student's work included (i) sorting leaf litter from riparian zone leaf litter traps from summer 2015 through fall 2015, according to species, and and (ii) analyses of carbon and mercury content of these samples. The student assisted the primary research student in processing samples and interpreting data.

EVALUATION:
Written by: Abir Biswas, Ph.D.

Andrew Buechel was an outstanding research student during the fall and winter quarters of 2015-16 working on an undergraduate research project in the bio-geo-sciences, focusing primarily on mercury cycling in terrestrial ecosystems. Over the course of the 2 quarters, Andrew continued to develop excellent research skills in studying ecosystem compartments, field collection of soil samples, laboratory processing of environmental samples, and primary literature research, as he worked toward a research manuscript that we plan to submit for publication in a peer-reviewed journal in the next year. Andrew worked incredibly well independently, was very reliable in the field and in the lab, and has developed excellent skills that suggest he would be a terrific candidate for graduate school upon graduation.

Over the past year Andrew has been the de-facto lab manager in our Evergreen Biogeochemistry and Ecology Lab (EBEL). He effectively taught fellow students about appropriate soil sampling methods, soil processing methodologies, acid-cleaning methods for trace metal work, and how to prepare their samples for mercury and carbon analysis. He was relied upon to tutor other students who joined the lab in sample processing and played an important role in supporting other students in their projects, while continuing to work on his own. Andrew taught other students how to analyze their own samples on the Nippon MA-3000 mercury analyzer, including the use of standard curves, replicates, and a NIST standard, so that fellow students could work independently to produce their own data.

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Andrew first joined his major research project in spring 2015, when he joined a group of students focused on characterizing the effects of forested vs. clear-cut plots, on mercury accumulation from the atmosphere in the Mt St. Helens area where mercury and carbon accumulation had been reset following the 1980 Mt. St. Helens volcanic eruption. He continued the project during summer 2015, when he was selected, out of a very competitive pool of potential students, as a paid Summer Undergraduate Research Project student to become the equivalent of a research assistant. Over the fall and winter, Andrew made great strides in completing the mercury and carbon analyses for his project, reading the primary literature that would form the basis of his research manuscript, and writing the manuscript that we are planning to send a peer-reviewed journal in the next year. Andrew read 40 articles from the primary literature and the current draft of the manuscript is in great shape, as we work toward preparing it for submission to a peer-reviewed journal. In winter, he successfully submitted an abstract to present a poster at the 2016 Rocky Mountain Geological Society of America meeting in Moskow, Idaho, entitled “Mercury accumulation in old-growth and recently clear-cut forests in the tephra fall zone of the 1980 Mount St. Helens eruption,” and it was accepted! This successful abstract submission highlighted Andrew’s ability to meet deadlines in terms of producing a sufficient amount of high-quality data as well as a well-written abstract.

During the past year, Andrew also selflessly contributed to several projects focused on mercury cycling in different ecosystem compartments in the Pacific Northwest as well as one study focused on water used by vegetation during the 2015 summer drought at Mt St Helens – all of this additional work helped Andrew develop breadth in his skills and studies of ecosystem-scale biogeochemical cycles. Andrew's efforts were notable and timely in helping a collaborating student research and complete a poster entitled "Species-Specific Litterfall Inputs of Mercury to a 2nd Order Stream In a 2nd Growth Temperate Rainforest" for presentation at the Northwest Scientific Association 2016 meeting in Bend, Oregon. During these quarters, in preparation for trace metal analyses of his soil samples, Andrew also trained to be certified to operate the Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) independently through a rigorous 3-workshop process and test, but did have not an opportunity to apply these skills as this aspect of the project was de-emphasized as we focused on producing a manuscript discussing mercury cycling at our sites.

Overall Andrew took advantage of every possible learning opportunity and he was a fantastic addition to my lab. He did a great job throughout and was an terrific research student. He is prepared for advanced studies in biogeochemistry and I look forward to working with him again in the future.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 16

*8 - Research Methods in Terrestrial Biogeochemistry
*8 - Independent Research in Terrestrial Biogeochemistry

* indicates upper-division science credit

Buechel, Andrew Jordan — A00232653
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March 2015 - June 2015: Tutoring Math and Science For Social Justice

2 Credits

DESCRIPTION:
Faculty: Vauhn Foster-Grahler, MS, M.Ed

Tutoring Math and Science for Social Justice was designed to enhance students' skills working with diverse types of people, and to introduce students to a variety of pedagogies and their effectiveness. In addition students, explored issues of power and privilege and how these dynamics impact teaching and learning.

The text used was *Privilege, Power and Difference (2nd Edition)* by Alan Johnson. In addition to the text, students read articles, prepared seminar prep guides, participated in weekly seminars, kept a journal, and wrote a summative journal entry.

EVALUATION:
Written by: Vauhn Foster-Grahler, MS, M.Ed

Andrew regularly attended class on time and was usually prepared for class. Andrew's summative journal entry was comprehensive and thoughtful. It demonstrated a good understanding of the topics of the course. Andrew was an active and positive participant in all class activities. Andrew was a pleasure to have in class.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 2

2 - Education

Buechel, Andrew Jordan — A00232653
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September 2014 - June 2015: Environmental Analysis

48 Credits

DESCRIPTION:
Faculty: Abir Biswas, Ph.D., Carri LeRoy, Ph.D., Clyde Barlow, Ph.D.

Environmental Analysis was designed as a full-year interdisciplinary science program that combined material in Analytical Chemistry, Aqueous Geochemistry, Biogeochemistry, Freshwater Ecology, Ecosystem Ecology, Statistics, and GIS around the themes of the analysis of lake and stream water and riparian ecology in the fall and around the theme of terrestrial-aquatic interactions in the winter. Students designed and implemented group research projects in spring quarter. During fall, winter, and spring quarters, the program consisted of the following sections:

Analytical Chemistry and Instrumental Analysis with Laboratory – The textbook *Quantitative Chemical Analysis,* 7th Ed., by Daniel C. Harris was covered fully with emphasis placed on techniques applicable to aquatic and environmental systems. Students submitted outlines for all chapters prior to the material being covered in class. Students also submitted problem-solving homework assignments. Two exams covered concepts and problem solving in analytical chemistry as well as two standardized ACS analytical chemistry exams. Topics covered were chemistry of analytical methods including chemical activity, chemical equilibrium, titrations, solubility, electrochemistry, and acids/bases in the fall. Chelation chemistry and instrumental methods of analysis were covered in the winter. The laboratory portion included experiments involving alkalinity by acid/base titration using a pH meter and Gran plot analysis, colorimetric phosphate, potentiometric titration, spectrophotometric analysis for nitrate, EPA lead-copper rule, and analysis of sediments. Students had the opportunity to become certified for theory and operation of analytical instrumentation such as anion analysis by ion chromatography (IC), cation analysis by Inductively-Coupled Plasma-Mass Spectrometry (ICP-MS), or gas chromatography-mass spectrometry (GC-MS). Throughout the program, emphasis was placed on reading and following standard analysis procedures published by the EPA, USGS, and APHA. Students maintained laboratory notebooks detailing their work in the laboratory and wrote technical reports based on results of their analyses.

Aqueous Geochemistry with Laboratory – Topics covered in the program progressed from equilibrium thermodynamics and activity, to the carbonate system, soils and chemical weathering, to the hydrologic cycle and evaporating systems, and finally redox equilibria and redox in natural waters. Students' learning in the classroom was supplemented through a week-long field trip to eastern Washington studying meromictic lakes in that region, in addition to the regional geology (primarily basalt) and recent glacial deposits. At the lakes, students worked in groups to collect lake waters at different depths (from a boat using a van Dorn sampler), characterize lake water quality (e.g., temperature, conductivity, secchi disk measurement). In addition students were given opportunities to participate in lake sediment coring and soil pit analysis (to inform their understanding of the regional geology). In geochemistry lab, students made hands-on measurements of alkalinity in naturals waters (using Gran-Alk plots), characterized lake water cycling and the development of meromixis (prior to going to the field), characterized lake cores for moisture and organic carbon content, and used the aqueous geochemistry modelling program PHREEQC (from the USGS) to characterize the speciation and saturation indices of the lake waters they visited (based on real measurements of cations and anions by ICP-MS and IC respectively). Students demonstrated their learning through weekly homework assignments and two written exams that covered material from lecture and components from the laboratory, in addition to lab and field notebooks recording their observations and interpretations. Observations of individual and group work in labs and in the field were also useful in evaluation. The program used *The Geochemistry of Natural Waters: Surface and Groundwater Environments*, 3rd ed., textbook by Drever and was supplemented by some readings from the primary literature.

Freshwater Ecology – Material covered in this section of the program gave students an introduction to various topics in freshwater ecology, limnology, wetland ecology, and the ecology of extreme environments. The primary text used was *Freshwater Ecology: Concepts and Environmental Applications of Limnology*, 2nd ed., by Dodds and Whiles (2010). We covered chapters on water quality, properties of water, movement of light, heat and chemicals in water, wetland habitats, lake and reservoir physiography, major taxonomic groups of aquatic organisms, microbes, plants, multicellular organisms, evolutionary biology, extreme aquatic habitats and extremophiles, and ecological interactions. In addition, we covered climate change topics, reduction-oxidation, the cycling of carbon, nitrogen, sulfur, and phosphorus, nutrient use, eutrophication and current restoration practices. Students demonstrated their understanding of these conceptual topics as well as quantitative problems in nutrient cycling, lake morphology, light attenuation, and species diversity calculations on midterm and final take-home examinations that required the synthesis of material from the readings, lectures, and field experiences.

Ecosystem Ecology – Ecosystem ecology concepts were taught through lectures, workshops and seminars on material from the *Biogeochemistry: An Analysis of Global Change* (3rd ed., by Schlesinger and Bernhardt) and reading primary literature in ecosystem ecology. Topics covered included: ecosystem processes (photosynthesis, respiration, net primary productivity, decomposition, nutrient cycling, water use, transpiration, canopy conductance, and stomatal conductance), stable isotopes in ecology (trophic dynamics, ecological forensics, hydrology, tracer studies), global change (elevated CO_2 effects, FACE experiments [Free Air Carbon Exchange], permafrost thaw, carbon dynamics in large rivers, landscape scale modeling of wetland change under drought, global amphibian decline), and global cycles of carbon, water, nitrogen, and phosphorus. Students demonstrated their knowledge of this material on take-home midterm and final exams.

Ecological Statistics – Students gained conceptual understanding of statistical thinking as well as practical applications of statistical methods through combinations of lectures and computer lab assignments. Readings were from the text *A Primer of Ecological Statistics*, 2nd ed., by Gotelli and Ellison (2013). Material covered included descriptive and summary statistics, measures of central tendency and spread, comparisons of two means using parametric t-tests and resampling t-tests, comparisons of many means using parametric analysis of variance (ANOVA) and resampling ANOVA, simple linear regression (parametric and resampling), correlation (parametric and resampling), categorical data analysis (Chi-square tests, contingency tables, and CART models [classification and regression trees]), multivariate and community analysis methods (Non-metric Multidimensional Scaling [NMS] ordination, Multi-Response Permutation Procedures [MRPP], Permutative Multivariate Analysis of Variance [PerMANOVA], Indicator Species Analysis, and Mantel tests [multivariate correlations]), and meta-analysis techniques (Hedge's d, funnel plots and tests for heterogeneity). Statistical programs used in this program include JMP Pro 11, Resampling Stats for Excel 2007, PC-ORD 5.32, and OpenMEE. Students demonstrated their understanding of statistical concepts and practical applications of statistical methods in weekly lab assignments, multiple choice midterm and final exams and take-home practical midterm and final exams that required the synthesis of material from the readings, lectures, and computer lab experiences. In addition, students demonstrated practical applications of statistical techniques in research projects in winter and spring quarters (see below).

Biogeochemistry – Concepts in biogeochemistry were taught using the text *Biogeochemistry: An Analysis of Global Change* (3rd ed., by Schlesinger and Bernhardt) through lectures, workshops, and discussions. This was supported by weekly seminars and workshops discussing recent articles from the primary literature. Topics covered included: terrestrial geochemistry and the origin of the elements; rock weathering and nutrient availability; soil and ecosystem development including organic matter accumulation, soil cation exchange capacity, and changes in nutrient sources; global cycles of sulfur and mercury; biogeochemical processes in the atmosphere; and natural and anthropogenic controls on

climate in the past and into the future. Students demonstrated their knowledge of this material on take-home midterm and final exams.

Geographic Information Systems (GIS) – Students learned the fundamentals of downloading and importing DEMs, queries, symbology, and creating new shape and raster files, using ESRI ArcMap 10.2. An emphasis was placed on using the Spatial Analyst and Hydrology tools, as students performed drainage basin analysis. Students reclassified elevation grids, converted grid to vector layers, clipped grids and vectors, defined stream orders and drainage basins, and learned how to produce maps (in layout view) that display geographic data. Proficiency was demonstrated through four weekly applied workshops, and a final project wherein students used publicly available data to produce a map for a location of their choice, complete with scale, inset map and legend. Students gained considerable proficiency in ArcMap 10.2 in a relatively short period of time and developed a foundation to use GIS in research or project work in the future.

Fall Field-Laboratory Meromictic Lake Project – The study of meromictic lakes (lakes that do not mix completely) in eastern Washington integrated understanding maps, rocks, floods, glaciation, chemical reactions and equilibria. Groups took field measurements of lakes (pH, dissolved oxygen temperature and conductivity). Lake water samples were analyzed in the laboratory for major chemical species - chloride, sulfate, sodium, potassium, calcium, magnesium, and alkalinity. Each group was responsible for producing complete major-element chemistry for 2 lakes at 3 to 4 depths using a variety of analytical techniques. Individuals in research groups wrote descriptive vignettes which together provided an elaboration of historical, geological, and chemical properties of the lakes. Students read literature from USGS reports and geochemical literature to expand their understanding of the origin of meromixis and rock-water interactions. Application of analytical chemistry, communication skills, report writing, and sharing information were a fundamental part of the field-lab study.

Fall Freshwater Ecology Specialty Group – Students in a subgroup of Environmental Analysis focused on lab and field methods in Freshwater Ecology in the fall quarter. They learned methods to measure and monitor stream environments in terms of physical, biological and chemical characteristics. Physical measurements included: slope, wetted width, depth, flow, discharge, and stream/riparian mapping. Biological measurements included field methods for sampling: periphyton, macroinvertebrates, canopy cover, leaf litter inputs, leaf litter decomposition and insect emergence. Laboratory methods for the analysis of periphyton, the identification of macroinvertebrates, and the processing of leaf litter decomposition bags complemented field activities. In terms of chemical measurements, students learned how to measure dissolved oxygen, conductivity and temperature in the field using YSI probes (Yellow Springs Instruments), pH using Oakton pH probes, and to collect water for water quality analysis: alkalinity, nutrients (by ion chromatograph), and dissolved inorganic carbon (DIC). Finally, in-stream carbon budgeting measurements included field and lab methods to measure: fine suspended sediments, coarse suspended sediments, fine particulate organic carbon, coarse particulate organic carbon, and in combination with alkalinity, pH and DIC, carbon dioxide out-gassing rates. Students kept field notebooks to demonstrate their attendance and learning and to record data from sites in the Evergreen Ecological Observation Network (EEON) for long-term monitoring. Students worked in small groups to design and implement a study in freshwater ecology. To provide an intellectual foundation to these studies, students completed a written annotated bibliography describing ten studies from the primary literature related to their research topic. Students then collected data, analyzed it using appropriate statistical methods, interpreted their results, and wrote a complete scientific paper. Students received faculty and peer feedback on their papers and revised their work. Groups prepared and delivered formal presentations of their work to the faculty and students in last week of the program.

Winter Independent Research in Biogeochemistry and Ecosystem Ecology – Students worked in groups of 4-7 to conduct winter quarter research projects investigating biogeochemical processes connecting terrestrial and stream ecosystem environments in a second growth temperate rainforest

ecosystem. Students and faculty together identified specific ecosystem measurements and compartments of interest in seeking to better understand carbon and mercury cycling in this system. Students planned sampling and laboratory analysis goals, independently analyzed samples for elements of interest, and conducted statistical analyses of their data. Final results were reported in a group poster presentation, in the style of a conference poster session.

In preparation for spring quarter group research projects, students worked in groups of ~4 to write 15-page NSF-style proposals, including an introduction, methods, a sampling plan in addition providing an explanation of the scientific merit of their project, a timeline, and a budget. These proposals employed field and lab techniques students learned during the program and were based on a foundation of readings from the primary literature.

Spring Group Research Projects – Students worked independently and in small groups (up to 4) to design and implement scientific studies on topics in biogeochemistry, terrestrial-aquatic interactions, and ecological genetics. Students were responsible for collecting all materials and equipment, detailing methods and analyses, designing experiments, collecting data, analyzing samples using a variety of instruments, analyzing data using a variety of statistical methods, interpreting analyses, placing results into the context of published literature, and communicating their findings in both written and oral forms. Descriptions of specific research projects are described below.

EVALUATION:
Written by: Clyde Barlow, Ph.D., Abir Biswas, Ph.D., Carri LeRoy, Ph.D.

Analytical Chemistry and Instrumentation:

Andrew made good progress in this study of analytical chemistry and chemical instrumentation. Andrew pursued learning of analytical chemistry by completing outlines of all the chapters in the analytical chemistry text, and all homework assignments. While his fine work did not result in excellent exam scores, his understanding was apparent in his ability to do quality laboratory work and to articulate concepts verbally.

Andrew was an active participant in analytical chemistry laboratory. He submitted results for all laboratory exercises demonstrating good precision and statistical analysis of results. He obtained excellent results on a Winkler oxygen comparison of adjacent natural water sources on campus. In winter quarter laboratory Andrew worked to apply theory to practice. His three technical reports included testing of a new spectrophotometric method to quantify nitrate ion concentrations in water and evaluation of mineral composition of sediment from a meromictic lake by complexometric titration for calcium and magnesium. The details of his work showed improvement in his ability to do analytical work and to report results as technical reports. Andrew took time to rewrite reports to improve their quality.

In addition to normal laboratory work, Andrew successfully completed training to be an independent operator of the ion chromatograph and the ICP-MS to perform analytical measurements of samples for field studies and independent research. The instructor for the final oral exam on theory and operation of the ion chromatograph reported, “Excellent on theory and software,” and for the ICP-MS, “Fully prepared, excellent job on theory and instrument.”

Aqueous Geochemistry:

Andrew was a good student in the aqueous geochemistry component of the program. He had perfect attendance and consistently completed the reading before class. He was very well engaged and was an important contributor to class discussions. Andrew submitted 5 of 6 homework assignments on time and they were typically well done. During group work, Andrew worked well with his fellow students to

understand the material. Through an in-class examination including topics of equilibrium thermodynamics, carbonate chemistry, and soils, which included a significant component of quantitative work, Andrew demonstrated an adequate understanding of the material. Andrew worked hard through the quarter and then demonstrated a very good understanding of topics related to chemical weathering processes and evaporation, redox equilibria, and redox processes in natural waters. Andrew was a strong contributor in laboratory activities and his lab group benefited from this effort and attention to detail. Andrew's lab notebook was relatively well organized and provided a good record of his laboratory work, though it could have been enhanced by additional labeling and details.

Biogeochemistry:

In the winter, Andrew worked hard to develop a very strong understanding of biogeochemical processes in terrestrial ecosystems. In a mid-term take-home exam, he demonstrated a good understanding of topics related to soil development and nutrient cycling in soils, the geochemistry and cycling of volcanically-derived elements, and the use of isotopes to study biogeochemical processes. He then worked hard to demonstrate a fantastic understanding on a take-home final exam including topics related to carbon and nutrient cycling in ecosystems, carbon cycling on geologic timescales, and the effects of climate warming on terrestrial ecosystem processes. Andrew consistently submitted his chapter outlines and homework assignments on time and consistently demonstrated a strong ability to understand and explain both quantitative and qualitative problems related to biogeochemical processes.

Geographic Information Systems (GIS):

Andrew worked hard to gain a foundational understanding of how to use GIS (ESRI Arcmap 10.2) to assess characteristics of topography and drainage basins. He completed all 4 of the GIS workshops, becoming familiar with importing, manipulating, displaying and analyzing spatial data, and demonstrating a strong understanding of how to apply GIS tools. His final project, wherein he found publicly available data and produced a professional-style map (in layout view) was very well done.

Freshwater Ecology:

Andrew showed a solid understanding of the majority of the conceptual and practical applications of freshwater ecology on both midterm and final exams. It was clear Andrew had read the chapters from Dodds and Whiles (2010) and had also paid attention during lectures on freshwater topics. He was able to correctly answer quantitative questions concerning nutrient cycling and lake morphology on the midterm exam, as well as questions about light attenuation, wave formation, and nutrient uptake rates on a final exam.

Ecosystem Ecology:

In terms of Ecosystem Ecology, Andrew built on his understanding of freshwater ecology concepts to expand into terrestrial and global processes. He did very good work on a take-home midterm exam which covered topics such as stable isotopes in ecology, carbon out-gassing in aquatic environments, and silica transport by rivers. His mastery of the material continued throughout the quarter as demonstrated by his strong showing on a final exam covering topics such as ecosystem ecology methodology, nitrogen-mineralization methods, and the human influences on the cycling of various major elements. He consistently turned in all chapter outlines on time and included details in the notes that provided evidence of engagement with the material at a fine level. His weekly problem sets overall showed an ability to grapple with difficult problems in ecosystem ecology and work to understand quantitative problems and methods.

Ecological Statistics:

Andrew completed most of his work in a timely manner and did overall very good work in statistics in this program. Andrew's statistics labs were strong and demonstrated that he understood the majority of the conceptual and practical material presented in class. During fall quarter, his performance on exams met expectations. Andrew did consistently strong work on statistics labs in winter quarter, even expanding on his experience in statistics to do some of the optional extension activities. This work throughout the two quarters put Andrew in an excellent position to do very good work on final exams. Andrew did very well on a final multiple choice exam and he did very good work on a final practical take-home exam.

Field and Laboratory Methods in Freshwater Ecology:

Andrew did consistently strong work in the Freshwater Ecology Specialty Area. He had excellent attendance and a super attitude about doing field and lab work throughout the quarter. He volunteered for time-consuming tasks and spent extra time in the lab when he was able to. Andrew organized his thought and experiences into a detailed field notebook. Andrew completed his writing assignments, and included 8 peer-reviewed primary literature articles in a well-written and informative annotated bibliography. In addition, he wrote a detailed and professional research article titled, "Returning salmon increase phosphorus loads in stream habitats where they spawn annually," with a research group that functioned well together. His article was significantly improved following both peer and faculty feedback, included all necessary sections and cited 14 sources.

Andrew's research group presented their findings in a visually appealing PowerPoint that made excellent use of images, bulleted text, and figures. It was clear that all members of the group participated equally and presented on material that was well known to them. Andrew presented background information on salmon spawning and marine-derived nutrients. He included several excellent images on his presentation slides and gave an interesting talk. He could work on improving eye contact with all members of the audience and could have practiced what he was going to say a bit more. There is room for him to improve on polishing his presentation skills.

Andrew organized research findings on meromictic lakes in eastern WA into a detailed one-page vignette that connected well to the other vignettes in the research group. Andrew's vignette matched the style of the others in the research group, was completed on time and discussed the detailed composition of basalt flows in the channeled scablands. He tried to link this geological context to the saturation indices of surface waters in the meromictic lakes. His vignette was detailed, organized, and very well done. His presentation was clear and organized and presented in a professional manner.

Independent Research in Biogeochemistry and Ecosystem Ecology:

During the winter quarter, Andrew worked in a group of 6 students studying “Mercury Accumulation in Terrestrial Soils of the Pacific Northwest.” They worked effectively together to process soils cores, that they had contributed to collecting during fall quarter, to quantify carbon and mercury storage in a second growth temperate rainforest. The group was well-organized in dividing tasks, including sieving soils, to isolate the <2mm fraction from roots and larger particles, homogenizing soils (by ball-milling) and then analyzing subsamples for carbon content by loss-on-ignition, and for mercury content using a Nippon MA-3000 mercury analyzer (with guidance from faculty). Andrew was a leader in his group and played an important role in keeping his group organized and on track. He also contributed to processing soils and played an integral role in helping his group with and in analyzing their soils for mercury content. Their final poster did a great job of summarizing their data in useful graphs and they observed a statistically significant relationship between soil carbon and mercury content, which was consistent with previous studies.

In preparation for a spring quarter research project, Andrew and 4 other students worked very well together to produce an NSF-style proposal entitled “*Mercury accumulation in Terrestrial Soils Near an*

Active Volcano and the Effect of Forested and Clear-cut plots [on Mercury accumulation]." Their proposal set out to characterize the effects of forested vs. clear-cut plots, on mercury accumulation from the atmosphere in the Mt St. Helens area where mercury and carbon accumulation had been reset following the 1980 Mt. St. Helens volcanic eruption. Their final document, which was improved through the review process, was very well written and included excellent information on mercury cycling in terrestrial ecosystems. Andrew read at least 10 peer-reviewed journal articles related to their topic and contributed significantly to their overall proposal. Andrew was a leader in his group who contributed significantly to producing and editing the content of the proposal, and in keeping his group on task over the quarter. Overall, their proposal, which included 18 references from the primary literature, explained the proposed project very well, though a more detailed justification of the rationale for this study and additional references and would have improved the document. The methods section was particularly strong and overall the proposal was very good to excellent.

In the spring quarter, Andrew and 2 colleagues successfully undertook their proposed research to quantify mercury storage in soils overlying tephra/ash from the 1980 Mt St. Helens volcanic eruption. They worked exceedingly well as a team to process soil samples, analyze them for carbon and mercury content, and then quantified mercury storage in areas characterized by old growth forest compared to areas that had been clear cut just prior to the 1980 eruption. They observed that the clear cut sites were characterized by significantly less soil mercury storage than that old growth sites, because of reduced canopy cover at clear cut sites limited scavenging mercury out of the atmosphere and resulted in less mercury storage, consistent with their understanding of mercury cycling. Andrew took the lead in his group to conduct carbon analyses using the CHN analyzer (Perkin Elmer) and conducting mercury analyses of their samples using the Nippon MA-3000 mercury analyzer without supervision. Andrew demonstrated excellent analytical skills throughout the quarter and was very independent in the lab.

Over the quarter, Andrew kept up well with weekly assignments including a timesheet, annotated bibliographies, and his final paper. Andrew's final paper "Accumulation of atmospheric mercury in a remote location: the role of forested vs. clearcut stands on soil mercury accumulation" was very well-written, well-referenced, and effectively organized, with solid figures and statistical analyses. It is an excellent record of his work this quarter and represents a large body of literature with which he made himself familiar. He read and produced detailed annotations of 50 scientific articles this quarter and cited 27 of them in his final paper. His research partners praised him for his dedication and analytical skills in the laboratory, and for his strong contributions throughout. His group's final presentation was excellent and Andrew demonstrated a well-metered speaking style and an overall improved confidence in public speaking.

In summary, Andrew was an excellent student in Environmental Analysis. He was consistently positive, respectful, hardworking, thoughtful, and frequently helped other members of the program in lab to conduct mercury analyses of their samples. He had excellent attendance, was a dedicated group member and completed all of his work in a timely and professional manner. It was great to work with Andrew this year. He has acquired a strong set of skills that will benefit him in his future work or academic career.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 48

*8 - Analytical Chemistry and Instrumentation with Laboratory
*3 - Aqueous Geochemistry
*3 - Biogeochemistry
*1 - Geographic Information Systems (GIS)
*3 - Freshwater Ecology
*3 - Ecosystem Ecology

Buechel, Andrew Jordan — A00232653

Last, First Middle — Student ID

*4 - Ecological Statistics
*4 - Advanced Field and Laboratory Methods in Terrestrial Biogeochemistry
*4 - Advanced Research in Terrestrial-Aquatic Interactions
*4 - Scientific Writing
*3 - Primary Literature Research in Biogeochemistry
*4 - Advanced Research in Analytical Chemistry
*4 - Applied Environmental Chemistry

* indicates upper-division science credit

Buechel, Andrew Jordan — A00232653
Last, First Middle — Student ID

June 2014 - September 2014: General Biology

8 Credits

DESCRIPTION:
Faculty: Clarissa Dirks, Ph.D.

General Biology with Laboratory: The program began with an overview of the history of the earth, the fossil record, and Darwin's observations. Students then studied the basic rules of genetic inheritance, cell division, evolution by natural selection, evolutionary forces, population dynamics, and misconceptions about evolution. These concepts were used to investigate representative organisms on the tree of life, learning about major characteristics of each group, replication modes, evolutionary history, and ecological significance. Students then studied cellular and molecular biology, focusing on the structure and function of cells and biomolecules, the central dogma, bacteria gene regulation, and a general overview of energetics and metabolic processes. Laboratory investigations were focused on basic microscopy, observational studies, microbiology techniques, plant dissection and analyses, DNA manipulation, and gel electrophoresis. The program used the *Biological Sciences,* 5th Edition, textbook by S. Freeman.

EVALUATION:
Written by: Clarissa Dirks, Ph.D.

Andrew demonstrated an overall outstanding comprehension of the concepts and skills presented to him as evidenced by his work in lecture and laboratory sessions. His performance on in-class exams and quizzes indicated that he had mastered most of the material. Andrew turned in all assignments which were completed with excellence. In general, Andrew showed a real enthusiasm for learning biology and worked well with his peers during workshop sessions. He was also an excellent student in the biology laboratory. His laboratory notebook was well done and served as a good record of his thinking and actions while performing his experiments. Andrew showed improvement in his technical laboratory abilities, was a good problem solver, and frequently asked insightful questions. In summary, Andrew was an excellent student in a rigorous science program and is ready for advanced work in this area.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 8

8 - General Biology with Laboratory

Buechel, Andrew Jordan — A00232653
Last, First Middle — Student ID

September 2013 - March 2014: Earth Matters: Geology and Chemistry

32 Credits

DESCRIPTION:
Faculty: Abir Biswas, Ph.D., Dharshi Bopegedera, Ph.D.

Earth Matters: Geology and Chemistry was a two quarter-long integration of geology and chemistry. Attention was paid to integrate the two disciplines to help students see the connections between them. Throughout the program students used science process and reasoning skills and were engaged in hands-on laboratory experiences and field work in order to develop their problem-solving skills. Students participated in weekly math skill building workshops where they solved chemistry- and geology-based problems in small groups to support their learning in both of these disciplines. Student evaluations were based on exams in each discipline, homework, laboratory and field notebooks, and participation in all program activities, which included lectures, workshops, library research, field trips, lab work, and oral presentations.

General Chemistry with Laboratory – Content in chemistry was based on the text *Chemistry*: *An Atoms First Approach* by Zumdahl and Zumdahl, (Cengage Learning) with custom laboratory work. Students were given weekly homework assignments and three exams to assess their learning. The chemistry laboratory focused on learning a variety of techniques and maintaining a good lab notebook. Labs focused on properties of matter, accuracy and precision in measurements, absorption spectroscopy, quantitative chemical analysis, acid-base titrations, chemical synthesis, calorimetry, kinetics, and chemical equilibrium. Students often used Vernier probes and Logger Pro software for data collection. Spreadsheet software was used for data analysis and graphical representation of data. Topics covered in lectures included classification and properties of matter, atomic structure, periodic table and periodicity, IUPAC nomenclature, quantum theory, bonding, Lewis structures, VSEPR model, hybridization, stoichiometry, types of chemical reactions, solution stoichiometry, thermochemistry, equilibrium, acid-base equilibria, pH, buffers, indicators, solubility equilibria, entropy, and Gibbs free energy. With minimal guidance students studied the nuclear chemistry chapter in the textbook on their own, providing their notes and homework problems from the chapter for assessment.

Physical Geology with Laboratory – Topics covered in the program progressed from the formation and evolution of Earth, plate tectonics and rock formation, into igneous, metamorphic, and sedimentary processes. Students then studied volcanoes and earthquakes, and major events and mass extinctions through geologic time. In geology lab, students learned to characterize and identify common minerals and rocks and applied these skills during a field trip to Mt. St. Helens. Students demonstrated their learning through weekly homework assignments, two laboratory practical exams, and two written exams that covered material from lecture and components from the laboratory. Observations of individual and group work in labs and in the field were also useful in evaluation. The program used the *Understanding Earth*, 6th ed., textbook by Grotzinger and Jordan.

Environmental Geology with Laboratory - Topics covered in the program progressed from physical and chemical weathering processes, soil formation, and biogeochemical cycling of carbon and nutrients, to later focus on climate and paleoclimate records and the hydrologic cycle and humans' impacts on the environment. In geology lab, students conducted field and laboratory investigations of soils (including analyses of carbon content and grain size distribution). Students were introduced to bench-scale geochemical studies and investigated laboratory weathering rates of different calcium-bearing minerals. Students demonstrated their learning through weekly homework assignments and two written exams. Observations of individual and group work in labs and in the field, in addition to students' lab notebooks, were also useful in evaluation. The program used the *Understanding Earth*, 6th ed. textbook by

Grotzinger and Jordan and students were responsible for readings from the primary literature discussing nutrient cycling in ecosystems and climate records.

Library Research and Scientific Presentation – Through explicit instruction and guided activities students learned and developed skills in library research, scientific writing, and scientific presentation. Students deconstructed primary literature papers into outlines and wrote outlines of their own papers researching a mineral, rock, or geologic process of importance. Students submitted a written annotated bibliography describing ten studies from the primary literature, and summarized their research in a short primary literature-based research paper. They prepared and delivered formal group presentations of their work to the faculty and students in the program.

Guided Undergraduate Research in Geology/Chemistry - As a synthesis of their work with science content, field work and lab work, and primary source literature, students worked in small teams to research and carry out a scientific inquiry of geologically-derived nutrient cycling in a forest ecosystem. Students collected soil profile samples from six sites, processed them in the laboratory to distinguish between exchangeable and mineral bound nutrients, and analyzed them quantitatively for a specific nutrient (calcium, magnesium, or potassium) using the atomic absorption spectrometer. Students were given instructions on the components and the operation of the atomic absorption spectrometer. Each group submitted a written annotated bibliography and students wrote individual research papers summarizing their research, including introduction, results, and discussion sections. Students prepared and delivered formal group presentations of their work to the faculty and peers in the program.

EVALUATION:
Written by: Abir Biswas, Ph.D., Dharshi Bopegedera, Ph.D.

Chemistry with Laboratory - In the fall quarter Andrew completed most of the assigned homework on time and they were fair. In the winter quarter his homework was consistently well done and submitted on time. He participated with fellow students in chemistry and mathematics workshops to improve his problem solving and quantitative reasoning skills. It was evident that he struggled when presented with a new problem. His notes on the self-study of the nuclear chemistry chapter showed that Andrew is able to learn this topic independently with minimal guidance from faculty fairly well. His performance in the exams ranged from below average to very weak showing that his overall grasp of the concepts covered is insufficient. He is unable to solve problems without access to resources.

In the fall quarter some of Andrew's lab reports were incomplete and his best effort was in the final lab report (chemical synthesis). However, in the winter quarter there was a significant improvement in his lab work as evidenced by his lab notebook. He completed all of his lab work on time, was able to draw meaningful conclusions from his lab data fairly well, and learned to use spreadsheet software for graphing and data analysis adequately. Andrew worked well with his lab partner.

Physical and Environmental Geology with Laboratory - Andrew was a satisfactory student in the Physical Geology component of this program and worked hard to become a good to very good student in the Environmental Geology component of this program. Andrew became an increasingly well-engaged participant in the program and had excellent attendance of the lectures and workshops throughout. In the fall, he completed only 5 of 8 homework assignments on time, but again he showed improvement to complete 6 of 6 homework assignments on time and very well. During group activities, Andrew improved from being a bystander to become an active participant who collaborated with fellow students. Through a fall in-class examination, Andrew demonstrated a weak understanding of topics related to the formation and differentiation of Earth, plate tectonics and rock formation, and igneous and sedimentary processes. Andrew worked over the quarter and demonstrated a fair understanding of material on a cumulative final in-class examination including new topics in metamorphic rocks and processes, volcanoes, earthquakes, geologic dating, and historical geology. In winter quarter, Andrew demonstrated a good understanding of

topics in Environmental Geology related to weathering processes, soils, and biogeochemical cycling of carbon and nutrients through an in-class examination. Andrew then demonstrated a very good understanding of topics on a take-home examination focusing on climate and paleoclimate records in studies from primary literature. In fall laboratory practical exams Andrew demonstrated weak skills in mineral and rock identification. In the winter, Andrew developed strong field skills in characterizing soils and strong bench skills in geochemistry lab.

Andrew's lab notebook in fall quarter was well organized and provided a strong record of his laboratory and field work but in the winter quarter his lab notebook provided only a fair record of his laboratory work and again could have been significantly enhanced by additional labeling and details. Overall, Andrew is ready for further studies in the geological sciences.

Literature-based Research Project - Andrew was engaged in developing library research and scientific writing skills over the fall quarter. He demonstrated good skills in reading studies from the primary literature and used his research to write an informative annotated bibliography summarizing his work. Andrew's final paper "The Serpentine Syndrome: the Formation and Ecology of Serpentine Soils" was excellent and used references to the primary literature effectively to support his statements. At the end of the quarter, Andrew was a member of a 3-person team who gave a good presentation on weathering processes in soils and their connections to saline lakes. Their presentation was relatively well-integrated, including good visual aids, and Andrew's delivery of his part was good, though he could improve by speaking with greater energy, relying less on his notes, and making more regular eye contact with the audience.

Guided Undergraduate Research in Geology/Chemistry – In winter quarter, Andrew was a significant contributor, and sometimes a leader, in a team of three investigating "Potassium cation cycling and the importance of clay and biota." He worked well with his group to produce an annotated bibliography as well as a field sampling plan focusing on sampling specific soil horizons and ferns at 6 sites. The group worked well together, processing all of their samples in the lab, analyzing them quantitatively for potassium concentrations by atomic absorption spectroscopy (AAS), and then plotting graphs of their data. Andrew's final paper was excellent and did a very nice job of placing the data his group collected in the context of studies from the primary literature. At the end of the quarter, their group gave a well-received and informative presentation and Andrew's delivery of his part was good.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 32

15 - Introductory Chemistry with Laboratory
6 - Physical Geology with Laboratory
6 - Environmental Geology with Laboratory
2 - Library Research and Scientific Presentation
3 - Guided Undergraduate Research in Geology/Chemistry

The Evergreen State College - Olympia, Washington 98505

FACULTY EVALUATION OF STUDENT ACHIEVEMENT

Student's Last Name	First	Middle	ID Number
Buechel	Andrew	J	A00232653

Program or Contract No.	Title
30211	Ecology of Grazing and Grasslands in the Pacific Northwest

Date began	Date ended	Qtr. Credit Hrs.
01-APR-2013	14-JUN-2013	16

DESCRIPTION:
Faculty: Mike Paros, D.V.M

This rigorous field-based course provided students with the fundamental tools to manage livestock and grasslands by exploring the ecological relationships between ruminants and the land. Time was divided equally between intensive grazing and extensive rangeland systems. Students studied advanced topics in grass morphology and physiology, co-evolutionary relationships between ruminants and grasses, rotational grazing, pasture establishment and management, forage production and quality, ruminant nutrition and digestive physiology, and animal foraging behavior. Ecological assessments of energy flow and nutrient cycling in grassland systems were emphasized, while utilizing the online textbook *Grazing Management: An Ecological Perspective* by Heitschmidt and Stuth. Students also reviewed targeted and multi-species grazing practices. Shrub steppe rangeland systems and upland riparian areas were examined, culminating in multiple day short courses on rangeland management and monitoring at research stations in Eastern Oregon and Central Washington. The class participated in a formal debate on public land grazing issues. Prairie ecology and restoration techniques were learned in depth. Students were introduced to basic research in plant breeding and perennial grain development. Classroom lectures and exercises corresponded with numerous field trips to dairy, beef, and sheep grazing farms in Western Washington and Oregon. Students looked at agricultural sustainability issues and precision agriculture by visiting some intensive large scale farm operations including Three Mile Canyon Farms--the largest integrated crop and livestock farm in the world.

EVALUATION:
Written by: Mike Paros, D.V.M

Andrew took advantage of learning opportunities in field trips, lectures, and workshops through active engagement of the subject material. He completed all of the assigned reading and study questions throughout the quarter demonstrating thorough preparation prior to lectures and workshops. Based on weekly exams, Andrew showed good comprehension of all major concepts covered in the course. Andrew acquired proficient knowledge of livestock grazing systems and grassland ecology. He is able to identify common forage species and assess pasture/rangeland health. Andrew can formulate appropriate grazing plans based on available pasture, paddocks, season, and animal nutritional needs. He has a very good understanding of how to use species-specific foraging behaviors in order to improve habitat. Assigned as a rancher, Andrew prepared and articulated lucid arguments in a mock debate on public land grazing. He can review and interpret primary scientific papers from a critical perspective.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 16

4 - Animal Science
4 - Plant Science
4 - Ecology
*4 - Rangeland Management

*indicates upper division science credit

June 25, 2013
Date

The Evergreen State College - Olympia, Washington 98505

FACULTY EVALUATION OF STUDENT ACHIEVEMENT

Student's Last Name	First	Middle	ID Number
Buechel	Andrew	J	A00232653

Program or Contract No.	Title
10126	Political Economy and Social Movements: Race, Class and Gender

Date began	Date ended	Qtr. Credit Hrs.
24-SEP-2012	14-DEC-2012	14

DESCRIPTION:
Faculty: Peter Bohmer, Ph.D., and Michael Vavrus, Ph.D.

In the first quarter of this two-quarter program students were introduced to the nature, development and concrete workings of modern capitalism and the interrelationship of race, class and gender in historical and contemporary contexts with particular attention to the United States. Recurring themes were the relationship among oppression, exploitation, social movements, reform and fundamental change, and the construction of alternatives to capitalism, nationally and globally. Students began an examination of how social change has occurred in the past along with present trends and alternatives for the future. Students studied different theoretical frameworks such as liberalism, Marxism, feminism, anarchism and neoclassical economics, and their respective explanations of the current U.S. and global political economy and key issues such as education, the media and the criminal justice system.

In Fall Quarter, the U.S. experience was the central focus. Students began with the colonization of North America, and the material and ideological foundations of the U.S. political economy from the 18th century to the present. Students explored specific issues including the slave trade; racial, gender and economic inequality; the labor movement; and the western push to "American Empire." Students continually examined linkages from the past to the present between the economic core of capitalism, political and social structures in the context of gender, race and class relations. Resistance by groups to full economic and political rights was a central theme. Microeconomics principles from a neoclassical and political economy perspective were introduced. Within microeconomics, students studied such topics as the structure and failure of markets, work and wages, poverty/economic inequality, and the gender and racial division of labor.

Students prepared brief seminar preparation papers on assigned readings for seminars that met five hours per week. Based on their readings, lectures, and films, students completed an in-class quiz on program material. They also completed a take-home economics examination and a short analytic paper that required a thesis with supporting evidence from program material.

Required readings included Hedges & Sacco's *Days of Destruction, Days of Revolt;* Kaufman's *Ideas for Action: Relevant Theory for Radical Change;* Alexander's *The New Jim Crow: Mass Incarceration in the Age of Colorblindness;* Marx's *Communist Manifesto* and *Wage Labor and Capital;* Moody, *US Labor in Trouble and Transition: The Failure of Reform from Above, the Promise of Revival from Below;* and one of the following by bell hooks: *Feminist Theory from Margin to Center* or *Feminism is For Everyone: Passionate Politics*. Students also read chapters from the following: Zinn's *A Peoples History of the United States*; Stanford's *Economics for Everyone: A Short Guide to the Economics of Capitalism;* and Folbre, *Greed, Lust and Gender: A History of Economic Ideas*. Films viewed and summarized by students included "You Can't Be Neutral on a Moving Train," "También la lluvia," "Reconstruction: The Second Civil War," "Who's Counting: Marilyn Waring on Sex, Lies & Global Economics," "Salt of the Earth," "Union Maids," "Made in L.A.," "Step by Step: Building a Feminist Movement, 1941-1977," "A Place of Rage," and "A Nation of Law?" (from series "Eyes on the Prize: America's Civil Rights Movement").

January 15, 2013
Date

The Evergreen State College - Olympia, Washington 98505

FACULTY EVALUATION OF STUDENT ACHIEVEMENT

Buechel	Andrew	J	A00232653
Student's Last Name	First	Middle	ID Number

10126	Political Economy and Social Movements: Race, Class and Gender
Program or Contract No.	Title

24-SEP-2012	14-DEC-2012	14
Date began	Date ended	Qtr. Credit Hrs.

EVALUATION:
Written by: Michael Vavrus, Ph.D.

Andrew Buechel completed this program by meeting most program expectations. The work that he submitted was generally good, but a pattern of late assignments and absences marred his overall performance. Nevertheless, taken holistically, Andrew overall evidenced significant academic analyses and critical reflections on program material and his own learning.

Andrew's seminar preparation papers demonstrated a positive engagement with assigned readings and program concepts. He was, however, a generally passive participate for whole group in-class seminars. Andrew's summaries of most assigned program films captured some relevant elements related to program themes.

Andrew's quiz over program content demonstrated a very good ability to access and interpret program material. The results of his economics examination indicated a good understanding of principles of economics.

Andrew's end-of-quarter synthesis paper, titled "Who's the Enemy," was developing as an academic paper. For example, the paper was developing in presenting a clear thesis although it contained documented evidence to support his position. The construction of Andrew's paper was uneven in coherence but generally used an academic voice. He appropriately used the program's peer review process to revise his final copy.

In summary, Andrew demonstrated the knowledge and academic skills to engage in further political economy studies.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 14

3 - Political Economy
4 - Economic Principles
4 - Survey of U.S. History
3 - Studies in Race, Class, and Gender

January 15, 2013
Date

The Evergreen State College - Olympia, Washington 98505

FACULTY EVALUATION OF STUDENT ACHIEVEMENT

Buechel	Andrew	J	A00232653
Student's Last Name	First	Middle	ID Number

20142	Russia and Eurasia: Empires and Enduring Legacies
Program or Contract No.	Title

03-JAN-2011	18-MAR-2011	12
Date began	Date ended	Qtr. Credit Hrs.

DESCRIPTION:
Faculty: Patricia A. Krafcik, Ph.D., and Robert Smurr, Ph.D.

Students in the winter quarter of *Russia and Eurasia: Empires and Enduring Legacies* undertook an in-depth study of Russian, Eurasian, and Caucasian history and societies. We emphasized historical, literary, and artistic developments that shook the vast Russian Empire during 19th and early 20th centuries and read several timeless literary works from Gogol, Dostoevsky, Tolstoy, Chekhov, Gorky, and others. We also encountered some of the world's most provocative social and revolutionary thinkers and practitioners (Herzen, Marx, Lenin) and concluded the term with the world-changing Bolshevik Coup (or Communist Revolution) in 1917. Students also studied the geography of the former Russian and Soviet empires and wrote three major expository essays. Some students elected to take beginning Russian language for additional credit, whereas others took an intensive history workshop for additional credit.

EVALUATION:
Written by: Patricia A. Krafcik, Ph.D.

Andrew joined our program in the second of its three terms. He completed all the required work in the program, although his attendance was not as strong as it should be. In his three required essays, he dealt with the role of Russian writers in the 19th century, the Great Reforms of Alexander II, and the social message in Russian 19th-century literature. Andrew showed in his essays a basic understanding of the phenomena involved, but he needs to strengthen his writing in significant ways to move forward in his writing skills. Better proofing will catch many mistakes (spelling, punctuation), striving to formulate a thesis, creating a better structure, and reading the essays aloud to find awkward sentences are all ways with which he could raise the level of his work. To his credit, he did write a revision of the first paper, yet even here, better proofing might have avoided a few technical errors. His faculty strongly urges him to approach his writing with greater care.

Andrew participated in a small group presentation on the Russian film *Lev Tolstoy*. His brief written review of it served as a summary of the plot. He is encouraged to produce, instead, a review of his impressions of whatever film with which he will be involved in spring term. Andrew's performance on our first two map quizzes, which monitored the students' ability to identify places and natural landmarks in the Russian Empire significant in the 19th century, was excellent, less so on the third essay. His final exam, which tested the students' knowledge of factual material as well as their understanding of the relationships among items of interest in the history and culture, exhibited some good detail and reflected the fact that he spent time preparing for the exam. Andrew completed this term with a good understanding of the history, literature, and culture covered. He is encouraged to improve his attendance and to focus his energies on his writing, particularly given that spring term will feature the writing of a major research paper.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours) TOTAL: 12

4 - Russian and Eurasian History
4 - Russian Literature
2 - Russian and Eurasian Cultural Studies
2 - Geography of Russia and the Former Soviet Union

May 19, 2011
Date

The Evergreen State College - Olympia, Washington 98505

THE STUDENT'S OWN EVALUATION OF PERSONAL ACHIEVEMENT

Buechel	Andrew	J	A00232653
Student's Last Name	First	Middle	ID Number

Russia and Eurasia: Empires and Enduring Legacies

Program or Contract Title

03-JAN-2011	18-MAR-2011
Date Began	Date Ended

Through out the Russia and Eurasia winter quarter I always made the greatest effort to stay on top of our readings and assignments. My understanding of Russian geography, literature, music, and visual art has grown out of knowing nothing and into an in depth understanding of most of these subjects. Although I did not attend every seminar I always made sure I had the reading done on time for my own satisfaction. I completed and turned in our writing assignments on time although they occasionally required editing after the fact. This is partially due to negligence on my behalf, as I could have taken in my papers to be reviewed at the writing center before they were due. I have learned such a great deal from both Patricia and Rob, but often had difficulty applying what I had learned to paper. Pat has certainly shown me that my writing needs improvement, drastic in my opinion, and I plan on working to improve. My writing did improve with our second essay but it soon degraded again with our third.

I am unsure whether I have lived up to my potential this last quarter because I do not know what it is. Although there are some instances where I believe I could have applied more effort, such as extensive editing of my papers, there were many things blocking me from committing as much time as I would have liked to the class.

I have learned during winter quarter that I no longer want to study literature. Although I read every day and cherish books like nothing else, it seems to not be my subject in school. I will of course give myself another chance with literature and hopefully feel more possessed by it, but at the moment I do not feel compelled to pursue its studies.

I appreciate what this class has taught me and it has renewed my hopes of finishing school with its interesting and engaging curriculum. Next time I am in school I hope to have more hours to commit to my education.

Student's Signature

22-APR-2011

Date

Faculty Member's Signature (optional)

Date

EVERGREEN

The Evergreen State College • Olympia, WA 98505 • www.evergreen.edu

EVERGREEN TRANSCRIPT GUIDE

Accreditation: The Evergreen State College is fully accredited by the Northwest Commission on Colleges and Universities.

Degrees Awarded: The Evergreen State College awards the following degrees: Bachelor of Arts, Bachelor of Science, Master of Environmental Studies, Master of Public Administration and Master In Teaching. Degree awards are listed on the Record of Academic Achievement.

Educational Philosophy:

Our curriculum places high value on these modes of learning and teaching objectives:

- Interdisciplinary Learning
- Collaborative Learning
- Learning Across Significant Differences
- Personal Engagement
- Linking Theory with Practical Applications

Our expectations of Evergreen Graduates are that during their time at Evergreen they will:

- Articulate and assume responsibility for their own work
- Participate collaboratively and responsibly in our diverse society
- Communicate creatively and effectively
- Demonstrate integrative, independent, critical thinking
- Apply qualitative, quantitative and creative modes of inquiry appropriately to practical and theoretical problems across disciplines, and,
- As a culmination of their education, demonstrate depth, breadth and synthesis of learning and the ability to reflect on the personal and social significance of that learning.

Our students have the opportunity to participate in frequent, mutual evaluation of academic programs, faculty and students. In collaboration with faculty and advisors, students develop individual academic concentrations.

Academic Program

Modes of Learning: Evergreen's curriculum is primarily team-taught and interdisciplinary. Students may choose from among several modes of study:

- **Programs:** Faculty members from different disciplines work together with students on a unifying question or theme. Programs may be up to three quarters long.
- **Individual Learning Contract:** Working closely with a faculty member, a student may design a one-quarter-long, full-time or part-time research or creative project. The contract document outlines both the activities of the contract and the criteria for evaluation. Most students are at upper division standing.
- **Internship Learning Contract:** Internships provide opportunities for students to link theory and practice in areas related to their interests. These full- or part-time opportunities involve close supervision by a field supervisor and a faculty sponsor.
- **Courses:** Courses are 2-6 credit offerings centered on a specific theme or discipline.

The numerical and alpha characters listed as Course Reference Numbers designate modes of learning and are in a random order.

Evaluation and Credit Award:

Our transcript consists of narrative evaluations. Narrative evaluations tell a rich and detailed story of the multiple facets involved in a student's academic work. A close reading of the narratives and attention to the course equivalencies will provide extensive information about student's abilities and experiences. Students are not awarded credit for work considered not passing. Evergreen will not translate our narrative transcript into letter or numeric grades.

Transcript Structure and Contents: The Record of Academic Achievement summarizes credit awarded, expressed in quarter credit hours. Transcript materials are presented in inverse chronological order so that the most recent evaluation(s) appears first.

Credit is recorded by:

Quarter Credit Hours:	Fall 1979 to present
Evergreen Units:	1 Evergreen Unit (1971 through Summer 1973) equals 5 quarter credit hours
	1 Evergreen Unit (Fall 1973 through Summer 1979) equals 4 quarter credit hours

Each academic entry in the transcript is accompanied by (unless noted otherwise):

- The Program Description, Individual Contract or Internship Contract which explains learning objectives, activities and content of the program, course or contract.
- The Faculty Evaluation of Student Achievement provides information on specific work the student completed and about how well the student performed in the program or contract.
- The Student's Own Evaluation of Personal Achievement is a reflective document written by the student evaluating his or her learning experiences. Students are encouraged but not required to include these documents in their official transcript, unless specified by faculty.
- The Student's Summative Self Evaluation is an optional evaluation summarizing a student's education and may be included as a separate document or as a part of the student's final self- evaluation.

Transfer credit for Evergreen programs, courses and individual study should be awarded based upon a careful review of the transcript document including the course equivalencies which are designed to make it easier for others to clearly interpret our interdisciplinary curriculum. These course equivalencies can be found at the conclusion of each of the Faculty Evaluation of Student Achievement.

The college academic calendar consists of four-eleven week quarters. Refer to the college website (www.evergreen.edu) for specific dates.

This record is authentic and official when the Record of Academic Achievement page is marked and dated with the school seal.
All information contained herein is confidential and its release is governed by the Family Educational Rights and Privacy Act of 1974 as amended.
If, after a thorough review of this transcript, you still have questions, please contact Registration and Records: (360) 867-6180.